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INDEX

MONDAY, SEPTEMBER 16, 1974

Special Address: Dr. Harold P. Rodes, President, General Motors Institute, Flint, Michigan 10

Fuel & Lube Oil: Chairman R. R. Holmes, Chief Chemist, Union Pacific Railroad, Omaha, Nebraska. Topic: "Problems Related to the Energy Crisis." 16

President's Address: C. P. Stendahl, General Manager, Motive Power-Electrical, Burlington-Northern Inc., St. Paul, Minnesota 28

Shop Equipment: Chairman Kjell Axelson, General Manager, Work Equip. & Mach., Burlington-Northern Inc., St. Paul, Minnesota. Topic: "New Developments in Shop Equipment 38

TUESDAY, SEPTEMBER 17, 1974

Diesel Electrical Maintenance: Chairman W. R. James, Superintendent, Locomotive Department, Chessie System, Huntington, W. Va. Topic: "Simplification of Electrical Systems and Maintenance." 52

MU Trains: Chairman C. D. VanSciver, Mech. Supt. Passenger & Special Equipment, Reading Company, Reading, Pa. Topic: "Energy and Power Consumption." 58

Diesel Mechanical Maintenance: Chairman W. M. Reed, Manager of Engines, Burlington-Northern, Inc., St. Paul, Minnesota. Topic: "Mechanical Problems Affecting Locomotive Reliability." 60

Diesel Material Control: Chairman D. M. Walker, Asst. Mechanical Engineer, Southern Railway, Atlanta, Ga. Topic: "Mechanical Department Economies." 76

WEDNESDAY, SEPTEMBER 18, 1974

New Developments: Chairman L. O. Townley, Assistant Manager Industrial Engineering, The Atchison, Topeka & Santa Fe Railway, San Bernardino, California. Topic: "New Developments Affecting Maintenance Costs and Pollution." 92

What's Your Problem? Chairman J. J. Dwyer, Environmental Consultant, (Retired), Chessie System, Huntington, W. Va. What's Your Problem Panel 102

1975 Advertisers

This space dedicated to the firms listed below for their cooperation and assistance in making possible the publication of our 36th Annual Proceedings in the year 1975.

Abex Corporation 287
Aeroquip Corporation-Barco Division 269
Ajax Consolidated 155
American Air Filter Company, Inc. 107
American Koyo Corporation 241
American Steel Foundries, Inc. 268
Ashland Oil, Inc. 193
Automatic Equipment Company 181
Aylor Associates 75
Baird-Atomic Inc. 221
Brenco, Inc. 335
Cam Industries, Inc. 275
Cardwell Westinghouse Company 193
C & D Batteries Division 325
Chandeysson Electric Co. ..... Front Cover
C & H Chemical Company 227
Chevron Oil Company 195
Chromalloy Radiator Division, Chromalloy American Corporation 291
Chromium Corporation of America 297
Cites Service Oil Company 51
Cleveland Technical Center, Inc. 235
Cobb Industries, Incorporated 50
Continental Oil Company 19
Dearborn Chemical Division, Chemed Corporation 251
J. P. Devine Mfg. Co. 45
Donaldson Company, Inc. 247
E. I. Dupont-Kapton Division 315
Durox Equipment Company 83
Edison Battery Division, McGraw-Edison Company 309
Louis C. Eitzen Company, Inc. 23
Electro-Motive Division, G.M.C. 259
Elcon National, Inc. 95
Ex-Cell-O Corporation 118
Exxon Company, U.S.A. 313
Farr Company 181

1975 Advertisers Index

FIPCO 351
Freightmaster, a Division of Halliburton Services 113
General Electric Company 231
Gould Inc., Industrial Battery Division ... 201
Graham-White Sales Corporation 47
Griffin Wheel Company 345
Gulf Oil Corporation-U.S. 343
Harris Controls 209
Ernest Holmes Co., Crane Division 339
Hughes Railway Supplies, Inc. 295
Hulcher Emergency Railroad Service, Inc.. 189
International Car Company 165
J & J Castings, Inc. 213
Kelly Radiator Company 289
Lix Corporation 55
Magnaflux Corporation 155
Manganese Steel Forge Company 63
Master Machine Tools, Inc. 203
John W. Mahon Company 353
McConway & Torley Corporation 163
Microphor, Inc. 179
Miller Felpax Corporation 289
M & J Diesel Locomotive Filter Company . 255
MLW Industries 211
Mobil Oil Corporation 99
F. J. Morse & Company, Inc. 25
Mosebach Manufacturing Co. 239
Motor Oils Manufacturing Company ..... 152 & 153
Motor Oils Refining Company ..... 301 & 109
Nalco Chemical Company 187
National Electric Coil 147
New York Air Brake Company 41
NL Industries Inc., Magnus Division 111
N-S-W Corporation 337
Oakite Products, Inc. 217
Ogontz Controls Company 319
Peaker Service, Inc. 118
Pick-Congress Hotel 335
Pocket List of Railroad Officials 87
Polymer Corporation ..... 281 - 282 - 283
Power Parts Company 27
Precision National Corporation .. Back Cover
Prime Manufacturing Corporation 263
Railco Engineering Co., Inc. 305
Railroad Friction Products Corporation .. 65
Sardello, Inc. 303
Shell Oil Company 199
Simmons-Boardman Publishing Corporation Railway Educational Bureau 5
Snap-On Tools Corporation 69
Snyder Company 171
Frank Speno Railroad Ballast Cleaning Co., Inc. 349
Stackpole Carbon Company - Carbon Division 293
Sterling Lacquer Mfg. Co. 185
A. Stucki Company 295
Sun Oil Company 175
Superior Diesel Filter Company 159
Surrette Storage Battery Co., Inc. ..... Inside Front Cover
Teledyne Metal Finishers, Inc. 37
Texaco, Inc. 311
Touchstone Railway Supply & Mfg. Co. ..... Inside Back Cover
Triangle Engine Rebuilders, Inc. 331
TRW Thompson Industrial Products 73
Union Carbide Corp., Carbon Products Division 79
Vanderhorst Corporation of America 197
Vapor Corporation 191
Wagstaff Battery Mfg. Co. 287
West Chemical Products, Inc. 323
Wheel Truing Brake Shoe Company 277

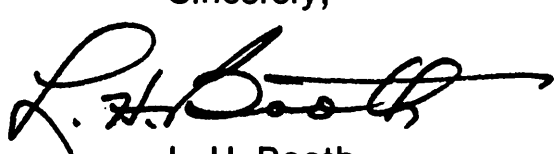
PRESIDENT'S PROLOG

Your President and staff proudly present for your use, the proceedings of the 1974 meeting along with the 1975 technical committee reports, and other information and photographs of the official organization which we hope will make you acquainted with them for the year 1975.

Our theme for this year is "Progress" and with the technical papers as developed by our very knowledgeable committee chairmen, we hope will assist you in achieving a better system of maintenance which is the goal of us all.

Read the contents of this book carefully as I am sure you will be greatly benefitted. And continue your very generous support by your membership in this great organization.

Sincerely,



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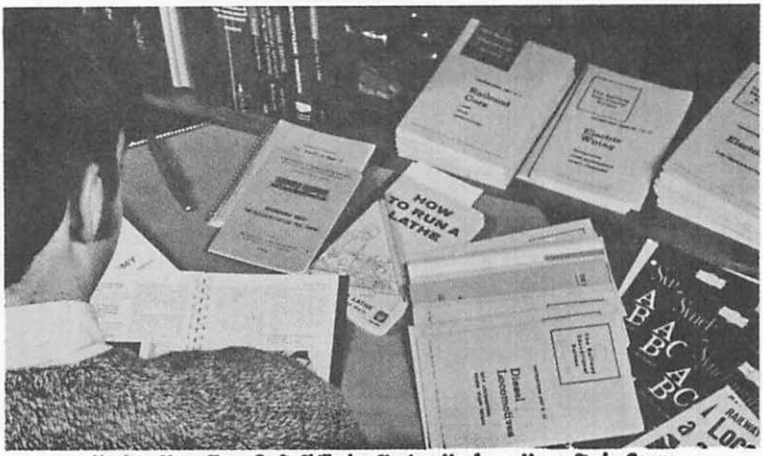

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	Lesson
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☐ 26L Brake Air Flow Description	4
☐ Wiring Diagrams	2
☐ Basic Electricity	10
☐ Locomotive Governor Maintenance	3
☐ ABD Control Valve	3
☐ 645E3 Engine Maintenance	12
☐ Alignment of Rotating Equipment	1
☐ Locomotive Journal Boxes	2
☐ Billing Repair Cards	15
☐ Loading Rules	20
☐ Electronics on the Rails—Transistors—Controlled Rectifiers Special Diodes, etc.	6
☐ TOFC Rules of Interchange	1
☐ Static Voltage Regulators	2
☐ Machine Shop Practice	20
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Be sure to read their ads in the Annual Publication.

MONDAY MORNING SESSION
September 16, 1974

C. P. STENDAHL, President
Genl. Mgr. M.P.-Elec.
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The 1974 annual meeting of the Locomotive Maintenance Officers Association, held on September 16-18, 1974 at the Pick-Congress Hotel, Chicago, Illinois, convened at 10 a.m., Mr. Carl P. Stendahl, President, presiding.

PRESIDENT STENDAHL: Gentlemen, good morning, and welcome to the 36th annual meeting of the Locomotive Maintenance Officers Association.

It gives me a great lift this morning to have Reverend Orville Wold with us. He will lead us in the invocation. Pastor Wold and his son, Reverend David Wold, are the pastors leading and providing inspiration for our congregation at the St. Timothy Lutheran Church, St. Paul. It is my pleasure now to ask Pastor Wold to lead us in the invocation. We will ask that you all please rise.

REVEREND ORVILLE WOLD; Thank you, Carl.

Before I lead you in prayer, I would like to make a couple of statements. One is that I am glad to be invited to share this meeting. It might be a good idea to identify the place of a man of the cloth in the presence of you who

are professional technicians. I do this in two ways. The first is to identify what the business of religion is. When you analyze the word, it simply means putting all the parts of life together and relating them carefully. That is borrowing your language of putting things together.

The second is a place of prayer, to take it out of the area of hokus pokus or the whipped cream or the frosting. Prayer is simply to be aware of the presence of God, and to be aware of our dependence upon Him. That being the case, I invite you to share with me as I lead you in these thoughts of God's presence.

Creator God, as handlers of many of the marvels of Your awesome creation, we come together to sharpen our responsibilities and our skills. We do it as unto You when we do it to those whom we serve and those who are served by our labors.

We pause to recognize You as the Maker of iron and fuels, of electricity and of power, from which we have been privileged to make wheels and shafts, switches and motors, and the means of releasing that power. You have given us the capability of invention, of improvement and innovation, and You have laid before us the adventure of solving problems and finding and making discoveries. You flatter us by sharing the custody, the stewardship, the glory and responsibility of handling this wonderful world of creation. So, we beg Your enlightenment in our efforts as we pursue our daily work and our relationships. We are grateful for both the direction and the redemptiveness of Jesus Christ in dealing with these relationships.

Bless the industry which we represent, with its great contributions of moving men and materials. Bless the nation of which we are a part, its leaders, and its role in the world's destiny. Bless the memory of the co-laborers who have been relieved since our last meeting of earthly responsibilities and earthly life. Comfort and strengthen their families. Multiply the effectiveness and the fruitfulness of their labors and their lives.

Make us grateful for all who serve us, who work with us, and keep us diligent and faithful in the services we perform for men. On Your behalf we pray. In Christ's Name, Amen.

PRESIDENT STENDAHL: Please remain standing for a moment in silent memory of those associates who have departed this world since our meeting here last September.

[Silent standing tribute to departed members.]

PRESIDENT STENDAHL: Thank you. Please be seated.

As I have already said, welcome to our meetings. A special welcome to the members of the Federal Railroad Administration and members of the Canadian Transport Commission. I want to say a special word of welcome also to the locomotive builders, MLW, ALCO, General Electric Company, and the Electro-Motive Division of General Motors. We enjoy seeing the good representation of your groups. It is really great to see the number of people in attendance this morning.

I will quickly introduce the officers seated at this table. We will ask that you hold your applause until we have introduced all of them.

Larry Booth, Chessie System. John Schroeder, Burlington Northern. Tom Tennyson, Southern Pacific. Eldon Dent, Missouri Pacific. Jim Butler; Jim is now with the U.S. Railroad Association, formerly with the Reading Company. Most important to the

functioning of your LMOA is our good Secretary, Joe Koerner. Let's give our Vice Presidents and Secretary a big hand. [Applause]

On our left we have some of our Past Presidents, Ky Pruchnicki, Carl Love and Jack Dailey. We are very happy to see you gentlemen with us. [Applause]

We are sorry that our Immediate Past President, Bill Dadd, could not be with us. Because of an ear problem his doctor ordered him not to travel, so therefore he is not with us. We hope for his speedy recovery.

We also want to mention our 7th Vice President, Jim Taggart. Jim is on an overseas assignment and sends his greetings to everybody. He will not be with us at this meeting.

My year of good fortune as your President has been very interesting in many ways. A very special highlight of my special trips away from home this past summer was the opportunity to visit General Motors Institute at Flint, Michigan, and to personally visit with our speaker, Dr. Harold P. Rodes, President of General Motors Institute. So that you will better know Dr. Rodes, I have some notes regarding his very active and busy life.

Dr. Rodes has been President of General Motors Institute, Flint, Michigan, since August 1960. General Motors Institute is the center for educational activities of the General Motors Corporation in engineering and management. It is the largest industrial college in the world, with a normal enrollment of about 3,000 undergraduate engineering and industrial administration students on the cooperative plan of education. In addition, more than 25,000 GM employees in plants throughout the world are enrolled in part-time programs provided by GMI.

Dr. Rodes was born in 1919 in Moorestown, New Jersey. He was graduated with highest honors from Dartmouth College in 1941, with a Bachelor of Arts degree. After a year of high school teaching in Bradford, Vermont and service with the U.S. Marine Corps as a lieutenant in World War II, serving in an engineering battalion until 1943, he then was an aircraft drafting instructor in San Diego (1943-1944) and a mechanical engineering lecturer in the Navy V-12 program at the University of California at Berkeley (1944-1945). During the latter period he also served as assistant supervisor of war training, and began graduate study in engineering and education at the University of California.

Dr. Rodes was a teaching assistant at Yale University, serving at the same time as assistant director of student personnel at New Haven College. He received his Master's degree from Yale in educational administration in 1946, and his Doctor's degree in 1948.

From 1948 to 1951 Dr. Rodes was an assistant professor of engineering and assistant director of relations with schools at the University of California, Los Angeles. He then became President of the Ohio College of Applied Science in Cincinnati, a two-year technical institute employing the cooperative plan of education.

Dr. Rodes was named President of Bradley University, Peoria, Illinois, in 1954 at the age of 34, which at that time made him the youngest university president in the United States. He continued to head that institution until appointed to the GMI post in 1960. He received an honorary Doctor of Laws

degree from Bradley in the same year.

Dr. Rodes is a member of numerous education groups, including the American Association of University Professors, American Management Association, American Society for Engineering Education, and the Michigan Association of Colleges and Universities. He is currently serving as a Board member of the American Society for Engineering Education, C.S. Mott Foundation, National Commission for Cooperative Education, Flint College and Cultural Center, and the Urban Coalition.

Among his twelve honorary fraternity memberships are Phi Beta Kappa and Tau Beta Pi. He is a member of Sigma Nu social fraternity.

Dr. Rodes is GMI's third President. His predecessors were Guy R. Cowing and Major Albert Sobey. Dr. Rodes, welcome. [Applause]

DR. HAROLD P. RODES
PRESIDENT
General Motors Institute
Flint, Michigan

DR. RODES: Members and guest of the Locomotive Maintenance Officers Association:

I am pleased and honored to have this opportunity to be a part of your annual meeting. When the invitation to speak was first extended by Mr. Stendahl, I wondered to what extent I could make a contribution. It soon became apparent, however, that we do have many areas of common interest. One of your recent announcements stated the purpose of your organization as follows:

"To serve the interests of its members educationally and those of their employers, the railroads, by studying and discussing problems relating to the repair and maintenance of locomotives, commuter equipment, and other railroad equipment, thus facilitating and accelerating improvements in practices."

I also note from the report of your September, 1972, annual meeting that your president at that time, Mr. Ky Pruchnicki, observed that training is "another way of saying progress." The theme of this conference is "The Search for Information." As I look at these quotations and your current conference theme, I would conclude that you have a very great interest in education, problem solving, technology, and management. All of these interests parallel my interests as a college president, as an educator, and as a member of the management team of the world's largest industrial organization. I might also add that General Motors has considerably more than a passing interest in the construction and maintenance of the diesel locomotive. In fact, the General Motors Electro-Motive Division is probably one of the major beneficiaries of the activities of your organization. This is true because from the beginning the acceptance and continued success of the diesel locomotive has been, as least in part, the result of expert maintenance.

I believe it might be of value and hopefully of some interest to tell you something about General Motors Institute and its policies and programs. GMI is the only accredited undergraduate college in the United States operated by one corporation; namely, the General Motors Corporation.

It began in 1919 when the late Major Albert Sobey, one of my two predecessors as President of GMI, went to Flint, Michigan, to establish part-time evening courses for the employees of the rapidly growing automotive industry at the end of World War I. From those early days of evening courses in such fields as drafting, automotive ignition systems, and foremanship training, General Motors Institute has grown to its present status as a cooperative college with 3,000 undergraduate students who alternate between periods of academic instruction on the campus in Flint and related work assignments in General Motors units. These students are working and studying for a bachelor's degree in mechanical, industrial, or electrical engineering, or industrial administration.

In addition, each year about thirty thousand General Motors employees enroll in part-time technical or management training programs which we offer on a resident or in-plant basis. As one might expect, this responsibility and opportunity results in a close working relationship with 135 different plants or units of the General Motors Corporation throughout the United States and Canada. We also have several hundred students from our overseas operations who take co-op programs of either one or two years in length on the campus in Flint.

With both a student body and faculty made constantly aware of the rapidly changing technology in manufacturing operations, we must maintain constant contact with GM plants, divisions, and staffs to see that our instructional programs are not only up-to-date but aimed at the technical and managerial knowledge and skills which will be needed in the years ahead.

I think it would be of particular interest to you to mention an incident in GMI's history which directly relates to your organization. I would like to quote from a book entitled, "On Time: The History of the Electro-Motive Division of General Motors Corporation" by Franklin M. Reck:

> "In 1934, when the first diesel-powered trains were touring the country, Mr. H. B. Ellis, the Service Manager of Electro-Motive, organized a diesel school for railroad men in cooperation with Major Albert Sobey, Director of the General Motors Institute at Flint, Michigan.
>
> "This first experimental school with 20 Electro-Motive district service men as students met on October 15, 1934. By 1935, railroads had generated enough interest so that Ellis was able to hold a special one-week school in which students were all railroad vice presidents. The school remained in Flint until 1938 when additions to the LaGrange plant permitted it to be moved to a part of the new machine shop."

Even at this early date, emphasis was upon efficient and effective maintenance of the locomotive. This is evidenced by the fact that Ellis designed a diesel maintenance shop using an elevated platform at locomotive floor level, a 4 foot pit between rails, and a 2½ foot depressed floor

outside the rails. Thus, whether working on the engine, adjusting brakes, or greasing motor bearings, the mechanic could work at the proper level without unnecessary climbing or crouching. Every part of the maintenance facility was located for convenience and a minimum of lost motion.

Although GMI no longer has the Diesel Service Managers School, it nevertheless emphasizes technical and management training for those employed by the General Motors Corporation. A current example is the Electro-Motive Manufacturing Management Development Program scheduled to begin operation later this month. The program consists of ten courses designed to prepare current foremen and general foremen for high level positions in the manufacturing organization. Recognizing that the future strength of an organization depends upon training personnel, this program has among its major objectives the following:

- To provide basic principles and concepts in subject areas which serve as a foundation for effective manufacturing management.
- To explore current theories of management and their application to business activities.
- To provide new insight into technology especially related to Electro-Motive operations.
- To encourage continued self-development through reading and study of professional publications and other sources of information.

The ten courses in this program will be taught by GMI professors with academic expertise in each subject area. A total of twelve professors will participate.

Another recent example of GMI's attempt to provide educational materials is a series of self-teaching metric education programs. With the decision to change to the metric system in General Motors came a recognized need for education and training. Accepting the challenge to provide the essential knowledge required for an employee to do his job, GMI developed twelve self-teaching audio tape and slide modules. Among the subjects included are linear measurement, the metric micrometer, temperature, mass, force, stress, strain, power and work. These training modules are made available to the various units of General Motors so that the person needing training in a particular area may receive it just prior to his need for this information on his job.

I understand there has been some reluctance by certain groups to accept the change to the metric system. For example, a few weeks ago the *Detroit Free Press* carried an article which said that housewives were refusing to accept recipes stated in metric terms. The housewives complained that by using metric measurements they would have little or no confidence in the outcome of their culinary efforts. However, I suspect if the real truth were known, they prefer to state their vital statistics in inches as "36-24-36" rather than in centimeters "90-60-90."

On a more serious note, we often hear about the speed with which changes are taking place and we wonder how our society can meet the challenges successfully. We might ask, "Is this unique to our generation?" Before answering, I should like to quote a United States Senator. See if

you can guess which one. Here is the quotation:

"It is an extraordinary era in which we live. It is altogether new. The world has seen nothing like it before. I will not pretend, no one can pretend, to discern the end; but everybody knows that the age is remarkable for scientific research into the heavens, the earth, and what is beneath the earth; and perhaps more remarkable still is the application of scientific research to the pursuit of life. The ancients saw nothing like it. The moderns have seen nothing like it until the present generation . . . The progress of the age has almost outstripped human belief."

(End of quote.)

The statement I have just read to you was made by United States Senator Daniel Webster almost 150 years ago. So you can see, even though many changes are taking place in the world about us, man's reaction to change remains amazingly constant.

This twentieth century since the birth of Christ has become the age of explosions. To mention only a few, we have nuclear explosions, the population explosion, and the explosion of knowledge. With regard to the last of these, new knowledge is developing so rapidly that no matter how hard he studies, a student graduating from college today actually possesses a smaller percentage of the total knowledge of the world than when he entered as a freshman. The price of progress in many fields is at times much higher than we would like to pay, but unfortunately we have not yet devised a means of discovering only good in the world without also uncovering some additional problems.

This means that we must do a better job of anticipating and managing change so that we can reap the benefits to the highest possible degree. It means that we must rely more upon the specialist to master his field and share it with others since we can no longer depend upon only a general knowledge to meet our needs.

Speaking of change, Winston Churchill once said, "There is nothing wrong with change, so long as it is in the right direction." To which someone added: "Change is when you stop making the same mistakes and begin making new ones."

Until about the seventeenth century, it was considered possible for one man to possess all of the existing knowledge in the world. Leonardo da Vinci probably came closest to the ultimate in this regard due to his tremendous knowledge and skill in all of the existing arts and sciences of his day. It is obvious, however, that it is no longer possible for one individual to know all there is to be known about even one branch or segment of human knowledge, whether it be engineering graphics, electronics, or the most difficult of all—human relations. Accordingly, we are becoming more dependent upon each other with every passing hour. Thus, whether we like it or not, the search for knowledge continues and with it new technologies are being discovered.

Accordingly, one of the greatest challenges confronting industry and education today is that of upgrading and updating engineers and other professional people in their respective specialties. This process has sometimes been referred to as "re-educating the educated." It may range all the way from self-study of textbooks and techniques to post-doctoral courses at

a university. This need is dramatized by the fact that engineering students who graduated only ten years ago received very little, if any, instruction in the fundamentals of semi-conductors, environmental control, design by computer, numerical control of machine tools, organizational behavior, human resources management, or many other aspects of modern engineering and management.

What is the answer to this problem of professional obsolescence? Well, first of all, the professional man in any field, whether it be engineering, science, education, or management, must assume the ultimate responsibility for his own professional growth and development. However, there are many things which those individuals and organizations associated with him can do to encourage and provide the elements of professional growth. Some of these resources may be in the form of tuition refund, available time, professional organizations such as LMOA, and special training programs within the company itself. The other portion of this responsibility must be borne by educational institutions through extension and part-time courses in addition to their regular undergraduate and graduate programs. As I mentioned earlier, at General Motors Institute we provide part-time instruction in a wide variety of management training and continuing engineering education programs designed to bring the latest developments in engineering and management to those holding responsible positions in General Motors.

As a specific illustration, we have offered for the past few years a course entitled "What's New in Engineering?" This is certainly not an original idea, but some aspects of the program might be of interest to you. Groups of about 20 engineers and engineering managers from throughout the General Motors Corporation come to our campus in Flint on a Friday and Saturday each month over a period of eight months for intensive presentations and discussion. This schedule involves one day of the engineer's personal time and one day of company time, and thus interferes only slightly with his regular work assignments.

The nearly 600 people who have completed this program received their engineering education anywhere from 10 to 20 years ago and therefore in some areas of specialization they no longer speak even the same language as the young engineering graduates of today. The format of this course on "What's New in Engineering?" includes presentations by teams of five to eight GMI faculty members on a variety of recent developments in engineering. One weekend is devoted to "What's New in Materials?," another to "What's New in Computers?," while the remaining weekends are devoted respectively to product liability, manufacturing productivity, industrial environmental control, energy, engines and ecology, solid-state electronics, and human performance considerations.

It is interesting to note that about 25 percent of the subject matter in this course changes each year, so an engineer in General Motors can take the same course once every four or five years with very little repetition.

In closing, let me say we must always be ready to accept change and that our success will be determined by how well we manage that change. Our search for knowledge must go on because in reality we know so little about the world in which we live.

For those who believe otherwise, I would refer you to some remarks by the late engineering genius, Charles F. Kettering. In his view, "The field of human knowledge is so far from complete, our schools should teach that we know very little about anything. Our educators should simply say to the student that this is the best package we can give you today." Boss Kett often told this story about a friend of his who was a teacher of medicine in one of the universities. In the professor's final lecture to his class he spoke as follows:

> "Gentlemen, during the months we have spent together, I have given you the best information there is about the practice of medicine. The textbooks we have used are the most widely accepted and reliable. I have cited the best case histories I could find. But, before we part, I want to caution you that the science of medicine is moving forward so rapidly that in a few years half of what I have taught you will prove to be wrong. And, unfortunately, I cannot tell you which half it will be."

It is evident to me from the subjects of your sessions and from your enthusiasm, that you will continue to search for and share new developments in your profession. As merely one participant in your program, I greatly appreciate the honor and pleasure of being invited here.

PRESIDENT STENDAHL: Thank you, Dr. Rodes. It is now my pleasure, on behalf of our Association, to present to you this desk set, as emblematic of honorary Life Membership in our Association. We hope as you see this desk set on occasion in the future it will serve to remind you of the work of our Association and your being with us today. Thank you. [Applause]

Dr. Harold P. Rodes, President, General Motors Institute, Flint, Michigan, is awarded Honorary Life Membership in LMOA and is presented the traditional engine desk set emblematic of the award. Making the presentation is LMOA President Carl P. Stendahl.

MONDAY MORNING SESSION
September 18, 1974

REPORT OF THE COMMITTEE ON FUEL & LUBE OIL

R. R. HOLMES, Chairman
Committee on Fuel and Lube Oil
Chief Chemist, Union Pacific Railroad
Omaha, Nebraska 68102

T. A. TENNYSON
3rd VICE PRESIDENT
Asst. Mgr.-Engineering-Technical
Southern Pacific Trans. Co.
San Francisco, Calif. 94105

Gentlemen, this brings us to the beginning of our technical session. We will ask that Mr. Holmes and his Committee come to the head table. I would also like to turn the meeting over to our Third Vice President, Tom Tennyson, Assistant Manager-Engineering, Southern Pacific Company, who will be the officer of this session.

Before Tom begins, I want to mention that these sessions will be handled much the same this year as they have always been. The report of each committee will be condensed and presented in a summarized version of the complete report which you will find in the publication. This will give us time for the discussion period to follow each report. We ask that you use the microphone and identify yourself before you speak. We want you to put these technical committees to work. This is your Association, so you should take advantage of every opportunity to gain further information on any subject, and also let the panel know if you disagree with what they are saying. So, let's make this a very lively program. I will now turn the meeting over to Mr. Tennyson.

MR. THOMAS TENNYSON [Assistant Manager - Engineering - Technical, Southern Pacific Transportation Company, San Francisco, California]: Gentlemen, for those of you who may

not be acquainted with Mr. R. R. Holmes, Chairman of the Fuel and Lube Oil Committee, and the events which led up to his present position as Chief Chemist of the Union Pacific Railroad, I suggest you read page 164 of the Annual Proceedings, where the story appears in detail.

Dick Holmes has been very active in the LMOA for many years, and has participated in giving leadership in such railroad-oriented organizations as the National Railway Lubrication Council, the National Railroad Engineers of Test, and the American Railway Engineering Association. What you probably don't know is that this is Dick Holmes' last year as technical committee chairman. He is going on to other duties. Judging from the response to the report of his Committee at the Greater Kansas City Railway Club last April, I know you will agree that he is going out nobly.

At this time I would like to thank Dick personally and on behalf of the LMOA for his excellent leadership and the work he has done with his fine Committee. With that I won't take up any more of your time, Dick.

[Mr. Holmes introduced the members of his Committee.]

MR. HOLMES [continuing]: I would like to present Mr. Verne Peterson, President of the Greater Kansas City Railway Club, and District Material Supervisor, Atchison, Topeka & Santa Fe Railway.

MR. V. D. PETERSON [District Material Supervisor, Atchison, Topeka & Santa Fe Railway, Argentine, Kansas]: I would like to thank this fine Committee for recognizing the Greater Kansas City Railway Club. We had our election this summer, and Mr. J. I. Pike, Superintendent of Shops, Santa Fe, Argentine, Kansas, is our new President. Our new Secretary is Mr. S. A. Briscoe, Local Storekeeper, of the Rock Island. Our kick-off meeting will be October 4. Again I want to thank Mr. Holmes and his Committee for coming to Kansas City and presenting their paper. Thank you.

[Mr. Brightwell, Manager of Tests & Research, Rock Island Lines, summarized Part I of the report.]

[Mr. Dennis Chirikos, EMD, La Grange, Illinois, summarized Part II of the report.]

MR. HOLMES: We will now open discussion of Parts I and II of the report. We will ask Mr. Peterson to lead the discussion by asking the first question.

MR. PETERSON: Will the railroads receive enough fuel and lube oil in the future to satisfy operational requirements?

MR. E. A. GOFF [Transportation Sales Department, Mobil Oil Corporation, Schaumburg, Illinois]: In the opinion of my company, the fuel crisis may be lessened. However, there is still a definite possibility of a diesel fuel shortage during peak periods of use of this type of material. We have and we will continue to comply with the government regulations in relation to furnishing enough fuel to customers that the government requires us to, and to give you a better idea of what these regulations are I will ask Mark Savage to make a few comments.

MR. M. W. SAVAGE [Senior Staff Product Engineer, Standard of California, San Francisco, California]: Whether there is a surplus or a shortage of petroleum supplies depends on the difference between two very large numbers — one of supply and one of demand, in the order of, say, 500 million gallons per day. The amount of

petroleum it takes to turn a shortage into a surplus is extremely small, perhaps as little as 2%. This small percentage differential can cause either an excess or a shortage within a short span of time — in a matter of weeks.

At the present time the supply situation is in fairly good shape, mainly because the demand has been decreased by conservation measures, a few of which have been discussed here. In the first half of this year petroleum demand in the United States was off about 7% compared to the previous year.

In this period of shortage, fuel supplies (and I will discuss only the middle distillates) are controlled and allocated by the Federal Energy Administration. These regulations are embodied in about 21 pages of very fine print. I won't attempt to discuss all the details, but I will give you a broad outline of the priorities and give you an idea as to where the railroads stand in these priorities.

The first priority for fuels goes to three classes of customers, and these three are entitled to all of their current requirements. They have first choice on fuels. These are agricultural production, the Department of Defense, and space heating in medical and nursing buildings. Space heating for homes and residences also is allocated full current requirements but is subject to a 6-degree reduction in temperature. All other space heating applications, including offices and factories, are subject to a 10-degree reduction in temperature.

Beyond those categories, all others are subject to an allocation factor, and are allocated less than their current requirements when there is a shortage. Each oil company must determine what its customers certify their needs to be. This is based either on their current requirements or a previous base period. If there is a shortfall, an allocation factor is assigned and applied to all customers in these categories. For example, if there is a 10% shortfall the allocation factor is 90%. At the present time essentially all oil companies are on an allocation factor of 100%. A lot of things can affect this, however, such as an unusually cold winter which can cause an increase in demand that could create a shortage and require use of an allocation factor.

Speaking of the railroads, if it does become necessary to apply an allocation factor, that part of the railroad transportation system which is applied to agriculture, including not only the shipment of the agricultural products but also for materials needed by agriculture, such as chemicals and equipment, will get 100% of current requirements.

These regulations are changed fairly often, and they indeed express the determination of a national priority as to where fuel should be applied. Jack Dwyer, in the June-July issue of *Railway Locomotives and Cars*, pointed out that railroads require about 4.2 gallons of fuel per 1,000 ton-miles for hauling freight. The trucking industry requires about 15-1/2 gallons. So, if these priorities are required to be changed, I am sure the Federal Energy Administration will take those facts into account and will use the fuel where it provides the most efficient contribution to the productivity of our country.

From the oil companies' side, during the first six months of this year the industry invested in capital outlays 34% more than their total profits, in their efforts to increase petroleum

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supplies. So, I think the answer to the question is yes, the railroads will get the fuel they need, providing we don't have an embargo situation like we had last fall.

MR. HOLMES: In the section on methods of conserving diesel fuel, the Committee also mentioned automatic fueling and possible re-use in locomotives or in powerhouses, and so on. All of that was in the report for you folks to read, so we will ask for further discussion now on either Part I or Part II. Part II deals with methods of conserving diesel fuel. Does anyone have a question on that section?

MR. L. H. BOOTH [Assistant Chief Mechanical Officer - Locomotive, Chessie System, Huntington, West Virginia]: Dick, you mentioned in your paper that shutting a locomotive down is one way to conserve fuel. It seems like a minimal thing, but has anyone calculated what it would mean to a railroad if they followed this practice religiously?

MR. R. R. POOLER [Manager - Testing, Atchison, Topeka & Santa Fe Railway, Topeka, Kansas]: I was reading the report of the Committee on Shop Equipment, and on page 233 of the book it says: "When you consider the potential many thousands of dollars that can be saved through lower labor costs and less fuel spillage (one road reports $6,000 per unit per year fuel loss due to poor fueling equipment maintenance), a few more dollars spent on maintenance will be more than offset."

MR. J. J. DWYER [Engineer Environmental Control - Retired, Chessie System, Huntington, West Virginia]: I seem to recall that in some of the reports we referred to this item of shutting down engines, and one of the considerations I think we wanted to emphasize was that the length of time the engine is going to be shut down is very important because of the environmental considerations involved, which are separate and distinct from the cost savings. This of course is the pollution effect.

One cold start could generate additional pollution greater than, say, several hours of idling. Just where the break-even point was on that, I am not sure, but I seem to recall testifying in some public hearings that under four hours there would be more pollution discharge than there would be if the engine was idled for four hours. This is something we must also consider. Cost is not the only thing.

MR. HOLMES: There are further ramifications of damage to the unit, water, having personnel around to start it again, and things of that type, which it would seem would more than offset the fuel savings you would realize.

Any further questions?

MR. W. R. JAMES [Superintendent - Locomotive Department, Chessie System, Huntington, West Virginia]: The two previous questions dealt with two extremes — either idling or shutting down an engine. I would like to ask whether either of the builders here have developed a system whereby we could have a reduced idle.

MR. DENNIS CHIRIKOS [EMD, LaGrange, Illinois]: I believe we have a reduced idle project in the field at this time. There is some savings due to the reduced idle system. I don't have the data on fuel savings.

MR. LUD KOCI [EMD, LaGrange, Illinois]: We do have low-idle equipment project units in the field now, and according to the present plans, probably some time in the spring of next year we will be ready to make

that available in general. I am going by memory now, but I believe that for a switcher unit duty cycle the savings are in the area of about 12%, and on a road locomotive duty cycle it is in the area of about 2%.

MR. DOUGLAS SIZEMORE [Machine Shop Foreman, Atchison, Topeka & Santa Fe Railroad, San Bernardino, California]: Would the oil companies like to comment on what it is going to cost us to purchase this oil? How does the cost factor look for the future?

MR. SAVAGE: All I can say is that I showed you the regulations covering allocation of supplies. There are additionally some 21 pages of regulations governing prices. What it will cost for fuel has to do with government regulations. The petroleum industry is under price control at the moment.

[Mr. Broman, Project Engineer, Atlantic - Richfield Research, summarized Part III of the report.]

MR. HOLMES: Are there any questions on this section, Composition of Diesel Fuel?

MR. FRANK FINDLING [Assistant Vice President - Mechanical, Chicago, Rock Island & Pacific Railroad, Kansas City, Kansas]: Along with the shortage of fuel oil, I understand we also have a compromising situation relative to pour point, clouding, and so on. I would like someone on the Committee to explain exactly how bad the fuel is going to be, and what we are going to have to contend with this year. I would suggest Mr. Brightwell give a portion of the answer, because he is a member of NARET and I think he has some information on it. There may possibly be others.

MR. N. E. BRIGHTWELL [Manager of Tests and Research, Chicago, Rock Island & Pacific Railroad, Chicago, Illinois]: I don't have too much information yet as to what the pour point and cloud point conditions will be this winter. Last year they were not as bad as we expected. We will have to start a program on the Rock Island in the next couple of months to see what our fuels are showing this year. We do have one test indicating that we may have a low cetane and high pour point fuel at one of our locations on the Rock Island, and we are having additional samples of that sent in to confirm this.

MR. HOLMES: We do know that certain oil companies have increased their limits for cloud point and pour point. One company I have in mind has specified that the manufacturing limit for cloud point can be as high as +20°F. In their case and others we are more extensively utilizing flow improvers. These flow improvers cause fuel oil to be pumpable at depressed temperature and allow the use of such fuel, although we have, on occasions, extreme operating conditions such as those experienced last year on the Union Pacific during 14 continuous days in January. At that time, average temperatures were as low as —13°F. At the same time, across the operating territory in Wyoming, the temperatures dropped as low as —16°F., with a wind chill factor of approximately —100°F. Those figures sound almost unbelievable, but it does happen.

In our case the flow improvers facilitated the pumpability of the fuel, as intended. However, during the severest conditions, as I mentioned, the bulk temperature of the fuel oil in the locomotive tank evidently was lowered to such a degree that crystals formed at their normal cloud point as would be expected. Although it is the function of the flow improver to

change the configuration of these crystals so that you do indeed accomplish filtration during severe operating conditions, the fuel didn't have a chance to move as far in the fuel system as the primary filter. As soon as a locomotive would stop at a fueling station, the wax crystals were dispersed throughout the locomotive fuel tank by fresh fuel being added, and accumulated in the intake pipe to the engine, which restricted flow. As soon as the units started to pull a train leaving the terminal, demanding full power, the engines, starved for fuel, shut down.

To relate experience of one of the oil companies in the use of flow improvers, I would like to call on Fred Lowe, of Exxon, which is one of the developers of flow improver additives that are in extensive use in diesel fuel oil.

MR. FRED W. LOWE [Marketing Technical Services, Exxon Company, Houston, Texas]: I would like to add a couple of words. Most people today are concerned with the cloud point of the fuel they are purchasing. In the past, flow improvers have been somewhat effective in depressing the pour point, but not too effective in modifying wax crystal formation. There have been some new developments in this area, and today there are a few new flow improvers that will modify wax crystal formation to a greater extent than the flow improvers in the past.

Specifically, there was an SAE paper published in 1973, entitled, *Operability of Automotive Diesel Equipment at Temperatures Below the Fuel Cloud Point.* This report deals primarily with automotive diesel equipment, but I think we can probably apply some of the results to the railroad locomotive. In engines previously considered critical to fuel cloud point, the authors were successful in operating about 15°F below the fuel's cloud point with some of these flow improvers. So, I think the technology is advancing, and I think we will see improvements in this area down the road.

MR. HOLMES: We are not going to have time to cover the entire paper. Are there any questions on the rest of the paper?

MR. H. A. HENDERSON [Assistant Chief Mechanical Officer - Locomotive, Southern Pacific Transportation Company, San Francisco, California]: On the Southern Pacific we run into a problem on the adjustment of governors because of the different types of fuel that we received during the energy crunch. I have a plant manager in Sacramento who is quite concerned about it, and he wants to know what the oil industry is doing as a group to help stabilize fuel to the extent that we can get the proper amount of power out of the engine.

We set the governor for one type of fuel. As you know, we have a run-through operation throughout the country, and we pick up various types of fuel. In fact, during the energy crunch we were glad to get any kind of fuel. In picking up various kinds of fuel we find it difficult to adjust the horsepower of the engine. Is there any move afoot at this time to help stabilize fuel?

MR. HOLMES: That would most likely be a problem related to the specific gravity of the fuel oil. The racks are adjusted according to the gravity of the fuel. Some railroads receive a lower API gravity fuel than others, and adjust their racks accordingly. Evidently you are receiving fuel

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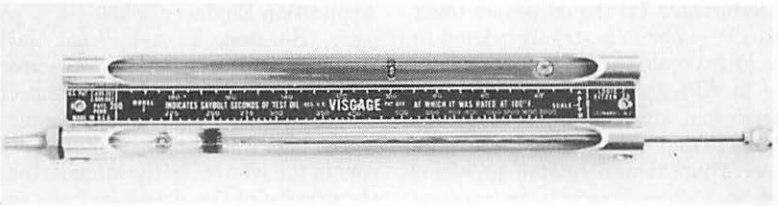

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oil from various sources over a wide API gravity range. I have noticed recently considerable variances of this type in API gravity of fuel received from various suppliers. However, there has been no problem requiring special rack adjustments.

Is there a volunteer on the Committee who will discuss that subject a little further? Do the oil people think the S.P. problem is strictly related to the fuel? Would variances we normally see in API gravity of different suppliers' fuel affect the power of the engine to that extent, or is there more likely a mechanical related problem? May we also have an opinion from one of the engine builders?

MR. J. G. HOFFMAN [Fuel & Lubes Engineer, General Electric Company, Erie, Pennsylvania]: I don't think I can answer Hollis' specific question, which was whether there are any plans by oil companies to further stabilize the variation in BTU content. I have no knowledge in that area.

With respect to whether it is a real or potential problem, I can give you a few thoughts. Within the ASTM No. 2-D range we can have a variation of approximately 10% in BTU/gal. Remember, fuel oil is metered on the engine on a volumetric basis, so without changing specifications in this connection in all there is at least a 10% variation in power that is potential. Is this what you wanted to know?

MR. HENDERSON: It partially answers the question, and that's about all. We are still having a problem adjusting horsepower because of the variation in BTU content of the fuel.

MR. HOLMES: I think it is the responsibility of the fuel oil suppliers to state whether the product they are furnishing meets the Southern Pacific's requirements for an oil with a limited API gravity range and BTU content and is available in normal refinery production today. All oil companies have established manufacturing limits for the various fuel oil characteristics. Jim Wilkison, can you comment on that for Shell?

MR. J. L. WILKISON [Products Application Engineer, Shell Oil Company, Houston, Texas]: What Jack Hoffman said is true. For example, let's suppose a locomotive is operating in the northern part of the country where it is warm in the summer and cold in the winter. In the summertime the gravity of the diesel fuel can run as low as 30 to 32 API. In that same part of the country, to get down to the required flow properties in the wintertime, a substantial quantity of kerosene, maybe as high as 75%, must be added. This will raise the gravity up to about 40.

I don't believe the question asked causes any deviation from practice that you are familiar with in many parts of the country, because in going from winter-quality fuel to summer-quality fuel of necessity there will be a change of 5 or 6 API units or more.

Speaking for the oil industry, most major companies do not impose a narrow API gravity specification, nor can we do this because of the difference in sources of crude oil, refinery processes, and the components that are available for blending diesel fuel. So, I think due to the energy shortage perhaps all of us are going to have to cooperate a little more, and make some compromises in regard to some of the things we would like to have in fuel quality.

MR. HOLMES: Due to the shortness of time we will have to close our discussion. I would like to call on

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Regional Executive Frank Bruner to summarize.

MR. BRUNER: Our thanks to Mr. Holmes and the rest of the Committee for their fine presentation this morning. The questions from the floor were very interesting, and I think they were fielded very well from the platform.

Your paper points up the variations in fuel and lube oil that have been received by the railroads this last year as a result of the energy crisis. It is going to be the job of all Mechanical Officers to utilize their chemists and laboratories to react to these changing fuels and lube oils in order to protect the mechanical fleet.

As concerns flow improvers and pour points of fuel, we on the Union Pacific suffered severely last winter, as pointed out by Mr. Holmes, in that icing and waxing of fuel caused road shutdowns and freeze-up damage to the extent of one-half million dollars. Consequently, we are looking very closely at a number of ways to improve this situation, including addition of heat to two of our major fueling stations, and are continuing a close look at water dump valves and fuel heaters on the locomotive.

Under the circumstances, although we keep putting pressure on the oil companies (and I am sure they will try to supply the best product possible), we will be buying fuels that are susceptible to cold weather problems.

I feel this paper was well done. Although not all of the subjects were covered this morning, I know that if Mr. Holmes' paper was closely analyzed it has a lot of information and action that could be taken before trouble is encountered.

My congratulations to Mr. Holmes and his Committee; and keeping in mind that this kind of meeting is the place to discuss and air our problems, we will say thanks again for a very fine presentation.

MR. TENNYSON: Thank you, Frank. Before I turn the meeting back to President Stendahl, I want to remind all of you members of LMOA to write your questions and hand them to me or any of the other officers so that they can get into the What's Your Problem session on Wednesday.

PRESIDENT STENDAHL: Just a few announcements before we break for lunch. We would like to request that everybody stay out of the supply rooms while the meeting is in session. While you are out among the supply people, enroll as many supply members as you can so that we can build our membership.

We will reconvene at 2 p.m. this afternoon rather than 3 p.m. as indicated in the program. We want you to hear the reports this afternoon. They will follow our business meeting.

Let's have a rising vote of thanks for Dick Holmes and his fine Committee.

[The audience arose and applauded.]

[The meeting recessed at noon.]

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MONDAY AFTERNOON SESSION
September 16, 1974

The meeting reconvened at 2 p.m., Mr. Carl P. Stendahl, President, presiding.

PRESIDENT STENDAHL: Gentlemen, we would like to start the afternoon program. To lead off the session this afternoon, I would like to give you a few thoughts regarding the subject, "Search For Information". First I would like to call your attention to a few factors that have been included this year to give your Association a "New Look".

You will recognize the bright Blazers! We want to recognize and give credit to certain officers of our Association from the *Chessie System* - Larry Booth, our First Vice President; Bill Dadd, Chairman of the Board (our Past President), and others. Let's give them a big hand of applause . . . Thank you . . .

Also a new look is the Advertiser's display board! All credit for the very neat and very practical display board goes to Marty Hausman and Pete Sasgen of Power Parts. [Applause]

As you note on the display board, we *do appreciate* our Advertisers, and we feel confident that it is a mutual feeling. The Advertisers appreciate *our Association* because thru the *medium* of our *Publication*, they have the opportunity to present their message to Railroad Officers and Management people, affording a *very large* coverage for their product.

So much for the new look . . . Gentlemen, I am sure we all want to work toward building a good, strong image. Most *important*, we all want to build *Strength* into our Association.

You will agree, Strength in our Association comes thru large Membership Roster, large attendance at our meetings, and *Active Participation* during the discussion periods.

These factors in turn are governed largely by our *ambitions* and *drive* in our "*Search for Information*", and also depending on how much useful information can be disseminated and exchanged at these meetings. This, together with the circulation and use of our *publication*.

You will recall comments made at our meeting last year, regarding the basic human instinct, which is strong in motivating us toward the goals we

C. P. STENDAHL
PRESIDENT
Gen. Mgr.-Motive Power
Electrical—Burlington
Northern, Inc.
St. Paul, Minn. 55101

wish to attain. This instinct is the drive for more information covering the subject matter interesting to us. Such information as required or desired to accomplish the goal or ultimate result.

The function and purpose of your association, "The Locomotive Maintenance Officers Association",, was brought out by Dr. Rodes this morning and has been pointed out on previous occasions at these meetings. It appears somewhat redundant to repeat, but we do wish to emphasize our purpose, therefore, again state as follows:

"To serve the interests of its members educationally and those of their employers, the railroads, by studying and discussing problems relating to the repair and maintenance of locomotives, commuter equipment and other railroad equipment, thus facilitating and accelerating improvement in practice."

It has also been mentioned at earlier meetings and in correspondence that we have a "Forum" here, dedicated to the above efforts and really the *only Forum* of its kind.

This function and purpose gives *you*, the *entire membership* in the Association, an opportunity to review with the Technical Committees, symptoms of problems as indicated and arrive at solution to these problems.

In the Railroad industry, and in fact most industries which employ skilled technical crafts, the generally accepted standard for learning a trade is four years.

Now, I do not wish to comment at this point to recommend that any change be made to shorten or lengthen the four-year apprenticeship training period. What I do feel is that regardless how long or short that period of Apprenticeship is, that such training in any particular craft is only a foundation or beginning in the learning process.

The "Search for Information" is without doubt a continuing process - much beyond the Apprenticeship training period. It must continue all thru the career of the individual. We must be in position to assist, thereby, assisting ourselves.

The rapidly changing technology is forcing all industry to continue some means of providing information in a systematic manner to keep up or, might say, "survive".

In the review of our responsibilities regarding locomotive maintenance, we very often think of *tools*, and direct our efforts toward obtaining the best, most efficient tool to get the work done as efficiently and expeditiously as possible.

One of these *tools*, and you may agree the "*Most Important Tool*", is *Information* and *Understanding* available to the working individual, for properly accomplishing his assignment. Such a tool ranks as having *priority over* all other tools.

It appears, due to the rapidly changing technology, together with the present day "tempo" of getting the locomotive back in service, that perhaps the older method of Searching through volumes of Maintenance Bulletins is not a very efficient method of providing this important tool, "The Tool of Necessary Information".

The mention of maintenance bulletins brings to mind a situation you are aware of, such as a technician seeking information, goes to his Supervisor and the Supervisor says, "You will find the information in Bulletin #XX34", and stop there.

The technician may well go look it up and proceed about his assigned work, but we are sure you will agree that the technician will be a great deal more productive and interested in his work, if he knows his Supervisor has *understanding* of the problem and shows the technician a definite interest in questions brought to him.

It well appears that our learning process is a full time effort and we, as management groups, need be constantly aware, planning for what must be done to more efficiently bring information to the technician and Supervisor.

Much is already being done on several railroad properties towards this end.

We also see a need to encourage Locomotive Builders and suppliers to alert them regarding a continual *need for and importance* of expanding training programs, to be made available on an increased basis to all forces in the field. We recommend including Supervisory personnel in such training classes or sessions, this so that Supervisory Personnel may also keep up with this rapid change in technology.

The need for a continuing "Search for Information" is very evident and this emphasizes the need for *your* "Locomotive Maintenance Officers Association". It is through such a "*Forum*" that we can exchange our views on how best to accomplish our goals and obtain the ultimate results that are important to us in our responsibilities as "Locomotive Maintenance Officers".

In closing these comments, I wish to express a very sincere thank you to all the Technical Committees and their Chairmen. These are the people who put a lot of hours of concentrated work into making up your program material being presented at these meetings and the Publication.

My sincere thank you, also, to all the Officers of your good Association and your good, hard-working Secretary, Joe Koerner, who really is outstanding for "Getting the Job Done". I am very grateful for having the opportunity to serve as your leader. I have thoroughly enjoyed all the pleasant experiences working with your excellent groups. It is great to see the strong response of our *Strong Organization.*

Thank you.

Before proceeding to the next portion of our program, I wanted to mention that for any of you interested, the Mechanical Services Section of Mechanical Division of Burlington Northern Inc., have a display set up in Room No. 993, of an Audio Visual TV Monitor and a few tapes.

J. D. Blaha, from Mechanical Services Section will be there to provide demonstrations and information as desired.

We do not wish to *endorse* any *suppliers* of such equipment, to *especially* "Sell the Idea", or to make any *inference* that this concept is the ultimate in providing information; we merely wish to demonstrate one method which we feel is proving to be successful in bringing information to the Crafts and Supervisors.

We think you will enjoy the display. [Applause]

PRESIDENT STENDAHL [continuing]: At this time I would like to call on our Fifth Vice President, Mr. E. T. Harley, of the Penn Central, who will be the officer for the next session. Mr. Harley.

MR. E. T. HARLEY [General Mechanical Superintendent, Engineering and Research, Penn Central Trans-

portation Company, Philadelphia, Pennsylvania]: Thank you very much, Carl.

I would like to call on our General Membership Chairman, Eldon Dent, for the report of the Membership Committee.

MR. ELDON E. DENT [Superintendent Motive Power, Missouri Pacific-Texas Pacific Railroad Company, St. Louis, Missouri]: Thank you, Carl, for a nice talk.

E. E. DENT
4th VICE PRESIDENT
(Gen. Membership Chmn.)
Supt. M.P., Missouri Pacific-Texas Pacific RR Company,
St. Louis, Mo. 63103

I am glad to report that the membership situation has continued to improve, despite these trying times of management's posture in effecting the necessary economies to bring about more efficient operations. I wish to thank the executive, the operating, and the mechanical staffs of all the railroads present, and the truly great number of supply and builder industry members present who have all made it possible for our Association to achieve its present level of quality in operation.

I, as one of the rank and file, enjoy the opportunity of serving in this most important capacity, and I am happy to have played a small part in this 1974 effort.

KY PRUCHNICKI
Past President
Genl. Supvr. Loco. Maint.,
Southern Pacific Trans. Co.,
San Francisco, Calif. 94105

We now have 1,823 active, 315 associate and 124 advertising members, for a grand total of 2,262 members. Thank you. [Applause]

MR. HARLEY: Thank you very much, Eldon.

I would now like to call on Past President Ky Pruchnicki for the report of the Nominating Committee.

MR. PRUCHNICKI: The Nominating Committee report is as follows:

President - L. H. Booth, Assistant Chief Mechanical Officer-Locomotive, Chessie System, Huntington, West Virginia.

1st Vice President - J. D. Schroeder, Assistant Chief Mechanical Officer-

Locomotive Burlington Northern, Inc., St. Paul, Minnesota.

2nd Vice President - T. A. Tennyson, Assistant Manager Engineering-Technical, Southern Pacific Transportation Company, San Francisco, California.

3rd Vice President - E. E. Dent, Superintendent of Motive Power, Missouri Pacific Railroad, St. Louis, Missouri.

4th Vice President - E. T. Harley, General Mechanical Superintendent - Engineering and Research, Penn Central Transportation Company, Philadelphia, Pennsylvania.

5th Vice President - J. J. Butler, Chief Mechanical Officer, United States Railway Association, Washington, D. C.

6th Vice President - J. Taggart, System Mechanical Officer-Motive Power, Canadian National Railways, Montreal, Quebec, Canada.

7th Vice President - J. H. Long, Regional Locomotive Superintendent, Chessie System, Cincinnati, Ohio.

EXECUTIVE COMMITTEE

C. N. Cawlfield - Engineer Motive Power, St. Louis-San Francisco Railway Company, Springfield, Missouri.

R. G. Clevenger - Supervisor Locomotive Maintenance, Atchison, Topeka & Santa Fe Railroad, Topeka, Kansas.

N. A. Buskey - Assistant Manager-Mechanical, Chessie System, Pittsburgh, Pennsylvania.

F. D. Bruner - Assistant Chief Mechanical Officer-Operations, Union Pacific Railroad Company, Omaha, Nebraska.

C. M. Smith - Manager Mechanical Engineering-Passenger & Locomotive, Penn Central Transportation Company, Philadelphia, Pennsylvania.

R. R. Holmes - Chief Chemist, Union Pacific Railroad, Omaha, Nebraska.

L. O. Townley - Assistant Manager Industrial Engineering, Atchison, Topeka & Santa Fe Railroad, San Bernardino, California.

Secretary-Treasurer - Joseph J. T. Koerner, Chief Accountant-Mechanical, Chessie System, Huntington, West Virginia.

MR. HARLEY: Thank you. Gentlemen, are there any other nominations from the floor?

MR. PRUCHNICKI: I move that nominations be closed and the slate be elected.

[The motion was severally seconded, was put to a vote, and was carried unanimously.]

MR. PRUCHNICKI: Mr. J. W. Gann, Assistant Chief Mechanical Officer, Chicago, Rock Island & Pacific Railroad, Kansas City, Kansas, and M. J. Chandler, Manager-Maintenance, Penn Central Transportation Company, Philadelphia, Pennsylvania, due to other assignments will not be able to carry on their duties as Regional Executives.

MR. HARLEY: Thank you very much, Ky.

I would now like to call on our newly elected 7th Vice President, Jim Long. Carl Stendahl will present him with his LMOA blazer.

PRESIDENT STENDAHL: Congratulations, Jim. It is a pleasure for me to present you with this blazer. We might call it the robe of office. I am sure you will enjoy the many experiences as Vice President that you will have working with this great group.

MR. LONG: I would like to thank you and the Association for this honor. [Applause]

MR. HARLEY: Now I would like to call on Past President Frank Upton for the report of the Resolutions Committee.

MR. FRANK UPTON [Assistant Vice President-Mechanical, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wisconsin]: I remember a few years ago when I went through the chairs and got a blazer, but I couldn't put it on. Are you going to change the colors every year? I talked to Bob Taylor about this, and we don't quite understand why the Past Presidents don't get jackets: but maybe that day will come. [Laughter]

F. A. UPTON
Past President
Asst. V.P.-Mech.,
Chicago, Milwaukee, St. Paul
& Pacific RR,
Milwaukee, Wisc. 53203

Newly elected 7th Vice President James H. Long, Regional Locomotive Superintendent, Chessie System, is shown being helped into his red LMOA officers blazer by outgoing president Carl P. Stendahl, while President Larry H. Booth looks on in pleasure.

The report of the Resolutions Committee is as follows:

RESOLVED: That the Locomotive Maintenance Officers Association recognize W. F. Dadd for his effective participation in the Association over the years, culminating in his successful year as President in 1973.

RESOLVED: That the Locomotive Maintenance Officers Association express its appreciation:

To Dr. Harold P. Rodes for his special participation in our program, and for the encouragement and inspiration of his message.

To Reverend Orville K. Wold for being with us and bringing a spiritual lift to our gathering.

To the Technical Committee Chairmen and members for their starring role in dispensing much valuable information through presentation of their reports and the resulting discussion of them.

To Railroad Managements for their interest by encouraging memberships in the Association, participation in technical committee activities, and attendance at the Annual Meeting.

To our good friends, the Railway Supply Association, without whom these meetings could not be held.

To our Advertisers, who are carried on our Honor Roll that you see here today, for their support of the Association and for their part in making possible the LMOA Annual Publication.

To the Pick-Congress Hotel for its service and hospitality.

To the Railway Clubs who host our Pre-Convention presentations.

Gentlemen, may I move approval of the Resolutions Committee report.

[The motion was severally seconded, was put to a vote, and was carried unanimously.]

MR. HARLEY: Thank you very much, Mr. Upton.

Now I would like to call on Past President Carl Love, who will make the financial report.

C. A. LOVE
Past President
Asst. V.P.-Mech.,
Louisville & Nashville RR,
Louisville, Ky. 40202

MR. CARL LOVE [Assistant Vice President-Mechanical, Louisville & Nashville Railroad, Louisville, Kentucky]: Sitting here watching the procession of red-coated gentlemen before me, moving back and forth, and getting exposed to the pin that is presented to Past Presidents, I can't help but reflect back through the years. I remember when we used to get a pin that looked like a Confederate war medal. We got a gavel, but no coat.

Looking at this financial report, I am reminded of the days when we had no money at all before the convention. The only way we existed was that we signed a long-term contract with the Sherman Hotel, which we paid after the convention. This Association has come a long way.

I am happy to present the following financial report:

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION
STATEMENT OF REVENUES, DISBURSEMENTS AND CASH BALANCES - CALENDAR YEAR 1973

BALANCES IN FUNDS JANUARY 1, 1973:			
Checking Account - Security Bank		$29,410	
Reserve Account - Security Bank		2,788	
Balances carried into 1973			$32,198
RECEIPTS:			
Interest on Reserve Account	$ 197		
Active Membership Dues	7,134		
Assoc. Membership Dues	3,318		
Registration Fees	2,100		
Advertising Revenues	23,809		
Miscellaneous	213		
TOTAL RECEIPTS		$36,771	
DISBURSEMENTS:			
Convention, Publication and Travel Exp.	$11,790		
Office Expense, Office Assistance, Supplies, Postage, Phone and Stationery expenses	17,221		
TOTAL DISBURSEMENTS		$29,011	
Excess Receipts over Disbursements			$ 7,760
Balances Carried Forward to 1974			$39,958
BALANCES DIVIDED AS FOLLOWS:			
Reserve Account - 1972 Balance		$ 2,788	
Deposit Transferred From Checking Account		1,500	
Interest Paid on Reserve Account		197	
TOTAL BALANCE IN RESERVE ACCOUNT			$ 4,485
Checking Account Balance 12/31/73 1)			35,473
TOTAL CASH BALANCE			$39,958

1) Reconciliation with balance per bank statement:

Balance per bank statement 12/31/73		$36,142.46
Less Outstanding Checks:		
Check #302	$235.61	
Check #303	18.15	
Check #304	187.92	
Check #305	210.00	
Check #306	17.50	669.18
Balance Per LMOA Check Book		$35,473.28

APPROVED:

C. P. Stendahl - President

L. H. Booth - 1st Vice President

Approved this 2nd day of April 1974, Chicago, Illinois.

MR. HARLEY: Thank you, Carl.

Now I would like to call on Joe Koerner for the report of the Secretary.

JOSEPH J. T. KOERNER
SECRETARY-TREASURER

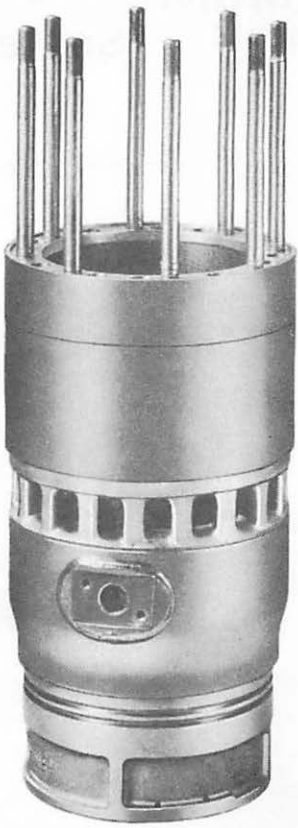
SECRETARY J. T. KOERNER: I have been so busy I haven't had a chance to write anything down. All I want to say is that it has been a real pleasure to work with this fine gentleman, Carl Stendahl, this year. I particularly want to thank the Membership Chairmen, of all the railroads, for their cooperation this year in getting memberships in early. We appreciate that a lot. If you will continue this year the practice of recruiting memberships as early in the year as possible, it will be a big help to the Association. This goes for advertising too. We appreciate you people who want to advertise with us, and to assure your space and help us meet our printing deadline, suggest you reserve space as early as possible.

Are there any questions for the Secretary? If not, that's it. [Applause]

MR. HARLEY: Joe, we certainly appreciate the job you are doing. You are a big credit to the Association.

W F. Dadd, center, accepting bound volume containing the record of his term in office. Making the award is LMOA President L. H. Booth, with the Association's Secretary-Treasurer Joe Koerner looking on. The presentation was made at Chessie System's Mechanical Headquarters in Huntington, W. Va. where all three LMOA officers are employed.

There's a lot more to restoring liners than just plating



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MONDAY AFTERNOON SESSION
September 16, 1974

REPORT OF THE COMMITTEE ON SHOP EQUIPMENT

KJELL AXELSON, Chairman
Committee on Shop Equipment
Genl. Mgr. Work Equip. & Mach.,
Burlington Northern, St. Paul, Minn. 55101

E. T. HARLEY
4th VICE PRESIDENT
Gen. Mech. Supt.-
Engineering & Research,
Penn Central Trans. Co.,
Philadelphia, Pa. 19104

MR. HARLEY: Now I would like to ask the Committee on Shop Equipment to come to the head table. Also, if Mr. Warfel, President of the St. Louis Club, is in the audience, will he please come up.

It is now my pleasure to introduce to you the Chairman of the Shop Equipment Committee, Mr. Kjell Axelson. For those of you who can't pronounce "Kjell", simply say "Swede".

[Mr. Harley introduced Mr. Axelson, who introduced the members of his Committee.]

[Mr. D. R. Burns, Manager-Industrial Engineering, Illinois Central Gulf, Chicago, Illinois, presented Part II of the report.]

[Mr. E. R. Hafling, Assistant Mechanical Engineer, Atchison, Topeka & Santa Fe Railway, Topeka, Kansas, presented Part III of the report.]

[Mr. T. F. Kelly, Superintendent Locomotive Shops, Chicago, Rock Island & Pacific Railroad, Silvis,

Illinois, presented Part IV of the report.]

MR. AXELSON: We are about midpoint through our paper, so we will open the floor for a few questions. You might have some questions to ask about the washing of locomotives and component parts, maintenance of automatic fueling facilities, or truck maintenance procedures. If so, we will entertain questions from the floor before we proceed with the report.

MR. DWYER: I have a question for Dave Burns. Dave, I thought I understood you to say that one method of cleaning trucks was to use a hydrostatic pressure of 10,000 lbs. I wonder if this applies to a locomotive in service. Can this be used without damage to the paint?

MR. D. R. BURNS [Manager-Industrial Engineering, Illinois Central Gulf, Chicago, Illinois]: With this equipment you can vary the pressure. 10,000 psi will take off the paint, the rust, and even the metal if you leave it on long enough. One powered by a 300 HP Ford engine will cut a brick in two quite easily. You can reduce the pressure, so you could use it for effectively cleaning the outside of the locomotive. It won't cut the paint unless you hold it in one position at around 10,000 psi.

MR. DWYER: If you cut the pressure down there will be no damage to the paint, and it will still remove all the grease?

MR. BURNS: Yes. It is a method that was developed primarily for getting paint out of paint spray booths. You get a buildup of 3 or 4 inches of paint and it is very difficult to get off, so they devised a water knife that would just cut it off.

MR. AXELSON: Because of the ecology and pollution standards that now face us, there is more and more interest in high-pressure, cold-water washing and cleaning to eliminate as much as possible the need for chemicals. In some applications you can get the pressures high enough so that cold water is actually heated by use of extreme pressures.

MR. J. J. BUTLER [Chief Mechanical Officer, United States Railway Association, Washington, D.C.]: What is the most effective method you have found for cleaning wheel plates, particularly car wheels where you get heavy carbon buildup from years of oil spillage?

MR. BURNS: There are two automatic wheel washers I know of that do a very effective job. The pressure is something like 500 psi, and the pressure is concentrated to the wheel disk and the axle. The Southern Pacific has one in Sacramento.

MR. BUTLER: I have seen those wheel washers, and they really don't do a satisfactory job because they do not get the carbon buildup off the plate. I think Swede knows what I am talking about. You don't have the problem in locomotive wheels as much as you do in car wheels when they are going through the wheel shop.

MR. AXELSON: I purposely threw out a little bait, talking about cold water to eliminate the need for chemicals. I want those people in the audience who represent chemical companies to feel free to enter the discussion. If you want to take issue with me, go to a microphone and have at it.

MR. SIZEMORE: I have a question for Mr. Kelly. Since the Dash 2 truck, especially on the 3-axle truck, has come into large service, is this truck giving better service than the conventional truck that we are accustomed to, and in your repair procedures is it more or less expensive to maintain?

MR. T. F. KELLY [Superintendent Locomotive Shops, Chicago, Rock Island & Pacific Railroad, Silvis, Illinois]: I don't have enough experience to answer that question. Perhaps EMD can give us some help.

MR. AXELSON: Is there anyone in the audience who has enough experience with the latest EMD offering to answer the question from a practical point of view? If not, do we have somebody from EMD who would care to expound on it possibly from a test performance evaluation aspect?

MR. FRANK P. BOATWRIGHT [Manager Product Installation, EMD, LaGrange, Illinois]: I saw a lot of those guys a while ago. Where are they now when we need them? [Laughter]

MR. WARREN KLINKE [Senior Project Engineer, EMD, LaGrange, Illinois]: The Dash 2 is similar, in some of the wear areas, to the SD truck that preceded it. There is a difference in the primary and secondary suspension. The wear surfaces using Nylatron for chafing plates and pedestal liners (the areas where you would get wear) are basically the same as before. At the center bearing of the truck the diameter is much larger than before. The unit loading is much lower, and consequently you would expect to get much less wear in this area.

MR. L. O. TOWNLEY [Assistant Manager Industrial Engineering, Atchison, Topeka & Santa Fe Railway, San Bernardino, California]: When we bring those trucks out from under one of the newer EMD locomotives we see that the springs on top of the journal box are doing all the work, and the rubber blocks that support the bolster on the truck aren't doing much. I think we are getting an awful lot of wear on the journal box wear surfaces on that truck, much more than we get on the standard SD truck.

MR. KLINKE: The primary suspension is softer on the Dash 2 truck. Do you get abnormal wear on the Nylatron pedestal liner specifically? As far as I know, this hasn't been reported, and I don't know that this has been a problem area. We would appreciate some feedback if you do have that trouble. We will certainly look into it.

MR. SIZEMORE: If there are advantages to running this truck, and if there are areas where you can extend the maintenance, such as jacking them up to inspect the center casting, on our road we now do it on a 12-month basis. Can this now be extended? Do we have enough data, or is it an area where we must continue to jack the locomotive on a 12-month inspection?

MR. AXELSON: At this point it is obvious we don't have enough backup data to give you a good, sound answer. Possibly this should be one of the questions we should research during the year, and bring it back to this convention next year.

MR. SIZEMORE: Thank you. I have another question. Mr. Burns may not have this information now, but when you bring in a locomotive for a heavy repair, would you care to guess what it costs to clean the parts on a heavy repair on a locomotive? I am talking about cleaning the trucks, the gear cases, the engine components, the air compressor, the car body. What percentage of the over-all cost are we tying up in cleaning parts before they are put back on?

MR. BURNS: That is a very difficult question to answer. First of all, it would depend on how sophisticated your shop is. I believe the over-all cost

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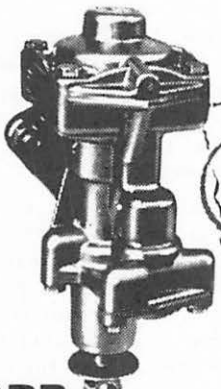

5. On the proposition to modify Section (a) (11) of Interchange Rule 3 to require that all cars rebuilt on and after January 1, 1969 must be equipped with air brake cylinder release valves, approved types, as recommended by the Committee:

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is about 15% of your cost for chemicals and manpower for cleaning, so it is 15% of the total cost. That is a kind of rule-of-thumb figure. If you are interested I could probably put some figures together for you.

MR. HENDERSON: In connection with the cleaning of the radiator cores and also the oil cooler cores, you had a short treatise in your report which represented a lot of work by the Committee, and I want to congratulate them on that. There wasn't much information in the paper concerning cleaning of iron oxide and calcium carbonate from the oil cooler cores and the radiator cores. I noticed there was a recommendation to use hydrochloric acid, but no procedure was given. Does the Committee have a further recommendation on that?

MR. BURNS: I ran a series of tests on the best way to clean a radiator core. There is a series of chemicals available around which we are designing a washer, and it does a very effective job. You use a solvent to remove the carbon, and then you rinse it. You go into another stage where you use, I believe, a particular type of acid. I am giving this from memory, so if you would like to see me later I will give you the name of the company and the chemicals we used. It appears to be very effective.

To give you an example, when we looked at the use of these chemicals, I asked them if they did any rodding. They said yes, they do it occasionally. I said, "What do you do it with?" They said, "Those tools over there." The tools were covered with thick rust, so I assume they don't do it too often. I checked a series of about half a dozen cores and I didn't find a blocked tube, so I assume the chemical is quite effective. If you would like to see me later I will tell you the name.

MR. HENDERSON: And the type of equipment that is also used for handling of the acid through the cores — do you have that?

MR. BURNS: Yes. See me after the meeting.

MR. AXELSON: For the benefit of the members, are there any chemical cohorts who would care to expound on that a little more before we leave it? No takers? Then we will move on.

MR. BURNS: In this particular case it was a small company that tended to specialize in cleaning radiators. They have developed their own chemical for the purpose.

MR. B. A. CUMBEA [Supervisor Production & Statistical Control, Chessie System, Huntington, West Virginia]: Mr. Kelly, you mentioned in the paper the necessity for running in traction motor wheel assemblies prior to application of the trucks. Why do you feel this is necessary?

MR. KELLY: It gives you an opportunity to run the wheel and motor in the same manner as it is in the truck when it is operating. It gives you a chance to detect any unusual noises and correct them prior to installation in the truck frame or under the locomotive. It also gives you an opportunity to clean and condition the commutator. If you have applied any new brushes, it gives you a chance to seat them. If the unit is properly instrumented with temperature gauges and meters, it gives you a chance to note whether the support bearings or any other parts are going to overheat in running. Also, in the higher horsepower locomotives it gives you an opportunity to match your traction motors and mount them in two or

more truck sets, and not be involved in wheel slip trouble due to field differential later on and having to remove the truck.

MR. AXELSON: You might consider that part of quality control, with which you are all familiar. I am a little surprised, as controversial as automatic fueling has been for so many years, that no one questions or has a difference of opinion with the Committee on that subject.

MR. E. F. HEATON, JR. [Supervisor Locomotive Equipment, Missouri Pacific Railway Company, St. Louis, Missouri]: I have a question about the automatic fuel shutoff equipment. Has anybody established a scheduled maintenance of this equipment? If so, what is their recommendation?

MR. AXELSON: Elmer, did we come up with somebody who had already established maintenance on automatic fueling facilities?

MR. E. R. HAFLING [Assistant Mechanic-Engineering, Atchison, Topeka & Santa Fe Railway, Topeka, Kansas]: In our research we never found anybody who had, per se, periodic maintenance, no.

MR. AXELSON: This gets back to our statement in the paper that for the little amount of money spent per year per nozzle or per on-board piece of equipment, I think we have a long way to go in maintenance. Of course the manufacturers recommend maintenance procedures, and it is up to the railroads to not only develop their own standards but to give it follow-up if they want this equipment to work.

MR. HAFLING: In our questionnaire 55% of the people who responded (55% of the railroads) do not have any periodic maintenance program on any of their equipment. Twenty-one, or 29%, that did have some kind of maintenance on equipment, maintained it when it was reported in bad order.

MR. AXELSON: We will move on to a relatively new subject, Vibration Testing Equipment.

[Mr. Boatwright, Manager-Product Installation, Electro-Motive Division, GMC, summarized Part V of the report.]

[Mr. N. J. Nielsen, Shop Superintendent, Milwaukee Road, summarized Part VI of the report.]

[Mr. Axelson summarized Part VII of the report.]

MR. AXELSON [continuing]: I would like to thank the St. Louis Railway Club. Mr. Warfel, president of the Club, was to be here today but was unable to make it, so I would like to thank the St. Louis Railway Club for inviting us to give this presentation in April of this year, and for the fine turnout that attended. This helps make committee work all the more gratifying.

I would like to open the question period and give you a final crack at us by asking Mr. Harley to cast the first stone.

MR. HARLEY: What is the largest size bolt that can be handled by the Una-Driv system?

MR. AXELSON: Una-Driv is new in development for sizes, lengths, and so on. Una-Driv has been predominantly used in car work to date, to the best of this Committee's knowledge. I see Mr. Hess, of Lamson and Sessions, in the audience, and I wonder if he would care to tell us what the latest development is as far as the largest diameter size bolt that the Una-Drive System can handle.

MR. GEORGE HESS [Sales Engineer, Lamson & Sessions, Cleveland,

Ohio]: We are running tests on 1-1/8" diameter by 6" long. The bolt is working very well. The only limitation we have in diameter is the necessity for more power in the tool. We feel the tool we have now, that drives 1" and 1-1/8", has a very good possibility of driving a 1-1/4". We know that will be the very maximum it can drive. Until we run some extensive tests on a 1-1/4" bolt, I don't want to say this tool will handle three sizes. There is no limitation of diameter you can go to, providing you want to add additional wrenches. Right now we have four wrenches covering a diameter range from 3/8" to 1-1/8", and we hope 1-1/4".

MR. AXELSON: How is the delivery?

MR. HESS: Like everything else, we are at the mercy of the steel companies. However, we are coming along slowly but surely. When we get up into the diameter range of 7/8" and 1-1/8" we are using a different type of wire, and it goes on a different machine. We have had some problems. Up through 1-1/4" we have not had too many problems. We hope in the next 90 to 120 days to be completely out of the woods product-wise.

MR. JAMES: Mr. Axelson, in regard to your comments on reprofiling and regrinding of bull and pinion gears, what are the cost benefits with these procedures? Secondly, do you recommend reconditioning more than once? I heard the original prices quoted, and I recall it was around 50% of new. The service life expected after reprofiling is what I would like to know.

MR. N. J. NIELSEN [Shop Superintendent, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wisconsin]: Right at this time I don't have too much on the service life of the reprofiling of the gear. Whether or not you can re-do it would be questionable because of the size of the pitch being changed the second time. I can't answer as to whether they would last the same length of time as a new one.

MR. AXELSON: It depends on the service type of the locomotive. Using a little logic, if you have two new mating gears you will have full tooth face contact to distribute the load. If you take an "as is" secondhand pinion or ring gear and put it with a new pinion or ring gear, you have only point contact on mating teeth, with accelerated wear condition until mating teeth are worn to similar profiles. Again, applying that logic, if you reprofile the gears at least you have a like-new mating surface to start with for initial load distribution, which does help to prolong gear tooth life.

MR. DWYER: Mr. Axelson, I am curious about this Formula 62 equipment. Is there any correlation between the efficiency of its stress-relieving ability and temperature of the part in which the stress is being relieved?

MR. AXELSON: In our paper we used case histories on railroad locomotive applications and found that the results were more satisfactory if Formula 62 was used during the repair process instead of applying the procedure after repairs were made. From this actual experience, we would have to say that the efficiency of vibration stress relieving ability is affected by the temperature of the part, and would recommend its use at the same time that welding repairs are being made, to take advantage of the welding heat.

MR. BURNS: I would like to add one thing. The concept of vibration

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stress relieving was developed by NASA. The problem was that the Saturn rocket housing is several hundred feet long and 30 feet in diameter, and is a weldment. They had no way of stress-relieving it. You couldn't stick it in a furnace because of the distortion, so they developed this method of vibratory stress relieving primarily for that purpose. It has been NASA that has been pushing it. They are one of its foremost proponents. I understand that obviously the higher the temperature, the better the stress relieving. But I believe you have to leave it on longer and you will get the same results.

MR. DWYER: Does the temperature change take place in the part during the stress-relieving operation, and is so can you give us an idea of the amplitude?

MR. AXELSON: From the information we have on it, the answer would be no. It is cold stress relieving.

MR. BURNS: Essentially you just shake the molecules and they settle themselves out to the easiest location under the conditions they are in. It is the same as demagnetizing a piece of metal by hitting it with a hammer. If you have a magnet and you hit it repeatedly in a certain plane, you force the molecules to vibrate into a plane and demagnetize themselves. The same thing takes place in stress relieving.

MR. TENNYSON: I would like to ask a question regarding the possible use of vibrational analysis to diagnose viscous damper malfunction. Have you had any experience with the application of this method of analysis to the diagnosis of viscous damper condition?

MR. AXELSON: It is rather unusual to get a manufacturer on the Committee who will undertake a subject such as this; therefore I will refer your question to Mr. Boatwright, from EMD, and if backup is necessary we still have Mr. K. O. Anderson of GE to discuss it. We credit this portion of the paper largely to the efforts of these two people.

MR. BOATWRIGHT: As far as viscous dampers are concerned, to my knowledge Electro-Motive has not used vibration test equipment or vibration analysis to determine failures. At this point it is strictly a visual identification.

MR. JAMES: In reply to Tom Tennyson's question I would add that we have had no experience with the viscous type dampener. Several years ago we ran vibration analyses on an engine with conventional dampeners, comparing 3-versus 6-pack harmonic balancers, and it is noticeable and discernible in picking out the levels obtained in the 3-versus the 6-pack. So, logic tells me that regardless of the medium, this could be a good means of qualifying the specific type dampener.

MR. AXELSON: I might add it is a new process for a lot of railroads, and I think those of us who are getting into it are learning new applications and still developing data. Possibly this would be a good subject to continue at some later convention presentation when we have researched more data such as that offered by Mr. James, and such as we have had from the Missouri Pacific on traction motors.

MR. JAMES: In regard to vibration stress relief with the Formula 62, does it have a 1:1 ratio? When you are welding, as indicated on your pictorial review of the slides, at the completion of the welding process are the stresses that are built in during the process relieved at the completion thereof?

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REPORT NO. 500-BS

ISSUE OF JAN. 1, 1965

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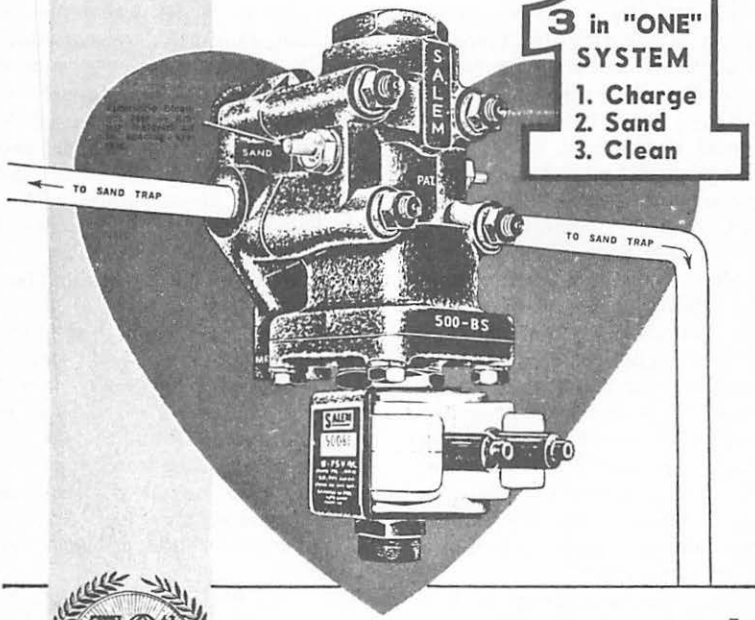

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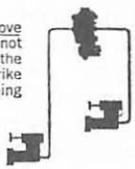

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MR. AXELSON: It is claimed by the manufacturer that stresses are relieved, because during welding repair the metal is fluid and the vibration process helps to align grain structure before solidification takes place.

As previously stated, this is a triangle of vibration amplitudes and is a controversial subject. There have been numerous technical papers written on it, and this is why we qualify this process by saying that there are applications we feel are very beneficial, and others that are still in a gray area and need more field evaluation.

I would like to read some of the back-up paper, if I may. As part of the controversy on vibration stress relief, it goes on to say: "Investigation by G.E. Company representatives was reported in the September 1968 issue of the *Welding Journal*. They concluded that under certain conditions some stress relief could be produced by vibration, but that it could not be expected to be uniform throughout the structure nor of the magnitude normally expected of thermal stress relief. They cautioned that attention should be given to the possibility of fatigue damage in parts subjected to vibration stress relief."

That is a "comme ci comme ca" type of statement. We have other papers where they are positively for it, and others where they are dead set against it. Our position takes case histories in railroad shops (such as those I cited to you in the paper) for a proof-in-the-pudding type of approach. I don't know how you are going to beat that, because we operate locomotives in a real-life world, not in the laboratory. We use laboratory research for guideline purposes.

MR. KLINKE: I might respond to the question on the torsional viscous damper. You can use special equipment to measure torsional vibration at the accessory end of the crankshaft. The paper Mr. Boatwright presented concerned linear vibration.

The problem on the damper is that you have to locate a sensor, to measure torsional vibration, at the accessory end of the crankshaft. The accessory drive gear, which is a spring device system, is not acceptable for measuring crankshaft torsional vibration. By measuring the torsional vibration (changes in rotational velocity) at the end of the crankshaft with special instrumentation, and comparing these results with the characteristics of an engine with a locked-up damper, the performance of the damper can be evaluated.

I am told that a much easier and less expensive means is that if a viscous damper does malfunction, 99% of the time it will be because of loss of silicone fluid in the damper through leakage or a dented casing due to rough handling. Through visual inspection and checking for lube oil contamination you can tell if there has been handling damage, or if there is leakage and therefore a bad order damper.

MR. TOWNLEY: I would like to comment on Formula 62. I approach it with tongue in cheek. Maybe I am wrong, but I think if you shake something hard enough to remove stresses while you are welding on it, you weaken the weld, and if you don't shake it hard you don't have a uniform distribution of stresses. If you try to shake it after the weld is done, you don't do anything. So, I think we ought to look at this with some real testing, and go into it cautiously before we do too much with it.

MR. AXELSON: I fully agree that the proof-of-the-pudding type of approach is the way we should go with this. We have to bear in mind that with the energy crisis for fuel involving thermal stress relieving and air pollution involved in thermal stress relieving, we should have something up our sleeve. A new process like this does offer that potential. In its infancy possibly not every application can benefit from it, but we have to start somewhere.

We try to be a controversial committee to stimulate your thinking, and I want to say that we appreciate your attendance here, as well as thanking you for all the good questions raised from the floor. Hopefully you will be back to see us next year so we can have some more controversial issues for you.

At this time I would like to call on Charlie Smith, the new Regional Executive, to give a summary of the report.

MR. C. M. SMITH [Manager Mechanical Engineering, Passenger & Locomotive, Penn Central Transportation Company, Philadelphia, Pennsylvania]: Mr. Axelson and the Shop Equipment Committee were charged with presenting new developments in shop equipment, and they have done an outstanding job in assembling this wealth of useful information.

C. M. SMITH
REGIONAL EXECUTIVE
Manager Mechanical Engineering,
Passenger & Locomotive,
Penn Central Transportation Co.,
Philadelphia, Pa. 19104

Economics was the key word of this year's report, and the Shop Equipment Committee has had this word in mind throughout the report. Their fine pre-convention presentation in St. Louis, under the auspices of the St. Louis Railway Club, gave the Committee the opportunity to further refine their paper and to produce the excellent and complete report contained in the LMOA Proceedings and the discussion which you have just heard.

I urge all of you to keep this report on hand and to use it in your work in the coming year. I am certain you will find it of great value and assistance.

On behalf of the Association I want to thank Kjell and his Committee for their work in compiling this outstanding report. I will now turn the microphone back to Mr. Harley and Mr. Stendahl.

MR. HARLEY: Thank you very much, Charlie. I certainly believe we have had a worthwhile afternoon, and we appreciate the attendance. We also appreciate the questions that have been asked.

I will now turn the meeting back to President Stendahl for announcements.

PRESIDENT STENDAHL: Thank you, Mr. Harley, Mr. Axelson and Mr. Smith.

Mrs. Emmons, our reporter, is taking down everything that is said. We ask that you review your remarks as soon as she sends them to you, and

send them back to her immediately so that the report can be made ready for publication.

We also ask that you stay out of the supply rooms while the meetings are in session.

I want to comment about the membership. You heard Mr. Dent's report on the membership. We are up a little over what we have had previously. Let's continue to grow, and let's grow even more. Let's approach the supply people and enroll them. Get them to give you their membership.

Wednesday morning we will have the What's Your Problem session. That committee is ready for any questions that were not answered today or that will not be answered tomorrow. We would like you to turn over to them any unanswered questions.

We will reconvene at 9 a.m. tomorrow for another full day. Try to be here promptly so we can start on time.

Now let's give Mr. Axelson and his Committee a rising vote of thanks for their fine contribution this afternoon.

[The audience arose and applauded.]

[The meeting recessed at 4:45 p.m.]

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TUESDAY MORNING SESSION

September 17, 1974

REPORT OF THE COMMITTEE ON DIESEL ELECTRICAL MAINTENANCE

W. R. JAMES, Chairman
Committee on Diesel Electrical Maint.
Superintendent M.P.,
Chessie System,
Huntington, W. Va. 25718

E. E. DENT
3rd VICE PRESIDENT
Supt. M.P., Missouri Pacific-
Texas Pacific RR Company,
St. Louis, Mo. 63103

The meeting reconvened at 9 a.m., Mr. Carl P. Stendahl, President, presiding.

PRESIDENT STENDAHL: Gentlemen, it is nine o'clock. May I say good morning to everyone. Our session is going to be handled much the same as usual. There will be reports of committees, somewhat condensed. The complete reports are in the Proceedings. A discussion period will follow each report, and we ask that you make use of the microphones. Let's put these technical committees to work.

As we said yesterday, this is your Association. You should take every advantage of the opportunity to gain further information on the subject matter, and also let the panels know if you do not agree with what they say. Let's make this a very lively program. Keep things going, and in the discussions bring up anything that is of interest to you.

We have a full schedule today, so I will now ask your 4th Vice President, E. E. Dent, Superintendent of Motive

Power, Missouri Pacific, to be the officer for the session. Mr. Dent.

[Mr. Dent introduced W. R. James, Chairman of the Committee on Diesel Electrical Maintenance.]

MR. DENT [continuing]: It was my good fortune to be present when Mr. James and his Committee made their pre-convention presentation at the Southern and Southwestern Railway Club in April in Chattanooga. It was an excellent program and was well received. Mr. James is most knowledgeable and competent in his chosen field of endeavor. Together with his Vice Chairman and Committee, they make an outstanding group, and are making a great contribution to the success of our effort to afford our membership the most meaningful program materials.

I would like at this time to turn the program over to Mr. James.

[Mr. James introduced the members of his Committee.]

[Mr. Harold Stringer, Supervisor of Motive Power - Electrical, Canadian Pacific Rail, Montreal, summarized Part I of the report.]

[Mr. James summarized Part II of the report.]

[Mr. W. E. Kelley, Manager-Electrical Engineering-Equipment, Penn Central Transportation Company, Philadelphia, Pennsylvania, summarized Part III of the report.]

MR. JAMES: Gentlemen, we will now have a question and answer period. However, prior to that I wish to acknowledge our appreciation to the Southern and Southwestern Railway Club which sponsored and hosted us at our pre-convention report in April in Chattanooga. Mr. Schuh, their president, is unable to be here today.

Are there any questions relative to the subject matters discussed?

MR. DWYER: Bill, the last slide you showed us intrigued me considerably. I wonder if you could quickly give us the main difference between the battery to which you never have to add water, and the conventional battery, because I can see quite an advantage here.

MR. W. E. KELLEY [Manager - Electrical Engineering-Equipment, Penn Central Transportation Company, Philadelphia, Pennsylvania]: In my hurry I forgot to mention that it is a calcium battery. The big difference is that up to now all the automotive batteries have been antimony batteries. This is a calcium battery which inherently has low water consumption, as shown on curves during the slide presentation. Also, this automotive battery has a special sealing arrangement on it which is vented. The venting arrangement is a very minute orifice with a diaphragm which limits evaporation and thus aids in lowering water consumption.

MR. DWYER: Could the water be lost by inverting the battery?

MR. KELLEY: It would be lost in minimal amounts, but even inverting it would not give any drastic loss. They don't recommend you use them in an inverted position.

MR. CHARLES R. LOUGH [Manager Motive Power, Chicago & North Western Transportation Company, Northlake, Illinois]: Bill, your Committee has recommended the elimination of all steps in shunting from the earlier GP-40 units, retaining as-built diodes. Has the diode failure rate on the unit so modified been excessive?

MR. JAMES: No. Our failure rate on diodes with Electro-Motive power on our alternator-equipped units and a sampling of our Committee is well within the rating of EMD's national

average, which is between 1% and 1.5%. The locomotives referred to that were deshunted, using the as-built diodes, have had a failure rate below that national average.

MR. R. P. TURNBULL [Manager Mechanical Engineering, Long Island Railroad Company, Richmond Hill, New York]: You mentioned two subjects on batteries that are problems with us. One is a dropped battery with a lot of damage, and secondly a discharged battery that will crack at low temperatures. Are the battery manufacturers or your Committee doing anything about these problems?

MR. KELLEY: In the monoblock construction the battery companies are now starting to use structural foam trays in place of hard rubber trays. Structural foam is a much stronger and more durable material than moulded rubber. The steel and fiberglas unitized batteries are directly a move to make easier handling and a stronger battery to prevent broken batteries in handling and in service.

On the point of the batteries freezing, the AAR is trying to have the locomotive builders incorporate a low voltage cutout on locomotives, something we sorely need, so that you don't draw the batteries down to beyond a useful point. When batteries are discharged well below the 50% point they are not going to perform satisfactorily in providing engine starting, control and lighting requirements. To take them down to a completely discharged state will be harmful to batteries if left in this condition for a long period, and could cause destruction during freezing weather.

Low voltage disconnects will become more necessary for protecting batteries with the addition of air conditioning and electric heating loads on the auxiliary generator system of diesel locomotives.

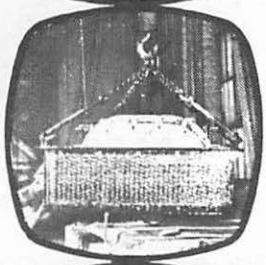
MR. FINDLING: In your wheel slip detection information you indicated the pulse rate counter in relation to existing systems on GE and EMD locomotives would provide a definite reduction in wheel slip indications by virtue of the fact that it is an entirely different system. I believe you said 120 readings. Has there been a comparison made, and what is the percentage of error?

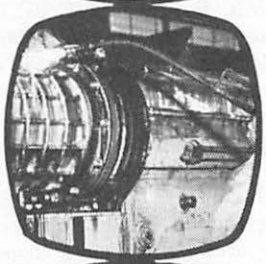
MR. JAMES: Mr. Findling, in reply to your question, the Rail-Tek system is still under development and has been for a period of approximately four years. Specifically, the axle counter is a 120-tooth pulse counter, and we have made tests over our ruling mountain grades on the Chessie System.

As a comparison, while operating over the 17-mile grade, between speeds of 10 and 16 miles an hour, we recorded 170 input signals from I.D.A.C. that would have activated the sanding system and reduced excitation. However, we did not permit the as-built system to do the job of controlling. We recorded only one input slip signal from the pulse counter system over this grade, which resulted in a considerable reduction in sanding system operation.

MR. TONY GARCIA [Assistant Day Roundhouse Foreman, Atchison, Topeka & Santa Fe Railway, Barstow, California]: I have two questions. With this Rail-Tek system does the power plant have to be running on the unit, and could the unit be on or off the line to detect a locked wheel, for example, or a slide?

MR. JAMES: No. It is functional during all modes of locomotive opera-





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tion, requiring a 74 volt input circuit. With a dead unit, in the trailing position of an M.U. consist you would have complete locked wheel protection provided the jumper cable was connected.

MR. GARCIA: My second question concerns batteries. Did I understand you to say that the unitized battery was a calcium plate battery? If so, how severely will the heat affect these batteries on the West Coast in the desert area?

MR. KELLEY: There are both antimony and calcium batteries in the unitized construction. All of the Exide unitized batteries are antimony types. C&D has furnished both antimony and calcium unitized batteries. Gould unitized batteries to date have been the antimony type. They also have the capability of making calcium batteries.

In the slides presented showing decrease of battery life with elevated temperatures, it could be seen that calcium batteries will not be any more adversely affected. Actually, due to the lower water consumption and the longer life expectancy of a calcium battery because of lower float current characteristics, it should last longer than an antimony battery under desert heat conditions.

MR. JAMES: I have just been advised by the boss that we have run out of time. I apologize to the gentleman who was about to ask another question. We will be unable to present the two remaining parts of the report, on Transmission Control and Auxiliary Systems. I trust you will read the remainder of the paper, as we feel there are many cost savings in those two chapters.

At this time I would like to call on our Southwestern Regional Executive, Mr. Bob Clevenger, to summarize the paper.

R. G. CLEVENGER
REGIONAL EXECUTIVE
Supvr. of Locomotive
Maintenance A.T. & S.F. Ry. System
Topeka, Kan.

MR. R. G. CLEVENGER [Supervisor of Locomotive Maintenance, Atchison, Topeka & Santa Fe Railway System, Topeka, Kansas]: Gentlemen, I think you will all agree that the report given by the Electrical Committee this year has been very enlightening and informative. To put together a report of this caliber requires the complete cooperation of all members of the Committee. This year's paper has dealt with problem areas that may seem old hat to many of you, but you must realize that maintenance is the name of the game, and this is what these committees are putting before us.

This year's paper has been presented in five parts, separated under the titles of:

1 - Electrical Rotating Equipment.
2 - Slip-Slide Detection Correction Systems.
3 - Batteries and Starting Systems.
4 - Transmission Control Equipment.
5 - Auxiliary Equipment.

You must agree that they have covered thoroughly the subject as pre-

sented by the title, "Simplification of Electrical Systems and Maintenance".

Problem areas of the AR10 have been discussed and recommendations made that they feel would make a better operating machine. The D-32 D.C. generator, of which there are thousands in service, was shown as having a commutator problem, and recommended procedures to cure this were offered. Basic overhaul of traction motors in regard to mileage was recommended, with the reliability of the bearings being a prime factor.

An explanation of wheel slip and wheel slide systems was given, and with the latest recommendations from the F.R.A. a system of locked wheel detection may be required in the future.

It has been quite some time since batteries and starting systems have been reported in one of these papers, and all of us should definitely take a look at the types of batteries that are available for diesel locomotives. The energy crisis and results of laws passed by environmental agencies may well play a large part in the battery requirements in the future. Batteries are a necessary part of the diesel locomotive and without proper maintenance can be a very expensive part of the maintenance.

The auxiliary cab equipment required by law for the comfort of the operating crews can be and is a major problem area. I am sure all of you agree that the solid-state, zero-maintenance liquid storage-dispensing system, the thermos bottle, is something to think about.

The Committee recognizes that there are circumstances peculiar to each railroad, and it also recognizes that modern-day railroading sees locomotives that are no longer bound by division, region or company boundaries. For this reason a uniform set of maintenance programs are needed.

Bill, I think you have put together an excellent paper, and I would like to ask the audience to give you and your Committee a vote of thanks. [Applause]

PRESIDENT STENDAHL: Thank you, Mr. Dent, Mr. James, Mr. Clevenger, and the Committee.

All of our proceedings are being recorded by Mrs. Emmons, and transcripts will be mailed out. We ask that as soon as you receive them you make the necessary corrections and return them to her so that she can get everything together for the Proceedings Publication.

There was quite a bit of information that we weren't able to get to, and I would remind you that at the What's Your Problem session tomorrow morning we will be glad to handle all the questions we were unable to answer today.

TUESDAY MORNING SESSION
September 17, 1974

REPORT OF THE COMMITTEE ON M. U. TRAINS

C. D. VANSCIVER, Chairman
Committee on M.U. Trains
Mech. Supt. Passenger &
Special Equipment
Reading Company, Reading, Pa. 19601

J. J. BUTLER
5th VICE PRESIDENT
Chief Mechanical Officer
U.S. Railroad Association

PRESIDENT STENDAHL: We will now move to the next report, by the Committee on MU trains. Will Mr. VanSciver and his Committee please come to the platform?

I will turn this next part of the session over to our 6th Vice President, Mr. J. J. Butler, formerly Chief Mechanical Officer of the Reading Company, now Chief Mechanical Officer for the U.S. Railroad Association.

[Mr. Butler introduced Mr. C. D. VanSciver, who introduced the members of his Committee and summarized the report.]

MR. DWYER: Charlie, I was particularly intrigued by your statement that you could get one free month of electricity by incorporating coasting into your train operation. Assuming there isn't a Santa Claus, how much longer will it take the average commuter to get to work under this type of operation? In other words, how much additional running time is required, say, for an average run?

MR. C. D. VANSCIVER [Mechanical Superintendent, Passenger & Special Equipment, Reading Company, Reading, Pennsylvania]: In a survey that was made, 1.4 miles between stations on the Reading Company, it would take 17 to 18 seconds per station stop. The longer the run, the more time would be consumed. The main thing is that if you go to that type of system it is going to take schedule changes in order to do it. When they originally did it, the time schedules were lined up to allow for one-third coasting. In other words, this would not be something you would implement and try to maintain your present schedules. It would be necessary for trains at an outlying point to start earlier in order to get people to work in the morning.

I will now turn the meeting back to Mr. Butler.

MR. BUTLER: Thanks, Charlie. That was a very interesting report, and I am sure everyone here learned something from it.

I understand yesterday a fellow was in here extolling the virtues of electric locomotives and how economical they are to operate. I don't think he has looked at his electric bill lately, because I know on several railroads it has gone up at least 30% to 45% in the cost of commuting power. You are talking of hundreds of thousands of dollars' increase per month. That is a tremendous increase.

Charlie VanSciver has been with us for three years on this MU car program. It took a little persuasion to get him on the Committee in the first place, and I had to threaten to fire him to make him its Chairman. He is leaving us this year, and Bill Kelley is going to replace him. Next year, the paper will be on MU cars and the electric locomotive, so we have a bright future ahead of us.

Charlie, we thank you on behalf of the LMOA for all you have done for us in the past three years. [Applause]

I will now turn the meeting back to President Stendahl.

PRESIDENT STENDAHL: Thank you, Mr. Butler, and thank you, Charlie VanSciver and your Committee for an excellent presentation.

We would like to remind you to review the transcript of your remarks and return them to Mrs. Emmons immediately. We would like everybody to be with us at the meetings, so we would rather have you here than in the supply rooms. The What's Your Problem session will be tomorrow morning. If you have any questions for them please bring them up at that time.

We will return at 2 p.m. for a full afternoon of reports. I suggest we give Charlie VanSciver and his Committee a rising vote of thanks.

[The audience arose and applauded.]

[The meeting recessed at 11:40 a.m.]

TUESDAY AFTERNOON SESSION
September 17, 1974

REPORT OF THE COMMITTEE ON DIESEL MECHANICAL MAINTENANCE

W. M. REED, Chairman
Committee on
Diesel Mechanical Maintenance
Manager of Engines,
Burlington Northern,
St. Paul, Minn. 55101

J. D. SCHROEDER
1st VICE PRESIDENT
Asst. C. M. O.-Loco.
Burlington Northern, Inc.
St. Paul, Minn. 55101

The meeting reconvened at 2 p.m., President Stendahl presiding.

PRESIDENT STENDAHL: It is two o'clock, and we are right on schedule. We have a lot to cover this afternoon. Welcome to our session.

John Schroeder will be officer of the session. He is our First Vice President and is Assistant Chief Mechanical Officer - Locomotive, Burlington Northern.

[Mr. Schroeder introduced Mr. W. M. Reed, Chairman of the Diesel Mechanical Maintenance Committee.]

[Mr. Reed introduced the members of his Committee and summarized the report.]

MR. REED: Is there any discussion on any part of the paper?

MR. DWYER: On the question of filters the paper is quite comprehensive. I was very much interested in all that I read and heard, but I am wondering why there has never been any mention of the electrostatic precipitator in connection with air filtration for diesel locomotives. In power plants and in industry this is used, and I have one in my home. I presume there is a good reason why it isn't used on locomotives, and I wonder if you can tell me why.

MR. J. K. SPARROW [American Air Filter Company, Louisville, Kentucky]: We make electrostatic precipitators. We do use them in a lot of different applications. They were tried on locomotives. Vibration is a real problem with the electrostatic precipitator, and the degree of filtration it provides and also its cost have not made it an economical or justifiable filter. It is not really a good application for an electrostatic precipitator.

MR. R. R. POOLER [Manager Testing, Atchison, Topeka & Santa Fe Railroad, Topeka, Kansas]: I would like to refer to page 354 of the report. I believe the "unknown environmental influence" you refer to is nothing but work. The more time you have in throttle position 8, the quicker scuffing occurs. Sooner or later anyone who has an SD-45-2 is going to have liner scuffing. Even our 1974 locomotives with 50,000 miles are showing some signs of port distress.

I would like to address a couple of questions to Mr. Turney. Has a reduction in gaseous emissions been great enough to warrant the change from the L-1 liner to the L-2 liner? The second question is, why don't we go back to the L-1 liner?

MR. L. F. TURNEY [Manager Technical Section, Electro-Motive Division, LaGrange, Illinois]: I can't answer your questions directly, but I might bring you up to date on the current status of scoring. When I get through I am sure someone from EMD Engineering will answer your questions which involve engine design.

The L-2 liner was introduced in EMD locomotives in 1972, and as it turned out the new design liners could not cope with certain environmental influences prevalent on some of the nation's railroads. Scoring due to the environmental influence predominated on a relatively few of the nation's railroads, as indicated by the various scoring rates of cylinder liners. The two major railroads mentioned in the paper at this point show approximately 70% of liners scored in 1972 model locomotives. Two other railroads in the country had a combined scoring rate of 15%. The combined scoring rate of all other railroads was 4%. Seven of the railroads in the country had no scoring at all. On the basis of the general performance, EMD concluded that the L-2 cylinder liner was sensitive to environmental influences on some railroads.

In our investigation we determined that two of the influences that we consider as environmental influences are lube oil practices and high temperature operation.

As a consequence of the ensuing investigations, EMD modified the cylinder liner Mae West shape characteristic as well as the piston ring shape and loading in order to increase the tolerance of the power assembly to environmental conditions which are conducive to scoring. These changes have been in production since October 1973, and have been good as far as our records indicate. Concerning the two major railroads that are discussed in the paper, A and B, one of them has a scoring rate of 0.3%. The other railroad has had no reports of scoring. Nothing has been reported to us. The over-all scoring is 0.15%.

A further change occurred in January 1974, whereby the L-3 liner was introduced. The L-3 liner has a 1/16th inch narrower port width than the L-2 liner. And although this change was made to reduce the incidence of casting defect scrap, its influence on

anti-scoring can be directionally good. That is the current status of the scoring.

As far as Mr. Pooler's questions on EMD cylinder liner design, will Jim Kotlin from EMD please provide the answers?

MR. JAMES KOTLIN [EMD, La-Grange, Illinois]: In answer to Bob's question as to the importance of the liner port width to the ecology performance of the locomotive engine, we can state that our engine definitely responds in a positive manner to increased inlet port area in that both brake specific fuel consumption and exhaust smoke are decreased.

We feel the increased port area is a good influence upon ecology, and does not compromise reliability. As Lou Turney has mentioned, we have established that Mae West shape characteristics and piston ring loading characteristics are the primary inputs significant to scuffing.

MR. TURNEY: Does that answer your question?

MR. POOLER: I still don't know. Can we buy an L-1 liner today?

MR. KOTLIN: The L-1 liner has been superseded by the L-2 liner in production. In the interest of convenience and economy to all concerned, EMD has historically maintained a philosophy of common parts application to our engines, and the L-2 liner is common to both the Roots blown engine and the turbocharged engine, and is important to the ecology of both of these engines.

MR. POOLER: I can't mention the names of the other railroads, but there are a number of them that have told me in the last couple of months that they are having the same problems we and the other large Western railroad are having. We operated our SD-45s with the same horsepower output from 1966 to 1971 and we never saw a scored liner. I just don't see any advantage in the L-2, L-3 liners, stainless steel ring, or any other thing about this new assembly.

MR. KOTLIN: I had hoped I had answered this question. I feel that data to support EMD's position is available for interpretation by not only EMD but the particular railroads involved with our test programs. I think the data clearly shows what the important inputs are to the scuffing situation, and supports our statements.

MR. TENNYSON: Mr. Reed, I know of one railroad that is having that trouble, but I can't imagine what the other railroad is. I am interested in the environmental factors involved. Lubricating oil practice was mentioned prominently. I would be interested if someone could give me a rundown on what lubricating practices are the factors involved here.

MR. TURNEY: The practices referred to were tested on the railroad involved, and also in our Engineering Laboratory at EMD. Oil mixing practice was a major factor. The best way to cover proper oil practices is to follow EMD recommendations relative to mixing of oils and how to cope with your oil problems.

We do not produce the oil. The oils are provided by the oil companies. All we can do is tell you what we think is best for the EMD engine. We are in no position to recommend a specific oil. Oils vary, especially today, with the nation facing a critical fuel shortage. The best oils for the EMD engine are those which meet the recommendations outlined in M.I. 1752. Conform to EMD recommendations about mixing oils, and follow our M.I., and you

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should stay out of trouble providing the quality of the oil remains the same.

MR. JAMES: Mr. Reed, I would like to ask a two-part question. No. 1, what should be the normal life expectancy for a power assembly in a GE U-30-B locomotive, and also what should be the normal life expectancy of a power assembly operating in an EMD 645-E-3 engine?

No. 2: At the time of condemnation, what would be the most likely cause for condemning those assemblies?

MR. L. K. ADAMS [Manager Locomotive Service, General Electric Company, Erie, Pennsylvania]: I don't know whether we can really give you an answer. The service life of a cylinder assembly is going to vary from one road to another, based on how much you are taking out of it, how you are controlling your support systems, and so on. Frankly, I don't know how to really give you a 3-, 4- or 5-year answer.

You begin to look for the weak link. With the Tufftrided liner and the chrome ring combination, ring wear is very, very low. So, I would say as far as ring life is concerned, that is not the limiting item now. It may still be our top seal. Unfortunately, I can't sit here today and say, "Our top seal or our lower seal will run 5 years." It is going to vary. This is not a very good answer to your question, but it is facing reality.

MR. REED: In regard to the second part of the question, I personally would like to see it go to the maximum of the ring side clearance on the EMD engine. You can't do this, of course, on a GE. It is the measurement between the ring and the bottom of the ring groove.

MR. JAMES: What value would you suggest?

MR. REED: Some railroads have a little difference. We prefer .025 as a criterion for changing it out to keep from getting broken rings.

MR. DANIEL McLAIN [Quality Control Inspector, Illinois Central Gulf Railroad, Chicago, Illinois]: I have a question pertaining to the GE recommendation for changing oil.

MR. L. K. ADAMS [Manager Locomotive Service, General Electric Company, Erie, Pennsylvania]: You can do it two ways. You can arbitrarily change on time, or if you have a good laboratory and you are following your lube oil condition, and you are monitoring the three aspects of lube oil that we want you to look at—viscosity, pentane insolubles, and acidity—you can condemn on the basis of those. If you are not, then I would say with today's engine you ought to be looking at probably a 4- to 6-month change.

MR. JAMES: One other question. I would like to have an expression of views from various members on your Committee as to their findings when processing an EMD 645-E-3 piston through their reclamation procedures. What rejection rate are they encountering? What percentage? We are finding on all 645-E-3 pistons going through our reclamation processes that we have an 80% rejection rate.

MR. REED: I don't have an answer for our own railroad, but I can tell you we are not that high.

MR. F. I. BURCHETT [Mechanical Assistant, Atchison, Topeka & Santa Fe Railway, Chicago, Illinois]: On our railroad our rejection ratio is probably a little higher than yours, due to our scoring factor. In early state on the 645-E-3 assembly we are experiencing a terrific failure rate. We are working with many people trying to come up

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with some method to recover some of these pistons. We will try almost anything to reduce the cost of rebuilding or repairing these locomotives. We will solicit EMD's cooperation in this area.

MR. TURNEY: I don't have any feel for it at all. I haven't explored this aspect. You are talking about when you pull down power assemblies and check them out. I didn't realize you had that high a rejection rate. This is the first time I have heard such figures. How long have they been operating, Bill?

MR. JAMES: Approximately 4 to 6 years, and the principal reasons for rejection have been cracking in the lower skirt area, and land breakage.

MR. HOWARD V. HINES [General Foreman, Southern Pacific Railroad, Los Angeles, California]: We are also experiencing, as the other Western railroad, a high loss of SD-45 pistons and liners. We do not have a reclamation program at the present time for the scored pistons which we are finding on a 90-day airbox inspection basis.

MR. KOTLIN: I am surprised at the figures of piston scrap reported by Mr. James.

From his description of the reasons for scrap, I surmise that damage to pistons caused by broken piston rings is a major reason for piston scrap. This may be true in our early vintage 645 engines, which utilized a ductile iron top compression ring.

However, since 1972 we have adopted the stainless steel compression ring, and this has been an important contributor to the reduction of ring breakage, for two reasons: First, the stainless steel ring reduces side wear to about one-half of that of the ductile iron ring. A stainless steel ring can therefore operate for a substantially longer time than the ductile ring before critical side clearances are reached causing ring breakage.

Secondly, the stainless steel ring is inherently less prone to breakage because of its increased strength as compared to ductile iron.

Insofar as the cracked skirt problem is concerned, I know of no general problem of this type, but we would appreciate having some pistons returned to EMD so that we could analyze probable reasons for this condition.

MR. JAMES: A point of clarification. The service life we have been receiving from the 645 assemblies, over-all, has been rather good, but comparing this E-3 piston with other pistons prior to it is what is causing our concern. I wouldn't want to guess, but we have had a very long service life with all pistons prior to the 645.

MR. REED: Is this with the modified firing piston?

MR. JAMES: This is the piston with the number one ring groove located 1-1/2" from the top.

MR. REED: I was thinking of the modified one, 1¼ inches from the top.

MR. LOUGH: Is there a paper filter on the market that can be changed on an annual basis?

MR. REED: I know of one member on the Committee who, since they have been modifying their filter assembly housing, feels they are going to get a year. I don't know of anyone who is getting that good service as yet. Mr. Leedy's railroad has come up with a hood to protect against ice and snow, which seems to help out quite a bit. Other than that, I can't say. Does anyone else on the Committee want to comment? Are there any other questions?

MR. S. D. SMITH [General Mechanical Superintendent, Florida East

Coast Railway Company, St. Augustine, Florida]: I wonder whether any of the panel members have had any experience with loose crab studs, broken crab studs, on the GP 40 and Dash 2 power. You mentioned torque procedures in the report.

MR. REED: I can speak for ourselves. Yes, we did have some problems with loose crabs and also with some broken ones. Most of ours were on the 45s as opposed to the 40s, but we did have some problems on the 40s. I don't know the answer to it. It took a lot of torquing before we solved the problem. We had a wholesale program of torquing these engines over again.

MR. TURNEY: I might add something to that. The general finds that we had, every time we investigated a problem of broken crab studs, were that it was due to failure to torque properly. It was a case of loosening up and not following our recommended torquing procedure. In practically all of the problems we investigated we found this. We are currently investigating the problem on your railroad. I don't know what we will come up with, but I would be almost willing to bet we will find there is something in the torquing.

MR. S. D. SMITH: We followed your instructions, and in fact we have had your service engineer down to see us. We even tried the degree method, and we still have a problem.

MR. TURNEY: As I said, we are still investigating your problem, and we will come up with an answer. Torquing has been the problem in most cases.

MR. JAMES: Mr. Smith, we have encountered that problem, and I would recommend to you as a temporary stopgap measure, that you set up a maintenance program for annual retorquing of your crab studs. This has greatly minimized the problems we have had.

It appears that the crab studs are stretching in service, which causes loss of initial torque values. However, with an annual retorquing program our problem in this area has been reduced.

MR. REED: At first we torqued the engine after it had been in service one month. We had to torque some of these engines as many as three times, in a short period of time, before we could get the torque to stay. One thing we did not do (and we are glad of it) is that we never followed one of the procedures that was set up and has now been changed, wherein they told us to go up to 2000 lbs. torque. We never did that. We went to 1800 lbs. and left it there.

MR. SIZEMORE: On the Santa Fe we have the L-1 liner in great numbers. We have the L-2 liner, we have the L-2 SP liner, and now we have the L-3 liner. We have the 1-1/2" 948 piston, and we have the 702 1-1/4" piston. My question is, can these combinations be run in a 645 engine together? What would EMD's recommendation be on those combinations?

MR. TURNEY: I think Jim Kotlin can answer that better than I. In my opinion you can run the 1-1/4" and the 1-1/2" in the same engine. Do you want to cover this, Jim?

MR. KOTLIN: Yes, the 1-1/4" ring belt piston and the 1-1/2" ring belt piston can be intermixed in the same engine.

In the turbocharged engine, all combinations of 1-1/4" pistons, 1-1/2" pistons, and all liner types can be intermixed. Obviously, fuel economy and exhaust smoke will be compromised to

some degree by mixing assemblies, but there will be no mechanical problems created by mixing.

In the Roots blown engines, 1-1/4" pistons and 1-1/2" pistons can also be intermixed with all liner types.

However, our present production Roots "fire ring" piston having a 3/4" ring position has such a tremendous influence on fuel economy and exhaust smoke that we recommend this piston be utilized in complete engine sets.

The fire ring piston must also be used in combination with cylinder liners manufactured after March 1971, these liners having a reduced lead-in chamfer at the top of the liner to accommodate the higher ring position of the fire ring piston.

MR. BURCHETT: I have another item I would like to discuss for a moment. Bill James asked a question about 3000 HP GE locomotives and what we could expect. I think we would be neglectful if we didn't point out that we do operate 3600 HP GE locomotives, and have experienced some short life or unexpected life due to intake valve wear on the mushroom. We have found it necessary to remove some of these assemblies prior to our expected life.

As Mr. Adams pointed out, we did find some good rings, good liners, and questionable top seal. We did find problems coming on with the intake valve. GE has offered a different valve, and we are experimenting with it. We are not far enough into it to be able to make a statement yet, but we hope that will be the answer.

MR. REED: We will proceed with the paper. We have a section in the paper on that valve. I don't know how many railroads are using it, besides our own, but GE was quite confident about it in the paper.

[Mr. Reed summarized the remainder of the paper.]

MR. REED [continuing]: I would like to thank the Chicago Railroad Diesel Club for inviting us there to give our presentation. We had intended to call on Mr. Carriere, president of the Club, but he is not here, so Mr. B. B. Morrison, Shop Superintendent of the Illinois Central Gulf, representing the Chicago Railroad Diesel Club, will open the discussion at this time.

MR. B. B. MORRISON [Shop Superintendent - Locomotive, Illinois Central Gulf Railroad Company Homewood, Illinois]: Thank you. Unfortunately Mr. Carriere had to leave. We would like to thank this fine Committee for being with us last spring and presenting their preconvention paper. We had a good turnout. Our next meeting will be held next month, if any of you gentlemen would be interested in attending.

The only question I have concerns scored liners. What is the exact cause of scored liners?

MR. TURNEY: I thought I answered that fairly well in my reply earlier. I indicated that we still say there are certain influences that can cause this. You might call them operational influences or environmental influences—take your choice.

In the case of the railroads involved, the investigation up to this point has indicated that one influence could be lube oil, the other heat. To cope with the adverse influences, we changed the design of the liner. With the change in the design, feedback so far on the L-3 liner indicates that this change in the Mae West area, and the change in the ring configuration, has helped. This is going to allow the power assembly to live with some of

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the adverse influences that are causing the scoring.

Basically, we might say the L-2 liner as it was originally put out in the field could not cope with all adverse influences which prevail on all of the railroads. There were a few roads where the liner could not exist. EMD made a design change to make the liner more tolerant to these influences.

There is one thing I would like to bring up at this point. We mentioned the nickel-plated head seat ring. In the paper we indicated that this could be the coming thing, but at this point problems have developed in our project testing of the nickel-plated welded-in head seat ring. At this time we are shelving the project because we do not like what we have seen. Engineering is going to explore the ring further, but in the meantime we are stopping the field testing of this project. In the paper as it was written, things looked great; but now, with more time on the ring, it is not working the way we had anticipated.

One other small item in the paper requires clarification. We talked about anti-friction bearings. A correction was supposed to have been made in the paper, but wasn't. The way the project was set up, there is one truck equipped with the Timken bearing and a standard motor, while the other truck is equipped with the Hyatt bearing and a standard motor. The paper indicated we had the two project anti-friction bearings on the same truck.

MR. SIZEMORE: To continue with the scoring problem, we discussed the liners, and you gave us the history of the liners. We would be interested in knowing about the 250 rings, the stainless steel rings. Could you give us some history on that, and what EMD's consensus is as to this continuing in service, or is it going to be the standard?

MR. TURNEY: The evaluation comparing the stainless steel to the ductile iron ring is continuing, and thus far the ring type influence on scoring seems to be secondary to the change made in the Mae West shape and the piston ring load specification. We do not feel at this time the ductile iron is any better or worse than the stainless steel. The rings are comparable, and at this point we cannot say one is better than the other.

The big change that was made to alleviate scoring is the change in the Mae West shape and the load specifications on the ring. We may come up with something later, but at this point the rings ar at a stand-off.

MR. REED: Lou, I asked you a question at one time on the phone, and I would like to ask it again. The book refers to ramp oil. Would you explain that, please? What do you mean by ramp oil?

MR. TURNEY: It would be best to have the railroad, that uses what is referred to as ramp oil, explain it.

MR. POOLER: Our lube oil practices on the Santa Fe system are exactly that which are laid out by EMD in their one-additive system. We have one additive put into a selected number of base oils. Somehow or other this has acquired the name of ramp oil. At Barstow, California we have two base stocks now, with one additive. Our lube oil program follows exactly what is listed in the EMD Pointers of September 18, 1972.

MR. REED: I thought surely someone would ask a question of GE on lube oil, as shown in the report. There is quite a reduction in lube oil used. I

think it was made by not actual measuring of locomotives, was it, Les—this lube oil consumption? How was that data gotten?

MR. ADAMS: Will you ask that again?

MR. REED: How was the data gotten on the lube oil consumption data figures? Did you follow it in a group of locomotives?

MR. ADAMS: We have checked locomotives in the field and also in our own lab in Erie, as to the consumption rate. It has substantially changed. I am not sure what you are asking about.

MR. REED: I am asking how the data was actually worked up, as to the validity of it. I am sure some railroads here don't see that improvement, and I just wondered whether it is something we are doing, or what it is.

MR. ADAMS: The initital rate of oil consumption with the Tufftrided liner and the chrome ring combination is in the ball park of .3% of fuel, and as the rings wear in it goes up to a stabilization level of around .5. Several roads have run their own consumption tests, and I understand results confirm our data.

MR. TENNYSON: I am pretty much in the same boat with Bob Pooler on oil practice. We do have some scoring of GE liners too, and I would like to have some expression from GE on the cause.

MR. ADAMS: Tommy, if you are borescoping an engine and you are used to looking at a chrome liner, when you look at a Tufftrided liner it will scare you to death. Cosmetically there is a substantial difference. We know on the SP, for example, we have pulled cylinders and because of surface spotting or streaking they look terrible, but they really weren't. I think this may be an educational process that we have to go through to get the man to realize he is looking at a Tufftrided liner instead of a chrome liner.

MR. TENNYSON: EMD's position is that it is a lube oil practice that influences the scoring. Do you also support this type of theory?

MR. ADAMS: No, not exactly. Certainly a lack of lubrication from whatever cause would contribute to scoring. Stuck rings, excessively worn rings, airborne dirt, faulty injection equipment, incorrect rings, excessive cylinder temperatures, all can produce scoring. We do know that the Tufftrided liner is more tolerant to these conditions than is a chrome liner.

MR. HOFFMAN: To specifically answer Tom's question, we have not seen any relationship with any of the lube oils that are currently being used in the field with any scoring problems or situations which might exist on a GE liner. The first part of his question, I think, perhaps could be amplified a bit from Les's point of view.

We have had a considerable number of liners that were returned from the field as representing unusual conditions as detected by the borescope. We put these in the laboratory engines just the way we received them, and continued to run them for hundreds of hours at 25% or more above commercial ratings, with no problems. In short, the non-chrome liner looks peculiar in the borescope.

We are presently developing a tool to help educate the folks who are used to looking at chrome liners and who are now suddenly looking at a different metallurgy. This tool not only gives you a chance to look but

also a chance to feel. It is nearly ready for its first field application. Perhaps, Tommy, the SP would be a good place to try it. It feels scratches and indentations.

On those liners which were returned, that were really scored, that could not be used, the primary cause which we have identified to date has been associated with airborne abrasives. In other words, iron, sand, and materials of that nature. So, air filtration continues to be as important a subject in engine maintenance as it has been over the years. I hope that helps you, Tommy.

MR. SIZEMORE: On this lube oil problem, we load test many engines out in California. It is very hot. In the 20-cylinder 645-E-3 engine the lube oil well get around 240°F. On the 16-cylinder 567-D-3 we load, the engine lube oil temperature gets up around 200°F.

My question is the scoring problem in the 645-E-3 assembly. Does this occur more in the 20-cylinder engine than in the 12-cylinder or 16-cylinder engines?

MR. TURNEY: Yes. The problem has been more predominant on the 20-cylinder engines. I don't have the percentage figures with me today, but it has been more predominant on the 20-cylinder engines.

While still on this subject, I might offer one more comment. While I was discussing mixing of oils, a remark was made that the same additive is being used with all the oils in the mix. I concur with this statement, but what happened is that after using a particular mix of base oils with the same additive as the ramp oil, suddenly there was a sizable increase in one of the base oils. The change in proportions of base oils used in the ramp oil created a different environment for the engine. Shortly after the change in oil practices, the railroad was deep into a scoring problem. The environmental influence, change in oil practice, triggered the scoring. The scoring on the railroad involved diminished after control was placed on oil practices.

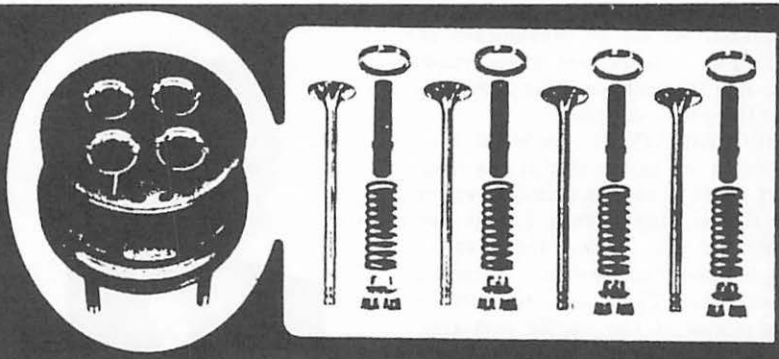
MR. KOTLIN: I think we need a little clarification here that is important to this discussion.

The reason we speak of lube oils in relation to scuffing on this particular railroad is simply that when we first became aware of the problem of this western railroad, we performed a comprehensive inspection of their fleet. We found excessively heavy piston ring belt deposits, and extreme deposit levels on the piston crown and cylinder head fire face which were terribly abnormal for our engine. At that time we then proposed a lube oil test program, because our inspections strongly indicated lube oil to be an important factor to this problem.

This program was put into effect, and from that time deposit levels have diminished to a normal level, as has the scuffing failure rate.

MR. JOHN ANGOLD [Assistant to Chief Mechanical Officer, Atchison, Topeka & Santa Fe Railroad, Chicago, Illinois]: On the subject of ramp oil, we had a group of SD 39s on this same oil through almost the entire life of the assemblies, and none of those locomotives developed scuffing. They went clear through their normal maintenance period without any scuffing. So, I think we are making a mountain out of a molehill on this lube oil matter as being a contributor to the scuffing problem.

Again I would ask the question Mr. Pooler asked: Why can't we go back to



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the old L-1 liner and get out of this situation? As far as convenience of having one type of liner is concerned, this scuffing problem is not a convenient thing to have either.

MR. KOTLIN: I would like to reiterate the comment that the liner port width is not the primary reason for this scuffing pattern. I think our programs have shown the area of trouble, and I think we have corrected those areas. There are still further evaluations of the ductile iron ring versus the stainless steel, as Louis said.

I don't like to harp on this question of oil, but I think it is important to get the record straight. When I commented on the piston deposit observations, it was also a fact that all 45 power on this railroad got into trouble, whether it was Dash 2 or not. There was an increase in scuffing on all units, whether they had wide port or narrow port liners. There was a general degradation in the fleet. The point is that it indicates oil can play a part in scuffing, and we also recognize that design and development can lead to more tolerance of these influences. That is always the goal of our design and development.

MR. REED: At this time I would like to call on Nels Buskey, Regional Executive, to summarize the report.

MR. N. A. BUSKEY [Assistant Manager - Mechanical, Chessie System, Pittsburgh, Pennsylvania]: Gentlemen, it is very obvious, from the questions generated by Bill Reed's Committee report, that considerable work remains to be done by the builders to improve reliability in our locomotive fleet.

As most of you are aware, the prime function of the organization is for the purpose of studying, discussing, reporting on, and recommending maintenance practices, procedures, tools, facilities, and materials to improve locomotive performance and/or reduce locomotive maintenance costs.

N. A. BUSKEY
REGIONAL EXECUTIVE
Asst. Manager-Mech.
Chessie System
Pittsburgh, Pa. 15219

In summarizing this Committee's report, I find many topics and subtopics which are of tremendous interest:

1 - The cylinder liner scoring problem.

2 - The port clipping problem. (These problems were experienced in 1962-63 on GP-30 units. EMD worked out of the problem, and I am confident they will again find the solution.)

3 - Torquing crab nuts properly has proved to be beneficial.

4 - We are still experiencing water leaks on GE locomotives.

5 - One item of utmost importance, during this present energy crisis, is lube oil consumption.

6 - Turbocharger life appears to have improved greatly.

7 - Cracked wheels have always been a problem, but the problem has been solved by pinpointing the area and retraining engine crews.

8 - Air filtration systems are much better, and require less maintenance than ever. Many roads are upgrading their filtration systems on older power, and it behooves all of us to investigate thoroughly the economics of the systems available. New innovations have been brought to the Committee's attention. One is the new primary air cleaner, which is available on 1975 deliveries. This new inertial air cleaner is a result of an extended research and development program aimed at eliminating the need to remove the inertial primary filters for periodic cleaning prior to major shopping of the locomotive, which is 3 to 5 years, depending on the operating conditions and overhaul policies of your particular road. This is certainly noteworthy with the ever-increasing cost of labor.

9 - Crankshaft stubshaft repairs have long been needed, and the Committee reports on a suitable solution.

10 - Another subject of interest is the methods of cleaning fuel tanks prior to welding.

11 - Lastly, the education of maintenance personnel by television.

One thing of great importance, not mentioned, is the shortage of materials, EMD head gasket kits, pistons, wheels, just to name a few items. And, gentlemen, these are becoming very critical.

I am confident you will all agree that Bill Reed's report, "Mechanical Problems Affecting Locomotive Reliability", is both timely and appropriate, and will be of some assistance to each and every one of us who maintain locomotives.

This Committee, representing many of the major railroads of the country, has presented their problems well and, wherever possible, the corrective or remedial measures. I certainly believe Bill Reed and his Committee deserve a vote of thanks for a job well done. [Applause]

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TUESDAY AFTERNOON SESSION
September 17, 1974

REPORT OF THE COMMITTEE ON DIESEL MATERIAL CONTROL

D. M. WALKER, Chairman
Committee on Diesel Material Control
Asst. Mechanical Engineer
Southern Railway
Atlanta, Ga. 30303

J. D. SCHROEDER
1st VICE PRESIDENT
Asst. C.M.O.-Loco.
Burlington Northern Inc.
St. Paul, Minn. 55101

PRESIDENT STENDAHL: We are asking Mr. Schroeder to do double duty today in the absence of Mr. Taggart, who is away on other business. We will ask Mr. Schroeder to continue as officer of the session.

MR. SCHROEDER: Thank you, Carl. Will the Committee on Diesel Material Control please come forward and be seated at the table.

The Committee on Mechanical Maintenance certainly has a big chore trying to gain greater life expectancy from components, and now following that report we will hear from the Committee on Diesel Material Control. Their topic for this year is "Mechanical Department Economies". I noticed in their paper they have gone a little farther than just economies. Things that have happened in the last six months while their paper was being

prepared have given them a lot of material with which to work.

[Mr. Schroeder introduced Mr. Darrell M. Walker, Chairman of the Committee on Diesel Material Control.]

[Mr. Walker introduced the members of his Committee and summarized the report.]

MR. WALKER [continuing]: This Committee was honored by having the opportunity to make its pre-convention presentation at the Great Lakes Railway Club. We have with us today, representing the Club, Mr. W. D. Eyerly, Superintendent of Shops, Chessie System, Pittsburgh, who is also Second Vice President of the Great Lakes Railway Club. I would like him to open the discussion.

MR. W. D. EYERLY [Superintendent of Shops, Chessie System, Pittsburgh, Pennsylvania]: The Great Lakes Diesel Club was honored to have Mr. Walker and his fine Committee present their pre-convention report on May 15, 1974 in Cleveland, Ohio.

Mr. Walker and his Committee have devoted considerable time and effort to their topic of "Mechanical Department Economics".

The Great Lakes Diesel Club will hold meetings at the Sheraton Midtown Inn on September 26, November 14, January 23, March 28 and May 15. If you gentlemen are in the area, please do not hesitate to attend our meeting.

I would like to open the discussion period with this question: How do the builders determine allocation of materials in short supply between the production of new locomotives and the customer's maintenance needs?

MR. R. J. HONDLIK [Parts Sales Manager, EMD, LaGrange, Illinois]: The end product in any manufacturing facility has to come first, of course, and therefore any shortage of material items that we would have would normally be directed to the production line for the end product.

However, there are other alternatives that I think could be and have been considered. We have a Parts technical group that could very possibly determine a substitution. We have a group just for that purpose. We find in our vast warehousing system that an item could be critical under one part number, but the same item is available perhaps under another part number, yet it is the same thing. I don't know how to explain why that happens, but with 50,000 items that we process in our warehouse I guess we could have this happen.

So, I think first we would explore a substitution. If that didn't work, perhaps our unit exchange pool would have material available in it for modification or perhaps as is, and we would go back to the customer and say, "We can't give you a new one of these, but we do have the possibility of unit exchange, and we will even modify it if we have to in order to keep the locomotive running."

EMD's policy has always been that the locomotive out of service takes all priority. There have been several cases in the past where material people in the factory would have to give the people in the parts department the material, and this of course could forestall the completion of an engine or generator or an entire locomotive, for that matter. We haven't had too much of that because our people know to whom we have sold these things and can arrange to get a few.

If we are in a tight spot for a part, and we know that railroad A had a recent shipment of fifty, we would go to them and say, "Can we buy back a couple, or will you sell a few to railroad B?" We can solve many situations in that way. Fortunately, these extremely tight situations are not of long duration, and to support all of this we have established a team of people who are traveling around the country right now. We call them super-expediters. They will knock on the vendor's door and will stay there until they get some satisfaction. So, if you get in a really tight situation we will dispatch men to the vendor and get whatever we can to keep the locomotive fleets running in this country. This is our number one dedication.

To answer the question, if it came right down to the wire, and to who is going to get the material, I would have to say that the fleet owner and operator would probably take priority over production.

MR. F. L. BAUMGARDNER [Manager, Locomotive Parts Marketing, General Electric Company, Erie, Pennsylvania]: With the shortage of material today, one of the problems is allocating where the material goes. We do allocate it based on past usage. We have gotten into some problems where there have been some failures, and usage by the railroads has increased tremendously. We do our level best to meet the existing fleet's needs.

Bob mentioned that a locomotive out of service has first priority, and material is shipped for that. The allocation then comes on the normal maintenance usage of the railroads versus the normal production.

MR. M. C. DOWNS [Parts Distribution Manager, Alco Engines Division, White Industrial Power, Inc., Auburn, New York]: Alco has two separate inventory systems, the parts system and the production system. Both are ordering and warehousing the same materials, independently at the same time. With this broad base we very often have material in one area when the other area dries up. As a matter of routine we meet every morning at 8 o'clock with our production people, and we go over our respective "hot lists" of short materials and we see where we can help each other. Often we find that some of the items we need they can't supply to us because they are short some individual component in an assembly. We check our stock and if-available supply, so we help ourselves by putting material back into production so that they can help us.

Of course there are always items that are real crunchers, where we don't have material anywhere except perhaps on the floor where it has been released for engine production. Where material availability is going to actually affect our production of original equipment, the decision is a serious one because it involves not only manpower utilization but delivery of our new engine product. For this reason, we have to weigh allocation of these materials at the presidential staff level.

My boss, the Vice President of Sales, gets together with the Director of Materials, and if they can't hash it out to their mutual satisfaction the problem is decided by the President. How do we make out? I will have to be honest with you. We lose most of the battles as far as items that are internal with the engine are concerned, where we do have manpower utilization prob-

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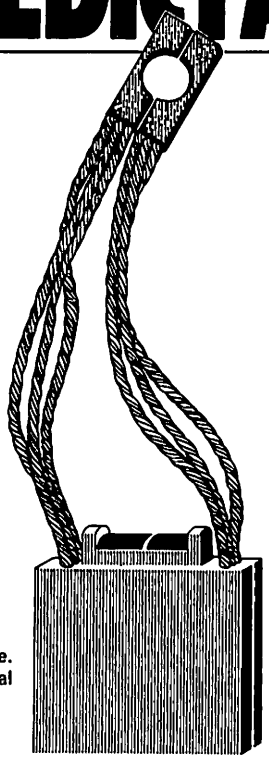

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lems—items that we can't work around.

We do win most of the battles where we are talking about items that are basically add-ons, like turbochargers or manifolds, something that you can build most of the engine without, almost to the point of test—items that can be added after the engine has been removed from the line. When there is not enough material to satisfy demands, it is a difficult decision as to which need is the most urgent. We do the best we can. I am sure we don't please everybody all the time.

MR. HENDERSON: Darrell, I think this is probably the most important discussion we have had since I have attended this meeting. The railroad industry is facing a critical situation. We talk about parts allocation like we talk about fuel allocation. I get an empty feeling sometimes when I walk into the office in the morning and see 1.8% of our fleet tied up waiting for parts.

I appreciate your comments. You had a very good paper on the parts situation and the parts supply situation; but when you have 45,000 pistons moving up and down inside of diesel engines and you go to the parts supplier and he says, "Your allocation of parts was five pistons today", that is absolutely unacceptable.

So, I have a question. You made a comment in the paper about claiming of warranty on parts. We happen to have a lot of engines on warranty, and if we have to set out one of those engines because we have no warranty parts to put back into the engine, and we are not pulling freight cars to make revenue simply because we can't get the parts, are the manufacturers ready to stand behind their warranty if we don't use warranteed parts?

MR. WALKER: Mr. Henderson, would you like to direct your question to one or both or all three builders?

MR. HENDERSON: I certainly would. I would like to direct it to EMD and GE.

MR. BAUMGARDNER: It is hard to hear you up here. Would you like to repeat your question?

MR. HENDERSON: If we have a GE engine sitting out of service for want of a part, and that engine is under warranty, and GE cannot furnish warranty parts for it, is the General Electric Company willing to say we can go ahead and use a second-hand part, or a part anywhere we can get it, to get the locomotive back into service, and assure us that we will have the same warranty on that engine?

MR. BAUMGARDNER: Generally yes, although I would presume our service people located on the property would have some judgment on what should be done. A part might be such that you just couldn't use it. You are saying you have a used part and you want to put it in the locomotive to get it running, and you ask if we would stand back of the warranty.

MR. HENDERSON: More precisely, it may be another manufacturer's part.

MR. BAUMGARDNER: What kind of a part is it? [Laughter]

MR. HENDERSON: It could be built by another company. Very precisely, it could be an electrical part. I could say the same for EMD. The question is very blunt, and I am looking for a direct answer. The railroad industry is in a critical situation. Let's face it, gentlemen. As far as I am concerned, this is probably the most important discussion we have had today. We can talk about scuffed and

scored liners, and we can replace them if we have the liners. We can talk about burned-out fuel pump motors, whether they are GE or EMD or Alco. But if you don't have the part to put back in, then where do we go from there?

I will ask the question again. If the locomotive builder cannot furnish the part, then what is the railroad to do? Are you willing to stand behind the warranty of your locomotive, since you can't furnish the part, if we use another builder's part? That is a very simple question.

MR. BAUMGARDNER: That is a simple question, but I don't have a simple answer. It is a hard question to answer. Again, it depends on the part you are talking about. I know that in some cases some other part than GE's was used and we stood behind the warranty to keep the locomotive running. I just can't answer the question. It will have to be looked at case by case.

MR. HONDLIK: I could turn this question around a bit. Perhaps this will throw some light on the discussion.

There have been many cases in the past where the locomotive is under warranty and the railroad, to keep the locomotive running, would put some other source material in the locomotive, and perhaps at a later time there would be a failure occur. I don't recall Electro-Motive ever denying warranty to a railroad that was using parts perhaps that were not, let's say, factory approved. I have never heard of a case like that, and I have been around EMD now going on 37 years.

To answer your question the other way, if you are faced with a situation of a locomotive out of service and we cannot support your requirement, I would feel then that it would be necessary to get some kind of an opinion from Electro-Motive through their service organization primarily, and if they gave you the okay to go ahead then I would go ahead, and I think EMD would stay with it at least until such time as they had the piece for you to put in the locomotive. When that time came and you did not put it in, and the other piece failed, you would be on your own.

That is a very unusual question. I haven't come across it before. There is a first time for everything.

MR. HENDERSON: That is a good, evasive answer to a direct question. I think it is a situation we need to look into, gentlemen, because it is a problem that is becoming more critical every day. I really don't think we obtained an answer here today. We need an answer, and the industry needs an answer, because if the locomotive supports the railroad, and supports the industry, then it is a very serious situation.

I have a question I would like to direct to Mr. Gregory. Is this a centralized production and control that is guided from the top level, or is it at the shop level? How does it tie in with quality control, because it also determines the processing of parts and even the elimination and scrapping and rebuilding of parts?

MR. J. J. GREGORY [Production Control Manager, Penn Central Transportation Company, Altoona, Pennsylvania]: If I understand correctly, your question is on the organization of production control and also its relation to quality control?

MR. HENDERSON: Right.

MR. GREGORY: Just to give you a brief summary, production control is located at our major repair shops at

Collinwood and Altoona. We rehabilitate 141,000 pieces of diesel material not only for the shop but for the entire system. We are under the direct supervision of the general manager, and report to the general manager, the same as the general shop superintendent of locomotives and the general shop superintendent of cars. We are responsible for maintaining pools at all terminals. The smaller terminals, of course, have a limited number in their pool. We constantly evaluate their usage. We know by 10 o'clock every morning what material we owe each terminal. This is in the form of a computerized daily report. We know the quantity owned, the date we received it, their pool quantity, and the amount on hand for repair.

As far as priorities are concerned, we have the same system with material shortages. A unit out of service gets No. 1 priority. It receives priority over the backshop—which ends up at times in some conflict.

As far as quality control is concerned, we work hand in hand with Quality Control. If the inbound material is under warranty, or if there is a question on the quality, Quality Control people are there. The Quality Control personnel check the production lines for the end product. So often in the past, many roads had quality control which was an inbound and outbound inspection only. Our Quality Control people check the material being rehabilitated "in-process". You might say we work very closely with them, and also very closely with Material Management.

Does that answer your question?

MR. HENDERSON: Yes, it does. Just one further point for clarification. On the production and control group, are they also related to the output of the locomotive itself from different shops, or is it just the internal mechanism of your general shop area?

MR. GREGORY: No. We have one and sometimes two persons assigned to what we call the E & M shop. The scheduler there, or analyst, or planner, or whatever he may be, works with the supervision on the floor. In other words, he knows that power assemblies have to be ready at a certain position for a certain unit. He knows when the main generators are to be there. He knows when the traction motors should be there.

Our schedulers in the processing of "repair-return items", as they call it in the field, also schedule major component shipments for the units being overhauled in the field. As to control of production, we tell the supervision what to produce, when to produce, how much to produce, and who to produce it for.

MR. HARLEY: You mentioned the production of castings for foundries had been severely reduced because of the application of OSHA regulations. What are the locomotive builders specifically doing to make up for the loss of this foundry capacity? Are you just allowing your orders to build up, or are you looking for alternative sources?

MR. HONDLIK: It is true, the foundry situation has been the cause of our inability to furnish the railroads with primarily things like heads, liners and pistons. Going all the way back, we had probably two major foundries supplying our requirements. They were meeting our schedules, and all went well up until perhaps a year ago. One of the foundries closed down because of the OSHA requirements covering safety, and so on. Beyond

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that, the foundry was pressured by ecology people, and in order to put their foundry in the kind of shape that OSHA and ecologists wanted, they elected not to make such a tremendous investment, and just closed their doors. This of course put us in a very difficult situation.

One foundry then was not capable of making, in variety, all the pistons, heads and liners we needed, so behind the scenes somewhere (and I don't know the full story) the foundry that had closed down was reopened. How they got back in business with the same OSHA pressures and the same ecology pressures, I don't know. I was very happy to hear they were back on line.

These two foundries were still not enough. Our Vice President, Mr. H. L. Smith, has himself been part of a group who have traveled all over the country, and we have people also exploring foreign sources. In total we met with 61 or 62 foundries to see if they had the capacity and the equipment and the wherewithal to make our heads, liners and pistons. Some did, but they didn't accept the proposition for reasons of their own.

We boiled it down to six of them who could do the job for us. Of the six, only one accepted the assignment, and that is a foundry in Cleveland. They are now making pistons for us. They have been very helpful, and they are coming on the line a little bit sooner than we thought they would. The samples they have been sending in practically daily for the last six or eight months have been all right, and they are geared up to go, and they are going.

Beyond that, we have another foundry. They too are coming on line, so it is our hope to have these two major foundries be able to make the full line of heads, liners and pistons. The two secondary foundries we hope will build or cast for us some of the heavier movers, like the E piston. That is in very great demand now, whereas perhaps two years ago it wasn't.

Now that we have the foundries and the capacity, and have machining capacity at Electro-Motive, the problem we are now facing (and the railroads have been helpful to this extent) is the matter of supplies of coke. The foundries now say they will be glad to make castings for us, except they can't get the coke. We are doing what we can with Washington, and so are the RPI and other organizations. Beyond that, there is the problem of pig iron. Beyond that, there is ferrosilicate that is pretty hard to come by. Nickel also is scarce. So, here we are with the proper capacities, but the foundries are looking to us to help them get these materials so they can help us get things done for the railroad. So, it has been a severe problem.

I have been here for two days and I have had many discussions about the availability of pistons, liners and heads. The big question is, when will this critical situation turn around? We all understand your problem. "When is this thing going to stop? When will the good old days come back? Do you see a light at the end of the tunnel?" I say yes, I do, but the tunnel is a long one, and I would venture a guess that it will probably be in the fall of 1975 before we will see a turning point.

The next question is, "What do you mean, turn up or turn down?" I mean turn up, because I think the situation will get better. When you are down as far as you can go, there is only one way to go, and that is up. I am quite

confident that will happen.

In the meantime it is easy for me to say you fellows let the grass grow under the wheels until next fall and then we will be back in shape. In the meantime we have gone through considerable study to find out the number of pieces that we shipped to any given railroad in the United States during the last twelve months. Then we have a total. We can determine we have shipped railroad A 1,000 pistons, for example. Railroad A last year took X number of Cs, Ds, E-2s, E-3s. Do you want to go that way in the next twelve months, or would you like to change the mix?

Our regional people are out today finding this out, and we are saying we are reasonably sure we can do as good in the next twelve months as we have done in the last twelve months. You say, "You didn't do so good in the last twelve months." We recognize that fact. We also recognize that the railroads were able to survive and have been able to run. It has been touch-and-go many times.

The railroad then will tell us, "We want to change the mix. We don't want any C pistons any more. We want all Es." This, especially from major users, would be relayed back to the production control people, and then back to the foundries, who will then change their production schedules to meet what we think the forward requirements are going to be. In this way each railroad will get at least what we gave them in total pistons, whatever kind they want. In the forward twelve months we will be able to give them that total.

We want to do better than that, because I say the figures are based on what we shipped you, not on what you ordered. We might have shipped you 100 and you ordered 200. We think this is the most equitable way to go until we can find a better way to do this. Be assured that everything possible is being done to keep your fleets running.

MR. WALKER: Frank, can you give us a date?

MR. BAUMGARDNER: I am a little more optimistic. I think next summer we will be out of many, many of our shortages of critical items. As we look at it, next summer I should be able to answer the telephone without worrying about who is going to hit me next.

MR. WALKER: Mr. Downs, do you have a different answer?

MR. DOWNS: I am not qualified to answer that question. I answered it last year at this time, and I said it would be over in six months, and here we are a year later and it's still terrible, horrendous. You read the papers and you find a lot of economists predicting a big downturn in the economy, which supposedly would do a lot to ease some of the demands and some of the shortages. Certainly we don't want that kind of solution to our problem.

I look at things optimistically. Based on all the things our company is trying to do, if we are reasonably successful we should be out of the woods on our critical items about the same time Frank talked about—about the middle of the summer.

Where we have had problems with single suppliers having our only patterns, and not doing a job, we have gotten extra patterns and we are trying to find other sources to cast them. Trying to find a new source today for castings or forgings is like looking for a needle in a haystack. We are having to go overseas in a lot of cases.

I don't really have any more than a feel for when the shortage will be over. I could be wrong again.

VOICE: How can the railroads aid the suppliers in better material delivery?

MR. WALKER: I will attempt to answer that. During the discussion in our Committee, one of the major problems that the suppliers and manufacturers had was that the railroads, for instance, will not let you ship material to their railroad in someone else's car. This seems to be the policy of several railroads. One member of the Committee suggested that possibly a pool could be established that would quickly let us get our shipments in someone else's car, and everybody could add to the pool, and maybe this in turn would lower the cost, which evidently is what the railroad is trying to do.

VOICE: I am wondering about the propriety of a policy that dictates that we will furnish the material for a locomotive that is out of service. The patient is already dead. We have many of them running around with symptoms of a serious illness, so we neglect those patients until they die. Where do we get the physician working through an epidemic, with a shortage of physicians? Can he spend his time retrieving the deceased, and neglect those that might possibly be saved? I am just wondering if that policy doesn't need to be re-evaluated to some extent. Thank you.

MR. WALKER: We are out of time. I would like to call on John Gann, our Regional Executive, to summarize the report.

MR. JOHN GANN [Assistant Chief Mechanical Officer, Chicago, Rock Island & Pacific Railroad, Kansas City, Kansas]: Thank you, Darrell. It

J. W. GANN
REGIONAL EXECUTIVE
Asst. Chief Mech. Officer
Chicago Rock Island & Pacific RR
Kansas City, Kansas 66105

is too bad we have run out of time with this important subject. Never in history that I can recall has there been a materials shortage like we have today. That reusable bolt or nut or contact or anything that we may have used the cutting torch on at one time—we had certainly better take a good look at it, and maybe we can repair it and reuse it. There are a lot of items we can reclaim, and we had better take a look at them.

In helping the manufacturers on their material deliveries, one item brought out in the paper was forecasting and advance planning for scheduled material deliveries. If we plan ahead and order the material in advance, it will certainly help the manufacturers on their material deliveries.

The manufacturer is to make sure deliveries are on time, even if the promised date is a long way off. Expediting critical orders to make sure production lines do not shut down for lack of material. I think it has been brought out here that there is

certainly a critical shortage of material, and I am sure all the manufacturers are going to do everything they possibly can to improve the material situation.

We are short of time, so I just want to say it has been a pleasure for me to have worked with Darrell Walker and this fine Committee. Let's give them a round of applause in appreciation for the work they have contributed. [Applause]

MR. SCHROEDER: Our thanks to John Gann for his kind remarks.

I will now call on President Stendahl for some closing remarks. My personal appreciation is expressed to the Burlington Northern Material Department for coming down and finding out that there are some real problems in this area.

PRESIDENT STENDAHL: Thank you, Mr. Schroeder, Mr. Gann, Mr. Walker, and this Committee.

We have a few announcements before we adjourn. We would like to remind the discussers to review their discussions as soon as received from Mrs. Emmons, and return them to her as soon as possible.

We will have the What's Your Problem session tomorrow, and any questions that remain unanswered during this meeting should be brought up at that time for handling by Jack Dwyer and his panel.

It is not too late to enroll another supply member. We have a nice membership this year, larger than it has been for some time. We would like to keep it growing.

Now let's give another round of applause to Darrell Walker and his Committee.

[The audience arose and applauded.]

[The meeting recessed at 4:45 p.m.]

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WEDNESDAY MORNING SESSION

September 18, 1974

The meeting reconvened at 9 a.m., President Stendahl presiding.

PRESIDENT STENDAHL: Good morning, gentlemen. It is good to see such a fine turnout again this morning. As you will recall, we have a new President. Mr. Larry Booth, will you please come to the podium? It is a real pleasure to turn the gavel over to Larry, and I am confident he will enjoy the very pleasant experiences during his tenure of office that I enjoyed in the past year. Larry Booth, your new President. [Applause]

[Mr. Larry H. Booth assumed the Presidency.]

PRESIDENT BOOTH: Thank you, Carl.

Gentlemen, I have the good fortune to announce to you our total registration for this convention, which includes 403 members and 100 ladies, for a total of 503. As far as the LMOA membership is concerned, we have picked up 110 new members and 65 associates, for a total of 175, and four complimentary, which makes our grand total for the year 2,356. I think that is marvelous. The credit goes to all the officers and members who solicited and procured these memberships.

Members of the Locomotive Maintenance Officers Association, it is with a very deep sense of humility that I accept this gavel, indicative of becoming your President for the next year.

Newly elected President L. H. Booth, on left, accepts gavel from Past President and Chairman of The Board C. P. Stendahl. Looking on is 4th Vice President E. T. Harley and Past President Carl A. Love.

As I look back in my memory at the very illustrious individuals who have occupied this office, I become somewhat frightened at the importance and responsibility that has been bestowed upon me.

When I first became associated with the LMOA in an official capacity, as committee chairman in 1957, and the tremendous activity of this organization, I have observed through the years (I am sure you will agree) many innovations, procedures and systems were outlined and described that enabled you to modify, rearrange and even restructure maintenance practices pointing to higher availability and better utilization of power. Many concepts of engine changes or parts modifications were proposed or recommended to the engine builders that were carefully evaluated and made standard on production models that have now become in many instances basic, all pointing to optimum performance.

There is still much to be done, and it is our charge to continue to present to you in our 1975 committee papers such new developments and procedures or ideas that will enable you to consider and adopt pointing toward our goal. Our papers will, therefore; be constructed with this thought in mind, and to explore briefly the advancements we can expect in the years ahead, as I am sure by the year 2000 the advancements in motive power will be as great as they were in the era converting from steam to diesel.

At any rate, we do not want to be lulled to sleep thinking the ultimate has been obtained, or to the point we are confused by monotony such as an experience I observed sometime back. I was transferred to our General Office in Richmond, Virginia, which was equipped with automatic elevators but were still attended. As I entered the elevator this particular day, the attendant was nodding, obviously half asleep, and I commented that things got pretty monotonous just riding up and down and going nowhere. "No, sir," he replied, "It never gets monotonous, because we have too much time to think about nothing."

And so it is. Our dedicated technical committees will have, as their charge, thought-provoking ideas and practices that will preclude the situation the elevator operator found himself in.

From this, it appears obvious that our slogan for 1975 will be "PROGRESS", emblazoned on your minds for your consideration in all our papers and communications. Our predecessors have passed the torch down through the years, and we in the coming year will continue to carry it toward our goal.

To my very good friend, Carl Stendahl, I want to commend him for a job very well done; and to our other officers, technical committee chairmen, and committee members, I can assure you it will be my pleasure to be working with you during the coming year. Your expertise and help is especially solicited.

Thank you, gentlemen. [Applause]

It is now my pleasure to introduce to you Mr. Frank Findling, Assistant Vice President of the Rock Island Railroad and member of the LMOA Advisory Board.

MR. FINDLING: Good morning, gentlemen. It is my honor and privilege to act in the capacity of presenter of various articles given to Past Presidents of this Association. Carl, if

F. B. FINDLING
Asst. Vice President Mech.
Chicago Rock Island & Pacific RR,
Kansas City, Kansas 66105

you will stand I will make the presentation.

First, I have a bound edition of the 1974 Proceedings, which of course includes the 1973 reports. [Applause] Secondly, a pen set with an old steam locomotive, symbolic of lifetime membership in the LMOA. Congratulations. [Applause] Finally, the Past President's pin, presented to Mr. Stendahl for an excellent job as President in 1973-74. Congratulations, Carl, and I hope you will be with us for a long time. [Applause]

MR. STENDAHL: Thank you very much, Mr. Findling. I have a deeply appreciative feeling for everyone for giving me such great support this year and all the past years in this great Association.

As I have said on many occasions, this was a year of good fortune, having had an opportunity to work with and for all of you. The enthusiastic support of everybody serving on technical committees, the committee chairmen and all the officers, has been unequaled. Their support has been great. It is this type of teamwork that makes this Association strong. I am confident this teamwork will continue and will be even stronger, continuing with an

Past President Carl Stendahl accepting bound volume containing 1973 Proceedings and 1974 Committee Reports from fellow Past President Ky Pruchnicki. Witnessing the presentation is LMOA President Larry Booth and Harold P. Rodes, President, General Motors Institute.

increasing enthusiasm and drive to keep our Association strong and make it grow.

Let's give Larry Booth a really strong year. Thank you again. [Applause]

Past President Ky Pruchnicki, right center, makes Lifetime Membership Award to Carl Stendahl. Looking on is 1st Vice President John D. Schroeder, Asst. CMO-Locomotive, Burlington Northern, and 5th Vice President James J. Butler, Chief Mechanical Officer, U.S. Railway Association.

Carl Stendahl, on left, accepts newly designed LMOA Past President's Pin from Past President Carl A. Love. Looking on is 3rd Vice President E. E. Dent and 2nd Vice President T. A. Tennyson.

WEDNESDAY MORNING SESSION
September 18, 1974

REPORT OF THE COMMITTEE ON NEW DEVELOPMENTS

L. O. TOWNLEY, Chairman
Committee on New Developments
Asst. Mgr. Industrial Engrg.,
A. T. & S. F. Rway.,
San bernardino, Calif. 92410

L. H. BOOTH
PRESIDENT
Asst. Chief Mech. Officer
Chessie System,
Huntington, W. Va. 25781

PRESIDENT BOOTH: Gentlemen, I have the very good fortune to introduce to you this morning Mr. Leland O. Townley, Chairman of the Committee on New Developments. Lee's personal history is printed in the Proceedings book, so I won't read it, except to say that Lee is a graduate electrical engineer. He started his service on the Santa Fe and moved up through several chairs and officerships on that railroad, and has now become Assistant Manager of Industrial Engineering, in San Bernardino, California.

With that, may I present Leland O. Townley, who will give the report of the Committee on New Developments. [Applause]

Mr. Townley introduced the members of his Committee. Mr. M. A. Scott, General Mechanical Engineer, Union Pacific Railroad, summarized Part I of the report. Mr. B. A. Cumbea, Supervisor Production and Statistical Control, Chessie System, summarized

Part II of the report. Mr. J. R. Ryder, Director Industrial Engineering & Economic Research, Rock Island Railroad, summarized Part III of the report.]

MR. TOWNLEY: We will now call on Oscar Summer, Chief Mechanical Officer - Motive Power, St. Louis-San Francisco Railway.

MR. O. H. SUMMERS [Chief Mechanical Officer-Motive Power, St. Louis-San Francisco Railway Company, Springfield, Missouri]: Mr. Milburn, President of the Southwestern Railway Club, could not be with us today. He extends his thanks as well as the Club's thanks to the Committee for honoring us with their pre-convention report in Little Rock in April of this year.

On fuel savings, I would like to ask the Committee what effect mixing power has on fuel consumption.

MR. TOWNLEY: I am sure that question has been in the minds of all railroad people for many years. Perhaps a straightforward, quick answer to a question like that is that if all of them have six or four axles and are fairly close to the same horsepower, and the gear ratios are not so far apart, and the terrain is not such that you are limiting the handling of tonnage by one or more of the units, you are not in bad shape.

Any time you are operating a big portion of your trip on a heavy grade, and some of your gear ratios are compatible to low speeds on that grade, and others are for higher speeds, you are sacrificing not only power but fuel. Any time you are operating a train and the units are working at somewhat less than full capacity to pull and develop tractive effort, you are sacrificing power.

Would anyone else like to make some comments about that?

MR. GEORGE W. JOHNSON [Manager, Product Planning, Locomotive Products Department, General Electric Company, Erie, Pennsylvania]: Our feeling is that turbocharged locomotives operating together are more efficient than operating in mixed consists of non-turbocharged and turbocharged locomotives, because of the variations in efficiencies for different throttle notch positions. Where you have high load factors, we would recommend utilizing turbocharged locomotives because they are more efficient in the higher throttle notch positions than non-turbocharged locomotives.

MR. SIZEMORE: Does operating trains on grades at a minimum continuous speed of the locomotive save fuel?

MR. TOWNLEY: I think that question relates to the horsepower optimization program that GE worked out. It depends a lot on the territory. If a great portion of the railroad that you are operating on and are concerned about is heavy grade, then putting enough power on that train to operate it at its full horsepower is the most economical way to operate the train. However, if this is a small portion of the territory you are concerned about, and you put enough power on to operate on that grade at full horsepower, then you are wasting power for the rest of the territory.

It has to be worked out by this set of curves, and to be really accurate you should have a set of curves for each type of locomotive and each makeup or consist of each territory. Then you would get to the point where you would have the optimal power to get you from one point to another in the

required number of hours with a minimum amount of fuel.

MR. R. W. LEEDY [Superintendent Motive Power, Illinois Central Gulf Railroad Company, Chicago, Illinois]: Concerning increased maintenance costs, what if you are working two units compared to three? It may save fuel. In the 6th notch you might have fuel savings the same as two units in 8 throttle, but the two units will wear out faster.

MR. TOWNLEY: The question is, what is the trade-off between operating a train with the locomotive all the time at 8 notch, and working it with higher maintenance cost in the 6 notch? I don't know. It certainly is a factor that if you develop full horsepower the turbocharged engine is put to a lot harder use. We even found on the Santa Fe that setting the horsepower on the low side of the curve makes the turbo last longer. So, it is a factor, that's for sure.

Operating any piece of equipment at temperatures and horsepower settings that would give you the greatest fuel economy is going to wear the engine out faster. It is very important that we realize that parts are going to get so scarce one of these days that we will have to back off of horsepower and use more fuel just to save the engine.

MR. JOHN O'NEILL [General Superintendent Motive Power, Chicago & North Western Railway, Chicago, Illinois]: I don't think the notch you are running in is a key factor in the life of a locomotive. If you are running at 8 notch that engine is going to perform just as well, and possibly perform longer than one you are fluctuating all over the map.

MR. W. R. WECK [Assistant General Service Manager, Electro-Motive, LaGrange, Illinois]: The locomotive should be run at the point it is supposed to run at. On turbocharged locomotives, particularly those that may be running partially on the gear train and partially free, the turbocharger is far more efficient when it is run in the free mode. The locomotive engine is designed to run at given temperatures and pressures. At these temperatures and pressures the engine operates most efficiently. Running at reduced horsepower and speed will probably result in a faster wear out, when compared to engines operated at their designed parameters.

MR. LEEDY: I am for saving fuel. We pay good money for it. We are buying horsepower when we buy locomotives, and we should be able to use all the horsepower. Whatever the manufacturer rates it at, that is what we should expect of it. Since this energy crisis I think we should make a play for fuel saving, but it seems to me with the critical shortage of material that also has to be considered.

MR. JOHN LEHMAN [Facility Analyst, Illinois Central Gulf Railroad, Chicago, Illinois]: In talking with other railroads regarding fuel savings, I have heard that to get better efficiency from units through the use of the 8 notch that they decided to take one unit and isolate it on the line of road where it is not needed. I wonder what the Committee's feeling is on running a unit in a consist with it isolated during part of the trip?

MR. TOWNLEY: Personally, I think you are dragging a locomotive around and not getting good tonnage. However, you might make some tests on it and see whether you are saving fuel or not in the territory, and whether or not it would be worth-

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while. Does anyone have any experience along that line in saving fuel? Any figures?

VOICE [Southern Pacific]: We have experimented a little bit with this procedure just mentioned. Our calculations indicated that there were some fuel savings. We ran actual service tests and found it was not true. I don't have any actual figures.

MR. TOWNLEY: There is one thing that I think can be done in some cases. If you have a slow-order curve or some limiting factor, and you come out of that curve and accelerate as fast as you can, up to a point where you have to start putting air on the train to get it back into another slow order or limit factor, there is a point where you are using a lot of fuel to accelerate up to the maximum speed allowable on that territory, and then braking down to the next limiting speed territory, whereas you could possibly accelerate up to a much lower speed and then drift to the point where you have to start slowing down. You don't really use up that much time, and you save a lot of fuel. Those things can be worked into computerized programs for fuel consumption and savings.

VOICE: What will elimination of the 30-day inspection rule do to fuel savings?

MR. TOWNLEY: That is a good question. There is some talk about eliminating the 30-day inspection rule, which will drastically change the pattern that you have to set up for moving your units into a point where the 30-day inspection can be taken care of. If you didn't have to do that you could probably utilize the power a little better.

I would like to hear from someone who has done some work on that. Would anybody on the Committee like to talk about that?

MR. CUMBEA: I don't have the figures with me, but in the petition which was presented to the FRA for elimination of the 30-day inspection rule, the N&W and the Chessie System both had worked up some potential fuel savings. The N&W was much greater than we had figured. I think on the Chessie System we came up with something in the neighborhood of 800,000 gallons per year potential fuel savings. This is just considering the savings in idling time around the shops when the unit is out of service.

MR. GARCIA: How do the noise levels compare between the SD-45-2, which is presently in Amtrak service, and our standard SD-45s?

MR. TOWNLEY: Those Amtrak locomotives have mufflers on them.

MR. WECK: There is a considerable difference in the Amtrak locomotives you are referring to, measured in a standard way. It has a dbA sound level of 82. The SD-45 sound level, measured exactly the same way, is something on the order of 90½ dbA. This is a tremendous reduction. It also represents a completely different state of the art. The SDP40F is equipped with a muffler, it has special cooling fans, and in addition to all this it has sound-deadening material built into the carbody.

MR. TOWNLEY: Did you say 82 against 90½? As you know, the difference between the noise that will read 82 and 90½ is a lot of difference, because it is a logarithmetic progression. Another thing, too: I think you have eliminated some of the objectionable sound frequencies as much as the amount of energy that the sound is putting out by eliminating some of the

squeal from the fans and some of the high-pitched noise from the turbo.

Walker, can you give us any kind of hint as to how durable this material is in this muffler? Do you think it is going to stand up? What are the maintenance problems going to be in the future?

MR. WECK: We are continually inspecting these muffler installations. The oldest is on the order of three years now. We don't anticipate seeing anything negative in the muffler system itself. It is not a simple retrofit installation. It is a matter of planning and finding space to put it in. We do not anticipate any additional expenses in the maintenance of the muffler itself. First cost and installation are the only costs we foresee.

MR. TOWNLEY: For the benefit of some of you who don't know what we are talking about, the steam generators in these Amtrak locomotives are eventually going to be replaced by a motor generator which will generate AC power for heating and air conditioning the train. I guess there are a few locomotives running with that now. The question was, how does the sound level compare?

MR. O'NEILL: We have a good size fleet operating with auxiliary power plants, and in the studies we have made we have found that this unit is a greater violator than the prime mover. There are two causes. One, we have a very noisy cooling fan arrangement. Also, the exhaust is in a range that causes complaints. When you get into high frequency and it starts screeching, you get your real complaints.

MR. TED BYDALEK [Facility Analyst, Illinois Central Gulf Railroad, Chicago, Illinois]: Mr. Weck, what is the difference in thermal efficiency or fuel consumption between a retrofit muffler engine and one without one?

MR. WECK: That has been evaluated. I would like to call on Mr. Hugh Williams to address that question.

MR. HUGH WILLIAMS [EMD, LaGrange, Illinois]: We have made several tests to determine the effect of an exhaust silencer on the performance of our turbocharged engines, and the results to date indicate that the presence of a silencer is essentially not measurable; that is, it lies within the accuracy with which we can measure performance. We see no detrimental aspects in the presence of a silencer as far as its effect upon engine fuel consumption is concerned, or insofar as turbine inlet temperatures are concerned.

MR. TOWNLEY: You have little back pressure on the turbine; is that right?

MR. WILLIAMS: Yes, the back pressure is extremely low, and the effect upon performance is essentially nil.

MR. TOWNLEY: How is the efficiency in the fans when you cut the engines off? Does it hurt the efficiency of the fans very much?

MR. WILLIAMS: I am sorry I can't answer that. Perhaps Mr. Marta of EMD can reply to that.

MR. HENRY MARTA [EMD, LaGrange, Illinois]: What was done on the fan to reduce the noise level was just to move the fan in a vertical axial direction to lower the noise. There was no reduction in efficiency of the fan by that modification.

I would like to add a comment on a question raised before. With the increase in noise level on Amtrak SDP40F locomotives above 82 dbA created by the addition of an EMD

application of two motor-generator sets for head and power, the over-all noise level at 100 feet is expected to meet the 87 dbA level indicated in the EPA proposed noise regulation for locomotives.

MR. HARLEY: I would like to make one comment about the muffler application. We have looked into the Universal Silencer which EMD uses on Amtrak locomotives. The regulations as now written may require retrofitting a muffler of this type. The back pressure produced is negligible, but there is a serious problem in retrofitting the device because it weighs 650 pounds and is about 5 feet long. When you try to apply this to an existing locomotive, a considerable amount of "surgery" is required, like moving dynamic brake equipment and pipes and changing the stack location. You also have to reinforce the turbocharger adapter to carry the additional weight. What we are looking at is cost between $5,000 and $10,000 per locomotive to retrofit the Universal Silencer into a locomotive.

If you look at the alternate that appears to be like a truck muffler (you will probably have read some of the articles in trade magazines), in present designs they produce additional back pressure which affects component life and fuel economy of the locomotive. They are not in the same league with a Universal Silencer with respect to weight and size, but if applied externally to the carbody may affect clearance limitations and visibility (on switchers).

MR. R. G. CLEVENGER [Supervisor of Locomotive Maintenance, Atchison, Topeka & Santa Fe Railway System, Topeka, Kansas]: All the talk here this morning has been about 8th notch mufflers, and so on. We think there is going to be trouble running at idle.

MR. HARLEY: What advantage is gained by putting road failures in the computer?

MR. J. R. RYDER [Director Industrial Engineering and Economic Research, Chicago, Rock Island & Pacific Railroad, Chicago, Illinois]: The subject of failure information included in the computerized locomotive information system is an area of disagreement even within our Committee. It is my personal opinion that the railroads spend too much time attempting to determine the validity of failures. I have read the failure reports that we generate, and in my opinion it is difficult to develop any meaningful failure trends. As I indicated, there are those on the Committee with opposite thoughts regarding failures. I would like to ask Mr. John O'Neill to express his feelings on this subject.

MR. O'NEILL: We are manually doing this work now, and in September we will be on the computer. I think maintaining a record for analysis is vital. We feel we can spot trends. While the report that you get is generally garbage, when you start working them regularly you soon develop a trend. It's like the old story of a locomotive not loading well. You know what that can mean. If you get enough of them, and you see the corrections made, you start anticipating problems. This is the only advantage to it.

There is one other thing. I agree strongly with him that you shouldn't put too much in and take too much out. A computer is only as good as the information you put into it. If you put in something that you don't need, you are going to clutter up the operation,

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and you will generate a lot of reports that nobody will read.

MR. DENT: What are the advantages of developing time standards through use of the computer?

MR. RYDER: It is interesting to me that railroads have taken the opposite approach in the utilization of the computer in production operations than some other major industries. Railroads seem to be attempting to control costs by using the computer to generate actual material and labor costs, whereas other industries such as steel use the computer to compare actual labor costs to standard costs. The comparison of actual to standard labor costs is then used to measure shop performance. Based on the survey taken by our Committee, I believe the lack of labor standards is the major weakness of the current railroads' computerized locomotive information systems.

MR. LEEDY: How can the maintenance cost of a locomotive be arrived at through the use of a computer?

MR. TOWNLEY: That of course depends on how you set up your program. My big gripe about so many of our computerized programs is that the computer can spit out the information and you have to analyze it. I think what we should insist on is that the computer do some of the analyzing for us so that when we ask it a question it will save us the time of having to analyze it ourselves.

By properly programming the computer and feeding in the information as to material and labor, it can be used to tell you exactly what that unit is costing you by a class of units or individual units, and it becomes a very useful piece of information. But it has to be done so that you don't have to do the manual labor yourself by taking great volumes of stuff out of the computer and trying to analyze it yourself.

This has been a great experience for me, gentlemen. I would now like to turn the meeting over to Regional Executive Frank Bruner, who will summarize the paper.

F. D. BRUNER
REGIONAL EXECUTIVE
Asst. C. M. O.—Operations
Union Pacific RR,
Omaha, Neb. 68179

MR. BRUNER: I would like to congratulate Mr. Townley and his Committee for a very well prepared paper, and I feel the response from the floor today has been exceptional.

The topics covered today are very important to all of us, because each costs considerable money and must be looked at very closely. The impact of EPA and the fuel crisis has had its effect on all railroads and on companies supplying materials. The industry is being taxed heavily to react to problems associated with the fuel crisis.

The study by the group concerning computers shows how the use of computers can change on a daily basis. We on the Union Pacific are using computer information extensively, and are increasing its use. A computer can generate a lot of information, and if

used properly can be a great benefit to mechanical departments. We use our computer to keep records of component change-out, and we are still in the process of putting all components available on our property into the computer so that instant availability of a spare component will be known.

We are increasing the utilization of the computer in our Car Department and will progress toward getting all the car components into the computer in time to come. Our heavy bad order program is computerized and is a good management tool in determining man-hours and money for budgeting purposes.

The Stores Department on the Union Pacific has been utilizing the computer for many years. Along with material availability information, instantaneous read-out can be obtained on the usage and project material requirements in advance for the benefit of both departments to insure having components available for Mechanical Department repairs and programs.

You and your Committee have done a very fine job, and I want to personally thank you. The Railway Club in Little Rock enjoyed your presentation, and I think we owe Mr. Townley and his Committee a vote of thanks. [Applause]

PRESIDENT BOOTH: At this time I would like to call Carl Stendahl back to the podium for a special task that he has been assigned.

MR. STENDAHL: I would like to call our stenotypist, Charlotte Emmons, to the platform, please.

In recognition of 25 years of devoted effort, together with your kind, pleasant enthusiasm toward the work of the LMOA, in the absence of Mr. W. F. Dadd, who was to have made this presentation, it now becomes my very great pleasure, on behalf of our Association, to present you with this gift. Please accept this as a token of our sincere appreciation for your excellent work. [Applause]

In recognition of her 25 years of outstanding service as official recorder of the LMOA Annual Meeting, Charlotte Emmons is presented with a gift from the officers and men of LMOA. Outgoing President C. P. Stendahl makes the presentation.

WEDNESDAY MORNING SESSION

September 18, 1974

PANEL ON WHAT'S YOUR PROBLEM

J. J. DWYER, Chairman
What's Your Problem Panel
Environmental Consultant
(Retired)
Chessie System
Huntington, W. Va.

J. H. LONG
7th VICE PRESIDENT
Regional Locomotive Supt.
Chessie System
Cincinnati, Ohio 45202

PRESIDENT BOOTH: Will Jack Dwyer and his What's Your Problem panel please come to the dais.

I would like to give you an LMOA background on Jack. I have 15 pages here, but I won't read it all. I am just going to pick out the highlights and skim through them, because we are running a little late.

The title of this story could be "Jack Dwyer and the LMOA". The prologue to it, however, might be titled "Jack Dwyer and the Master Boilermakers Association", because that is how Jack became an LMOA member back in 1955. He joined the MBMA in 1948, and as Chief Chemist of the C&O in charge of water treatment he became active on the MBMA committees concerned with all facets of water treatment.

The Master Boilermakers Association was a member of the Coordinated Mechanical Associations, like LMOA, whose annual meetings are still held jointly each September in Chicago. As

some of us will remember, with the demise of steam locomotives, adversity finally caught up with the Master Boilermakers—after 52 years of active participation in railroad activities—and on March 10, 1955 the MBMA accepted an invitation to join LMOA.

This invitation included Jack Dwyer, so that was when he became one of us. That year he was a member of the LMOA committee listed as Master Boilermakers Section, whose two 1955 topics covered "Oil in Feedwater" and "Water Conditioning for Package Boilers and Steam Generators". These subjects were Jack's specialties at that time on the C&O. His comments appear repeatedly in the 1955 and 1956 Annual Proceedings reporting the floor discussions on the topics of water treatment. And by then the Committee on Master Boilermakers Section was being introduced as the Committee on Diesel Water Treatment. In 1957 it was officially listed as the Committee on Steam Generator Maintenance.

This Committee's name in 1960 became the Committee on Steam Generator and Water Treatment, and Jack became its Vice Chairman. In 1961 he became Chairman. But his tenure was short lived. At the end of that same year his Steam Generator Committee was abolished. The deciding factor was that railroads were going out of the passenger business, taking interest in steam generators along as a casualty.

Out of the demise of one committee, however, another was born. The year 1962 saw the birth of a new and radically different type of LMOA committee, which was given the unlikely name of "WHAT'S YOUR PROBLEM?" Page 244 of the 1962 LMOA Bulletin, Volume 2, shows a picture of this first W.Y.P. Committee in action, and these charter members were: Cornell Snow (L & N); K. L. Pollitt (SOU); Cecil Wilson, (A.T.S.F.); J. R. Mitchell (I.C.); George Niemeyer (M.P.); Tom Bellhouse (S.L.S.W.) and Bill Dadd (B.&O.). At least three of those in the picture went on to become LMOA Presidents—Niemeyer, Bellhouse and Dadd.

That same year, 1962, through the cooperation of the late C. L. Combes, Editor of *LOCOMOTIVES AND CARS MAGAZINE*, and to keep the LMOA before the eyes of the railroad public, Jack started editing a WHAT'S YOUR PROBLEM department in *LOCOMOTIVES AND CARS*, starting with the October issue. This was always Saturday, Sunday, or night work, but in these twelve years he hasn't missed a single issue. He says, however, that a time or two it may have been "close".

The rest of the story, of course, is history. As you all have guessed already, this is Jack's final presentation as Chairman of our What's Your Problem Committee. He thus ends up with two LMOA records, one for shortest tenure as a committee chairman (one year piloting the Steam Generator Committee) and one for longest tenure, as Chairman of his present Committee for twelve years. I haven't researched the records to see if he may be the only member to have been chairman of two of our technical committees.

In recognition of Jack's knowledge and outstanding work pertaining to water chemistry, he was made approximately two years ago a Life Member of the American Water Works Association.

Only this year he was awarded a Life Membership in the American

Engineering Association Division of A.A.R. And last week he was notified that he was being made Member Emeritus of the American Chemical Society.

And now, Jack, it is our pleasure to add to your illustrious career, and present you with Life Membership in the Locomotive Maintenance Officers Association. [Applause]

MR. DWYER: Mr. Booth, I am overwhelmed with this. I knew I was being

J. J. Dwyer, center, retired Engineer Environmental Control, Chessie System, receiving award of Life Membership in LMOA. Making the presentation is L. H. Booth, Asst. Chief Mechanical Officer, Chessie System and newly elected President of LMOA. Looking on in happy approval is C. P. Stendahl, General Manager Motive Power-Electrical, Burlington Northern and Chairman of The Board of LMOA.

phased out as Chairman of the Committee. As the old saying goes, all good things must come to an end. These people are experts at keeping secrets, and I had no idea I was going to be given this honor. I am at a loss to reply. Maybe they thought if I knew about it I might write a 45-minute speech of appreciation, and then we wouldn't have any time for a Committee report.

I do appreciate what you have done. It takes me back to my days as a marine engineer. The captain of the ship couldn't go anywhere without the help of the fellows down in the engineroom, and by the same token we never would have had any Committee up here if it hadn't been for the members of my panel who have done all the work. So, in appreciation for this I want you to know that these are the fellows who really deserve the credit. Thank you. [Applause]

PRESIDENT BOOTH: And now it is my distinct pleasure to call on the newly elected 7th Vice President, Jim Long, to serve as officer for this session.

[Mr. Long introduced Mr. Dwyer.]

[Mr. Dwyer introduced the members of his What's Your Problem Committee.]

MR. DWYER [continuing]: We don't have much time, so to save the time of our Committee members running back and forth to the microphone to answer individual questions,

I will ask each one to step to the podium for 7 or 8 minutes and field all the questions that will be directed to his particular committee. I think we will save a little time by doing it this way.

Last year Charlie VanSciver didn't get to appear at all. He was up here at the podium but he didn't get to comment, so we will give Charlie the privilege of being No. 1 on the program this morning. We will accept questions directed to the MU Car Committee. Does anyone have a question for Mr. VanSciver?

MR. HARLEY: With all the price increases we have had in recent years, with cars costing a lot more than they did a few years ago, is there any possibility that MU cars will become noncompetitive with other modes of transportation?

MR. VANSCIVER: That could be a possibility. The Penn Central and Reading are operating in the Philadelphia area. The original price was $52,000, and today you are talking of over $500,000 per car. You can go too far when it comes to protective devices. If some engineers put in all the protective devices they would like to, you never would get the unit to run. There has to be a balance between what is needed, what has been proved in the past is needed, and what you can live with.

You can so design a unit that no railroad electrician would ever be able to decipher the components or even be able to use some of the test devices that are needed in order to maintain the car. On a couple of operations at present it is going to require an electronic engineer just to use them in order to test the unit.

MR. BUTLER: You received a unit from GE to run an electrical test on the new MU cars. It was similar to a SEARCH unit to be used on a diesel locomotive. Is that unit operating now?

MR. VANSCIVER: No, sir. We are still awaiting the Engineering Department in Erie to train their own GE personnel in the operation of the machine so they can in turn teach us. [Laughter] Believe it or not, in the past month or two we could have used him; but the machine is there, and as of the present time it is nothing but a blaze of lights and switches. When we learn which one is which we will be in pretty good shape.

MR. KELLEY: Charlie, you have had the new Silverliner cars in service for a while now. Do you have any comments to make on the new dynamic brake grid arrangement on the roof without any blower cooling air?

MR. VANSCIVER: So far, the dynamic brake system on the new Silverliners has done a very good job. Most of the failures that we have experienced have been due to a brake valve needing a little bit of adjustment, and the use of time delay relays. While they appear to be a very good relay, there have been problems with them. It is a possibility that it could be due to the area in which they were stored. They show corrosion even though they are brand new.

As for the braking resistance on the roof, we have had no problem. There may be some secondary problems, some of the ambient temperatures coming down through the cooling air system which is also on the roof. The ambient temperatures of the air compressor and a few other components are pretty high. It is still under investigation.

MR. DWYER: Thank you very much, Mr. VanSciver.

We will now turn to comments on Mr. Holmes' committee report. While Dick is coming up to the microphone, during his presentation the other day there was a floor discussion on the subject of reduced idling speed. Mr. Lud Koci had some comments to make from the floor. I would like to ask Lud to go to the microphone and amplify some of the comments he made during Dick Holmes' presentation.

MR. KOCI: What I wanted to do was to correct the figures I gave you. If you will recall, I indicated what I thought they were to the best of my recollection. Based on the possibility that someone was listening, I thought I had better correct them.

Our projections for savings with the low idle speed are 9% to 12% for what we believe represents a switcher duty cycle, and I think that is about what I said the other day. It is about 2% fuel savings projected for what we call a "light duty" road cycle, which is probably the most typical road duty cycle, and down to about .6% saving on a very "heavy duty" road cycle, which is probably beyond the heavy end of what most people run. Thank you.

MR. RYDER: If I understood the statistics correctly, the locomotives are using 3 or 4 gallons of fuel oil per hour while idling. What are the estimated savings which can be generated by reducing the fuel oil usage by .6% for an annual period?

MR. KOCI: Those percentage figures are in per cent fuel consumption over the entire duty cycle, taking into account all throttle positions. When we try to generalize we are really reaching out. But if you are accumulating 12,000 miles per month, perhaps that is 36,000 gallons per month. Does that sound right? Then take 2% of that off for a light duty road cycle, and you will figure the savings with a low idle.

MR. SIZEMORE: At what temperature is the optimum operating temperature of lube oil, and at what point in temperature rise would you suspect scoring or scuffing in the cylinder assembly to start to occur?

MR. HOLMES: I think the engine builders would be best qualified to answer that.

However, average temperature of the oil in the crankcase would be about 200°F. or slightly higher. I am not sure whether it has been established at what elevation in oil temperature scuffing might occur.

I would like to have an answer to Bill's question as to whether or not lube oil temperature might be a significant factor in this problem, considering both short-term and prolonged exposure to such abnormal condition.

It would also seem that the oil temperature control should be checked for malfunction in case of question, as well as temperature of the lube oil leaving the lube oil cooler.

Would someone from the floor like to answer that? Jack Hoffman, would you like to comment first for GE?

MR. HOFFMAN: Dick, I can't really give an answer to the question as to a specific oil temperature at which scoring might develop. The only way in which I can think of temperature being involved at all is if the oil temperature were allowed to progress to such a point that piston cooling would be significantly affected. In that case we could have a gross reduction in clearance between piston

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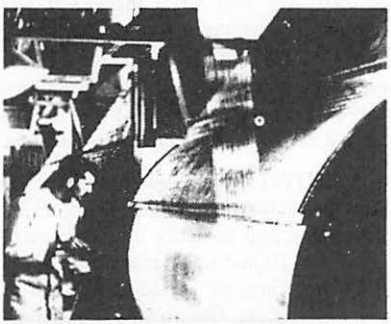

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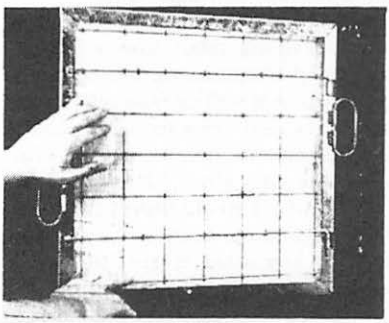

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and liner, and resultant scoring. Beyond that, I really can't answer the question.

MR. KOTLIN: In our study of scuffing, we have been conducting laboratory engine tests to determine what conditions of engine operation are conducive to scuffing.

Normally, scuffing is very hard to evaluate in a test cell. We first decided to utilize the lube oil involved in the scuffing problem of the aforementioned western railroad.

Secondly, we devised a cycle of engine operation which would build deposit levels and also subject them to cyclic ranges of temperatures.

Thirdly, we had to have higher than normal oil temperatures to produce consistent scuffing.

A question was asked, "At what oil temperatures does scuffing occur?" There is no one simple answer, in that a critical oil temperature will depend on the lube oil, the state of oxidation of that oil, and the mode of operation of the engine in its environment peculiar to a given railroad.

Our particular lab scuff cycle is designed around 250° oil in temperature levels, but cycle operation and lube oil influences are also important.

MR. TENNYSON: I don't have a question to ask about scoring in relation to oil temperature, but certainly in regard to wear our radioactive ring test in the past years has shown there is a tremendous increase in ring wear when the oil viscosity is lowered by fuel dilution. I would expect the same increase in ring wear if it were lowered by any other means, such as a very high increase in temperature.

MR. SIZEMORE: With the SD-45-2 or SD-45, a 20-cylinder 645-E-3 engine, it is not uncommon to have lube oil temperatures at 240°. We could have damage to the engine at 240° to 250° temperature. Would Mr. Kotlin care to comment on this?

MR. KOTLIN: First, I understand the statement to be that an SD-45 running in normal revenue operation will have oil in temperatures higher than 240°F. My comment is that 240° oil in temperatures is an abnormally high temperature even under very high ambient temperatures.

MR. SIZEMORE: Generally speaking, a 645-E-3 engine will run at 240°.

MR. KOTLIN: At what water temperature?

MR. SIZEMORE: I believe the water temperature is around 180°.

MR. KOTLIN: At 180° water temperature, oil in temperatures should be around 200°F. If oil in temperatures is around 240°, then there is a fault in the external system, possibly a plugged lube oil cooler.

MR. SIZEMORE: We have taken no exception to the oil cooler, and most of those engines (I will say all of them) run at 240° when they are load tested.

MR. KOTLIN: I believe there must be a measurement error.

MR. SIZEMORE: If we have an error, you are saying if we are running at 240° we will have increased our chances of scoring?

MR. KOTLIN: If you are consistently running 240° oil in temperatures, it would appear that you would have a sensitivity situation to scuffing.

MR. DWYER: We will have more to discuss on this particular problem by Mr. Reed and possibly his Committee members in just a few moments.

At this time we would like to call on our Electrical Committee chairman. Mr. James will now field your questions. He also has a question he would like to comment on.

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MR. JAMES: I would like to ask Mr. Sizemore whether that is inlet or outlet oil temperature.

MR. SIZEMORE: Inlet oil cooler temperature and engine outlet temperature.

MR. HARLEY: In your report you covered the subject of electric cab heat. It has been noted that the electric cab heat system uses electricity or power that has to be generated by the burning of fuel. One of the builders tells us this costs .3% in additional energy on a southern railroad, and .4% on a middle U.S. railroad, and .5% on a railroad operating in the northern part of the United States or in Canada. Do you feel the added reliability of the electrical system outweighs this fuel loss, which could amount on a national scale to as much as 20 million gallons a year?

MR. JAMES: Yes, personally I do. I would like to clarify it with these comments:

No. 1, we are in the transportation business, and it behooves all of us to improve over the road reliability and costs of operation. On the efficiencies to which you refer, or the fuel consumed, I would further add that the gain we have picked up through the use of the alternator versus the DC main generator is far in excess of the values you have stated. So, depending on where your baseline measurement is, I say the over-all efficiency through the AC traction alternator versus the DC offsets the slight increase in fuel that we would have as an expense in supplying electrical cab heat.

MR. FINDLING: Yesterday I asked a question relative to the RAILTEK pulse counter in relation to the IDAC. The answer you gave me was that you have it on a cycle test, and that indications on the IDAC were about 7 to 1 versus the pulse rate counter.

After that conversation I was told that the IDAC system you were using was highly sensitized, that it will pick up a greater number of current variations in the work area. Is this true?

MR. JAMES: Yes, Mr. Findling. I appreciate very much your bringing this question up.

The test to which I referred utilized a special IDAC system, one that was especially designed for the B&O Railroad, and the principal variation in that design versus EMD standards is in the area of sensitivity and response. EMD's latest version looks at the rate of change and then says, let's hold on for a time period. The system the B&O used in the earlier design was much more sensitive in relation to response time. Consequently, all other things being equal, we would have a greater input signal activity with the B&O special design.

The data to which I referred was gathered during a particular test run over a 2.2% grade. During this test we were monitoring and recording both input signals, i.e. axle counter and IDAC, and during the time on the grade we recorded 170 input signals from IDAC with only one from the axle counter.

MR. CLEVENGER: In your paper you had something on a 110-volt 60-cycle water cooler, the same as you use in the house, that you put on a locomotive. Will you elaborate on that?

MR. JAMES: We have on test currently some Oasis Model 360-A, 110-volt, 60-cycle AC water coolers. They are connected to our alternator, and of course are subjected to the variable frequencies and voltages that the alternator puts out. It is interesting to note, however, that due to the

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inherent characteristics of the electrical circuits, the current flow is practically constant. We have had these in service for 2½ years, and have not had a single failure to date, so it has been very promising.

MR. DWYER: You all remember Fred Houser, who was Editor of *Railway Locomotive and Cars*. We were able to discuss these problems during the year in that publication. Fred recently resigned from *Railway Locomotives and Cars* in order to accept a position as Manager of the Transportation Research Board with the Railroad Research Information Services, so he isn't with us today, but his successor and the new Editor of *Railway Locomotives and Cars* is here. I would like to introduce him to you at this time. He is Mr. Ken Ellsworth. Ken, will you please stand so everyone can see you? [Applause]

K. G. ELLSWORTH
PUBLICITY CHAIRMAN
Editor, Railway Locomotives
and Cars,
350 Broadway
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MR. KEN ELLSWORTH: Just a very brief word to thank you for the introduction, and to say that I am honored to be in your midst. I appreciate the opportunity to be here with you. Thank you. [Applause]

MR. DWYER: We will now go to the next subject. Diesel Mechanical Maintenance. Mr. Reed.

MR. REED: Gentlemen, now is the perfect time to talk about scored liners. Would anyone like to pursue that subject any further?

I have two questions that were handed to me. "To what extent are maintenance facilities finding problems with maladjustment of engines due to the varied characteristics of the fuel burned?"

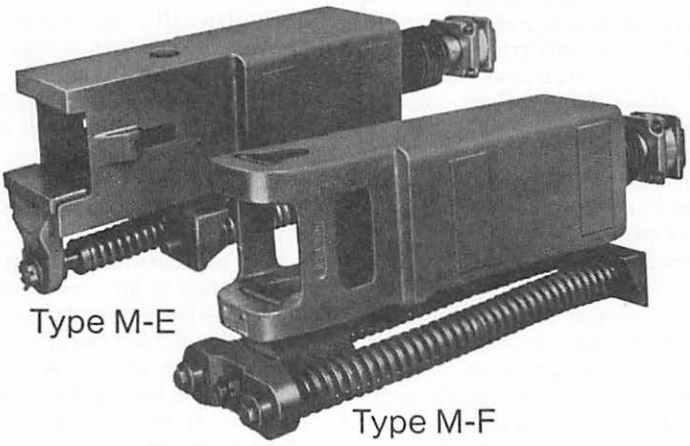
First, I have to say it depends on how far down in the barrel we have to reach for the fuel. You will notice anything from lower horsepower on load box, and possibly to some extent because of reduced horsepower you can even get into scoring. Would anyone from EMD or GE like to comment?

MR. JAMES: Yesterday, during our discussion of scoring and scuffing, one comment was made that requires further comment, and that is the definition of scored liners. What is a scored or scuffed liner?

MR. REED: You will see vertical marks running from the top of the ring belt or the top of the piston ring travel, extending down to the Mae West area. It seems to get more pronounced as it gets lower. The skirt of the piston below the ring belt also is all scuffed.

I think probably the Southern Pacific or Santa Fe could enlighten us more, because they have the problem much more pronounced. Would they like to comment?

MR. JAMES: I would add further that we ran some tests of our own, and found that the so-called scored liners will heal themselves in service. It



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appears to be a transient condition. On many of our units the scuffing completely disappeared.

MR. REED: The second question: "During our presentation we mentioned that four railroads advised they had thermal cracking problems on high and low horsepower locomotives, but that the problem had been corrected. What were the corrective measures?"

One of the railroads involved returned to a low phosphorus cast iron brake shoe, with significantly reduced thermal cracked wheels. Another thing (and I don't have the figures) was to change the brake pressures depending on the brake shoe type and the brake rigging type that was used.

Would anyone on the Committee like to comment on what they did, and what they changed to? I know Bob went to a low phosphorus shoe. Do you have any percentage figures or anything like that?

MR. LEEDY: No, we don't have anything that I can recall. It was something we had to do in this chaotic situation. Everything has to be considered.

MR. BURNS: This question is addressed to both the Mechanical and the MU committees. There is available an ultrasonic device that can be installed in the rail that will detect cracked wheels as they go over it. Has the Committee any opinion on this device?

MR. TOWNLEY: We have one on the Santa Fe that seems to be working out all right. The device has picked up some thermal cracked wheels on locomotives and cars both, and in some cases they were found to be so bad that the wheels had to be scrapped, and in other cases the thermal cracks were quite shallow and could be turned out. While it doesn't sound like it could be very effective, it is working out satisfactorily, and we think we are going to extend the use of this machine.

MR. DWYER: The next gentleman we will call on is Kjell Axelson, of the Shop Equipment Committee. He will field any questions from the floor, or there may be some that were left over from his presentation.

MR. AXELSON: Thank you, Jack. Well, here I am. Do you have any questions, gentlemen?

MR. SIZEMORE: I might direct this question to Mr. Reed concerning the Houdaille viscous damper on the 20-cylinder 645-E-3 engine. Does the Committee or anyone in the room have a way of testing the Houdaille in place to determine if it is good or if it is a problem on the engine?

MR. REED: Only by visual inspection have we been able to tell whether a viscous damper is any good, and that is by looking at it and seeing if there is any trace of the lubricant coming out. Mr. Axelson did talk about new testing equipment in his report. There is none that I know of, other than that one machine.

MR. AXELSON: In our report we had quite a few comments on vibration analysis, and this could be one way of picking it up. Several years ago I learned from Jack Dwyer that the secret of being a good committee chairman is to work the committee, so I am going to call on Mr. K. O. Anderson of GE to comment on the aspect of possibly picking that up through vibration analysis techniques.

MR. ANDERSON: The question in this particular case regarded a Houdaille damper on the EMD engine. Obviously I don't think I am qualified to talk on that. [Laughter]

We do use on GE engines a similar damper also made by Houdaille. We are well along in the development of a torsional vibration measuring technique whereby an accelerometer with a small FM transmitter can be bolted to the front barring over hub on the diesel engine (obviously this has to be an operating engine). Readings of vibration are then taken on an FM receiver, indicating on a millivoltmeter.

This development has a lot of promise. It is not yet to the salable stage. One of the problems right now is that it takes a highly skilled technician to obtain accurate readings. Whether this same technique or instrument would be applicable to an EMD engine with a similar damper, I am not able to say.

MR. BOATWRIGHT: When this question came up the other day regarding detecting a failed viscous damper, the general consensus of opinion was that at this point in time, visual inspection is the most practical way to find a failed viscous damper. However, since then I have heard several railroad people tell me they have had experience in picking up a failed damper with vibration detection equipment.

MR. KOTLIN: I would like to make one comment in reference to the development of a device that can be used on an engine to determine the condition of the damper.

I am glad to hear our competitor uses a pick-up type of device. We have also been working on an actual test application to the engine, whereby we will monitor the torsional response of the crankshaft. We have worked on the device for quite a while now, and it is about 80 per cent through its development stage. I hope we will be able to offer it some time in the future.

In the meantime, the visual inspection to recognize a failed damper is still the only immediate observation that can be made. Beyond that, if a damper is taken off of the engine and looks to be in good condition, and has less than three years' service life, it is probably all right to put it back on. But if it is in the fourth-year stage, the only way to be sure that damper is still operating properly is to have it requalified by returning it to the vendor for qualification test.

MR. CLEVENGER: I want to comment on this damper. We asked these people, and they told us that even they do not have a real way of checking a damper. The visual inspection is the only way to handle it. We have cut some of them apart and have come up with a parameter of a 3-year changeout on the EMD engines. It is interesting to note that on the GE engine we have set up a 9-year cycle, as they are lasting three times longer on the GE locomotive than they do on the EMD.

MR. DWYER: Thank you, Mr. Axelson.

We will move right along. You will now have an opportunity to ask questions about diesel material control. We will call on Darrell Walker to answer any questions.

MR. WALKER: I have had a question handed to me: "With the recent rule change for locomotives that are used in switching service, some major change is going to be required in the end stairway and vertical hand holds. Have the builders or any of the suppliers of such items given any thought to any of the railroads that have a retrofit problem?" If they have, it is hoped there will be some standardization between railroads.

MR. P. SASGEN [Power Parts Company, Chicago, Illinois]: We are in the process of working up a kit of material for a locomotive that will take care of the retrofit required by the FRA rule that requires the use of an additional lever and steps and grab irons.

MR. B. E. FRIER [Manager EMD Products - Engineering, EMD, La-Grange, Illinois]: We presently have worked up drawings on the footboard retrofit, and we are applying it to locomotives that we are shipping before the date where full side boards are required. We will offer this to the railroads, either drawings or parts from the Parts Department. The retrofit is not as extensive a change on the locomotives shipping before April 1, 1975 as the change on the locomotives shipping after the cutoff date next April, where the side steps have to be larger. The retrofit isn't too bad on our locomotives.

MR. SIZEMORE: With the critical shortage of material and castings, especially with heads, pistons and liners, does the Committee have a recommendation on a re-processed head, those that will be acceptable for service, and are there any companies now in the process of reclaiming EMD pistons by various processes? A lot have scored.

MR. SASGEN: I am sorry the people who are involved in reclaiming pistons are not here. I will speak for them. Triangle Engine Rebuilders are now reclaiming pistons by regrooving the ring groove and putting a steel spring shim in to bring the ring groove

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back to standard size. They also can reclaim the piston which has been slightly scuffed. If you will see me later I will give you the names and addresses of these gentlemen. They have some 200 pistons now in service which have been reclaimed by this method.

MR. DWYER: Gentlemen, we are out of time. We have not officially yet heard from the New Developments Committee, although you have heard from Mr. Townley. I promised him one more minute to comment on anything he would like to say.

MR. TOWNLEY: Being last on the program, maybe I can summarize some of the things that were said on this new development of reclaiming some of the material. It has really come to the forefront and has always been a problem when to reclaim and when to throw away and when to buy new. New material is getting so expensive that we have to save material. We are in the process of trying to take some of the pistons from storage and putting them back in service by taking a very slight cut off of them. There are other things we didn't do in the past, such as plating the AR10 alternator slip rings with stainless steel flashing. That seems to be working out well.

There are other areas, such as chrome plating the rocker arm pins back to standard. I think this is one of the things we are going to have to really get into in the next few months; that is, wherever we can we should help each other with methods we develop in being able to reuse and change our tolerances and do things that will have to be done to reduce material costs.

MR. DWYER: We are going to have to move along, gentlemen. I have one final comment. Of course you have already been advised that I have retired from the Chessie System, and as of today I am also retiring from this position. The question I have been asked most often is, how do you like retirement? Gentlemen, I just want to say it's wonderful. It is almost like a second honeymoon, but perhaps with a slight difference this time around. I am getting to see a little more of the beauties of nature.

With that final comment I would like to say again, thank you very much. I will now turn the meeting back to Mr. Long. [Applause]

MR. LONG: Mr. Dwyer, you and your panel are to be congratulated on an excellent What's Your Problem session. From the discussion on the floor it brings to mind an article I read some time ago about our late President, Harry Truman. He had a sign on his desk that read, "The Buck Stops Here". As far as the LMOA is concerned, that is the case with this Committee: The buck stops here. Again, congratulations on a perfect presentation. [Applause]

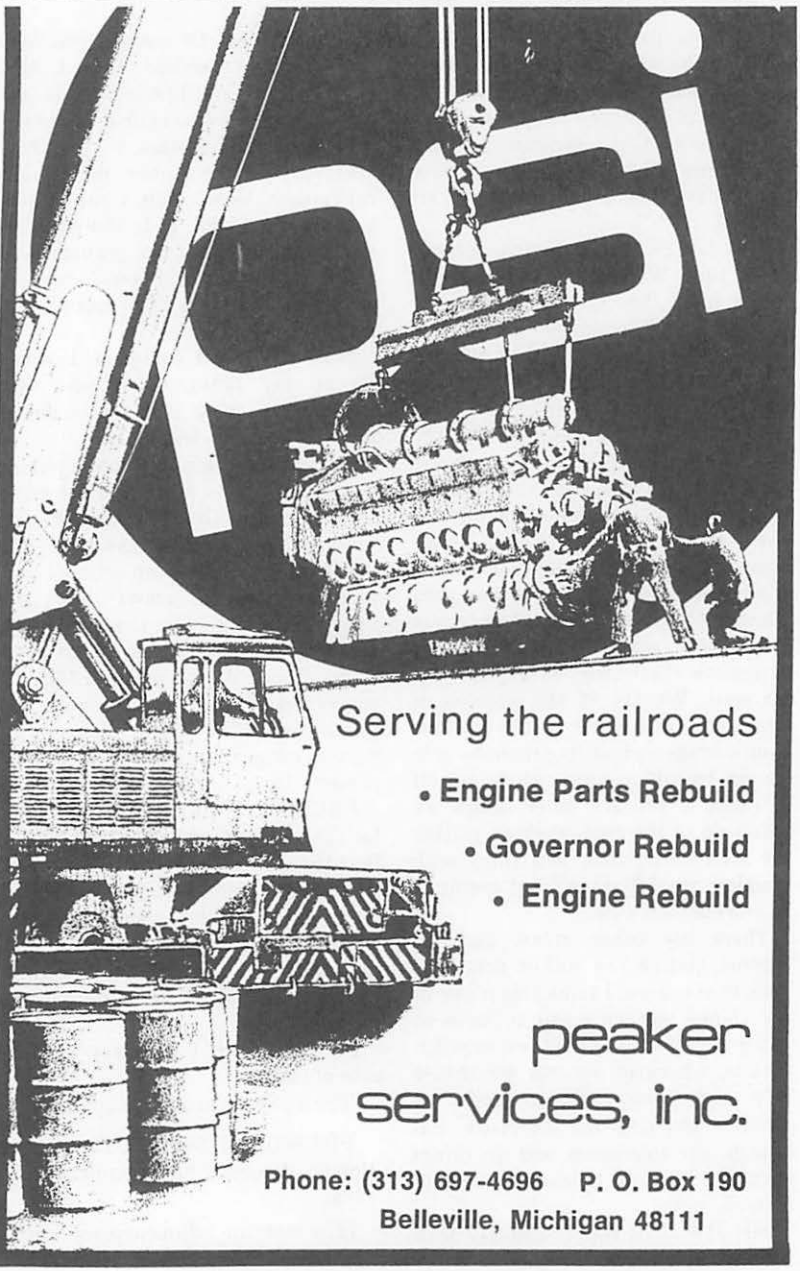
PRESIDENT BOOTH: Gentlemen, for those of you who are here for the first time, I would like to suggest that when you return home you write your boss and tell him what you have learned at these meetings. Let him know that you attended the meetings and that you did get something out of them.

Let's give this Committee a rising vote of thanks.

[The audience arose and applauded.]

PRESIDENT BOOTH: The convention is adjourned until September 15, 1975.

[The meeting adjourned sine die at 11:30 a.m.]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PRE-CONVENTION PRESENTATIONS

INDEX

LOCOMOTIVE MAINTENANCE OFFICERS ASSOCIATION
GRAND BALLROOM, SECOND FLOOR

MONDAY, SEPTEMBER 15, 1975 Page

9:30 a.m. Keynote Address: S. Graham Hamilton, General Manager, Locomotive Products Dept., General Electric Co., Erie, Pa.

10:00 a.m. Diesel Electrical Maintenance: Chairman W. R. James, Superintendent, Locomotive Department, Chessie System, Huntington, W. Va. Topic: "Effective Managing of Electrical Maintenance." 143

2:00 p.m. President's Address: Mr. L. H. Booth, Assistant Chief Mechanical Officer-Locomotive, Chessie System, Huntington, W. Va.

2:30 p.m. Diesel Mechanical Maintenance: Chairman R. W. Leedy, Superintendent Motive Power, Illinois Central Gulf Railroad, Chicago, Ill. Topic: "Progressive Action on Maintenance and Ecology." 177

TUESDAY, SEPTEMBER 16, 1975

9:00 a.m. Fuel and Lube Oil: Chairman D. H. Propp, Engineer of Tests, Burlington Northern Inc., St. Paul, Mn. Topic: "Progress in Fuel and Lubricating Oil Technology." 205

10:45 a.m. New Developments: Chairman J. R. Ryder, Director Industrial Engineering, Rock Island Lines, Chicago, Ill. Topic: "Progress in Management and Equipment Development." 243

2:00 p.m. Shop Equipment: Chairman Kjell Axelson, General Manager Work Equipment and Machinery, Burlington Northern Inc., St. Paul, Mn. Topic: "Progressive Approaches to Painting, Cleaning, and Reclamation" 273

WEDNESDAY, SEPTEMBER 17, 1975

9:00 a.m. Diesel Material Control: Chairman Darrell M. Walker, Assistant Mechanical Engineer, Southern Railway, Atlanta, Ga. Topic: "Material Crises — What Can Be Done!" .. 341

10:00 a.m. What's Your Problem? Chairman R. R. Holmes, Chief Chemist, Union Pacific Railroad, Omaha, Nebr. What's Your Problem Panel.

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REGISTRATION FEE AT ANNUAL MEETING $5.00 PER MEMBER!

LADIES FREE

1. TO SAVE **YOUR** TIME, WE HAVE A "REGISTER AT THE MEETING SYSTEM." This is described on page **122** of this book. (USE IT **TODAY!**)

2. **SUPPLY COMPANY MEMBERS: SPECIAL ATTENTION!** Your membership card and registration fee of $5.00 paid at **our** desk **will entitle you to attend any and all regular meeting room sessions. IT WILL NOT ADMIT YOU TO THE EXHIBITS and ENTERTAINMENT**: they are owned, financed, and operated by the Railway Supply Assn., Inc., 332 South Michigan Ave., Chicago, Ill., in which we recommend membership, which may be arranged if you desire at their desk at the meeting, or by mail to the above address.

3. **IF YOU LIVE IN THE CHICAGO AREA:** Our registration desk will be open Sunday, beginning at 12 noon. Come in Sunday afternoon, register, and enjoy this special opportunity to visit with our officers and your other friends. THIS WILL SAVE YOU VALUABLE TIME ON MONDAY MORNING. KEEP YOU OUT OF THE REGISTRATION RUSH.

4. **BRING YOUR WIFE WITH YOU:** She will enjoy the special entertainment planned for her!

5. BE SURE **NOW** YOU HAVE YOUR MEMBERSHIP CARD FOR THIS YEAR, (If you can't find it, ask for another **TODAY, please don't wait to get one at the meeting.**

6. If you come to the meeting without a this year's Membership Card, and **really think you have already paid,** TO SAVE YOUR TIME, PLEASE JUST PAY YOUR DUES AT THE MEETING, tell the registration girl you think you have paid, and she will type right on the record, "DOUBLE CHECK, HE THINKS HE HAS PAID, IF SO ISSUE HIM FREE CARD FOR NEXT YEAR." **This we will do when we return home.**

SPECIAL INSTRUCTIONS: TAKE NOTE

7. **STUDY these reports closely.**
8. **SEND written questions to the Chairmen.**
9. **READ registration instructions on page 122.**
10. **BRING THIS BOOK TO EVERY SESSION OF THE ANNUAL MEETING! There are no extra copies.**
11. **SAVE YOUR TIME: Prepare your Registration Form on page 122. BRING IT WITH YOU!**

ATTENTION ALL MEMBERS COMING TO THE ANNUAL MEETING

SPECIAL CONVENTION REGISTRATION INSTRUCTIONS

WE WILL NOT "Register By Mail" This Year

(Development of the Sun. afternoon registration has made this unnecessary.)

Please DO NOT Send In Any Registrations By Mail! AT THE ANNUAL MEETING

1. Register at Registration Desk in the Lobby of the Conrad Hilton Hotel.
2. CLIP (don't staple) **A FIVE DOLLAR BILL HERE.**
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WE ARE NOT PERMITTED TO ISSUE GUEST BADGES FOR ANY SUPPLY COMPANY REPRESENTATIVES OR FOR ANY RAILROAD PEOPLE WHO SHOULD BELONG TO THE **TRAVELING ENGINEERS, CAR DEPARTMENT OFFICERS, and AIR BRAKE ASSOCIATIONS.** WE ARE NOT PERMITTED TO ISSUE ANY BADGES FOR WIVES OF SUPPLYMEN: THESE ARE ISSUED AT THE RAILWAY SUPPLY ASSN. BOOTH.

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☐ I AM COMING TO THE CONVENTION, BUT CANNOT FIND MY CARD. MAIL ME ANOTHER.

Name .....

Title .....

Company .....

Address .....

Please don't come to the meeting without your card, the **other fellows** won't like standing in line behind you while **you are getting** one.

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ATTENTION ALL RAILROAD MEMBERS!

The ground rules of this Annual Meeting require:
"THAT ALL SUPPLY COMPANY HOSPITALITY SUITES MUST BE CLOSED TO AND OFF LIMITS TO **ALL RAILROAD PERSONNEL** WHILE THE MEETINGS ARE IN PROGRESS." ALL HOSPITALITY SUITES CLOSE AT 8:30 A. M., 1:45 P. M., 11:00 P. M.
Please do not **embarrass** your Supply Company friends by calling at their suites while the meeting are in progress; it will cause them:

1. **To remind you of this ground rule.**

or

2. **To lose their reservation at this meeting, and to forfeit their right to attend future meetings.**

ALL SUPPLY COMPANY MEMBERS: Your strict observance of the above rule is absolutely necessary, will be greatly appreciated.
You are urged to attend the meetings because:

1. **Your** product might be discussed.
2. You might be in position to answer a question that is asked.
3. You need to know what **our** problems are, in some cases, they are **your** problems also.

ATTENTION ALL MEMBERS:

THIS IS A SINCERE WORD OF THANKS TO THE ORGANIZATIONS LISTED BELOW WHO HAVE CONTRIBUTED MUCH TO THE SUCCESS OF OUR PRE-CONVENTION PRESENTATION PROGRAM BY PROVIDING COMPLIMENTARY USE OF ROOMS FOR COMMITTEE MEETINGS AND FOR THE PRE-CONVENTION PRESENTATIONS THEMSELVES:

Glenwood Manor Motor Inn, Kansas City, Kansas
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Midland Hotel, Chicago, Ill.
Pick-Congress Hotel, Chicago, Ill.
Sheraton Motor Hotel, Little Rock, Arkansas
Sheraton Motor Inn — Midtown, Cleveland, O.
Stouffer's Riverfront Inn, St. Louis, Mo.

There are no obligations for the use of these facilities, but we are quite sure that these establishments would appreciate the opportunity to serve you if and when you are in their vicinity.

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	Advertisers	Associate	Active	Total
1939	0	27	60	87
1940	34	48	162	244
1941	38	48	210	296
(Annual Conventions were discontinued during the war after the 1941 meeting)				
1942	31	29	82	142
1943	36	23	57	116
1944	70	58	164	292
1945	76	76	214	366
1946	103	187	676	963
1947	101	284	937	1321
1948	113	295	1183	1591
1949	134	595	1789	2521
1950	123	595	2101	2822
1951	125	626	2912	3663
1952	135	510	2747	3392
1953	118	597	3288	4003
1954	118	545	2943	3606
1955	81	434	3235	3750
1956	110	419	3257	3786
1957	100	423	2678	3201
1958	82	350	2320	2752
1959	90	387	2395	2872
1960	98	393	2302	2793
1961	101	348	2201	2650
1962	118	316	2291	2725
1963	125	275	2345	2745
1964	138	273	2345	2756
1965	155	289	2372	2816
1966	163	464	2368	2995
1967	180	408	2327	2915
1968	200	321	2575	3096
1969	192	335	2173	2700
1970	184	345	1929	2458
1971	140	283	1621	2044
1972	132	343	1777	2252
1973	108	345	1563	2016
1974	124	384	1735	2243

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R. R. HOLMES, Chairman
What's Your Problem Panel
Chief Chemist
Union Pacific R.R.
Omaha, Nebraska 68102

Monday, September 15, 1975

10:00 A.M.

REPORT OF THE COMMITTEE ON DIESEL ELECTRICAL MAINTENANCE

Pre-Convention Presentation: Southwestern Railway Club

April 24, 1975
Sheraton Motor Hotel
Little Rock, Arkansas

W. R. JAMES, Chairman
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J. H. Ray, Chief Electrical Engineer, Erie Lackawanna Railway Co., Midland Building, Cleveland, Ohio 44115

John R. Anderson, Electrical Foreman-Dale St. Shops, Burlington Northern, Inc., B. N. Building, 176 East-5th Street, St. Paul, Minnesota 55101

D. I. Smith, Senior Service Engineer, General Electric Company, 2901 East Lake Road, Erie, Pa. 16501

F. F. Button, Engineering Technician, Canadian National Railways, 935 Lagauchetiere St. West, Fl. 14, Montreal, Quebec, Canada H3C 3N4

H. Stringer, Supvr. Motive Power-Elect., Canadian Pacific Ltd., Room 903 Windsor Station, Montreal 101, Quebec, Canada

1975 TOPIC:

"EFFECTIVE MANAGING OF ELECTRICAL MAINTENANCE"

PERSONAL HISTORY — WILLIAM R. JAMES

Born in New Castle, Pa., December 11, 1928.

Education: Coyne Electrical School of Chicago 1947-1949 (Industrial Electrical Engineering), University of Baltimore 1964-1966 (Industrial Management).

Railroad Career: Joined the Baltimore & Ohio Railroad as an Electrician Apprentice in 1944. Made an Electrician in 1947 and promoted to Diesel Electrical Supervisor in 1948. In 1950 was appointed Engine House Foreman, then General Foreman in 1952. In 1954 he was promoted to Regional Diesel Supervisor and in 1960 to Asst. Engineer-Electrical, 1966 Asst. Superintendent Motive Power. Promoted to Superintendent of Shops, Cumberland, Md. in 1968, and in 1973 was promoted to Superintendent-Locomotive Department of the Chessie System.

He is married to the former Ruth Sanfilippa, and they have three sons: Clifford, Daniel and William.

I. THE SUPERVISOR'S RESPONSIBILITIES FOR TECHNICAL TRAINING

In a 1924 interview, the then new president of General Motors, Alfred P. Sloan, made this statement:

"The human problem is far more delicate and difficult to handle than any production problem, or distribution problem or engineering problem, or financial problem."

The ability to get people to work together is of the greatest importance. J. P. Morgan stated, "I will pay more for the ability of a man to lead others than for any other asset".

This then is the area in which we believe a significant contribution can be made. Accordingly we offer the following points.

As managers and supervisors, one of our greatest responsibilities is that of striving for maximum cost effectiveness. For most of us, this responsibility for getting the most for the maintenance dollar is a way of life, in good economic times as well as bad. The need for greater cost effectiveness is a vital, often deciding factor in most of our decisions, large and small. We weigh this factor carefully in controlling maintenance policies, the improvement of facilities, and the purchase of tools, equipment, and supplies. It is necessarily a factor in determining distribution and employment of the labor forces. In fact a large portion of our maintenance cost is attributed to our payrolls.

Control of the cost effectiveness of the labor force is in the hands of the men who keep the trains running. These are the "men on the ground", the electricians, machinists, pipefitters, and so on. Their skill and technical competence determine the effectiveness of the labor cost. It has often been said, and rightly, that the attitude of these people has a strong impact on cost effectiveness. We agree, but we should also recognize that there is a significant correlation of an individual's attitude towards his job and his proficiency in handling his job. If we, as managers and supervisors, give serious attention to the interaction of attitude and proficiency, we can make a positive and rewarding step towards the goal of improving the labor cost effectiveness. The way to achieve this goal is through effective technical training of the men on the ground.

All members of railroad management, from the line foreman to the top, have a vital responsibility in the technical training and development of our

MEN WHO MOVE AMERICA

people. All too often, unfortunately, this vital responsibility is soft pedaled. We tend to think of training as a field requiring a technical, sometimes mysterious expertise of its own. We think of special training departments, staffed with polished instructors, sometimes using rather sophisticated methods of conducting instruction. All of this is in the area of methodology, but, although its importance cannot be denied, the most important aspect of any training is its *effectiveness*. Only the supervisor can determine the effectiveness of training. He must

1. Determine exactly *who* requires training.
2. Determine precisely what training is needed—set training objective.
3. Determine if the training program accomplished the training objective.

It should be obvious that the supervisor/manager of the activity concerned is best qualified to determine these three requirements, since he is the man who has to live with the results. In fact, most training departments will heartily welcome the supervisor's direct concern and aid on these requirements.

To appreciate the supervisor/manager's responsibilities more objectively, consider this description of technical training:

"Those activities or programs designed to develop an employee's specific skills and technical knowledge to enable him to perform an assigned task without special help", consistent with good safety procedures and a reasonable expectancy.

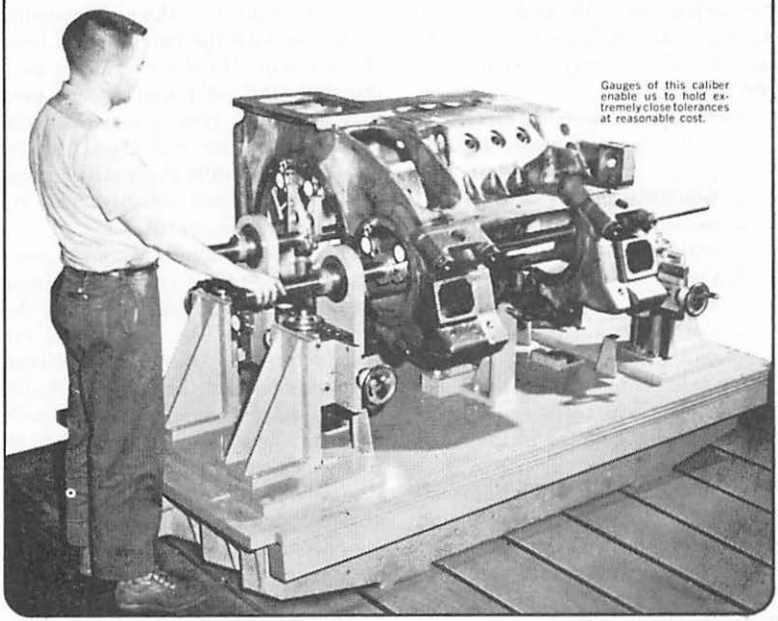
The keywords in this description are "specific skills", "assigned tasks" and "without special help". It may be clearer to substitute "coaching" for "special help".

By this description technical training encompasses far more than the application of teaching skills or methodology. To be effective, all training activity must be specifically directed to the exact people who need it and to the precise skills that must be improved, and must succeed in meeting its objectives. Unless the training effort has satisfied all three of these conditions, it is a wasted effort, regardless of how brilliantly or ingeniously it was developed and conducted. Again, the only man who can determine training effectiveness is the supervisor of the affected activity. It should now be apparent that for training to be effective, it must be localized and, in many cases, highly personalized.

The manager/supervisor, thus, has a critical part in the whole training process: the responsibility to accurately determine *who* needs training and *what* training is needed. To fulfill these responsibilities he can develop a "training needs analysis". As a first step, make a list of all tasks a particular class of employees *should* handle without the need for coaching. For an electrician at some specific location, such a task list might include:

1. Perform locomotive inspections ranging from daily up to and including annual inspections in accordance with FRA and company rules.
2. Clean, test, service and make minor repairs to rotating equipment in accordance with prescribed standards.
3. Read and correctly interpret schematic diagrams for (specific model) locomotives.

In rebuilding traction motors, National balances accuracy against operating economies



Gauges of this caliber enable us to hold extremely close tolerances at reasonable cost.

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4. Troubleshoot locomotive electrical problems.
5. Replace defective components.
6. Perform electrical tests and adjustments.

The list could go on to describe several more tasks pertaining to the specific job at the specific location.

The manager/supervisor must now analyze each task, breaking it down into its component elements which are based on specific skills or knowledge. For example, under the task "perform electrical tests and adjustments", the "task detailing" may include the following:

a. **correctly use electrical meters:**
   1. Select proper meter for the job
   2. Calibrate meter
   3. Select proper function and scale settings
   4. Correctly connect meter to circuit
   5. Correctly interpret meter indications

Other elements within the task "perform electrical tests and adjustment" should be detailed in the same way.

The job of compiling this information is difficult and time consuming but pays off in three ways:

1. It specifies the exact skills required for job efficiency.
2. It heightens the supervisor's awareness of job requirements.
3. It provides accurate, up-to-date details for revising job descriptions.

Most of us are aware that job skill requirements have changed drastically in the last 20 years, even in the last 10 years. Yet it is claimed that "top management" does not consider these changes so far as recruiting and development policies are concerned.

What better way of documenting these changes than by developing the task analysis system just described? Top management should not only welcome this information, but should demand it. Again, the manager supervisor in the field is in the best position to develop these data.

Having completed a task analysis of what the job requires, the manager/supervisor must now develop a "skills inventory" for each of his subordinates. He compares the requirements of the job with the current skill level of each man. The difference between the skills the job requires and those that the man now possesses, constitutes what we call the "training needs": the specific skills which must be developed, and exactly who requires this development.

The manager/supervisor now knows what portion of the required training should be handled by a training department or outside agency and can specify precise training objectives. Just as important, he can also decide exactly what training he can handle with his own resources, either by acting as a trainer himself or by using the services of another man in his group. An objective analysis of training needs often reveals that the greater portion of the training can be effectively handled by means of old fashioned "eyeball to eyeball" coaching, or short, informal classes.

Upon the completion of training, the manager/supervisor *must* provide each man with opportunities to put his newly-acquired skills into practice. This will enable the manager/supervisor to determine if the training effort has met its objectives. He does so by observing the performance of assigned tasks, noting further requests for coaching, and comparing

these with the job requirements spelled out in his task analysis. He is now able to pinpoint needs for additional training and can so advise the department or outside resource that handled the training.

Among the outside training resources we have long enjoyed have been those schools conducted by railroad suppliers, notably the locomotive builders and the air brake companies. Although these suppliers have made a good effort to keep us abreast of modern technology, we believe there is room to improve this effectiveness of these schools. First, we should be more selective of whom we send to them and look for ways better to prepare those selected to attend. We should also look for ways to disseminate more broadly the technical knowledge acquired through attendance. The suppliers could contribute to greater effectiveness by reevaluating the objectives of their courses and devising means of determining whether these objectives are met. The Electrical Committee believes that we should work with the railroad suppliers to improve training objectives. This would benefit all parties in terms of improved product performance and more returns for the maintenance dollar.

Profitable companies, large and small, have found that good training programs invariably pay out on the bottom line. The cost of training is recovered many times over in measurable cost savings and measurably increased productivity that result in measurable increases in profitability.

Good training is necessary at all times, but especially when the economy gets tight. At such times there is a temptation to trim the training budget, but is should be remembered that good training *increases* profitability by boosting efficiency, decreasing downtime, and improving morale. And that is effective managing.

In summary, the effectiveness of training and as a result the effectiveness of the cost of labor, can be improved only by the manager/supervisor's acceptance of his training responsibilities. He is in the best position to determine training needs, prescribe training objectives, and evaluate the training effort. An important by-product of his analysis of job requirements is valuable data that, provided to top management, will increase *its* awareness of today's skill requirements.

We earnestly recommend that you consider this approach, discuss it with your subordinates, and put it to work for you. Through your own effort you will benefit, your people will benefit, and the railroad that pays the bills will benefit.

Yes, one important aspect of effective management is improving productivity through continuing educational programs for our employees. We respectfully direct your attention to this need.

II. EFFECTIVE MANAGING OF ELECTRICAL ROTATING EQUIPMENT

This portion of our paper will deal with the maintenance of electrical rotating equipment, concluding with a few thoughts on tomorrow's needs today.

We clearly recognized that it would be difficult to add to the volumes of information issued by the builders, railroad periodicals, railroad seminars and reports previously issued by the LMOA on specific hardware.

We further realize that railroad Mechanical department personnel are

subject to varying attitudes, such as:

"One railroad's experience is not adaptable to another railroad's operation", or

"Railroad maintenance is a circumscribed specialty to be handled under its own plan".

Therefore, we will not attempt to address ourselves to the technical aspects of disassembly, overhaul procedures and re-assembly; rather we will confine our comments and recommendations to the so-called running maintenance.

Since the repairs to and maintenance of electrical rotating equipment accounts for a major portion of Mechanical Department budgets, we felt this was reason enough to pursue this subject once again.

With the state of the economy being somewhat depressed, it seems most appropriate to offer suggestions that can, through effective managing, (1) improve plant productivity; (2) reduce the impact of inflation; (3) with the present energy crisis, more effectively utilize available manpower, and (4) increase the effective utilization of skilled labor.

1. **TRACTION MOTORS.**

The useful work produced by a traction motor is expended converting electrical energy to mechanical energy through a pinion and ring gear arrangement, to rotate a pair of wheels that are friction coupled to the rails to produce tractive effort, whereby circular motion is converted to linear motion to move our trains.

Dimensionally the traction motors have remained *unchanged* since the introduction of the D7 and 752-A1. Since 1940, the rating of the EMD motor has increased from 337 horsepower to 750 horsepower and the GE motor has increased from 350 horsepower to 900 horsepower. These increases have been brought about by new insulating materials and improved manufacturing techniques.

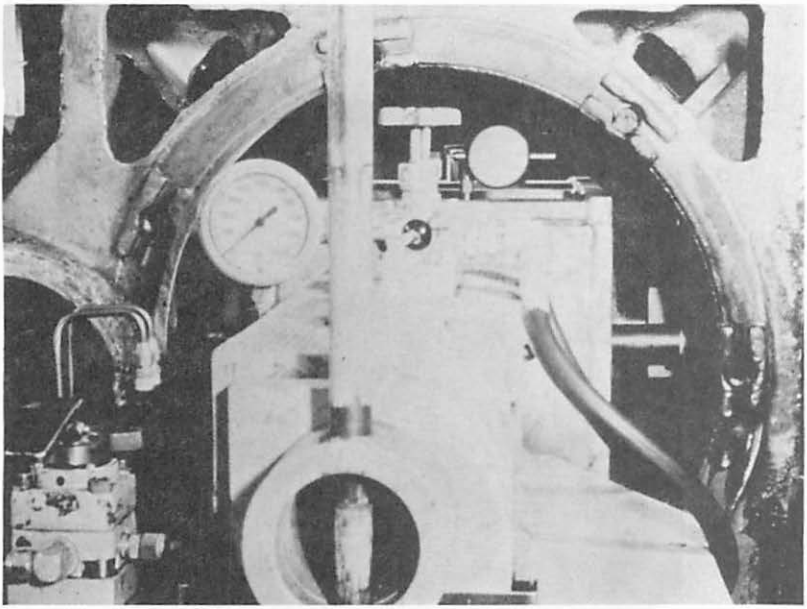
Today's traction motor performance is such that a new or overhauled motor is fully expected to wear out several pairs of wheels before requiring overhaul; therefore, it must be our goal, each time we re-wheel a motor to *wear out* that pair of wheels before major attention is required to the traction motor. In other words, effective managing of electrical maintenance dictates that no other cause for traction motor removal is acceptable under normal operating conditions.

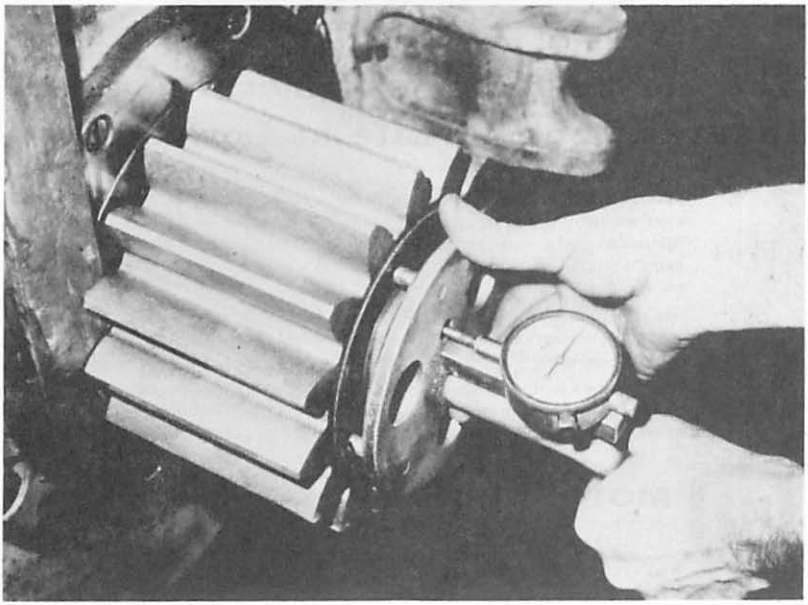
Assuming that each railroad's manager of electrical rotating equipment has established sound traction motor overhaul policies and procedures, and has an effective quality control program that will insure the day-to-day carrying out of these policies, then the true life cycle of the traction motor, from the Mechanical Department's viewpoint, will be determined by the running maintenance received during scheduled locomotive maintenance.

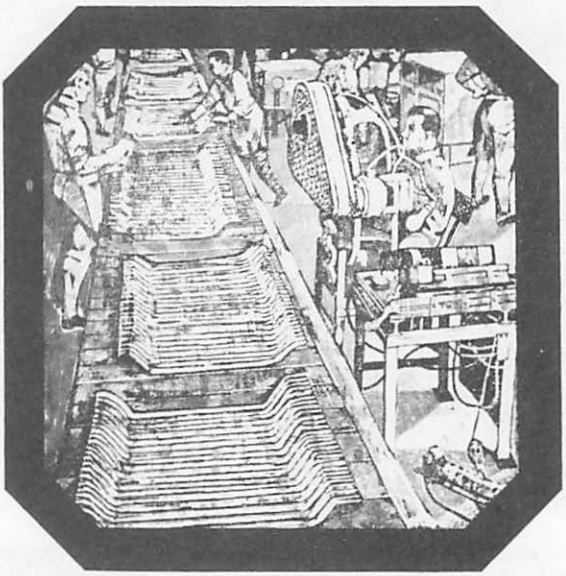
It is the recommendation of this Committee that the following items be specifically *managed* prior to and after installation of driving wheel sets, to achieve optimum traction motor performance.

A. **Pinions.** Install a new or qualified pinion in accordance with the builders maintenance instructions.

Place motor on test stand. Attach *vibration pick-ups* in the vertical, horizontal, and axial planes, at both pinion and commutator ends of motor frame. Connect motor to an adequate power source (d-c welding machine) and rotate at 1500 rpm. Operate motor for 2½ minutes and observe indicated







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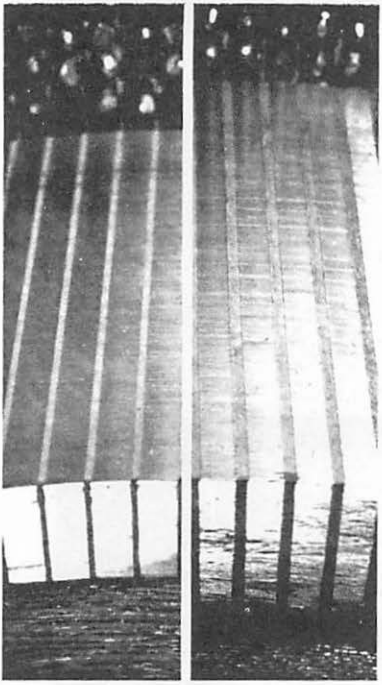

Left: Conventional commutator construction. Right: WIDE-MIKE construction, with extra-heavy mica segments.

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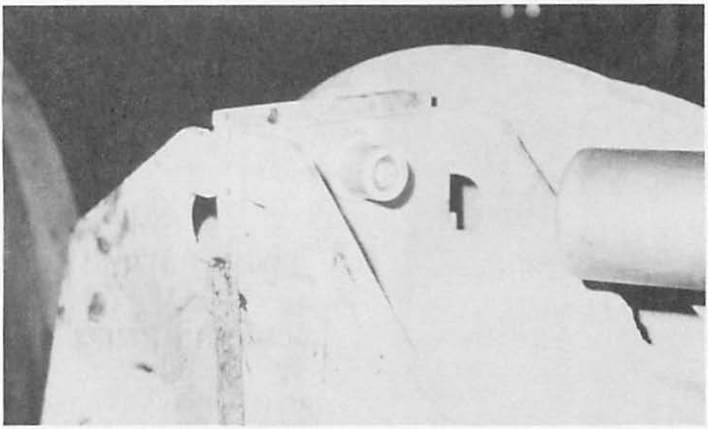

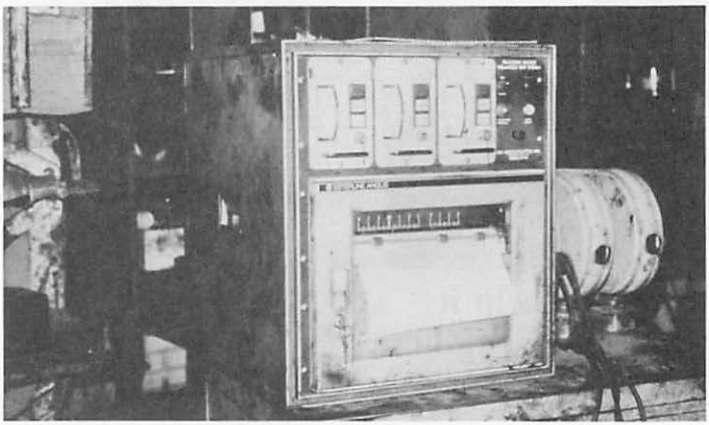

values, noting that a value of .13 in/sec. or over will cause the red light to glow, indicating that the motor *must not* be placed in service but instead, forwarded to motor overhaul shop for complete tear down.

If motor passes the vibration test, 0 to .12 in/sec. for main line freight and passenger service, remove recording chart and file by motor serial number for reference and comparison during the next shopping period. Proceed with the application of support bearings, wheel set, bearing caps, lubricator assemblies, mounting and torquing per builder specifications.

B. **Gear Cases.** In preparing the traction motor gear case, be certain that case *Geometry* is correct and that seals to be used are of known quality.

Upon completion of mounting of the gear case halves, they should be secured with a Huck system of fastening, to obtain the optimum case securement and service life.

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a continuous seal should be applied around the entire perimeter, using a room temperature curing sealant applied with a caulking gun. This minimizes the possibility of water and dirt entering the suspension bearings and oil well.

When the assembly is complete, the initial charge of gear lubrication (GE 12 lbs. and EMD 8 lbs.) must be added. Then, motor the assembly, paying specific attention to the voltage applied and the current required to obtain initial rotation and operate for two minutes to verify the mechanical integrity and freedom of movement, and to distribute lubrication throughout gear contact area. The motor-wheel assembly is now ready for the journal box, and truck application when required.

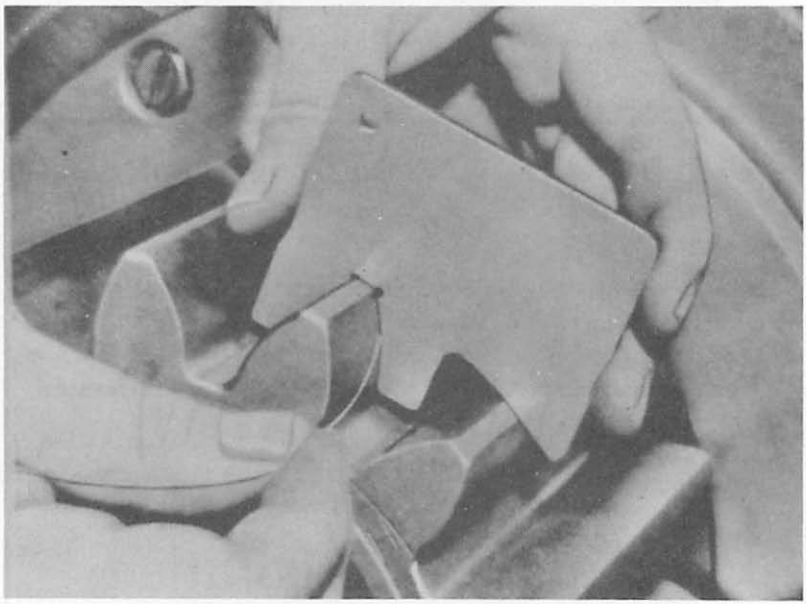
This is proper preparation of the motor-wheel assembly and will provide the basis for achieving optimum performance.

Once the motor-wheel assembly has been applied to the truck of an active locomotive unit, we recommend:

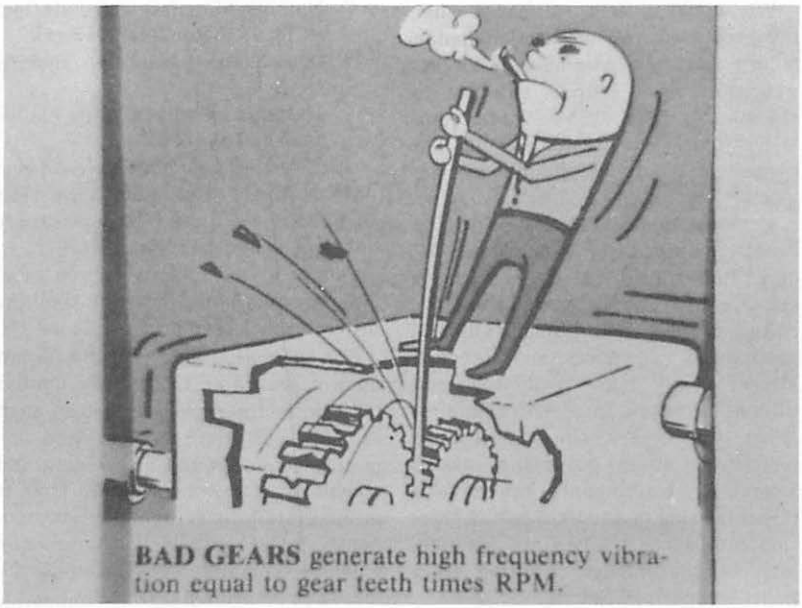
(1) Filling of support bearing reservoirs to proper height with quality lubricant.

(2) Thereafter, addition of gear case lubricant and checking of support bearing oil on a 15-day cycle.

(3) Inspection of traction motor interior on a 90-day cycle, if miles per month will permit a brush life of this duration.



In about two years of service under a GP-7 type locomotive (8000 mi. per/month), or one year under a GP-40 or U-30-B type locomotive (10,000 mi. per/month), your motor will have completed its first service life and the assembly will be removed because of worn out wheels.



Prior to re-wheeling the motor, we recommend that you:

(1) perform di-electric test between A-AA and F-FF motor leads and frame, applying 1500 v d-c and permitting no more than 1 ma leakage current.

(2) Perform visual inspection of motor interior and exterior, repairing all obvious defects.

(3) Motor with d-c power supply and lightly touch up commutator with large hand stone to remove minor surface irregularities; blow-out and wipe all creepage surfaces.

(4) Re-brush as may be required.

(5) Thoroughly inspect pinion gear for surface defects and gauge for deviation from profile, per builder's maintenance instructions; renewing those that do not qualify.

(6) Place on test stand and subject motor to vibration run as outlined previously.

Upon completion of these items, the motor is ready to receive another pair of wheels, and strict adherence to the previously stated wheel and gear case mounting procedures will ensure one more wheel wear out cycle.

You should direct specific attention to checking the ring gear for deviation of profile. Achieving the optimum motor performance requires strict adherence to pinion and ring gear qualification procedures. It is a well documented fact that the mechanical forces induced into the motor frame and armature windings as a result of excessively worn pinion and/or ring gears is of sufficient magnitude literally to chafe away insulation on both the armature and field coil insulation systems, causing grounding and premature armature bearing failures.

We would clearly emphasize that the primary cause of traction motor failure is from *mechanical* forces, generated from sources external to the motor proper, such as track conditions, truck maintenance, and improper matching of pinion and ring gears.

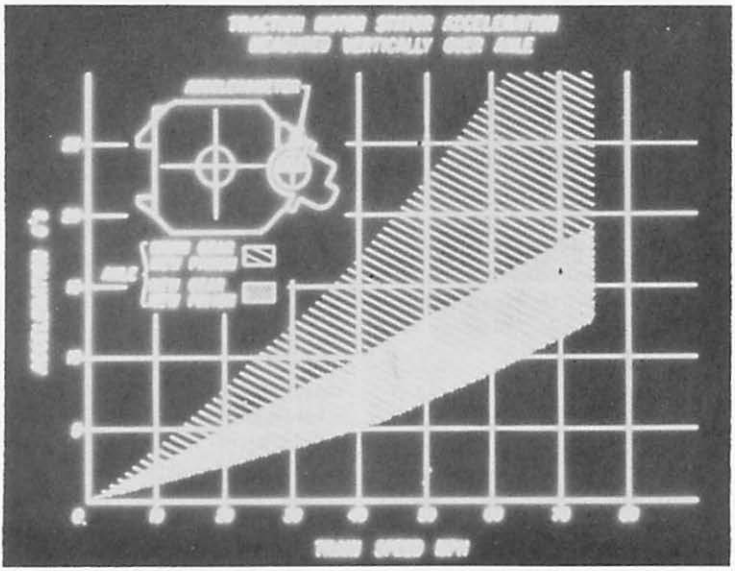
C. **Maintenance Policies.** With the best of maintenance, track conditions, and Operating Department policies relative to tonnages moved over the ruling grades, the normal inservice mechanical, electrical and thermal stresses will take their toll and ultimately result in a motor failure. When this occurs, the maintenance policies in effect governing *overall* locomotive maintenance can have a direct bearing on the total cost of traction motor repairs. As an example, imagine the impact resulting from policies covering:

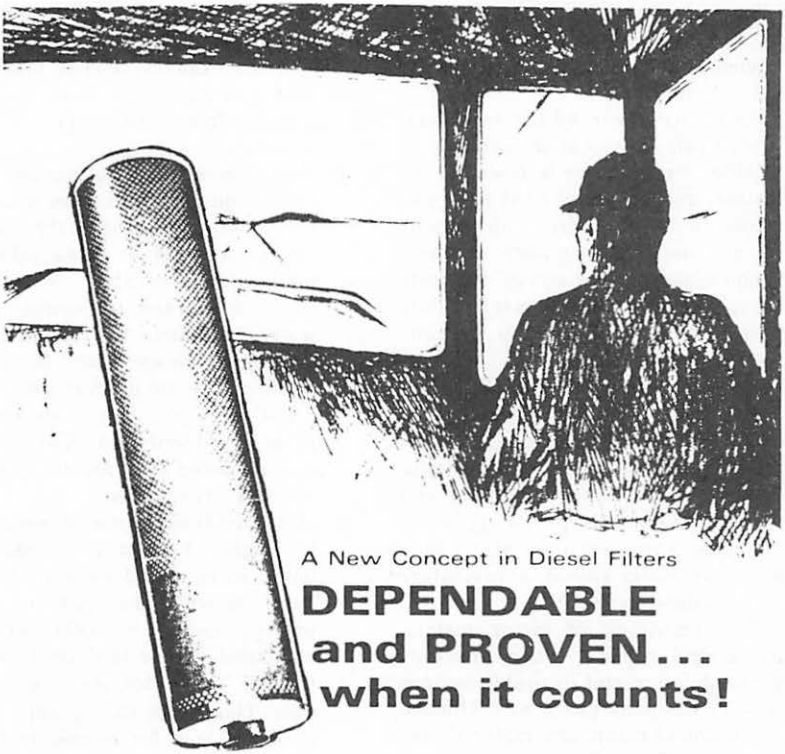
1. Procurement of locomotives with traction motor cut out switches.
2. Number of maintenance stations assigned motor renewal work.
3. Centralized locomotive maintenance facilities.
4. Methods of distributing failed and good motors.

These aspects of policy have a direct bearing on the total quantity of traction motors required in your spare motor pool, which is *capital at rest!*

Further, how effectively you manage your overhaul policy, can spell the difference between profit and loss.

For example, suppose your railroad finds it profitable to perform limited traction motor repairs in-house, such as field coil replacements and armature renewals, but no welding and machining of magnet frames. Then it is suggested that the failed components be selectively gathered and when one complete set of components has been identified, they be shipped to one of the outside traction motor repair shops as sub-assemblies, *but*





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representing one complete motor on a special unit exchange program, instead of shipping armatures, field coils, and motor frames to different M. & R. Shops, with the assembly responsibility being yours, and without warranty.

As we have learned the hard way, when a railroad motor shop rebuilds a traction motor using a rewound armature, reconditioned field coils and armature bearings from an outside repair shop, the supplier of these components will not accept warranty for a particular component failure because he did not perform the complete assembly and thus did not control the workmanship. Yet, the cost of warranty is priced into each of these products. Further, if this type of motor repair is considered on your property we recommend you specify the U.X. motor with *pinion applied* to minimize any debate relative to a warranty claim should a premature motor failure occur.

This managing of motor maintenance and repairs, when seriously pursued, will result in sizable savings to your company along with efficient utilization of manhours, material, and physical plant. That is "effective management".

During overhaul of traction motors, we recommend that all motors processed be upgraded to the latest manufacturing standards, but not necessarily the latest design.

The latest design is of course, highly desirable in that it adds flexibility to the motor pool by having one type of traction motor to handle all operating assignments; however, indiscriminate upgrading would *not* be considered effective managing.

It appears that a logical approach to repair and upgrading, would be:

1. Any new or rewound armatures are to be the latest design; however, their use must not be limited to applications in a motor of that design.

   As an example, a D-37 motor with qualified field coils, in a qualified frame can accept a D-77 armature.
2. Motor armature serial numbers, types and manufacturers must be immediately available through data processing or some other method to give shop management the means to identify a warranty claim, the armature age and mileage, and permit intelligent re-use of an armature.

   For example, how does one properly identify an EMD remanufactured D-77 armature by *visual reference alone?*
3. Motor field coil assemblies should be upgraded on a progressive basis, using failed coils as the basis on which to upgrade. A practical method is, in the event of a failed D-27 or D-37 field coil, to strip the motor frame of all coils. Those coils that qualify as good are held for re-use, to be "spotted in" to replace their failed counterparts. The stripped frame then receives the latest type coils.

   When an excess of a particular type of field coil accumulates, arrangements can be made with certain suppliers to exchange, say, four D-27 or D-37 No. 2 coils for a set of the latest type. This failure-generated management directed upgrading procedure results in maximum service received from materials bought and paid for.
4. Bearings must be considered in a

somewhat different light. Armature and field failures, while undesirable, can be tolerated. A bearing failure on the other hand can be a very destructive, expensive occurrence. Therefore, bearings must be of high quality, subject to thorough inspection and rejected if there is any question regarding their use. The manufacturer's specifications *must* be considered and the latest proven design should be standard.

Attention to detail, an open acceptance of innovative methods and persistent follow through will guarantee a level of performance commensurate with the state of the art.

2. **TRACTION GENERATORS.**

A. **AR-10 Performance Review.** Since May 1973, Electro-Motive Division has been installing the large bearing in a nickel plated hardened steel ring, and as of this date, the performance has been satisfactory.

The new large bearing can be applied in railroad shops that are equipped to bore the end bell. There are numerous older alternators still operating with the phenolic bearing housing *insert*. The committee recommendation of 1974 directing periodic inspection of bearing clearance is still a sound policy. Past experience indicates that the clearance between the bearing and seal approaches zero at the sixth year or 700,000 mile mark. Alternators operating with the phenolic sleeve bearing housing should be checked periodically by either the feeler gauge method or by placing a dial indicator on top of the slip-ring and raising the rotor with a jack; a sixty thousandths movement will condemn the bearing and the assembly must be changed out.

This latter method of checking the clearance eliminates the necessity of removing the slip rings to check the bearing clearance. During bearing renewal it is of the utmost importance that the bearing, cap, and cover be thoroughly packed with approved grease. The recommended amounts are 6 oz. for the bearing cap, 4 oz. in the bearing proper, and 6 oz. in the outer cover, a total of 16 oz. EMD maintenance instruction #3317 covers the proper method of grease application. We cannot over-stress the importance of packing the bearing rollers and the space between the two rows of rollers as covered in the instructions; of equal importance is the method of applying the grease in the cap and covers.

Any time the front covers are removed, exposing the diode panels, we recommend they be cleaned by blowing with dry air. If dirt accumulation cannot be removed with air, the panels should be removed and thoroughly cleaned by washing with a mild alkaline, which contains a water soluble oil solvent soap and a synthetic wetting agent, but no sodium hydroxide.

When diodes require replacement the committee recommends using the 2400 prv rated diodes in sets, because mixing of different types will cause unequal load sharing and premature failure.

When new diodes are applied, the mounting surface of the heat sink must be clean. Apply compound part #8346481 to the diode base, being careful not to get any of the compound on the diode threads and torque the diodes to 35 ft. lbs.

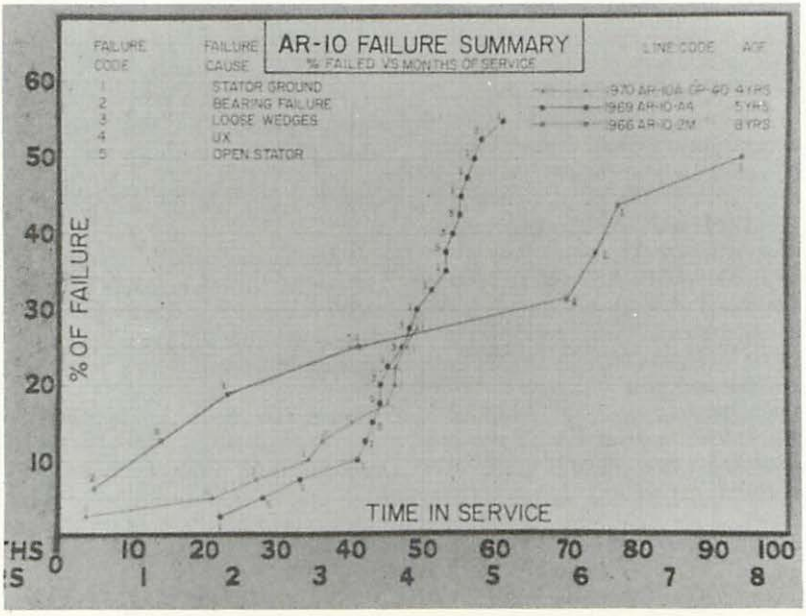
One railroad has a group of SD-40-2

locomotives operating with alternators equipped with a modified snow hood. This test hood has a ¾ in. hole in the lower left hand side, and a 5/8 in. hole in each top and bottom slip ring hinge inspection cover. This modification permits a through flow of cooling air from the AR-10 air box and should reduce the temperature in this location. To date, these units have performed very well and have been subjected to operations involving several snow storms with no negative effects.

After careful evaluation, it is the considered opinion of several members of this committee that reversing of slip ring polarity is not profitable and therefore should be discontinued.

Current production AR-10 machines are being supplied with slip rings having a spiral groove that should minimize selective action and improve overall reliability.

The AR-10 has left much to be desired. It is suggested that each road identify its AR-10 ownership by year purchased and graphically compare performance by months of service received, to time of failure by percent of ownership. This can be an effective management tool for decision making relative to establishing a unit exchange program that can result in thousands of dollars saved. Figure 1 is such a graph, from which it was decided to unit-exchange the remaining 31 AR-10 machines of this ownership, resulting in a minimum projected saving of $156,000 plus no unscheduled out of service time. Once again, this is *effective managing of the problem.*



B. **GTA-11 Performance Review.** Since our last reporting, there has been no new problem causing failures that would require removal of the alternator from the carbody. We are pleased to announce that GE has developed a new type of *diode protector* which mounts on the heat sink of each diode panel. It senses temperature rise, and in case of overheat will cause the engine to stop. This device will detect any type of ventilation failure, as well as single phasing.

Diode replacement on GE locomotives is somewhat different than on EMD's, since as GE recommends the diode be coated on the hexagon contact surface, and when placed in the heat sink, it must be screwed in and torqued to 25 ft. lbs., then backed out about one full turn and then again tightened to a value of 25 ft. lbs. This method is recommended to insure complete contact of the diode base with the heat sink to obtain optimum heat transfer.

With the advent of high horsepower locomotives, the cooling air for dissipating the I^2R losses within the traction generator or alternator is derived from the primary locomotive air filtration system. Therefore, to ensure an adequate air supply, we must maintain this filter system on the basis of manometer readings taken every 30 days, with a primary air filter cleaning frequency of no less than one year.

C. **Locomotives For Emergency Power.** In these days of energy crises, we would be remiss not to mention what several railroads have done during extended power outages. They have utilized the U-33 locomotive as an emergency power plant to supply fixed property power during outages, in order to keep the critical plant machinery and lighting in operation.

If your railroad is confronted with an extended power outage, for whatever reason, and you have GE locomotives in your ownership or available, the following locomotive set up pro-

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cedures are recommended for establishing a locomotive *back up* wayside system:

GEN. TYPE	POLES	60 CY. RPM	TH. SPEED	K.W.	MAX. AMPS
GTA-9	12	600	#3 Raised	400	1000 *
GTA-10	10	720	#4 Raised	900	1850 *

Set Generator Volts To 480. *Checked At 1080 K.V.A.

Figure 2 gives additional materials and procedures.

Figure 2: Operating a U-33 Locomotive in Standby Power Service.

A. **Materials Required**

The following listed material is for a-c standby service.

1 Simpson a-c voltmeter—volts 0-500, model 157, part number 9520

1 Simpson a-c ammeter — amperes 0-5 full scale, model 157, part number 2310

2 100 K, 2 watt carbon resistors

1 100 K, 3 watt rheostat, General Electric part number 41A 281081-10

1 Split core current transformer, General Electric type G-4 No. 7397965, Spec. 3195414, cycle 50-60, amperes 1000, 5 ratio 200

1 Single phase transformer .050 KVA, General Electric, volts 240-480 primary 120-240 secondary, part number 9T51Y2

1 Frequency meter—JBT Instrument Company, cycles 58-62, volts 100-130

B. **Locomotive Setup**

1. Install standby power cable sized to carry standby load. Connect to 1000 amp, 3-phase breaker or use 1000 amp line limiter fuses.
2. Connect 3-phase load leads to T1 - through 1000 amp to 5 amp current transformer and to T2 and T3 generator terminals. *Do not* remove rectifier panel leads. Connect ammeter to current transformer (See Dwg. 41B512456 Sec. 'C' 2.)
3. Connect 600-volt meter between terminals 2 and 3 at generator.
4. Install voltage control resistor 2-50K, 3-watt in series with 100 K, 3-watt potentiometer at 17FM50B3 exciter panel terminal strip, in series between GA wire and BE terminal — (See Dwg. 41B512456 Sec. 'C'2.)

4A. Remove YB wire from EXP-M terminal. Apply jumper between EXP-M to EXP-AF terminal. Insert 30-volt D.C. meter between EXP-M terminal + to YP wire negative. (See sec. D3 - dwg. 41B512456).

5. Move reverser to forward or reverse.
6. Cut out control air and drain system.
7. Remove EF 2-wire from reverser interlocks. (See dwg. 41B542456 sec. 3)
8. Start engine, warm up and set governor to Th. 4 for generator 5GTA9 600 rpm, and Th. 4 for generator 5GTA11 720 rpm. Raise or lower engine rpm at governor to required 60-cycle frequency by adjusting speeder nut.

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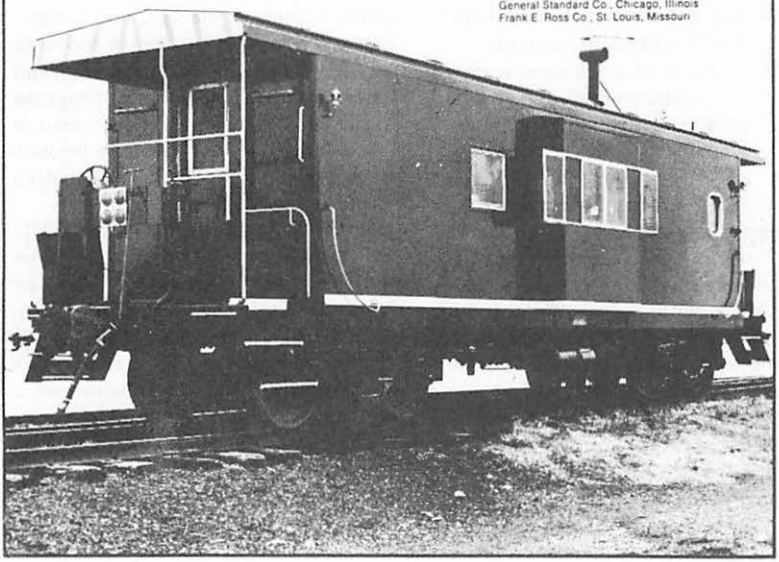


9. Close generator field switch and advance throttle to Th. 4 position.
10. Close GF switch and allow voltage to settle out and set look load pot to 480 volts. Switch 5 K resistors in or out, as required.
11. Check direction of frequency rotation as compared to load and reverse T1 and T3 leads if necessary.
12. Close load circuit switch and check amp and volt meters for load and voltage control.
13. Trim look load pot to 480 volts and check load current to insure generator not overloaded.
14. *Caution:* The diesel loading must be monitored for overloading. The governor will drive load pot to minimum field, but will not be able to unload generator. Any voltage on 30-volt load pot meter will indicate engine overload.
15. Governor load pot should operate in maximum position.
16. The use of a frequency meter is recommended and loss of frequency will indicate an overloaded unit.

In concluding our discussion on electrical rotating equipment we respectfully request that the locomotive builders continue their research and development programs, with the aim of adopting as standard such items as: the a-c 18 kw auxiliary generators; replacement of the dynamic brake blower motor with either an a-c motor or a duct-shutter arrangement utilizing the present a-c engine cooling water fan assembly; elimination of the d-c fuel pump motor through the use of a mechanical shaft; elimination of the air push, motor driven windshield wiper with an electric motor driven assembly; a redesign of all brush holders that will permit the use of shuntless brushes in all auxiliary rotating equipment; and finally a-c cab heater motors.

III. IMPROVEMENT IN MAINTENANCE OF TRANSMISSION CONTROL AND AUXILIARY EQUIPMENT, THROUGH TECHNOLOGICAL PROGRESS

1. **Transmission Control.** During the years when the F-7 and GP-9 locomotives were the mainstay of the U.S. and Canadian Railroads, the maintenance of transmission control and auxiliary equipment accounted for a major portion of our electrical maintenance man hours. Then along came the GP-30 and GP-35 locomotives, and shortly thereafter Mechanical department electrical supervision was confronted with maintenance problems that were at times almost insurmountable.

Finally, the builders and several of the railroads' engineering and maintenance personnel were able to reconcile the deficiencies of past systems and today, through technological progress we have the best electrical switch gear since the diesel electric locomotive became the principal motive power of the rail industry.

With the introduction of the EMD "-2" series locomotives, we believe that a very progressive step was taken through the design of multipoint, cam actuated, electrically motor driven switch gear. To date, this design has proven to be reliable and *is* reducing the cost of maintenance.

The new power contactors, with the arc directing coil as part of the main assembly, and *not* part of the arc chute, has reduced failures and thus has reduced maintenance costs; fur-

ther, the arc chute interlock designed to prevent pick up unless the arc chute was in proper position was a significant improvement in controlling the arc and resultant contact tip life.

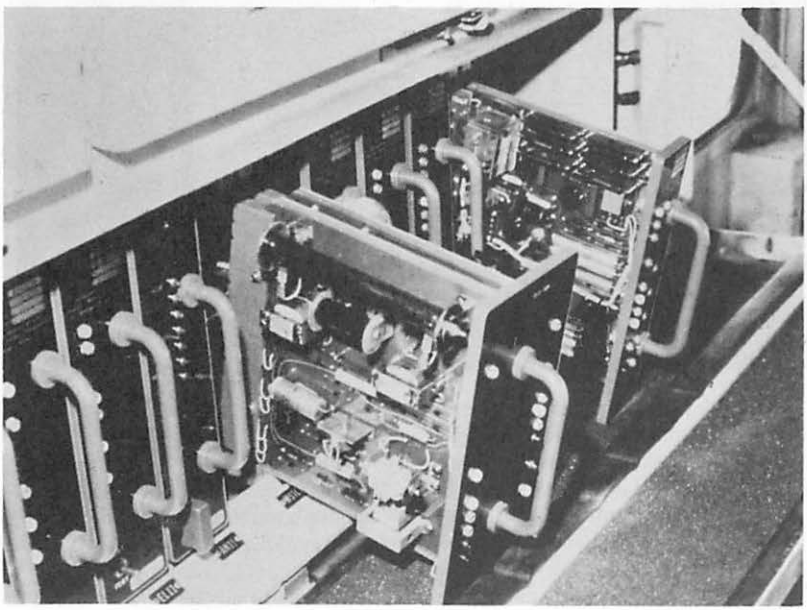
The modularized control system was another progressive step. To date it too has proven reliable and is contributing towards reduced maintenance costs.

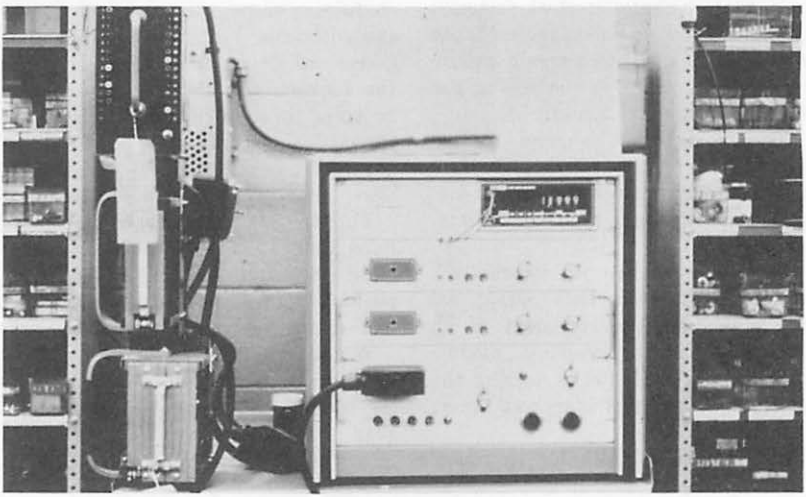
With many of the "-2" locomotives now out of the warranty period, we recommend the procurement of an Oregon Technical Products module tester, model 444, for evaluating the operational status of suspected defective cards.

If you find it profitable to repair modules in house, this tester can be an asset in determining circuit malfunctions; and if you unit-exchange with the builder, considerable money can be saved through verification, prior to forwarding. Further, the General Electric modules can be evaluated also.

The General Electric locomotives have always utilized multipoint, cam actuated switch gear; however, it is positioned through the use of an air push motor.

We recommend that consideration be given to eliminating the use of air for operation of all electric switch gear.





An inquiry covering the performance of the General Electric company's advanced excitation control system, known as "Chec" for Constant Horsepower Excitation Control, has brought a very favorable response. Approximately 200 units are in service on the U.S. and Canadian railroads and a performance record of 2 percent failure with components related to this system has been achieved to date.

The primary goal of this design was to achieve a significant gain in system reliability, along with simplification of maintenance.

A portable analyzer *Checkit* was

designed for use by the maintenance forces in diagnostic analysis of system functions. Checkit can also stimulate system signals so that faults can be pinpointed with the engine running (isolated), or shut down.

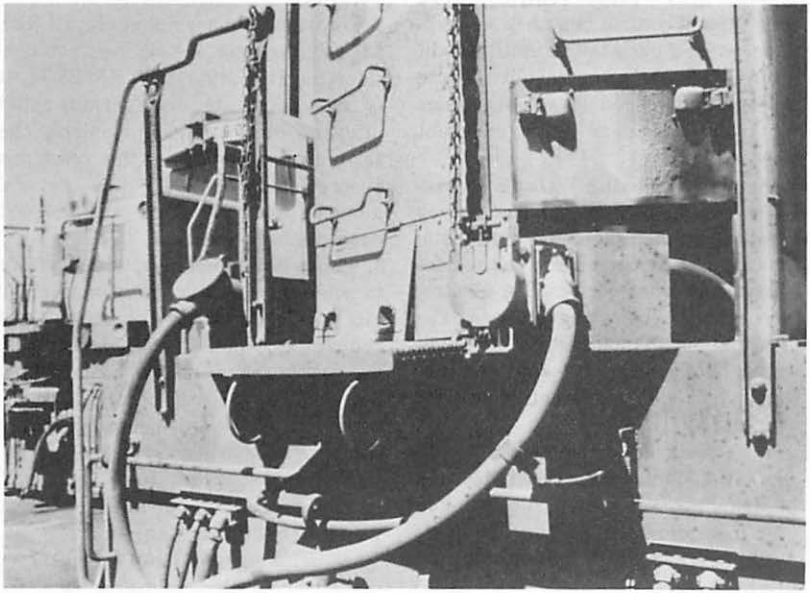
Turbocharger speed is measured by means of a magnetic probe. This signal is delivered to the Chec panel and is used to determine the correct fuel rate during throttle change. It provides prompt response with minimum smoke, and eliminates the need for having air biasing, thus simplifying the governor and trouble analysis.

2. **Auxiliary Equipment.** A new type of temperature control switch for cooling fan and shutter control applications has been adopted by the Union Pacific Railroad. The switch consists of a snap-acting bi-metalic wafer that operates a micro switch encapsulated in a metal tube, inserted into the medium being controlled.

The temperature settings are part of the manufacturing process and therefore are non-adjustable. These switches are interchangeable with the standard fan control switches. An operational test consists of raising the bulb temperature above the switch setting for a go-no-go test. Price is comparable to the earlier standard switches.

Prototype switches were tested in 1968. All four temperature switches were applied in five different EMD locomotive models in 1972, following single random test applications. To date, one switch has failed, due to grounding.

3. **Jumper Cables.** If your railroad is plagued with shortages of jumper cables at the various power distribution points throughout your system, or if you wish to minimize the cost of repairs to jumper cables, then we recommend an in-depth evaluation of a



system for attaching jumper cables permanently to each locomotive, as has been recently done on the Louisville & Nashville Railroad.

The cost involved in making this modification, or having it done in the case of new units, caused the L&N to look for a relatively inexpensive method of accomplishing a retrofit. It has applied to a locomotive a junction box with cable attached which was designed for L&N by the Power Parts Company. It can be applied to the existing MU receptacle and held in place by four long bolts. A regular jumper can be plugged into the front of the box if needed. Application time is less than one hour, including installation of a dummy receptacle. Every indication is that this concept will be very satisfactory.

4. **Radio Equipment.** Due to widespread abuse and loss, several railroads have adopted as standard "Handsetless" radio control heads. This type of control head has a microphone with a push-to-talk button built into the face of the control head. These systems have been in active service for over one year with excellent results.

5. **Sanitary Drinking Water Systems.** Here again, technology has solved another problem involving high maintenance and dissatisfaction on the part of our operating crews. The electromechanical coolers have been the principal means of chilling drinking water. While they have done the job, they have been extremely costly to maintain.

With today's stringent rules and regulations governing the dispensing of drinking water, we suggest you give consideration to the following system of chilling and dispensing drinking water.

It is a commercially available, 60 Hz a-c hermetically sealed refrigeration system that utilizes two 2½ gallon pre-packaged water cartons for dispensing water, and is built by the Oasis Company.

It is suggested that this system could eliminate ready-track servicing of water coolers through installing a spare container holder on board the unit. Then when the unit is dispatched off a 30-day card, the chilling compartment would be supplied with two containers, and four spare containers placed in reserve. Thus, when the active container became empty, the spare pre-chilled container would be activated and the empty container in the chilling compartment replaced with one from the reserve on-board storage.

Another a-c model that is on test, and to date doing very well, is being marketed by the Ajax Consolidated Company.

For units that are not equipped with a D-14 alternator, we suggest you consider the Dometic model RM-23-74. It is a solid state refrigerator that utilizes a 74-volt heating element. The refrigeration cycle is the ammonia absorption system. To date, several hundred are in service with a good performance record.

6. **Cabs - Personnel Supplies.** If we are to achieve a significant gain in clean cab profile, for our older power, and reduce the complaints received from the Brotherhood of Locomotive Engineers and state health inspectors, we *must* give consideration to the adoption of pre-packaged crew kits, covering personal supplies.

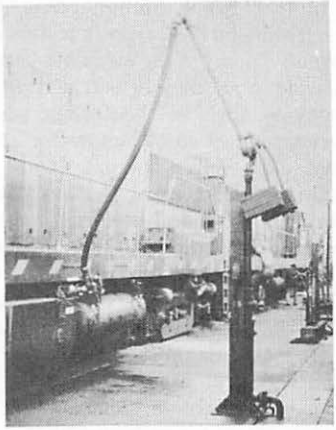
A typical cab, operating today, would be equipped with:

(a) drinking water cup dispenser
(b) Hand soap dispenser

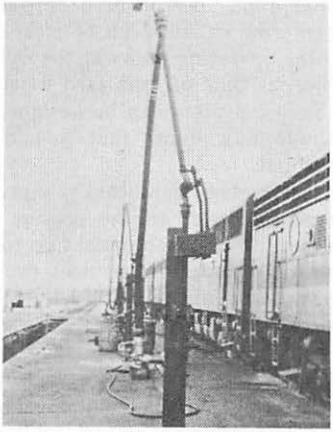
SNYDER DIESEL FUELING SYSTEMS

OPW AUTOMATIC DIESEL LOCOMOTIVE FUELING SYSTEM

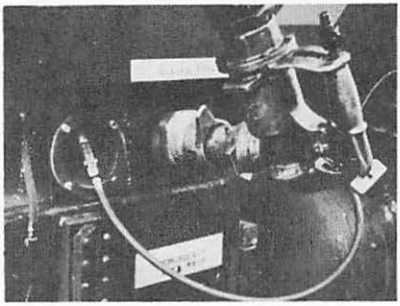
FOR SAFE, EFFICIENT DIESEL FUELING



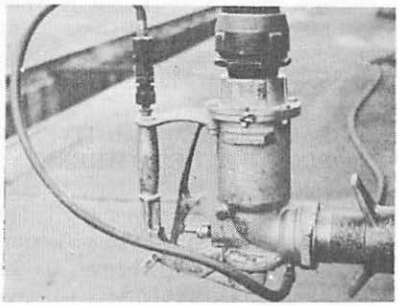
Snyder OPW 1620-DS Automatic Nozzle Fueling on Snyder No. 104-S-2½" Fuel Crane.



Snyder OPW 1620-DS-2½" Automatic Nozzle Secured to Snyder No. 104-S-2½" Fuel Crane.



Close-Up of Snyder OPW 1620-DS Automatic Nozzle in operation, with Snyder No. 565 Quarter Turn Fuel Quick Coupling Adaptor, connected to Standard Protectoseal Diesel Fuel Tank Fill Adaptor.



Close-Up of Snyder OPW 1620-DS Automatic Nozzle secured, with Snyder No. 565 Quick Coupling Fuel Adaptor to No. 104-S Fuel Crane.

The automatic diesel fueling installation pictured above increases safety and efficiency in fueling diesel locomotives because spillage of diesel fuel is eliminated, fire hazard minimized, and water is not contaminated by fuel spillage.

Efficiency is doubly increased because unattended fueling is possible with automatic shut-off nozzles. Maintenance costs are reduced because the fueling crane pulls the nozzle and hose up and out of the way, (the nozzle is secured to the fueling crane when not in use) which prevents it from swinging freely and being battered about.

The SNYDER COMPANY stands ready at all times to supply you with the equipment and systems that best meet your needs and to meet your exact engineering specifications. For further information on the 1620-DS Nozzle

Write or Call SNYDER COMPANY, 655 W. Pratt St., Baltimore, Md. 21201; Phone, Area Code 301, 539-4966

(c) Paper towel dispenser
(d) Toilet paper dispenser
(e) Trash bag.

We have a completely sanitized, waterproof, personalized pre-packaged crew kit, that can be picked up by the operating crews at the caller's office, at time of time card issuance.

Such a system can be designed to include any items that you deem essential.

This system significantly improves sanitation, removes the present dispensers that are potential hazards to the cab occupants, and does provide individual distribution directly to the users.

This committee recommends that you give the items we have discussed your most serious review. During heavy upgrading of units due either to scheduled class repairs or accident damage, you may well find it desirable and essential to retrofit these items. Doing so will help improve locomotive reliability and reduce maintenance costs.

IV. ELECTRIC LOCOMOTIVES — FROM WHERE TO WHERE?

Ironically the first electric traction in the United States was attributed, not to an electrician but to a Vermont blacksmith. In 1834 Thomas Davenport built a small battery-powered electric motor and with it operated a small car on a short oval section of track to demonstrate that electric traction was possible.

Most electric traction experimentation and development from that time until the 1880's was done in England and Europe, but in 1880 Thomas Edison built an electrically propelled car which could carry several people over tracks in which power was fed through the two rails, which were insulated from each other. Short circuits in wet weather and shocks to horses and pedestrians tended to reduce the popularity of this short electric railway.

In 1886 Frank Sprague electrified the Richmond (Va.) transit system and invented many of the elements used in electric and diesel-electric traction today — such as the trolley wheel, series connection of motors for starting, axle hung motors, and the multiple-unit control system. Later the Edison-General Electric Company bought out Sprague, and Thomson-Houston Company, his competitor, and began what is today the General Electric Transportation Department.

On main line railroads, electric traction was first used to eliminate the smoke menance in tunnels and terminals. The first such tunnel electrification and electric locomotive was in the Mount Royal tunnel on the Baltimore & Ohio Railroad in 1895. New York Central electrified the approaches to Grand Central Terminal in 1906.

The Illinois Central, New York Central, Reading, Pennsylvania, Long Island and New Haven railroads electrified commuter lines to eliminate the dirt and smoke problem and to give fast service.

The Milwaukee, Great Northern, Virginian and Norfolk & Western Electrified to expedite movement over heavy mountain grades.

In the 1930's the PRR started and completed its 11 kv 25 Hz electrification for heavy density through passenger and freight service. Because of the advent of the diesel electric locomotive in the 1940's this electrification is the only through main line electrification remaining in the United States.

Early electric locomotives were all of the direct current type, usually

with resistance control. With the development of the series a-c commutator type traction motor a number of electrifications were put in service at 11 kv 25 Hz, particularly the New Haven, PRR and Virginian. There was also some use of a-c electrification with motor-generator type locomotives.

The PRR class P5a and GG1 locomotives are typical of the a-c locomotives which used series a-c commutator type traction motors. Acceleration and horsepower output of these locomotives is controlled by varying the voltage on the traction motors through voltage taps on the secondary of the main transformer.

In 1949 a multiple-unit car on the PRR was equipped by Westinghouse with ignitron tube rectifiers to permit use of d-c traction motors in place of a-c series commutator motors. The successful operation of this car was the basis for all future rectifier locomotives and multiple-unit cars both on the PRR and elsewhere. Rectifiers enabled the efficient use of direct-current traction motors with the advantages of a-c for transmission and distribution of the catenary power. Unfortunately only the European and other foreign countries have made use of this breakthrough by adding many new miles of a-c electrification.

The New Haven, Virginian and PRR were the first to use these new rectifier type locomotives. The schematic of an E-44 power circuit shows this application of rectifiers. It also shows that transformer secondary voltage tapping was still maintained for control. A new step forward in reliability and lowered maintenance was taken when E-44 locomotives were equipped with silicone diode rectifiers to replace ignitron rectifier tubes.

A new step forward was taken in the mid 60's with the advent of 25 kv 60 Hz locomotives for the Muskingum Electric Railroad. These were the first locomotives operating on commercial frequency in the U.S. and also the first to use silicon controlled rectifiers in place of relying entirely on secondary voltage tapping for control.

This has been followed by the E60C Locomotive, a 50 kv 60 Hz locomotive for hauling coal on the Black Mesa and Lake Powell railroad, and the E60CP, a passenger locomotive for Amtrak which can operate on 12.5 and 25 kv 60 Hz as well as 11 kv 25 Hz. Both of these locomotives utilize silicon controlled rectifiers. The Amtrak electric locomotives are the first passenger electric locomotives built in the United States since the ignitron rectifier passenger units were placed in service on the New Haven in the mid 1950's.

Except for the first experimental ignitron rectifier locomotives built by Westinghouse-Baldwin in the early 1950's all modern-day electric locomotives have been built by the General Electric Company.

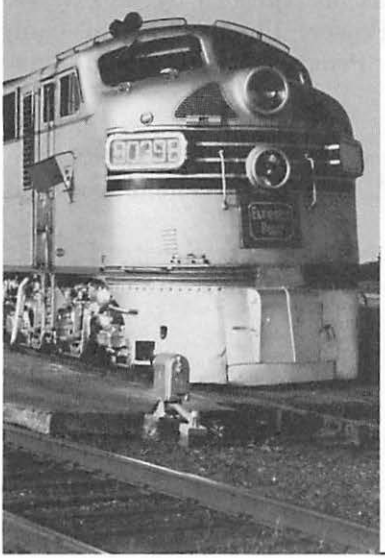
Now, for the first time, Electro-Motive Division of General Motors is entering the electric locomotive field with two new prototypes. The first, which was placed in demonstration service on the Penn Central in 1975, has 6000 diesel-equivalent horsepower and standard diesel-locomotive three-motor trucks with axle-hung traction motors. The second, which will go in service in early 1976, will be 10,000 diesel-equivalent horsepower and will have six truck-frame-mounted traction motors on three four-wheel trucks designed by ASEA and built by EMD.

Both of these locomotives will have full thyristor (silicon controlled rectifier) control and will have separately excited armatures and fields for the traction motors.

Electric locomotives have some definite advantages over other motive power such as diesel locomotives. They receive power from a large central supply so they can develop short time power far in excess of their rating to start heavy trains, accelerate rapidly, and negotiate steep grades. They are quiet and produce no smoke or fumes. Also, they have a long life with low maintenance and high availability. The disadvantages mainly are the high capital expense for the electrified system and the additional fixed plant maintenance, plus the loss of flexibility in yard and branch line service.

Modern, efficient electric locomotives are available. Are the American railroads prepared to put them in service?

It Takes A Company Like Sunoco To Help Keep A Railroad Like Yours Rolling



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Greater Kansas City Railway Club

J. I. PIKE
PRESIDENT
Shop Superintendent
Locomotive Department
Santa Fe Railway
Argentine, Kansas 66106

A Pre-Convention Presentation was made at our regular meeting in Overland Park, Kansas on April 25 by Mr. R. W. Leedy, Superintendent Motive Power, Illinois Central Gulf, Chicago, Illinois. His subject was: "Progressive Action on Maintenance and Ecology."

The members of this club sincerely thank Mr. Leedy, the members of his committee, and LMOA for the excellent program.

For full information as to membership in The Greater Kansas City Railway Club, and schedule of meetings, write to our Secretary-Treasurer.

S. A. BRISCOE
Secretary-Treasurer
Local Storekeeper
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P.O. Box 2351
Kansas City, Kansas 66110

Monday, September 15, 1975

2:30 P.M.

REPORT OF THE COMMITTEE ON DIESEL MECHANICAL MAINTENANCE

Pre-Convention Presentation: Greater Kansas City Railway Club

April 25, 1975 Glenwood Manor Motor Inn Kansas City, Kansas

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Supt. Motive Power,
Illinois Central Gulf Railroad,
233 North Michigan Avenue
Chicago, Illinois 60601

Vice Chairman

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W. M. Reed, Manager of Engines, Burlington Northern, Inc., 176 East 5th Street, St. Paul, Mn. 55101

1975 Topic:
"PROGRESSIVE ACTION ON MAINTENANCE AND ECOLOGY"

PERSONAL HISTORY
ROBERT W. LEEDY

Robert W. Leedy was born April 30, 1927 at Wilmar, California. He attended American Schools High School, Chicago, Illinois. Additional management training was taken thru the American Management Association, and he completed Electro-Motive Training Courses in 1948, 1957 and 1963.

Mr. Leedy joined the Illinois Central Railroad as a machinist in 1947; was promoted to Machinist Gang Foreman at Paducah in 1960. In 1963 he was made Assistant General Foreman, and in 1967 General Foreman. Since 1970 he has been Superintendent Motive Power.

He has been a member of the Locomotive Maintenance Officers Association since 1960.

Main outside interests are in the field of sports.

He married Dorothy Mae Woodyard, and they are the parents of three children.

The Leedys live in Richton Park, Illinois.

PROGRESSIVE ACTION ON MAINTENANCE AND ECOLOGY

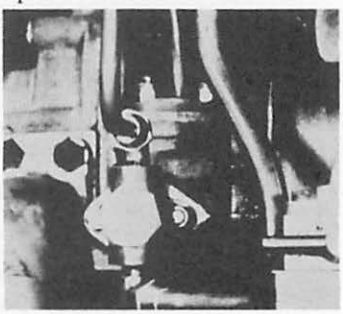
Engine Protective Devices

Of ten member roads submitting reports, all report using the following engine protective devices: low oil, low water, crankcase pressure, and hot engine protection. As these reports did not separate engines by builder, it is assumed that roads having a mixture of power have the same protection on all engines. In addition, five member roads report using the additional device of hot oil protection.

Following is a summary of engine protective devices offered by the locomotive manufacturers.

Electro-Motive Division reports that its engines are equipped with the following:

1. **Low Oil Pressure Shutdown** - The low oil pressure shutdown device is not an accessory to the engine, but is a component of the governor. Engines equipped with the electro-hydraulic speed control governors have the low oil pressure shutdown device as an integral part of the governor. The device will respond by shutting the engine down when a low oil condition is created. This can be caused by a true system low oil pressure, a positive crankcase pressure, low water supply or hot lube oil.
2. **Low Water And Crankcase Pressure Detector Assembly** - The low water and crankcase pressure detector assembly is a compact device for detecting loss of engine cooling water or lack of engine cooling as well as any change in the normal negative crankcase pressure to a positive pressure. If either of these conditions exist, the device will cause the engine to be shut down.
3. **Overspeed Trip** - An overspeed mechanism is provided as a safety feature to stop the injection of fuel into the cylinders should the engine speed become excessive.



4. **Hot Oil Shutdown** - The hot oil shutdown device will cause the engine to shutdown when oil temperature rises to 255° - 260° F.

This committee does not agree with EMD that the hot oil shutdown is necessary for all railroads.

In many cases, low oil pressure shutdown will take place with hot oil. In still other cases, low oil shutdown will take place with plugged turbo lube oil filters.

We recommend that with any hot oil shutdown device, maintenance people be told of any occurrence of a hot oil condition, but that the engine not be shut down automatically.

The "Engine Protective Features" plate, shown on next page, is applied to the electrical cabinet door in the cab of all EMD road locomotives.

Engine Systems Monitor

General-Electric states that recent extensive system performance tests conducted on four to five year old locomotives with the very fine cooperation of Southern Pacific reconfirm system performance and qualification data furnished in maintenance instructions. They also show the present system design provides adequate margins to operate with some degradation of system components. However, if degradation is substantial for an individual component or is additive as several system components suffer degradation, the effect on engine condition can be adverse. Further, the study team considered that for maximum over-the-road reliability and to avoid maintenance costs resulting from unnecessary shutdowns and for

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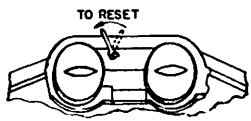
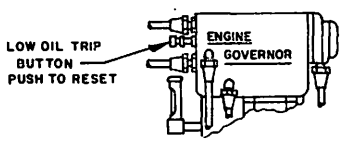
ENGINE PROTECTIVE FEATURES

ENGINE OVERSPEED TRIP
BLUE LIGHT & BELL



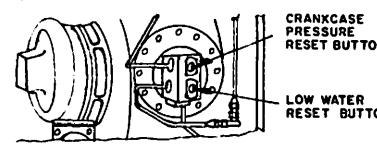
ENGINE WILL NOT START UNTIL OVERSPEED IS RESET. MOVE ISOLATION SWITCH TO START POSITION. START ENGINE IN NORMAL MANNER.

LOW LUBE OIL PRESSURE
YELLOW LIGHT & BLUE LIGHT & BELL



IF TRIPPED – RED BAND SHOWING – CHECK LOW WATER & CRANKCASE PRESSURE DETECTOR. CHECK LUBE OIL LEVEL AT DIP STICK. TO RESET – MOVE ISOLATION SWITCH TO START POSITION, PUSH IN LOW OIL TRIP BUTTON (ABOVE), START ENGINE IN NORMAL MANNER – IF SHUTDOWN REPEATS DO NOT RESTART ENGINE – DRAIN TO PREVENT FREEZING.

LOW WATER & CRANKCASE PRESSURE DETECTOR
YELLOW LIGHT & BLUE LIGHT AND BELL



CRANKCASE PRESSURE TRIPPED – RED BAND SHOWING – ISOLATE, DRAIN TO PREVENT FREEZING.

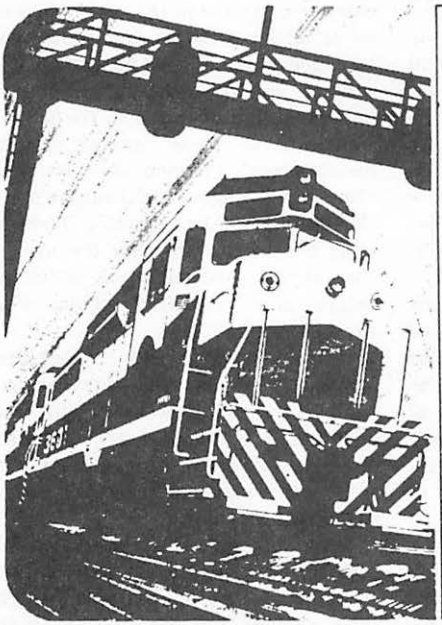
LOW WATER TRIPPED – RED BAND SHOWING – ISOLATE – CHECK WATER LEVEL. TO RESET PUSH RESET BUTTON AND OIL TRIP BUTTON ON GOVERNOR. START ENGINE – SEE PROCEDURE UNDER LOW OIL.

HOT ENGINE WARNING – RED LIGHT & BELL, CONTINUE OPERATION – MAX. POWER WILL BE REDUCED AUTOMATICALLY.

HOT ENGINE SHUTDOWN – RED, YELLOW & BLUE LIGHTS & BELL. ALLOW TO COOL. CHECK WATER LEVEL. RESET OIL TRIP BUTTON. START ENGINE – SEE PROCEDURE UNDER LOW OIL.

WARNING:

DO NOT UNDER ANY CIRCUMSTANCE REMOVE ENGINE OIL PAN COVERS, AIR BOX COVERS OR OPEN TOP DECK FOR AT LEAST TWO HOURS FOLLOWING AN EMERGENCY ENGINE SHUTDOWN.



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example, cold weather freeze-ups, the basic concept should be to keep the engine running, tailoring load and engine speed to system capabilities.

Following are highlights of the resulting engine system monitor which responds to both abnormal system oil and water pressures and temperatures and provides a logic guide for maintenance personnel in trouble-shooting a locomotive.

1. **Modulating Governor** - Provide continued operation at reduced speed and load under adverse oil or water pressure conditions. Provides ultimate engine shutdown in case of complete loss of oil or water pressure. Cranking is locked out if shutdown is due to complete loss of either.
2. **Lube Oil Temperature Switch** - Takes load or dynamic braking reduction action if oil temperature out of the engine reaches approximately 235°F. Engine continues to run at full speed and load is restored when oil cools to approximately 228°F. Braking is restored after going to "off."
3. **Hot Oil Temperature Switch** - Provides upper limit on oil temperature out of the engine, causes engine to unload and return to idle if oil out of engine reaches approximately 245°F. Loading is not reapplied if oil cools down.
4. **Hot Water Temperature Switch** - Provides upper limit on water temperature out of the engine, causes engine to unload and return to idle if water out of engine reaches approximately 235°F. Loading is not reapplied if water cools down.

Each of the above actions will cause mechanical latching relays to light individual red lights in the control compartment and in the case of loss of oil or water pressure and shutdown, reset for cranking must be made in the control compartment. Additionally, indicating lights located in the operator's cab will show "engine system maintenance", "engine over temperature" and/or "governor shutdown" as the case may be. Trouble-shooting logic is available through the use of the control compartment latching relays and associated lights. For example:

The foregoing devices are familiar to most of us; however, many of our enginemen and mechanics do not understand the importance of these devices or their function and it is our responsibility as maintenance officers to see that they do.

While this committee recognizes the present need for these devices, we recommend that all builders design their engines and systems so as to eliminate the need for so many devices that fail or shut engines down under adverse operating conditions.

We believe that each safety device should have a means, either mechanical or electrical, of indicating that the device had tripped, even though the problem no longer exists. Each device should permit manual resetting but we caution that the causes leading to the tripping of any protective device should be thoroughly investigated to prevent serious engine damage. Finally, to avoid serious problems with these devices and your engines, maintain clean water, fuel and lube oil systems.

Cleaning G-E Lube Oil Coolers

Most roads report removing the lube oil coolers, disassembling and cleaning in a caustic solution. One member road offers the following two procedures (both approved by G-E.):

OPERATOR'S CAB	CONTROL COMPARTMENT	
Indicating Light	**Indicating Light**	**Probable Cause**
Engine System Maintenance (Yellow)	LOP (Low Oil Pressure - Red)	(Engine will be running and may take full load. Indicates engine saw below normal oil pressure.) Check: Oil level, filter, filter tank drain back valve, relief valve, dirty oil side of lube oil cooler, electrical bogging or overloading, dirty crankcase strainer, governor.
Engine System Maintenance (Yellow)	LWP (Low Water Pressure - Red)	(Engine will be running and may take full load. Indicates engine saw below normal water pressure.) Check: Low water, system not pressurized, lube oil cooler plugged on waterside or water tank screen plugged, governor.
Engine System Maintenance (Yellow)	LOT (Lube Oil Temperature-Red)	(Engine will be running and may take full load. Indicates engine saw higher than normal oil temperature.) Check: Dirty radiators, plugged braking grid screens, excessive braking current, water temperature control, dirty lube oil cooler, failed fan drive.
Engine System Maintenance (Yellow) and Governor Shutdown (Yellow)	LOP (Red) and GSD (Governor Shutdown Red)	(Engine will be shut down and requires resetting in control compartment to crank.) Check: Severe conditions under LOP, failed bonded drive or lube oil pump, fuel filters.
Engine System Maintenance (Yellow) and Governor Shutdown (Yellow)	LWP (Red) and GSD (Governor Shutdown Red)	(Engine will be shut down and requires resetting in control compartment to crank.) Check: Severe conditions under LWP, failed water pump, fuel filters.

OPERATOR'S CAB	CONTROL COMPARTMENT	
Indicating Light	**Indicating Light**	**Probable Cause**
Engine Over Temperature (Red)	EOT (Engine Over Temperature -Red)	(Engine will be running at idle and won't load.) Check: Severe water oriented problems, turbos, LOT switch, cylinder air inlet port carbon.
Engine System Maintenance (Yellow) and Engine Over Temperature (Red)	LOT (Red) and EOT (Red)	(Engine will be running at idle and won't load.) Check: Severe conditions under LOT especially radiators, water temperature control.
Engine System Maintenance (Yellow)	LOP (Red) And LOT (Red)	(Engine will be running and may take full load.) Check: Lube oil relief valve, plugged lube oil cooler—oil side, filter tank drain back valve, partially failed bonded drive.
Engine System Maintenance (Yellow)	LWP (Red) and LOT (Red)	(Engine will be running and may take full load.) Check: Plugged lube oil cooler—water side.
Engine System Maintenance (Yellow) and Engine Over Temperature (Red)	(LWP (Red) and EOT (Red)	(Engine will be running at idle and won't load.) Check: Water level, system pressurization.

Cleaning The Cooler Removed From The Unit

1. Remove the oil cooler from locomotive but do not remove tube bundle from the housing.
2. **Clean The Water Side** After brushing off loose scale, use steam generator washing apparatus to circulate a solution of sulfamic acid from bottom to top of cooler tubes and return to steam generator washer supply tank for 2 hours. Remove head and examine tubes to see if clean. If not, repeat. If clean, circulate a solution containing 2 ounces of baking soda per gallon for 10 minutes to neutralize acid. Note: Some tubes may require rodding before acid cleaning is started. Sit cooler in vertical position with open end up and cover the tubes with water. Those which do not drain must be punched out with a rod before acid washing is started.

Sulfamic acid cleaner is to be used at the rate of 1/2 pound of cleaner per gallon of water. While this is a very comfortable acid to use, be sure that all precautions for handling strong acids are observed

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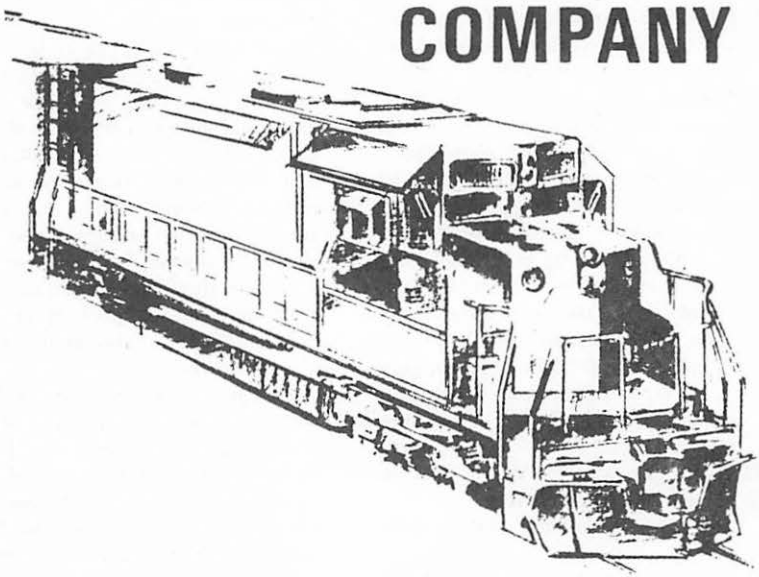

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such as face shield, rubber gloves and protective clothing. Baking soda can be used to neutralize spills or accidental contact with the acid.

3. **Clean The Oil Side** by removing tube bundle from housing and placing it in an agitating tank containing an approved cleaner. Agitate at least 8 hours, preferably overnight. Remove from cleaner, rinse thoroughly with hot water (inside and out) and inspect for cleanliness. Run a feeler gage between tubes to determine no stoppage exists on the oil side or clean the oil side of the tube bundle by immersion in a tank containing a cleaner to completely cover the tube bundle and allow to soak for at least 16 hours. Remove bundle, drain thoroughly to conserve cleaner and then clean with steam gun. Repeat if cleaning is not complete.

Cleaning The (Cooler) Water System In Place On The Locomotive

1. Drain engine cooling system completely.
2. Fill engine cooling system with untreated water; add solution containing 100 pounds of citric acid while system is being filled.
3. Start engine and bring up to temperature.
4. Run engine for approximately one hour and determine the free citric acid. This is done by observing the color of the acid solution circulating in the cooling system. When the color is yellow, green-yellow or has a slight brownish tinge it can be assumed to be still active. When the color of the solution is red-brown it is no longer effective and should be discarded. At this time system should be refilled with fresh acid solution and the circulation repeated. If solution in the cooling system is not red-brown the washing is complete at the end of an hour at operating temperature.
5. Drain out the acid solution, refill with fresh water, run engine for 15 minutes, drain and discard the rinse water.
6. Visual inspection of the system can now be made. A logical place to examine the system is the inlet side of the oil cooler and screen in water tank. If the surfaces are not rust and scale free, repeat the above procedure. When visually inspected surfaces are rust and scale free, the cleaning procedure need not be repeated. However, large pieces of scale may yet be present on the screen and these should be physically removed.
7. Recharge engine cooling system with fully *treated* water and bring engine up to temperature. It is very important to get *treated* water back into the engine cooling system as quickly as possible after acid cleaning to prevent rust formation.

NOTE: Be sure cooling systems do not contain oil or grease at time of citric acid cleaning. Derusting cannot be accomplished if surfaces are covered with oil.

If you are experiencing hot oil problems on G-E locomotives, this committee recommends that you clean the water cooling system by one of the above two methods.

To better understand the importance of a clean cooling system, we offer the following analysis from one railroad:

"Approximately 49% of the deposit material would be termed junk. This is, it consisted of solder chunks, burrs, turnings, chips, combustible material such as carbon, rubber slivers and the

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Nalco Waste Water Disposal Treatments	Formulations and "know-how" to help you improve waste treatment plant efficiency . . . sharply reduce sludge generation . . . increase capacity . . . meet stream pollution requirements. Consulting and analytical services help solve immediate and long-term problems.
Nalco Diesel Fuel Oil Treatments	Improve engine performance and minimize maintenance costs. Nalco's exclusive formulations control microbial and sludge formation for improved combustion.
Nalco Diesel Cooling Water Treatments	Wide selection of formulations to keep diesel cooling systems scale and corrosion free.

NALCO CHEMICAL COMPANY

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like. The remaining 51% would be considered as having come from the water or action of the water on the system materials or from water treatment material itself. For our particular consideration the important part is the 51%. Included in this half of the material was 30% which surely resulted from non-softened water and only 10% which resulted from corrosion (rust) of the system parts (tank or otherwise). The remaining material is a mixture of hard water scale and some silicates which we believe came from the water treatment material itself.

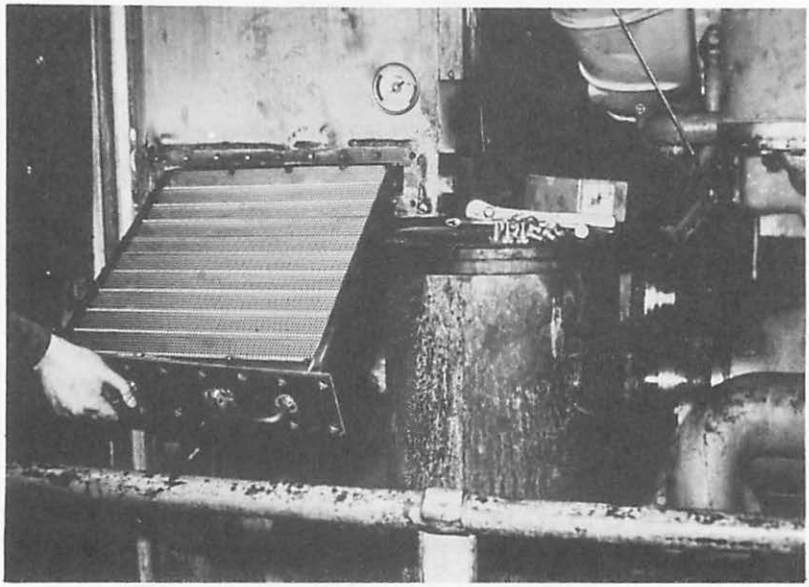
This distribution of water system deposits is grossly different than that observed in the severe problem that has plagued another railroad on their U30 locomotives. In the sample approximately 70% of the material was a form of iron oxide or, in other words, an iron corrosion product. Only 4% represented material that surely developed as a result of non-softened hard water."

Four roads have units equipped with the "top hat" screens with reports of 75% to 100% of the units equipped. One member notes that the cooler still must be removed to clean this type screen and that this also has its problems. Two roads are investigating the latest modification offered by the builder which has a removable screen without removing the cooler core.

This Committee feels this will extend lube oil cooler core removal cleaning time.

G-E Cooling System Improvements

1. General Electric offers improved stainless steel screening in water tank and over lube oil cooler, including a roll-out bubble screen for easy cleaning. Two modernization kits



...a phone call initiates

HULCHER *ACTION*

2:33 A.M.

HULCHER DISPATCHER CALLED

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3:12 A.M.

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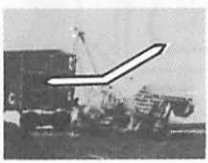
7:56 A.M.

HULCHER IS ON THE JOB

Removal of damaged cars from the right-of-way, transfer of lading ... whatever the problem, HULCHER experience soon has everything under control.

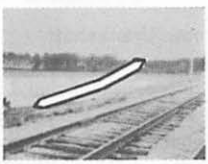
9:09 A.M.



PROGRESS REPORT

Anticipated time of job completion is reported to base to minimize time between clearing right-of-way and reopening line to normal traffic.

1:43 P.M.



JOB COMPLETE ... SITE RESTORED

Restoration of site includes cutting up and loading out of junked equipment in railroad cars and finish grade of affected area.

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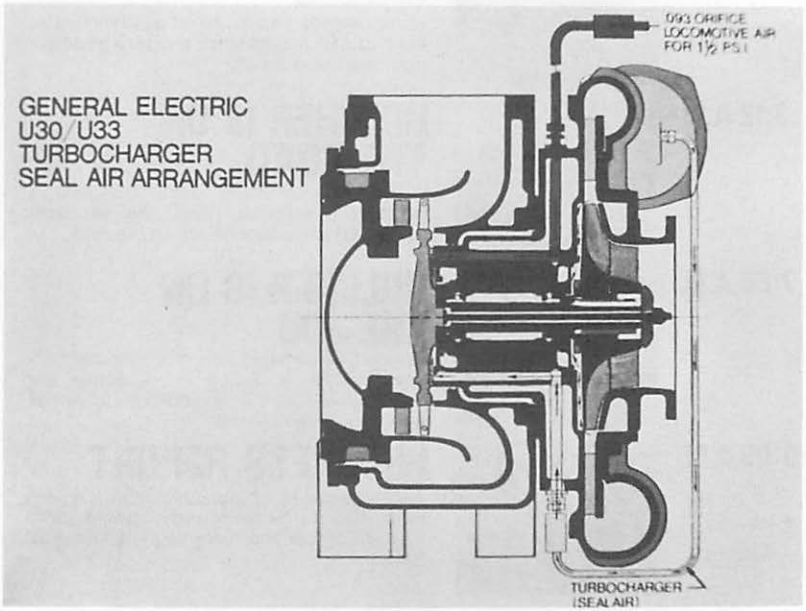
are available for retrofit—both provide a vee screen over the lube oil cooler.
2. Use of corten steel for the cooling water tank reduces rust formation.
3. Bolted-on water fill allows ease of replacement should fill cap sealing surfaces deteriorate. These surfaces are nickel plated and the bolt-on fill is retrofitable. Proper sealing is important in order to maintain system pressurization.

G-E Turbo Labyrinth Seal

Four member roads report that 5% to 20% of total turbo failures are caused by failure of the turbo labyrinth seal. One road attributes 60% of its failures to the labyrinth seal on one type turbo only. Another member relates 90% of these failures to this seal.

External seal air is provided to turbo oil seals on U30, U33 and U36 General Electric turbos. This seal air



is particularly effective at lower engine and turbo speeds when internally pressurized seal air is minimal. Existing turbos and locomotives can be modified through unit exchange service.

Reclaiming Diesel Pistons

Presently, EMD piston ring grooves are being reclaimed by at least four companies. Following is a brief summary of processes used.

Chrome Crankshaft

"Recent (within the past year) developments of hard chrome processes as applied to piston ring grooves and carrier pilots have proven successful. This slide shows the finished products with descriptive letters by this company.

If the pistons are removed from engines before wear progresses beyond EMD recommended limits the

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if you are among those who still think a speedometer is a speed indicator, look at the Mark IV

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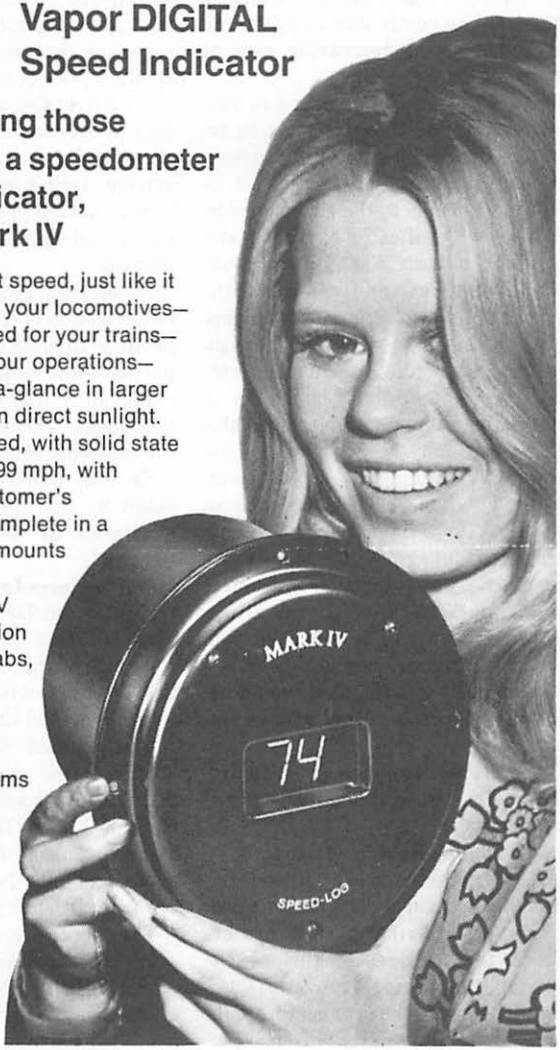

VAPOR CORPORATION
TRANSPORTATION SYSTEMS DIVISION

loading and consequent wear on the lower groove is very slight. The worn area is abrasively cleaned and treated to receive a chrome deposit. It is economically feasible to deposit up to approximately .020", beyond which it becomes more costly due to excessive tank times and a decreasing rate of deposit of chrome.

The groove has to be ground to size after plating and of course has to be straight. The upper side of the groove is also ground to ensure that it is absolutely parallel to the chromed side and within specifications. There are now approximately 3000 units operating in locomotives and tug boats without any failure. The main problems really pertain to excessive deposit requirements. From a technical viewpoint, .020" per side is good as a tentative maximum and therefore the piston can usually be restored. As an example, if the piston groove was "standard" when last installed and is worn say, .105", then the groove will be chromed and ground to "standard". If the groove was previously machined 1/32" oversize and is worn, say .015", then the groove will be chromed and ground to 1/32" oversize. This is because a deposit of .046" plus, would be required to restore the groove to standard.

The finished product is graphite coated and is boxed individually prior to shipment."

Triangle Engine Rebuilders, Inc.

"After extensive research and development by their company, worn and/or oversized ring grooves can be restored to standard dimensions by the installation of ring groove inserts. These inserts are heat treated steel, edge rolled into units of precise dimensions.

The piston ring groove is machined to receive these inserts in such a way that they become an integral part of the piston. They are inserted to remain static to the piston groove after installation. The inserts are manufactured in sufficient thickness to restore piston ring grooves to standard ring width dimensions even though previously machined to the second oversize and worn. The retention properties are built into the inserts and are further enhanced by groove configuration of their own special design produced on machinery tooled and equipped for this particular purpose.

After ring groove preparation the entire piston is treated by micro bead peening to assure removal of foreign particles and in preparation for application of a friction reducing surface treatment. The piston is returned to the customer ready for immediate use.

Several hundred have been processed by this method and are being evaluated by several railroad customers."

Metal Surfaces Inc.

"Metal surfaces have developed over the last 4 years a method of repairing worn ring grooves. They at first worked with hard chrome and fully developed that method.

The method finally developed as being best all around was nickel plating. During processing the part never exceeds 120°F. It is compatible with chrome rings and nickel is applied equally giving the same wear advantages to both faces of the groove.

The processing cycle is listed below:

1. Steam Clean
2. Blast Inside and Out
3. Record Serial Number, Check Ring Groove Sizes
4. Machine Groove Straight and Parallel

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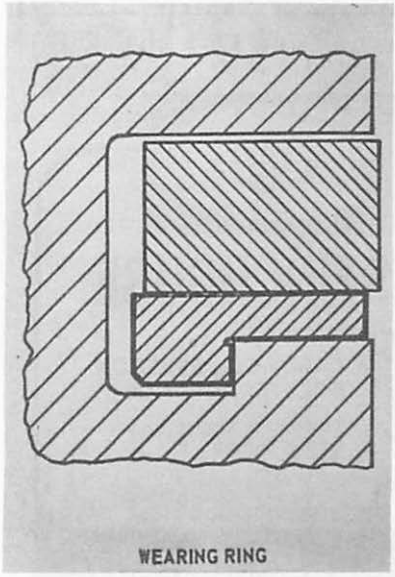
5. Magnetic Inspect
6. Mask Area Not Being Plated
7. Clean and Nickel Plate
8. Unmask Inspect
9. Grind To Standard Or 1/32 Oversize (Depending On Incoming Condition)
10. Inspect, Mark Piston With Actual Size and Ring Requirement
11. Dri Film Lube
12. Pack In Boxes, Crate and Ship Marking Outside Of Box With Piston Type, Size & Ring Requirement"

Koppers Company

"The wearing ring is used in conjunction with a compression ring. Its purpose is to reclaim pistons which have experienced side groove wear and to allow the use of standard width rings.



WEARING RING

The wearing ring has a rib on its lower side which fits into a recess in the lower side of the piston groove so that the wearing ring is restrained from springing out against the cylinder wall and is practically an integral part of the piston. The space between the upper side of the wearing ring and the upper side of the piston groove is equivalent to the original groove width, thus allowing the use of an original standard width ring which is free to spring outwards against the cylinder wall.

Side wear is kept to a minimum because the material used for the wearing ring is relatively hard, possessing unusually high tensile and impact strength and is extremely tough. It is hoped the wearing ring will ordinarily outlast several sets of piston rings. When necessary it may be replaced easily, eliminating the necessity of regrooving or replacing pistons."

Six member roads have had piston ring grooves reclaimed by chrome plating. All roads testing this process report inconclusive results as they have not been in service long enough to evaluate. One road is testing pistons with the ring grooves plated with nickel. These also have not been in service long enough to evaluate.

One road has reclaimed approximately 2,500 pistons by using Vacublast on the scuffed pistons and then polishing in a lathe. Results of this process have been good. Another road has polished 40 pistons in a lathe and knurled the scuffed area on an additional ten. Results of this process are inconclusive at this time. One member has had the skirts tin plated on four pistons but has not yet placed them in service.

This Committee believes that significant progress has been made in reclaiming worn piston ring grooves. However, these processes have not

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been tested for a long enough time to determine which is best suited for each railroad. Remembering the piston shortage we had in 1974, this Committee recommends that locomotive maintenance officers evaluate the economics of reclaiming EMD piston ring grooves as opposed to scrapping and buying new.

Diesel Piston Scrap Rate

With five roads reporting, there is considerable disagreement on piston problems. One member has an unusually high scrap rate for cracked or broken pistons. This member is currently conducting an in-depth investigation into its piston problem on low-horsepower locomotives. One road reports a high percentage of problems with scored or scuffed skirts. The remaining three roads report high scrap rates for worn ring grooves. These three roads do not indicate whether or not they reclaim worn grooves by machining to oversize or scrap at the first sign of wear.

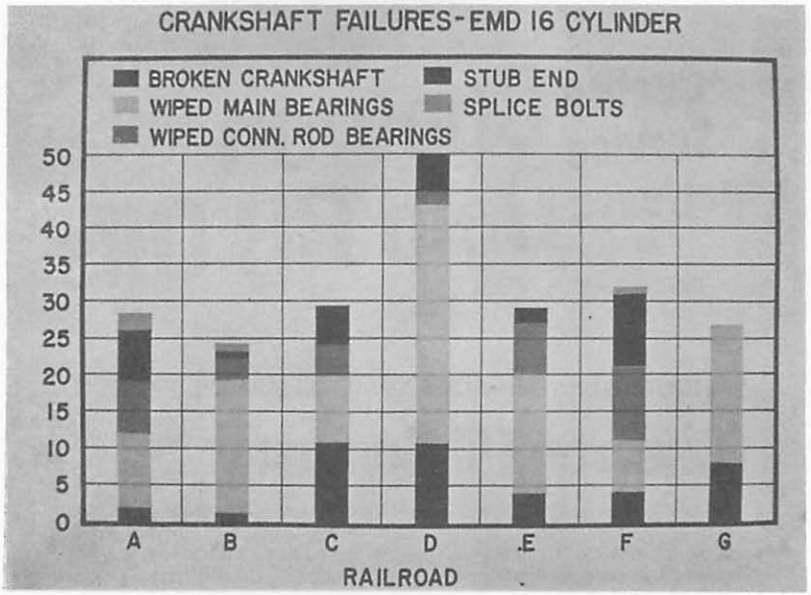
As you can see, the information we have is incomplete. This Committee will make an in-depth study into this problem next year.

Crankshaft Failures

Two member roads have a high number of broken crankshafts. All reporting roads have problems with EMD power on wiped main bearings.

Sixteen cylinder engines do not indicate any pattern where the break is likely to occur. There were, however, three reports of breaks occurring at the #9 main bearing. On twenty cylinder engines the breaks were reported as occurring at the #11 main bearing and the #10 connecting rod journal.

The contributing causes of crankshaft failures have been reported in



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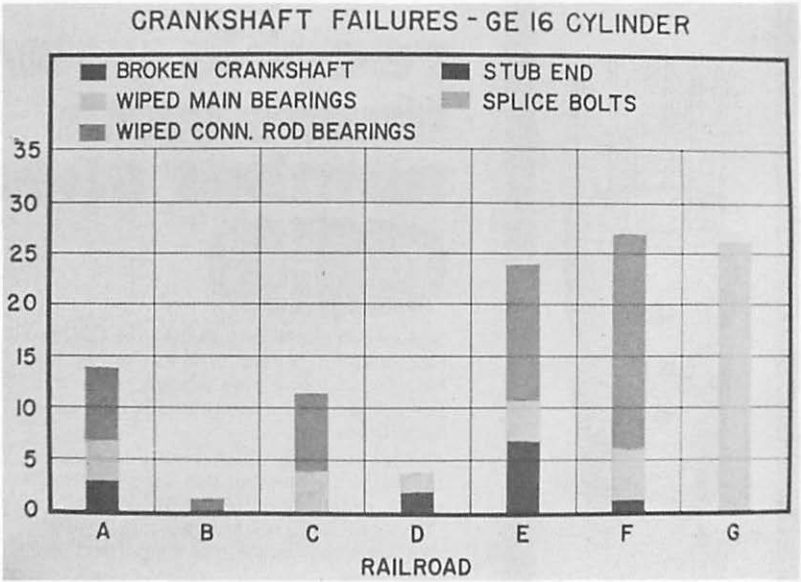

previous papers. This Committee can only point out the need to control water and fuel leaks as well as the importance of scheduled changes and proper torquing procedures.

Scored Liners EMD 645

EMD introduced the "L-2" cylinder liner in new locomotives effective January 1, 1972, as a step toward cleaner combustion for ecological reasons. After 8 to 12 months of service, several railroads had a severe cylinder liner scoring problem. Investigation indicated the problem was attributed to environmental influences.

During 1973, a series of changes were introduced to make the power assembly more tolerant of varying environmental influences. The changes involved top ring tip protrusion, reinstating "L1" liner profile, and the ring load pressure pattern changing from 19-25 psi to 18-24 psi. Effective January, 1974, the "L3" liner with the "L1" liner "Mae West" configuration and closely controlled 11/16" port width was introduced.

This slide shows an EMD study of power assembly scoring on original equipment "L2" liners delivered in 1972 compared to the same period for "L2" liners delivered in 1973. The chart also shows the status of scoring on "L3" liners delivered in 1973 and 1974.

This committee does not take exception to the information supplied by EMD. However, the member roads involved are not convinced that all environmental influences related to liner scoring have been resolved.

Exhaust Mufflers

Two roads reporting have tried mufflers (silencers). One of these roads has had an SD45 retrofitted by the builder but has not completed its evaluation. The other road has entered

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	1972 L-2 Liner		1973 L-2 Liner		1973 L-2SP Liner*		1974 L-3 Liner	
Railroad	Months	% Scored	Months	% Scored	Months	% Scored	Months	% Scored
A	21	73.7	21	4.5	0	0	7	0
B	15-20	45.0	15-20	27.0	16	2.0	5- 9	0.4
C	18	30.7	0	0	0	0	6	0
D	24	18.7	24	0.7	13	0	2	0
E	20	9.7	20	0.6	0	0	5- 6	0.2
All Others	25-36	0.1	13-24	0.2	12-15	0.3	1-12	0.2

*Same As L-3 Except Port Width 1-1/8"

into a test with EMD on three GP-38-2 locomotives without drawing any conclusions as yet. The same road has on order a prototype silencer for its lower horsepower locomotives.

According to EMD, "To date EMD is evaluating the performance of an EMD design turbo engine locomotive exhaust silencer on a total of five railroads (Amtrak, B.N., C&NW, D&RGW, and NWSTD). In addition, one other railroad (ICG) is participating in an EMD evaluation of an EMD design roots blown engine road locomotive exhaust spark arrester and silencer system.

Research and development of locomotive engine exhaust silencer hardware has been continuing for many years. Design requirements for suitable exhaust silencer hardware along with spark emission control to meet the needs of current production locomotives are quite extensive. Structural stability, special considerations, effects upon engine performance, and of course, noise reduction capability requirements, must all be met.

EMD's exhaust silencer development program has been based solely on EMD's own design with no other manufacturer's designs being evaluated. As part of the development program, locomotives have been equipped with silencers and are presently on test in field service.

EMD anticipates developments in locomotive noise reduction hardware which will satisfy the current E.P.A. proposed stationary locomotive sound level limit of 87 dba at 30 meters at any throttle setting."

According to G-E, "General Electric locomotives built since July, 1974 meet noise standards of 1975 and very nearly meet proposed 1978 standards. If the proposed 1978 standards become official, some muffling will be required. Development and testing work is under way for current production locomotives to design a muffler with minimum adverse effects on engine performance. The first factory applied muffler equipped locomotives will be in operation by third quarter 1975. We expect these locomotives to meet the proposed 1978 standards."

Several other companies are actively involved in research and design of exhaust mufflers and spark arrestors. This committee does not feel that sufficient time has elasped, on test models, to make a recommendation on muffler models.

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GOULD

Economics of 3-cylinder Versus 6-cylinder Air Compressors

Three member roads report that the three-cylinder air compressor is more economical than the six-cylinder. One member reports that the material and labor cost to repair three- versus six-cylinder compressors is approximately 65%.

The cost for a three-cylinder compressor is approximately 80% less than a six-cylinder compressor. The choice between the three- and six-cylinder compressor depends on the type of service the locomotive will be subjected to. The following factors should be considered when selecting a compressor to suit the operation:

1. The rate displacement of the 3-cylinder WBO compressor at 900 RPM is 253 CFM.
2. The rated displacement of the 6-cylinder WBG compressor at 900 RPM is 400 CFM.
3. Usable air delivery of a WBO compressor is 177 CFM compared to 280 CFM for a WBG compressor.
4. Maintenance cost for oil, material and labor is approximately 50% less on the WBO compressor than for a WBG compressor.

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After several failures with associated equipment, a Penn Central U33B has been running successfully on a field test since September, 1974. The associated problems were an oil cooler leak, loose coupling and loss of oil due to a cracked flare fitting. Capacity is 250 CFM at 140 PSI when running at 2500 RPM which is rated engine speed of 1050 RPM.

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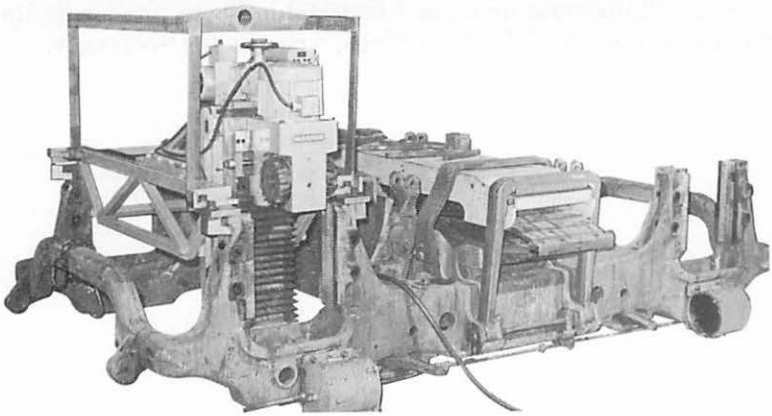

ST. LOUIS RAILWAY CLUB

D. HAMEL
PRESIDENT
Manager, St. Louis Refrig. Car
St. Louis, Missouri 63103

A Pre-Convention Presentation was made at our regular meeting in St. Louis, Missouri, On April 1 by Mr. N. E. Brightwell, Manager of Tests and Research, Rock Island Lines, Chicago, Illinois, and his Committee on Fuel & Lube Oil.

The members of this club sincerely thank Mr. Brightwell, the members of his committee, and the LMOA for the excellent program.

For full information as to membership in the St. Louis Railway Club, and schedule of meetings, write to our Secretary.

D. J. FAULKNER
Secretary
P.O. Box 818
St. Louis, Mo. 63188

Tuesday, September 16, 1975

9:00 A.M.
REPORT OF THE COMMITTEE ON FUEL AND LUBE OIL

Pre-Convention Presentation: St. Louis Railway Club
April 1, 1975, Stouffer's Riverfront Inn, St. Louis, Mo.

N. E. BRIGHTWELL, Chairman
Retired Manager of Tests and Research
Chicago, Rock Island & Pacific R.R.
Chicago, Ill. 60609

D. H. PROPP, Vice Chairman
Engineer of Tests
Burlington Northern Inc.
St. Paul, Mn. 55101

Committee Members

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R. A. Wolfe, Engineer of Tests, Reading Company, Reading, Pa. 19601

1975 TOPIC:
"PROGRESS IN FUEL AND LUBRICATING OIL TECHNOLOGY"

PERSONAL HISTORY OF
Newton E. Brightwell

Newton Edward Brightwell was born in Pine Bluff, Arkansas, on August 18, 1912.

He received the Bachelor of Science degree from the University of Central Arkansas in Conway in 1938 and subsequently attended courses in chemistry and math at the University of Arkansas in Fayetteville.

He started his career as a chemist in a cotton oil mill. After four years of active duty in the United States Army Chemical Warfare Service during World War II, he was employed by the Rock Island Railroad as a water chemist in 1947.

He was married to Alice May Ames of Saltsburg, Pennsylvania, on December 25, 1944. They have a married son, who received his PhD degree from the University of New Orleans on Dec. 20, 1974, and is now employed by a St. Louis chemical manufacturer. They have a married daughter who received her Master of Arts degree from the University of Illinois in June 1975.

Mr. Brightwell is a member of the American Chemical Society, the American Society for Testing and Materials, and the American Society of Lubrication Engineers. He was a charter member of the Midwest Society of Electron Microscopists. He has been Chairman of the National Association of Railway Engineers of Tests and has recently completed two years as Chairman of the National Railroad Lubrication Council.

At the time of retirement Mr. Brightwell was Manager of Tests and Research in the Mechanical Department of the Rock Island Railroad.

PERSONAL HISTORY
Dale H. Propp

Born in Clinton, Minnesota, October 23, 1935. Attended public schools and graduated from high school in Clinton, Minnesota.

In June 1957, graduated from Gustevus Adolphus College, St. Peter, Minnesota, with a Bachelor of Science Degree in Chemistry. Post-graduate studies included Physical Metallurgy, Environmental engineering, and Management courses at the University of Minnesota.

After graduation, began employment with the Northern Pacific Railroad in 1957, with the first assignment as Chemist in charge of oil laboratory development in Livingston, Montana. Served in the capacity of Assistant Chief Chemist with NP and merged BN Railroad. Became Engineer of Tests of Burlington Northern in August 1974.

Married, with one son and one daughter.

Active member of technical organizations: ASTM — American Society for Testing Materials; LMOA — Locomotive Maintenance Officers Association, presently Vice Chairman of the Lube & Fuel Oil Committee; NRLC — National Railroad Lubrication Council; ASLE — American Society of Lubrication Engineers; NARET — present Chairman - National Association of Railroad Engineers of Tests.

Other activities include, active member of Church Council, political organization, and community affairs (Boy Scout Commissioners Staff).

PROGRESS IN FUEL AND LUBE OIL TECHNOLOGY

INTRODUCTION

The Fuel & Lube Oil Committee last year assessed the problems arising from the decline of petroleum production. We concluded that shortages of energy and petroleum-derived materials will be a basic fact of life in the future.

This year's report covers progress made in adjusting to fuel and lubricant shortages. We examine possible future trends such as:

1. Increasing use of synthetic lubricants and additives to prolong lube oil life.
2. Improvements in interpretation and interchangeability of lubricant test data to reduce the number of needless oil changes.
3. Growing importance of rerefined lubricants and solvents and more frequent use in locomotives of fuel oil reclaimed from spillage.
4. Conservation of crankcase oil through improved engine design.
5. A standard LMOA lube oil test procedure.

I. SYNTHETIC AND HIGH VISCOSITY INDEX LUBRICATING OILS

Synthetic lubricating oils are produced in chemical plants by reacting two or more molecules to form a new substance. They are man made products. Building blocks are selected and joined by chemical synthesis to make a predetermined reaction product. By contrast, mineral lubricating oils are derived from naturally occurring crude petroleum by physical separation and refining.

Petroleum lubricants contain thousands of different hydrocarbon compounds that cannot readily be separated. Their physical properties and performance characteristics are, therefore, based on the average of all compounds present. If it were feasible to separate only the molecules of petroleum oil best suited for lubrication purposes, the resulting performance would be improved over petroleum lubricants currently being marketed.

Synthetic lubricating fluids on the other hand, have been tailored to provide special physical and chemical properties required to meet broad temperature extremes, oxidizing conditions and various other hostile environments. Synthetic fluids have been used for several years to fulfill certain specialized lubrication roles.

Typical properties of the most common synthetic lubricating base oils appear in Table I along with those of mineral (petroleum) oil.

Specialized Synthetic Lubricants

The polyalkylene glycol fluids, also called polyglycol ethers, are used extensively as brake fluid and, when mixed with water, fire-resistant hydraulic fluids. They have good compatibility with rubber parts. Water is soluble in the polyglycols which reduces the hazard of free water freezing in hydraulic brake systems. The polyglycols do not have the balanced properties desirable of the base oils for engine lubrication. Engine-oil additives are poorly soluble in polyglycols and the polyglycols do not mix with petroleum oils.

A polyglycol-base automotive engine oil was introduced commercially during the early 1950's. It was not a commercial success because of its high cost and lack of anti-rust protection.

Silicone fluids exhibit superior high temperature stability, viscosity properties and low volatility. Their lubricating performance in highly loaded

TABLE 1 - RELATIVE PERFORMANCE OF SYNTHETIC FLUIDS AND MINERAL OILS FOR AUTOMOTIVE ENGINE OIL APPLICATION

Typical Properties	Typical Mineral Oil	Synthesized HC Oil	Dibasic Acid Ester (Type I)	Hindered Poloyol Ester (Type II)	Polyalkylene Glycol	Phosphate Esters	Dialkylated (C12) Benzene	Silicone Fluid
Viscosity-temperature properties	Fair	Good	Very Good	Good	Good	Poor	Fair	Excellent
Low-temperature fluidity, low pour point	Poor	Good	Good	Good	Good	Fair	Good	Good
High-temperature oxidation resistance with inhibitors present	Fair	Very Good	Very Good	Excellent	Poor	Fair	Fair	Good
Compatibility with mineral oils	—	Excellent	Good	Fair	Poor	Fair	Excellent	Poor
Low volatility	Fair	Excellent	Excellent	Excellent	Good	Good	Good	Good
Effect on most paints and finishes	None	None	Slight	Moderate	Moderate	Considerable	None	Slight
Stability in presence of water	Excellent	Excellent	Fair	Fair	Good	Fair	Excellent	Good
Antirust properties in presence of inhibitor	Excellent	Excellent	Fair	Fair	Good	Fair	Excellent	Good
Engine oil additive solubility	Excellent	Excellent	Good	Fair	Fair	Good	Excellent	Poor
Elastomer swelling tendency—buna rubber	Light	Nil	Moderate	High	Light	High	Light	Light

Source: SAE Paper No. 74012, Authors: Miller, Rogers, Smith & Trautwein.

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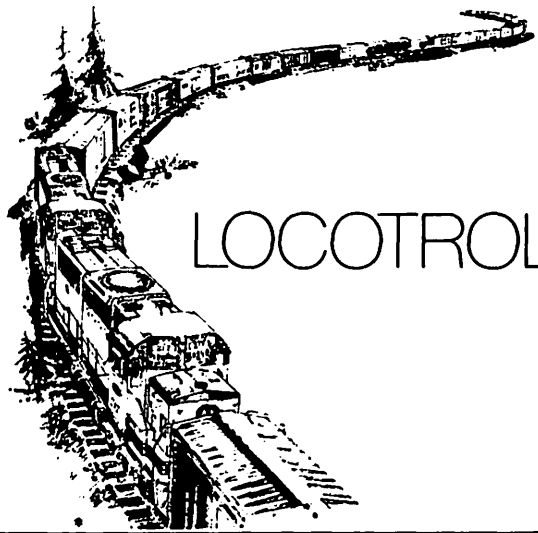

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steel on steel sliding systems is poor, allowing scuffing to occur. Engine oil additives are not soluble in silicone fluids and neither do they mix with petroleum oils. They perform best in high temperature, light load applications where petroleum oils are inadequate. Silicones have proved to be good lubricants for antifriction bearings and satisfactory lubricants for gears that are designed primarily for rolling contact such as spur gears.

Phosphate esters are known for their fire-resistant properties. They are used to lubricate high-pressure air and oxygen compressors where petroleum lubricants present a fire hazard. They are also used in hydraulic systems where leaking fluid, if ignited, could cause danger to personnel and damage to equipment. Fire-resistant hydraulic fluids find a good application in mines and in die casting operations. Phosphate ester hydraulic fluids are used in commercial aircraft where passenger safety is of prime importance.

Phosphate esters have poor temperature - viscosity properties and they damage the common rubber seal materials. Their compatibility with petroleum oils is not good.

Hindered polyol esters have excellent high temperature oxidation and thermal stability when properly inhibited. They can perform well as lubricants at temperatures 150° to 200°F higher than the best petroleum lubricants. Lubricants used in the latest aircraft gas turbine engines are compounded from the polyol esters. One important disadvantage is their high seal swell property. Engines lubricated with polyol esters must be equipped with viton (fluorocarbon) seals.

In order for a synthetic lubricant to find broad application in the railroad industry, it must be compatible with petroleum-base oils and it must not damage seals (or other components) in existing machinery. Only diesters, synthetic hydrocarbons and alkylated benzene meet these requirements. Alkylated benzene is a hydrocarbon and will be referred to as such along with other synthetic hydrocarbons. All of the synthetic engine oils being marketed or under develpment today are based on these two types of synthetic-base oils.

The diesters have been on the scene for many years, being developed in Germany during World War II. They outperform petroleum base oils in the following areas:

1. Better temperature/viscosity characteristics (V.I. ranges from 125 to over 200, averaging about 150 for diesters used in motor oils).
2. Improved oxidation and thermal stability when properly inhibited.
3. Lower volatility for a given viscosity.
4. Superior low temperature fluidity (pour points in the range of —50 to —90°F).
5. Natural solvency power that helps keep engines clean.

Diesters respond well to additive treatment. However, they are different in molecular structure from petroleum oils and, therefore, may not respond to the commonly used additives in the same way. New additive technology is needed in compounding diester-base oils if their full potential is to be realized.

Diester lubricants will survive in higher temperature environments than petroleum oil. During development after World War II of the aircraft turbine engine, it became

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apparent that petroleum oil did not have the thermal and oxidation stability necessary to provide adequate lubrication and satisfactory oil change interval. Neither did petroleum oils have low temperature fluidity to allow starting in cold weather. Diester-base oils were adopted; they served the aircraft gas turbine operators well through the mid 1960's (Type 1). At that time, a change was made to polyol ester oils for the second generation gas turbines (Type 2).

Good performance in gas turbine engines cannot be translated directly into good performance in internal combustion engines. The two applications are quite different. Aircraft gas turbines are equipped with all antifriction bearings, they have no sliding parts and they do not contaminate the lube oil with combustion products. Internal combustion engines require good oil performance in the last two areas. Just as it was possible to compound a better gas turbine lubricant using diesters, it may also be possible to blend better engine oils with diesters, provided the proper additive balance is achieved. This improvement can only be achieved at much higher cost — from 5 to 10 times higher than petroleum oils.

Synthetic hydrocarbons consist of hydrogen and carbon only. In this regard they are like the petroleum oils. Whereas petroleum oils contain small amounts of other elements such as sulfur and nitrogen that can have an adverse performance effect, synthetic hydrocarbons have none of these. Because of their molecular similarity, synthetic hydrocarbons have been called "Synthetic petroleum oil." Only those end products are synthesized that have physical characteristics better than petroleum oil.

Synthetic hydrocarbons used in oils today are either polymerized olefins or alkylated benzene. These materials perform better than petroleum oils in the first four categories listed under diesters. Their natural solvency power may not be as good as for the diesters, but existing oil additives perform better in synthetic hydrocarbons than in diesters. The synthetic hydrocarbon oils benefit from the vast additive technology developed with petroleum oils.

Cold Weather Performance

Synthetic lubricants possess excellent low-temperature fluidity and viscosity properties. Engine cranking can be accomplished with synthetics 20-30°F lower than for petroleum oils. Claims are made by synthetic oil suppliers that diesel engines can be started at —50°F. For vehicles to operate at this temperature, they must be completely winterized. Synthetic gear oils or other low temperature performers must be used in transmissions and differentials to prevent damage. Low-temperature oil or grease must be used in such applications as wheel bearings, water pumps, alternators, starter motors, etc., to insure proper lubrication. Diesel fuel will not auto-ignite at temperatures below about 20°F (including kerosene or jet fuel), thus starting aids must be used at the lower temperatures. Providing attention is given to the lubrication requirements of the entire vehicle, synthetic oils can provide for machinery performance down to the level of human tolerance.

Theoretically, it is possible to make diesters in the SAE 40 viscosity range. Practically speaking, diesters in the high viscosity range are extremely expensive and scarce. Another dis-

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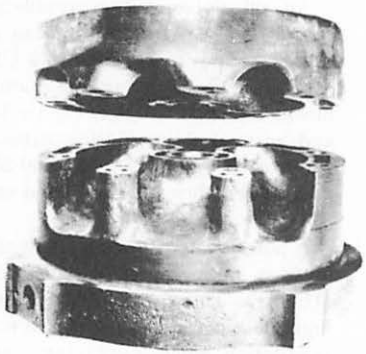

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advantage is that the solubility of the common oil additives decreases as viscosity (molecular weight) of the diester increases. The diester-base oils marketed today are made of lower viscosity stocks to which viscosity index improvers are added.

In addition to imparting better viscosity-temperature properties, some viscosity index improvers have a tendency to limit heavy duty diesel performance. Development of multigrade heavy duty (diesel) engine oils from petroleum has been very difficult. The use of synthetic-base oils should make this easier. Synthetic oils have been formulated that pass MIL-L-2104C, Mack T-1 and API Classification SE Tests.

Oil Consumption

For a given viscosity, synthetic lubricants have lower volatility than petroleum oils. Synthetics consist of a narrow range of molecular species having neither low boiling or high boiling components in comparison with petroleum oils. Thus, synthetics are subject to less volatility loss in hot service than petroleum oils. Loss of volatiles from petroleum oils result in thickening that occurs to a much smaller extent in synthetics. Volatility loss is particularly noticeable in winter grade oils. A 5W/20 viscosity petroleum oil is made of a light, volatile lube fraction that tends to evaporate rapidly from cylinder walls once the engine warms up. By comparison, a 5W/20 synthetic has volatility properties more like an SAE 20W/20 viscosity mineral oil. So, in addition to lower oil consumption, the synthetics can provide a thicker oil film in upper cylinders.

High-Temperature Performance

Due to their better high-temperature oxidation and thermal stability, synthetics can perform at temperatures about 100°F higher than petroleum oils. As engine output continues to increase, peak oil temperature will go up proportionally. Certain specialized engine and compressor applications already require synthetics to achieve peak performance.

An oil deterioration problem occurred in the Army's Sheridan tank. This vehicle is powered with a DDAD 6V-53T engine having an aluminum block. Its small engine compartment and restricted ventilation caused oil temperature to rise to 300-350°F. Synthetic lubricants are used in this application.

A potential application for synthetic oil is in air compressors installed in MU cars. These compressors have a high load factor and restricted cooling ventilation which overstress conventional oils.

Engine Cleanliness

Diester lubricants have unusual solvency power and the capability to keep dirt in suspension. Diesters are reported to hold five times the quantity of pentane insolubles compared to petroleum oil and still keep engines clean. The synthetic hydrocarbons are superior to petroleum oils in their ability to maintain clean engines in that they are more chemically stable.

Longer Oil Life

Some marketers of synthetics make claims for very long oil change intervals in the range of 20,000 to 50,000 miles in passenger cars and 50,000 miles in diesel trucks. These claims are being used by some to solicit sales of oils for locomotives. Long drain interval is already being practiced in locomotive engines. Certainly, synthetics have properties that

will allow compounding of lubricants capable of long oil life. However, synthetic oil marketers are hampered in oil development and marketing by the lack of recognized laboratory engine tests that define long drain performance. Insufficient experience has been compiled with synthetics to correlate their performance in the standard test engines with field performance. Ideally, engine tests should be developed specifically for synthetic lubricants.

One synthetic oil marketer has used an automotive additive package in a diester base to achieve API SE performance. Only extended use in automobile engines will reveal how this product compares with petroleum base SE oils. Some synthetic oil developers are resorting to double or triple tests to allegedly prove the superiority of their products.

Synthetic lubricants have been used in automotive engines a relatively short time. Much more field experience will be necessary to establish their performance quality. This fact is reflected in General Motors' policy regarding synthetic lubricating oils. Following is a quotation from a Buick Dealer Information Bulletin.

> "The recommended oil change interval for normal service for 1974 model GM cars is 4 months or 6,000 miles, whichever comes first. With the required use of unleaded gasoline in 1975 cars, the interval has been increased to 6 months or 7,500 miles. These intervals apply to any SE engine oil, conventional or synthetic.
>
> "Information currently available on synthetic oils does *not* justify any additional lengthening of the oil change intervals. Any engine part failures caused by use of an oil beyond the recommended change intervals *will not* be covered under the New Vehicle Warranty."

The policy of other U.S. auto makers coincides with GM's in that they require the same oil drain interval for both conventional and synthetic engine oils.

Synthetic lubricants have been used in Detroit Diesel Allison Division engines operated both in high and low temperature extremes. Yet DDAD maintains a cautious attitude in regard to the use of synthetics in its engines. Its latest lube oil specification makes the following statement:

> "The lubricants that have shown the best performance when subjected to Method 354 evaluation may be described as multigrades having a synthetic base stock and low volatility characteristics. These lubricants are not comparable to the performance of SAE 30 or 40 oils after the engine has started and is operating at elevated engine temperature conditions. For this reason, MIL-L-46167 lubricants should be considered only as a last resort when engine cranking is a severe problem and auxiliary heating aids are not available."

A well publicized test of a synthetic diester-base API SE oil was run in the cars of the Houston Police Department. A second test of synthetic oil is underway in Philadelphia police cars. In the Houston test, 19 vehicles ran without oil changes for mileages ranging from 20,000 to 45,000. The test was terminated and synthetics are no longer being used.

Little documented information is available from the Houston test. None of the cars were reported to have

failed or suffered any engine damage. Parts removed from one engine after more than 25,000 miles operation without oil change are available for inspection. These parts are clean and appear to be normal for this short period of service.

In mid-1974, a lubricant made from blended diester and petroleum-base oils was introduced into a rebuilt 16 cylinder EMD 645 Roots blown engine in a Mississippi River towboat. This product is being compared with a conventional railroad locomotive engine oil. After 3,300 hours of operation, one power assembly was pulled from each engine for comparison.

Cleanliness of the two engines was reported to be about the same. Use of the synthetic blend caused no apparent distress of the silver trunnion bearing. The only definite thing that is now claimed in favor of the synthetic blend is that lower consumption results from its use in non-turbocharged engines. Consumption in the engine using the synthetic blend is reported to be about one-half the consumption in the engine using petroleum oil.

The synthetic - petroleum blended oil was developed at the request of a customer. No guarantees were made regarding performance in EMD engines. The oil was not subjected to the normal screening tests as required by EMD. Base number of the lubricant is in the 10-11 range and its V.I. is 75.

After satisfactory performance was established in the normally aspirated 645 engine, the oil was put into six other EMD engines, two of which are turbocharged 567 models. Oil consumption in the turbocharged engines is reported to be the same as that of petroleum oil.

Synthetic hydrocarbons and diesters can be blended with petroleum bases to achieve improved viscosity and low-temperature fluidity. However, engine cleanliness performance will improve little or not at all unless a substantial part of the base oil is synthetic. Multi-viscosity lubricants can be compounded by adding some synthetic-base oil along with a small quantity of viscosity index improver to petroleum oil. Twenty percent synthetic oil in petroleum oil increases cost by a factor of 2 or 3. It is believed that greater than 20 percent would be required to achieve appreciably cleaner engines.

Re-refining of synthetics may become attractive if their usage expands, although none are re-refined at present. The synthetic hydrocarbons respond to the same re-refining technique as petroleum oil. New procedures may have to be developed for reclaiming of diesters, however.

Raw materials used in the manufacture of synthetic lubricants come from petroleum, animal fats and vegetable oils. Other sources of organic matter, such as coal derivatives, are also potential raw materials. Currently, petroleum products constitute the largest single source of raw materials. As demand for synthetic lubricants increases, petroleum will supply an increasing portion of the raw materials. This is owing to the much larger quantity of petroleum, coupled with the fact that fats and oils can be used for food. Coal could evolve into the major source of raw materials as petroleum supplies dwindle.

The use of synthetic lubricants will not extend our petroleum supplies since the raw materials from which synthetics are made come largely from petroleum. While well compounded synthetics may last longer in

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service than petroleum-base oils, this is offset by the larger energy requirement to manufacture synthetics.

Ester-based lubricants will hydrolyze to some degree in the presence of water and high temperature to form organic acids and alcohols. However, hydrolysis has not been a problem in field service. Certain additives are used that reduce the rate of hydrolysis of esters in the presence of water. Ester-based lubricants have been marketed commercially in cold climates for use in diesel equipment and passenger cars for the last few years. Engine problems caused by hydrolysis have not been reported. What effects water leaks in a locomotive engine would have on an ester-type oil can only be evaluated through field experience.

Rest assured, synthetic lubricants will not replace petroleum lubricants in the near future. In the majority of applications, petroleum-base oils are completely satisfactory at much lower cost. Rather, synthetics are going to complement petroleum oils in some severe applications where the latter cannot provide adequate performance. At this time, no synthetic oil has been authorized by the locomotive engine manufacturers. In the final analysis, each operator must decide for himself whether the higher cost of synthetic oils can be justified by the performance benefits they provide.

Medium Viscosity Index Oil

Viscosity index (V.I.) relates to the viscosity/temperature characteristics of a liquid. Higher V.I. fluids change viscosity less with change in temperature than lower V.I. fluids. Carbonaceous deposits resulting from decomposition of naphthenic, medium V.I. oils are soft and crumbly. This characteristic is desirable for lubricants used in ported engines.

Carbonaceous deposits build up in the upper compression ring grooves. The quantity of ring groove deposits in high-output engines can become so great that ring faces are forced out beyond the piston surface. If this occurs in ported engines, rings can be damaged as they traverse the scavenging ports. Medium V.I. oils leave soft deposits that can work their way out of ring grooves by the action of the rings. For this reason, Electro-Motive Division of G.M. specifies a maximum 75 V.I. for oil lubricating its engines.

Good naphthenic, medium V.I. base oil is in relatively short supply. The known supply of naphthenic lube crude around the world is diminishing. Naphthenic crude production represents only a small fraction of the total. In the short range future, medium V.I. oil availability may be insufficient to meet demand. When this occurs, a shift to high V.I. oils will follow.

High Viscosity Index Oils

Carbonaceous deposits formed from high V.I. oils are hard and compact by comparison with deposits formed from medium V.I. oils. Nevertheless, this characteristic has been largely overcome with the use of additives. Antioxidants retard degradation and detergent/dispersants reduce deposition of solids on vital engine parts. By far the majority of total engine oil usage is of the high V.I. type.

Several major oil companies are working to develop high V.I. oils that will perform well in ported engines. The proper selection of base oil in combination with additives is expected to give good performance in these engines. High V.I. oils, in general, are superior to medium V.I. oils in stability.

II. PROGRESS IN THE INTERCHANGEABILITY OF INTERPRETATION OF LABORATORY OIL TEST DATA

For several years the railroad laboratories of this country have been involved in an ongoing effort to update and synchronize test data whereby interchanged information can best be utilized by all railroads. In the 1973 report, this committee stated that a completely automatic and computerized lube oil analysis was, at that time, still a dream. This is a progress report on that dream.

It is well established that laboratory procedures for analytical testing of used diesel lube oil should include spectrographic analysis. It is the only quick method by which wear that takes place in an engine can be detected by metallic elements in a sample of the engine oil. For example, if ring or liner wear is abnormal, then iron and chromium will be high if chrome plated rings or liners are used. Excess silicon suggests poor air filtration. Higher than normal boron or sodium indicates water leaks. To make it short, each metal found in spectrographic analysis gives a clue to the condition of that part of the engine where this type of metal is used. Although spectrographic analysis identifies metallic elements present, one must be familiar with the engine and its environment to be able to utilize it fully. The spectrograph does not analyze the oil, it simply shows what elemental contaminants are present.

Spectrographic analysis of used lube oil is so far not as dependable as desired for predicting random sudden crankshaft bearing failure. However, it is the best method available, and the use of the spectrograph as a segment of the analysis of used lube oil is a valid and effective preventive maintenance tool.

To illustrate this point, it was observed that the average metal level of the oils in certain fleets of locomotives varied significantly. On the low side the significant values were iron 7 ppm, lead 2 ppm, copper 2 ppm, and chromium 1 ppm. On the high side these values were respectively 20, 19, 10, and 6. Note that all the engines involved in this study utilized iron liners and chromium ring combinations. Disassembly of representative engines from the "high" fleet exhibited serious, abnormal bearing and power assembly wear. Disassembly of representative engines exhibiting "average" metal levels in the lube oil demonstrated normal wear conditions.

It is important that the laboratory performing spectrographic analysis be familiar with the metals making up the major components of the engines from which the oil samples are taken.

Now that railroads are interchanging locomotives in national operations, it has become imperative that some control and standardization among laboratories be established. To facilitate this, the National Association of Railroad Engineers of Tests has initiated a program to improve the repeatability and reproducibility of spectrograph test data presently involving 26 laboratories. Also, there is a continuing program for round-robin samples being circulated in 1975 among railroads, oil companies, and engine builders' laboratories.

In comparing test results of those 26 laboratories, deviations were found. Some participants believed those deviations were associated more with the type of instrumentation than the accuracy of calibration standards

used. Others believe that the opposite differences occurred in preparation of the standards.

Since standards are prepared in so many ways, it is likely that the difference in results arises from their manner of preparation. If so, the solution is a common source of standards for all the laboratories.

A statistical evaluation method is needed in order to tie together a multi-laboratory operation nationally. Such a method is the "Youden Method," which is widely used by testing agencies of the U.S. Government. This method is named after its developer, W. J. Youden of the National Bureau of Standards, and is based on graphical diagnosis of interlaboratory test results of spectrographs. It is relatively easy to interpret and no statistical background is required to demonstrate the nature of deviations.

Over the years many attempts have been made to eliminate the spectrograph from railroad oil analysis, but the method has always returned. Although there is a definite need for a method to detect large metallic particles and determine their source and method of formation, nothing has yet come forth which will fit the time and manpower parameters imposed by railroad laboratories.

SPECTRO WEAR-METAL CONDEMNATION EXCEEDING LIMITS (ppm)

Element	Loco.	Railroad "A"	Railroad "B"	Railroad "C"	Railroad "D"	Recommended Action
Chromium	GE (1)	10 (2)	—	—	—	Check for scored liners
Chromium	EMD (3)	60	—	—	—	" " " "
Chromium (4)	All	—	40	150	50	Correct Water leaks
Boron (5)	EMD	40	—	—	—	" " "
Boron (5)	GE	20	—	—	—	" " "
Silicon	All	10	15	40	10	Correct air filters
Silver	EMD	1.5	12	20	0.7	Inspect piston pin bearings
Aluminum	GE (6)	10	—	—	—	Inspect pistons
Aluminum	Alco	—	20	—	—	" "
Aluminum	EMD (7)	50	—	50	10	" "
Iron	Alco	—	40	—	—	Inspect rings, pistons, liners
Iron	GE (8)	25 (8)	40	—	25	" " " "
Iron	EMD	25 (9)	100	150	75	" " " "
Lead	Alco	100 (10)	30	—	—	Inspect crankshaft bearings
Lead	GE	100 (10)	50	—	—	" " " "
Lead	EMD	100 (10)	150	150	—	" " " "
Copper	Alco	100 (11)	40	—	—	" " " "
Copper	EIMD	100 (11)	80	150	—	" " " "
Zinc	Emd	10	—	—	25	Drain oil

(1) Chrome plated liners
(2) If iron is 20 ppm or higher
(3) Chrome plated liners
(4) Chromate water treatment
(5) Borate water treatment
(6) With aluminum pistons
(7) With roots blower
(8) With chrome plated liners and chromium is greater than 10 ppm
(9) Iron doubles in amount in 10 days
(10) Iron 120, Copper 100, Tin 60 ppm
(11) Iron 120, Lead 100, Tin 60 ppm

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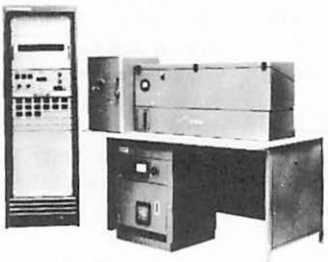

Insolubles

When deposits of carbon, environmental contaminants, wear metals, and corrosion products are suspended in the oil, attention must be given analysis of those oils to assure that the capacity for holding deposits in suspension is not exceeded. Methods for obtaining this information are numerous, including blotter spots (chromatographs), filtration, separation by centrifuge, use of absorbants, and optical methods. A widely acceptable method which is based on separation by centrifuge is called "precipitation number."

The lack of correlative interpretation of the blotter spots among the laboratories prevents this particular procedure from becoming more widely used. Since the blotter spot cannot be described numerically the results are not exchangeable. The newest method of insoluble determination that yields statistically identical results with a pre-1969 ASTM procedure is based on filtration using a millipore filter. This method, yielding equivalent results is at least as accurate as the former ASTM centrifugal method, while the time of analysis is greatly reduced. At the present time, however, when insolubles are run, the method most mentioned by the railroads is the coagulated ASTM-D 893 pentane-benzene insoluble test. This method is a centrifugal procedure which gives pentane and benzene insolubles separately, and interpretation is based on their difference. It is time consuming and expensive.

Pentane insolubles represent total contaminants consisting of dirt, soot, carbon, wear metals, combustion and oxidized products. Since benzene dissolves the organic portion, the difference between the pentane and the benzene insolubles represents the oxidized products in the oil. These relate to engine temperature and/or chemical stability of the oil.

To date there has been little exchange of this kind of information between railroads, but its repeatability will respond to the same sort of statistical comparison as any other test method.

Guidelines For Interpretation Of Engine Oil Tests

(c) *Insolubles 0.5% but below 1.0%*
Change oil filter.

Insolubles 1.0% but below 1.5%
Change oil filter, check by-pass valve.
If more than two filter changes are required in a month, change oil and filter.

Insolubles 1.5% more
Change oil, change oil filters, check by-pass valve. Inspect engine for broken rings. Examine a lube oil filter element for metal cuttings and, if found, determine source and take appropriate action.

Acid And Base Numbers

Acid and base numbers are terms frequently used in determining the acidity (TAN) or alkalinity (TBN) of lubricating oils. The interest in acid and base numbers began with the alkaline detergent additive oils introduced to neutralize acidic products of fuel combustion and oil oxidation to combat wear. Used oils may have both an acid and base number. The acidity of an oil measures the degree of its contamination with acids from fuel combustion and oxidation products, while the alkalinity of an oil measures the remaining alkaline reserve.

There are several procedures for determining acid and base number. Some of these are the ASTM Methods

D-974, D-2896, and D-664. The D-974 Method is a colorimetric procedure and is not suited to our needs because third generation highly dispersant oils will not allow observance of color change. ASTM Method D-2896 is a procedure for determining only the total base number (sometimes called Alkalinity Value or "AV") of petroleum products by potentiometric perchloric acid titration. This is reported to be an extremely accurate method for base numbers and gives less fluctuation during titration than the other procedures but the results are not the same numerically as from other methods. Although a ASTM Method D-2896 to determine base numbers has become official, the majority of the railroads still use ASTM D-664 Method extensively and find this method to be very satisfactory for their use.

The interpretation of acid and base numbers among the railroads is moderately uniform. Low base number accompanied by viscosity increase are two items usually helpful in making a decision on whether to change oil or not. The use of blotter spots sometimes aids in deciding if a longer base number test should be run on the oil.

Viscosity

The viscosity of an oil is a measurement of its resistance to flow and is considered a lubricant's most important single physical property. Viscosity varies with temperature; thus when viscosity test results are compared, temperature must be included. Viscosity is ordinarily determined at temperatures of 100 and 210°F. Changes in viscosity test results, such as a distinct increase, indicate thickening of the oil owing to oxidation and/or excessive insolubles; a decrease indicates fuel dilution.

There are various types of equipment used for checking viscosity of lubricating oils. The railroads use instruments ranging from field visgage to reverse-flow tubes in automatically controlled viscometers. One carrier contends that, when properly operated, the visgage for field measurements gives good results despite darkness of the oil. Most roads use either the Cannon-Fenske or the Shell-Braun Design Viscometer and Cannon or Zeitfuchs regular and reverse-flow tubes. Operation of this equipment is governed by the procedure covered in ASTM D-445 Method, which is fast and precise and well suited to railroad use.

Cannon now offers a new bath for automatic viscosity determinations. This apparatus determines viscosity, records time, calculates KV values, cleans tubes, and prepares for the next set of samples. It is interfaced with a computer and gives a read-out of results. It operates at both 100 and 210°F; it costs approximately $30,000. There are other such instruments on the market.

ASTM D-445 requires temperature of the bath not to vary by more than 0.02°F and gives repeatability of 0.35 percent and reproducibility of 0.70 percent of mean. An experienced operator using a reverse-flow tube for dark oils should have no trouble staying within this range. Viscosity results have been exchanged by railroads and oil companies for a long time, and their reliability can be tested by Youden's Method. Calibration standards are readily available and they should be in the stock of every railroad oil laboratory.

Fuel Dilution 3% to 4.9%
(Viscosity 189 to 154 cs at 100 degrees F.)
Make inspection for fuel leaks and correct any found.

Fuel Dilution 5% or More
(Viscosity 152 or less)
Shut down engine, find and correct fuel leak and/or defective injector. *Drain oil and change oil filters after repairs made.* Inspect the used oil filters for signs of metal which could indicate unusual bearing wear and be guided accordingly.

Viscosity 260 centistokes or higher at 100 degrees F.
Change oil and filters immediately. Check oil cooler efficiency at next maintenance. On SW-1500 units, check adjustment of cooling fan drive.

III. PROGRESS IN RECLAMATION - PROCEDURES AND STANDARD FOR RECYCLING FUEL AND LUBRICATING OILS

With the impact of increased demand, reduced supply and expanding environmental control, reclamation is becoming a way of life in all phases of our changing society. Our past historical attitude of a land of unlimited resources is challenged by an ultimatum to conserve and reuse for survival.

While technology is developing new areas to harvest energy, such as coal, solid waste, solar, tidal wave, wind, geothermal, fusion power, and others, we may immediately save energy by recycling waste oils. (Fig. 1)

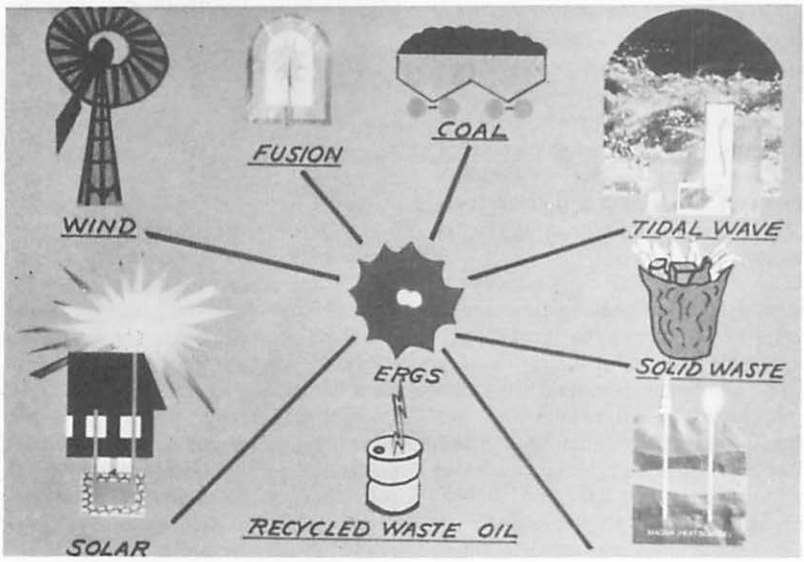

Figure 1

According to Webster, "Reclamation is a process of rescuing a product from an undesirable or uncultivated state," whereas rerefining is "to reduce to a pure state, free of impurities." Whether a product has become contaminated through the process of service or inadvertent spillage, all technology must be employed to rescue and recondition these materials.

Recent data from the Federal Energy Administration and SAE (Society of Automotive Engineers) indicates that the U.S. will generate 1.03 billion gallons of waste lubricating oil this year. About 47% of the waste oil is generated by automobiles, 32% from industrial lube oil, 17% from other industrial uses, and the remainder from a variety of applications. Other reports have doubled the magnitude of this problem. (Fig. 2)

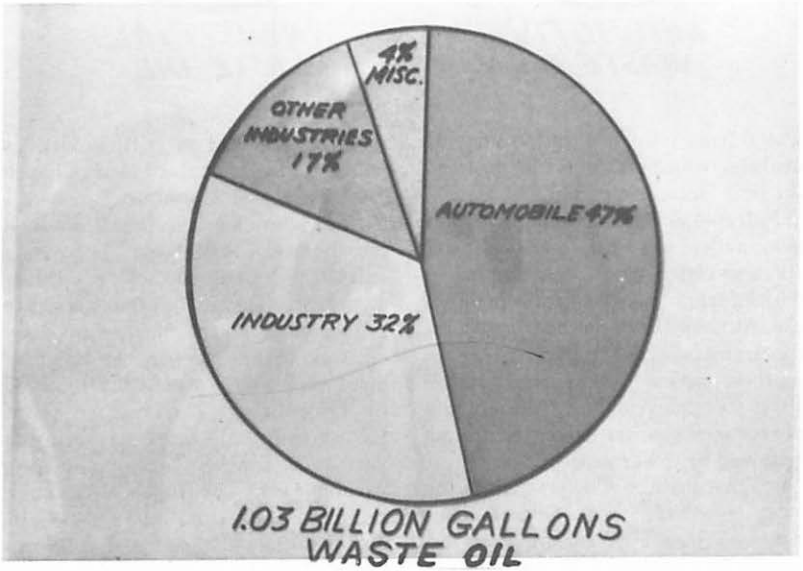

Figure 2

In the automotive waste oil area, approximately 50% or 350 million gallons, is either disposed of or used as road oil; 36% or 260 million gallons, is used for fuel and only 11% or 80 million gallons is rerefined. In the industrial waste oil area, 54% or 400 million gallons is reprocessed or reclaimed and 46% or 287 million gallons is left unaccounted or consumed. (Fig. 3)

In order to reclaim or rerefine diesel fuels and lubricating oils, uniform procedures are required to maintain quality control and conformance within adopted specifications.

First, we discuss *lubricating oils.* Lubricant conditioning may be accomplished by settling, filtering, centrifuging, rerefining, or by a combination of two or more of these methods. The *settling process* will remove solids and

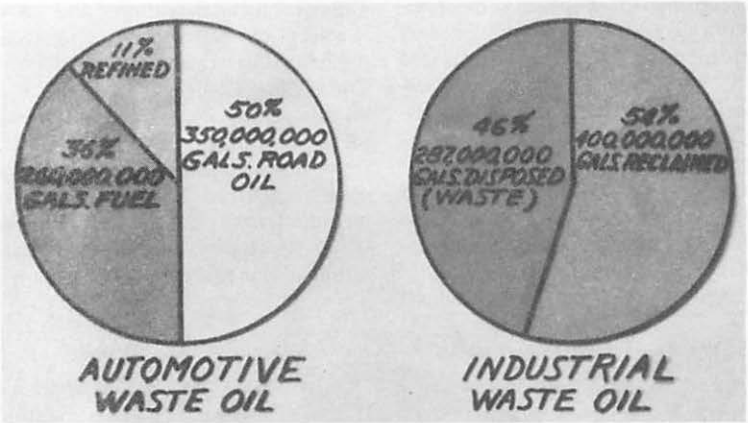

Figure 3

water from used oils, but even with heating, which hastens this process, the time factor is magnified.

Filtering and *centrifuging* are common methods of purifying lubricating oil, especially when conditioning is desired while the lubricant remains in use. Although both methods lower the contaminate level and improve the oil, neither process restores the product to an original condition. Finely dispersed particles and additives are not removed by either process.

In most instances, *rerefining* is the most practical and advantageous method. Generally, rerefining is accomplished by steam or vacuum distillation. In this process solid particles are removed by settling and water by dehydration. Chemical or acid treatment is employed to precipitate additives. Acids are neutralized and soaps are removed by steam stripping or water washing. Special clays bleach the oil and absorb other contaminants. Light volatile diluents are extracted during distillation, after which final filtering removes the clay and all other solids. Blending and refortifying the base mineral oil with additives under rigid laboratory surveillance provides a finished product.

One alternate rerefining method incorporates caustic soda-silicate as a substitute for sulfuric acid, producing an acid-free sludge, but is reported to reduce yields of the finished product.

Other technology, in the development stage, uses distillation followed by Hydrofining. The distilled oil is Hydrofined with catalysts, utilizing various parameters of temperature, vacuum, and hydrogen. Although catalyst deactivation was not evident during initial tests, reasonable Hydrofining catalyst life is an important requirement of this method. This procedure will minimize potential pollutant by-products of spent acid, spent caustic, spent clay, sulfur dioxide, etc.

A new process, developed by the French Petroleum Institute, utilizes propane clarification of spent oil prior to conventional acid/clay treating. This new process alleges to reduce the amount of acid and clay required, reduce sludge formation, associated

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pollution, improve product quality, and increase recovery yields. In addition, plant and operating costs are low. Low plant investment is due to simplicity of design and use of carbon steel construction because corrosion is not a problem. It has been reported that propane clarification results in a production gain of nearly 8%.

In propane clarification, dehydrated and preheated used oils are mixed with liquid propane in a specially designed reactor. Propane containing dissolved oil is taken from the top of the reactor, while the insoluble residues are drawn from the bottom. Bottoms are mixed with a small amount of fuel oil and flashed to recover propane. The remaining residues are burned in a rotary furnace.

The propane is separated from oil in a double stage flash and sent to a chiller for liquefaction and recycling. Propane clarified oil is then acid treated. (Fig. 4)

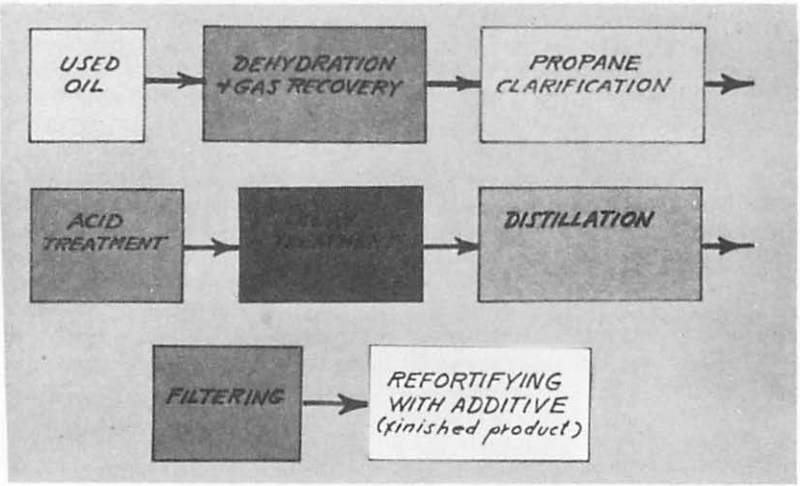


Figure 4

New expanded technological developments will continue because rerefining is receiving new acceptance in the commercial world, promoted greatly by the energy crisis.

In the railroad industry, collection of waste lubricating oil for recycling is not a barrier as known by the automotive industry. However, during the collection process, segregation of railroad diesel crankcase oils from journal oils and automotive oils isolates the unknowns and thereby enhances rerefining.

Whichever rerefining process is applied, constant laboratory monitoring is essential to assure a product that conforms to new lubricating oil specifications and controls the refortification with presently approved additive formulations.

The following typical inspection test limits are guidelines for controlling diesel SAE-40 lubricating oil:

Test Identity	Base Oil	Refortified Additive Oil
Gravity, °API.	24.7	23.5 - 25.5
Flash, °F.	475	455 Minimum
Viscosity @ 100°F., SUS.	875 - 925	925 - 1040
Viscosity @ 210°F., SUS.	70 - 75	78 - 85
Viscosity Index	62.5	65 - 75
Pour Point	0	+15
Color	3.5	6.0 - 6.5
Sulfated Ash - %	0.01 Maximum	0.75 - 0.92
Base Number	—	8.0 Minimum
Acid Number	—	1.1
Initial pH	—	8.5 Minimum
Calcium, %	—	0.22 - 0.40 (1)
Added Nitrogen, %	—	0.13 - 0.17
Zinc, ppm	—	5.0 Maximum
Sodium, ppm	—	20 - 30
Metals, ppm (2)		
Silver	Less than 0.1	Less than 0.1
Aluminum	Less than 1	2
Boron	" " "	Less than 1
Chromium	Less than 1	1
Copper	" " "	Less than 1
Iron	" " "	" " "
Lead	" " "	" " "
Silicon	" " "	" " "
Tin	" " "	Less than 1
Infrared Scan	—	(3)

NOTES: (1) — Depending on additive concentration
(2) — Emission Spectrographic results
(3) — Additional tool per users direction and pre-established standards.

Lubricating oils represent only a small percentage of the total petroleum production, so let's consider a major area in the conservation of *spilled diesel fuel oil.*

Within the railroad industry, individual roads have reported diesel fuel spillage and losses in a range of 0.1 to 3.0% of the total fuel purchased. (Fig. 5) Considering the railroad industry used four billion gallons of diesel fuel last year, a 1% loss represents an incredible 40 million gallons.

In most instances these losses have been substantially reduced in the past year with resultant savings to the industry.

Today, recovery of spilled or otherwise contaminated diesel fuel is essential and in many cases economical. A large variety of collection systems are available, but the ultimate cure is the elimination of spillage.

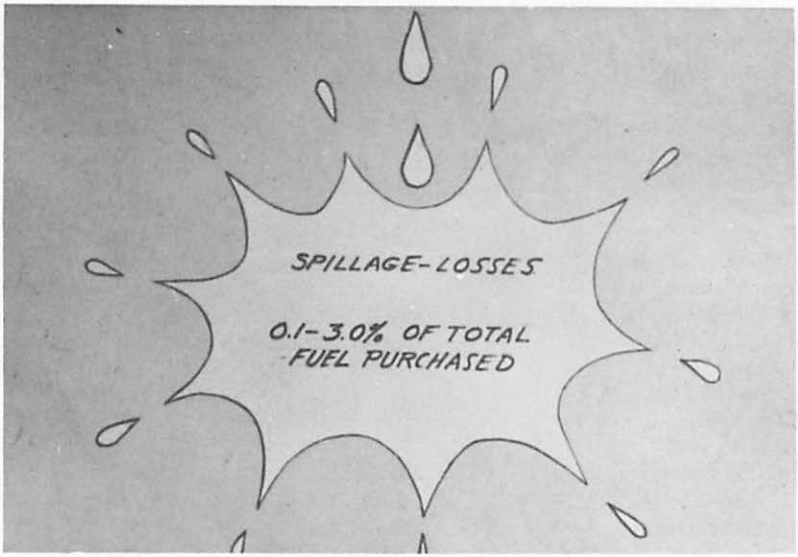


Figure 5

ULTIMATE CURE—

ELIMINATE SPILLAGE

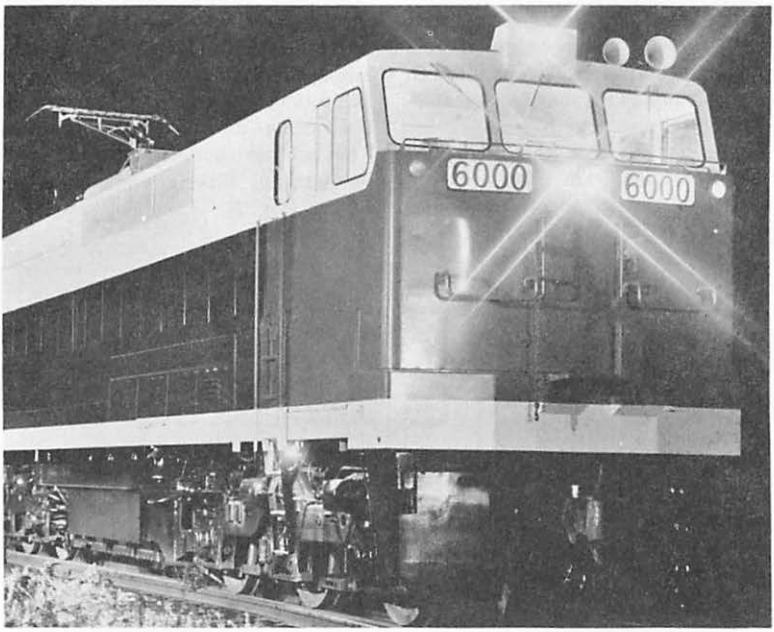
BY:—

1.-STRONGER MANAGEMENT CONTROLS.

2.-GOOD MAINTENANCE OF FUEL EQUIPMENT.

3.-GREATER RELIABILITY ON DELEGATED HUMAN RESPONSIBILITIES.

Figure 6



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Perhaps this statement is theoretical, but through stronger management controls, good maintenance of fuel equipment, and greater reliability on delegated human responsibilities, spillage can be eliminated. (Fig. 6)

To protect against the accidental spillage of fuel, drain pans are constructed of either concrete or metal under rails on the fueling track, with drainage to a sump tank located below the frost line. Possible overflow spillage from fuel tank lagoons may also be directed to the sump tank. The sump tank or gravity separator is the first phase in conditioning the fuel. This process should then be followed by settling, filtering and/or centrifuging. (Fig. 7)

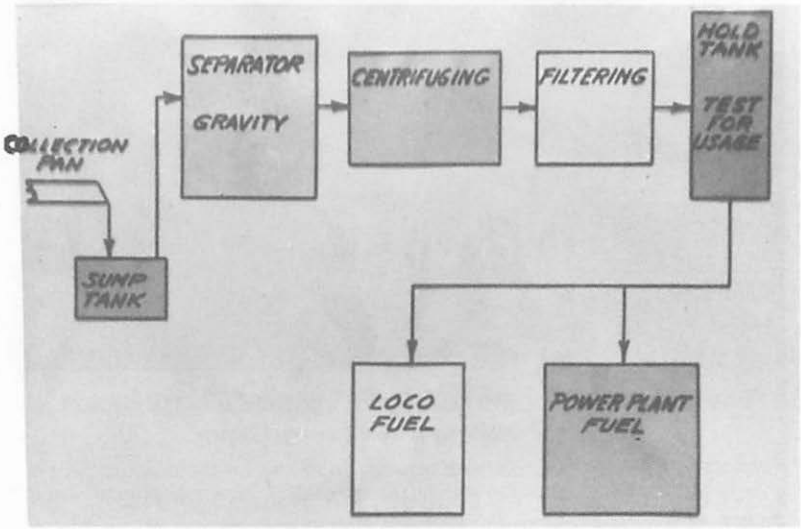

Figure 7

A wide range of fuel filters are available with different filtering media, including pleated paper, porous stainless steel, pleated wire cloth, cotton, rayon, ceramic, cellulose, wood pulp, fiberglass, fluorocarbon, polyester, and other fibers. Each filter is available in various pore sizes from less than one to greater than 100 microns. Most diesel fuel is filtered in the 2 - 10 micron range.

Centrifugal separation employing high gravity forces, is essentially an accelerated form of sedimentation. High-speed centrifuges are available in various designs from simple manually cleaned systems, to complex, high cost, automatic units.

In many instances, centrifuging and filtering are combined with a coalescing phase to obtain the final purification of diesel fuels.

Spilled fuels may be economically reused in many different areas. With proper collection and purification methods, the fuel may be used as auxiliary power plant fuel, locomotive fuel, or sold to outside companies.

Heavy, undersirable sludges may be blended with solvents or light fuels for power plant use. Only extremely contaminated fuels should be disposed of by incineration. Fueling areas should be isolated so that spilled fuel may be segregated whenever possible.

Upon collection of spilled fuel, the fuel is accumulated in a holding tank. Water and dirt are separated by the settling method. The fuel may be further centrifuged and filtered again. At this point, representative samples taken from the top, middle, and bottom of the fuel shall be analyzed by the laboratory for further disposition.

Depending on the condition, the fuel will be allocated for locomotives or auxiliary power plant fuel. Only strict laboratory control will alleviate distrust and assure locomotive fuel quality.

Fuel to be used in locomotives must conform to new specifications with limited deviations.

For added quality assurance, reclaimed fuel destined for locomotives should be returned to diesel storage in concentrations not greater than 10%. Transportation and other factors affect the economic feasibility. Therefore, the Committee suggests that each area be studied individually. Laboratory rejected batches of fuel not acceptable for locomotives are recommended for power plant oil. This fuel and other heavy waste oils may be sprayed as a supplementary fuel over a burning coal fire. Normally the draft is increased slightly to assure complete combustion. It is also feasible to dispose of 10 - 40% water-oil emulsions when sprayed with special nozzles over a coal bed at a rate of 50 - 100 gallons per hour. Waste fuel may also be blended and fired in oil burning furnaces.

Reclamation of journal car oil is another area of oil recovery. Approximately 40% of the nation's railroad freight cars still require journal lubricator pads. One car set (8 pads), will absorb about 4 gallons of oil. Consider that 100,000 cars require 400,000 gallons of journal oil. After the normal service life of those lubricators, the oil may be extracted or squeezed from each pad. The recovery yield is normally about 1½ gallons per car set. Therefore, 150,000 gallons of valuable oil can be recovered for recycling from the 100,000 cars.

Reclaiming soluble cutting oil is another area that may provide substantial savings. By centrifuging the oil and metal chips, most of the soluble oil can be recycled. Ultrafiltration is a new process that has shown its ability to reclaim soluble oil economically. In the ultrafiltration process, waste soluble oil is pumped through a porous tube on which a membrane has been integrally cast. The pore diameter of the membrane is approximately 1,000 times smaller than the oil droplets; consequently, only the water passes through the membrane. There is no depth to the pore structure, so plugging does not occur, and backwashing the media is not needed. Each of the processes mentioned above will provide beneficial savings to the industry, reduce pollution, and help relieve the energy crisis.

Today there are less than 90 refiners in the United States and many are very small. To achieve the national goal of energy self-sufficiency, each of us must reduce our consumption of energy. Elimination of spillage and collection and reclaiming or rere-

fining more of our waste oil will assist in achieving this goal.

Industries' attitudes toward waste must change. Legislative and institutional constraints are needed to revitalize the reclamation industry. (Fig. 8) With such changes will come new interest and technology for rerefining and reclaiming as an economical, profitable business.

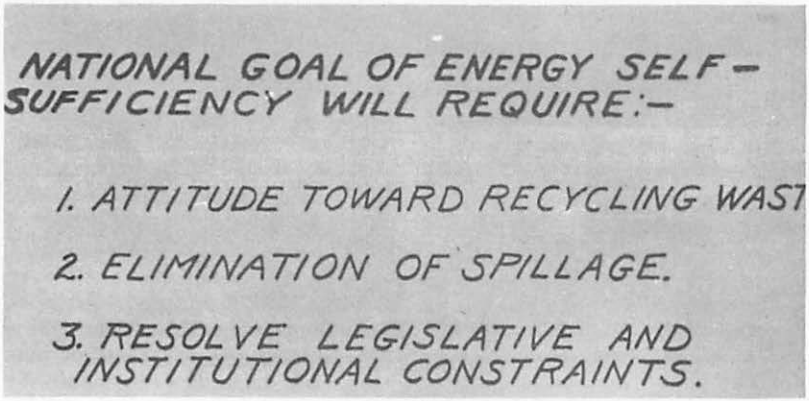

Figure 8

IV. CONSERVATION OF CRANKCASE OIL THROUGH IMPROVED ENGINE DESIGN AND ITS EFFECT ON LUBE OIL PERFORMANCE.

A. Status in 1975.

Engine builders have developed engine designs providing drastically reduced lube oil consumption in an effort to conserve petroleum and to improve operating economies. Several locomotive engine oils currently marketed are capable of satisfactorily lubricating the latest locomotives. However, high output coupled with reduced oil consumption puts severe stress on the engine oil. Oil properties affected most by the reduced oil consumption are viscosity, the alkaline reserve of the oils as measured by TBN, and insolubles. Of currently available oils those with the highest base number when new are probably best able to retain a satisfactory equilibrium base number.

The first reaction to the knowledge that oxidation and viscosity of crankcase oil increases along with a loss of alkaline reserve is that this will require more frequent lube oil changes. Reduced lube oil consumption in new locomotives is viewed as a problem foisted on us by the engine builders. The consensus of this committee is that this is an unfortunate attitude and that a more positive look at the situation should be made. With dwindling petroleum reserves and ever increasing costs of petroleum products, every effort should be made to conserve petroleum. EMD and GE report a 50 percent reduction in oil consumption in their engines. In comparison to make-up oil requirements, lube

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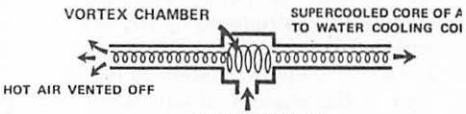

This diagram shows how temperature is reduced in the VORTACOOL. Air under pressure is admitted into the vortex tube through a jet-like opening located in the tube wall. This opening is arranged to make the air spin in the tube, creating a vortex. The air on the outside of the vortex picks up heat from the air in the center, lowering its temperature. The outside wall of heated air is then vented away. The chilled central core of air is used to cool the refrigerated compartment. Depending on the pressure and temperature of the compressed air to operate the VORTACOOL, temperatures as low as 20° BELOW ZERO can be obtained in the center of the vortex. The temperature of the containerized water in the refrigerator is held to a standard 50° by a snap-action temperature actuated valve. Aside from this thermostat, all that moves in the VORTACOOL is air and water. ABSOLUTELY NO ELECTRICAL POWER IS REQUIRED.

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oil changes are a very small part of the total lube oil usage. About 25 to 30 percent less lube oil is used overall with the improved engine designs, in spite of the more frequent routine oil changes that are necessary. An additional benefit gained from reduced lube oil consumption is a greater percentage of oil recovery for lube oil reclaiming operations. The savings to be derived from reduced lube oil consumption were covered in great detail in the 1974 report of the Committee on Diesel Mechanical Maintenance.

B. Cause and effects of reduced lube oil consumption.

The engine builders' contribution was the changes in engine design that led to reduced oil consumption.

GE introduced early in 1971 a Tuftrided liner chrome ring combination that has contributed to lube oil consumption in the order of 0.3 to 0.5 percent of fuel consumed. The change in power assembly components introduced by GE has resulted in a lubricating oil *usage* reduction of approximately 25 percent in GE engines of equivalent horsepower. The actual oil consumption reduction is more in the neighborhood of 60 percent when the power assemblies are brand new. As a result of this drastic reduction in oil consumption the effects by blow-by etc. are more pronounced in the oil in the crankcase. As a result, either of two conditions makes lubricating oil changes more frequent with respect to oil condition. These are loss of alkalinity and insoluble saturation. It is becoming increasingly evident that those two negative effects are more pronounced in GE engines on roads having an operation that might be termed "cold" — that is, light duty. On the positive side, in addition to the savings in lubricating oil (in spite of the more rapid used oil contamination), the incidence of cylinder liner scoring and ring distress in the field has been reduced as a result of this engine metallurgical change.

EMD has accomplished a 50 percent reduction in oil consumption with its 140 psi slotted oil control ring in production since mid 1973. EMD 16-cylinder turbocharged engines previously consuming one gallon of lube oil in an hour at full load, use only one-half gallon per hour when the new oil control rings are applied. Even though higher horsepower will contribute to more rapid oil deterioration in either engine builder's ring liner combinations, early oil deterioration is a fact of life with the reduced oil consumption even in lower horsepower locomotives with these ring liner combinations.

Based on reports from roads represented on your committee, the effects of reduced consumption on oil deterioration have been greater in the case of the GE locomotive. This may be understandable in that the lube oil consumption of the GE engine, which was already somewhat lower, has probably been reduced a greater amount; and the four-cycle engine has historically been harder on lube oil due to the high soot laydown and fuel debris than its two-cycle counterpart. Therefore, the longer the oil must remain in the engine and the greater contamina-

tion without sweetening of the additive dispersant and alkaline reserve components, the greater the likelihood of oil deterioration.

The railroads were in some instances unaware of the problems arising from reduced oil consumption. Such early signs of trouble on many roads noted were a dramatic change in the color of the oil, lacquer formation, major oxidation increase, filter plugging, sludging of top decks and other areas, and frequent engine shutdowns due to low oil pressure. Again, those problems seem to have been greatest, as reported by member roads, with the GE fleet with Tuftrided liners. The problem arose, we now speculate, through adhering to old oil change-out practices based on time rather than policing oil condition by measuring viscosity increase, TBN decrease, pentane insolubles increase, etc. Once the problem was discovered and oil change-outs were based on oil condition, in most cases difficulty with operating the engines ceased. The most frequent oil change-out criteria reported by railroads operating those engines are a minimum pH value and maximum pentane insolubles level. A pH value of from 4.5 to 5.0 and pentane insoluble levels of about 3% are used by these roads. Most railroads reporting indicate that this results in an average oil change-out period of from three to four months using current superior Class 2 lubricating oils in G-E engines. Several roads report change-outs as frequent as every 60 days.

There is less information available as to the life of oil in the low consumption EMD engines. Those reporting indicate that the oil change-out interval has not been shortened.

As a sidelight, one railroad has reported that the frequent (60-day) change-out has interfered with normal spectrographic oil analysis.

The oil companies' position in regard to reduced oil consumption, like that of the engine builders, is that reduced oil consumption has provided a net decrease in oil usage; therefore, even though oil must be changed on a 90-day basis, the railroads should not consider this a problem. As is the case with railroads, there is great variation of opinion as to what oil life can be expected from any specific oil formulation.

The oil companies and engine builders may feel that we have all lost sight of the fact that reduced oil consumption is a blessing. It does result in reduced oil use and, therefore, less of a burden on our scarce national resource. But the drive should always be for improvement. The railroads that are now involved with three-month change-outs, find certain additional expense in making the more frequent oil changes. Our resources should be further conserved. Therefore, improvements in oil quality to provide increased oxidation resistance, better equilibrium base number retention, (probably through higher base number) is being considered by several oil companies and is anxiously awaited by many railroads. We do need an improved oil to take full advantage of reduced lube oil consumption, to extend oil change-outs back to the six-month or a year interval to

which we have become accustomed.

V. PROGRESS ON LMOA OIL EVALUATION PROCEDURE

In addition to its normal annual assignment, the Fuels and Lubricants Committee has a continuing project to develop a standard LMOA lubricating oil evaluation procedure. Last year the committee recommended the development of a standard field test procedure. We also recommended that the committee explore the possibility of an evaluation mechanism to eliminate the necessity of full scale field tests. Those recommendations were approved by the Executive Committee, and work has begun in this effort.

Thirteen members of the Fuel & Lube Oil Committee met for a full day to work on this project. Due to the economic situation, only a few railroad personnel were able to attend. It was felt that additional railroad input was needed and as a result a mail survey was conducted by the National Association of Railroad Engineers of Tests. Twenty-one roads responded to our questions.

The data contained therein will be valuable in setting the course of future oil developments as well as a major aid in the standardization of oil evaluation procedures. The information sought in this inquiry was first, "What do railroads do at the present time to reach a technical decision regarding a new oil?" The second area of interest involved the causes of oil changes. This latter point may well assist in pointing the course for future oil developments. An examination of the responses will shed light on this subject. Fourteen or two-thirds of the roads responding, require the oil company to document that the product has the engine builders approval. Nine of the roads specifically mention field testing. In this area, the most interesting point is that six of the roads require engine builder approval but *also* require field tests on their road. The important point here is that both engine builders require that an oil be field tested before receiving approval. It was also interesting that three roads accept the oil company's word that an oil is satisfactory for its intended use, and one road examines physical and chemical tests but none of the four require engine builder approval nor conduct field tests.

An indication of the importance railroads attach to compatibility is seen by the fact that six roads require a compatibility statement from the oil company, and five more roads conduct compatibility tests themselves. This is even more important than the 50% would indicate, since the idea of compatibility was not mentioned in the questionnaire at all.

Of the 21 roads responding, eight change oil on the basis of time or mileage, and two roads reported that they have a time or mileage schedule for warranty locomotives. It is most revealing to note that 46% of the oil changes on those roads that utilize a time or mileage schedule are made for that reason.

A review of the reasons for oil changes on those roads not having scheduled changes, reveals that 58% of the oil changes are made because of water or fuel contamination, 20% as a result of shop work or foreign contamination, and only 22% as a result of such oil property changes as viscosity, insolubles or alkalinity loss. This means that if it were possible to develop an oil which could hold unlimited quantities of insolubles, never

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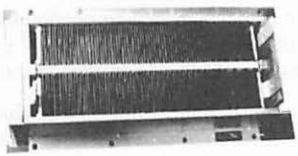

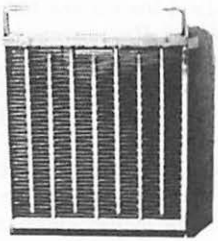

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oxidize and never lose alkalinity, only 22% of the oil changes could be eliminated.

This seems to imply that new lubricating oil development should focus on performance need rather than on oil life, since 78% of changes will be required regardless of quality.

As we began our work toward drafting an LMOA oil evaluation procedure, we first questioned the need for full scale field tests given today's state of technology. It was overwhelmingly concluded by those who met that this type of procedure is needed today. The response from the railroads is less conclusive (only nine specifically require field test). However, it must be remembered that inherent in the 14 who require engine builder approval is the requirement for field tests.

Alternatives to full scale field testing were discussed at length. Two alternatives were explored. The first is the use of full scale stationary engines, and the second is the possible development of a series of laboratory and small-size engine tests. For financial and energy conservation reasons neither approach appears practical at this time. The operation of a stationary full scale engine in such a manner as to fully qualify lubricating oil would require approximately 200,000 gallons of fuel oil at a cost of about $70,000. Test facilities, parts and manpower would require many thousands of dollars more. Further, the energy generated by fuel oil used in this manner would be wasted while field test engines are doing useful work.

It was felt by many that it would be technologically feasible to develop a series of small scale engine tests combined with glassware tests which could predict oil performance in existing power. The cost of a program to develop such tests would be hundreds of thousands of dollars. It is our belief that it would not be economically justifiable to spend this money even if it were available from pooled sources.

Our deliberations also disclosed that a single field test procedure would not serve our needs. There are a number of categories of "new" oil which should be evaluated. They differ in degree of change and thus suggest different test complexity. For example, some represent completely new formulations and some may differ only in one component. A single test procedure would naturally have to be the most complex and severe one but would not always be justified. Therefore, your committee will have to define several levels of tests.

We hope to complete field test procedure development by this time next year and will offer it as our progress report.

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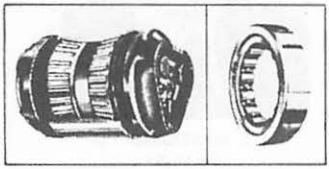

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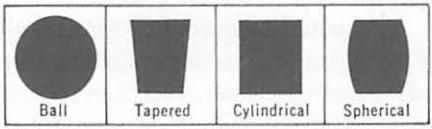

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REPORT OF THE COMMITTEE ON NEW DEVELOPMENTS

Pre-Convention Presentation: Southern and Southwestern Railway Club, Inc.

April 17, 1974
Kahler Plaza Hotel
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Chicago, Ill. 60605

Vice Chairman

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1975 TOPIC:
"PROGRESS IN MANAGEMENT AND EQUIPMENT DEVELOPMENT"

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Jimmy R. Ryder

Jim Ryder was born in Chicago, Illinois on January 12, 1939. He attended Chicago public schools through high school and graduated from Illinois Institute of Technology with a B. S. degree in Industrial Management. He is currently enrolled in graduate school in the Stuart School of Management and Finance at the Illinois Institute of Technology.

Jim started his career with International Harvester Corporation, Wisconsin Steel Division, as an Industrial Engineer Analyst in 1959. He was promoted through various positions to the position of Senior Industrial Engineer before leaving International Harvester Corporation to take a position of Systems Analyst with the Chicago Northwestern Railway in 1968. In 1969 he joined the Rock Island as Manager Industrial Engineering and was promoted to his present position of Director Industrial Engineering in January, 1972.

Jim was a Nuclear Weapons Assemblyman in the United States Army from 1962 to 1964. He married the former Janice M. Matz on June 14, 1970, and they have one son, Christopher, born on February 4, 1974.

He is past president of the Calumet Chapter of the American Institute of Industrial Engineers where he currently serves on the Board of Directors.

PROGRESS IN MANAGEMENT AND EQUIPMENT DEVELOPMENT

Introduction

Our presentation is divided into four major sections. The first section deals with "New Methods and Techniques in Training". In September, 1968, the U.S. Department of Labor produced a study entitled *Railroad Shopcraft Factfinding Study.* The study stated that "as of 1967, the median age of railroad shop workers was 49 years, substantially higher than the median age of 39 for male non-agricultural workers as a whole". The study also stated that, as of 1968, "more than a third of the present journeymen and mechanics will thus reach the normal retirement age of 65 during the coming decade". We are quickly approaching the end of the decade indicated in the study. Our committee suggests that the training of employees to replace the older, skilled employees will become more critical in the years ahead.

The second section deals with "Oil Collection Drainage Systems". In this section we discuss some possible solutions to pollution problems through the modification of locomotive designs and external collection systems. Part three deals with computerized locomotive information systems. The systems being introduced are currently being utilized by railroads represented on our committee. Part three is only an introduction to a system; the committee plans to expand these concepts in future papers. The last section deals with the "Clean Cab Project". In this section we have described the history, detailed the current position, and attempted to outline the future for this project. It is felt that programs such as the "Clean Cab Project" indicate the deep regard railroad management has for safety.

I. NEW METHODS AND TECHNIQUES IN TRAINING

In discussing new methods and techniques in training, it is first necessary to categorize the type of personnel to be trained, i.e., appren-

tices, mechanics, line supervision, staff supervision, etc., and to develop the objectives to be reached for each category or classification. The curriculum may be totally technical in nature or may cover the broad spectrum of management techniques including tools and instruments necessary for decision making and for providing a better insight into the corporate structure or plan. In the case of line and staff supervision, the training program may combine the technical aspects with the overall management functions.

The approaches and techniques being used by the American railroads may be varied in nature but all have the same objective of developing to a maximum degree the skills and knowledge required by personnel to fulfill the responsibility of their present positions and to develop their potential for possible advancement to more responsible positions. Since the objectives of all railroads are basically the same, this portion of our paper represents an outline of the training program and approach being used by the Mechanical Department of the Chessie System for providing technical training and general assistance to apprentices, mechanics and supervisory personnel responsible for locomotive maintenance.

A. **Supervisory Training General**

A management training program has been developed for presentation to line supervision at various locations on the railroad. Currently, the classes are held in shop meeting rooms, hotels or motels; and all general supervision, locomotive foremen and car foremen from the geographic area are invited to participate. The course presently offered requires two days and is divided into seven sessions of from two to three hours each.

The first session covers safety and emphasizes the need for an aggressive safety program and the importance of active participation at all levels. Safety is considered a supervisor's most important task as well as being the most difficult to control; thus much emphasis is placed on the role of the supervisor in the safety program. In addition to the text material offered, special talks and instruction may be given by representatives of the Safety First department.

The second session deals with professional management and the four basic functions — planning, organization, motivation, and control. The text material for this session was obtained through the National Management Association.

The third and fourth sessions are a continuation of the basic management functions dealing with motivation and controlling respectively.

Session five covers cost appreciation and methods improvement. This session emphasizes what a foreman can do to contribute to the financial success of the company. It also provides instructions related to proper implementation of labor and material source documents essential to reliable accounting and/or management needs.

Session six covers air brakes and stresses the importance of air equipment to overall train performance and operations. It is designed to make foremen capable of supervising and instructing inspectors and repair men in the proper servicing, inspection, and testing of the air brake system.

The final session is devoted to AAR loading rules and provides a general outline of the AAR loading rules manual.

As previously noted, these sessions are presently being conducted at locations where meeting room facilities are available. A new mobile classroom is on order for delivery during 1975. This unit will be equipped with all necessary classroom aids, projection equipment, wall charts, etc., so that the classroom can be taken to all locations where a need for supervisory training exists.

B. **Supervisory Training - Technical**

To provide sound technical training for supervisory personnel, the Chessie System has set up a training center at Cumberland, and has a similar center planned at Huntington, W. Va. The Cumberland Locomotive Educational Center offers seven different locomotive-oriented courses, each covering one week:

1. 26-L Air Brake System
2. EMD Diesel Engine
3. Amtrak Steam Generator
4. Electricity I
5. Electricity II
6. Electricity III
7. Electricity IV

The courses are offered to supervisors from all areas of the Chessie System including personnel from other departments, such as road foremen of engines who may benefit from a better technical understanding of the locomotive and trouble shooting techniques. The facility is also used in conjunction with the apprentice program, and special classes for local mechanics covering such things as governors, turbochargers, main generators, etc., are held when demands require a review of the maintenance practices and procedures for such components.

The photographs reproduced here offer a pictorial guide to the Cumberland Locomotive Educational Center.

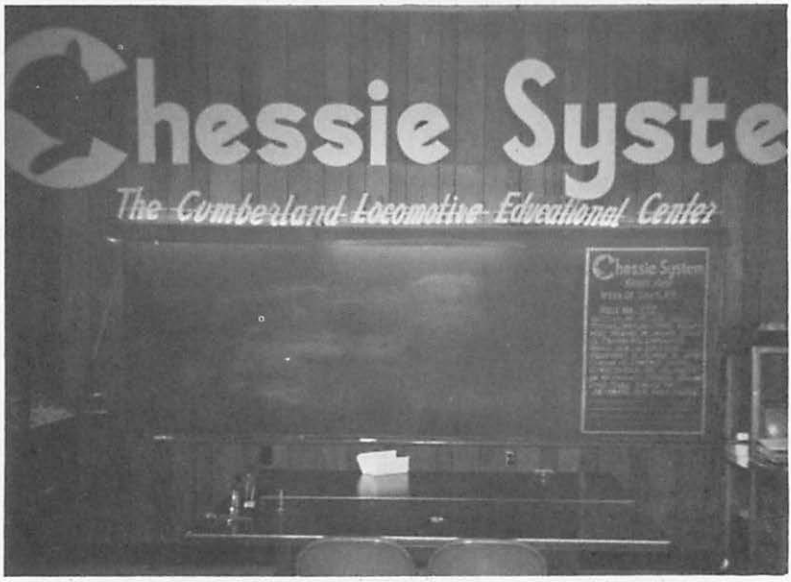

Figure 1

position the selector and reverse levers, open the throttle and listen to the various contactors, relays, switches, etc., picking up or dropping out. Each event which would occur on board a running locomotive will also occur on this simulator.

Figure 3 shows the total view of the simulated electric locker and control stand. Located above the control stand is a light indicating panel which clearly indicates which contactors, relays, switches, and solenoids are energized or de-energized during any given sequence.

Any action taken by the student or instructor is immediately relayed to the light panel to indicate which components are being operated. A visual check of the electric locker will confirm that the proper component has been energized or de-energized. The student can not only follow the wiring diagram to determine what should occur, but can also see and hear the actual events.

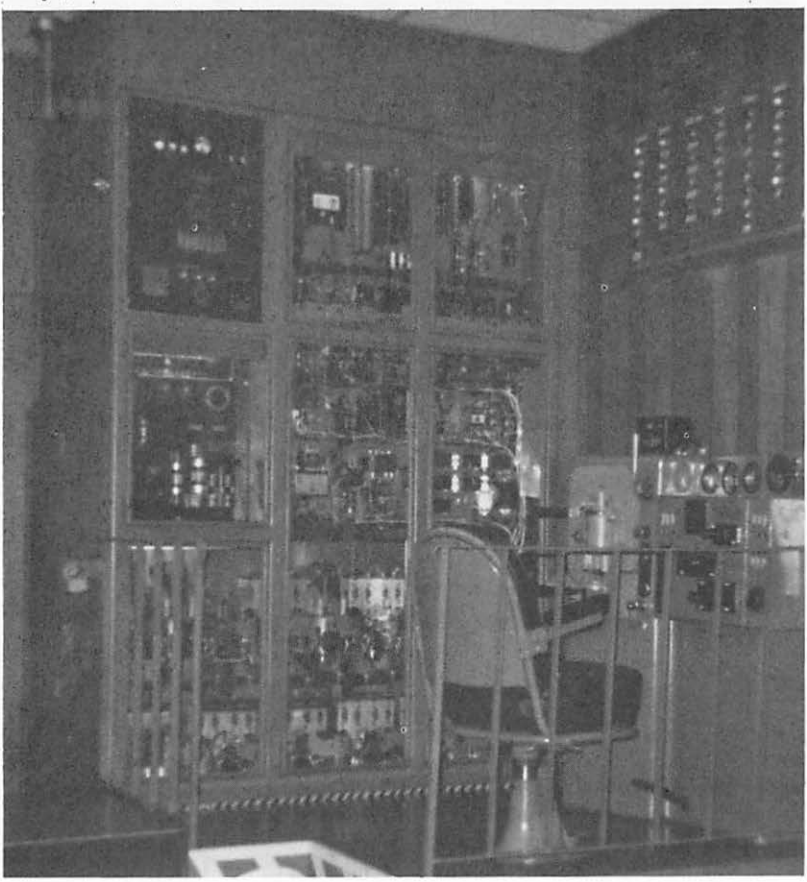

Figure 4 offers a close-up view of the engineer's control stand. Again, every component pictured is fully operational. When the throttle is opened, the engine speed solenoids are energized, the power contactor picks up, interlocks make, air gauges register when the brake valve is moved, the ammeter indicates that the unit is loading, the flow meter registers air flow, and even the bell rings in a precise clang when operated.

Figure 4

Figure 5 depicts various views of the 26-L locomotive air brake equipment. All components are clearly identified and color coded. As with the control stand, all components are fully operational and simulate actual train conditions. Note that Figure 5 shows that the brake cylinder is fully extended, indicating that a brake application has been made.

In addition to the above actions simulating normal operations, failed conditions can be induced to assist in providing trouble shooting tips.

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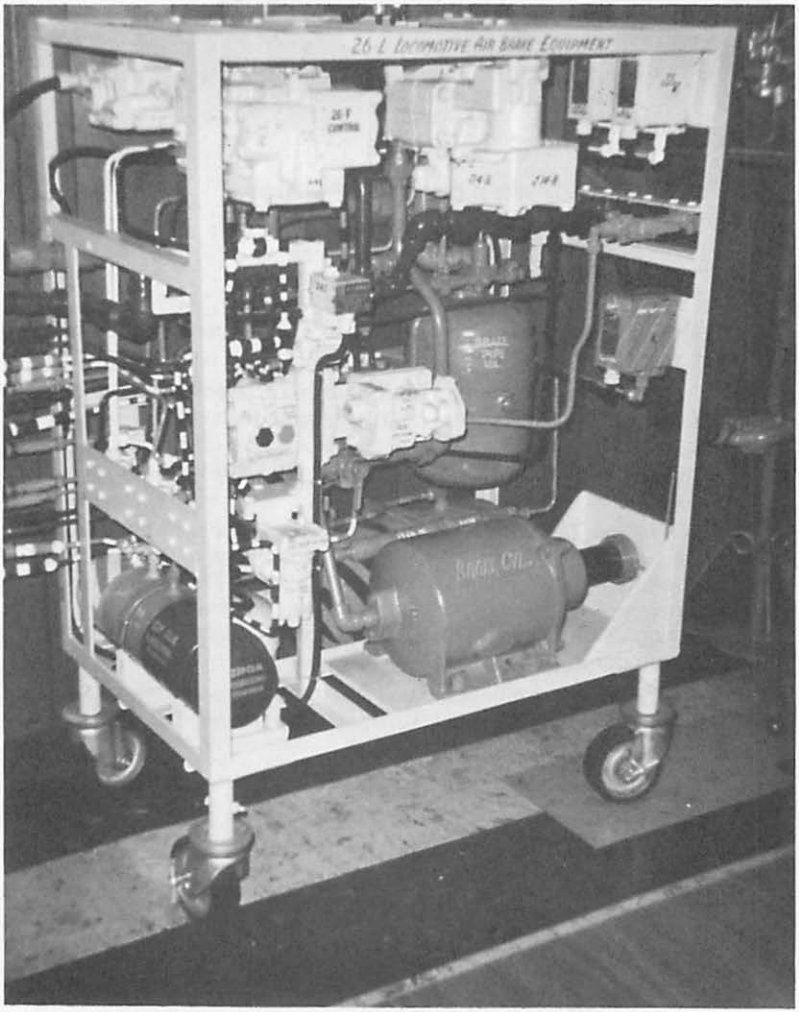

Figure 5

Figure 6 indicates the relationship between the locomotive and car air equipment. This shows the AB freight brake equipment which operates from the automatic brake valve just as it would on a car. This equipment is color coded for assistance in tracing air flow.

Other components and parts available at the center but not pictured include a fully operational Vapor OK-4625 steam generator: a partial cut-away of an EMD 567B engine which has been converted on one side to a BC engine; cut-away of a complete air compressor, engine governors, cylinders, injectors, water pumps, etc. Virtually, all equipment was salvaged from scrap or "trade-in" locomotives and was reconditioned and made operational by personnel at Cumberland.

During the week of classroom instruction, short tours are conducted through the Cumberland Locomotive Shop so that students can also view all aspects of locomotive maintenance and repair on the spot.

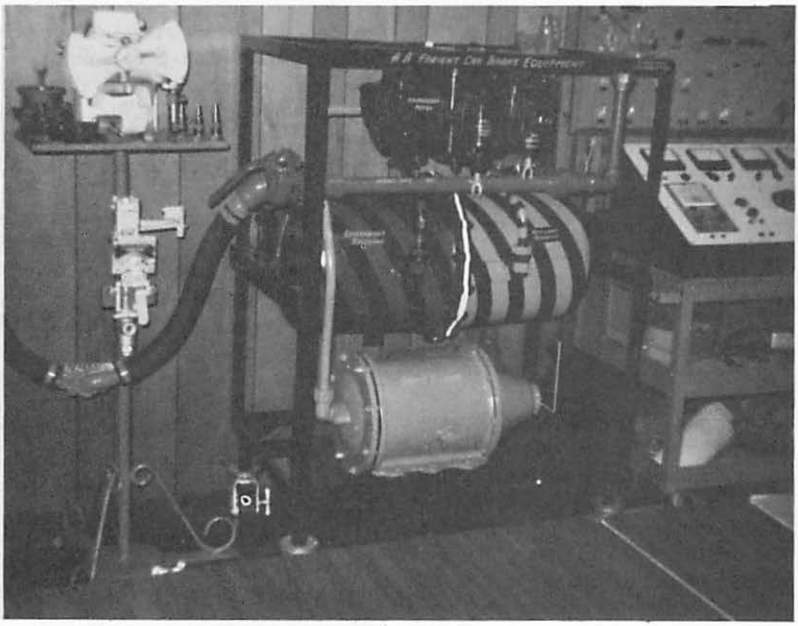

Figure 6

C. **Apprentice Training**

In spite of the increase in unemployment brought about by the current recession in business, it is becoming increasingly difficult to find and hire qualified personnel for locomotive maintenance. With continued lowering of retirement age and/or improved retirement benefits, attrition is causing a more rapid decrease in available manpower than can be absorbed by improved productivity. To look ahead and plan for needed qualified personnel, we must re-establish or upgrade apprentice programs. In some cases, we may be locked in by agreements

which specify the ratio of apprentices to mechanics and the length of time an apprentice must serve before being promoted to mechanic. Agreements also may or may not specify supplemental study by apprentices such as correspondence courses offered by the Railway Educational Bureau or other accredited correspondence schools. In such cases, it may be necessary to negotiate new agreements to insure the availability of qualified personnel.

There is an old adage that a problem on a steam locomotive would require five minutes to find and eight hours to fix, whereas, a problem on a diesel can require eight hours to find and five minutes to fix. With the complexity of the modern diesel-electric locomotive, apprentice programs should be strongly oriented toward development of a full understanding of the operation of the various systems and circuits found on the unit and geared to trouble shooting or find/fix procedures.

Proposed streamlining of apprentice programs provides for increased participation in correspondence courses and successful completion of such courses before promotion to journeyman. Plans also include providing classroom assistance at the Cumberland Locomotive Training Center or the similar center to be installed at Huntington, W. Va. Also under consideration is outfitting the mobile training center previously mentioned for supervisory training with sufficient training aids and equipment to provide periodic classroom assistance at smaller, outlying terminals.

Before concluding discussion on training techniques, we would be remiss if we did not mention the many fine training programs in existence or under development by other roads and those provided by the locomotive builders.

The Burlington Northern video training program was impressively demonstrated at the 1974 LMOA annual meeting. Similar programs are in place or are being planned by the L&N, SP, and UP. The Southern has recently opened a major training center near Atlanta for the development of apprentices to qualified journeymen and technicians.

EMD and GE have continued to upgrade their on-site schools to make available to railroad personnel classes related to their latest designs in motive power and equipment. They also provide publications, wall charts, trouble-shooting guides, etc., essential to setting up the classrooms and training programs being used by the railroads.

Sound educational programs must be developed and perpetuated if we are to improve locomotive reliability, performance, and economy.

II. OIL COLLECTION DRAINAGE SYSTEMS

Current as well as possible future environmental regulations have drawn industry-wide attention and consideration of the contribution, reduction, and control of railroad-associated pollutants.

The locomotive fuel and lube oil systems, as well as the sand and cooling water systems, are all potential pollution contributors. Obviously, the first requirement in preventing fuel and lube oil pollution is constant surveillance and consistent, good maintenance practices to detect and hence prevent or correct leaks and other minor problems before they become major problems. Recognizing the need to protect against any onboard spillages, both General Electric

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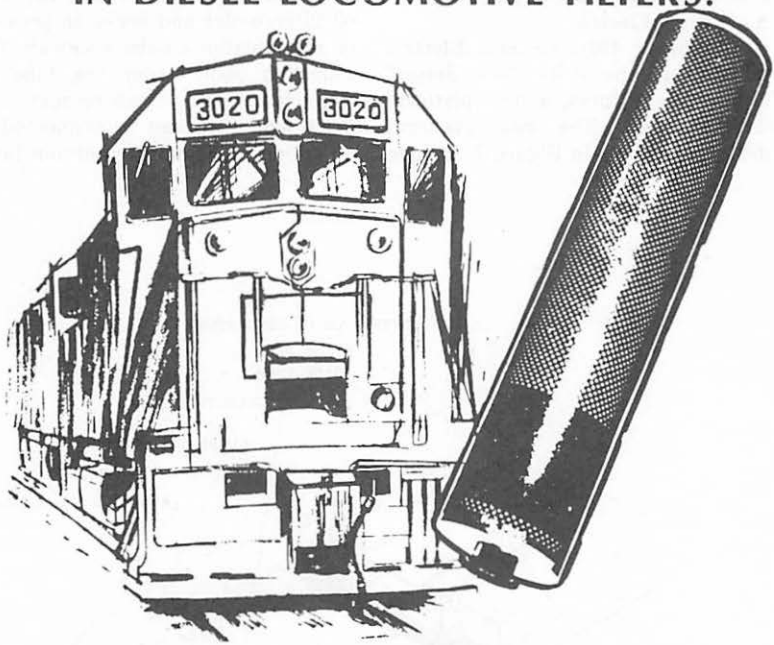

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and Electro-Motive have developed and incorporated various platform and carbody drainage systems in current locomotive designs. Catchment or retention tanks are, in both instances, available as optional equipment.

A. **General Electric**

In January 1975, General Electric initiated, as one of its "New Series" locomotive features, a new platform drain system. The new platform drains, as shown in Figure 7, include an engine room drain system that incorporates: (1) a sump under the engine that slopes toward the lube oil filter/cooler area, and (2) narrow sumps along the inside of the engine hood that also slope toward the lube oil filter/cooler and serve to prevent oil accumulation on the walkway. The collection point under the lube oil filter/cooler has, as can be seen, two drain pipes that can be connected to an optional 100-gallon retention tank.

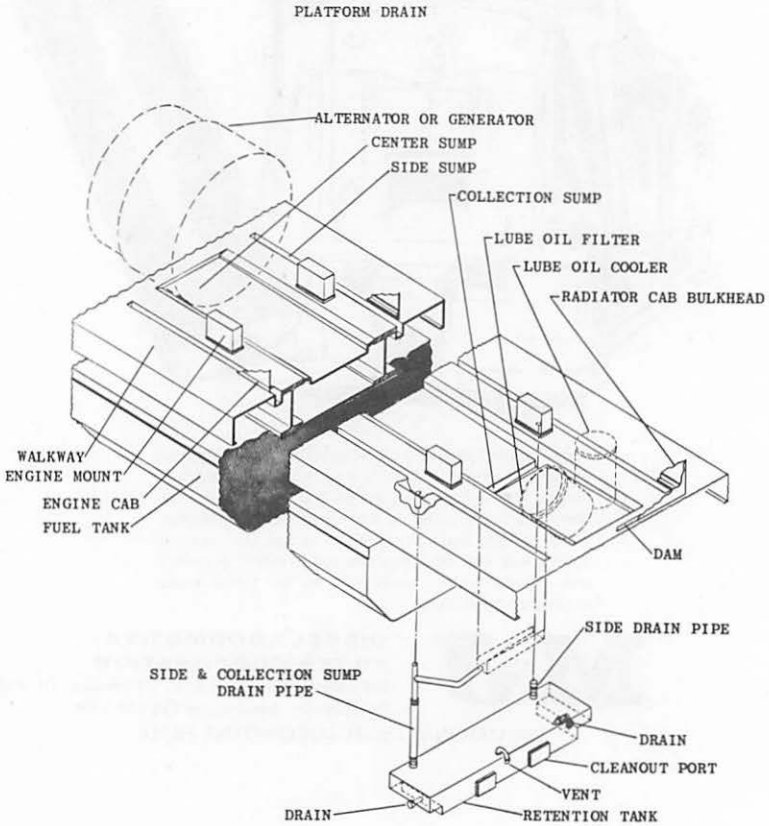


Figure 7

Figure 8 illustrates the arrangement for collecting and draining accumulations from the radiator compartment. Leakage and spillage substances are collected in the radiator compartment sump and, if the locomotive is so equipped, drained through connected piping to the optional retention tank.

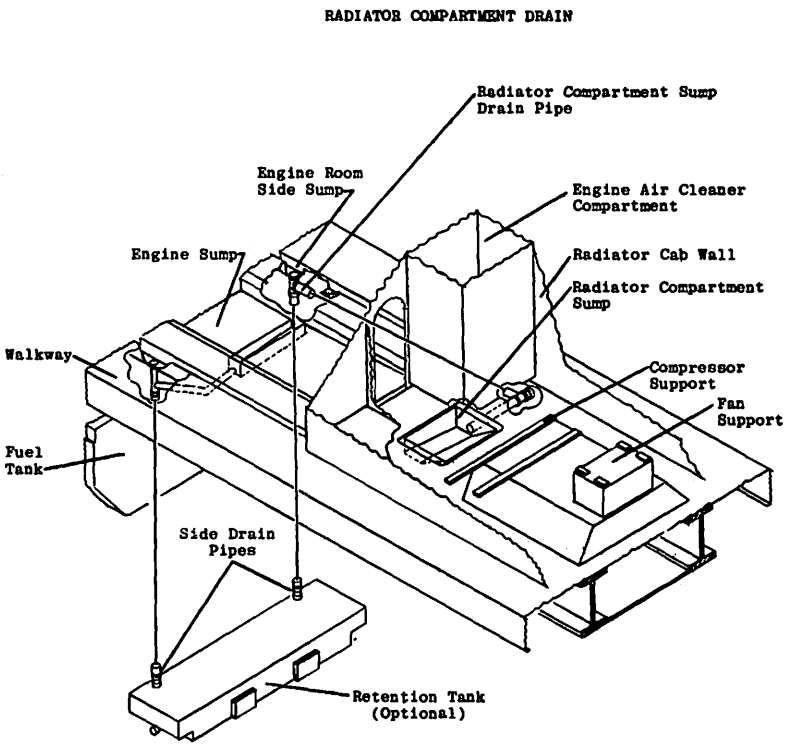


Figure 8

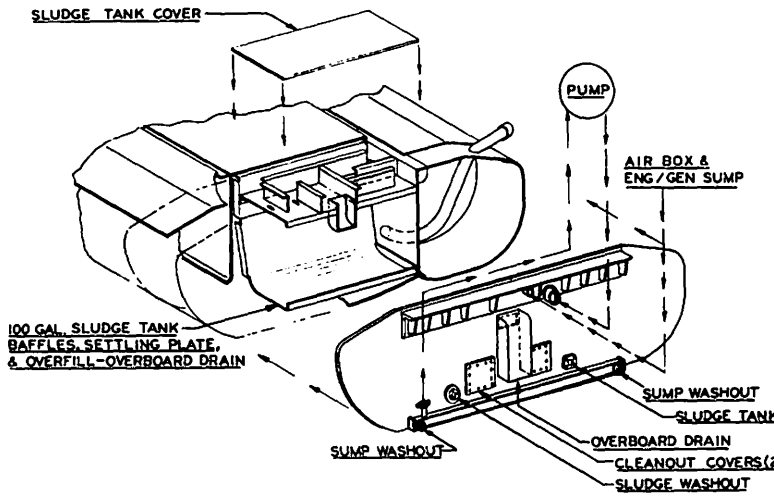
B. **Electro-Motive Division of General Motors**

Figure 9 depicts the retention tank arrangement offered by Electro-Motive as an option to current locomotive designs. The retention tank is an integral part of the main fuel tank with a piping connection for piping from the air box drain and the engine sump drain. The tank is designed to hold 100 gallons.

C. **Retro-fit of Locomotives**

A member of our committee has investigated possible retro-fit arrangements on an EMD Model SW-1200 switching locomotive. No drawings have been prepared to date, but the investigation seems to indicate that retro-fit on some locomotives would be difficult and not advisable.

It is suggested that the SW-1200 Locomotive have a collection reservoir



EMD FUEL TANK WITH RETENTION TANK
REFERENCE EMD DRAWING 8495762

Figure 9

of at least fifty gallons. A reservoir of the above capacity would allow the locomotive to be away from an engine terminal for a reasonable amount of time. If we assume that it would not be advantageous to further reduce the fuel tank (present capacity approximately 600 gallons) then other reservoirs would be required. Investigation indicates that space does not exist for a tank of a 50-gallon capacity without seriously destroying accessibility to components requiring maintenance. It does appear possible to provide two small rectangular section reservoirs to lay on top of the fuel tank, one on each side behind the air radiating piping. It is estimated that each reservoir would hold only 17 or 18 gallons. The collection reservoirs would also effectively block off the opportunity to inspect the fuel tank securing bolts which must be replaced from time to time.

The principal connections to the collection tank would be the two air box drains at the rear of the fuel tank and the pit drain below the equipment rack at the front. Piping would be awkward at the front due to the amount of space which the radiating piping occupies. An air admission opening (vacuum breaker) should be provided in the air box drain piping to prevent any possibility of siphoning under adverse conditions.

The collection tanks must be provided with cleanout openings to remove grit and sludge. The collection tanks must also be provided with an overflow so that excess water would be discharged and the oil retained.

Means must be provided, possibly from the cooling water circuit, to heat the retention tanks in order to permit rapid draining of the collected oil waste at the terminal in cold weather. Facilities would have to be provided to receive the waste oil.

The conclusion reached by our committee member making this investiga-

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tion is that he would "not recommend or encourage the retro-fitting of waste oil collection tanks as most railroads can ill afford the additional burden."

D. **External Collector Systems**

Undoubtedly the largest single source of fuel oil waste occurs at the fueling stations in the form of spillage. Development of the automatic fuel nozzle and its widespread acceptance by the railroads have effectively reduced fueling station spillage. However, fueling equipment maintenance is inadequate, and the lack of fuel nozzle fitting standardization necessitates the use, or more appropriately, facilitates the misuse, of a variety of adapters. These factors tend to prevent further progress in the reduction of spillage. And at best, it seems unreasonable to expect that spillage can ever be eliminated entirely. Thus collection facilities should be provided. The more effective and ecological acceptable fueling station and locomotive storage location designs appear to be totally constructed of impervious concrete or a combination of concrete platforms and metal pans between the rails and/or between the platform and the rails. An example of metal pans between the rails is shown in Figure 10. This collector system, produced by The Armco Steel Corporation, is made up of steel pans and aprons which are installed directly over the railroad ties. The basic unit is 19 ft. in length, but the units can be joined together to form longer collection areas.

The system has three basic components: the center collector pan between the rails, side pans for collection on both sides of the track, and cross drains. The pans empty into the cross drains with the spillage or drainage then flowing into an underground

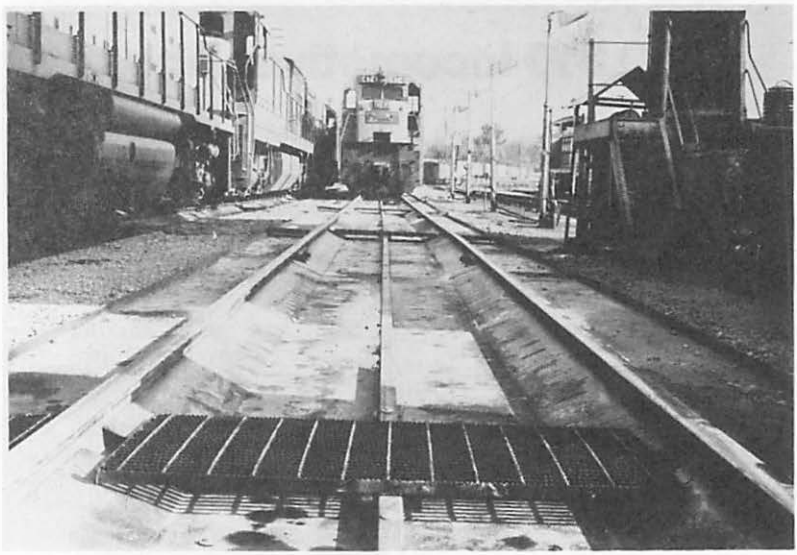

Figure 10

piping system. The piping system is connected to a grit chamber, oil separator, or other treatment facility. The system can be removed for routine maintenance or movement to another location.

E. Fiberglass Pans

Some railroads have installed fiberglass pans at low volume fueling stations. The results of the fiberglass installation seem satisfactory in terms of wear and deterioration. The railroads using the fiberglass have stated that the installation can be repaired easily. Damaged sections are cut out and filled with a new mat and resin.

The first fiberglass installations were much cheaper than the metal pans (estimated at 60 percent). However, a recent investigation by one railroad indicates that fiberglass has increased in cost considerably. This railroad found that fiberglass is not as cost attractive as it once appeared.

The committee was not able to discover any substantial cost savings which can be generated by the above locomotive modifications or facility installations.

III. LOCOMOTIVE INFORMATION SYSTEMS

In previous papers, this committee has reported on computer systems outlining the types of information requirements locomotive management considers important. In this paper one member road has been selected as an example of information requirements and how this information is accumulated. The member road exemplified in this paper is the Illinois Central Gulf.

The ICG's system is called MACS, which stands for Motive Power Accounting and Characteristics System. This system was developed for the Mechanical Department to improve maintenance of the motive power fleet and to provide management with a better insight into problem areas. The system utilizes an outside vendor and inhouse time-sharing option with the MACS network.

Data stored in MACS are received on input forms covering all aspects of locomotive maintenance. These forms are prepared by line supervisors and when completed are sent to the central office in Chicago. Only the Chicago office has the facilities to enter information into the computer.

The basic source document is the Unit Work Report (Figure 11). This report is completed any time a locomotive enters a repair shop for scheduled maintenance, running repair, accident damage, FRA inspection, heavy repair or rebuilding. The Unit Work Report is broken into five parts. They are:

(1) Owner identification code, locomotive number, date and time in shop, date and time OK'd for service, date and time dispatched, and any delay time caused by material shortages.

(2) Reasons in shop. One or more of these reasons can be checked to indicate the reason the locomotive was shopped.

(3) Defects or repairs performed. MACS has supplied 959 three digit defect codes covering virtually every known type of repair that can be performed. Listed on the back of each form, the proper code covering the repair made is selected and entered in the column under "Defect Code". Under Position there is a column to indicate #1 or #2 engine as in the case of an E-8 locomotive. Should the com-

ponent be designated by position number as in the case of a power assembly, this number is to be entered in the center of this column. In the event the component is a water pump either R or L would be circled indicating right or left. The next

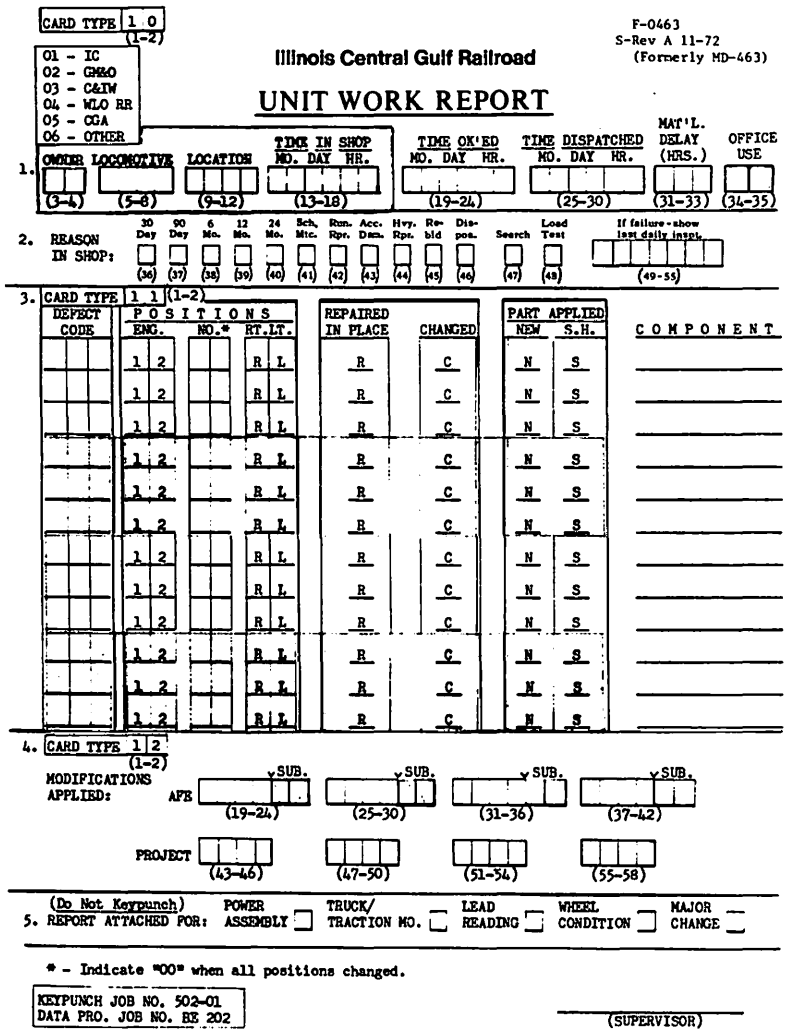

Figure 11

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section within this group indicates whether or not repairs were made in place or the component changed out. The fourth column in this group has to be marked by circling either N for new material or S for second hand material.

(4) Modifications applied. Programmed modifications are given a code number when they are issued. As these projects are performed, the number assigned to each is entered in one or more of these blocks.

(5) Certain types of repairs require additional source documents. When these documents are completed, the appropriate block is checked indicating an attachment.

The Power Assembly Report, another input form, is completed whenever a power assembly is replaced in the diesel engine. This form is a card that is attached to the completed assembly by the reclaim shop. Information is entered by the reclaim shop as to serial numbers of the head and liner as well as to whether they are new or reclaimed. If the component was reworked by another manufacturer, the code number assigned to that firm is entered in the appropriate space.

The using shop removes this card when installing the assembly and enters the locomotive number, shop location, month and date, position number, and the lead reading when installation has been completed. The card is then attached to the work report and the appropriate block checked in section 5. The service life of individual components and a comparison of manufactured parts can readily be determined from this information.

Another report entitled Traction Motor and/or Truck Changes is completed any time a traction motor or truck is changed. Truck and traction motor serial numbers are entered on this report beside the proper position number. A continuous computer survey is maintained to evaluate service life and frequency of changeouts under specific locomotives or types of locomotives. This constant observance helps to evaluate the performance of the overhaul shop and the manufacturer of traction motors.

Diesel engine lead readings are recorded on the Locomotive Diesel Engine Lead Reading Report. This report is made out when the annual or biannual inspection is made and whenever an assembly is changed. Lead reading reports, in conjunction with lube oil spectrographic analysis, pinpoint thrust washer and wrist pin problems quickly before serious engine damage occurs.

The Wheel Condition Report is completed on each Federal inspection and at the time of individual wheel or truck change. This report provides enough advance notice to allow the scheduling of locomotives requiring wheel truing or change to a shop location equipped to handle this type of work.

The last type of input is the Major Component Change-Out Report. This report is completed any time the turbocharger, main generator, batteries, air compressor, or engine are changed. Its major purpose is to provide information to program periodic change-outs or scheduled maintenance of major components and determine service life.

Reports are sent to the general office each day. As these reports arrive, they are visually checked for

obvious mistakes, keypunched and entered into the MACS system.

A large portion of this information is available to shop personnel using the on-line system. Twenty maintenance facilities have Western Union Telex machines that give them access to the system. Information available to these shops is inspection data, last fifteen defects, laboratory lube oil analysis, last oil change, scheduled maintenance information, and all tests and modifications due. Another type of inquiry, through this system, is the present location and destination of each locomotive. With this information, each major shop has a rapid source of information on approximately 1100 locomotives.

The MACS system utilizes an IBM 370/155 main frame with 3330 disk. Included is a TP computer containing 1,024,000 bytes of memory using an additional 370/155 as a backup and for batch processing.

The system can analyze the service life of all major components and inform the maintenance force which specific classification of locomotive contributes to a high rate of failure or frequent component change. An additional vital report printed monthly is the Locomotive Operating Statistics Report which contains data on locomotive performance for each classification, cost per mile, cost per unit, average age, total available tractive effort, and horsepower.

Timesharing is presently being used in a variety of areas by the Mechanical department, such as in lube oil analysis of both spectrographic and physical examination. A matrix report reveals where the majority of problems exist in lube oil contamination, enabling the Mechanical people to concentrate on the problem source. A second type of timesharing report, using the matrix format, is printed on a monthly basis indicating all line of road failures. An additional report which schedules each locomotive to be Search tested is produced on a regular basis. The number of broken crankshafts has been dramatically reduced through the usage of matrix reports and other statistical data which enable the ICG locomotive management to concentrate on trouble areas.

The potential of the computer is almost unlimited; the MACS system is being continually expanded and improved to encompass the information requirements of locomotive maintenance, improve reliability and availability, and to better manage the railroad.

IV. CLEAN CAB PROJECT

Our committee would like to thank Mr. Keith L. Hawthorne, Manager Safety Research Division of the AAR, for his assistance in the preparation of this section of our report.

A. Background

The Locomotive Control Compartment Committee was formed in 1971 to be charged with the responsibility of assessing "... the possibility and/or feasibility of effecting improvement in the design, location, and construction of control compartments not only to enhance the safety of cab occupants in the event of collisions or derailments, but to achieve an optimum environment under normal operating conditions." The committee is made up of members from the Association of American Railroads, United Transportation Union, the Brotherhood of Locomotive Engineers, and the Federal Railroad Administration.

The FRA funded two pertinent studies that were presented to the committee in mid-1972. The purpose of

these studies was to identify the hazards and potential hazards which existed in the cabs of locomotives. The data presented in these studies, entitled Human Factors Survey of Locomotive Cabs and Categorization of Accidents and Injuries in Cabs of Locomotives, were obtained from FRA records and information provided to the contractors during visits to several railroads.

The AAR Research Department initiated the Locomotive Clean Cab Project on behalf of the Locomotive Control Compartment Committee. Electro-Motive Division of General Motors and General Electric Company were contracted separately by the Research and Test Department of the AAR. The major portion of the project expense was provided by the builders with the AAR providing "seed" funds. These contracts were made in the belief that the railroad industry and the locomotive builders could accomplish the near-term reduction of hazards in the cabs of locomotives. Copies of the studies were provided the locomotive builders and they were requested to prepare cab mock-ups. The mock-ups were to incorporate as many hazard reduction features as practicable. The builders were also instructed to incorporate proposed changes within current production-designed cabs with a few dimensional and structural changes as possible.

In December, 1973, the AAR presented the Locomotive Control Compartment Committee with the procedural agreement "Guidelines for Review and Approval of 'Clean Cab' Mock-ups of Locomotive Cabs". Following is the guideline approved by the committee.

The AAR has contracted with the General Electric Company and the Electro-Motive Division of General Motors for so-called "clean cab" mock-ups. These are intended to provide an opportunity for studying possible improvements in the work space in the locomotive cab so as to increase its safety and increase the efficiency of work performed in the locomotive cab.

The mock-up is not intended to result in major changes in the configuration of the cab; that is, the present envelope of the cab is intended to be continued in use. However, within the present envelope of the cab, all efforts will be made in the mock-up to reduce the potential for contusions, cuts, and bruises resulting from impact of the occupants of the cab on protusions.

Other steps in the cab design are being taken to attempt to reduce the facility with which foreign objects can enter the cab, to reduce the potential of minor accidents in the cab such as those involved in falling due to slippery floors, injuries from the closing of the cab door on the hand of the cab occupants, or the breaking of the water bottle.

The AAR has delegated the responsibility for final approval of final changes in the locomotive cab mock-ups to the Locomotive Control Compartment Committee. To that end, the following steps are contemplated:

1. The mock-ups will be viewed by the Locomotive Control Compartment Committee when they are available.
2. Changes will be suggested and agreement will be made on those changes to be incorporated in the cab mock-ups.
3. When those changes have been

made, a series of visitations will be scheduled with all interested parties to the locomotive cab starting in January or February, 1974, and completed by early March of 1974. A member of the Locomotive Control Compartment Committee will accompany each group, and Mr. Hawthorne of the AAR will also accompany each group visiting the mock-ups.

4. Suggestions made by each group visiting the cabs will be described in detail and submitted to the Locomotive Control Compartment Committee for its review and consideration not later than the end of March, 1974.
5. The Locomotive Control Compartment Committee will adopt those recommendations compatible with the overall objectives of the clean cab mock-up.
6. On behalf of the Locomotive Control Committee, the Research and Test Department will present these recommendations to the Mechanical Division of the AAR in the form of a recommendation that they be incorporated in what will be considered to be the new standard locomotive cabs on GE and EMD locomotives. Each cab will be different because of the different configurations of the locomotives and the impossibility of achieving total standardization of a locomotive cab at the present time.
7. Action will be requested by the Mechanical Division of the AAR in time to permit production of the improved locomotive cabs early in 1975. This time delay is necessary because of the regular problem of the time required for making engineering drawings, developing manufacturing procedures, ordering parts, and beginning the assembly of the improved locomotive cab for installation in production locomotives.
8. If it is feasible to incorporate some features of the improvement in earlier models of the locomotive cab, not incorporating all of the proposed new standard features, enthusiastic support will be given by the Locomotive Control Compartment Committee to such action on the part of any individual railroad and each of the locomotive producers.

On March 12 and 13, 1974, the AAR Mechanical Division's General Committee and Locomotive and Electrical Equipment Committee reviewed the proposed mock-ups. Approval was granted by the AAR Mechanical Division for a special letter ballot approval. In the 1974 letter ballot the following items were approved:

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Proposal	Item	Purpose
1	Door Closure Bar	To eliminate many of the cab door related finger injuries which occur when the door closes abruptly.
2	Door Hinge Guard	To prevent intrusion of fingers into the hinge area and consequent finger injuries.
3	Head Bump Pads Over Doors	To reduce the occurence of head injuries resulting from striking against the upper edge of the door frame.
4	Windshield Wiper Motor Covers	To prevent occupant injuries resulting from impact against protruding sharp edges and corners.
5	Wiper Motor Handle	To prevent injuries which result from a cab occupant's head striking against a parking handle.
6	Outside Access to Headlights and Road Number Lights	Reviews of grade crossing collisions involving the release of hazardous materials have shown that number lights panels provide a principal path of hazardous materials into cabs.

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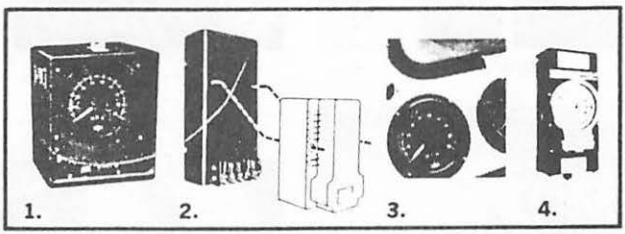

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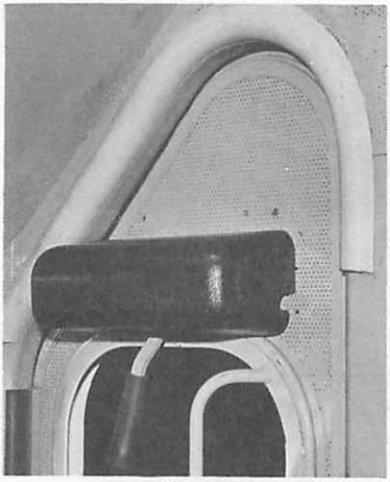

Figure 12

Figure 13

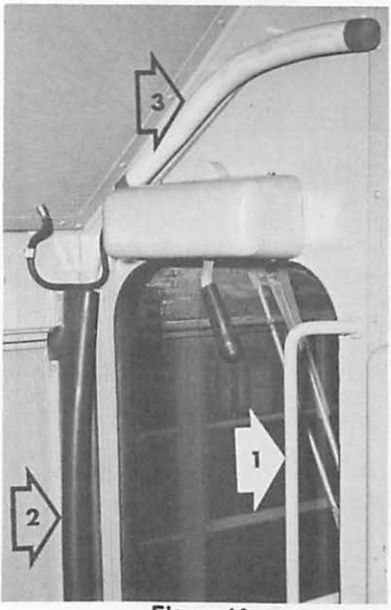

Figure 14

Figure 15

The above items are standard on both GE and EMD locomotives after June 1, 1975. Figures 12 and 13 show the approved items as they appear on GE locomotives while Figures 14 and 15 indicate EMD locomotive items.

Future

A second letter ballot will be submitted for approval during the summer of 1975. If approved, the following items will be standard on all locomotives (where required) ordered after January 1, 1976. 1. Standard Water Cooler Alcove, 2. Standard Radio/Control Head Receptacle, 3. Modified Sun Visors, 4. Recessed Wiper Valves, 5. Flush Mounted Cab Light, 6. Recessed Cab Light Switch, 7. Rounded Corners on Defroster Ducting, 8. Toilet Room with Floor Drain and Non-Directional Ventilator, 9. Full-Length Short Hood Door, 10. Guard Rail, 11. Recessed Engine Control Panel, 12. Horn Valve (lowered with Rubber Grip). 13. Rounded Window Latches. Some of the above items are available on locomotives currently being produced. Other items, such as scuff-coated floors, were available in the past.

Cab Seats

The AAR is also investigating a "Standard Improved Locomotive Cab Seat Project". The AAR has supplied grants to Jaggers Equipment Company and Coach and Car Equipment Corporation for the preparation of prototype seats. These seats are being designed to include human factors and structure guidelines which were proposed by the Department of Transportation.

When the prototype seats are complete, the AAR intends to extensively test them, both structurally and in-service. It is felt that the proposed seats will be safer and more comfortable. It is hoped that the seats, built to industry-wide standards, will be less costly to purchase than many of the models currently available. The cost reduction is based on the concept of increased manufacturer efficiency available through increased production runs.

Through industry cooperation, it is hoped that the action taken to date, and in the future, will help to improve railroad safety. Improved safety for employees, public, equipment, and property is a major goal of every railroad officer.

Summary

Training of Mechanical Department personnel, management or craft, is becoming more critical as locomotive systems become more complex and skilled mechanics retire. The training methods may vary, but the goal of obtaining "smarter workers" is foremost in all training programs.

Oil collection drainage systems attached to the locomotive or included in the design of locomotive facilities are increasing the overall expense of railroad operations. Many railroads have already spent large amounts of money for automatic fueling nozzles. For some marginal railroads, the additional capital required for further modifications is difficult to obtain. The committee feels that additional innovation is required in order to reduce the current cost of collection systems.

Computerized locomotive information systems have provided Mechanical Department management with data that were not available a few years ago. This area is still in the development stages and will become a more important tool in the years ahead. We hope to discuss other computer applications in future presentations.

The "Clean Cab Project" is an example of railroads working with other organizations to improve railroad safety and working environments. It is through these types of projects that our industry shows the desire to progress.

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On April 1, 1954, representatives of eight railroads operating in Cleveland and representatives of railroad supply companies met to organize the Great Lakes Railway Diesel Club.

This club is dedicated to the purpose of promoting mutual and educational interest of its members by reports and discussions for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men engaged in supervising any branch of railway work and railway supply with kindred interests, and to cultivate good fellowship.

Membership of the club is limited to supervisory railroad personnel and representatives of railroad suppliers or persons especially qualified in the opinion of the directors to promote the objective of the club.

Five business meetings will be held annually. One meeting will be scheduled in each of the following months: January, March, May, September, and November at the Sheraton Midtown Motor Inn, 3614 Euclid Avenue in Cleveland, Ohio 44136.

R. J. KETTERINGHAM
Secretary
4236 Bentley Drive
No. Olmsted, Ohio 44070

Tuesday, September 16, 1975

2:00 P.M.
REPORT OF THE COMMITTEE ON SHOP EQUIPMENT

Pre-Convention Presentation: Great Lakes Railway Club

May 15, 1975 Sheraton Midtown Motor Inn Cleveland, Ohio

KJELL AXELSON, Chairman
General Manager
Work Equipment & Machinery
Burlington Northern Inc.
St. Paul, Minnesota 55101

VICE-CHAIRMAN

E. R. Hafling, Assistant Mechanical Engineer, Atchison, Topeka & Sante Fe Railway, Topeka, Kansas 66612

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1975 TOPIC:
"PROGRESSIVE APPROACHES TO PAINTING, CLEANING, AND RECLAMATION"

PERSONAL HISTORY

Kjell Axelson

Kjell Axelson was born in Oslo, Norway, arriving in the United States in 1925.

He graduated from the McCook, Nebraska Public High School and the McCook Junior College (University of Nebraska Extension School).

Mr. Axelson entered the service of the Chicago, Burlington and Quincy Railroad as a Machinist Apprentice at McCook, Nebraska in March of 1941, taking an International Correspondence School course during his apprentinceship.

In September of 1942, he entered the United States Navy and after having graduated with honors from the Naval Machinist's Mate School at the University of Minnesota, was retained as an instructor. A later request for sea duty brought tours of duty aboard a destroyer escort in the Atlantic and Pacific, after which he served aboard an Aircraft Training Carrier on Lake Michigan until his discharge as a Chief Machinist's Mate in October, 1945, at the close of World War II.

Upon his return to the CB&Q, he received his Machinist Apprentice Indenture, worked as a Machinist and Machinist Federal Inspector in Omaha, Nebraska, was progressively promoted to Assistant Night Roundhouse Foreman at Lincoln, Nebraska, Night Roundhouse Foreman at Greybull, Wyoming, Staff Mechanical Inspector out of the Superintendent of Motive Power Office, Chicago, Illinois, Terminal General Foreman at Galesburg, Illinois, Assistant District Master Mechanic at Galesburg, Illinois and District Master Mechanic at Alliance, Nebraska, Supervisor of Methods and Machinery on the staff of the Chief Mechanical Officer of the Burlington Lines (CB&Q, C&S and FW&D), out of Chicago, Illinois, Manager of Production Standards-Motive Power, Burlington Northern Inc., St. Paul, Minnesota prior to his present position as General Manager of Work Equipment & Machinery at the Burlington Northern Inc., St. Paul, Minnesota, General Office.

Mr. Axelson also has served as a committee member on the A.A.R. Wheel and Axle Committee and the AAR/OSHA Ad Hoc Committee, as well as being a past member of the Chicago Diesel Club and the Car Foreman's Association of Chicago.

He was married to Arlene Frances Walters of McCook, Nebraska, on June 29, 1941, and they have one married son.

INTRODUCTION

In regard to this year's Convention theme of "progress", we would like to point out that the measure of progress is not only the ability to look back to see where you have been, but also the ability to look ahead to see where you are going.

The easy part of progress is to look back and pick out the mistakes, but these past mistakes are an important ingredient for the building block research of future progressive planning.

At any given point in time, the question always seems to be "Where do we go from here"? There are many influencing factors that motivate a decision for change but to bring this matter into better focus for an industry such as transportation, and railroads in particular, the motivating force pretty well boils down to an economic factor as the cause for our desire to progressively improve.

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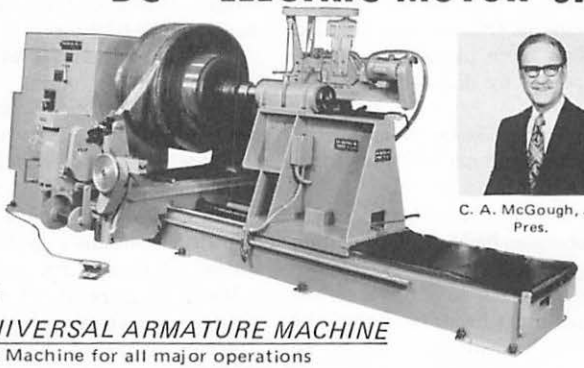

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on progress and the best testimonial to this progress, is the fact that the industry spans some 270 years since its inception as wagons being pulled on wooden rails by horses, as early as 1705 in England. Our industry is still a commanding force in today's way of life, but pulled by different types of horses.

Much credit must be given to the far-sighted forerunners of our industry, when you stop to think of the limited research and technology that our predecessors had at their disposal.

These people realized that a more economic approach to motive power than horses must be developed if the full potential of railways were to be exploited. Some of the early experiments and research included the use of sails, treadmill fitted locomotives powered by a horse, inclined tracks where cars coasted for nine miles by gravity with mules riding in one car and then using the mules to pull the cars back to the top of the grade.

Progress prevailed until Richard Trevithick of Great Britain built a workable three-wheeled, steam powered vehicle in 1797. Another Englishman, George Stephenson brought the locomotive to a much higher degree and more practical stage of development in the first three decades of the 1800's until finally, in 1829, his famous engine, the "ROCKET", weighing 4-tons, pulled a 14-ton load. This provided the economic breakthrough for a practical transition from the hay burning horse to the "Iron Horse."

In the same year of 1829, the first steam locomotive ever operated on a *commercial* track in America was the 7-ton "Stourbridge Lion," imported from England by the Delaware and Hudson Canal Company to make its historic 16 mile run between Carbondale and Honesdale, Pennsylvania.

From these seemingly humble and frustrating beginnings, the progressive evolution of the steam locomotive brought it to the status of a precision machine in the 1940's.

Once again, the motivating factor of economics was forcing progressive change and this time, human ingenuity replaced the steam locomotive horsepower with diesel-electric horsepower.

In the relatively short period from the late 1920's to 1960's, the diesel-electric locomotive put the "Iron Horse" out to pasture.

History has recorded as fact, that the progressive growth of railroads in America is one of the revolutionary changes occurring in the 19th century. It has had important and profound effects in periods of history that embrace frontier expansion, the industrial revolution and various wars.

The significance is that the *progress* of *motive power development* provides the *greatest* impetus to force or motivate other necessary operating or support concept changes.

Many of you have been very instrumental in the support changes that have been required and made to date, in this transition from steam to diesel. We also recognize that the job is not yet done and that is the reason we are still searching by trial and error through the auspices of conventions such as this. It provides one more avenue of exchanging ideas and provoking further thought.

As part of the contribution towards continued progress, this committee presents some developments and ideas on economic improvement support for modern motive power in the following areas:

I. Painting

II. Internal Carbody Cleaning

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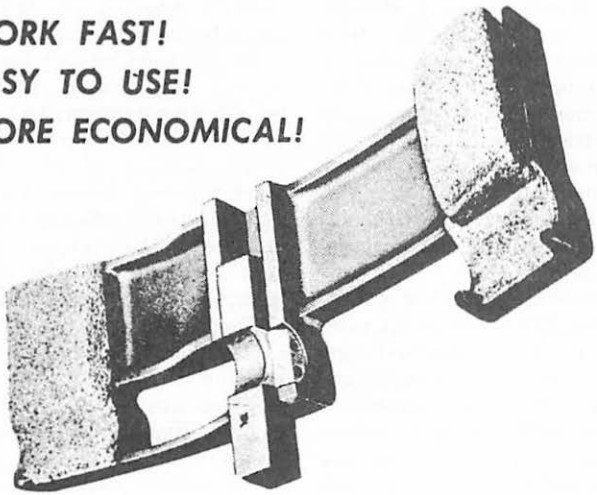

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III. Component Reclamation
IV. Improved Tooling and Equipment Progress

I. PAINTING

One of the most dramatic and outwardly noticeable support changes accompanying the transition from steam to diesel locomotives is painting.

From the basic black enamel of the steam locomotive we have progressed to the intricate paint schemes of today's diesel locomotives, which utilize seemingly endless shades and types of paints, such as lacquers, acrylics, polyurethanes and silicones, as well as alkyd enamel.

To permit efficient handling of these intricate designs and new paints, paint equipment and facilities had to change.

In a relatively short time, equipment technology rapidly progressed from the blowpipe-type spray nozzle, which generally was a piece of pipe with a flattened end, to the well-known air spray guns, and finally to the modern and recently introduced Varispray-type nozzle.

This Varispray nozzle fits airless guns of any manufacturer and permits immediate hand adjustment of paint volume or pattern width without changing tips. This fingertip control breakthrough should produce labor savings, material savings and reduced tip inventory investment, thus helping to release the locomotive sooner.

The benefits of airless spraying are more uniform mil thickness, a better finish, reduced paint loss, and better environment control because of reduced overspray.

This change in techniques forced a change in equipment from the old pressure pot type unit that literally blew the paint, to a machine that pumped the paint out as a solid material without any air entrained, such as the Spee-Flo Hydra-Airless unit illustrated here.

The Paint Industry soon came up with another change, the *hot airless* spray system. Heating units that could be mounted on portable paint units also were developed.

The Chessie System states that use of the hot airless spray system permits a 4 mil coverage with one coat where it took two coats of the air-spray. Because of less overspray, there will be a 50% saving in paint. Paint waste is less because the hot airless goes on the work and not out the vent. And with no need to thin the paint, there is a savings on thinner.

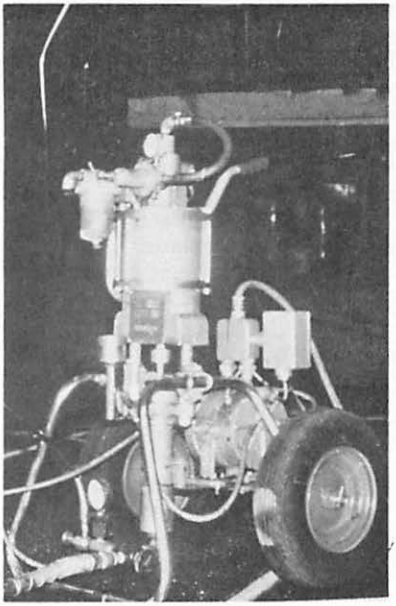
The transition in painting also advanced more rapidly than many railroads could react to with Capital Expenditures for the completely new facilities required if full potential in savings are to be realized.

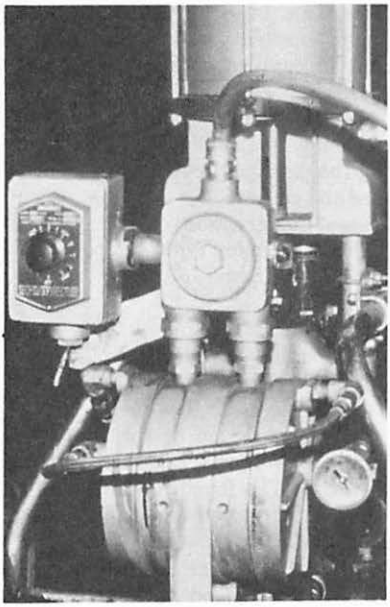
The modern portable airless equipment with which you are now all familiar, can be utilized as an effective beginning anywhere, but we will now outline how some roads effectively upgraded an existing stub track facility or planned and constructed an entirely new run-through facility in the interest of progress.

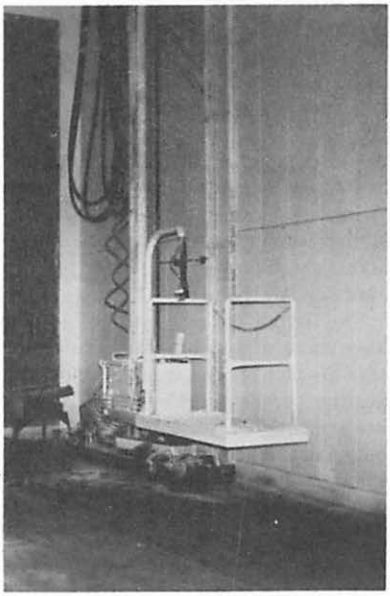
Locomotive Paint Spray Booth

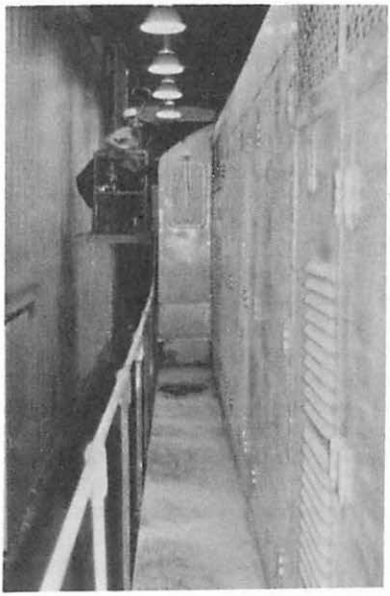
Increased concern for our environment has resulted in emphasis on the effects of air pollution on mankind and nature. Two sources of air contaminants are paint overspray (particulate emissions) and organic solvents used in paints(hydrocarbon emissions).

Some railroads have changed to reformulated paint using exempt solvents which are non-photochemically reactive. These types of paints usually increase the limit in pounds per day or hours to a quantity higher than their present production pro-









duces. This, in turn, relieves them of the responsibility of installing equipment to capture or scrub the paint vapors.

However, many railroads find it necessary to install paint booths so that the paint particulates can be confined and collected.

General Construction

There are many types of booth configurations. Some of them are as follows:

1. Downdraft
2. Modified downdraft
3. Traveling spray booth
4. Horizontal air flow

The construction of the first two booths allows for a run through-type operation. The fourth type usually is "stub end": locomotives must enter and leave in the same direction.

The National Fire Protection Associations recommend in Pamphlet #33 that the interior surfaces of the booth be a minimum of 18 gauge steel, smooth and continuous. A peelable coating should be applied to the interior of the booth. When this coating becomes built up with paint it can easily be removed. The booth should have enough pedestrian doors to prevent employees from being trapped in case of fire.

Ventilation

If more than one booth is to be constructed, each should have an independent exhaust system discharging to the building exterior. The total amount of air to be exhausted is based upon (a) the configuration of the booth, which usually dictates the required velocity through the booth, and (b) the cross sectional area through which the air must travel. The minimum velocity is usually 100 fpm (feet per min.)

The fans' construction should conform to NFPA #33 and #91-1961 recommendations. The exhaust ducts should have adequate cleanouts to facilitate cleaning. Some type of stack cap is needed on the discharge duct to prevent reverse air flows and also stop rain from entering the booth when the fans are turned off.

Overspray filters

Many types of filter systems are available. Here are three:

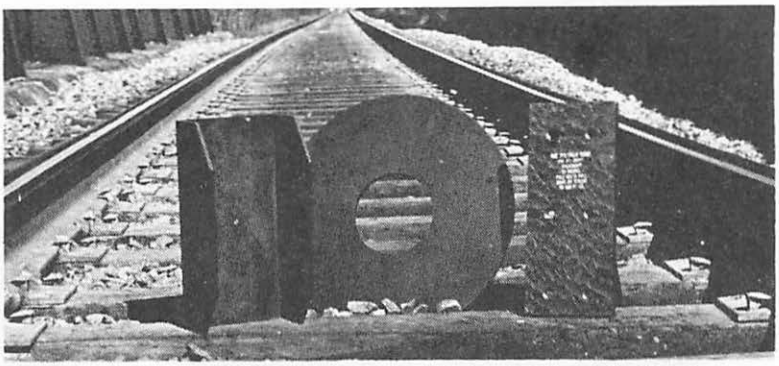
1. Water wash: paint pigments are literally washed from the exhaust air.
2. Dispo: a filter element in the form of a continuous cloth type media placed on rollers. When the cloth becomes saturated, a new section is rolled in place either automatically or manually.
3. Dry filters or paint arrestor type: oversprayed particles are trapped in dry-type filter elements. When a predetermined pressure drop exists, the filters are discarded.

Warning Device

A warning device should be installed to indicate that the required exhaust air velocity is being maintained. The type of device chosen would depend on the filters used. If dry filters are used, an inexpensive visible resistance gauge can be installed to measure the pressure drop across the filters.

Make-up Air System

The make-up air system should have its own power blower system so that the paint booth is maintained at a positive pressure. This feature will keep unwanted dust laden air from entering the booth. An adequate filter system should be provided on the make-up unit to keep out lint and dust. These filters should be located inside the booth for ease of removal and cleaning. In colder climates a heating



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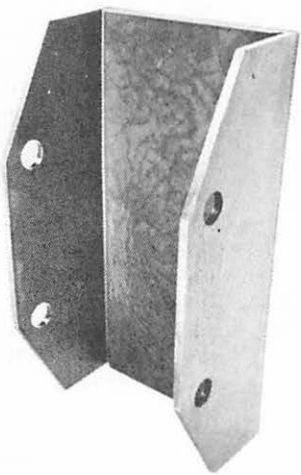
- Nylatron nylon liners generally outwear carbon steel 2½ times, and are at least equal to manganese steel liners.
- Nylatron nylon pedestal liners virtually eliminate wear on mating parts.
- Nylatron liners are one-piece construction. They eliminate problems with two-piece liner assemblies which can come loose and cause excessive wear on the pedestals that can require welding to rebuild.
- Nylatron pedestal liners weigh only 1/7 as much as manganese liners and are easier and safer to install.



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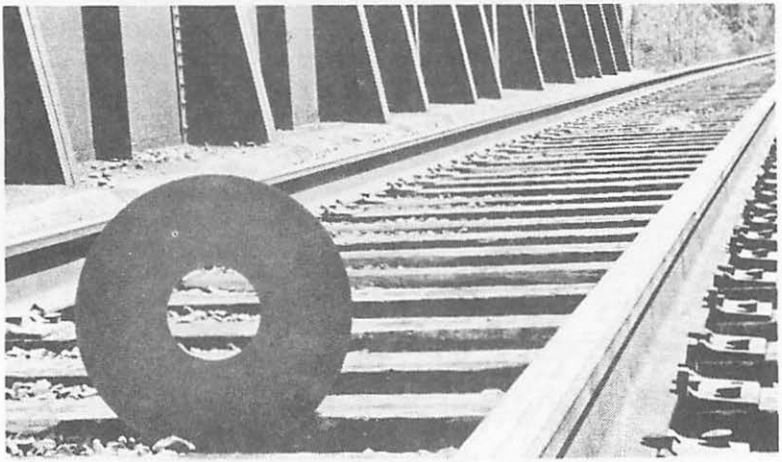

Center Plate Liners

- Nylatron® nylon center plate liners are made of the same self-lubricating and wear-resistant material as Nylatron pedestal liners and are designed for both EMD and GE locomotives.
- Molybdenum disulphide solid lubricant provides Nylatron nylon center plate liners with excellent wear resistance.
- Nylatron center plate liners cost less than the filled phenolic parts you are probably using on your locomotives now.
- The excellent resilience of Nylatron nylon center plate liners enables them to withstand heavy shock loads without cracking.

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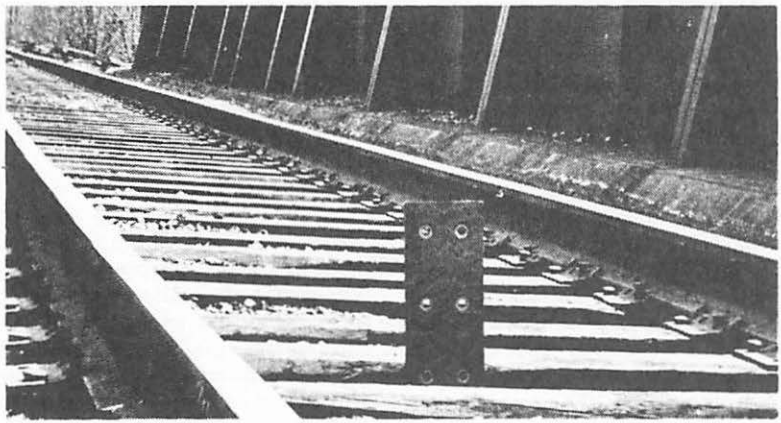
NYLATRON® LOCOMOTIVE PARTS...



Bolster Wear Plates

- Nylatron® nylon wear plates are made of the same self-lubricating and wear-resistant material as the Nylatron pedestal liners which outperform steel. They also incorporate a witness groove or wear line across the narrow ends ¼" from the face, which aids in the evaluation of wear.
- Nylatron nylon bolster wear plates are approved by EMD.
- Nylatron wear plates feature a unique proprietary insert which permits maximum bolting torque for installation, provides high resistance to pullout, and resists loosening of bolts under vibration. The wear plates are installed using the same procedures as for laminated phenolic wear plates.
- Nylatron wear plates cost less than the laminated phenolic you probably now use on your locomitive.
- Nylatron wear plates weigh less than bonded phenolic, which affords savings in shipping, handling and installation. The lighter weight of the Nylatron wear plate also makes it easier to handle and install.

Join the others who have successfully replaced steel with Nylatron nylon pedestal liners, and ask your Polymer representative for information on our Nylatron center plate liners and bolster wear plates.

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unit must be added to the make-up air system.

Protection Equipment

An approved sprinkler system is recommended by the NFPA to be installed in the booth and duct systems. These systems usually have flow switches that sound an alarm if the sprinklers are activated.

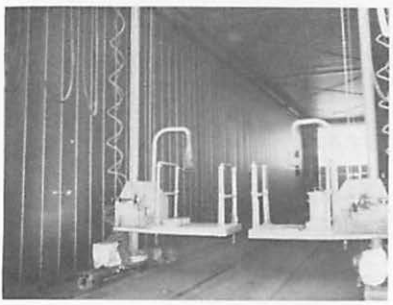
Lighting

The lighting of a paint booth is one of the most important features. One method is to install all lights behind the booth wall with glass lenses. Another method is to install the lights inside the booth. When using lights inside the booth strict electrical codes must be met. The fixtures should have UL approval for NEC as a Class I, Division I, Class II, Division II, and also should be suitable for contact with paint residue.

It is very important that the proper footcandle illumination levels be maintained, especially inside the carbody, trucks, and cab.

Paint Scaffolds

To achieve the best productivity, the painter should have easy access to all surfaces to be painted. When a traveling paint booth is used, a scaffold is usually provided on each side of the booth. These scaffolds move up and down and travel longitudinally with the booth.



Another type of scaffold used at one locomotive manufacturer and several railroads is an air-operated scaffold used two to a booth. This allows each painter access to half of the locomotive, independently. The paint scaffold has three motions:

1. Up and down.
2. Longitudinal movement full length of booth.
3. Rotation of 90 degrees.

The operator controls the scaffold's movements with air-operated pendant throttles. Shop compressed air is festooned to the scaffold for the paint spray equipment and scaffold movement components. Painting is usually performed manually by two painters using spray equipment located on the scaffolds.

Suggested Code

There are many items that make up a properly designed paint booth. These items independently and as part of the whole system must conform to many requirements of various regulatory organizations, some of which are listed here:

1. Environmental Protection Agency (EPA)
2. Local air pollution control boards
3. National Fire Protection Association and local fire departments. (NFPA Standards for Paint Spraying and Spray Booths. Vol. NBFU Pamphlet #33. Standard for Blower and Exhaust System for Vapor Removal NFPA #91-1961.)
4. State department of health
5. National and local electrical codes-hazardous locations.
6. Occupational Safety and Health Administration (OSHA).

All of the above agencies should be contacted to determine the latest regulations before installing a booth.

Run Through Painting Facility

The Illinois Central Gulf Railroad is constructing a progressive stage paint facility for painting all types of locomotives. The layout incorporates four major stages.

The first stage is where priming, inside painting, engine room and cab painting will take place.

The second stage is for primary painting. Here, the total locomotive body is painted. The major piece of equipment at this location is a DeVilbiss traveling paint spray booth with scaffolds. It provides for (1) mechanical ventilation and fresh air input, (2) collection of discharged paint overspray, (3) movable scaffolding for increased production, and (4) aids in the overall fire protection of the facility. The spray booth is power ventilated to collect or limit the escape of overspray, vapor, and residue, and to safely direct them to an exhaust system. The scaffolding equipment eliminates the need to climb on top of the locomotive hood and cab to paint.

The third stage for drying utilizes an infrared oven. This oven permits quicker drying, thus increasing productivity. Locomotives are alternated between stage two and three for applying and drying various color combinations.

The last stage is the finishing station for putting the final touches on the locomotive (stencil, apply air hoses, etc.). From here, the locomotive is ready for service.

Several major assumptions were made in arriving at the schedule of locomotive movement from stage to stage, as follows:

1. Priming and painting of the inside of engine room and cab would be done in one shift or less.
2. Paint white or orange separately, each color to require one shift or less.
3. Stages laid out assuming application of two different colors.
4. Drying will be accomplished in one shift or less for each color.
5. Finishing work will take two shifts or less.

The schedule of locomotive movements through various stages of the painting as follows.

Day #1, Shift #1 - Locomotive #1 is brought into Stage #1 for priming and inside painting. Locomotive #1 progresses on Day #1, Shift #2, to Stage #2. On Day #1, Shift #3, Locomotive #1 progresses to Stage #3.

On Day #2, Shift #1, Locomotive #2 is started at Stage #1, and Locomotive #1 is returned from Stage #3 to Stage #2 for second color application. Locomotive #1 progresses on Day #2, Shift #2, back to Stage #3 for drying of second coat. On Day #2, Shift #3, Locomotive #1 arrives at Stage #4 for cooling prior to stencilling and finishing work being done on Shift #1 and #2 of Day #3, thus finishing Locomotive #1. Locomotive #2 has progressed to Stage #2 on Day #2, Shift #2, and from here it goes to Stage #3 on Day #2, Shift #3.

On Day #3, Shift #1, Locomotive #3 is started, and Locomotive #2 is returned from Stage #3 to Stage #2 for second color application. On Day #3, Shift #1, Locomotive #2 progresses to Stage #3 for drying of second coat. On Day #3, Shift #3, Locomotive #2 arrives at Stage #4 for cooling prior to stencilling and finishing work being done on Shifts #1 and #2 of Day #4, thus finishing Locomotive #2. Locomotive #3 has progressed to Stage #2 on Day #3 for initial color application and the process continues as above.

Painting is based on a two-shift

operation, hence only drying takes place on the third shift.

The basic needs to be met by the new facility are ability to:

1. paint locomotives and component parts in a clean and controlled environment:
2. paint a minimum of 150 locomotives per year plus all related component parts;
3. paint at least three locomotives at a time because of paint drying cycles;
4. complete requirements concerning fire protection;
5. complete requirements concerning explosion-proof electrical standards;
6. filter and collect paint overspray with a water wash-type paint spray booth;
7. comply with OSHA and State EPA Rules and Regulations;
8. improve employee morale—work efficiency should increase.

Locomotive Manufacturer's Role

Products and procedures for locomotive painting are numerous and varied. However, Electro-Motive Division utilizes a system found to maximize both product reliability and productive efficiency.

In order to meet the varied requirements of its customers, EMD has a highly flexible paint shop, sub-divided into three major sections:

1. Paint preparation room consisting of two positions for sanding, cleaning, and masking prior to paint;
2. Paint shop consisting of eight controlled environmental positions in which either acrylics or polyurethane may be applied;
3. Paint annex—four controlled environmental positions for applying finishing touches.

Paint Cycle

A locomotive enters the paint facility in a basic primed state. The entire carbody is sanded to remove surface rust and weld splatter, cleaned, and then masked. Enamel is typically applied to the engine room and cab interior next, while the underframe is being sprayed from a pit underneath the locomotive. An appropriate intermediate coat is applied, depending on whether the final finish is to be acrylic or polyurethane, and then the final surface coats are added. A "pressure pot" system, whereby relatively small quantities of paint are stored in pressurized vessels, is used. The color flexibility afforded by this system is essential when considering that over one hundred shades of acrylics were applied to EMD locomotives in 1974. Lettering and fine detail work, if any, are added throughout the process at the most advantageous time.

Throughout the final process, an average of sixty gallons of paint are consumed after priming during the paint cycle, which can last from two to four and one-half shifts.

EMD locomotives with an acrylic paint covering can expect a paint service life of from four to seven years. The polyurethane units, while costing more, are expected to last approximately ten years and have an advantage over the acrylics in the areas of cleanability and long-lasting luster.

Currently, with the wide variety of styling requests by the railroads, EMD is forced to procure special paints and styling supplies (Scotchlite, etc.) for each individual order. Owing to the non-uniformity of design, many manhours must also be spent in pattern layout and fabrication. These

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two factors combine to complicate an already difficult problem of facility scheduling. With increasing labor costs adding to the problem of physically limited facilities, EMD offers for consideration, guidelines for simplified paint styling to help keep costs down.

Guidelines

High Visibility Ends

Solid nose - Example S.P.

Stripes - 12-inch or larger

A.) Horizontal-May be extended along side of nose

B.) Vertical

C.) Diagonal - Example B. N.

D.) Chevrons - 30 Degrees or 45 Degrees

E.) All appendages to be last color (usually darkest)

Basic Unit Styling

Preference is for one (1) basic color with striping and lettering of another color

Only one (1) color should be applied to grill areas

Handrails, along hood walkways, should be main body color

Pilot - No Stripes

If stripes are required, Chevrons should be used - Limits: Top of plow or pilot - One (1) plane application

Railroads today use several types of exterior finish for locomotives, including acrylic lacquer, urethane (of more than one variation) and silicone. Those paints have substantially different characteristics in application processes, drying time before masking for the next color, techniques for repairing a mistake, and some variations in the equipment required for proper application.

For example, acrylic lacquer dries fast enough to allow masking for the next color in a very few hours. Some of the urethanes require two to three times as long before the tape can be applied without danger of pulling off the paint or "spider-webbing" along the edges as the tape is removed. Even when a second color is not involved, but application of reflective striping or numbers is required, consideration must be given to the drying, since a gas is emitted as the urethane sets. This gas will prevent proper adhesion of the reflective material.

Pot life of the various paint materials is also a consideration. With acrylic lacquer, no special difficulty is found in preserving a mixture for several days, if necessary, until that color is needed again. With urethane, however, since the drying involves a chemical reaction, a pot life of 8 to 12 hours is typical once the activator is mixed with the base material. Pot life can be extended somewhat if the mixed material is refrigerated, but it still is relative short. Extra thorough cleaning of the spray equipment also is required to prevent the urethane paint from setting in the guns and hoses.

Silicone paint is even harder to repair, when an error is made, than is urethane, and the drying time before taping is also longer.

Other considerations in applying urethane and silicone paint include more attention to air temperature, relative humidity, temperature of the metal to be painted, and more elaborate breathing equipment for the workman — mask with shop air supplied through a purifier is preferred.

Many parameters apply to the choice of paint finish. Included are impact resistance, flexibility, adhesion resistance to salt spray and washing chemicals, resistance to general outdoor exposure, and gloss,

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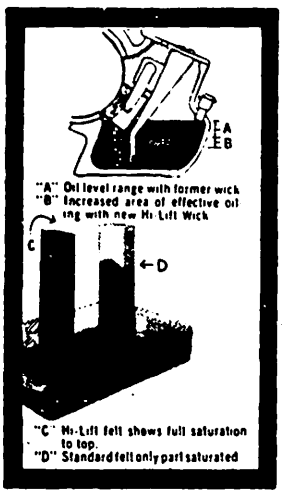


How Miller Hi-Lift Wick Lubricators cut maintenance costs

Here's a locomotive traction motor lubricator that offers 40% greater oil lift and doubled oil capacity. *Upper* picture shows increased oiling efficiency provided by Miller *Hi-Lift* wick lubricator. *Lower* picture illustrates simple test that proves greater oil-lifting ability of *Hi-Lift* felt. *Hi-Lift* felt segment ("C") is completely saturated to top with oil. Standard felt ("D") has unsaturated, white area at top. Both are same size and were placed in tray before oil was added. Details available from your locomotive builder or write direct to:

MILLER FELPAX, CORP.
Winona, Minn., Ph. 507, 452-2461

both originally and after a period of time. No one material, or brand, appears to be superior in all factors.

The several choices of urethane and silicone paints tend to be more expensive, and more is wasted because of the short pot life; cleaning time for equipment is longer, and paint spray booths may be occupied longer because of drying time requirements.

Locomotive manufacturers have found it necessary to charge extra for urethane and silicone paint finishes because of these factors.

For a railroad, careful investigation of the various paint characteristics is recommended, with a balance made of the costs, difficulty of application, and special equipment required against the benefits expected.

II. INTERNAL CARBODY CLEANING

Cab Cleaning By Suction Fan

Cab and under floor cab cleaning can be expedited by use of a movable suction device currently used on the L&N. This device consists of two 36" dia. locomotive engine cooling fans, hoods, expanded metal enclosure with urethane foam filters, a detachable plastic trash bag, hoist with elevating frame and casters. The device is set on angle iron tracks and can be pulled out of the way when locomotives are being moved. The hoist and elevating frame allow for adjustment of the hoods and fans to accommodate any type of locomotive.

After a locomotive is spotted, the device is moved manually up against the cab. Urethane foam outlines the perimeter of both hoods, which allows for the various discontinuities of different cab styles, thus providing a very efficient suction. One set of cab windows and one set of under cab access doors are opened. The door at the opposite side of the cab is opened to provide cross ventilation. The opposite under cab access door is opened or the inside cab hatch is opened to provide cross ventilation of the under cab floor area.

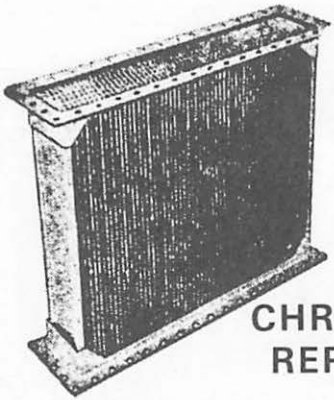
Each cab vacuum device is equipped with a blow gun connected to the shop compressed air system. The blow gun is equipped with a long extension nozzle and is used to blow out dust, dirt and other debris from the hard to get areas in the cab, electrical locker and under cab floor. All of this debris is then picked up and carried through the fan and held against the filter wall of the enclosure behind the fans. When the vacuum device is turned off, the captured material drops into the plastic trash bag, which when filled, is disposed of without allowing foreign matter to escape over the shop area. The small particles and dust matter is captured by the urethane foam filter material, lining the expanded metal enclosure.

At some locations where track space is at a premium, it is advantageous to install two units on the same side of the track. In that way, a locomotive can be accommodated in a minimum amount of space, regardless of the cab's direction.

Run Through, Manual Form Wash and High-Pressure Rinse Station

The L&N has recently placed in service a run through, manual foam wash and high-pressure rinse station for external and internal carbody cleaning. One operator is used on each side of the locomotive. Both men have complete wash and rinse equipment.

The locomotive must be spotted under the building's power exhaust hood because the engine is kept running while washing is taking place. Each operator applies alkaline foam



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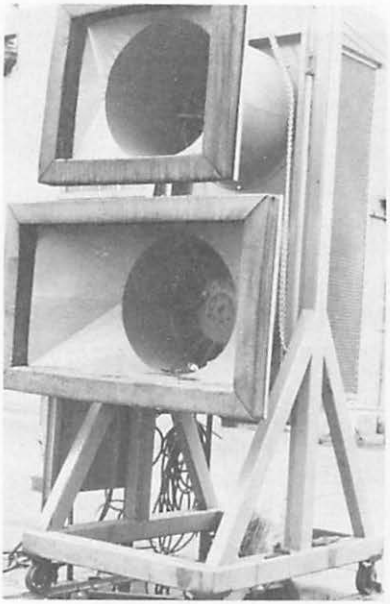

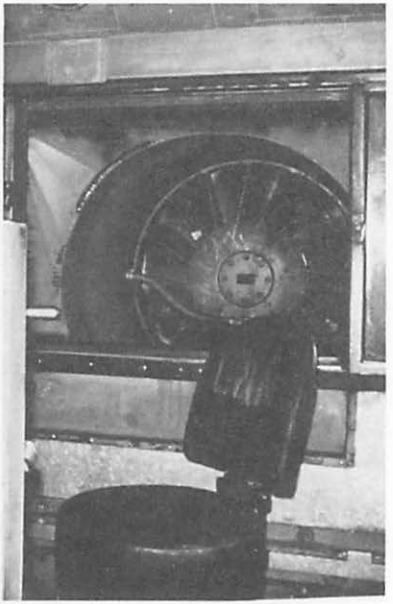

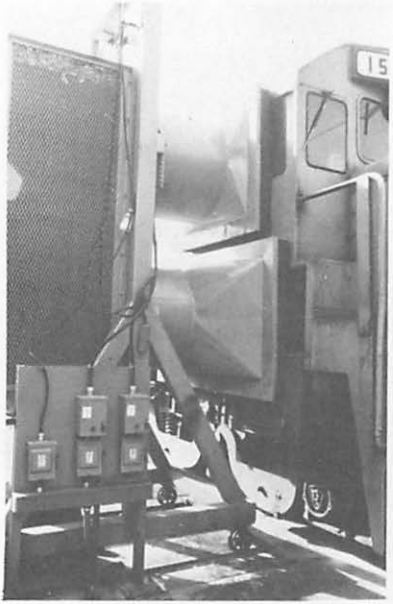

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For any type of power, Stackpole's new traction motor brush grade AC-124 gives you the edge. Try it! Order direct from Electro-Motive Division regional stock. For additional information, call or write: Stackpole Carbon Company, Carbon Division, St. Marys, Pa. 15857. Phone: 814-781-8511. TWX: 510-693-4511.

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cleaner with special, low-pressure, aeration foam guns.

After a large area is covered, it is hand scrubbed with long handled brushes. The final step is to rinse the scrubbed area using a 500 psi, hot water spray gun with a 7½ gpm rated spray tip and a long extension. The rinse pump is a 100 psi air-operated 5 to 1 ratio pump, which maintains a constant volume through each of the spray tips. When the guns are not in use, the pump stalls out, starting and operating only at the speed necessary to maintain the required demand. Water is heated only when required, by a steam-operated heat exchanger at approximately 160 degrees F.

The foam system has a 10,000 gallon capacity bulk liquid storage tank. Chemical flows by gravity to the automatic mixing pumps where chemical and water are proportioned by two separate but mechanically connected piston pumps. By-pass piping is provided in the event that a pump failure occurs.

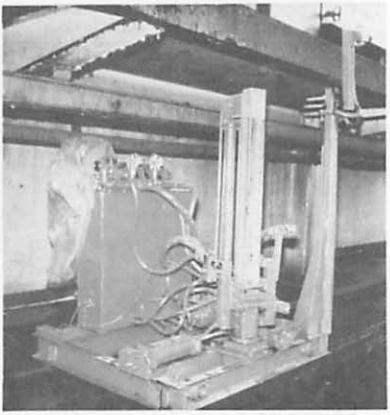
A 1,400 gallon tank for storage of mixed chemical is kept pressurized at 35 psi with shop air. This forces the chemical through the distribution piping and on to the foam guns, a short distance away.

A liquid level gauge is provided for manual filling by gravity with the system shut down. The proper proportion is indicated behind the glass of the level gauge. If for any reason the mixed chemical storage tank cannot be filled with these automatic pumps or the gravity system, a third means of filling has been provided. A 2 inch gate valve is located at the top of the tank and is used for manually filling with 55 gallon drums.

An electronic level control maintains the tank at a preset level. This control is not affected by foam.

The air-pressure system is equipped with a self-relieving pressure regulator on the downstream side. The pressure is maintained by this valve at the preset pressure during the automatic refill operation.

The mixed chemical storage tank also feeds two automatic truck washers in the same area as the carbody cleaning. Such a system is very versatile and dependable on a 24-hour-a-day basis.



With this system, approximately 44 gallons of mixed chemical is required for external, internal carbody and truck cleaning per locomotive. This chemical is an alkaline at a ratio of 1 part chemical to 7 parts water.

Central Vacuum System For Water Removal

Water can be quickly removed from the engine room floor and pits after internal carbody cleaning with the use of a central vacuum system.

If the water is not removed after washing and the engine is "shut down" serious problems could result, such as:

1. Water seeping into the traction motor fan ducts and possibly grounding the motor.

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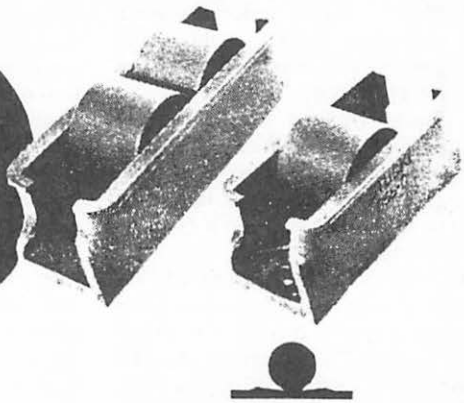

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2. Water collecting in the bottom of the electrical locker, which could cause a road failure and a possible rewiring job.
3. Water trapped under the main generator, which could cause grounds and possible removal of the generator.
4. Water trapped in the vee of EMD engines, which could seep down into the upper deck and give a false water leak indication or, possibly hydraulic a cylinder assembly.

One railroad (L&N) estimated that $50,000 a year could be saved using the central system instead of the shop towel method. This analysis was using 20 locomotives a day, 365 days a year.

The central system consists of a 7½ HP multi-stage centrifugal exhauster connected to a centrifugal wet collector with a hi-lo water level control and 4 inch drain valve.

Two operators can work simultaneously with this system on either side of the locomotive, using hose connection outlets located at platform level every 12 ft. for a total of 100 ft. each side. Both operators have a 1 ½ inch dia. x 25 foot long flexible hose with various types of pick-up tools attached. The main header is 3 inch in diameter with a tubing and slip-on fitting construction.

The total cost of that system in 1974 was approximately $6,500 installed.

III. COMPONENT RECLAMATION

Reclamation By Metal Spray Process

The Milwaukee LD Shops has begun using the Roto-Tec Metal Spray Process for the reclamation of worn parts. This is basically a two-step process in which two different types of alloy powder are sprayed onto the work piece through the Roto-Tec gun.

Traction motor armature shafts are being rebuilt with the metal spray process. The following method is used to spray a shaft. Armature shaft is set up in the lathe. Photo #56 shows the shaft being machined down .060 inch overall. Photo #58 shows a protective mask being applied to the area where the metal spray is not wanted. A cleaning solution is sprayed onto the machined area. In photo #60, the shaft is being preheated to 250° - 45°F. Because of the low heat, this is considered a cold process. The temperature of the work piece is checked with a temperature stick. The bonding coat powder, "Exo-Tec" #29904 is sprayed onto the shaft while it is rotating in the lathe. This is a .005 inch thick bonding layer. Photo #63 shows the shaft with the bonding layer applied. Photo #64 shows the coated shaft being sprayed with .040 inch of "Lubro-Tec" #19985. The spray gun is held about 8 inches from the shaft while spraying at a rate of approximately 20 seconds for each inch of shaft. An exothermic reaction takes place during spraying, so that the superheated particles adhere to the prepared base metal. Photo #68 shows the finished shaft.

Exploratory Reclamation On The Santa Fe

1. **Pistons-EMD Engines**
   a. Metal Spray - Pistons that were worn beyond limits due to scuffing or scored below the ring carrier, were reclaimed. On application to engine and load test all pistons failed.
   b. Knurling - One piston skirt that was worn beyond limits was lightly knurled. After engine was load tested, the piston and liner were inspected and found to be good. The locomotive that had this piston

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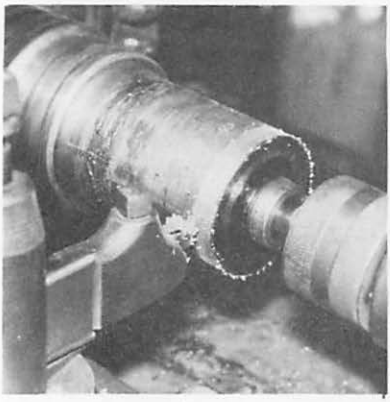

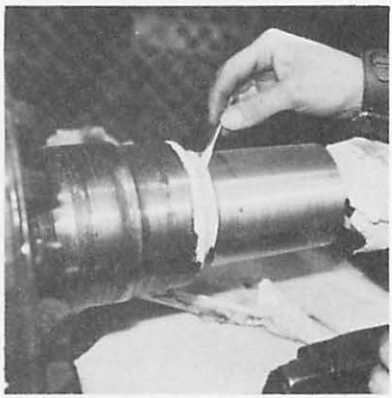

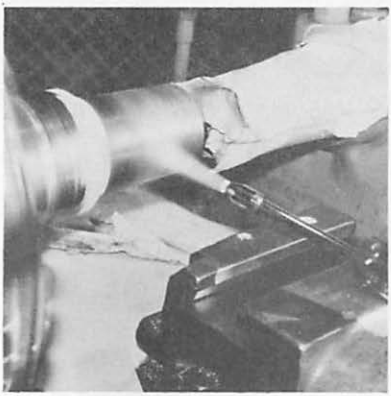

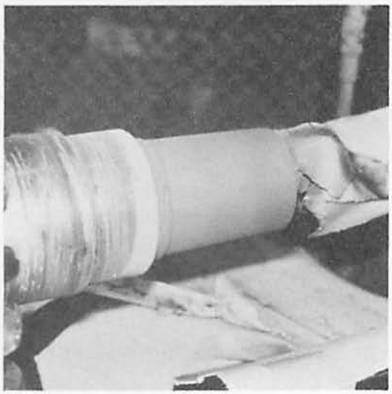

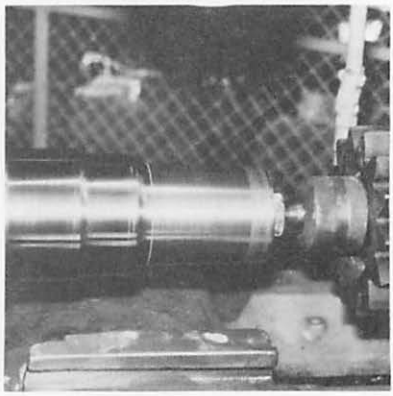

applied was still operating as a test unit after six months time.

c. Inserts applied to ring grooves - Pistons condemned due to worn ring grooves. The top two ring grooves were machined, the top groove was machined on top, while the second groove was machined on the bottom, a wear ring was applied to both grooves to bring to standard. We have two such engines with this application and are presently on their second quarter of operation.

2. **EMD Rocker Arm Pins** - Several condemned rocker pins have been chrome plated to bring back to standard. This concept has proven practical to date and now has been made a standard process on the Santa Fe.
3. **Water Pump Impellers (EMD)** - Upon overhaul of EMD diesel engine cooling water pumps, it was found that the impellers had to be renewed due to the fact that the shaft fit was worn and no longer within the recommended tolerances. A vendor found a way to recondition the worn impellers by boring out the impeller and applying furnace brazed bushing.

Presently they are realizing a savings of 50% of the cost of a new impeller, as well as alleviating the difficulty in obtaining impellers from EMD.

Air Compressor Cylinder Reclamation - Sleeve Method

One method of reclaiming worn or scored air compressor cylinders is with precision made sleeves.

The cylinder is bored oversize leaving a shoulder in the end that bolts to the crankcase as illustrated in this slide.

A precision made sleeve, of a slight interference fit is placed in the cylinder using a shrink fit method.

Once a cylinder has been bored out to accept the sleeve, future reclamation is most economical as it is only necessary to remove the worn or scored sleeve and replace it with a new sleeve.

The step at the bottom of the cylinder bore and the cylinder head retain the sleeve in service operation.

The sleeve method provides excellent oil control, ring wear etc., and does not adversely affect heat transfer.

Both air cooled and water cooled compressor cylinders can be reclaimed using the sleeve method.

Air Compressor Crankshaft Standardization and Valve Standardization

It is recommended by this committee that locomotive manufacturers standardize the Gardner Denver WBO, WXO Compressor to permit universal usage and reduction in parts inventory.

Air compressor crankshafts supplied by EMD has what is known as Shoulder Relief Type machining at the ends of the connecting rod journal (see figure 1).

Air compressor crankshafts supplied by GE has what is known as Shoulder Radius Type machining at the ends of the connecting rod journal (see figure 2).

We feel that all 3 cylinder stage WBO, WXO Gardner Denver compressors should be equipped with the Shoulder Radius Type Machining at the ends of the connecting rod journal.

Existing air compressor crankshafts can also be reclaimed and con-

verted from Shoulder Relief to Shoulder Radius type.

Connecting rod bearings should only be supplied by vendors in the narrow width style used with the Shoulder Radius Type Machined Crankshaft to prevent maintenance personnel from installing incorrect type of bearing, resulting in rapid crankshaft journal destruction.

Air compressor valves also should be standardized so that compressors can be universally used in both high- and low-horsepower units of all locomotives.

This committee further recommends that locomotive manufacturers and suppliers standardize on the flat-type double-disc valves and use nine springs on the discharge valves. This standardization will, we believe, reduce failures, maintenance cost, and also reduce inventory of replacement parts.

It is economically feasible and practicable to convert the 6-spring valve bumpers to 9-spring valve bumpers by machining the three additional spring retaining holes in the bumper body casting. The Rock Island has been doing this for some time with excellent results.

Reclaiming Lube Oil Pressure Regulating Valve - G.E.

A Rock Island shop has made a holding and centering fixture mounted on a radial drill press. The regulating valve is set for machining of the valve seat. The seat is refaced to proper contour and surface with a fly cutter tool mounted in the arbor constructed exclusively for the operation.

Seats contoured this way require little or no grinding or lapping in of the valve to function correctly.

Extensively worn or damaged seats are repaired by the bronze welding process; the valve body seat is machined using the special set up fixture and fly cutter arbor.

Centerless Grinding/Polishing Pin for Reclamation Processing of Various Pins and Components.

The Rock Island has developed the polishing machine illustrated in photo #75, whereby, General Electric diesel engine rocker arm pins can be polished in 6 seconds per pin.

General Electric fuel pump push rods can also be cleaned and polished in about the same length of time.

Electro-Motive rocker arm pins can be cleaned and polished in 5 to 6 seconds per pin.

The cleaning and polishing process leaves the various pins in excellent condition ready for use in an engine.

Various other components have been processed via use of the machine shown, i.e., air compressor pistons, line shafts, fan drive shafts, etc.

Reduction in labor time and slight cost and long service life of the polishing media make it possible to write off the cost of this equipment in six months or less.

General Electric has also developed a more efficient polishing fixture for

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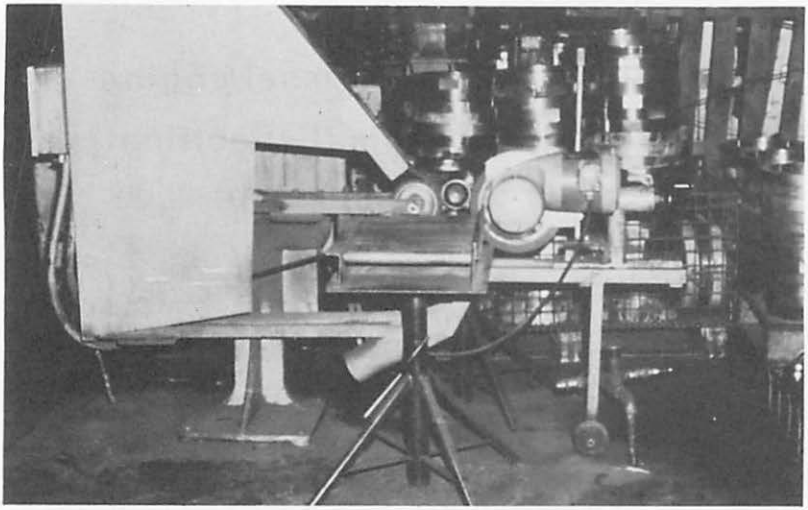

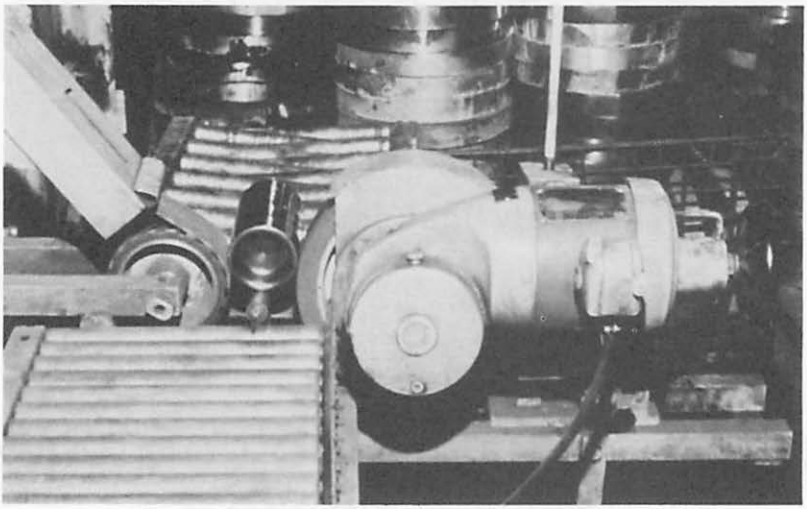

piston and articulated rod pins, as illustrated in photo #76.

This is a machine consisting of a belt sander with small conveyor feed. Pins are placed on the conveyor one at a time. Because of the skew of the conveyor with respect to the axis of the sander, they progress through automatically.

It can also be used for polishing rocker shafts, the O.D. of crosshead guides, or any other cylindrical part up to about 6 inches in diameter. (See photo #77.)

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This machine has a long belt of 320 grit paper running at relatively high speed, while the rubber drive drum, at left, runs at relatively slow speed to spin the work piece. This drum is also set at a slight angle with respect to the nearest sanding belt guide roller, so the workpiece progresses through.

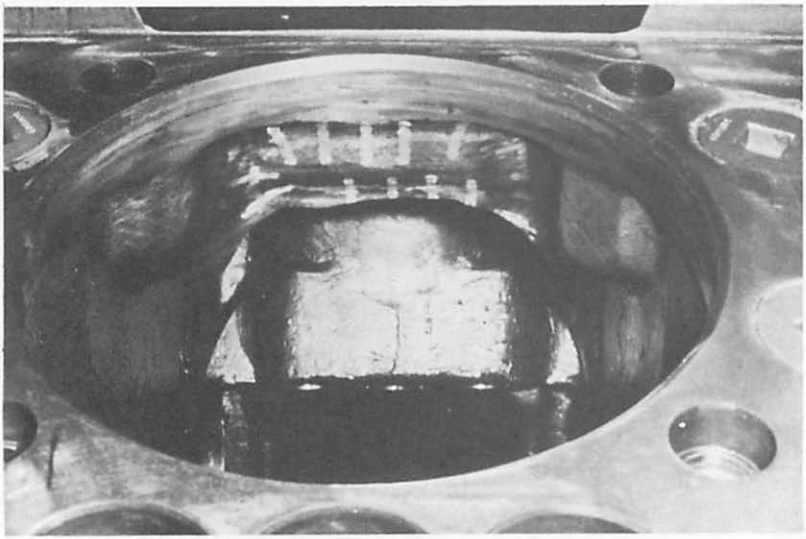
General-Electric feels that this is the lowest-cost least-labor method of polishing these pieces. Even after several passes, which are sometimes necessary, only 1 or 2-10,000ths of metal is removed. The finish is about 5 microinch.

Metal Stitching

We are all acutely aware of casting shortages due to the closing of many foundries that simply could not afford the expense of upgrading to comply with pollution standards. That situation has caused renewed interest and consideration for the metal stitching process of reclamation.

In brief, this is a process used to repair cracked or broken castings, such as the main engine frame on a General-Electric engine. In the process, a hole (1/4 or 3/8 inch dia.) is drilled right into the crack. It is then tapped, and a metal plug is screwed in, the top broken off, and the remainder peened over. A second hole is then drilled, partially overlapping the first, with a second plug applied, broken off, and peened down. This process is repeated the full length of the crack. Properly done, the resulting mended joint is oilproof and its strength approaches that of the original before damage.

Photo #78 shows a metalstitch repair to the main lube oil header (located at the base of the cylinder "V"). This repair was made in 1967, and has been operating successfully since. The need for the repair was caused by a connecting rod that had failed and broken out the bottom part of the header. Metalstitch repairs have been done many times in cast main frames. Judgment is always re-



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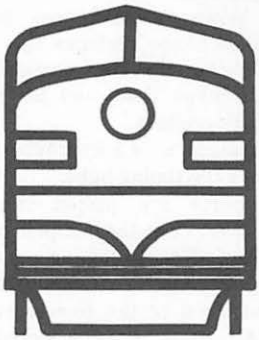

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quired, to assess whether too much of the original strength will be lost.

Blower Rebuild

The blower rebuild area in the Milwaukee Shops reclaims the EMD engine blowers for the locomotives of the Milwaukee Road and for reseal and rebuilt engines.

A machinist uses a hydraulic puller to remove the timing hubs.

The parts are placed in wash baskets that keep the components for each blower from becoming separated during washing. The clean parts are then returned to the blower rebuild area. All parts are inspected and reworked if necessary.

The blower cases are inspected and the high spots removed. They are checked with gages for clearance and warping. Broken and loose studs are replaced. The rotors are inspected and the high spots removed while they set in cradles at the bench. A machinist cleans the timing hub grooves on the rotor. The smaller ports are also inspected visually and checked with measuring instruments such as micrometers where necessary. A gage is used which checks the height of the timing hub.

If either the blower rotor, gears or timing hub is found to be defective, the blower can be retimed using the timing stand. Photo #90 shows the timing stand which was built in the Milwaukee Shops. With this stand, the shops no longer discard blower rotors which have failed a timing hub or a timing gear. A new rotor can be mated with a qualified used rotor, new gears can be used with old rotors, and worn-out timing hubs can be replaced. In the past, if any of these parts were in distress, the complete assembly would be scrapped. Now if a timing hub has worn, it can be replaced at a cost of $37 instead of $619 for a complete rotor assembly.

Photo #91 shows the machinist timing a set of rotors in the timing stand. He uses feeler gages to check the clearance between the mating lobes of the rotors. By slipping the timing gear on the timing hub slightly, an equal space can be achieved between all lobes.

The rotors are thus timed. The gear bolts are then tightened and the gear and hub is then removed in one unit from the rotor. The gear and hub is then drilled, reamed and doweled.

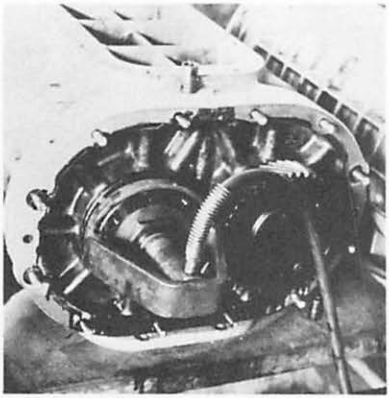
A hydraulic press and gear puller is used to facilitate the timing procedure by installing and removing the timing gears and hubs, saving about one hour in labor per blower over a manual method.

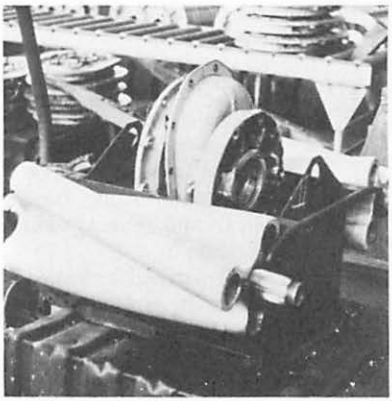
A knife-edge fixture is being built to qualify the blower rotor O.D. size and thus eliminate the possibility of assembling a blower in which the lobe-to-lobe clearance would be greater than the allowable maximum.

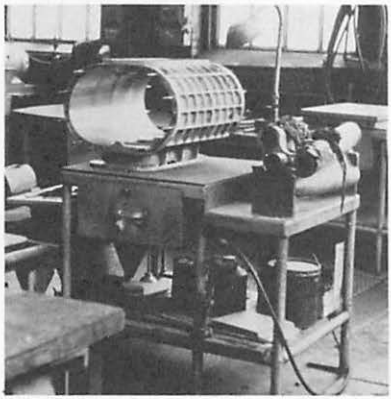
Prior to assembly, the parts are washed with industrial alcohol. The end plate is then assembled with seals and bearings and placed on the two rotors. Photo #96 shows this subassembly being lowered into the case. The blower is then placed on a bench where the gears are applied (Photo #97). The lined marks show that the two zero timing marks have to be in line to assure proper timing. After assembly, the tolerances are checked with the long feeler gage and the finished blower is then run on the test stand for about three hours and shipped.

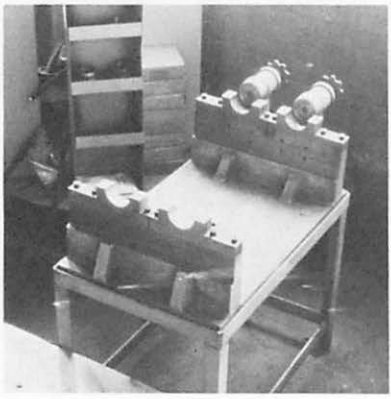
Proposed Automated Engine Rebuild Line - Illinois Central Gulf

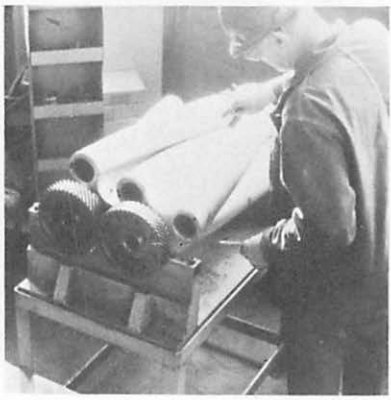
The automated engine rebuild line will be an all-encompassing system,











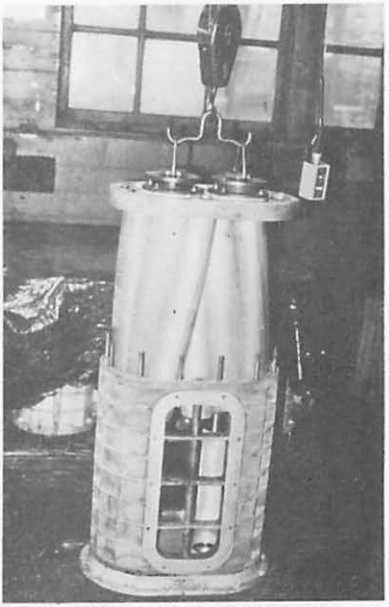
performing the following operations:

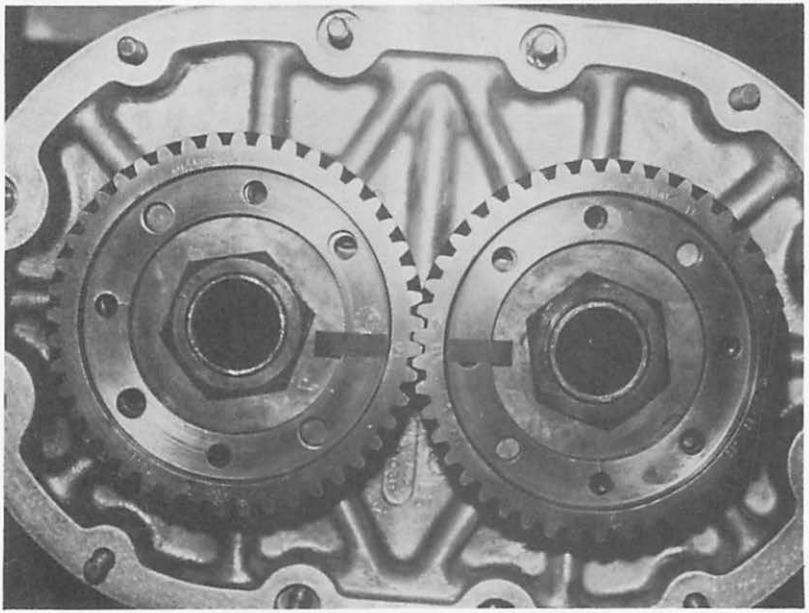
1. Stripping
2. Cleaning
3. Component Overhauling
4. Engine Rebuilding
5. Air Compressor Overhauling

Included in the project will be a pollution controlled cleaning facility for engine blocks and general component parts cleaning.

At present, all material is cleaned in a single lye vat, with its related pollution problems and material handling problems. All material is handled by lift truck or overhead crane. Component parts rebuilding areas are not located relevant to the engine assembly area, causing material handling problems.

In the new operation engine stripping will be accomplished in a high bay with easy access to the power assembly line and to a small one-ton over-





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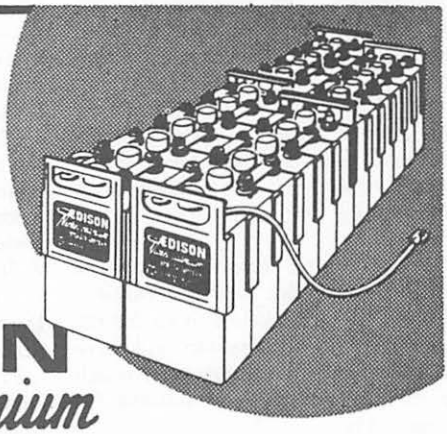

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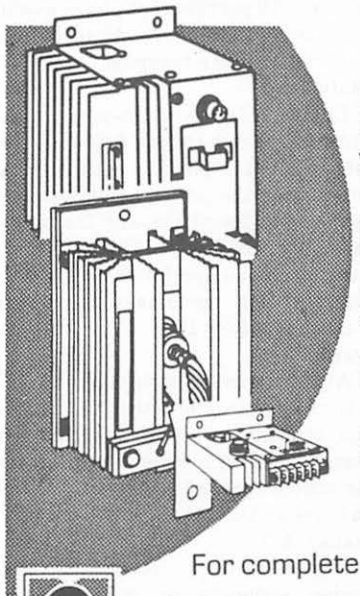

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head crane. The components are removed from the engine and placed directly on the overhead monorail conveyor system for automatic washing before delivery to the rebuild area. In the rebuild area, components are stripped, and if additional washing is needed, the parts are placed in a basket and recycled through the washer.

The overhead monorail conveyor system will utilize powered carriers equipped with baskets and chains for parts handling. This system will move parts from stripping stations through washers, then to work stations for reassembly.

Selection of routing will be accomplished by the man loading monorail carriers. Flags on carriers will trip switches directing baskets to progress along prescribed routes.

Parts to be recycled from component rebuild work areas will bypass the stripping area; only empty carriers will be allowed to enter the stripping area.

To move rebuilt parts from rebuilding stations, there are semi-powered roller conveyor sections entering onto the powered conveyor at each work station. To bring parts to the points of use or storage areas, the unpowered conveyor will be used. The powered conveyor is the over and under type allowing movement in two directions.

Engine "A" frame, oil pan and crankshaft will require conveyors or dollies of special design because of their weight.

The component parts rebuild area is ideally located close to the station on the engine rebuild line requiring the components. Components will be placed on roller conveyors and sent to the various assembling stations. If there is a surplus of a particular component, it will be routed to the stores department pick up area. Only the air compressor will require the use of a lift truck for removal from the rebuild area.

The engine assembly line will have the capacity of one engine every six hours on a single shift operation. The engine frame will be moved down the assembly line on specially designed dollies, thus keeping the use of the overhead crane at a minimum.

Description Of Stations

Station A

First is the process of stripping the engine. Engine is removed from the locomotive, or from storage on this station, and parts are removed and placed on overhead conveyor to washer. All parts except power assemblies are removed here. All oil pans to A-frame bolts are removed.

Station A-1

Engine A-frame is moved by overhead crane from station A to A-1. The oil pan is left in place at station A. At this station the power assemblies are removed and sent through the power assembly rebuild line. The A-frame is then placed on special pallet or dolly designed for movement to special washer at station B-3.

Station A-2

Air compressor stripping. At this station all air compressors, locomotive and stationary, are dismantled and parts placed on overhead carriers for movement through cleaning cycle and on to rebuild station.

Station A-3

Engine blowers are moved from engine stripping or warehouse to blower stripping area by roller conveyor because weight and bulk of blowers won't permit use of overhead carriers. Blowers are dismantled and parts placed on overhead carriers for

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movement through cleaning cycle and on to rebuild station.

Station A-4

Component parts stripping. At this station all components, either removed at station A or coming in from outside points, are completely stripped and then sent through washer before entering their respective rebuild areas.

Station B-1

A run-through type washer, using caustic solution, for cleaning and clear water rinse before exit. All parts not sensitive to caustic solutions will be run through this washer.

Station B-2

A run-through-type washer for aluminum parts and other parts that are sensitive to a caustic solution. This washer is a bypass to main washer and both washers will utilize same prerinse and final rinse.

Station B-3

The A-frame, oil pan and top deck frame are moved from stripping area to this area and placed in a revolving agitating or turbolator type, caustic solution, cleaning vat. It is then removed from this and placed in a steam rinse.

Station C

Gasket stripping - to maintain cleanliness in rebuild areas and make gasket removal easier, parts with gasket surface will immediately after washing, while still hot, be taken from overhead conveyor for gasket removal. Then parts will be sent to their respective rebuild stations by overhead conveyor.

Station D & D-1

Air compressor rebuild, stationary and locomotive. The station is divided to separate the two types and has conveyor switches routing parts, to the two sections, as required.

Station E

Top deck covers, top deck supports and end housings arrive at this station cleaned and with gaskets removed. Threaded holes are tapped and cleaned, damaged components are repaired, new gaskets applied to top deck covers and other work required is done here. Components, after rework, are placed on power roller conveyor for movement to paint area, (if paint required), and then to using area or storage area.

Station F

This is the component parts paint station where all engine components will be painted before going to storage area for shipment to outside points. This will be built adjacent to the A frame wash and prime building so that we may utilize the same exhaust and filtration system.

Station G

This is the component parts storage for parts that have been painted and are awaiting pickup for shipment to outside points.

Station H

This station handles camshaft, harmonic balancer, rocker arms, idler shaft, governor drive stubshaft, test cocks, pressure relief valve and valve bridges.

Parts delivered to this station by overhead monorail and work performed as necessary. Jigs and fixtures are arranged to accommodate and facilitate overhaul of parts listed for this station. Rebuilt parts are transferred to user area by way of unpowered roller conveyor extending into crankshaft rebuild area and positioner locations or on powered conveyor to unpowered roller conveyors extending into storage area.

Station I

All engine gears (received by over-

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head monorail cleaned and ready for polishing and deburring). Fixtures for gauging, polishing, deburring, thread chasing and other required operations are located in this area. As at other stations, appropriate scrap bins are located on aisle side of area for disposal by fork lift of scrap accumulations.

Station J

The station handles injector linkage, control layshaft assembly, governor drive, suction strainer, flywheel, counter weights and blower stubshaft.

Parts are received at this station by overhead monorail from washer. Parts are clean and ready for reworking. Recycling through washer is available, if needed. Jigs and fixtures required for the rebuilding of parts listed will be located at this station. Roller conveyor is used for movement of parts to pickup area for materials department or to user area in engine rebuild line.

Station K

This station handles water pumps, lube oil pumps, scavenging pumps, auxiliary generator drive, oil separator, lube oil suction strainer housing, and fuel filter.

Parts will arrive by overhead monorail cleaned and ready to be assembled. After cleaning, parts will be gauged and given a final inspection then used or scrapped as tolerances indicate. Jigs, fixtures and gauges will be located at this station for work required. Rebuilt parts will move by roller conveyor to point of use or by powered conveyor to paint station and then into materials department pickup storage area.

Station L

Disassembled blowers will arrive at this station, from washers, by overhead monorail. Parts requiring additional cleaning can be recycled through washers. Gauges and fixtures will be located at this station for parts inspection, rebuild and testing. The completed blower will move by powered roller conveyor to the paint station and removed at paint station and put in storage area for pickup for shipment.

Stations M-1, M-2 and M-3

A-Frame received from cleaning vat, following is performed: Line sight and check serations, weld bores requiring line bore, line bore to specifications, recheck bores with line sight, repeat cycle if necessary, rework thrust pads if necessary and repair Pee-Pipe damage if necessary.

Station N

This dual-purpose station will be enclosed and have filter and exhaust system. It receives A-frame from the line bore, and shavings and oil accumulated in line boring are removed in agitating wash. A-frame will be masked and spray primed.

Stations O-1, O-2 and O-3

A-frame will come from wash and prime area and set on positioner. The work cycle is as follows: apply crankshaft; apply power assemblies; apply pee-pipes; apply piping required for hydro; make water hydro; take lead readings; tap out front and rear end; apply camshaft; apply injectors; apply rocker arms and valve bridges; and apply test cocks.

Stations P-1, P-2 and P-3

The oil pan will be moved from pan storage area and set upon dolly specially constructed to hold pan level. This will either be of the wheeled type that rolls on track or air pallet design. The A-frame will be removed from positioner and applied to pan and bolted down. The work cycle for each station is as follows:

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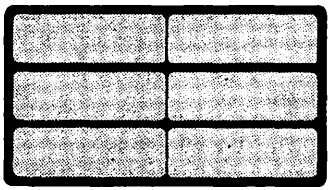
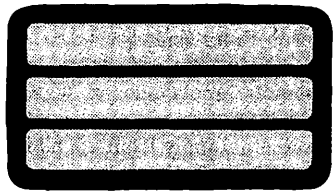


Cross section of armature coil with insulation of KAPTON



Cross section of armature coil with mica/glass insulation

Insulation of DuPont KAPTON polyimide film allows up to 20% more copper in any given armature coil! (See illustration.) That's because KAPTON is a thin, tough, exceptionally efficient insulating material, requiring less space than other insulation systems. The result: more horsepower and/or a cooler running motor.

KAPTON not only dissipates heat faster, but it has greater resistance to thermal degradation, which results in less motor maintenance, more time between rewind jobs. Some railroads have reported as much as 40 to 100% longer life.*

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*For case histories reporting railroad and transit line experience with insulation of KAPTON, write:

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Station P-1

Front End

Apply governor drive shaft, apply oil manifold and wire, apply cross over pipe, apply governor drive gear and wire, apply pressure relief valve, and apply, align and wire accessory drive housing.

Rear End

Apply on pan and bolt down, apply idler stub shaft, apply gears, align gears, remove gears, wire and dowel idler stub shaft, apply back housing and wire, apply top deck frame, and reapply gears.

Station P-2

Front End

Apply injector linkage and control lay shaft assembly, apply oil and water pumps, apply governor drive, apply engine protector, apply front coupling and seals and apply suction strainer housing.

Note: Pipefitter work bench and fuel line test in this area.

Rear End

Apply fly wheel, time camshaft, drill, ream and wire camshaft and counterweights, time injectors, set lash adjusters, and apply blower stub shaft and blower drive gears. Apply rear cover.

Station P-3

Front End

Apply, align and drill front counterweights, remove front counterweights, apply overspeed trip & wire, apply front counterweights & wire, adjust overspeed linkage, apply governor, apply fuel filter, hook-up linkage, adjust injector rack, drill control shaft arms.

Rear End

Apply auxiliary generator drive, apply blower stands, apply blowers, apply oil separator, apply top deck piping, set injector timing, and make fuel hydro.

Station Q

This station receives the crankshaft from the cleaning vat and is for the purpose of polishing the journals of the crankshaft. The plugs will be removed from crankshafts before going into cleaning vat, also polished crankshaft is magnafluxed.

Station R

This station receives the crankshaft from the polishing station and the parts are applied as follows: blow out galleries and wipe down crankshaft; mike crankshaft and record sizes; apply main drive gear; apply harmonic balancer; apply accessory drive gear and oil slinger; and apply crankshaft plugs.

Stations S-1, S-2 and S-3

After the oil pan is removed from cleaning vat it is taken to station F for painting and then it is brought to this area for storage until it is needed at station P-1 for application.

Major Equipment

1. Turbulator for cleaning engine block, oil pan, camshafts etc. **Description:** Illinois Central Gulf proposes to purchase a Turco Low Profile Turbulator. The apparatus will be 21 ft. long x 10 ft. wide x 8 ft. deep and will handle a part with maximum dimensions of 20 ft. long x 7 ft. wide x 7 ft. high. The turbulator will have four way agitation system for circulating the cleaning solution. This piece of equipment has continuous automatic desludging.

   Time reductions are as follows:

   a. Time for cleaning engine block

      7 hours 30 min. - existing lye vat

      2 hours - Turbulator

      Time reduction - 5 hours 30 min.

b. Time for cleaning oil pan
   7 hours - existing lye vat
   1 hour - Turbulator
   Time reduction - 3 hours
c. Time for cleaning baskets of various parts
   5 hours - existing lye vat
   2 hours - Turbulator
   Time reduction - 3 hours

The total time reduction based on an engine block and oil pan is: 14½ hours —3 hours = 11½ hours reduction.

2. Overhead monorail system
Description: An overhead power and free conveyor system to assist in rebuilding engines. The system will handle engine parts in baskets or racks on transporters. The parts will be loaded and the transporters dispatched to process areas and work stations. Carriers will be called for from storage lines via the operator panel located in the load station area. A carrier having been loaded will be coded by the operator for dispatch to: (1) component parts stripping, (2) nonferrous washer, (3) ferrous washer or, (4) parts cleaning line other than engine. A second code setting is set to provide entrance into one of eight work stations.
3. Component parts washer
Description: A power spray cleaning system. A monorail power spray washer for difficult cleaning problems that require heavy duty equipment. A three-stage wash system consisting of a prewash to remove surface dirt and oil; an immersion soak to loosen stubborn soils; and final wash to complete the removal of the remaining soils.

It is proposed to design the washer so that it has two separate washers incorporated into one, a washer for ferrous material and one for non-ferrous material. It is also proposed to utilize the same pre-wash and final wash for both types of material.

The washer will be a dip tank run-through-type operation. The parts to be cleaned will be processed through on the monorail system at a rate of 2 feet per minute.

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CALCULATIONS FOR DETERMINING MAN-HOURS PRESENT AND PROPOSED

OPERATION	TARGET Present	TIME (Hrs.) Present	100% Eff. Future
	(With Power Assembly Line)		
Strip Engine	31.4*	30.4	24
Clean Parts (Pro-rated Proportion of Lye Vat Output)	40.0*	30.0	4
Rebuild Engine	306.2*	244.4	209.5
Rebuild Blowers	12.0*	12.0	10.0
Rebuild Injectors	11.8	11.8	11.8
Rebuild Governor	6.2	6.2	6.2
Paint Inside Engine	6.0	6.0	6.0
Load Test	47.6	47.6	47.6
Paint Engine	4.0	4.0	3.0
Material Handling (Pro-rated Lift Truck)	16.0	12.0	2.0
Line Boring	40.0*	40.0	14.0
	521.2	444.4	338.1

*Target Time For Present Operations Covered By 36 Men

Total 429.6 Hours

Calculation to Obtain Present Labor Efficiency:

No. men rebuilding engines (Excluding painters & Lift truck drivers) = 36

No. men on running repair = 3

Total "Capital" employees = 33

Total "Capital" hours - 33 x 1936 = 63,888 hours
hours/engine = hours divided by 98 engines = 652 hours

Target hours (100%) for 33 men = 439.6 hours

Efficiency % - 429.6 divided by 652 = 66%

Actual hours to rebuild engine (with power assembly line) at 66% = 444.4 divided by .66 = 673 hours

Proposed hours to rebuild engine at 75% efficiency = 451

Man-hours savings/engine = 222

Total "Capital" hours saved/year - 222 x 98 = 21,756

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ENGINE RUNNING REPAIR PART –
BASED ON 1973 PRESENT & IN FUTURE REBUILT ON LINE:

	No. Rebuilt in 1973	No. For Running Repair	Present Hours (Target)	Running Repair Total	Proposed Hours (Target)	Running Repair Total
Engine Blowers	401	205	6.0	1230	5.0	1025
Water Pumps	356	58	2.4	139	1.8	104
Oil Pumps	129	31	2.5	78	1.9	59
Scavenging Pumps	122	24	2.5	60	1.9	46
Power Assemblies		602	5.0	3000	2.0	1200
				4507		2434

An assumption is required that the manpower is working at 75% efficiency to show that at present 3 men of 36 are working on running repair parts (4507 divided by 75 = 6009 hour - 3 men)

Labor Savings on Running Repair Engine Parts Target (100%) (Excluding Power Assemblies) = 273 hours at 75% = 364 hours

Air compressor rebuilt total '73 = 240

Hours/air compressor - 6 men x 1936 divided by 240 = 50 hour/air comp.

Manpower saved by line = 10% = 5 hours

Running repair air compressor = 175

Hours saved = 875 hours

Capital hours saved = 65 x 5 = 325

Total hours saved = 1200

Induction Heating To Bake Armatures

The conventional method of baking varnish on EMD traction motor armatures is to utilize an electrically heated oven. The oven is an electric recirculating air heater-type unit, which makes use of carts for loading and unloading armatures from the oven. The conventional oven is designed along the following lines:

Load: 3 carts each with 2 armatures or 6 armatures per charge

Production: 12 armatures per 24 hours
2 charges per 24 hours

Heat Cycle: Preheat to 150°F in approximately 1 hour
Remove load from oven and process through varnish cycle.
Heat to 300°F in approximately 2 hours
Hold at 300°F for 8 hours

Oven Size

Inside Clear: 9'-1" wide x 6'-10" high x 10' - 0" long, approximately.

The electric oven loading and unloading process is accomplished by overhead crane and is both time consuming and cumbersome. The armatures must be loaded by crane into carts and the carts then move on rails into the oven. The process is reversed for unloading.

As can be seen from the design criteria, the electric oven method of baking armatures is time consuming, taking approximately 10 hours to process 6 armatures (this time does not include the varnish cycle). The preheating time is lengthy, i.e., 2 to 3 hours.

On a basis of 6 armatures being placed in the oven for baking at once it requires:

2 - 3 Hours Pre-heating Time
8 Hours Baking Time

10 - 11 Hours TOTAL

The Illinois Central Gulf proposes to utilize an induction heating process, designed and developed by Motor Coils Manufacturing Co., to bake EMD traction motor armatures. It is proposed to purchase an 80 - 100 KW cycle generator and utilize this piece of equipment in designing an induction heat baking process. This process consists of placing copper heating coils in a helix spiral arrangement around the exterior of the armature but not in contact with armature and then by generating an electrical heat field bringing the armatures to the proper baking temperature.

The system would be designed so that the armatures are placed in a non-conducting wooden fixture and the controls set for bringing the armatures to the proper temperature. This fixture would hold the armatures in a vertical position. The armatures are loaded into the heating coil arrangement by crane and there is no further handling of the armatures until they have baked properly and are ready for removal.

The design criteria for the induction heat baking process is as follows:

Load: 6 armatures per charge

Production: Possible 24 armatures per 24 hours
4 charges per 24 hours

Heat Cycle: Pre-heat to 150°F in approximately 1/4 hr.
Remove load from fixture and process through varnish cycle.
Heat to 300°F approximately 1/2 hour.
Hold heat at 300°F approximately 4 hours.

Layout Size: Approximately 8' wide * 7' high * 12' long

As can be seen from the design criteria, the induction heating process of baking the armatures is much less time consuming, taking approximately 4 1/2 hours to process 6 armatures (this time does not include the varnish cycle). The pre-heating time is very short - - 1/2 hour.

The time for baking 6 armatures will be reduced from 10 hours utilizing the electric oven to 4 1/2 hours by utilizing the induction heating process. This is a reduction of 5 1/2 hours in baking time, representing a 55% reduction in the time of the process.

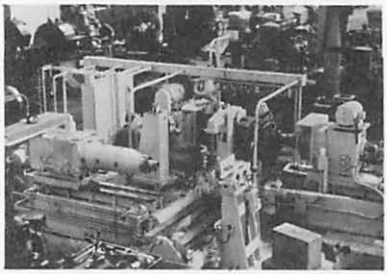
The installation of the induction heating process will allow ICG to increase its baking production rate 200% — from 6 armatures per 2 shifts to a production of 18 armatures per 2 shifts.

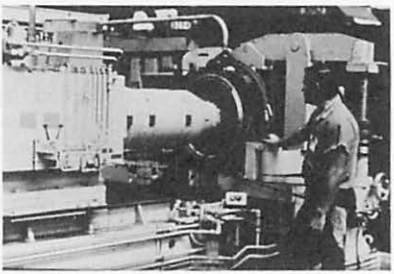
The cycle generator is the main cog in the induction baking process and will make the whole operation of baking more economical from an electric power cost per armature standpoint. With a 210 KW electric oven, 182 KW hours per armature is required for baking at a cost per armature for electric power of 80c. The KW hours per armature utilizing an 80 KW cycle generator is 33.2 or 15c per armature for electrical power. The 65c reduction in cost per armature for electrical power is an 81% reduction in cost.

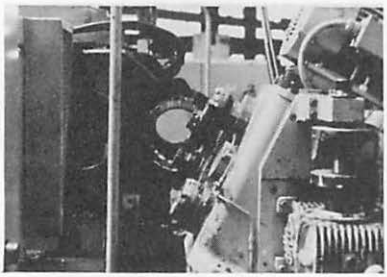
Shuttle Machine for Machining Traction Motors

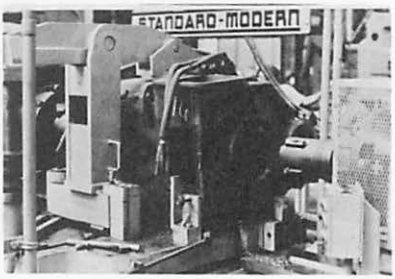
In 1972, this Committee presented a new concept for the machining of traction motors. This concept is now a working reality.

The Illinois Central Gulf has installed a machining center to machine EMD traction motor frames. The machine was designed by Standard-Modern Tool Company Limited of Toronto, Canada, in conjunction with ICG, to handle only EMD traction









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have been provided in the shuttle area.

The traction motor machining center has allowed the ICG to greatly reduce manhours required for machining traction motor frames. This equipment is one portion of a production line for traction motor overhaul, the basic concept for which was presented at the 1972 LMOA annual proceedings. The ICG is presently in the process of designing in conjunction with Standard Modern Tool Company, the second major portion of the line — the automatic welding of the traction motor frames. When this production line concept is fully installed, manhour savings and productivity increases can be better evaluated.

Proposed Automatic Traction Motor Frame Welding Machine

The basic concept developed by Standard Modern Tool Company and ICG is a single machine with multiple weld guns mounted on brackets with necessary movements to allow welding of the several surfaces of a traction motor frame. The change over from one part to another is at an absolute minimum.

It was found extremely difficult to combine off-the-shelf welding feed units into a reasonable package. Most are single-motion devices with manual adjustment for locating the gun, and are not designed to be used in conjunction with another unit or gun. They can be inadequate for use with the large water cooled guns and associated cable. The control systems cannot be interlocked or switched as required in ICG's case. These obstacles necessitated a custom built gun manipulator. Even with a design of combination slide and rotary motion unit the major problem is the controls.

Both spray arc and short arc methods are being recommended. In the axle bore area where there is a large amount of material required and a minimum of on-off sequencing, the spray arc allows for the fastest deposit of weld rate. This method requires a bead at each end as a dam, which must be applied manually. (There was detailed research done on the problem of the dam being required.) For the areas where sequencing the gun on-off regularly due to holes or the pattern required, the short arc method allows for this without need for manual operation.

The system uses hydraulic power and limit switches controlling relays. These are standard components with a well-documented history of reliability and ease of maintenance. The system has to be adequately protected against ground faults that cause mechanical failures. The system totally eliminates problems that might arise in use of any type of solid state electronic control system.

Six guns operate simultaneously as much as possible. Their arrangement is as follows (see chart for preliminary operators sequence): guns 1 and 2 are mounted on a common slide system at a 45 deg. angle from the center line of the arm bore. This allows them to weld both the inside of the bore as well as the bolt face. These guns will start welding at either 3 or 9 o'clock depending on the cycle set up and weld to 6 o'clock turn off and rapid return to the start. While welding on the bolt faces, a templet will turn the gun on and off to skip over the bolt holes.

Guns 3 and 4 are mounted on a common slide unit perpendicular to the center line of the axle bores and rotating about the center line of the axle bores. These guns will lay a linear

...only EMD, but GE ... which ... GE 752 frames.

The ICG unit has a multiple milling head, which enables the traction motor frame to be machined in approximately 1 1/2 hours. The machining sequence follows:

The operator loads the traction motor frame into the holding fixture and positions a parts centering pilot. The pilot expands to hold the traction motor frame on the armature and pinion bores, coils, inside frame surface, or any combination of these points. The pilot then rotates the traction motor frame plus or minus 5° until it is in a position determined by the keys located in the axle bore. Once this positioning is accomplished, the motor frame is jacked at several points on the fixture and then clamped from the top. The part is now clamped in place, and the pilot removed.

The main slide is now shuttled to the far end of the machine where a cross milling slide cuts the axle spline faces.

The axle caps are applied, and the same cross slide returns and machines as required on the gear case arm.

The slide then shuttles to the position where it will perform the machining of the armature and pinion bores. This operation is performed by a bore and face head on each side of the machine. The bore face heads are equipped with tooling for boring and facing the armature or pinion bores and the axle bores. After the armature and pinion bores are completed, the boring head is returned. The main slide shuttles to the axle bore position and the machining of these bores is accomplished.

...shuttled to the load position once ... returned and the slide is again, and the completed traction motor frame is removed.

The machine also is equipped with a drill head, giving ICG the ability of drilling and tapping the holes located in the pinion end of the motor frame.

The newer machine for CPR Montreal, is bigger and better, although it retains the basic philosophy of the ICG machine. The CPR machine is large, permitting more operator access between working stations.

The frame locator has been improved by an increase in power on all the jaws; the two sets of jaws formerly located in the armature finished bores have been changed to a series of three jaws each bore, to better locate and find the true center of a bore that is not exactly round. There is a universal fixture for the clamping of all components.

Center distance adjustability facilitates machining different frames. The different frames also require different cutters for machining certain surfaces, therefore, a quick change cutter system has been provided. A major requirement for the improved machining center is fast convertibility; now it is believed that this conversion could be accomplished in one hour.

Major changes in the drilling and tapping unit were made to permit machining all types of frames. The basic drilling and tapping facility has been retained with jig plates for each frame; in addition, milling, boring, spot facing, and back spot facing facilities were provided to permit the cover bosses on the GE frames to be remachined and updated to the latest specifications supplied by General Electric.

Improved chip handling systems

bead and step by rotating up the sides of the bore as they progress. As these are continuous surfaces there will be no provisions for templet-controlled guns, the stroke length will be by limit switch settings. The incremental movement of the rotary step will be determined by an adjustable pilot cylinder arrangement.

Guns 5 and 6 will be doing two distinctly different areas and will be reset during each cycle. Their first operation is the cap bolt faces and spline faces during which they will be mounted on a common slide at a 45 deg. angle to these surfaces. This operation is a linear bead with a linear step. During the cap bolt part of the operation, provisions for on-off operation of the gun will be made again using a templet. This also will allow maximum coverage of irregular shapes on certain frames. The second operation for these two guns is the axle bore faces, utilizing a rotary motion and linear step with a continuous bead for welding these two surfaces. During this second operation they are mounted on the slide which holds the guns for the axle bores.

The requirements and technique for automatic welding of this component were reviewed at some length. There is a definite requirement for a dam to be formed prior to applying the weld in the bearing area. Also in this area due to the flow of the molten metal it is necessary to start welding in the lowest area and step up the wall as weld is applied.

In order to maximize heat distribution, long continuous strokes of the gun seem to allow best heat radiation by the part. For the vertical faces on the axle, pinion, and commutator bores, it is necessary to start the weld at the top and weld down. Welding down is a key point, even though it requires gun shut off and retract after each stroke; a more uniform weld is assured. This also applies to the pinion and commutator bores. However, start for this position is at 3 o'clock or 9 o'clock, and welding down to 6 o'clock because splatter makes welding upside down impractical.

See prints detailing the concepts discussed above. The first is a machine concept incorporating sufficient detail to be realistic.

The second is a layout showing the basic slide arrangement. This design can be utilized for both axle bore and pinion bore areas with only the stroke different. The slide for the cap bolt faces will be the same basic design however having three linear axis of motion.

From the various tests that were conducted and also from the design development work done, there is sufficient evidence that an automatic welding machine is a practical idea.

OPERATORS SEQUENCE

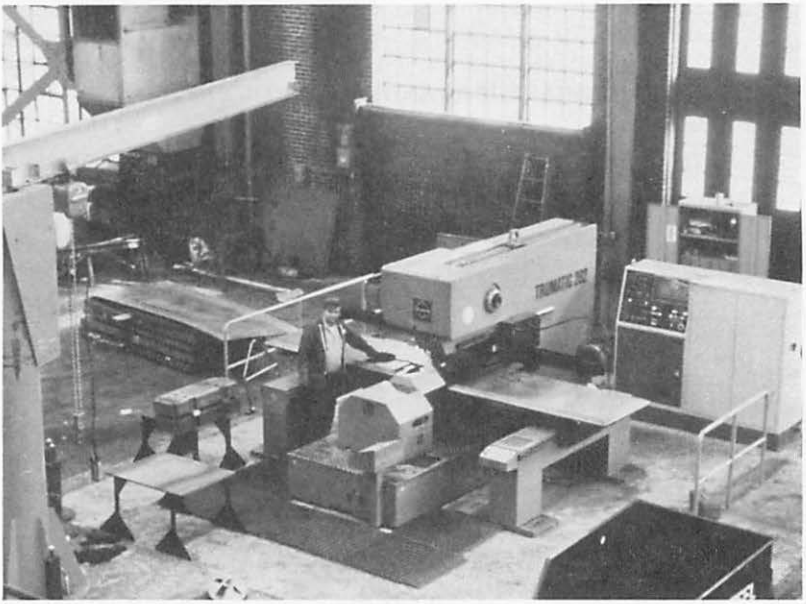
1.	Roll part into trunion fixture	½ min.
2.	Clamp part	5 min.
3.	Rotate into position	½ min.
4.	Swing axle bore guns in position P.E.	½ min.
5.	Set axle bore guns	2½ min.
6.	Start axle bore guns	14 min. cycle
7.	Locate cap bolt guns C.E.	½ min.
8.	Set cap bolt guns	2½ min.
9.	Start cap bolt guns C.E.	10 min. cycle
10.	Locate arm. bore guns C.E.	½ min.
11.	Set arm. bore guns C.E.	1 min.
12.	Set arm. bore gun P.E.	2½ min.
13.	Start arm. bore guns	10 min. cycle
14.	Reset cap bolt guns P.E.	2 min.
15.	Start cap bolt guns	10 min. cycle
16.	Reset axle bore guns C.E.	2 min.
17.	Start axle bore guns	14 min. cycle
18.	Reset arm. bore gun C.E.	1 min.
19.	Reset arm. bore gun P.E.	2 min.
20.	Start arm. bore gun	10 min. cycle
21.	Relocate cap bolt gun for axle face P.E.	3 min.
22.	Relocate cap bolt gun for axle face C.E.	3 min.
23.	Start axle face guns	4 min. cycle
24.	Reset arm. bore gun C.E.	1 min.
25.	Reset arm. bore gun P.E.	2 min.
26.	Reset axle face gun P.E.	1 min.
27.	Reset axle face gun C.E.	1 min.
28.	Start axle face guns	4 min. cycle
29.	Rotate part 180°	1 min.
30.	Start arm. bore guns	10 min. cycle
31.	Reset arm. bore gun C.E.	1 min.
32.	Reset arm. bore gun P.E.	2 min.
33.	Start arm. bore gun	10 min. cycle
34.	Rotate part to load position	½ min.
35.	Unclamp part	5 min.
36.	Roll part out of fixture	½ min.

This sequence is for a typical part and the exact sequence for a given part will vary.

P.E. is equal to pinion end and C.E. is equal to commutator end.

WELD PARAMETERS AND DESCRIPTION BY AREA

Area	Description	Type Weld	Description Of Motion
1	Arm. Bore C.E.	Short Arc	4-90° segments of motion on cylindrical surface
2	Arm. Bore P.E.	Short Arc	starting at 3 or 9 o'clock and finishing at 6. Continuous bead and rapid retract for next bead, linear step follows rotary motion 2-90° segments then rotate part for other 2.
3	Arm Face C.E.	Short Arc	4-90° segments on flat circular surface starting at 3 or 9
4	Arm Face P.E.	Short Arc	o'clock and finish at 6. Broken bead for bolt holes requires templet, rapid retract and linear step follows rotary motion. 2-90° segments then rotate part for other 2.
5	Axle Bore C.E.	Spray Arc	2-90° segments on cylindrical surface starting at 6 o'clock
6	Axle Bore P.E.	Spray Arc	and finish at 3 or 9. Continuous bead, linear with rotary step at each end of stroke. Requires manual bead dam both ends of stroke before auto weld.
7	Axle Face C.E.	Short Arc	2-90° segments on flat circular surface start at 3 or 9 o'clock
8	Axle Face P.E.	Short Arc	and finish at 6. Continuous bead, linear step follows rotary motion.
9	Cap Bolt Face C.E.	Short Arc	2 flat horizontal surfaces with bolt holes linear motion and
10	Cap Bolt Face P.E.	Short Arc	linear step requires templet on-off gun for flange outline and bolt holes also includes 2 spline faces. Vertical surface continuous linear motion, linear step.
11	Mounting Pads C.E. P.E.	Manual	Manual



Carbody Reclamation

The Illinois Central Gulf Railroad has redesigned a portion of its boiler shop around a numerical control punch press and two other standard pieces of equipment. This versatile machining center utilizes three major pieces of equipment (1) Trumph Trumatic 202 W numerical control punch press, (2) Cincinnati hydraulic shear, (3) Cincinnati hydraulic brake press.

The all-steel hydraulic shear is 10 ft. 3 in. between housings with an 18 in. throat and 3/8 in. capacity mild steel at 9/32 rake. The hydraulic brake press is rated at a tonnage of 400 tons fast press, 160 tons with bending capacity of 1/2" x 10' (4" die).

The above two machines have given ICG the advantages of (1) improved capabilities of forming, (2) improved production time requirements, (3) decreased required floor space, and (4) decreased number of machines required to perform work.

The major piece of equipment in the machining center is the Trumph Trumatic 202 W numerical control sheet metal machining center. The 202 W is a high-speed machining center for the fabrication of sheet metal and plate work pieces. Cutouts and contours of any desired shape and size can be made in flat materials by punching or contour nibbling.

The machine is equipped with an automatic tool changer, which provides a high degree of automation. Short to medium runs of parts can be manufactured very quickly and accurately. Several operations are combined automatically from the storage magazine into the single station tool adapter. All tools are preset into cartridges away from the machine. Machine utilization is very high.

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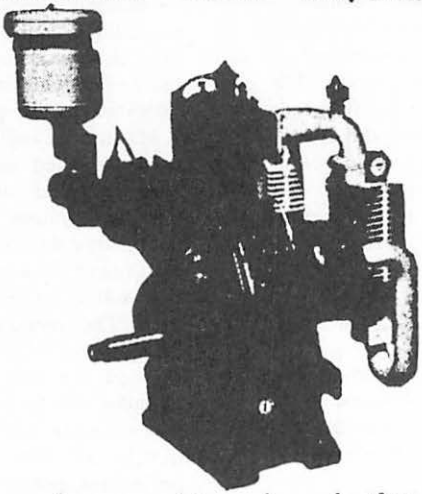

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- **Valves**
- **Connecting Rods**
- **Oil pumps**

Air Conditioning • Generator and Reefer Units

The automatic tool changer represents an entirely new concept in the fabricating machine field. The tool storage magazine with its re-loaded cartridges reduces set up time to a minimum. Only the tools required for a specific job need be in the magazine. Cartridges can be exchanged in a matter of seconds.

Programming the Trumatic 202 W is exceedingly fast; because of its basic simplicity, programmers can learn the method quickly. The programming function is used to preset work piece data from the drawing in a form that can be recognized by the numerical control system.

The Trumatic is the heart of the machining center, permitting major reductions in working time prior to fabrication as follows:

Locomotive Front End Sheet (Fabrication)

Comparison of old method vs. new N/C punch press

1. Front sheet including windows, receptacle, door and wire way hole.
   Old Method - 2 hrs. 30 min.
   N/C - 9 min.
2. Inside cover sheet with radius and windows
   Old Method - 1 hr.
   N/C - 3 min.
3. Number light box front including headlight number light holes and radius
   Old Method - 1 hr. 15 min.
   N/C 4 min.
4. Number light box bottom with cut-out for access door
   Old Method - 25 min.
   N/C - 3 min.
5. Access door including latch holes and bolt holes on 45 degree angle
   Old Method - 30 min.
   N/C - 2 min.

Total time old method - 5 hrs. - 40 min.

Total time N/C - 21 min.

Time reduction of 5 hr. 19 min.

The machining center's equipment is arranged for most economical flow of material in and out of the center. Other primary consideratons were (1) to minimize backtracking, (2) deliver incoming material directly to center, (3) plan storage area to handle a minimum of material in the center, (4) minimize walking required for operators.

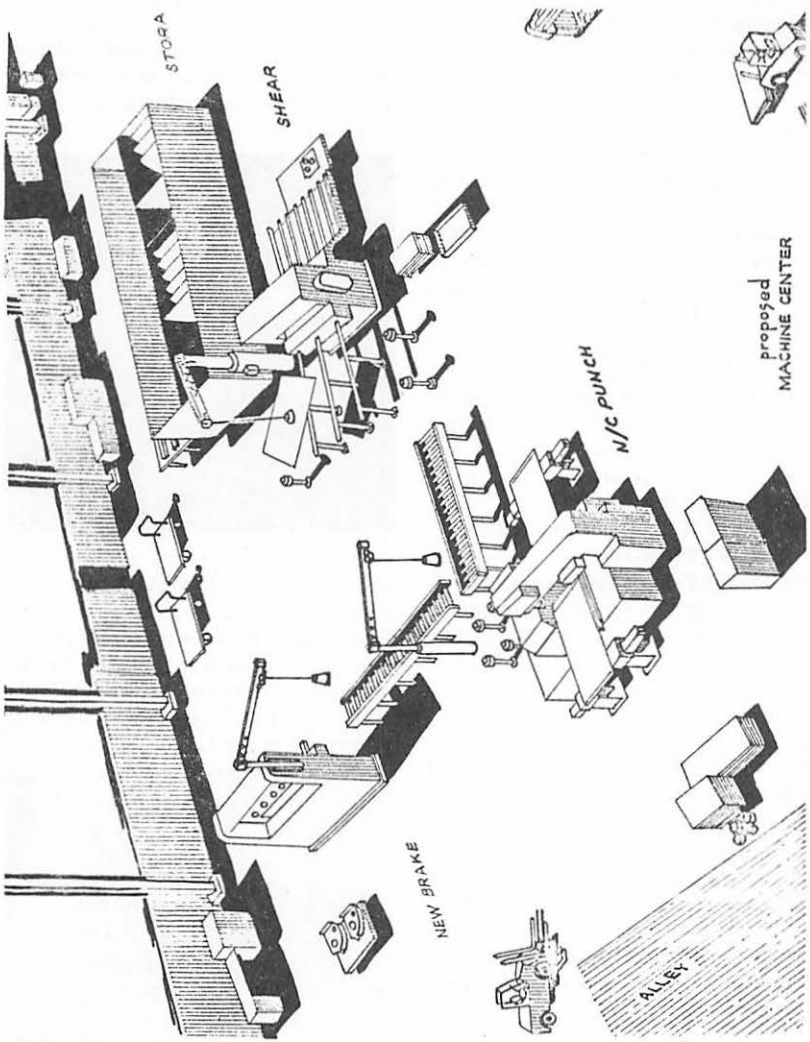
Material handling problems have been lessened in several ways: (1) Installation of an auto vac material handling system. The auto vac is a load-lifting device that picks up a flat load (example sheet metal) by means of a self-produced load-retaining vacuum. The vacuum is created by the increase in the cylindrical volume through the raising of the piston and cylinder and by a sealing ring in contact with the load. This allows ICG to handle all sheet metal in a flat horizontal position on and off machines.

(2) Each machine is set up independently of each other, yet functioning together as a unit to process products through the center. Each machine has a jib crane positioned to handle material for it and the adjacent machine.

(3) Installation of ball bearing tables to ease the movement of larger sheets in and out of the individual machines.

The machining center is completely separate from the rest of the shop. Job orders are submitted to the foreman in charge of the center and these orders are filled and material sent to the appropriate area.

The utilization of the overhead traveling crane has been eliminated.


STORA
SHEAR
N/C PUNCH
proposed
MACHINE CENTER
NEW BRAKE
ALLEY

The only occasion the overhead traveling crane is utilized, is to place material into the storage area. This eliminates the overhead crane from moving over men and machines with materials, a safety as well as material movement advantage. Production is not stopped by an overhead crane passing above a machine.

The sheet metal utilized in the machining center is to be stored on edge thus drastically reducing the amount of area taken up by storage of material. This gives ICG the advantage of conserving valuable shop floor space for future expansion and production purposes.

The sheet metal will be brought into the shop area with specially designed material carts which will carry the metal on edge. This eliminates any loss of time or production for placing the sheets in the storage bins.

IV. IMPROVED TOOLING & EQUIPMENT PROGRESS

Automatic Fueling Improvements

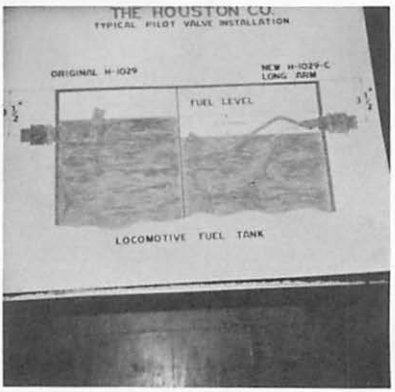
Last year this Committee made an extensive survey of automatic fueling problems with very good response. The replies pointed out the many problems yet to be overcome before a satisfactory industry standard could be achieved. Meanwhile, energy and fuel dollar losses continue in disturbing proportions.

As a followup report to this convention, we advise that the 1974 survey data has been forwarded to the AAR to assist and encourage continued AAR research until a workable industry standard can be found to overcome this problem.

We are also happy to report, that fueling equipment manufacturers have responded to our needs by making design change progress to reduce spillage.

The Huston Company recognized that because of more modern and updated higher flow rate fueling pumps, nozzle shut off settings could not cope with the internal fuel tank turbulence in time to prevent overflow spillage. They went back to the drawing board and this photo shows the long and the short of it.

Here you can readily see the difference between the old style short arm pilot valve H-1029 previously used in an attempt to fill fuel tanks to the top, as opposed to the newer style long arm pilot valve H-1029 C, which initiates shut off by approximately one in. lower tank level.



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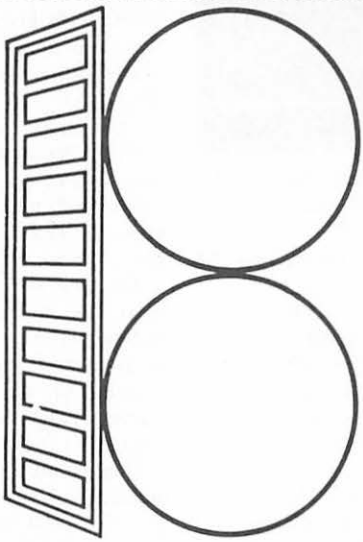
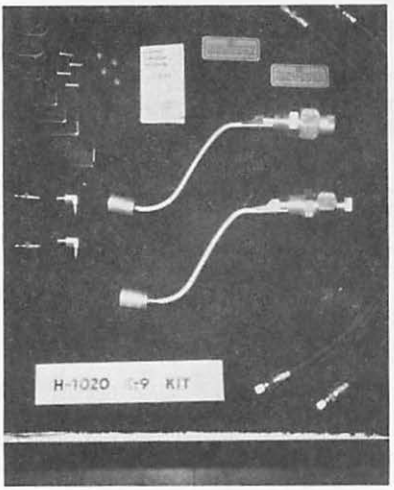


BRENCO

This photo illustrates the difference in fuel tank shut off levels and dependent on pump flow rate, this means a reduction of from 80 to 100 gallons in most tanks.

To depict the relative simplicity of this improvement modification, this photo shows a typical H-1020-K9 kit which may vary only slightly by locomotive type or model.

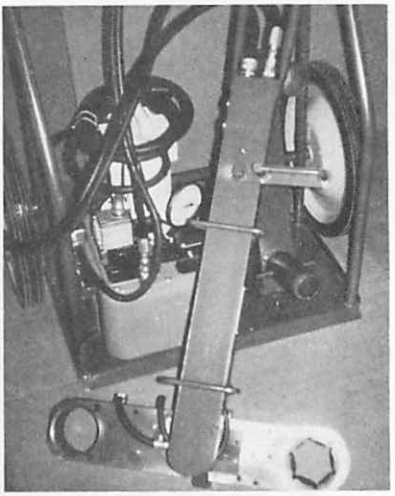


We extend our appreciation to the manufacturer for this much needed and timely improvement.

Hydraulic Wrench Improvement Progress

We are all familiar with the Tame, Inc., hydraulic main bearing wrench, which provided a much needed breakthrough several years ago to help reduce maintenance costs and improve quality control for proper torque value reliability.

The tooling industry has again responded to our needs for improvement with the N-S-W Corporation's "Slect-a-Torque" hydraulic power wrench system for power torquing top deck EMD cylinder crab nuts.



The system uses controlled hydraulic force to loosen or tighten nuts with accurately controlled torque.

This tooling concept was developed initially for heavy industrial applications, and special tooling to adapt the system for railroad use is now being developed.

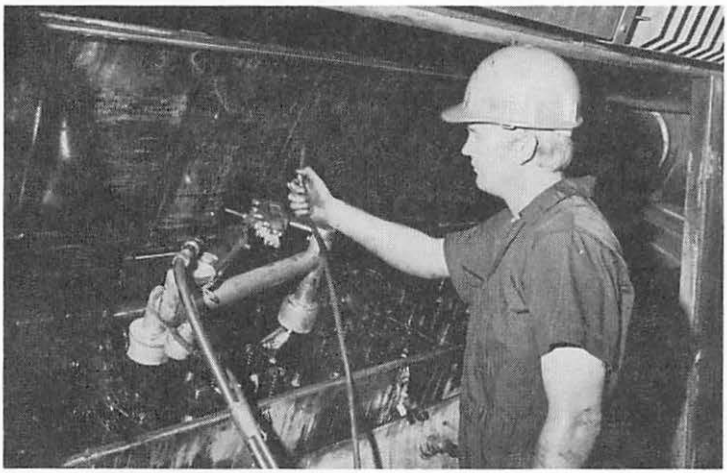
The N-S-W Corporation is working with the Southern Pacific Transportation Company. N-S-W feels it can readily extend this principle to other areas of critical locomotive maintenance torque requirements.

This crab nut tooling application can easily be handled by one man. No manual labor is required to achieve proper torque value, except actuating a finger-tip control air button and repositioning the ratchet wrench head.

This shows how the reaction member seats on the adjacent crab nut to provide resistance for the hydraulic cylinder stroke. The desired torque value is preset at the control console; at the end of each full stroke, the cylinder plunger is retracted to en-

Slect-a-torq®

HYDRAULIC POWER WRENCH SYSTEM



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Slect-a-torq® handles bolts from ⅞" through 6" across the flats; tooling supplied to fit all bolting patterns. It is NOT an impact tool, but a system for CONTROLLED, labor-saving torquing. It eliminates striker wrenches and sledges. For complete product data, write or call.

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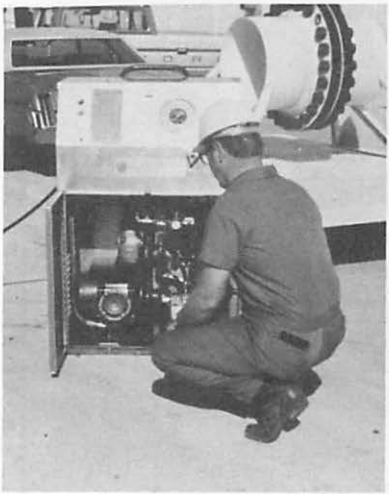
NSW375

gage the next tooth on the wrench head until torque value is reached, at which time the plunger will not fully extend.

The control console provides for storage of hoses, cylinder and wrench sets in the top of the cabinet.



deliver up to 14,700 foot-pounds of torque.

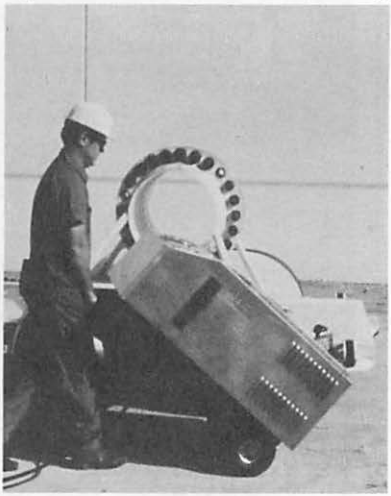
We welcome such tooling progress to better ensure maintenance quality control at lower costs and are gratified to learn that major tool manufacturers, such as Ingersoll Rand, now are exploring railroad applications for their hydraulic products to give us added dimensions for tooling improvements.

Infra-Red Burn Off Machine

The Sante Fe has just completed installation of an Infra-Red burn off machine in its traction motor overhaul shop. It is used to burn off insulation on traction motor armatures and AR-10 alternator rotors.

There is easy access to the hydraulic and air components housed in the control console.

Also available is a wheel-mounted control console. This model will deliver up to 60,000 foot-pounds of torque; a smaller version is available that will



The new concept machine is equipped with automatic sensors that read the armature core temperature and regulate the temperature to prevent overheating the core. Attached to the machine is an incinerator that completes combustion to comply with ecology standards.

CONCLUSION

In conclusion, and in retrospect, this Committee is hopeful that in some small measure this contribution will fit into the spirit and intent of progress.

As long as we remain aggressive and progressive, we will always be ready to accept the challenge of "Where Do We Go From Here?"

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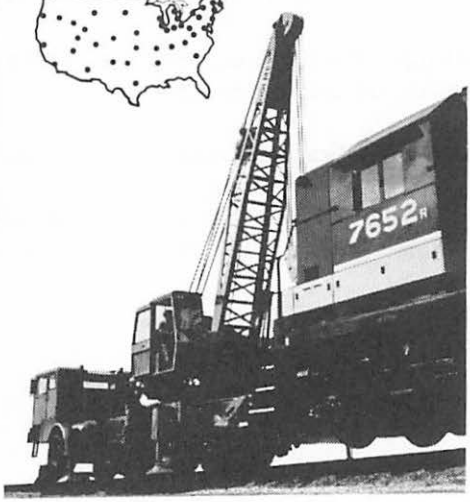

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We of the Chicago Railroad Diesel Club were again pleased to be hosts to the Locomotive Maintenance Officers Association for their April 7, 1975, Pre-Convention Presentation.

Mr. Darrell M. Walker, Diesel Superintendent, Southern Railway, and his committee on Diesel Material Control presented their paper entitled "Material Crises—What Can Be Done."

Meetings: We meet on the first Monday of each month except July, August and September.

Monthly Publication: Issued to all members.

Membership: We welcome all railroad and railroad supply personnel. For further details please contact our Secretary-Treasurer.

E. C. FOSDICK
Secretary-Treasurer
225 Illinois Boulevard
Hoffman Estates, Ill. 60172

Wednesday, September 17, 1975

9:00 AM.

REPORT OF THE COMMITTEE ON DIESEL MATERIAL CONTROL

Pre-Convention Presentation: Chicago Railroad Diesel Club

April 7, 1975 Midland Hotel Chicago, Ill.

D. M. WALKER, Chairman
Diesel Superintendent
Southern Railway Co.
Atlanta, Georgia 30303

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D. L. Ward, Engineer Motive Power, St. Louis-San Francisco Railway Company, 3253 E. Trafficway, Springfield, Missouri 65802

P. D. Wright, Quality Control Inspector - Elec., Illinois Central Gulf RR, 22nd Floor, 233 North Michigan Ave., Chicago, Ill. 60601

1975 TOPIC:

"MATERIAL CRISES — WHAT CAN BE DONE!"

PERSONAL HISTORY
Darrell M. Walker

Born in Rutledge, Tennessee, April 6, 1938.

He attended public schools in Kingston, Tennessee, graduating from high school in 1956.

He entered active military service with the U.S. Air Force after high school serving two years in Japan and two years in the United States.

After being discharged from the Air Force in 1960, he attended Tennessee Institute of Electronics, Knoxville, Tennessee, graduating in 1963.

His railroad career started in 1963 as he joined Southern Railway Company as an Electrical Trainee. He has held numerous positions in the ranks of Southern's Mechanical Department from electrician to present position of Assistant Mechanical Engineer.

He is married to the former Patricia Luttrell and has a daughter.

His hobbies include home improvements, gardening and sport activities.

I. MATERIAL SOURCES AND REPAIR

A. Repairable Materials — What And Where

Today's critical material shortages and long lead times for new locomotive components suggest that the railroads re-evaluate their policies on repairing such components. In general, railroads are seeking to increase the amount of repairs. The increasing demand for repairs has brought about the formation of a number of new firms who specialize in repairing specific items. Existing repair firms are adding new items to their lists. Many railroads are also investigating expansion of their own repair facilities. Whether items are repaired in company shops or sent to outside concerns for repair, the objectives are the same: Reduce deferred maintenance and locomotive down time caused by the lack of new parts, and minimize material costs.

It is not feasible to attempt to list all locomotive items that can be or presently are being repaired. However, as new shortages are recognized, the list of repaired items grows.

To determine whether or not a component should be repaired or purchased new, a number of questions must be answered: Is the part current or obsolete? Is it available? What is the lead time? What are its value and usage? Can it be repaired?

Existing guidelines under which a component is not repaired if the cost to repair exceeds 60 or 70 percent or whatever, of new cost must be re-evaluated. Total repair cost includes packaging, freight, and in the case of shop repair, the cost of carrying repair parts inventory. A repair cost exceeding the new cost is justified if the new part is not readily available or if a locomotive is out of service. Repair cost equaling a high percentage of new cost can be acceptable if there is a large usage of that item.

When investigating whether an item can or should be repaired in company shops, take into account local union work agreements, frequency and extent of repair, existing facilities and availability of outside repair. But, most important, determine all applicable costs, for it is easy to overlook some that do not readily appear to be part of the cost of the company shop repair. Costs associated with company shop repair are:

1. Inventory of repair parts including cost to carry such inventory
2. Storage

Waste Recovery, Water Quality, Air Monitoring, Fish Bioassay, Radioactive Tracer Studies, Process Evaluation

If you recognize a problem, aim, or goal in the list above, then you should know about Gulf Analytical Services.

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To help you get answers to all sorts of questions. Here are some examples:

Waste Recovery Water Quality Air Monitoring

Gulf Analytical Services can not only determine the makeup of a waste stream, but can suggest methods of purification, recovery, or disposal of the waste based on distillations, chromatographic analysis, or other techniques. Any analysis recommended by APHA, EPA, or ASTM can be conducted including fish bioassays, biodegradability, etc. Consultations based on extensive air monitoring experience are available.

Process Evaluation

Process plants can be evaluated by radiotracer studies. Many unit operations can be simulated and tested for the effect of changing conditions, feedstreams, etc.

Techniques

The list below indicates the range of techniques that can be applied to get answers to problems of waste disposal, machine performance, or special questions.

Atomic Absorption Spectroscopy
Elemental Analysis by Nuclear Techniques
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3. Overhead
4. Transportation of repairable & repaired items
5. Handling
6. Labor, including fringe benefits
7. Inspection
8. Packaging
9. Paper work
10. Facilities, tools, fixtures
11. Supervision
12. Training
13. Purchasing activity
14. Expediting
15. Potential loss of warranty

To examine outside repair, consider quality control, warranties, reliability and the need to establish a pool of items at the repair service. Determine internal costs applying to outside repair such as purchasing costs, which include cost to place a repair order, negotiations and contracts, and all applicable paper work — plus, potential delay in shipping items to the outside service.

Only after *all* costs involving company shop repair and outside repair are determined, can a proper decision be made as to which route to take. This would be on an item-by-item basis. Then clear and predetermined routes for each item can be established so that when an item is in need of repair, there will be no question as to what to do.

All decisions relating to buying or repairing, or where to repair, should be made by responsible staff personnel and not line or lower rank supervision. This is to insure some degree of standardization. Furthermore, it is important that the repair policy be reviewed periodically to determine if it is still valid.

B. **When Supply Improves**

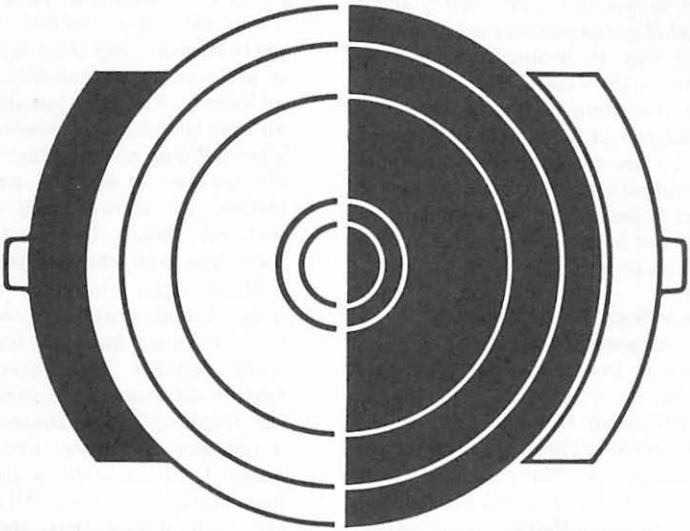
One result of material shortages is that they lead to expansion of repairs. Lately, however, the supply condition has improved somewhat because of a temporary lessening of demand. The decline in demand and resulting increase in supply have been brought about by the reduction in orders due to the faltering economy. Also, production of parts has increased as raw material has become more available.

What happens when supply improves? Usually, orders for new parts will increase while the amount of repairs will lessen. With a plentiful supply of parts, the tendency is to simply replace a worn part with a new one. This increased demand for new parts will once again affect supply.

At no time should we totally disregard our former decisions to repair items in lieu of buying new ones. If it is more economical to repair rather than buy, then repairs should be made regardless of the supply-demand situation. With increasing uncertainties involving raw materials and energy, the "replace and throw away" approach to maintenance could very soon become a thing of the past. Intelligent conservation of resources will not allow this concept to continue.

C. **Care Of Removed Components**

Frequently, the handling damage inflicted on components removed from a locomotive exceeds that which caused the removal. Common sense in handling removed and repairable components will protect them from further damage and ultimate higher repair costs. Loose parts should be secured and holes plugged. Specially designed containers may seem to be a luxury that few, if any, railroads can afford. However, when you consider the cost of the container spread over its usable life, the protection it affords a component and the resulting lower repair cost, the specially designed container



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may not be such a luxury. If containerization is rejected, a reasonably small amount of packaging and lading can go a long way in protecting the component. In the case of unit exchange, re-use the same packaging that was originally used to ship the component to you. Care of removed components and minimizing further damage means dollars saved. The repairable item should not be treated as scrap unless that is its destiny.

D. **New Sources For Materials**

1. **Alternate Materials**

When investigating alternate sources or substitutions for an item in short supply, determine first of all if there is a need for the original item. Many items are used because of past practice or because of a problem that no longer exists. Also check to determine if the short supply item is under too rigid specifications or deviates from the O.E.M. specification. For example, why use a high tensile strength bolt when a standard bolt will do; or a fabricated footboard instead of a stamped or punched footboard?

Substitutions can take place; e.g., plate for castings, bar for forgings, plastic for metal, etc. However, care must be taken to insure that performance and specifications are not sacrificed.

Some of the domestic shortages are being met by foreign sources. The supply field is active in seeking out these sources. The railroads should do likewise.

The railroads can encourage new entries into the railroad supply field. The machine shop down the street might possibly become an important supplier with the assistance of the railroad.

2. **The Hidden Sources**

Many mechanics are "pack rats". They will save critical, usable parts because they once ran short of these items. Periodically, check all lockers. You may possibly find an item that is badly needed elsewhere. We do not recommend that the practice of keeping parts in lockers be allowed. All usable material should be in storage, accessible to all who may need it.

Many repair locations means many storage locations. Consolidation of repair facilities leads to many benefits. One benefit is centralized storage of parts and the resulting better control over usage and inventory. Limit the quantity of an item withdrawn from stock at one time. All of this can help insure that sufficient levels of shortage items are on hand where needed.

Different suppliers assign their own part numbers for the identical end use parts. The railroad may also assign a separate stock number for each supplier's part. In either case, it is possible that parts from different suppliers for the same application are on hand at the same time. A critical shortage of one supplier's part could be alleviated by the stock on hand of another supplier's part which has an identical application. Recognition of such items and consolidation of stock can eliminate an apparent shortage.

E. **Exchange Of Inventory Listings Between Railroads**

This committee feels that exchanging surplus inventory lists is of limited value. Most surplus lists are redundant in that all contain the same obsolete and inactive parts. Rarely do

these lists include short supply items that are considered essential to the advertising railroad's operations.

Nevertheless, surplus lists have been helpful at times. To issue or receive such lists is a decision for each railroad to make. Emergency swapping and self-help between railroads on a personal basis could be far more effective.

The opinion of the committee is that the railroads should establish contact with each other to ascertain major component availability. In the event of an emergency, this would provide a lead for possible replacement of a major component.

II. LEAD TIME AND PURCHASE ORDERS

A. Lead Time

For the past several years, railroads have been faced with the problem of being unable to obtain replacement parts for locomotives when they are needed. In an effort to determine why this situation exists, this portion of the paper deals with one of the key factors contributing to this problem, which is

Commodity	Sept. 1972 (Weeks)	Sept. 1974 (Weeks)
Battery	10	16
Bearing Shells	32	45
Castings - Steel	10	40
" - Aluminum	10	20
" - Brass	6	12
" - Bronze	6	12
" - Ductile Iron	10	40
" - Cylinder Head	12	32
" - Cylinder Liner	10	32
Copper Tubing	8	20
Admiralty Tubing	16	20
Crankshafts	28	37
Expansion Joints	6	14
Filters (Air)	8	16
Forgings - Aluminum	16	46
" - Steel	20	42
" - Turbo Disc.	20	60
Turbo Blade	32	32
Injectors	12	24
Heat Exchangers & Aftercoolers	12	30 - 40
Traction Motor Blower	36	36
Fuel Transfer Pumps	4	12
Piston Rings	20	36
Packaging (Corrugated Boxes)	3	6
Steel Mill Products		
Plates	8	26
Sheets	8	36
Brass-Hot Rolled	8	30
Brass-Cold Rolled	8	40
Brass-Ground & Polished	14	40

the radically increasing and erratic lead time that builders now experience in obtaining materials needed to manufacture component parts.

The following is a survey from one builder showing how lead time for certain commodities used to manufacture parts has increased from September 1972 to September 1974:

When the above times are added to the builder's time for manufacturing an item, it becomes a little easier to understand why railroads have been experiencing a material crisis.

What has caused lead time to increase so dramatically over the past several years? To best answer this question, it is necessary to look at the factors that determine lead time and then pinpoint the factors which have most significantly contributed to the increases.

A survey was conducted among both builders and railroads, and the following is a summation of what they felt were some of the factors that determine lead time:

Availability of raw materials
Time of manufacturing cycle
Capacity of manufacturing source
Ordering cycle, including engineering
Backlog of orders
Market demand
Profit margin of finished product
Order processing
Energy availability
Strikes
Acts of God

Of these, it was the general opinion that (1) availability of raw material; (2) capacity of manufacturing source; (3) backlog of orders; (4) market demand; (5) profit margin of finished product; and, (6) energy availability are the six most important factors which have combined to cause lead time to increase so drastically.

Two other factors which were not mentioned in the above survey, but which have also contributed significantly to increasing lead time, are the new regulations concerning the environment (air and water pollution), and the regulations concerning occupational safety and health (OSHA). These two factors have caused many former exclusive sources of supply either to cease operation for a period of time in order to comply with these regulations or to shut down completely. This has served as the catalyst in making many of the other factors so important.

We have now looked at one of the causes for the material crisis we are experiencing, that of increased lead time. We have also tried to determine the factors which have caused lead time to increase so drastically over the past several years. This brings us to a final question yet to be answered — "When will this situation with long and erratic lead times improve?".

Most builders feel that lead times have stabilized at the present levels and no more major increases will occur. This stabilizing effect in itself will afford the builders a better opportunity to plan for users' future needs. It was also the opinion of the builders that the length of lead time on most items will begin a downward trend sometime in the summer of 1975.

Is there anything that railroads can do right now which will ease the burdens placed on them by long lead times? There are probably many things that can be done, but the remainder of this portion of the paper will deal with just two areas, better purchase order planning, and the

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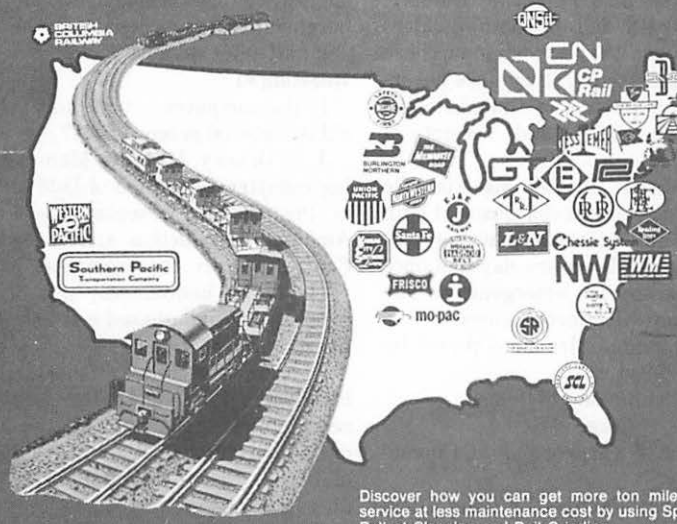

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direct shipment of material to a shop spot location.

B. **Purchase Order Planning**

It costs money every time a purchase order is issued. A survey shows that it can cost anywhere from $25.00 to $50.00. With this amount of money involved, it is obvious that each purchase order should be well planned to cover material needs, both now and in the future.

Builders and railroads were asked to comment on what they felt was the ideal size of a purchase order and how often orders should be placed; and the following is a summation of their opinions:

Ideal Size of a Purchase Order: It was generally felt by both builders and railroads that any size purchase order is satisfactory. Size does not influence the amount of time between placing an order and receipt of material.

How Often Should Material Be Ordered: It was the consensus of both builders and railroads that the railroad should order every day and once a day, except for emergencies. The factors that will affect this are:

(1) Minimum order amounts set by suppliers.
(2) Dollar amount of items.
(3) Yearly usage of items.
(4) Cost of warehousing and inventory.

C. **Shipment To Specific Shop Locations**

Regarding a shipment of material directly to a specific location within a shop, both railroads and builders felt this system had advantages. It was the builders' opinion that separate purchase orders should be issued for each shop location, and that each shop spot be well defined so the material can be properly tagged. Also, material should be checked by material management prior to releasing it to a spot location.

In summary, procurement of material should be planned as thoroughly as possible to cover future material needs. Only through good planning of material needs can railroads cope with the increased and erratic lead times which are so much a part of today's material crisis.

III. QUESTIONS AND ANSWERS ON MATERIAL PROCUREMENT

The third portion of our paper is devoted to outlining the committee's response to some of the questions and suggestions concerning material procurement that have been assigned this committee for review.

Question #1

Is the computer a hindrance or an aid to material procurement?

J. A. Orlicky, Manager Manufacturing Industry Education of IBM stated in the annual presentation to the American Production and Inventory Control Society that computer-based systems are undoubtedly one of the most often *used, abused and confused* operations.

A computer follows instructions blindly and to the last letter — but it accepts no responsibility for the logic of its instructions nor for the validity of output. The computer only produces what it is programmed for.

Our committee discussions reveal that it is true a computer improperly programmed can produce problems, *but these problems can be quickly corrected by communication between the departments involved.* With good communication and cooperation by the various departments to develop the proper program, the computer is an aid unmatched to date.

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Question #2

When a locomotive is out of service under warranty, awaiting material not available from the manufacturer,

(a) Is the warranty affected if used or robbed material is used to get the locomotive back in service?
(b) What happens if the robbed or used part causes a failure of another component?
(c) Who should pay for the cost of the extra labor for making these temporary and additional repairs?
(d) When a locomotive is out of service under warranty due to a component failure and the replacement component cannot be delivered by the manufacturer, should a cost per day out of service charge be made to the manufacturer?

The builders state that warranty could be jeopardized if robbed or used parts are used in locomotives under warranty without the builder's consent. In all cases the builder's representative should be contacted and if consent is granted then the warranty will apply.

The railroad would have to bear the labor cost for making such repairs other than in exceptional cases where the cost could be negotiated.

As for charging the builder for a locomotive out of service because of a replacement component not available from the manufacturer, even if the manufacturer agreed to accept such a charge, the railroad would end up paying this charge with an increase in the purchase price for the locomotive.

Question #3

It has been suggested that the committee investigate and determine how many locomotives are being held awaiting material by the railroads. In an attempt to make a realistic comparison the committee's definition for a locomotive out of service awaiting material was established as "when a locomotive has all inspections and repairs made but repairs cannot be finalized, or the locomotive placed in service, or further work progressed because of unavailable material". Wreck and fire damaged units should be considered on the same basis.

The committee found that no statistics within the guidelines were currently available for comparison by railroads.

Question #4

Are newly designed components and materials adequately tested by the manufacturers?

Some feel that components are not adequately tested and have suggested a board of railroad officers should approve all new components and materials before the manufacturers are allowed to place them in service.

After much discussion the committee feels that the normal procedures used by the manufacturers are adequate as all components are first lab tested and then placed in service for a test period before being approved for general use.

Question #5

Is the availability of replacement parts so critical that the builders should curtail new locomotive production until the backlog for replacement parts is eliminated?

The committee finds that of the total locomotive parts demand only about 25% is used for building new locomotives. The committee feels that if new locomotive production were curtailed, the total parts demand would increase as the railroad buying the new locomotive would be required

to replace parts on locomotives scheduled for trade-in.

The components parts most critical are heads, liners, and pistons which in many cases are supplied to the manufacturer from outside sources that have been faced with many ecology, energy and other related problems. However, this problem appears to be improving and hopefully will be solved within this year.

We would like to point out also that new locomotives also require lead time in excess of a year before delivery.

The committee would like to add that due to the economic recession the component parts demand has decreased. Some orders for critical items such as heads, liners and pistons have been cancelled. If and when the economy improves we can probably find ourselves in even a more critical component parts shortage due to a higher demand and accelerated maintenance.

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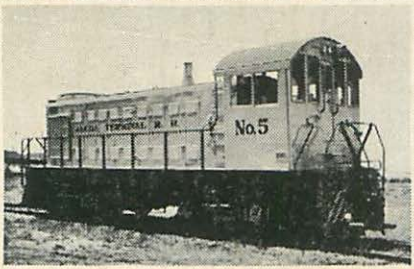

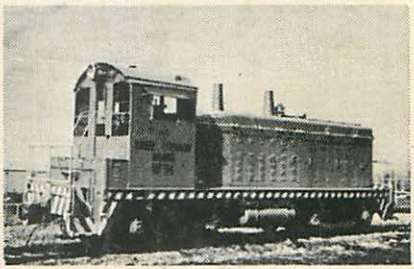

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