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SAINT LOUIS



1970 Pre-Convention Report, Sherman House, Chicago

SEPT. 14, 15, 16, 1970

Special Notice to All Concerned: Information in this book **MUST NOT**
BE REPRODUCED OR QUOTED WITHOUT WRITTEN PERMISSION
Official Discussion Guide for 32nd Annual Meeting, Sherman
House, Chicago, Illinois

L M O A

LOCOMOTIVE MAINTENANCE
OFFICERS ASSOCIATION

Exclusive Design — Proven in Railroad Service

Surette

MULTIPLATE BATTERIES

WITH REZISTOX PLATES — RUBBER CLAD

5 PLY INSULATION INCLUDING DYNEL

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Dynel Tubes protected by rubber envelopes with solid edges, eliminate any possibility of treeing or shorts at plate edges. Heavy plate feet protrude through die cut rubber insulators on bottoms of plates, elements rest on plate feet not on plate frames. Plates are sealed top, bottom and sides with both rubber and Dynel.



More effective plate area results in faster cranking longer. Beats any battery in total performance.

58 Railroads have purchased Surette Batteries

Deep Well
Requires 50%
Less Water

1. Lower current density per plate made possible by the greater number of plates and greater effective plate area. 2. Reduces water consumption. 3. Reduces positive plate oxidation. 4. Anticipated service life increased by months. 5. Requires up to 50% less watering and attention through their greater service life.

Exclusive REZISTOX GRID CONSTRUCTION makes possible 40% more plate area. Costs no more than other recognized brands. Proven in tests and field service over a 25-year period. The extra capacity, lower current density per plate, REZISTOX plates, 5 Ply Insulation with Dynel is a bonus which reduces maintenance and adds months of longer trouble-free life.

Rubber Monobloc Containers also available for Low Compartments.

The Surette STORAGE BATTERY CO., Inc.

Box 711

Jefferson Ave., Salem, Mass.

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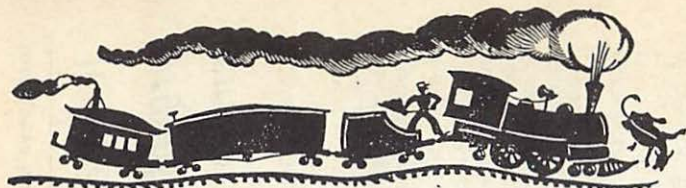
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ATTENTION ALL MEMBERS:

THE MEMBERSHIP SPECIAL IS ROLLING!
PAY YOUR DUES — (Check your card) THEN
GET A NEW MEMBER TODAY!
MANY THANKS!

PLEASE COMPLETE THIS FORM, THEN ATTACH YOUR PERSONAL PRINTED CHECK IN FAVOR OF: **LOCOMOTIVE MAINTENANCE OFFICERS ASSN., 1721 Parker Street, North Little Rock, Ark. 72114** FOR: **\$6.00 ACTIVE** (Railroad) MEMBERSHIP or **\$10.00 ASSOCIATE** (All other than Railroad) MEMBERSHIP. Please do not send cash unless absolutely necessary; there's no way to trace lost cash payments.

Dues for year ending December 31, providing one copy of all Technical Committee Reports in the Pre-Convention Report, and one copy of the Discussion of all these reports in the Annual Proceedings.

All Members attending the Annual Meeting will pay an additional \$5.00 registration fee there only.

IMPORTANT: Complete ALL information below. ATTACH YOUR PERSONAL NUMBERED PRINTED CHECK.

Name (Print) _____

Position _____

Company _____

Your address of **Company Service**.

Street _____

City _____ State _____ Office Zip Code _____

WE MUST HAVE YOUR COMPANY OFFICE ZIP CODE NUMBER! SUPPLY MEMBERS: Payment of dues and registration fee at Chicago will entitle you to attend **OUR MEETINGS ONLY; NOT THE EXHIBITS & ENTERTAINMENT;** they are owned by Railway Supply Assn., Inc., 332 So. Michigan, Chicago, in which we urgently recommend membership, too.

Recommended By _____



SUPPLY MEMBERS: Payment of dues and registration fee at Chicago will entitle you to attend **our meetings only;** Not the exhibits or entertainment; they are owned by Railway Supply Association, Inc., 332 So. Michigan Ave., Chicago, in which we recommend membership.

*It never has been so
urgent to train and upgrade
employes — or so easy!*

. . . OR SO INEXPENSIVE!

Home-study courses, tailored to the different needs of the maintenance-of-equipment department, can develop skilled journeymen from your present force of unskilled labor. It can cost as little as \$6 per month per trainee. The Railway Educational Bureau provides the courses, and does the grading.

MANY RAILROADS USE IT!

The Bureau already has formal arrangements with about a third of the Class I railroads, and with many industrial and other short-line roads. The completion of four-year courses qualifies apprentices as journeymen. Some roads use accelerated programs, turning out skilled machinists, electricians, carmen, car inspectors and other craftsmen in as little as three years. In the case of especially responsive students, two years is sufficient for the regular four-year course. Many other railroads use shorter REB courses for upgrading and refreshing. The Bureau also offers four two-year courses, as follows: Locomotive Engineers, covering diesel-electric equipment and air brakes; Locomotive Electrical Equipment; Locomotive Mechanical Equipment; and Car Inspectors and Carmen.

RAILROADS AND TRAINEES GET FEEDBACK

Instructors of the Railway Educational Bureau, all active railroad men themselves, grade students' examination papers and make individual comments and suggestions to the students when such help is needed. In the case of formal, company-sponsored programs, the railroad gets a monthly report of each student's progress.

WHO QUALIFIES?

Anyone. Courses are written for employes with a high school education.

HOW TO PARTICIPATE

Besides formal apprentice training programs on a contract basis, railroads may help an employe by paying half his monthly tuition, or all of it, or by reimbursing the employe on successful completion of his training. Or they may authorize payroll deductions.

FOR MORE INFORMATION

Write now, or phone collect, to Joe S. Betz, Director, Railway Educational Bureau, 1809 Capitol Ave., Omaha, Nebr. 68102, telephone (402) 341-7889.

RAILWAY EDUCATIONAL BUREAU
Railway Locomotives & Cars

1970 Advertisers Index

This space dedicated to the firms listed below for their cooperation and assistance in making possible the publication of our 31st Annual Proceedings in the year 1970.

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ATTENTION EVERYONE COMING TO THE MEETING!

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 8 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. There will be no facilities there to issue one to you. This delays too many other members waiting behind you in line.)
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 8.
10. **BRING THIS BOOK TO EVERY SESSION OF THE ANNUAL MEETING!** There are no extra copies.
11. **SAVE YOUR TIME:** Prepare your Registration Form



America's railroads. Who needs them?

The man who has a special on cantaloupes this week. The man who builds a house you can buy, without going to the poorhouse. All the businesses you do business with.

Where would most of them be without railroads to deliver the goods at the lowest cost? Out of business.

America without railroads? We can't afford it. But, if railroads are given the freedom to do business like any other business—with up-to-date regulations and fair taxation—then they'll always deliver the goods.

America's Railroads
Who needs them? You do. We all do.

**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 Lobby at Sherman House.
2. CLIP (don't staple) **A FIVE DOLLAR BILL HERE.**
3. CLIP (don't staple) **YOUR THIS YEAR'S MEMBERSHIP CARD RIGHT OVER THE MONEY.**

4. **I WANT A BADGE FOR MY WIFE (CHECK BOX)** (Supplymen get Wives Badges at Allied Booth.)

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.

5. **TEAR OUT THIS PAGE (attach your card and money now) AND PRESENT IT TO REGISTRATION GIRL UNDER SIGN READING, "PAID UP MEMBERS REGISTER HERE."**

6. **THE REGISTRATION GIRL WILL KEEP YOUR CARD. (It will be mailed to you after the meeting.)**

7. **IF YOU CAN'T FIND YOUR THIS YEAR'S MEMBERSHIP CARD, CHECK THE BOX BELOW: RUSH TO THE SECRETARY TODAY.**

I AM COMING TO THE CONVENTION, BUT CANNOT FIND MY CARD. MAIL ME ANOTHER.

Name

Title

Company

It never has been so urgent to train and upgrade employees -- or so easy!

. . . OR SO INEXPENSIVE!

Home-study courses, tailored to the different needs of the maintenance-of-equipment department, can develop skilled journeymen from your present force of unskilled labor. It can cost as little as \$6 per month per trainee. The Railway Educational Bureau provides the courses, and does the grading.

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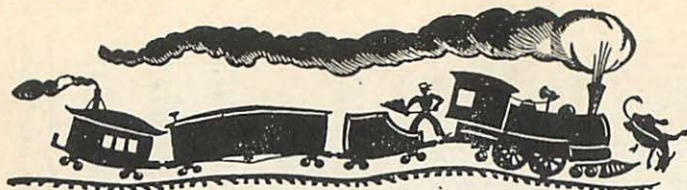
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RAILWAY EDUCATIONAL BUREAU

Railway Locomotives & Cars



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Name (Print) _____

Position _____

Company _____

Your address of **Company Service.**

Street _____

City _____ State _____ Office Zip Code _____

Recommended By _____

WE MUST HAVE YOUR COMPANY OFFICE ZIP CODE NUMBER! SUPPLY MEMBERS: Payment of dues and registration fee at Chicago will entitle you to attend **OUR MEETINGS ONLY; NOT THE EXHIBITS & ENTERTAINMENT;** they are owned by Railway Supply Assn., Inc., 332 So. Michigan, Chicago, in which we urgently recommend membership, too.



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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 meetings 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:

Albany Hotel, Denver, Colo.
 Caboose Restaurant, Union Station, Denver, Colo.
 Coachman's Inn, Little Rock, Ark.
 Downtowner Motel, Memphis, Tenn.
 Engineer's Club, Philadelphia, Penn.
 Golden Buffet Restaurant, Kansas City, Mo.
 Golden Triangle Motel, Norfolk, Va.
 Holiday Inn, Downtown West, Chattanooga, Tenn.
 Holiday Inn, Richmond West, Richmond, Va.
 Fred Harvey's King Louis IX Dining Room, Union Station, St. Louis, Mo.
 Mayflower Hotel, Jacksonville, Fla.
 Muehlebach Hotel, Kansas City, Mo.
 Roanoke Hotel, Roanoke, Va.
 Sheraton Hotel, Philadelphia, Penn.
 Sherman House, Chicago, Ill.

There were 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.

OUR OFFICERS - BOARD OF DIRECTORS AND GENERAL EXECUTIVE COMMITTEE



PRESIDENT
G. R. WEAVER
Director Eqpt. Engineering
Penn Central Company
Philadelphia, Pa. 19104



4th VICE PRESIDENT
(Gen. Membership Chmn.)
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Asst. C.M.O.-Loco.
C. & O. Ry. - B. & O. R.R.
Huntington, W. Va. 25718

MEMBERSHIP GROWTH THRU THE YEARS

	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

OUR OFFICERS — BOARD OF DIRECTORS AND GENERAL EXECUTIVE COMMITTEE



1st VICE PRESIDENT
(Program Chairman)
G. W. NIEMEYER
Mechanical Superintendent
Texas & Pacific Ry.
Fort Worth, Texas 76102



2nd VICE PRESIDENT
(Advertising Chairman)
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A. T. & S. F. Ry.
Chicago, Ill. 60604



3rd VICE PRESIDENT
(Meeting Procedure Chmn.)
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Supvr. Loco. Maint.
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5th VICE PRESIDENT
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Electrical—Burlington
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6th VICE PRESIDENT
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C. & O. Ry. - B. & O. R.R.
Huntington, W. Va. 25718



7th VICE PRESIDENT
(Advertising Vice Chmn.)
J. D. SCHROEDER
Asst. C.M.O. - Locomotives
Burlington Northern, Inc.
St. Paul, Minn. 55101

OUR OFFICERS - BOARD OF DIRECTORS AND GENERAL EXECUTIVE COMMITTEE



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(1949 Past President)
Asst. Vice Pres. - Equipment
Seaboard Coast Line R.R.
Jacksonville, Fla.



F. D. SINEATH
(1954-55 Past President)
Chief of Motive Power
Seaboard Coast Line R.R.
Jacksonville, Fla.



C. A. LOVE
(1963 Past President)
Chief Mech. Officer - Eqpt.
Louisville & Nashville R.R.
Louisville, Ky.



H. N. CHASTAIN
(1964 Past President)
Gen. Mgr. - Mechanical
A. T. & S. F. System
Chicago, Ill.



J. J. EKIN
(1965 Past President)
Supt. Marine & Pier Maint.
Baltimore & Ohio R.R.
Mech. Dept. - Mt. Clare
Baltimore, Md.



F. A. UPTON
(1966 Past President)
Chief Mechanical Officer
C. M. St. P. & P. R.R.
Milwaukee, Wis.
(Merged with L.M.O.A.
3-10-55)

ATTENTION EVERYONE COMING TO THE MEETING!

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 8 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. There will be no facilities there to issue one to you. This delays too many other members waiting behind you in line.)

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 8.
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 8, **BRING IT WITH YOU!**
12. **Come to Sherman House to Register for a Convention Badge: On Joint-Exhibit Years ONLY, ALL Registration will be at the Exhibit Hall ONLY, AFTER SUNDAY.**

**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 Lobby at Sherman House.
2. CLIP (don't staple) **A FIVE DOLLAR BILL HERE.**
3. CLIP (don't staple) **YOUR THIS YEAR'S MEMBERSHIP CARD RIGHT OVER THE MONEY.**

4. **I WANT A BADGE FOR MY WIFE** (CHECK BOX) (Supplymen get Wives Badges at Allied Booth.)

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.

5. **TEAR OUT THIS PAGE** (attach your card and money now) **AND PRESENT IT TO REGISTRATION GIRL UNDER SIGN READING, "PAID UP MEMBERS REGISTER HERE."**

6. **THE REGISTRATION GIRL WILL KEEP YOUR CARD.** (It will be mailed to you after the meeting.)

7. **IF YOU CAN'T FIND YOUR THIS YEAR'S MEMBERSHIP CARD, CHECK THE BOX BELOW: RUSH TO THE SECRETARY TODAY.**

- 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.

8. **DO THE ABOVE BEFORE COMING TO THE CONVENTION; IT WILL SAVE TIME FOR EVERYONE, especially YOU.**

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L.M.O.A? WHAT IS IT? IT IS: THE LOCOMOTIVE MAINTENANCE OFFICERS ASSOCIATION

THE ASSOCIATION IS:

A group of railroad officers whose responsibilities and interests are concerned with the repair and maintenance of railroad locomotives, commuter equipment and other railroad equipment.

WHAT ITS PURPOSE IS:

The object of the Association is 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.

WHO IS BACK OF THE ASSOCIATION:

The Locomotive Maintenance Officers Association is one of five member groups of the Coordinated Railroad Mechanical Associations.

WHAT THE ASSOCIATION DOES:

It carries out its previously stated purpose by the work of **permanent committees** on —

DIESEL ELECTRICAL MAINTENANCE

DIESEL MECHANICAL MAINTENANCE

SHOP EQUIPMENT

DIESEL MATERIAL STANDARDIZATION & CONTROL

DIESEL FUEL AND LUBE OIL

NEW DEVELOPMENTS IN MOTIVE POWER MAINTENANCE

COMMUTER EQUIPMENT

WHAT'S YOUR PROBLEM?

These committees are made up of members who are engaged in Locomotive and Commuter Equipment maintenance work and whose efforts on these committees will bring to the membership a broad survey of the best practices and facilities for shop and enginehouse work. The reports of these committees and the discussions at the annual meeting, published in the Proceedings of the Association and distributed to the members, constitute a library of shop practices the scope and value of which will increase each year as the work of the Association progresses.

WHERE DOES IT OPERATE? NATION-WIDE!

In addition to regular committee meetings, each of the Technical Committees makes one "trial run" of its report, before one of the outstanding railroad clubs as indicated on the map below, prior to the formal presentation at the Annual Meeting in Chicago.

1970 PRE-CONVENTION PRESENTATIONS



L.M.O.A IS A VERY COSTLY, HIGHLY DEVELOPED, PRODUCTION TOOL for individual, group, and industry-wide improvement in Motive Power Maintenance Practices. If **thoroughly mastered**, universally used, it is of inestimable value; if not so utilized, it is as worthless as a ticket to last year's world series.

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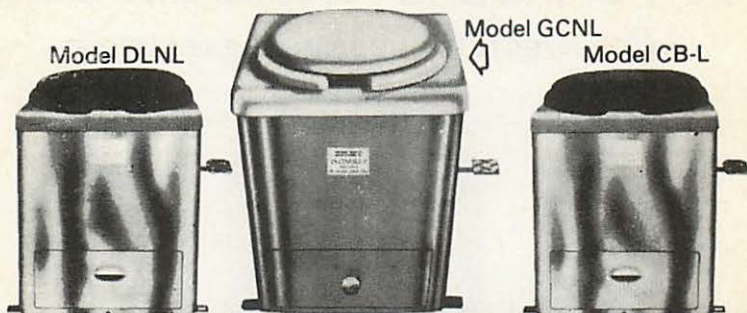
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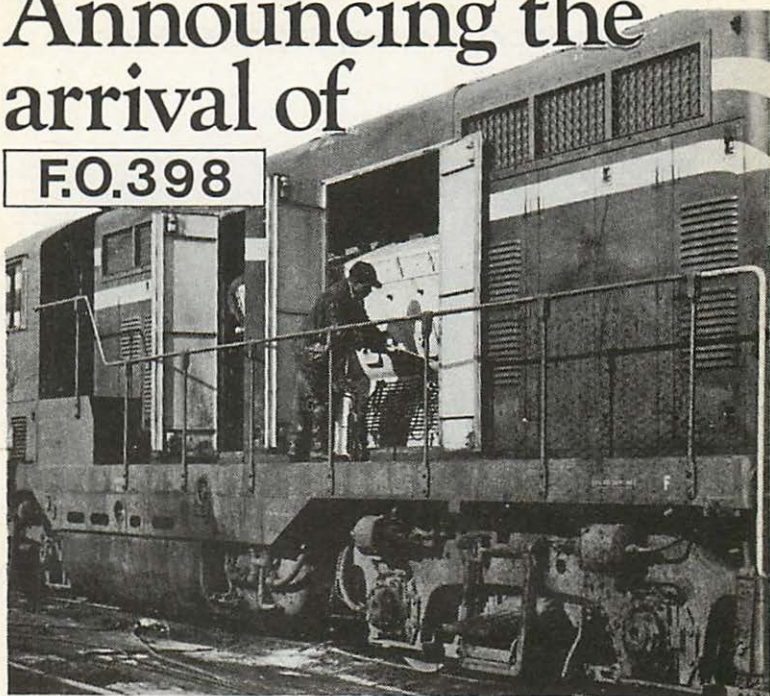
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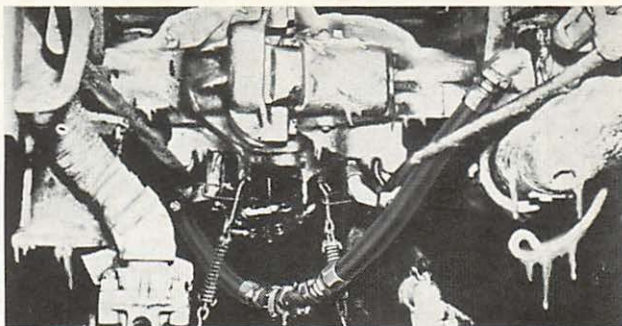
- 1939 & 1940—F. B. DOWNEY (Deceased) Asst. to Shop Supt., C. & O. Ry., Huntington, W. Va.
- 1941—J. C. MILLER (Deceased), M. M., N. Y. C. & St. L. R.R., 419 Liberty Street, Conneaut, Ohio
- 1942-1946 Inc.—J. E. GOODWIN, Retired Exec. Vice-President, C. & N. W. Ry., 4 River Ridge Road, Little Rock, Ark.
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- 1948—C. D. ALLEN, Retired Asst. C. M. O. - Locomotive, C. & O. Ry., B. & O. R.R., 1538 Upland Road, Huntington, W. Va.
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- 1956—T. T. BLICKLE (Deceased), Retired General Manager - Mechanical, A. T. & S. F. System, 5115 Clausen Avenue, Western Springs, Ill.
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- 1959—E. V. MYERS, Retired Supt. Mechanical Dept., St. Louis-Southwestern Ry., 2700 Howard Drive, Pine Bluff, Ark.
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- 1961—O. L. HOPE, Retired Asst. Chief Mechanical Officer, Missouri Pacific R.R., RFD No. 1, Box 25, Conway, Ark.
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- 1964—H. N. CHASTAIN, Gen. Manager - Mechanical, A. T. & S. F. Ry., Chicago, Ill.
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- 1966—F. A. UPTON, Chief Mechanical Officer, C. M. St. P. & P. R.R., Milwaukee, Wis.
- 1967—G. M. BEISCHER, Chief Mechanical Officer - Locomotive, C. & O. Ry. - B. & O. R.R., Huntington, W. Va.
- 1968—G. F. BACHMAN, Retired Chief Mechanical Officer, Elgin Joliet & Eastern Ry., 612 E. Bevan Drive, Joliet, Ill.
- 1969—T. W. BELLHOUSE, Supt. Mechanical Dept., S. P. Co. - St. L. S. W. Ry., Houston, Texas.

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- 1955—Past President, Master Boilermakers Association when merged with L.M.O.A. 3-10-55, F. R. MILLIGAN, Retired General Boiler Inspector, Canadian Pacific Railway, 541 Leon Street, Kelowna, B. C., Canada.
- 1963—Past Third Vice President, TOM MURRAY, Retired Master Mechanic, St. Louis-San Francisco Ry., 16349 Felice Drive, San Diego, Calif.
- 1963—Past Alaskan, Canadian & Great Lakes Regional Executive C. L. HALL, Retired Supervisor Locomotive Maintenance, New York Central System, 38 Ferris Place, Ossining, N. Y.
- 1965—Past Third Vice-President, S. C. SNOW, Asst. to General Purchasing Agent, Louisville & Nashville R.R., Louisville, Ky.

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DO THESE TWO THINGS TODAY

- A. GET A NEW SUPPLY MEMBER AT THIS MEETING.**
- B. TURN TO PAGE THREE (3) OF THIS PRE-CONVENTION REPORT**
 - 1. THANK these Advertisers as you visit their room and exhibit. (Where consistent.)**
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A Pre-Convention presentation was made at our regular meeting in Kansas City on April 29 by Mr. K. D. Reed, Manager Research Laboratory, Penn-Central, Cleveland, Ohio. His subject was: "Relation of Operating Conditions to Lube Oil Characteristics." The members of this club sincerely thank Mr. Reed, the members of his committee and the L.M.O.A. for the excellent program.

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Monday Morning, September 14, 1970

10:30 A. M.

REPORT OF THE COMMITTEE ON FUEL AND LUBE OIL

Pre-Convention
Presentation:

**GREATER
KANSAS CITY
RAILWAY CLUB**



K. D. REED, Chairman
Committee on Fuel and Lube Oil
Mgr. Research Laboratory,
Penn Central Co., Cleveland, Ohio

6:00 P. M.
APRIL 29, 1970

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Vice Chairman

N. E. Brightwell, Senior Test Engineer, Chicago, Rock Island & Pacific, Chicago, Ill.

Committee Members

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D. L. Bowman, Mechanical Inspector, Norfolk & Western, Roanoke 24011
V. E. Broman, Project Engineer, Atlantic Richfield Research, Harvey 60426
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C. A. Nicol, Mgr. Railway Accounts, Imperial Oil, Toronto, Can.
C. A. Phalen, Senior Engineer, Shell Oil, San Francisco 94106
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K. D. Relyea, Technologist, Texaco, Inc., Beacon 12508
M. W. Savage, Product Engineer, Std. of California, San Francisco 94104
J. D. Smalling, Special Assistant, Southern Pacific, San Francisco 94105
R. A. Wolfe, Engineer of Tests, Reading, Reading 19601



1970 TOPIC:

**"RELATIONSHIP OF OPERATING CONDITIONS
TO LUBE OIL CHARACTERISTICS"**

PERSONAL HISTORY OF

K. D. REED

Kenneth Duane Reed was born at Burgettstown, Pennsylvania on March 5, 1921. He attended public and high school in this small Pennsylvania town on the former Panhandle Division of the former Pennsylvania Railroad.

Duane attended Washington and Jefferson College at Washington, Pennsylvania, where he received a Bachelors Degree in Chemistry and Biology. His four years at college were interrupted by three years in the Navy where he served as a Pharmacists Mate in charge of the Electro-Cardiograph Department at the Philadelphia Naval Hospital.

While in the Navy, he married a Navy nurse, Naomi Evey, whose hometown was Altoona, Pennsylvania. After the war, Duane returned with his wife to Altoona and within a few weeks, hired with the former Pennsylvania Railroad Test Department as a Chemist. He served in this capacity until 1958 when he was made Chief Chemist. Soon after the merger of the Pennsylvania Railroad and the New York Central System, he was transferred to Cleveland, where he now serves as Manager of the Research Laboratory at the Research Department in Collinwood, Ohio of the Penn Central Transportation Company.

Duane has three children, two girls and a boy. He has been a member of the Fuel and Lube Oil Committee of the LMOA for five years, is a member of three AAR committees (including the Lubrication Committee) and is a member of several ASTM committees including D-2 on Petroleum Products.

1. OIL DEVELOPMENTS:

This year's report will approach the topic of engine lubricating oils from a different viewpoint than previous years. **This year your committee felt it advisable to stress the operating conditions which can influence the choice and performance of oils.**

In our report the last two years we described test work on a "large Western road". Some of the oils under test last year are now branded commercial products. In addition, new formulations of oil are starting their field evaluation.

Although last year it seemed the horsepower thirst of the railroads had been satisfied for the moment, at least two new higher horsepower engine designs are in the offing which may lead to increased demands on the lubricating oil.

Operating conditions and maintenance policies are continually under review. Changes in operating conditions have included pooling of power, elimination of intermediate repair points and extension of time intervals for routine maintenance.

Previous reports have defined four general types of lubricating oil. Straight mineral oil, the first type to be used in railroad diesel engines, is no longer in use.

The first detergent oils have also essentially passed from the scene. The problem with the latter, even though they represented a vast improvement over the straight mineral oil, was the lack of stability of the additives. Because the detergents were unable to suspend certain sizes of dirt particles, and had an affinity for water, they would drop their dirt burden with changes in temperature.

The next group of oils to appear on the market were similar to the

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first detergent oils in that they were detergent in nature. However, in addition, dispersancy was included by the introduction of an ashless dispersant to the additive system, permitting the oils to carry contaminants, even in the face of water contamination, temperature change, etc. The oxidation stability of this group of oils also was improved. This group of oils has been referred to in past reports as second generation oils. It was this group of oils that allowed for the first time, full flow oil filtration, paper filters and a reduction in filter change costs due to longer periods between filter changes. To a great extent, it was the need of one type of engine prone to producing a greater soot burden and requiring greater dispersancy to prevent ring fouling and filter plugging that spurred the development of this generation of oils. Truly, in the words of Shakespeare, "Sweet are the uses of adversity, which like the toad, ugly and venomous, wears yet a jewel in its head."

Demands of increased horsepower in new locomotives and more severe operating conditions encouraged an improvement in this already good group of oils. Improved stability especially oxidation stability rather than increased dispersancy, has been the mark of the new oils appearing on the market in the last few years. These oils, which are in fact an upgrading of the first truly high dispersant oils, have been referred to by this L.M.O.A. Committee as third generation oils. There is no clear-cut demarcation between the first truly high dispersant oils, sometimes called "second generation" and the oils being sold as new and "third generation". The difference

is one of a gradual upgrading to better meet the requirements of high horsepower and more severe operating conditions. On some railroads no vast changes in the economy of operation may be evident, due to the use of these newest oils, such as the revolution in filter practices that was made possible by the first high dispersant oils. Possibly, because of this, these latest oils have not as yet cornered the market, replacing the first truly high dispersant group. They have been accepted with the greatest interest only where the more severe operating conditions exist. However, where these severe operating conditions do exist, the savings realized from these newest oils, in oil change intervals, corresponding filter changes and engine life can be outstanding.

2. OPERATING CONDITIONS:

Following are fourteen major operating conditions that exist in different combinations and degrees of severity on railroads in North America. The list, which does not purport to be all inclusive, is as follows:

1. Altitude.
2. Tunnels.
3. Ambient temperature.
4. Fuel.
5. Engine type.
6. Loading cycles.
7. Power utilization.
8. Train handling.
9. Degree of laboratory control.
10. Maintenance practices.
11. Natural airborne contaminants.
12. Lube oil change schedule.
13. Sanding requirements.
14. Interchange of locomotives.

Let us look briefly at the effect these operating variables have on the lubricating oil and the engine.

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High Altitude Operation results in lower density air, or less excess air, with a reduction in oxygen for combustion. Cooling water temperatures are increased as are bulk oil temperatures in addition to raising temperatures of engine components. The combustion products the oil must handle are changed from those of a lower altitude operation. They are increased soot, semi-burned materials, long chain acids. Unless the lubricating oil is eminently able to handle the increased load, debris, under-crown deposits and ring belt deposits, ring sticking and increased wear will result. The oil best able to cope with high altitude operation should have superior detergency, dispersancy, oxidation stability and alkalinity reserve.

Tunnel Operation in many ways

simulates extreme high altitude operation. Engine operating temperatures are likely to be higher. Bulk oil temperatures are high. Cooling water temperatures approach boiling and in the most severe cases cooling water is essentially boiled away unless properly designed and maintained pressure systems are used. The viscosity of the oil may be thinned by the high temperature, which must be taken into account in the engine lubrication design and protective systems to maintain hydro-dynamic lubrication. Hot, thin air to the turbo-chargers simulate high altitude operation. The high temperatures and reduced air lead to poor combustion and accelerated acid formation. Under-crown deposits, ring belt desposits, ring sticking and wear are only held in

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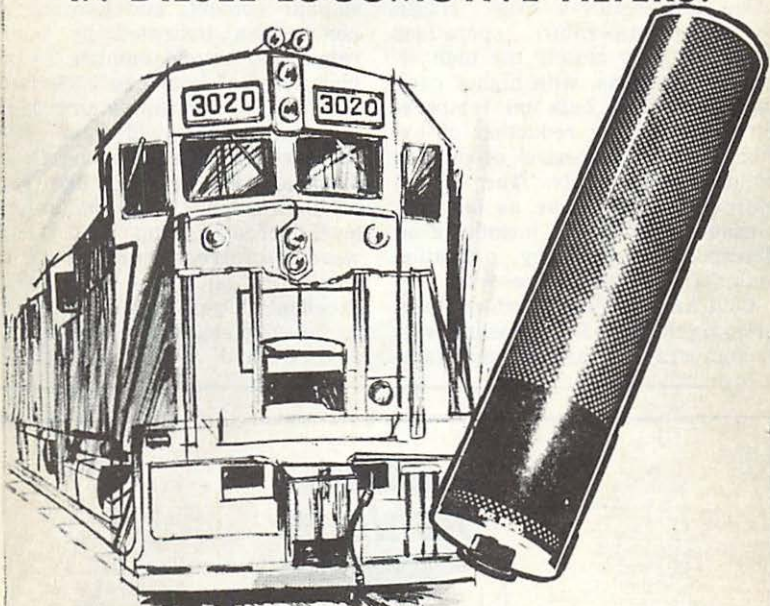


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check if the lubricating oil has adequate detergency-dispersancy, oxidation stability, alkalinity and film strength. Tunnel operation may well be the most severe environmental condition encountered on American railroads.

Both hot and cold ambient operating temperatures exist. High ambient temperature operations resemble very closely the high altitude conditions, with higher cooling water and bulk oil temperatures, and some reduction of excess air with increased production of oil contaminants. The oil requirements, the same as for high altitude operations, include good detergency-dispersancy, oxidation stability and alkaline reserve.

Cold Ambient Temperature Operation, including idle, if cooling water temperatures are not maintain-

ed high enough, leads to low temperature sludging, fuel dilution and wear. An oil with good dispersancy and alkalinity to combat wear, including corrosive wear, is needed.

Fuel Quality, as it effects oil and engine condition, is best defined by sulphur content, and hydrocarbon composition indicated by boiling range and cetane number. A sulphur level of less than 0.5% is defined by the Committee as acceptable quality and will have less measureable effects upon oil stability and engine wear than fuels of high sulphur. As the sulphur level increases, ring and liner wear can increase markedly if the lubricating oil is not able through excellent dispersancy and alkalinity to counteract and disperse the acids formed. Cetane numbers be-

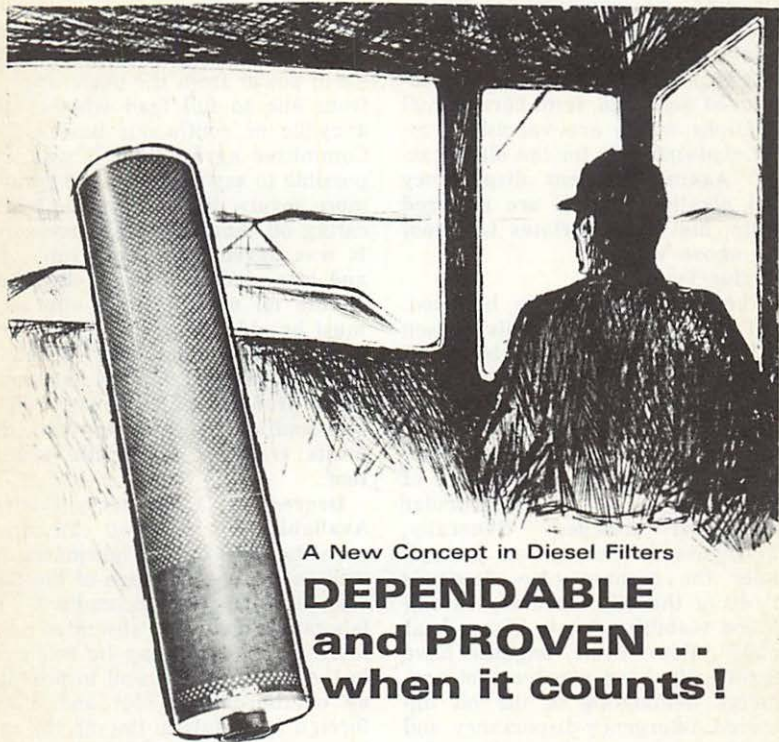


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low about 40 in commercially available fuel indicate increasing amounts of aromatic hydrocarbons. If these fuels have 90% points above 640° F. the likely result is poorer combustion, with increased soot and semi-burned fuel fractions which are varnish forming contaminants for the oil to carry. Again, excellent dispersancy and alkaline reserve are required if the fuel used deviates far from the above values.

Engine Type:

The choice of oils to be used, and the effect on the oils chosen is influenced greatly by the diesel engine involved. By this, we mean the horsepower output of the engine, or B.M.E.P., whether it is two or four cycle, the mechanical condition and adjustment of the engine, and the particular auxiliaries attached. Generally, the higher the horsepower per cylinder the greater the demands made of the oil, especially in oxidation stability, due to higher heat loads. Four cycle engines have historically been greater soot producers demanding of the oil improved detergency-dispersancy and alkaline reserve. Generally, the poorer the engine condition, the greater the importance of oils, that are superior in almost every feature.

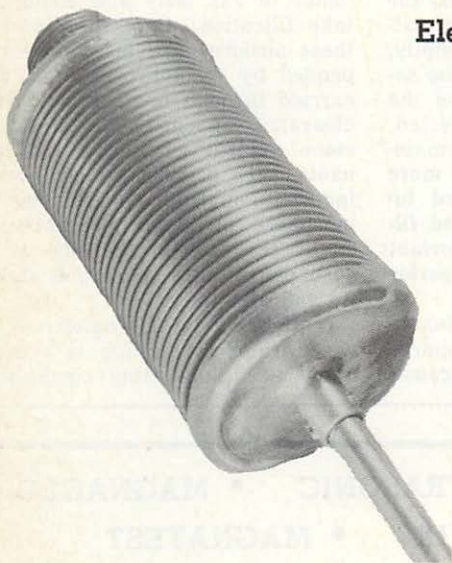
The presence of the turbo-clutch and silver wrist pin bearings on EMD engines have placed some special requirements on the lubricating oils. Oil characteristics are known to be related to the performance of the turbo charger clutch, but the exact phenomenon has not as yet been established. The presence of silver bearings has prevented the use of a well-known family of anti-wear additives in railroad diesel oils.

Loading Cycles, Power Utilization and Train Handling, although describing different aspects of locomotive operation, have in common the drawing of different levels of power from the diesel engine from idle to full load whether on a cyclic or continuous basis. The Committee agreed that it was impossible to say that full load placed more severe demands on the lubricating oil than idle, or conversely. It was agreed that both full load and idle placed different demands on the oil and that the oils used must be able to cope with the high temperatures of full load operation and with the fuel dilution and semi-burnt products which cause sludge, soot and under-crown and ring deposits resulting from idle operation.

Degree of Laboratory Control Available on a railroad can influence the selection of lubricants as well as the performance of the oils selected and the locomotive. If laboratory control is absent or minimal, "over kill" may be required in the selection of an oil to prevent an overburden of soot and other foreign materials in the oil, the unknown quantities of oxidation products, fuel and water dilution, etc. Where no laboratory control exists, it may be wise to purchase the oil having the greatest protection, through high dispersancy, oxidation resistance, additive stability against water and fuel contamination, alkaline stability, etc. Where comprehensive laboratory control is available, it is possible to arrive at optimum lubricant cost performance. Laboratory control has the benefit of detecting water leaks, fuel leaks and unusual engine wear regardless of the quality of the oil used, thus repairs can be made before an oil change is re-

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quired, or damage to the engine results, which in turn reduces oil consumption and maintenance costs.

Maintenance Practices:

Lube oil change schedules and maintenance practices, such as the oil filter change schedules and the diligence with which fuel and water leaks are repaired promptly, have a marked effect upon the selection of lubricating oils and the performance of the oils selected. In general, the less rigid the maintenance practices and the more prone the policy to extended lubricating oil drain periods and filter changes, the more important becomes the selection of superior lubricants.

Natural Airborn Contaminants and sand from sanding requirements entering the engine cause

catastrophic wear. Such abrasive wear cannot usually be coped with by proper selection of the lubricating oils. The operating conditions that increase the presence of these airborn particles demand greater care in the selection and maintenance of car body and engine intake filtration. Only the finest of these airborn particles can be suspended by the lubricating oil and carried through bearings and ring clearance spaces. The effect of some natural airborn contaminants, such as acid atmosphere in industrial environments, marine atmosphere, etc., can be counteracted by the selection of oils with good dispersancy, oxidation stability and alkalinity.

Interchange of Locomotives between railroads, which is a relatively new "operating condition",

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has placed new requirements upon oil selection and performance. The interchange will usually lead to the mixing of oils where mixing may not have been a practice before. Even if mixing had been tolerated on the individual roads involved under controlled conditions, interchange may require the consideration of new combinations of oils. The first consideration in the selection of oils to be used in the engines in interchange should be that the individual oils selected be capable of coping with the most severe combination of operating conditions existing on each of the interchange roads. In addition the performance standards of mixtures must equal the standards of the individual oils in the mixture. This is another way of saying the oils must be compatible. The qualities

of the mixture that should be determined to be equal to those of the individual oils are:

1. Silver and lead corrosion.
2. Oxidation stability.
3. Dispersion.
4. Silver lubricity.

Experience has indicated the more similar the oils are, especially the additive components, the less the risk of incompatibility. With current widely used oils, incompatibility seems to be non-existent.

3. STANDARDS FOR SPECTROGRAPHIC CONTROL OF LOCOMOTIVES IN INTERCHANGE SERVICE:

The Committee questions whether it is possible or even necessary to standardize spectrographic procedures between railroads involved in interchange of locomotives. There was a strong feeling that be-

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cause of the relatively limited time a locomotive was off line, spectrographic sampling could be eliminated by the foreign road. Suitable control could be exercised by tests to determine the presence of fuel and water leaks, leaving the more complicated interpretation of spectrographic tests for wear metals to the home line. Since the interpretation of spectrographic results depends so heavily on trends, rather than entirely on critical values, and since the results of the analysis of immediately preceding samples are usually inaccessible to foreign roads, the complexity of spectrographic control approaches the impossible when the locomotive units are not your own. Others on the Committee felt that there was something to be gained by the foreign road performing the complete program of analysis including spectrographic analysis using the techniques and equipment available and using the values and interpretations of the road doing the analysis. Even though the values for the various elements may not agree with the values the home road would have obtained on the same oil sample with their own spectrographic equipment, the foreign road's interpretation of their own findings will inevitably lead to the same corrective action being taken. Before the two roads can hope to agree exactly on spectrographic values, the laboratories involved would have to standardize on methods and equipment as far as economically possible, and exchange standards. This surveillance by exchanging standards would have to be continued on a regular basis.

Certain elements are used universally by laboratories making spectrographic analysis of used lu-

bricating oil. The level considered condemning may vary between laboratories due to different methods, instruments and standards, but the interpretation will very likely be made the same by each laboratory, even if analyzing oil from a foreign railroad. These universal elements are Silicon, an indication of engine intake air filtration problems; Sodium and Chromium or Boron, are indications of water leaks, depending on the type of water treatment used; and Silver, an indicator of distress in EMD wrist pin assemblies. The determination of Iron, or Chromium in the case of chrome liners, usually as an indicator of ring and liner wear, has been found useful by most laboratories. The use of wear metal elements, such as Copper, Lead or Tin for an indication of incipient bearing failure is more controversial. Some railroads and at least one engine manufacturer believe that bearing failures proceed so rapidly that it is unlikely that the spectrograph can pick up a failure before severe bearing and crankshaft journal damage can result, considering that a week, two weeks or a month elapses between samples.

Most roads represented on the Committee believe that mixing oils due to interchange of locomotives, or other reasons, does not confuse the spectrographic picture, within the limitations discussed above, including the limitation for mixing oils. That is, the performance of the mixture as indicated by dispersion level, oxidation stability, etc., be equivalent to the individual oils in the mixture. Mixing oil could confuse spectrographic data if changing from a low dispersant to a high one, or vice versa, resulted. Most spectrographic interpretations

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are trend evaluations and these trends could be disrupted by such a switch.

4. SPECTROGRAPHIC ANALYSIS FOR MONITORING ENGINE CONDITIONS:

Spectrographic analysis, as opposed to other facets of laboratory control, would probably not save on oil costs since most oil changes are made due to low base numbers, high insolubles, viscosity changes and water leaks, while spectrographic data gives an insight into engine wear patterns and other engine conditions. In other words, no one should expect to control lube oil changes by spectrographic data alone. In any case, the reduction of lube oil costs should not be criterion for spectrographic analysis; the effort should be in saving engines, not oil.

For most railroads, the value of a spectrograph lies primarily in the area of failure prevention. However, if records are periodically reviewed, a maintenance program can be established on a realistic schedule.

The frequency of oil sampling for spectrographic analysis has been more or less standardized, probably because of an economic compromise, to about twice a month for heavy working road locomotives, and once a month for switchers. A few railroads having a unique laboratory setup, involving multiple laboratories including spectrographs at major terminals, have samples taken and analyzed as often as every three days for road locomotives. Few would claim that samples can be taken too frequently.

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THE SOUTHWESTERN RAILWAY CLUB
 LOCOMOTIVE MAINTENANCE OFFICER'S ASSOCIATION DIESEL
 MECHANICAL MAINTENANCE COMMITTEE SPEAKERS' TABLE AT
 LITTLE ROCK PRE-CONVENTION PRESENTATION



J. D. SWAUGER, Pres.
 Southwestern Railway Club,
 Mechanical Superintendent,
 Atchison, Topeka & Santa Fe
 Railway, Amarillo, Texas

Now in its 24th year, the Southwestern Railway Club is an organization dedicated to free and open discussion of problems, solutions, and new developments in the Railway Industry. Membership is open to all Railway personnel and all Railway suppliers and builders. Meetings are held in Houston, Texas (January), Little Rock, Arkansas (April), and Ft. Worth, Texas (October).

Application for membership should be forwarded to Southwestern Railway Club, 6671 Myrtle Street, Houston, Texas 77017 (\$3.00 Railway, \$6.00 Suppliers).

(Photo Courtesy of Southwestern Railway Club)

Monday Afternoon, September 14, 1970

2:00 P. M.

REPORT OF THE COMMITTEE ON DIESEL MECHANICAL MAINTENANCE

**Pre-Convention
Presentation:
SOUTHWESTERN
RAILWAY CLUB**



N. A. BUSKEY, Chairman
Committee on Diesel Mechanical Maintenance
Supt. Shops, C. & O. Ry. - B. & O. R.R.
Russell, Ky.

**9:00 A. M.
APRIL 23, 1970
Coachman's Inn
Little Rock, Ark.**

Vice Chairman

W. B. Harris, Supt. Diesel Equipment, Western Maryland Ry., Hagerstown, Md.

Committee Members

W. E. Becker, Mgr. Tech Section, Electro-Motive Div., LaGrange, Ill.
 C. H. Cavinee, Master Mechanic, Texas & Pacific, Ft. Worth, Texas
 R. J. Chinn, Mech. Engineer, Illinois Central, Chicago, Ill.
 W. B. Dobbs, Supt. Sys. Assy. Shop, Southern, Chattanooga, Tenn.
 W. P. Fenton, Diesel Insp. & Instr., Illinois Terminal, Alton, Ill.
 J. B. Fister, Mgr. Loco. Shop, Reading, Pa.
 R. R. Forbes, Mech. Supvr.-Loco., Norfolk & Western, Roanoke, Va.
 M. H. Kuhn, Master Mechanic, C. & E. I., Dolton, Ill.
 P. W. Larey, Asst. C. M. O. - Loco., Missouri-Kansas-Texas, Parson, Kan.
 K. R. Manson, Service Manager, MLW-Worthington, Montreal, Can.
 J. A. McDonald, Mech. Asst. Loco. Maint., Canadian National, Montreal, Can.
 G. H. McDonald, Shop Superintendent, R. & R. G. W., Denver, Colo.
 K. F. Miller, Mgr. Loco. Mint. Mech., Penn Central, Philadelphia, Pa.
 C. G. Moon, Mgr. Elect. Syst. Engr., General Electric, Erie, Pa.
 W. M. Read, Supt. of Engines, Burlington Northern, St. Paul, Minn.
 W. H. Chidley, Consult. Engr., American Iron & Steel Inc., 230 N. Mich. Ave., Chicago, Ill.
 L. H. Sultan, Asst. Supt. Mech. Dept., Southern Pacific, Los Angeles, Calif.
 G. E. Voest, Supt. Loco Shop, Lehigh Valley, Sayre, Pa.
 J. R. Williams, Reg. Supt. of Loco., Burlington Northern, Chicago, Ill.



1970 TOPIC:

**"MAJOR LOCOMOTIVE MAINTENANCE MECHANICAL
PROBLEMS - 1970"**

PERSONAL HISTORY NELSON A. BUSKEY

Nelson A. Buskey was born November 17, 1922 in Cumberland, Maryland. He attended grade and high school there, graduating in June 1940. In July 1940, he began his railroad career as a Machinist Apprentice on the Baltimore and Ohio Railroad. In March 1943, he entered the military service for three years, spending most of it in the European theatre of operations in an Armored Division.

Upon returning from the service and completing his apprenticeship he has held the following positions. Diesel Electric Supervisor at East Saint Louis, Illinois and Parkersburg, West Virginia. Assistant Engine House Foreman at Chillicothe, and Newark, Ohio. While in Newark he served as Diesel Shop Foreman and Relief General Foreman. In March 1961 he was promoted to Regional Mechanical Inspector at Cincinnati, Ohio. In July 1961 he was transferred to Cumberland, Maryland as Project Engineer and Production Control Supervisor. In November 1965 he was transferred to the Chesapeake and Ohio Railway as Superintendent of Locomotive Maintenance at Huntington, West Virginia. In March 1967 he was promoted to Assistant Superintendent of Motive Power. In July 1968 he was promoted to the position he now holds, Superintendent of Shops, Russell, Kentucky.

Introduction

Without a doubt we have experienced, during the past ten years, a great evolution in railroad motive power.

Let us review some of the changes that transpired during the sixties. An electric, small foreign and domestic locomotive builder became a major diesel electric lo-

comotive manufacturer, while several other locomotive builders faded out of the picture as did the imported diesel-hydraulic locomotive, mainly because of maintenance costs and economics. Two cycle engines were equipped with clutch and turbochargers. This, along with other engineered engine component parts design changes, enabled the builder to double the horsepower output. New exotic lubricating oils were required and developed to carry additional loads and temperatures generated by these high horsepower engines. These new oils played a very vital role in the success of these engines. Radical changes were made in truck designs. Many technological improvements were made in electrical power, control and excitation systems.

These are just a few of the many changes we have witnessed during the past decade. During this period several new phrases were coined. Like "High Horsepower and Reduced Maintenance Locomotives." When we spoke of high horsepower locomotives we naturally thought of them as the reduced maintenance locomotives, which has not always been the case, not all of the changes have been good. Fact of the matter is, in some areas the problems have increased for us as diesel locomotive maintenance people.

Those of you who attended the Annual Meeting in Chicago last September will recall that Past President Tom Bellhouse charged the 1970 Committee Chairmen and Members with the responsibility for making definite recommendations and conclusions whenever possible concerning our many problems.

It is the expressed desire of this

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Committee, to fulfill this obligation, report to you on progress which has been made, encourage you to participate in research and development pertaining to these problems and to take advantage of experience of others who feel they have made progress.

The topics and sub-topics assigned to this Committee for this year are as follows:

Trucks and Related Equipment

- A. Wheel Wear
- B. Brake Rigging
- Cab Equipment
- A. Speed Recorders
- B. Sanitary Facilities

Engines—E.M.D.—G.E.—Alco

- A. Water Leaks
- B. Fuel Injection Equipment
- C. Crankcase Protectors
- D. Spark Arresters and Exhaust Systems
- E. Air Filtration
- F. Turbochargers

Air Compressors—Gardner Denver and Westinghouse

- A. Crankshaft Failures
- B. Cylinders
- C. Air Filtration

2. TRUCKS AND RELATED EQUIPMENT:

A. **Wheel Wear:** Much has been said and written during the past five years by this Committee concerning the problem of wheel wear. Let us review some of the wheel wear tests that have been conducted and their results.

In 1965, this Committee started reporting on a special test being conducted by a railroad on AAR-40 multiple-wear wheels with a 1 3/8-inch flange thickness and 3/4-inch radius in the throat of the flange, as compared with the standard 1 5/32-inch flange and the 11/16-inch radius throat. These wheels have a 5 5/8-inch rim width and are mounted back-to-back at 53 1/8 inches. All test units after Nos. 1 and 2 had wheels matched on the same axle, to the same tape, and a maximum hardness differential of ten points Brinell. Acceptable Brinell hardness for these wheels is 310 minimum, with 330 preferred. Following are results of seven of nine units which completed the test:

Unit	Type	Total Miles Service	Remarks
1	F9B	635,761	
2	F9B	543,199	Average Mileage
*3	F9B	364,196	521,056
4	GP35	337,729	
5	GP35	353,519	Average Mileage
6	GP35	323,407	349,683
7	GP35	384,066	

*Approximately 50,000 miles service lost account flat spots.

Results of this test indicate F9B type power had a 30%-40% increase in wheel life on the wide flange wheel, compared to the conventional width flange wheel, while Class GP35 units experienced only a slight increase over the conventional wheel.

Another road reports on testing of wide flange wheels with standard contour against wide flange wheels with Heumann contour. This test began in November 1968 on four SD35 units. When units in these tests were used exclusively in main line freight service, wheels

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were condemned for high flanges before they approached condemnation point for sharp flanges, consequently, no additional service life could be realized by wide flanged wheels. When these units were used in pusher type helper service, a 50% to 60% increase in wheel service life was attained. However, to restore wide flange wheels to the 1 3/8-inch thick flange or original thickness, required wheel removal and restoring profile in a wheel lathe, or purchase of additional cutter heads and blades for wheel truing machine. It is felt there is little to be gained by the use of wide flange wheels, when the following facts are considered:

1. Amount of tread metal removed to restore to a 1 3/8-inch wide flange. (One turning.)

2. Cost to remove wheels and re-profile in a wheel lathe. (Average 120 man hours.)

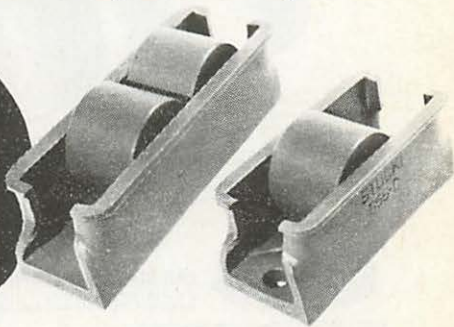
Another road reports as follows:

"We ran a test on cast steel and wrought iron wheels, one truck under a SW 1200 being cast steel wheels and #2 truck, wrought steel wheels. The trucks under our SW 1200's are Flexi coil with friction type journal boxes. After fifteen months of service, 46,680 miles, wheel wear on both trucks averaged out the same. Flange thickness 1/8" wear, rim thickness 1/8" wear, flange height 1/8" increase, with 1/16" hollow wear. All wheels are B type. We have modified brake heads on trucks and use a V-145 Cobra brake shoe."

Last year we reported results of still another cast steel versus wrought steel wheel test, in which

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it was pointed out, that average rim thickness of new cast steel wheels was somewhat less than wrought steel wheels and exclusive use of cast steel wheels, even under optimum conditions, would be expected to result in a slightly shorter service life and a corresponding increase in wheel change frequency. If cast steel wheels are furnished with equivalent rim thickness, performance would be equal.

Several other roads are conducting tests which should be of interest. One test involves two new SD40 locomotives which went into service in November 1968. First test unit has EMD wide flange Uni-point cast steel wheels on No. 1 truck and narrow flange multiple-wear wrought steel wheels on No. 2 truck. Second test unit has narrow flange multiple-wear wheels on No. 1 truck and EMD wide flange Uni-point wheels on No. 2 truck.

Initial wheel test data is summarized as follows:

Test Unit	Truck	Wheel Tape		Carbon Content	Flange Width
		Size	Brinell Hardness		
1	1	345 -	331 -	0.64% -	1-28/64" -
		346.5	341	0.67%	1-30/64"
1	2	343 -	321 -	0.65%	1-19/64" -
		347	341		1-20/64"
2	1	343 -	321 -	0.65% -	1-19/64" -
		347	341	0.66%	1-20/64"
2	2	345 -	321 -	0.64% -	1-28/64" -
		346	341	0.67% -	1-30/64"

Another Committee member reports the following:

"Wide flange wheels were ordered for this evaluation with the fol-

lowing specifications:

AAR wide flange wrought steel wheels, class BR with rim brinell hardness range 310-330, 330 preferred.

Test wide flange wheels have been applied to the following locomotives:

Unit Type	Date Applied	Miles to First Wheel Turn
EMD GP-40	12- 1-68	-----
EMD GP-40	12-12-68	67,000
Alco C-628	3- 7-69	-----
Alco C-628	2-19-69	-----
EMD SD-40	2-17-69	46,000
EMD SD-40	1- 6-69	35,000

Based on performance of above wheels, we have placed orders for 120 additional wide flange wheels to be applied in 1970.

In addition to above, we have just received 25 new EMD SD-45 units equipped with wide flange

"Uni-Point" wheels. We intend to follow wheel wear on these units very closely, along with units already equipped with wide flange wheels.

Another member of the Committee reports, with purchase of new

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GP-38 locomotives, a group of ten were designated for tests of wide flange "Uni-Point" wheels.

EMD has been very active in the testing of new wheels and wheel contours, and all or part of the preceding tests mentioned have been joint tests between EMD and the railroads involved. EMD has offered the following comments:

"In our many field tests we have seen no discernible difference in wear between the cast steel wheels and the wrought steel wheels. A recent survey of one road's test data indicated slightly greater wear for cast steel wheels, but differences are within the accuracy of the measurements taken. Also, in our test work we have not seen any wheel failures or failure indications of cast steel wheels."

In conclusion, it appears wide flange wheels can be used advantageously on flange cutting railroads operating in hilly and curving territories. Although not conclusive, wrought steel wheel versus cast steel wheel tests, reflect equal wear rate. However, a cost savings may be realized on cast steel wheels because of less machining required, due to manufacturing methods, which hold casting to closer finished sizes on hubs.

Several roads have developed data, indicating an increase of wheel wear on units equipped with IDAC wheel slip control system, associated amount of sand, and length of sanding time. EMD comments:

"IDAC controls wheel slip by recognizing the condition in its earliest stages and almost instan-

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taneously removes and gently re-applies small increments of power thus retaining highest possible tractive effort consistent with a given rail condition. Previous wheel slip circuits recognized slip condition later, reacted slower and removed and reapplied fairly large blocks of power thereby generating a lower overall average tractive effort.

"In general, railroads which operate in hilly territories and over curving right-of-ways, require maximum available adhesion, thus generating high average tractive effort which means simply that more horsepower is transmitted to wheel-track interface thereby establishing the condition for maximum wheel wear.

"Conversely, railroads which operate at higher speed with lower adhesion requirements frequently report less wheel wear with IDAC equipped units probably due to more rapid recognition of slip conditions and overall lesser sander requirements.

"We have noted through the past year or so that some railroads are getting into trouble with IDAC equipped units because they do not maintain wheel size matching within the specified limits. Following are tabulations of the recommended wheel size limits for non-IDAC as well as IDAC equipped locomotives.

"On non-IDAC equipped locomotives the maximum wheel size differentials should be a maximum of two tapes between wheels on one axle, a maximum of 3/4 of an inch in diameter between wheels in any one truck and a maximum of 3/4 of an inch in diameter between wheels under any one locomotive.

"On IDAC equipped units a maximum of two tapes between wheels on any one axle, a maximum of 3/4 of an inch in diameter between wheels in any one truck, and a maximum of 1 1/4 inches in diameter between wheels under a given locomotive."

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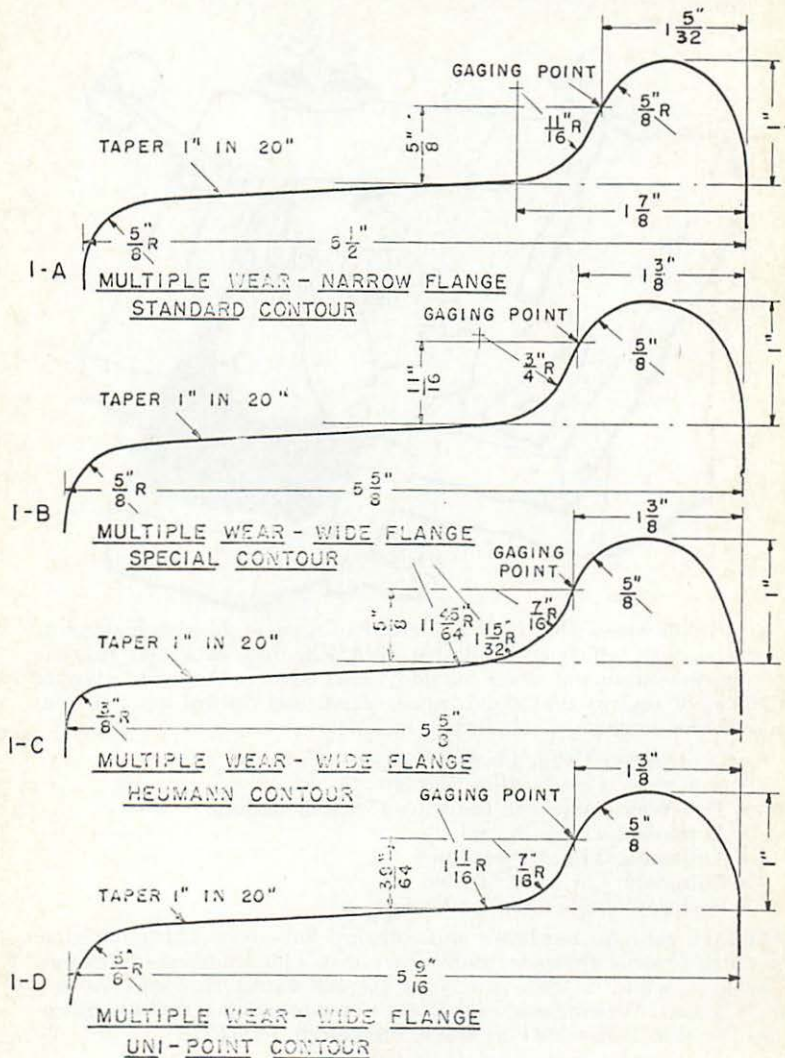
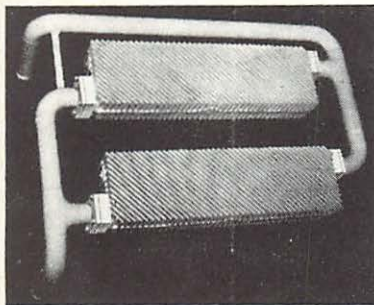


Fig. 1

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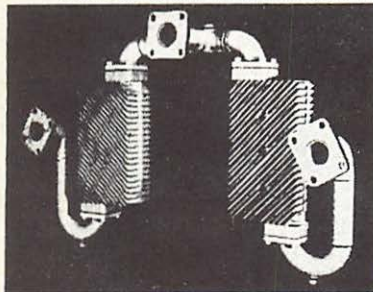


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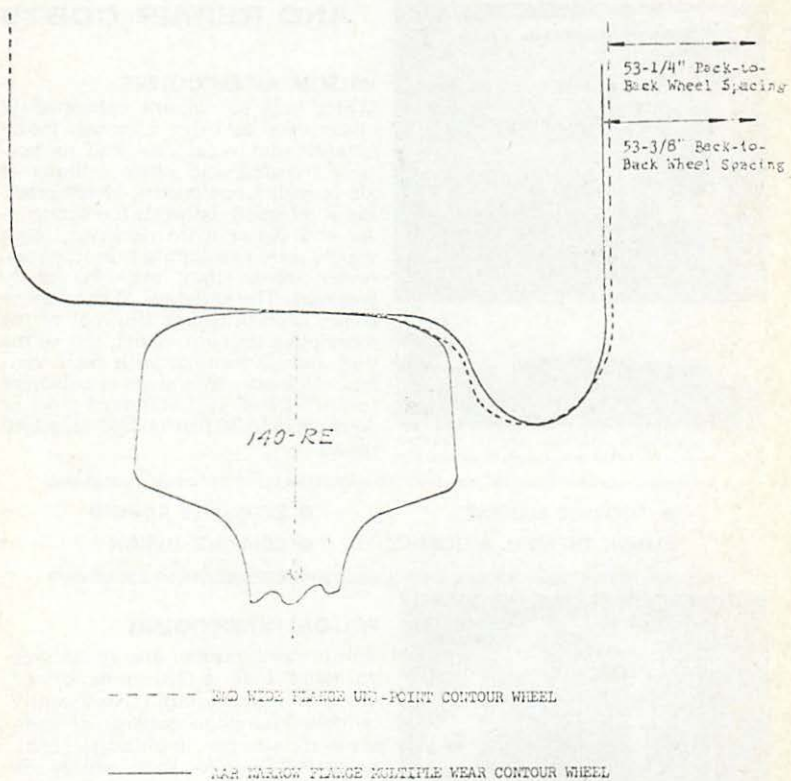
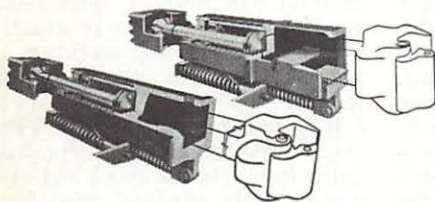


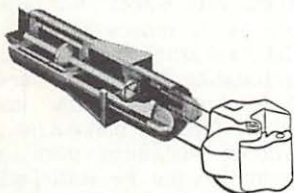
Fig. 2

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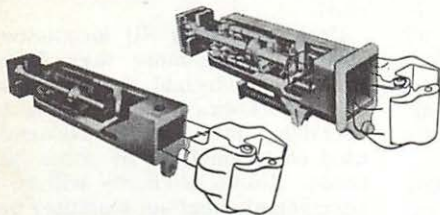
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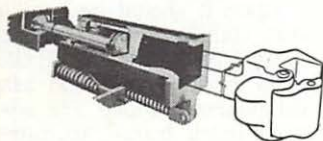
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B. Brake Rigging: Members of this Committee report that they have not found a solution to the overriding brake shoe problem on the single shoe, low mounted brake cylinder, six wheel E.M.D. truck.

Some SD locomotives with the original single shoe brake rigging, exhibit constantly overriding brake shoes. It was found during a substantial period of time that a number of physical conditions, in addition to component wear on the truck, contribute toward the cause of constantly overriding brake shoes. It was also determined that a number of modifications have to be made in the attempt to correct and prevent this undesirable condition.

Practically all constantly overriding brake shoes have occurred at the location where one brake cylinder operates two brake shoes (two-shoe-cylinder location). It should be pointed out that not all two-brake-shoe cylinder locations on a locomotive, and not all locomotives with this brake rigging arrangement, experience constantly overriding brake shoes.

A slight constantly overriding brake shoe condition has been experienced at locations where one cylinder operates one brake shoe when the non-metallic ferrules in the brake head exhibited extreme wear. The wear is such that the ferrules are no longer cylindrical but elliptical at both the I.D. and O.D. When constantly overriding brake shoes occur at the two-shoe-cylinder position, they are usually accompanied by stabilized bars that are bent outward permanently. Effect of excessively bent out stabilized bar itself is to hold associated brake shoe outboard of normal shoe to wheel position and perpetuate a condition of a con-

stantly overriding brake shoe. Possibility of a constantly overriding brake shoe occurring depends on severity of outboard position of shoe relative to wheel. Once a shoe wears concave to edge of wheel, a constantly overriding condition apparently becomes self perpetuating.

It should be pointed out that since brake rigging is hung from truck frame, brake shoes and associated brake rigging must have flexibility of lateral movement along with wheel and axle assembly as it moves laterally within the rigid truck frame during curve negotiation. Stabilizer bars, therefore, must be flexible enough to allow lateral movement rigging without sustaining permanent deformation but be sufficiently rigid to guide brake shoe properly to wheel tread when brakes are applied.

Brake shoes on SD locomotives should not be more than 3-3/8" wide. Some freight car shoes are 4" wide (Cobra V-139). These, on occasions, have been inadvertently used on locomotives by some railroads. Result, obviously will be a permanently bent out stabilizer bar and a permanently overriding brake shoe.

Again it should be kept in mind that stabilizer bar arrangement must have sufficient flexibility to allow brake levers and associated components, which are suspended from truck frame, to move laterally with wheel-axle assembly. Arrangement must be rigid enough to guide brake shoes properly to wheel tread when brakes are applied and to keep rigging from jostling when locomotive is in transit with brakes released.

One member reports the following: "We are still having a



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- Nylatron GSM liners virtually eliminate wear on mating journal box wear plates. A better fit is maintained between liners and journal box and maintenance costs are reduced.
- Nylatron GSM pedestal 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 GSM liners weigh only 1/6 as much as manganese liners and are easier and safer to install.
- Nylatron GSM pedestal liners are available from your locomotive builder.
- Nylatron GSM should also be considered for other areas of high abrasion and wear on your locomotives.



THE
Polymer
CORPORATION

ENGINEERED PRODUCTS DIVISION
Reading, Pennsylvania 19603, U. S. A.

multitude of problems with brake rigging on single-shoe design EMD six-wheel trucks. We have applied various modifications as recommended by EMD and as of this date have not found a satisfactory correction. As a result of troubles we have experienced with this truck, we have changed our new locomotive specifications to include clasp type brakes and high mounted brake cylinders on all future orders of EMD six-axle units."

Other members report they have replaced 3/8 inch by 2 inch stabilizer bar with 1/4 inch by 3 inch by 3 inch angle iron to keep shoes in line with wheel.

One other complaint received about this truck is relatively short life of brake cylinder packing cup, which has been attributed to brake cylinders when releasing, creating

a partial vacuum, drawing in road dirt, etc., through vent on the non-pressure head.

In view of the fact that this problem exists on the SD 40 and SD 45 locomotive trucks, built between September 1965 and February 1967, railroad members of this Committee feel that the recommended modifications to these trucks are not the complete solution and it is imperative that builder take another look at this three or four year old problem.

3. CAB EQUIPMENT:

A. Speed Recorders and Drives: Brought to attention of this Committee was expense that is incurred annually on speed recorder maintenance and servicing, removal of and application of speed recorder tapes.

Results of a recent study, con-

Compliments of

**CHICAGO PNEUMATIC TOOL
COMPANY**

Suppliers to Railroads for

Sixty-five (65) Years

VORTACOOOL*

Water Cooler with Spare Vortex Refrigerating Unit!

200% or more cold water with Vortacool . . . the low maintenance water cooler designed specifically for railroad use. 200%, even 300% more cold water availability! And now, you can stock up during this limited time offer. With each Model WC-200V Vortacool you purchase, we'll include a spare Vortex refrigerating unit. That way, your maintenance people simply replace the Vortex unit for routine cleaning and clean the replaced unit at a more convenient time. In just 5-10 minutes, the unit is replaced; this assures virtually continuous performance for your Vortacool.

Simple, efficient, air operated Vortacool is covered by a five year factory warranty and is the industry's model for low maintenance. Now we're making simple maintenance even simpler. Send for this Special Offer today!

NEW IMPROVED MODEL WC-200V

Very Special
Limited Time Offer! **\$233⁰⁰**

Cleve-Tek Products designed for low maintenance operation: Megawatt Hour meter / U-Sonic Ear / Filter-X-Tender / Coupler Blocks / Tracon Cross-level Measuring System / OC-1 Preamplifier / Pen-Gwins / Sno-Go / Spectra-Check Oil analysis / Switch Heaters / Water Seals / Propak Products



Products designed for low-maintenance operation!



CLEVELAND TECHNICAL CENTER, INC.

13600 Deise Avenue • Cleveland, Ohio 44110

* Trademark, Cleveland Technical Center, Inc.

ducted by an Eastern railroad, revealed cost of speed recorder and speed recorder tape maintenance was in the neighborhood of \$200,000 a year.

One road reports:

"All of our recorders are Chicago Pneumatic. We change recorders and angle drives on annual inspections. Our biggest problem is getting too much grease in liner, which penetrates into recorder and then recorder sticks."

Another member reports they use both Barco and Chicago Pneumatic speed recorders. They are changed out only at heavy overhaul, which is six years, or when they fail. Also, this road requires a speed tape on all units in a consist.

Several roads report that tapes are not used on freight units, but,

are used on passenger locomotives only.

Another member reports the following:

"All of our road units, with a few exceptions, are equipped with mechanically driven Chicago Pneumatic or Barco speed recorders. These recorders are changed out and reworked each time the unit is overhauled (approximately 42 months). The recorders are periodically calibrated at 21 month intervals or whenever a malfunction is reported. Periodic calibration or track-side calibration is performed with a company designed and built test set, which consists of two main parts. Drive portion uses a high-torque electric motor to drive a gear box, which provides output shafts and connections suitable for connecting to flexible drive shaft



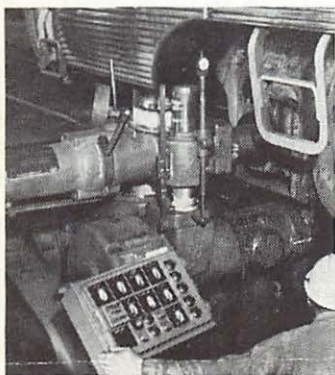
Morganite can make:

Carbon brushes to meet the needs of modern railroads: For over 60 years Morganite superiority has been acknowledged by railroad men the world around. To meet the operating requirements of your traction motors and generators, call the man from Morganite. **Morganite Incorporated**, 60 East 56th Street, New York, N.Y. 10022 (212-421-7910)

Where can you invest to get a 23% return?

Right here.

Invest in a Standard Wheel Truing Machine
—then watch your savings mount up!



Where do the savings come from? Less time. Less labor. Less out-of-service time. The Standard Wheel Truing Machine permits four or five reconditioning operations per wheel, not three. A true milling machine, it need not cut as deeply as lathe tools. One railroad that kept careful records found the Standard Wheel Truing Machine returned 23.64% of its cost in the first year on the job. Perhaps you can do better! One thing sure: You can do no better than to talk with your Standard representative.



STANDARD RAILWAY EQUIPMENT
division of **STANRAY CORPORATION**

Hammond, Indiana • Chicago

of each type instrument to be tested. A tachometer-generator is also mounted on gear box to provide an output proportional to main drive shaft speed.

Second portion of system is a control box, which contains rheostat for regulating drive motor speed and a speed indicating meter that shows main driver shaft speed in miles per hour.

Our policy regarding speed recorder tapes is that each unit of a locomotive consist, is to have a tape installed and the recorder in proper operating condition. Tapes are renewed only when nearing depletion. Used tape is retained for a period of seven days unless unusual circumstances dictate otherwise. It is not our policy to read recording tapes except for special reasons."

As you can see, there is considerable differences in frequency of recorder overhaul periods and recorder tape maintenance.

It is the recommendation of this Committee, that the speed recorder manufacturers look at their present day machines, which have experienced very few changes, during the past twenty-two years, with the thought in mind of improving their accuracy and reliability.

B. Sanitary Facilities: Container Type Toilets:

Several manufacturers have developed designs for container type toilets. One type requires a change

of water, to which is added a chemical. A flush cycle pumps the water from a filter to flush the hopper. These require servicing by dumping the sweep tank into a holding wagon or directly to the sewer. Servicing periods depend on the amount of use, type of service, and the capacity of the holding tank.

Other designs have used heat developed from electricity, fuel oil, or propane. The disposal cycle incinerates the waste and a fan runs to circulate air during the cycle.

Each design has its good and bad points. It behooves each railroad to become familiar with what is available so that the best design can be selected to best suit its needs.

Several reports received concerning an incinerator type toilet, indicate an odor problem exists on some applications. The location of the present vent line, where it terminates below the underframe, is being investigated to assure that back pressures are not created by traction motor exhausts or movement of the locomotive. An exhaust fan, on a time cycle, to assist venting odors, is being investigated.

Several members of this Committee report they are currently testing the chemical type toilets, but to date, results are not conclusive.

REWARD

FOR CUSTOMERS



Monogram's 12800-001

ALIASES

New-matic toilet, Air-operated toilet, Self-contained toilet, Recirculating toilet, Flushing toilet.

LAST SEEN IN

Cabooses, Locomotives, Camp Cars, Bar Cars, and Passenger Cars.

WANTED

for Monthly Service, Economy, Low cost, Dependability, Immunity to freezing temps. and only ONE moving part.

Any information leading to the capture of a 12800-001 air toilet may be obtained from:

Monogram Industries, Venice Division

3226 Thatcher, Venice, Calif. 90291

Phone: (213) 870-8772



Fig. 3 — Typical Application of Incinerator Type Toilet

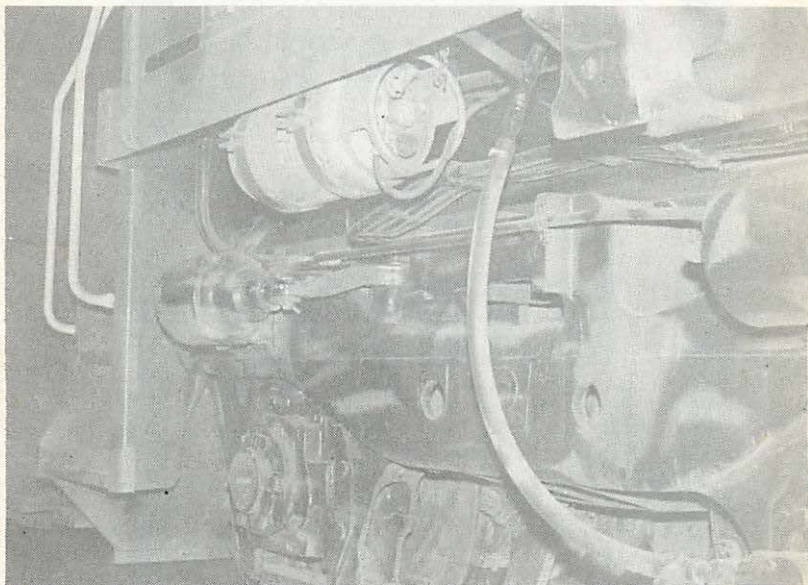
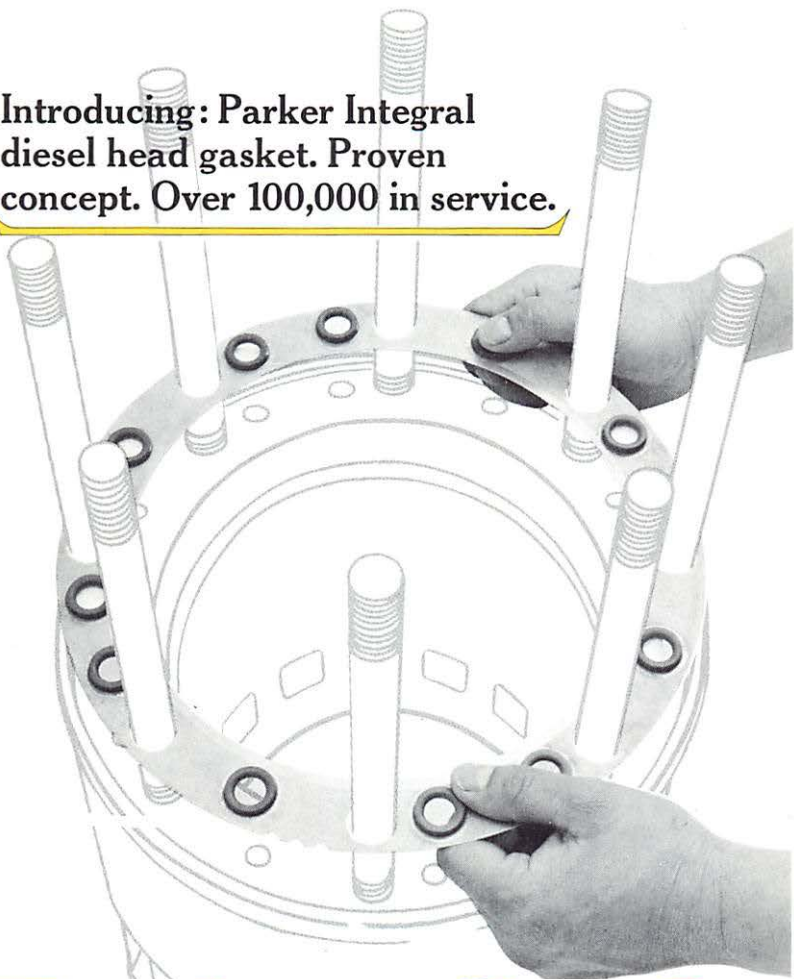


Fig. 4 — Typical Application of Propane Tank for Incinerator Type Toilet

**Introducing: Parker Integral
diesel head gasket. Proven
concept. Over 100,000 in service.**



Parker Seals

- New: Raised shield around each seal for total protection against exhaust and combustion gases.
- New: Reconfigured seal cross section for optimum volume/void and maximum life.
- Now: One seal; P/N 698058 fits all cylinder models B thru E. (That's right! 567's & 645's.)
- Exclusive: Raised fireseal around I.D.— a Parker first for positive combustion sealing.

You say your
metal-reinforced
rocker arm seals
stop oil seepage
dead in its tracks?

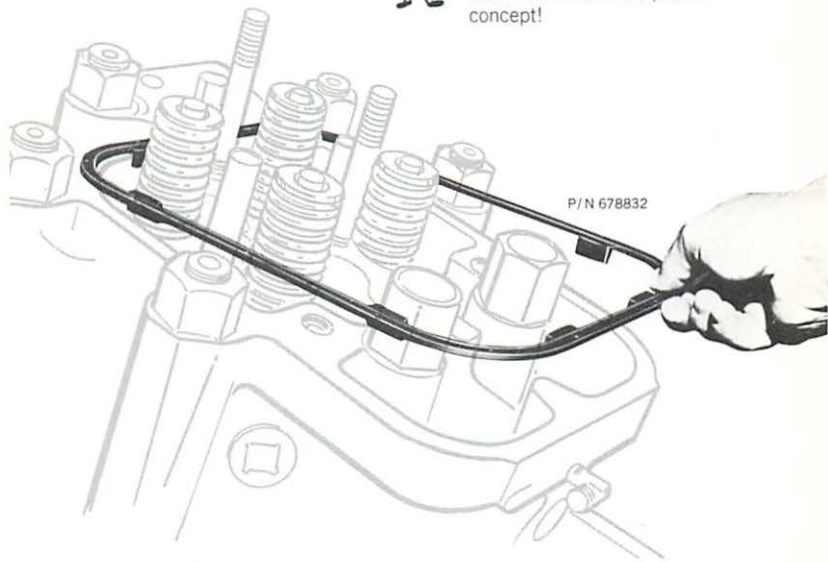
You bet. And they're
a snap to install with these
self-aligning tabs...

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Any other annoying LID
or COVER SEALING problems?

Let us help you solve
them with this NEW, proven
concept!



P/N 678832



P/N 688420



P/N 5-294-S455-7 O-RING

What's your
installation time
on these new
type water
jumper seals?

Five-six seconds.
They seat with bolts in
place. And when you max
torque these babies,
there's no doubt about it!

P/N 688420

Parker Seals

...and Water Jumper Seals
are available separately
or in kit form.

Ask about Water Jumper
Kit No. 698021



P/N 688766



What's so hot about your all-metal
exhaust stack base seal?

For one thing, it
stays tight on the job...
even at 650°F.



Parker Seals



Parker's
new exhaust stack
base seal torques to maximum,
stays tight under temperature condi-
tions and time periods that normally destroy
conventional stack seals. Eliminates periodic
re-tightening due to vibration in service. It's
part of a complete line of service-proved
locomotive seals. For full information, get
our free Railroad Seal Handbook
(J-5841). Parker Seal Company,
Culver City, California
90230

P/N 688098

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2. REINSTALLABLE after the second and third cycle of service.
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4. CONFIRMED PERFORMANCE — made possible by 50 years of specialized experience in producing over 250,000,000 pistons to date, in sizes as large as 19" diameter.

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McDonald Railway Supplies, Ltd.

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and

2185 Madison Avenue, Montreal, 261, Quebec, Canada

Manufactured by:

Mahle Komm. Ges.

Stuttgart-Bad Cannstaff,
West Germany

that this is not related."

One road reports it has experienced several cracked cylinders on a recently purchased fleet of U23B units, while another reports water leaks on U30B locomotives.

This is an age old problem and to date we are still experiencing water leaks. **THIS COMMITTEE FEELS THIS PROBLEM HAS BEEN WITH US ENTIRELY TOO LONG AND THAT THE LOCOMOTIVE BUILDERS MUST TAKE MORE POSITIVE CORRECTIVE ACTION.**

B-1. E.M.D. INJECTORS: Relatively short life of the EMD five and six hole injector nozzle is of prime concern to many railroad maintenance officers. Nozzles inspected and condemned for enlarged orifices indicated service periods as low as three to seven months.

One member reports that when reworking "E" injectors, approximately 75-80% of nozzle tips are scrapped because of enlarged orifices. Examinations indicate the orifices enlarge to approximately twice the normal diameter and stabilize at this dimension.

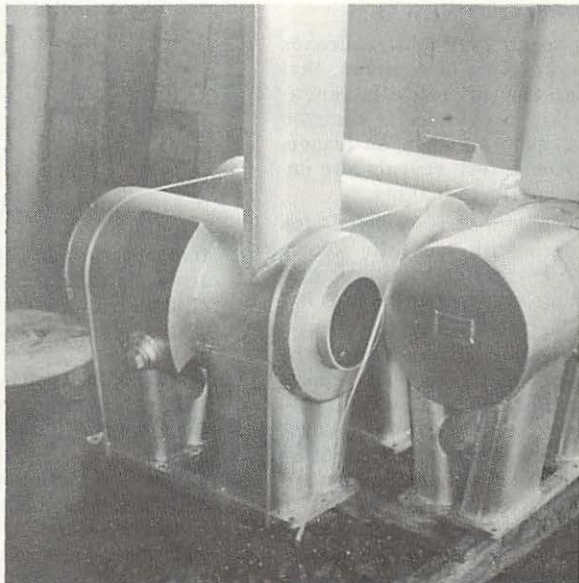
EMD comments: "We have recently completed a test over two years duration wherein performance of over 200 current model injectors was monitored in the field on two Western railroads using medium to low quality fuels. Test results indicated that mean life of injectors operating under these conditions would be slightly over three years before calibration became condemning at high end of tolerance range.

We recognize the fact that this probably represents a slightly shorter life than could be obtained with 567B or C engine injectors, but is still very reasonable when

you consider that current model of higher horsepower engines require that injector output be at least 70% higher per unit time than that of older engines. Generally speaking, where high injector tip wear rates are noted, one or more of the following conditions exist:

1. **Contaminated Fuel:** Most railroads have good way-side filtration units and maintain elements in these as well as locomotive filters. Occasionally, however, fuel is supplied from a refinery with finely divided particulate material in suspension in fuel which filters cannot remove and this is the type of material which causes serious erosion wear to the injector tip orifices.
2. **Sea Water Contaminated Fuel:** A few of our customers who buy fuel delivered by tankers occasionally run into a problem of sea water contamination which directly results in rapid erosion and/or corrosion of injector tip orifices.
3. **Algi in Fuel:** Railroads storing fuel in above ground tanks in areas where ambient temperatures vary broadly between day and night and particularly in humid territories, frequently experience algi or bacteria contamination problems. The storage conditions outlined above promote rapid formation of condensation within fuel storage tanks and algi or bacteria grow and multiply at water to fuel interface. These organisms eventually die and are ingested into engine fuel system where they plug filters, starve injectors for fuel oil and cause failure due to insufficient fuel cooling."

Spark Arresting Manifolds for EMD Locomotives by HARCO



SPARK ARRESTERS APPROVED:

7AB6	E7, E6 & E3
8AB8	SW1, SW2, SW1200 & others w/8" stack
10AB8-8	SW7, SW9, SW1500 & others w/8½" stack
10AB12	SD, GP7, SW8, SW900
12AB12	GP9
32379, 32379B (pair)	F3, F7, F9, FP, GP7, GP9, SD without dynamic brake
44379 & 44379B (pair)	EMD Swirl type manifolds

APPLICATIONS:

HARCO MANUFACTURING CO.

7700 S. W. 69th AVENUE
PORTLAND, OREGON 97223

B-2. GE NOZZLES are not satisfactory after one year's service. Many dilutions and sticking nozzles are experienced after six months of service.

B-3. INJECTOR OR NOZZLE RENEWAL:

It was found that most railroads have one practice in common, that is, the injector or nozzle is renewed whenever a cylinder is changed for any reason or when an inspection or Kiene test reveals the injector or nozzle is leaking.

This problem has existed too many years with too little known about the corrective measures taken by the manufacturers to improve this condition.

C. Crankcase Protectors: The Committee has received reports that considerable difficulty is being experienced with crankcase pressure and low water shut down device on EMD 645 engines on SD-45 locomotives. This device in many cases is too sensitive and shuts the engine down for no apparent reason. One reported cause for false shut downs, is the loss of sensitivity, due to brinelling of ball retainers in the retainer cup.

Another member reports, that until recently, experience indicated there was no need of periodic changeout. The apparent periodic exercising of the device had prevented shut down failures. Lately, this procedure fell into disuse and the end result looks like a failure to operate.

IT IS THE CONSENSUS OF THIS COMMITTEE, THAT THE ENGINE PROTECTOR ON ALL MAKES OF ENGINES IS A VERY IMPORTANT COMPONENT AND THE MAINTENANCE COST IN RELATION TO ITS POTENTIAL COST SAVINGS IS NOT CONSID-

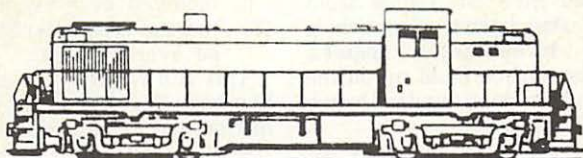
ERED EXCESSIVE. MAINTAINING THIS EQUIPMENT SO THAT IT FUNCTIONS PROPERLY IS VITAL TO MINIMIZE ENGINE DAMAGE.

D. Spark Arresters: The diesel engine, like any other internal combustion engine, forms carbon deposits in cylinder head exhaust passages and in crankcase exhaust elbows when lightly leaded. As carbon deposits build up they eventually break off and are exhausted to the air.

Known factors contributing to sparking are:

1. **Improper fuel injection**, brought about by dribbling, incorrectly adjusted or sticking injectors that deliver excessive amounts of fuel to combustion chamber.
2. **Water leaks** getting into combustion chamber will result in ash deposits from water treatment.
3. **Excessive amounts of lube oil getting into the combustion chamber**, which is a result of worn valve guides or oil control rings, will result in excessive and wet carbon deposits in exhaust passages.
4. **Engine operating temperature too low** can result in objectionable carbon deposits in exhaust passages.
5. **Engine idling for relatively long periods at low temperatures** will often cause a temporary sparking condition when the engine is put under heavy load.
6. **Other possible contributing causes** are poor quality fuels, dirty air filters restricting air supply to the engine, plugged air box drains, and plugged exhaust manifold drains on some types engines.

One of the most efficient spark arresters available today is the



POWERFLOW[®]-MX

ADDITIVE SYSTEM THRU
AIR INTAKE

FOR - - -

AIR BOX CLEAN UP

INCREASED POWER ASSEMBLY LIFE**

RESULTING IN - - -

EXHAUST EMISSION REDUCTION

IMPROVED ENGINE PERFORMANCE

**Field tests available upon request show over 40% reduction in power assembly change-out rate with POWERFLOW-MX.

CARRIERS SUPPLY COMPANY
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turbocharger. A turbocharger engine should give no trouble from sparking. One known exception is on EMD turbocharged engines. That is, the carbon build up on the eductor tube which under heavy load will break off.

Spark arresters for normally aspirated diesel engines have been developed and are available from manufacturers. Arresters fall into the following general categories:

- (1) Fixed screen externally mounted over exhaust. (Many versions of this type have been manufactured in railroad shops.)
- (2) Flexible screen (self cleaning) externally mounted over exhaust.
- (3) Centrifugal or swirl type internally mounted in exhaust manifold.
- (4) Centrifugal type externally mounted over exhaust.
- (5) Inertial type externally mounted over exhaust.

This is a relatively new type that has been developed and tested and has proved to be successful.

Centrifugal or Swirl type directs the gases upward, around one side of manifold chamber setting up a "swirling action." Centrifugal force of this swirling action keeps larger carbonaceous particles swirling around perimeter of chamber, breaking into smaller particles and cooling them simultaneously before being discharged or diverted into externally mounted traps.

One road reports, that a recently concluded test indicates the internally constructed centrifugal or swirl type is highly efficient. Also, the so called "side pocket" or re-

DIESEL WATER COOLER BOTTLE

(Plastic Throwaway)

5 Quart Capacity — Model 1005 DWCB



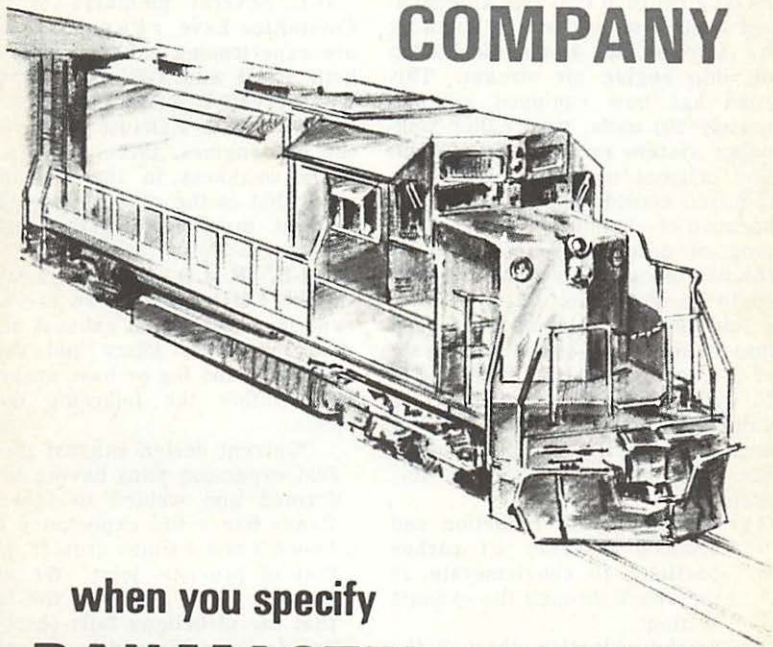
Translucent
Carrying Handle
Screw Cap
Unbreakable
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tention trap has some side advantages in that it can narrow down a bad power assembly or an injector to four cylinders.

Last year this Committee reported on a railroad that was approaching control of locomotive sparking by introducing a chemical-laden oil into engine air stream. This road has now equipped approximately 200 units, with either siphoning system or pressure system. The original or siphoning system required considerable maintenance because of suction leaks and plugging of nozzles. Maintenance on the new pressure system is reported to be negligible.

Additive formulation is fogged into intake air system at the rate of 3/4 to 1 gallon per 24 hours in 16 cylinder engines and 1 to 1 1/4 gallons per 24 hours in 20 cylinder engines. It is felt that four results are being accomplished with this system.

- (1) Carbon deposit reduction and reduced tendency of carbon particles to conglomerate as they pass through the exhaust system.
- (2) Smoke reduction, through the use of a smoke suppressant.
- (3) Increased piston cleanliness through use of a material to reduce ring groove deposits and keep ring belt area free of lacquer deposits.
- (4) Reduction of power assembly wear rates through the use of an additional lubricity agent.

One other railroad reports, that it has equipped 27 units with the chemical atomization principle and the reports are encouraging.

Typical properties of the formulation currently being used are:

Viscosity 100° F SUS.....	40.0
Viscosity -60° F SUS.....	600.0
Specific Gravity 60/60° F.....	0.88

Pounds / US Gallon.....	7.3
Flash Point °F	160
Barium Content	2.0% (wt)
Calcium Content	1.3% (wt)
Nitrogen Content	0.1% (wt)

D-1. Several members of this Committee have reported they are experiencing exhaust leaks on both EMD and GE engines, ON RELATIVELY NEW POWER.

D-1-A. G.E. Exhaust Leaks: On the GE engines, there appears to be a weakness in the transition pipe, that is the pipe between the exhaust manifold and the turbo-charger.

D-1-B. E.M.D. Exhaust Leaks: On the EMD engines, we are still experiencing leaks at exhaust manifold expansion joints and some leakage at the leg or base gaskets. EMD offers the following comments:

"Current design exhaust manifold expansion joint having liner formed and welded to face of flange has a life expectancy between 3 and 4 times greater than that of previous joint. We are, however, well aware of the fact that life of bellows falls short of our design goals and have established a continuing development program aimed at improving both material and manufacturing techniques in order to further extend useful life of this device.

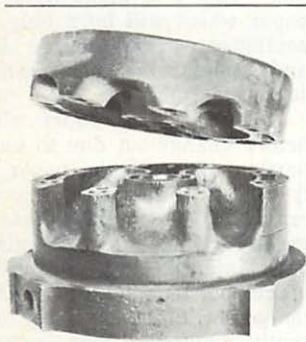
"Effective in production January 1, 1970, exhaust manifold mounting flanges were increased in thickness and bolting arrangement was improved to provide better clamping of leg to crankcase gaskets in order to reduce exhaust leakage at this point. Field tests are currently being run on a new bolting arrangement for application to older locomotives in the field in order to provide better gasket clamp-

Mr. C.M.O.—

**How much per year does diesel
cylinder head replacement cost your road?**

(About \$612,000 per 1,000 locomotives you operate.)

**WE WANT TO GIVE YOU
38% OF IT BACK.
STARTING NOW!**



Jones Process Remanufactured Diesel Cylinder Heads can do just that: save you about 38% of your annual cost for cylinder head replacement.

We make new heads from your defective ones. By remanufacturing each head with a new cap section that gives it better efficiency than the original head: uniform wall thicknesses internally, improved water flow and cooling, superior metallurgy. These are not claims—they are facts we can prove to your satisfaction.

Some 45 U.S. railroads are now specifying JP Heads for replacement—and saving hundreds of thousands of \$. We want to give **you** these savings too. **STARTING NOW.**

Jones Process remanufactured Diesel Cylinder Heads

SEND FOR ILLUSTRATED BROCHURE DESCRIBING OUR PROCESS

Distributor for U.S., Canada, Mexico
RAILWAY SERVICE & SUPPLY CO.
510 South Harding, Indianapolis, Ind. 46221

Phone: 317-632-5596

Manufacturer
J & J CASTINGS, INC.
Hibbing, Minn. 55746

PHONE: 218-262-3874

ing without having to install the new style exhaust manifold."

E. Air Filtration: During the past ten years we have experienced several advantageous improvements in diesel locomotive air filtration.

In the early part of 1960 we were introduced to inertial type air cleaners. It was found, however, inertial type engine air filter was not as efficient as first believed. Then came the oil bath and paper filters.

Oil bath and paper engine air filters are definitely superior to the inertial engine air filter. EMD has conducted tests on oil bath air filters versus paper filters since inception of current 40 and 45 model locomotives. Test results indicate that component part wear rates of engines equipped with oil bath or paper filters are essentially equal. Therefore, the choice of one filter over the other must be made on the basis of maintenance economics.

In some applications the oil bath filter has required more maintenance than was originally anticipated. Many railroads find it necessary instead of six months and are cleaning the sump in six months instead of one year. Also, contrary to initial test indications, some oil bath applications do develop a pressure drop across the filter with service, necessitating annual disassembly and cleaning of filters. In other instances, aftercooler plugging has been noted after service periods ranging from 12 to 18 months, requiring that the aftercoolers be removed and cleaned on an annual basis. These additional maintenance items are reflected, of course, in added maintenance costs and, therefore, weigh

in favor of the paper filter application.

Paper elements originally represented a fire hazard and were, in fact, involved in a number of filter compartment fires. The original paper filter media has been changed twice to decrease the fire hazard. A treatment was developed to make the paper flame-retardant. Altho this was an improvement and did not ignite easily, it could be ignited with a flame, and, once ignited, was almost impossible to extinguish, particularly with air being drawn thru the assembly. A further treatment is now in production. This treatment results in a paper which will burn only with a continued external source of flame and extinguishes itself when the source is removed.

Service life of paper elements before change-out due to plugging, particularly with the paper initially used, was found to vary considerably. This problem has been greatly reduced by the advent of new materials and improved manufacturing techniques. In addition, the paper filter assembly as currently applied to new locomotives is equipped with a warning system to prevent prolonged locomotive operation after the engine air inlet air depression reaches a total of 14 inches water. This warning system consists of a vacuum switch, mounted on engine room side of filter compartment partition and connected to filter plenum. When filter depression reaches 14 inches water value, switch trips and causes a warning light in cab to be turned on. Light lens cab lettering says "Check Filter" and is intended to alert maintenance forces to the fact that filter pressure drop is at the recommended limit. At this time it is recom-

Save on filter maintenance costs

with AMER-kleen replaceable filters

AMER-kleen nonflammable filters are ideal for engine intakes. They cost less to use and throw away than washing and re-oiling metal filters. With AMER-kleen filters, you don't need filter cleaning equipment at all.

Air cleaning efficiency is greater than that delivered by any panel-type filters available for locomotive service. AMER-kleen filters are progressively packed for greater dust-holding capacity.

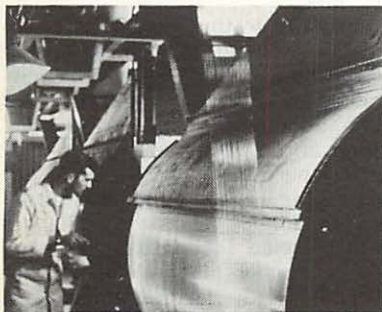
And because AAF glass-fiber filaments are spun continuously bonded together, and coated with a heavy-duty adhesive, fiber particles cannot be dislodged despite air volume and dirt buildup. For additional information on the most practical filter for engine intakes, write American Air Filter Company, Inc., 128 Central Ave., Louisville, Ky. 40208.



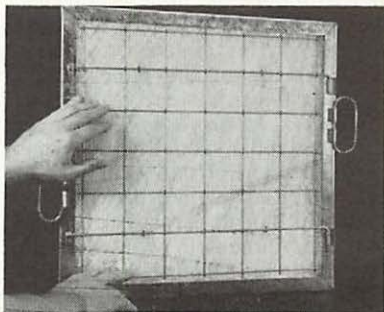
American Air Filter

AIR FILTER SYSTEMS

Designed specifically for locomotive service.



Unique spinning process guarantees continuous filament fibers throughout the pad.



Fast, easy installation. Throw away old filter, tuck new one in, close grid . . . in seconds.

mended that filter light relay be reset and locomotive rechecked in throttle eight to verify original indication. This is to prevent possibility of premature filter changes as a result of unusual conditions such as wet filters or severe icing of inertial filter screen, which cause the indicator to trip. If indicator does trip when rechecked, the filters should be changed.

When all factors are carefully weighed, EMD study showed that under an average of all locomotive operating conditions, the economic scale balanced equally between the oil bath and paper filter applications when paper filter element life reached approximately one year. Obviously, not all railroads will operate under average conditions and there will undoubtedly be some operations where heavy soot loads or other environmental factors will cause premature plugging of paper filters. In these instances, the economics will weigh in favor of the oil bath application.

General Electric reports that a recent inspection of paper filters on several units on a Western railroad which have accumulated over 300,000 miles, indicated that filters were still in good condition after approximately 18 months service. The vendor has asked that filters be returned for analysis, to establish what life of the paper might be, since there is some concern as to whether or not a life of longer than 12 months should be considered. Inspection of two cylinders at that time did not indicate the ring life would be substantially different from that indicated with other air filter systems. Railroad members of this Committee have expressed a general agreement with the opinions of both EMD and GE.

Several members of this Com-

mittee report that they are currently testing a new concept of disposable air filters on high horsepower locomotives. This filter is being developed with the following objectives in mind:

1. **Efficiency:** Air cleaning efficiency to equal currently used oil bath or paper filter.
2. **Life Cycle to Permit Servicing Filters on a Time Basis:** Filter life should permit media change at quarterly (three-month) maintenance period. Filter must have an adequate safety factor to protect against possibility of locomotive being late in receiving maintenance.
3. **Economical:** Disposable media must be inexpensive so that its operating expense will be competitive with other types of engine intake filtration.
4. **Installation:** Disposable element is designed so that it can be installed easily with minimum opportunity for error in application.
5. **Low Pressure Drop:** Studies indicate that horsepower required to overcome an inch water gauge restriction placed in front of the engine air inlet, costs approximately \$40 a year in fuel.

In initial testing period, standard media was cut to size so that it could be wrapped around a removable rack. Rack was then inserted into a housing, with media compressed between removable rack and a permanent back grid. Upon observing application, it was decided to make necessary changes which would facilitate installation. As a result, blanket media was covered with scrim, which is a netting material, and a cloth binder covering all edges. This, in effect, turned straight media blanket into

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a flexible cartridge that was much easier to install, minimizing the opportunity for misapplication. Subsequently, a bag type cartridge was developed.

Advantages of this new cartridge are:

1. **Blanket does not need to be wrapped around rack.** Cartridge slips into place, automatically positioning itself correctly to insure proper air seal.

2. **Its bag-type construction,** which keep all trapped dirt within the element and eliminates possibility of some trapped dirt falling on the dirty air side of the housing during media change-out period.

As previously mentioned, this filter is being tested on six railroads and it is hoped to have some reports on the results of these tests for our Fall meeting.

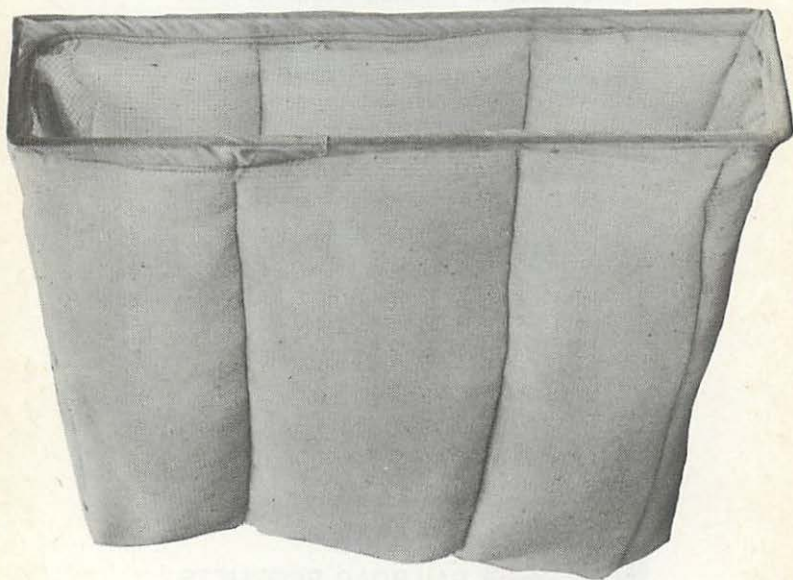


Fig. 5 — Disposable Air Filter Element

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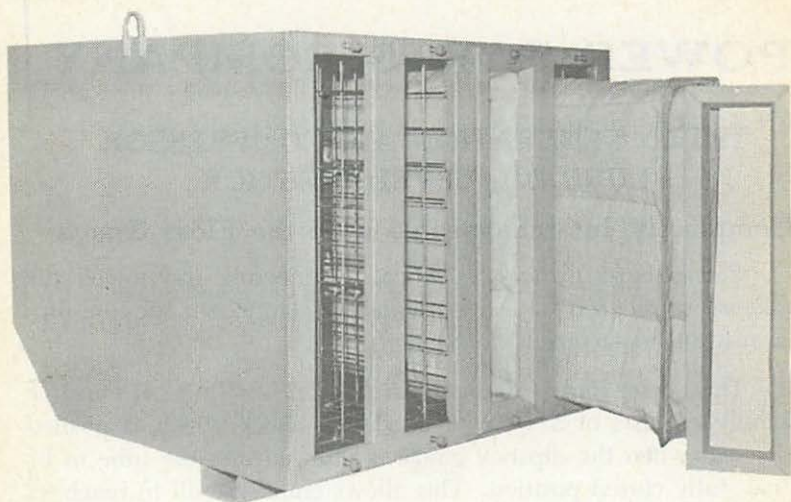


Fig. 6 — Application of Filter Elements to the Housing



Fig. 7 — Completed Application of Housing and Filter Elements

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F. Turbochargers continue to be one of the most costly maintenance items on today's locomotive. Following is a recapitulation of failures occurring in 1969 on three railroads:

Railroad	Class	No. Percent-		Clutch	Bearing	Foreign Matter	Misc.	Average Mileage
		Failures	of Fleet					
1	U25B	10	26%	----	2	8	--	192,134
	U30C	3	23%	----	2	1	--	124,452
	GP30	14	30%	13	1	--	--	230,992
	GP35	13	33%	10	1	--	2	230,762
	SD35	2	17%	2	--	--	--	329,000
2	GP30	8	11%	6	1	1	--	575,146
	GP35	8	20%	6	2	1	1	402,747
	SD35	3	13%	2	--	1	--	158,000
3	GP30	8	21%	6	--	--	2	248,000
	GP35	5	23%	4	--	--	1	567,800
	U25B	2	33%	----	--	1	1	115,500
	U25C	3	25%	----	--	2	1	331,334
	U28C	6	37.5%	----	--	3	3	306,833
	U30B	10	67%	----	1	3	7	169,500

Of 61 turbochargers reported failed on EMD units, 49 or 80% were changed because of clutches. Records reported by Railroad No. 2 indicate 5 of 8 turbochargers changed out on GP30 units ranged from 768,000 miles to 865,000 miles. Overall average 342,800 miles.

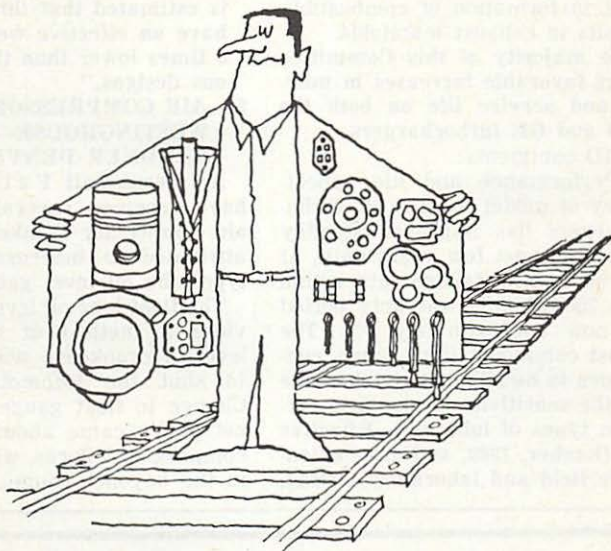
Of 34 turbochargers reported failed on GE units, 21 or 61% were changed because of foreign material. Overall average 206,620 miles.

Deposits of thick soot, puddled fuel, glossy varnish, or soot which is saturated with fuel, accumulate in exhaust manifolds during periods of poor combustion, under certain conditions these deposits catch fire, resulting in severe overheating and overspeeding of turbine. Poor combustion can be caused by lack of air from a malfunctioning turbocharger with such defects as a slipping clutch, sticking clutch,

inefficient turbine, or surging compressor, from leaking or defective injectors, restricted air intake systems, improper engine timing, and improper governor function.

Recently a turbocharger was replaced because of slipping clutch and approximately two weeks later the turbocharger was again replaced because of bearings. Inspection of this turbocharger disclosed stretched turbine blades resulting from combustible material igniting in manifolds and air box thus overheating turbine blades and causing considerable engine damage.

Even when combustible deposits are negligible in manifolds, manifold fires can still occur and overheat turbocharger if air boxes contain an excessive accumulation of combustible fluids. Lube oil and fuel accumulations in the air box, if prevented from draining because



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of plugged air box drain pipe, will be picked up by air stream as vapor and droplets and will readily result in formation of combustible deposits in exhaust manifolds.

The majority of this Committee report favorable increases in mileage and service life on both the EMD and GE turbochargers.

EMD comments:

Performance and life expectancy of model 567 and 645 turbochargers has improved steadily over the past few years until, at present time, failure rate within the 250,000 mile warranty period is now approximately 2%. The most common failure cause, continues to be slipping clutches due to the sensitivity of clutch to certain types of lube oils. Effective in October, 1969, and after extensive field and laboratory testing,

a chrome plated clutch cam plate was released for all engine models. Based on test results, it is estimated that this clutch will have an effective wear rate 3 to 5 times lower than that of previous designs."

5. AIR COMPRESSORS—
WESTINGHOUSE—
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A. Crankshaft Failures: We have received several reports of air compressor crankshaft failures attributed to inaccuracy of float type lube oil level gauges.

The float lube oil level gauge provides a method of checking oil level in crankcase without having to shut the locomotive down. Change to float gauge from bayonet gauge came about because of compressor failures, which resulted in the bayonet gauge being blown

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out and all lube oil in the crankcase being pumped out onto locomotive floor.

We are now in the third generation of float gauges and it is not clear at this time which version of the float level gauge has failed.

Several members report they are currently testing a spring loaded ball check dip stick that provides an accurate check of lube oil level with the engine running or shut down. It is also claimed, that no lube oil spillage will occur when lube oil level reading is taken, or should dip stick inadvertently back out. Another advantage of this lube oil level gauge is that, a sample of lube oil can also be obtained while the engine and compressor are running. Many of us today are periodically sampling compressor oils for viscosity, water, metals, etc.

B. Cylinders: We continue to receive reports concerning heavy build-up of solids in water passages on low pressure cylinders, on both 3CDWL and WBO compressors. Analysis of deposits indicates iron, silicon, boron, lead and tin. These deposits are believed to be caused

by little or no water circulation in the cylinders at idle speed. They will eventually reduce the cooling effect and cause hot spots in the cylinders.

Many of us have lost WBO air compressors, partially or completely, due to high presurse piston pin needle bearing failures. It is believed that, improper application of needle bearing assemblies caused damage to retainer portions of the races. This resulted in ultimate cracking of retainer lips, which provided an escape path for the needles. This design has been changed to a large roller bearing assembly in place of the needle bearing.

C. Air Filtration: Reports indicate that many roads are specifying on all new equipment and are equipping compressors at heavy overhaul periods, with one of two types of dry filtration.

Housing cracking problem experienced on the early single element filtration system appears to have been corrected.

Most roads report interval of change on both single and dual element systems is one year.

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Locomotive Maintenance Officers Association's
Diesel Material Standardization and Control Committee
Speakers' Table at Roanoke Pre-Convention Presentation



(Photo courtesy of Southern and Southwestern Railway Club, Inc.)



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Tuesday Morning, September 15, 1970

9:00 A. M.

REPORT OF THE COMMITTEE ON DIESEL MATERIAL STANDARDIZATION AND CONTROL

Pre-Convention
Presentation:
**SOUTHERN &
SOUTHWESTERN
RAILWAY CLUB**



9:00 A. M.
APRIL 16, 1970
Roanoke Hotel
Roanoke, Va.

J. J. BUTLER, Chairman
*Committee on Diesel Material
Standardization and Control*
Chief Mechanical Officer
Reading Company
Reading, 19601

Vice Chairman

J. W. Gann, Asst. Chief Mech. Officer, Chicago, R. I. & Pac., Kansas City, 66105

Committee Members

N. E. Anderson, Asst. to Chief Mechanical Officer, Western Pacific, Sacramento 95817
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F. D. Crist, District Storekeeper, Chicago, Rock Island & Pacific, El Reno 73036
K. H. Dotson, Industrial Engineer, Louisville & Nashville, Louisville 40201
L. J. Fett, Prod. Plan. & Control Officer, Canadian National, Montreal 3, Quebec, Can.
D. W. Glesh, Mech. Supvr. Locomotives, Norfolk & Western, Roanoke 24011
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R. E. Rathert, Manager Materials, Missouri Pacific, St. Louis 63103
R. W. Sundborg, Supvr. Quality Control, Southern Pacific, Roseville 95678
V. E. Varno, Parts Mkt. Mgr., Alco Prod. Service, 1 Nott St., Schenectady 12305
D. M. Walker, Electrical Engineer, Southern, Atlanta 30303



1970 TOPIC:

**"INCREASED LOCOMOTIVE AVAILABILITY
THROUGH STANDARDIZATION"**

**PERSONAL HISTORY OF
JAMES J. BUTLER**

James J. Butler: Chief Mechanical Officer, Reading Company, 6th and Perry Streets, Reading, Pennsylvania. Home Address—703 Jerome Place, Whitfield, Reading, Pa., 19609.

Born: Philadelphia, Pennsylvania, December 13, 1920.

Married: Kathleen Hagan, October 16, 1948.

Children: Mary Margaret; Kevin J.

Education: West Catholic High School, Philadelphia, Pennsylvania; ICS—Machinist Course; Penn State Extension — Management Training.

Career: All with Reading Company. November 1938—January 1946, Machinist Apprentice; January 1946—July 1948, Machinist; July 1948—October 1949, Machinist Leader; October 1949—March 1950, Relief Foreman; March 1950—January 1956, Foreman; January 1956—March 1957, General Foreman; March 1957—July 1957, Asst. Master Mechanic; July 1957—August 1960, Master Mechanic—Marine; August 1960—April 1963, General Master Mechanic; April 1963—October 1965, Supt. Locomotive Equipment; October 1965—August 1966, General Mechanical Superintendent; August 1966—Chief Mechanical Officer.

Member: Locomotive Maintenance Officers' Association (Chairman, Committee on Diesel Material Standardization and Control); Car Department Officers Association; Air Brake Association; Railway Systems Management Association; Executive Committee of the Philadelphia Railway M.U. Car Club; Executive Affiliate American Society of Mechanical Engineers; Southern & Southwestern Railway

Club, Inc., Manufacturers' Association of Berks County (Board Member); Berks County Chamber of Commerce.

Clubs: Berks County Young Republican Club; Heidelberg Country Club.

Military Service: Served with U. S. Armed Forces from September 1942 until November, 1945.

**1. WHERE ARE WE GOING IN
LOCOMOTIVE
STANDARDIZATION?**

During the "What's Your Problem" session at the conclusion of our 1969 meeting, several officers brought up the pointed question of where the L.M.O.A. is going in standardization. What are our objectives, and what are we going to do about it?

Included in the questions were, "What standards should be set up for lube oil; Standard for Reporting failures; Standard for Cleaning Components; Standard for Engines out of Service and Not Available; Material Standards With Interchange Locomotives; Compatible Standards for Interchange Locomotives."

This Committee doesn't know the answer to all of these questions, but it has attempted over the last three years to supply some of the answers with the thought of taking action to make recommendations to the A.A.R. to set up a locomotive standard.

At the Executive Committee Meeting following the 1969 meeting, we were given the task of reporting on:

- A. Setting up material standard replacements on interchange locomotives.
- B. Trends in material control.
- C. Handling of warranty items by the builders.
- D. Locomotive warranty to be

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based on material availability by the builders.

2. MATERIAL STANDARDS FOR INTERCHANGE LOCOMOTIVES:

When considering "Material Standards" for the purpose of repairing a failed locomotive in interchange, the material on a locomotive can be divided into three categories.

A. Carbody, trucks, and all the mechanical running gear such as draft gear, brake rods, wheels, couplers, brake beams, etc.

Material standards for items in this category, can basically be established from the present D.O.T. Rules and A.A.R. Manual of Standards for Recommended Practice. No matter what locomotive, whether ownership or foreign, all running gear and draft gear components are of a common nature and are easily replaced, either from working stock or new. While this procedure is not absolutely A.A.R. approved, we are sure that no one would make a poor replacement with any of these items since they are essential for the safe performance of a locomotive over the road. In reality, we can see no problem in billing (in this category) whenever repairs are owners' responsibility. It is even possible that some repairs under this category would be the operating line's responsibility; and as everyone is aware, most of these items are not only policed by the railroad, but are carefully regulated by the D.O.T.

B. Traction motors, main generator and all the mechanical and electrical components pertaining to the prime mover, fuel system, lube oil system, cooling system and electrical control systems:

Under this category, the answer

to this is of a much more complex nature. There are three basic methods which can be used to repair a failed interchange locomotive.

- (1) Apply all new components;
- (2) Replace, in kind, with reconditioned components of a unit received on a unit exchange basis;
- (3) Replace, in kind, with components that have been rebuilt by the operating railroad.

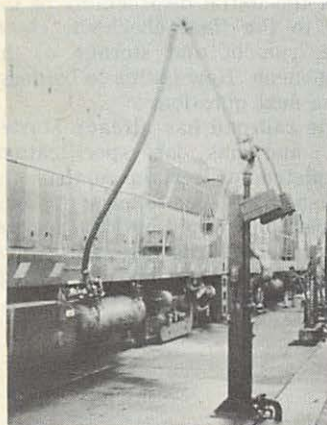
The first two methods, replacement with new and replacement with unit exchange materials, should really satisfy anyone as to the quality of the replacement parts. The workmanship, of course, could be handled in the agreement set up between the companies that are interchanging the locomotives. We are sure a formula could be worked out by the A.A.R. to satisfy everyone. However, each of these solutions, while satisfying each railroad as to the quality of parts replacement, could be viewed by some railroads as expensive and as a possible loss of locomotive availability when the replacement of new parts or unit exchange parts are not available. Hence, we come to the third answer, which is the replacement of parts with components being reconditioned by the user railroad.

As we said, this could be a very involved job; but it is not an impossible job. Let's look at just what could be involved in replacement items, since we all agree that on any major job the unit would be returned to the owning railroad for repairs. Therefore, we have the following components that could possibly be replaced in a running repair shop in order to keep the locomotive in service:

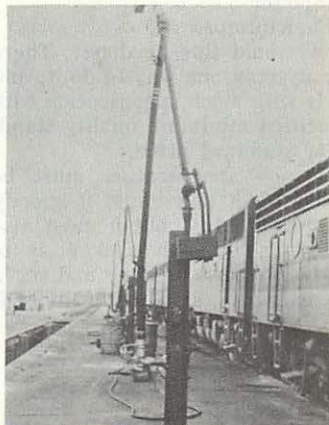
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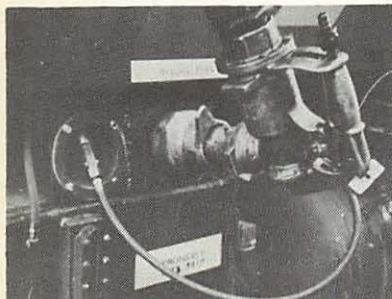
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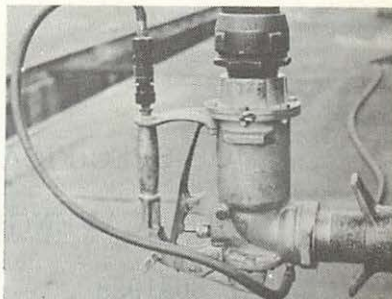
Snyder OPW 1620-DS Automatic Nozzle Fueling on Snyder No. 104-S-2 1/2" Fuel Crane.



Snyder OPW 1620-DS-2 1/2" Automatic Nozzle Secured to Snyder No. 104-S-2 1/2" 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 Protected 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.

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ual railroads that repair the particular component. The job specifications should show a definite source of information; the builders' parts list, description and each step from the initial disassembly of the part to the final checkout, clearance, run-out and storage of the component. How is this to be done, is the next question.

One railroad has already started this, and has job specifications completed for certain components. One such job spec follows: Its basic principles would be ideal for setting up standards for railroad rebuilt components on interchange locomotives.

JOB SPECIFICATION NO. 2313

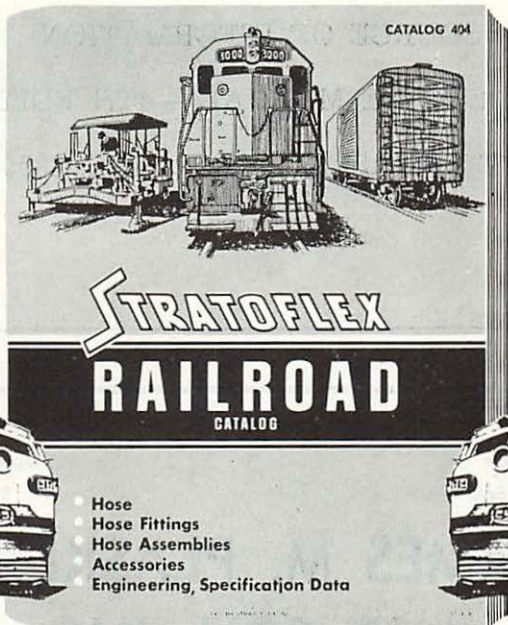
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That's why many of today's heavy-duty locomotives operate with AMOCO® Super Diesel Lubricating Oil. A product that's proven its dependability in more than 15,000 unit months of closely monitored operations in units that include the latest high-output engines.

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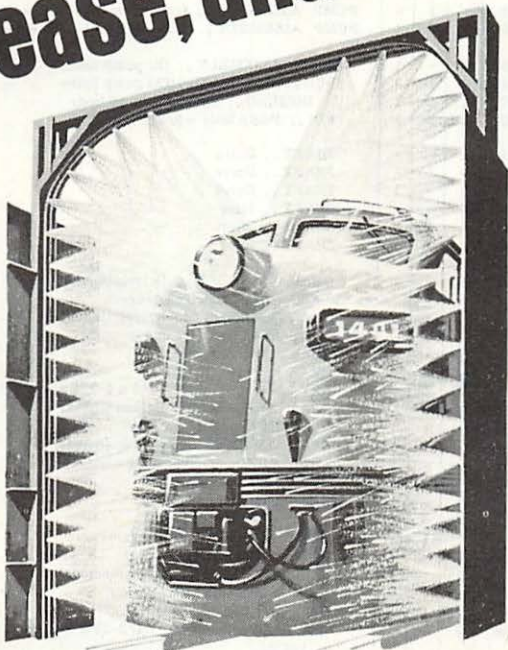


AMERICAN INGENUITY:
WE CAN MAKE IT WORK
FOR YOU.

DESCRIPTIONSCAVENGINE OIL PUMP

THE SCAVENGING OIL PUMP IS A POSITIVE DISPLACEMENT, HELICAL GEAR TYPE PUMP, AND SELF PRIMING. THE PUMP HOUSING, WHICH IS SPLIT TRANSVERSELY FOR EASE OF MAINTENANCE, HOUSES A DOUBLE SET OF MATED PUMPING GEARS. THE DRIVING GEARS ARE RETAINED ON THE PUMP DRIVE GEAR SHAFT BY WOODRUFF KEYS. THE IDLER SHAFT IS HELD STATIONARY IN THE HOUSING BY A LOCK SCREW, AND DRIVEN PUMP GEARS ROTATE ON THIS SHAFT ON BUSHINGS PRESSED INTO THE GEAR SHAFT BORE. THE DRIVE SHAFT TURNS IN BUSHINGS PRESSED INTO THE PUMP HOUSING. THESE BUSHINGS ARE MADE WITH THRUST COLLARS WHICH PROTRUDE SLIGHTLY ABOVE THE PUMP BODY AND ABSORB THE THRUST OF THE DRIVE GEARS.

**Off with the oil, the
grease, and the soil.**



Flush them from locomotive exteriors, engine rooms, trucks and engines with our powerful line of chemicals for railroad maintenance cleaning. They're concentrated, so they go further. Yet, are gentle to painted surfaces.

Write for literature to Penwalt Corporation, Metal Processing Department, 3 Penn Center, Philadelphia, Pa. 19102.

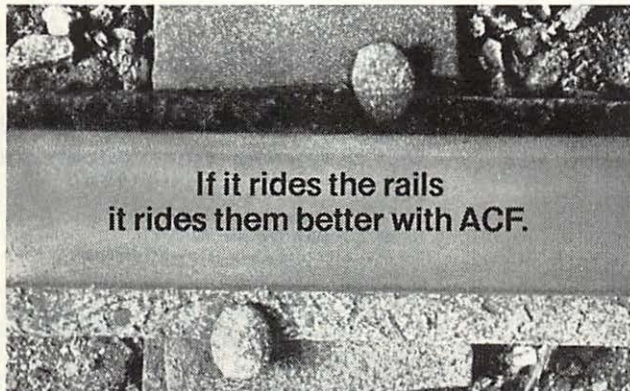
 **PENWALT**
METALWORKING CHEMICALS

ELECTRO-MOTIVE DIVISION GENERAL MOTORS CORPORATION

OIL PUMP
SCAVENGING PUMP

PLATE A395-3 and 4

Ref. No.	Part Number	Number Required	Description
1	8042376	1 - -	PUMP ASSEMBLY .. Scavenging oil - All series 6 and 8-567 engines
2	8041928	- 1 -	PUMP ASSEMBLY .. Scavenging oil - All series 12-567 engines
3	8042375	- - 1	PUMP ASSEMBLY .. Scavenging oil - All series 16-567 engines
4	8029460	1 - 1	BODY ASSEMBLY .. Oil pump inner
5	8029458	- 1 -	BODY ASSEMBLY .. Oil pump inner
6	8039667	1 1 1	BUSHING .. Oil pump inner body
7	8028366	2 2 2	PIN .. Pump body - 3/8 x 7/8
8	8029556	1 - -	SHAFT .. Drive
9	8029553	- 1 -	SHAFT .. Drive
10	8029566	- - 1	SHAFT .. Drive
11	8029503	1 - -	SHAFT .. Idler
12	8029496	- 1 -	SHAFT .. Idler
13	8029511	- - 1	SHAFT .. Idler
14	8029462	1 - 1	GEAR ASSEMBLY .. Driven (inner)
15	8029461	1 - 1	BUSHING .. Driven gear
16	8028868	- 1 -	GEAR ASSEMBLY .. Driven (inner)
17	8028883	- 1 -	BUSHING .. Driven gear
18	8029529	1 - 1	GEAR .. Drive (inner)
19	8029522	- 1 -	GEAR .. Drive (inner)
20	117982	1 2 2	KEY .. Gear to shaft - 3/8 x 1-1/4 Woodruff
21	8028972	- 1 -	GEAR ASSEMBLY .. Driven (outer)
21A	8028883	- 1 -	BUSHING .. Driven gear
22	8029513	- - 1	GEAR ASSEMBLY .. Driven (outer)
23	8029461	- - 1	BUSHING .. Driven gear
24	8029523	- 1 -	GEAR .. Drive (outer)
25	8029547	- - 1	GEAR .. Drive (outer)
26	8029459	- 1 -	BODY ASSEMBLY .. Outer
27	8029512	- - 1	BODY ASSEMBLY .. Outer
28	8039669	1 1 1	BUSHING .. Oil pump outer body
29	8029527	1 - -	PLATE ASSEMBLY .. Pump
30	8029034	1 1 1	GASKET .. Body
31	179884	8 - -	BOLT .. Plate to body - 1/2-13 x 1-3/8 hex. head - Replaces 106342
32	8028956	- 8 -	BOLT .. Pump body - 1/2-13 x 4-1/8 hex. head
33	187152	- - 8	BOLT .. Pump body - 1/2-13 x 5 in. hex. head - Replaces 8072397
34	103323	8 8 8	WASHER .. Lock - 1/2
35	8028880	1 1 1	SLEEVE .. Drive shaft
36	8029141	1 1 1	WASHER .. Plain - 2-5/16 O.D. x 1/4 thick
37	8029139	1 1 1	NUT .. Drive shaft - 1-14 hex. slotted
38	103388	1 1 1	PIN .. Cotter - 1/8 x 1-3/4 in. lg.
39	8029495	1 1 1	SCREW .. Set - 1/2-13 x 1-1/8 hex. head
40	8029494	1 1 1	WASHER .. Plain - 1/2 - Copper
41	8029562	1 1 1	COVER .. Oil pump
42	8029498	1 1 1	GASKET .. Pump cover



**If it rides the rails
it rides them better with ACF.**

Better, because products from ACF are specially designed for every type of load.

Take dry bulk goods. The unique construction of our Center Flow covered hopper car provides unequalled ease and speed of handling. Perishables requiring temperature control get careful treatment, summer or winter, aboard ACF's Conditionaire.

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That's why railroad men know if it rides the rails, it rides them better with ACF.



ACF INDUSTRIES

ELECTRO-MOTIVE DIVISION GENERAL MOTORS CORPORATION

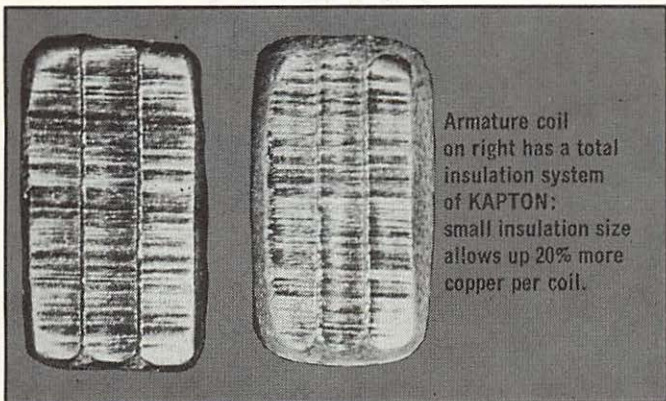
OIL PUMP

Ref. No.	Part Number	Number Required			Description
	8042376	1	-	-	PUMP ASSEMBLY .. Scavenging oil
	8041928	-	1	-	PUMP ASSEMBLY .. Scavenging oil
	8042375	-	-	1	PUMP ASSEMBLY .. Scavenging oil
43	100138	3	3	3	BOLT .. Cover to pump - 3/8-16 x 2 hex. head
44	179839	4	4	4	BOLT .. Cover to pump - 3/8-16 x 1 hex. head - Replaces 100134
45	8028313	1	1	1	BOLT .. Cover to pump - 3/8-16 x 1 hex. head drilled
46	8116738	As Req.			WIRE .. Lock - 3/64 dia. - Available 500 ft.
47	103321	6	6	6	WASHER .. Lock - 3/8
48	8029142	1	1	1	WASHER .. Plain - 3/8 - Copper
49	8035625	1	1	1	GEAR .. Pump drive (spur 80 T)
*50	8028984	2	2	2	DOWEL .. Pump shaft to gear - 1/2 inch dia. 8040414 .. .015 O. S.
*51	8028889	1	1	1	RETAINER .. Dowel
*52	8028327	2	2	2	BOLT .. Retainer to dowel - 5/16-24 x 1/2 hex. head
53	8028287	4	4	4	BOLT .. Gear to shaft - 1/2-20 x 1-3/8 hex. head drilled
54	8028264	1	1	1	GASKET .. Pump mounting
*55	179865	10	10	10	BOLT .. Pump mounting for 567 engines - 1/2-13 x 1-1/2 hex. head - Replaces 100160
*56	103323	10	10	10	WASHER .. Lock - For 567 engines - 1/2
57	181428	10	10	10	BOLT .. Pump mounting for 567A engines - 1/2-20 x 1-1/8 hex. head - Replaces 106296
58	6101229	10	10	10	WASHER .. Lock - For 567A engines - 1/2
*59	181432	-	10	10	BOLT .. Pump mounting for 567B and 567BC engines - 1/2-20 x 1-5/8 hex. head - Replaces 109849

8028984 dowel, Ref. No. 50, 8028889 retainer, Ref. No. 51 and 8028327 bolt, Ref. No. 52 are no longer included in new pump assemblies.

**Traction motors run cooler
or at higher horsepower...
because of**

DU PONT KAPTON®



Armature coil
on right has a total
insulation system
of KAPTON:
small insulation size
allows up 20% more
copper per coil.

Traction motors run cooler, last longer when the armature coil insulation system is all Du Pont KAPTON® polyimide film. Or they work at higher horsepower.

How? Because KAPTON is a thin, tough material, armature coils have highest dielectric integrity using less insulator space. This means more copper per coil — up to 20% more copper — and adds up to longer insulation and motor life because of faster heat dissipation.

The result: less motor maintenance, more time between rewind jobs. Insulation of

KAPTON is available on both new and rebuilt motors from major manufacturers.

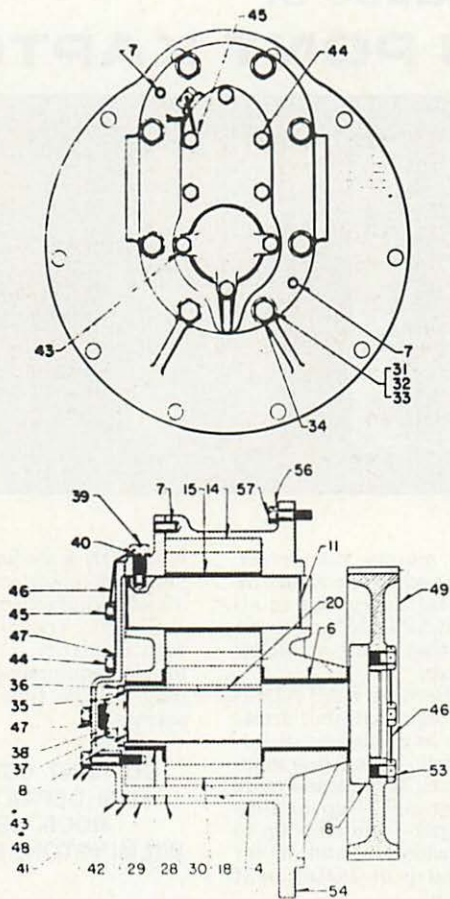
Specify traction motors with insulation of KAPTON for your equipment. The result may well be time and dollar savings.

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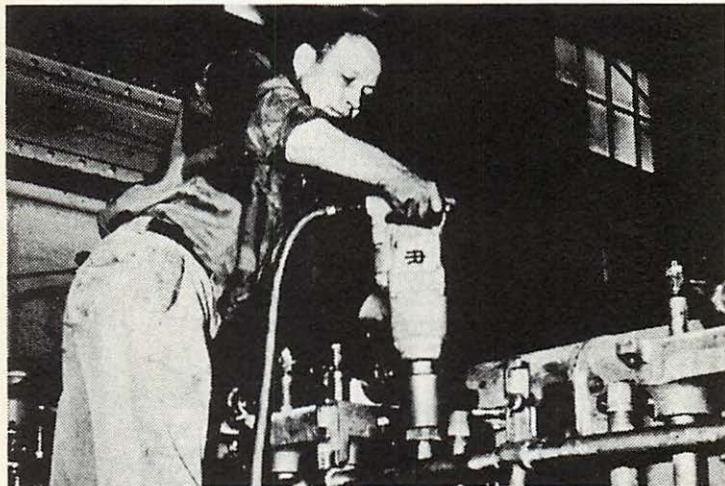
ELECTRO-MOTIVE DIVISION GENERAL MOTORS CORPORATION

OIL PUMP



SCAVENGING PUMP
ALL SERIES 6 AND 8-567 ENGINES
PLATE A395-3

Ingersoll-Rand portable tools cut maintenance time on big jobs or small ones



Cut maintenance time and get vital equipment back in service quicker with Ingersoll-Rand air tools! Impact tools, screw drivers, drills, grinders—all built to Ingersoll-Rand's high quality standards have been proven on the toughest railroad maintenance jobs.

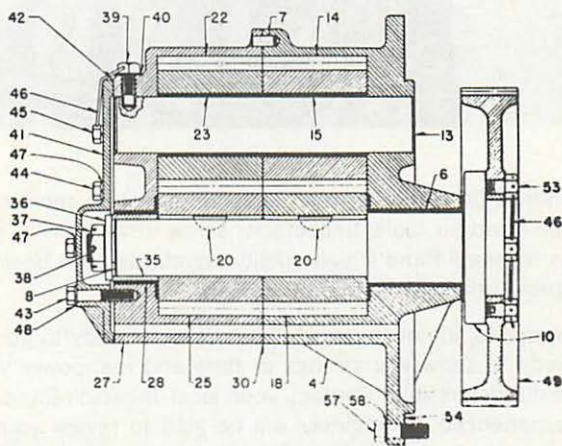
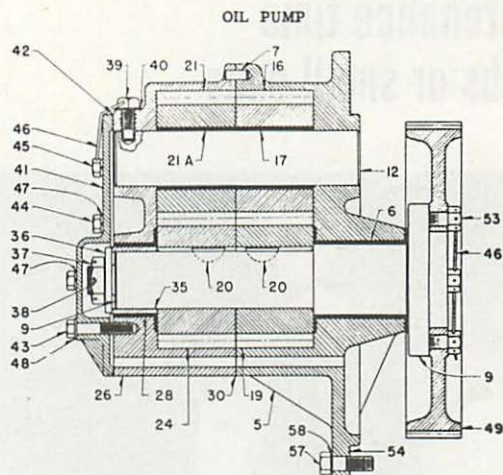
There's a complete line of Ingersoll-Rand air tools ready to go to work for you. Ready to show you savings in time and manpower you may not have realized possible. Contact your local Ingersoll-Rand branch office; an experienced AIRengineer will be glad to review your operations—help you tool up for efficient maintenance. Ingersoll-Rand, 11 Broadway, New York, N.Y. 10004. Or write for Tool and Hoist Catalog, Form 5319G.

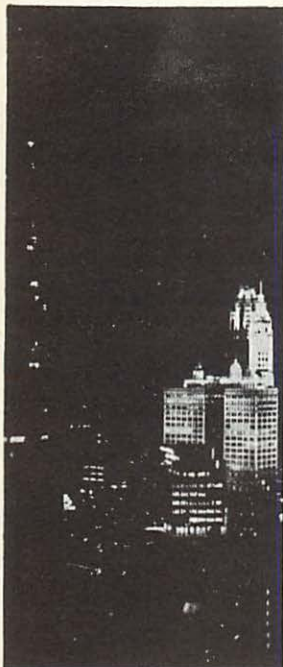


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SHERMAN HOUSE

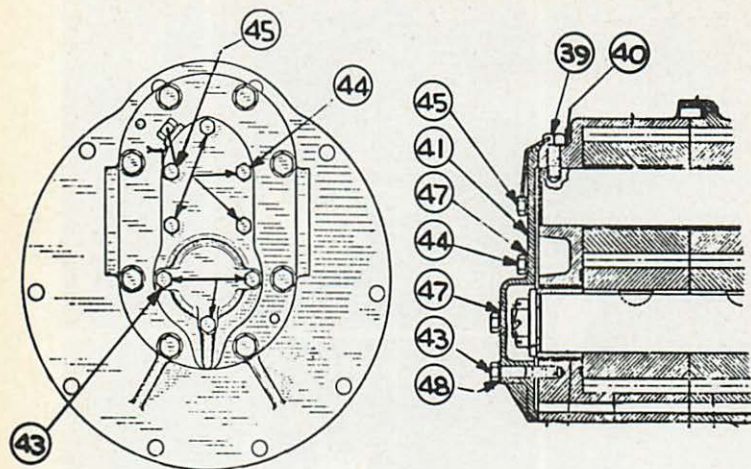
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Gerald S. Kaufman, President

Joseph L. Osajda, General Manager

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For reservations: 312/FR 2-2100 TWX 312/222-0631



REMOVE END COVER

1. Lift pump to bench - gear end down. "With hoist".
"Put bolts through holes in gear and holes in bench to keep gear from turning. Do not clamp pump flange in vise."
2. Remove 3 bolts (43), 4 bolts (44) and 1 bolt (45) 1 washer (48) and 7 washers (47) "to basket".
3. Remove cover (41) "to basket".
4. Remove screw (39) and washers (40) "to basket".

**Convectair
Cab
Heaters**

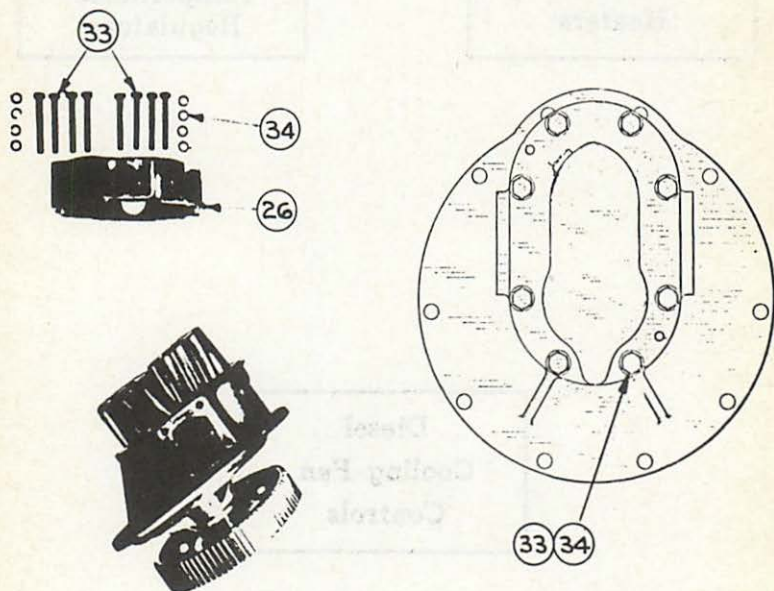
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CONTROLS CO.**

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Willow Grove, Pa. 19090



REMOVE BODY ASSEMBLY - OUTER

1. Remove 8 bolts (33) and 8 washers (34) "to basket", "speedwrench".
2. Remove body assembly (26) - "to cleaning".



Install Automatic Ground Reset Limiter...it "keeps you going"

KEEPS YOU GOING during temporary ground conditions that cause occasional ground relay pick ups. Vapor Automatic Ground Reset Limiter automatically resets ground relay up to four consecutive grounds before locking out.

KEEPS YOU GOING during permanent ground conditions caused by malfunctions. Power Reduction and Voltage Limit models provide for safe, continued locomotive operation at reduced horse power until permanent repairs can be made.

KEEPS YOU GOING over the long haul by guarding against traction motor burn out. Vapor Automatic Ground Reset Limiter features a positive counting and lock out system that protects against the cumulative damage of grounds, whether they be temporary or permanent in nature.

All Vapor Automatic Reset Limiters adhere to standard railroad practices for ground relay resetting and are applicable to both new and existing locomotives.



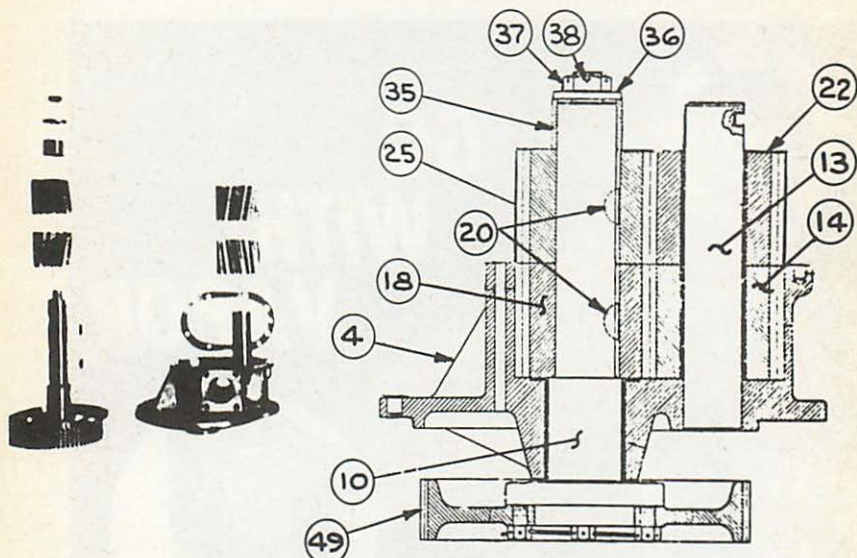
SINGER
TRANSPORTATION EQUIPMENT



Vapor Corporation, 6420 W. Howard St., Chicago, Ill. 60648 / 312 967-8300

IN CANADA, "VAPOR CANADA LIMITED"

TRANSPORTATION SYSTEMS DIVISION



STRIP BODY ASSEMBLY - INNER

1. Remove cotter pin (38) - "to scrap".
2. Remove nut (37) and washer (36) "to basket".
3. Remove sleeve (35) - "To basket".
4. Pop mark gears (22) and (25) "for timing and position".
5. Remove gears (22)(25) and key (20) "to cleaning"
6. Pop mark and remove gears (14)(18) and key (20) "to cleaning"
7. Remove shaft and gear assembly (10) (49) "to cleaning"
8. Remove shaft (13) - "to basket".
9. Remove body (4) - "to cleaning".

Alco locomotives are still in good hands.



Alco is still vitally interested in the proper operation and maintenance of their engines and locomotives.

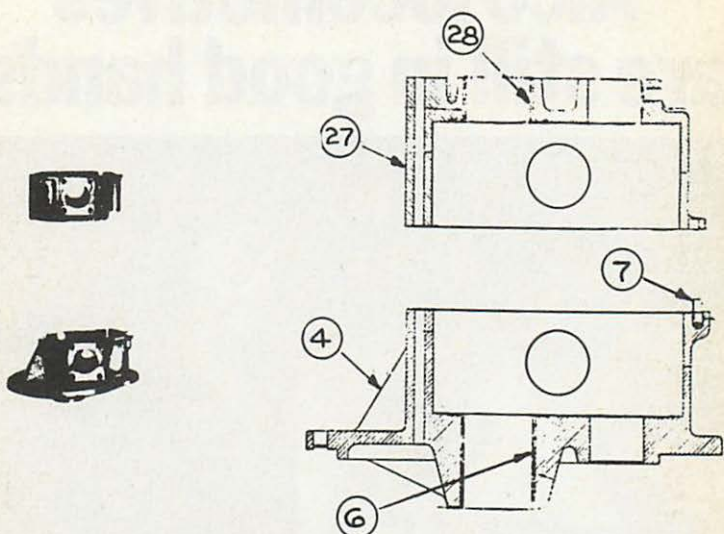
We intend to make sure that Alco engines and locomotives live normal, productive lives. Alco Products Service is organized and staffed to do it.

Alco Products Service will continue to warehouse new and rebuilt replacement parts and to maintain the technical backup team to satisfy customer requirements. Our people are available to provide parts and service recommendations and to give individual attention to your needs.

In short, we'll continue to provide improved service on all Alco products. Alco Products Service, 1 Nott Street, Schenectady, N.Y. 12305.

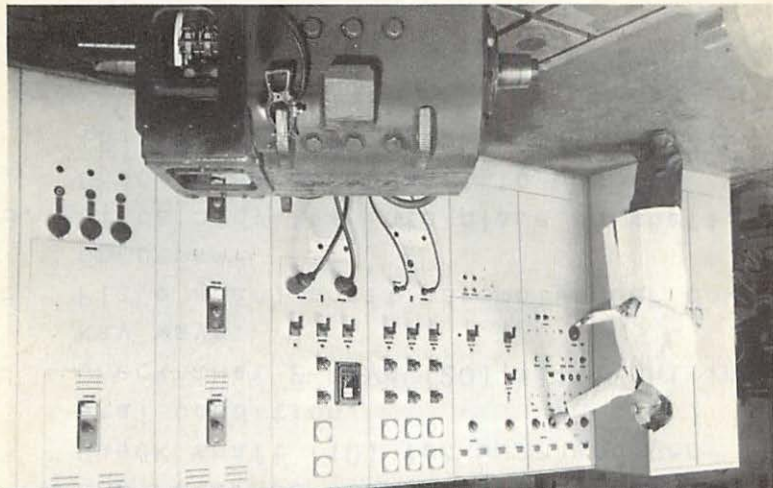
ALCO

Alco Products Service
Div. of White Industrial Power, Inc.



INSPECT AND REPAIR BODY ASSEMBLY

1. Examine bodies (4) (27) carefully, general condition, cracks, burrs, etc. and clean up threads.
2. Examine condition and installation of 2 dowels (7).
3. Check condition of bushings (6) and (28). Thrust faces flush with bodies.



GENERAL ELECTRIC

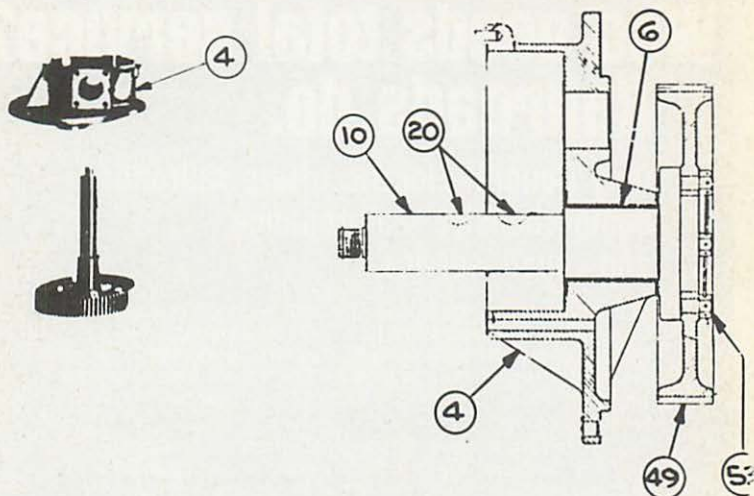


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560-01

**Who needs total service?
Railroads do.
Only General Electric offers railroads
comprehensive maintenance
and repair service.**



INSTALL SHAFT - GEAR ASSEMBLY

1. Examine gear teeth (49) and smooth up as necessary - "fine file".
2. Cut locking wire from 4 bolts (53) and retorque "69 ft. lbs.", rewire.
3. Check shaft (10) for wear and general condition.
4. Check that 2 keys (20) fit tight in key ways.
5. Place gear, shaft assembly gear down on bench.
6. Slide body (4) into place on shaft. Check clearance shaft to bushing (6), New .0015"-.0045" Limit .007".



America's Railroads Who needs you? We do!

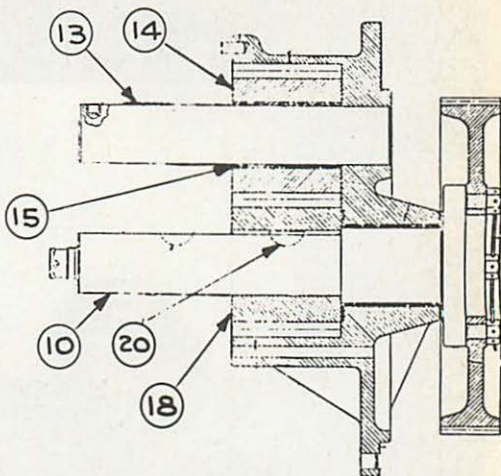
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Compressor valve rings

Distributors: NIFE nickel cadmium batteries

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INSTALL INNER GEARS

1. Install inner key (20) - "Snug Fit".
2. Examine gear (18) for general condition and wear - "No wear permitted at key way".
3. Slide gear (18) into place on shaft (10) - "pop mark out".
4. Slide idle shaft (13) into position in body.
5. Examine gear (14) and bushing (15) for general condition and wear - I.D. of bushing - Max. 2.004 ".
6. Slide gear (14) onto shaft (13) - "original position". Note - gears are matched sets and may not be mixed.

ROSS

RAILWAY AND INDUSTRIAL SUPPLY CO.

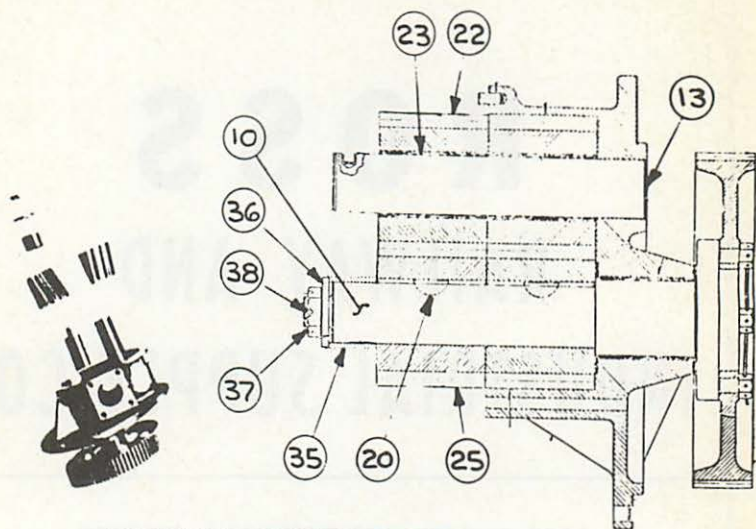
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MOTOR COILS CORPORATION
TRACTION MOTORS**

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Pedestal Liners, Wear Plates, Vertical Rings



INSTALL OUTER GEARS

1. Install key (20) in shaft "snug fit".
2. Examine gear (25) for condition - "no wear at key way".
3. Slide gear (25) onto position on shaft (10) "snug fit" key must fit tightly - "pop mark out".
4. Inspect gear (22) for general condition.
5. Slide gear (22) onto shaft - "original position". Clearance pushing (23) to shaft (13) max .0015" - .0051" limit .007"
6. Install sleeve (35), washer (36) and nut (37) on shaft (10).
7. Torque nut (37) "150 ft. lbs."
8. Lock with new cotter key (38).

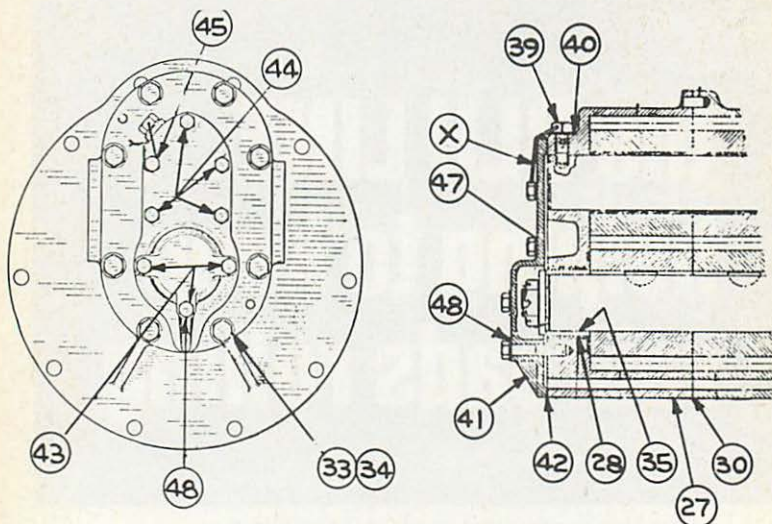
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- Locomotive and engine renewal parts
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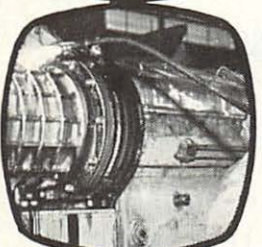
BALDWIN · LIMA · HAMILTON
A subsidiary of Armour and Company





APPLY OUTER BODY AND COVER

1. Grease and apply new gasket (30).
2. Slide body assembly (27) into position.
"Clearance sleeve (35) to bushing (28).
New .0015" - .0045" limit .007"."
3. Line up hole in idle shaft with body and apply screw (39) and new washer (40) - "snug".
4. Apply 8 bolts (33) and 8 washers (34).
"Torque 56 ft. lbs."
5. Grease and apply gasket (42) and cover (41) with 1 bolt (45), 4 bolts (44), 3 bolts (43) and 7 washers (47) and 1 washer (48). "Torque 23 ft. lbs."
6. Torque screw (39) - 56 ft. lbs. and apply lock wire as (X).



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SOAK TANK CLEANERS . . . proven by years of satisfactory service in railroad shops throughout the country. Many formulations, in both concentrated and mild solutions.

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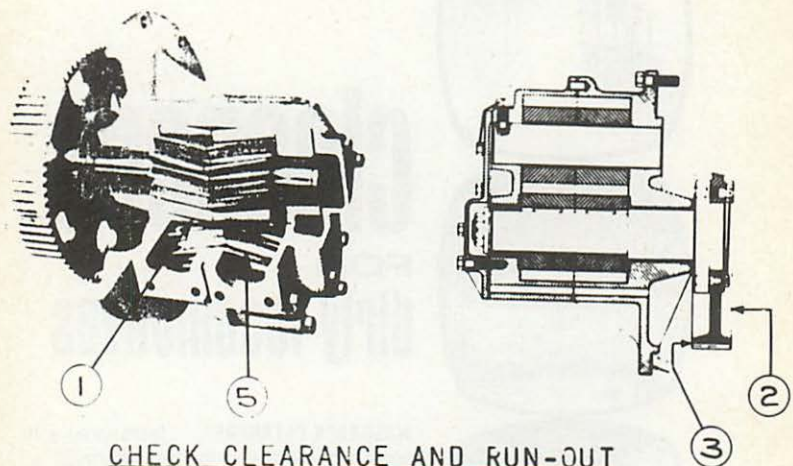
There's a **LIX CLEANER** to do your particular diesel cleaning job . . . faster and more economically. Why not call or write for complete information about all our cleaners.

THE



CORPORATION

General Office: 300 West 80th St.
Kansas City, Missouri 64114
816-333-4464



CHECK CLEARANCE AND RUN-OUT

1. Check back lash on pump gears
New .012" - .016" Limit .030" - "Dial Indicator".
2. Check drive gear run-out
Max. .003" - "Dial indicator".
3. Check runout to flange face
Max. .005" - "Dial Indicator".
4. Rotate pump by hand. Must run free with no binding.
5. Check that pitch of bevel gears are as shown



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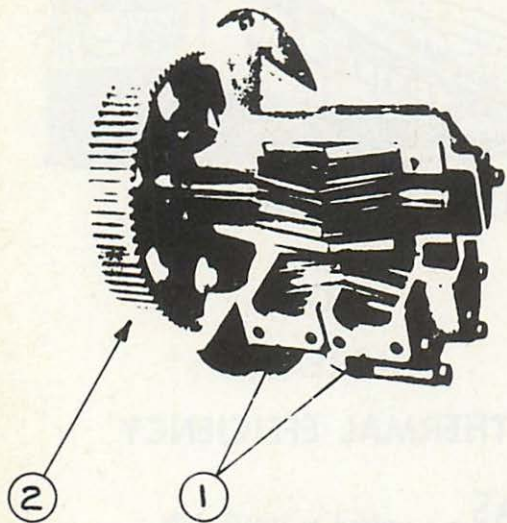
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2. Apply masking tape to protect gear teeth (3).
3. Send for painting.



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It's a self-contained, completely portable,
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To do this for the various components as mentioned above, is not the responsibility of one railroad; but should be the responsibility of the various committees of the A. A. R. The "Job Spec" on the Scavenger Oil Pump which we have just reviewed, would be the responsibility of the Mechanical Committee of the A. A. R., and naturally a "Job Spec" for traction motors or other electrical apparatus would fall on the Electrical Committee of the A. A. R. Upon completion of the "Job Spec" which in its final form would include a time study of actual hours to rebuild the components, it could then be submitted to the A. A. R. membership for their final approval. It would then be published under A. A. R. Rules and Recommended Practices, subject to change at any time builder changes standards.

This program could be enlarged to include as many components, or even a lesser number of components, as the A. A. R. felt was necessary to give optimum locomotive availability and minimum shopping time, throughout the nation.

Once the pricing and standards

have been set up and published by the A. A. R., there is no reason why the billing could not be handled in the same manner as car billing.

C. "Bread and Butter" items such as the type of lubricants for the engine, air compressor, roller bearings, etc.; water treatment, type of lube oil and fuel oil, filters, traction motor brushes, main generator brushes, etc. In this category, although each railroad seems to have an individual preference for these "Bread and Butter" items as we call them, we feel that each unit should be equipped with a "Specification Card" mounted in the cab, the card to be the standard 6"x9" size, and to include information as shown on the following sample: (see page 160).

Thus, if it became necessary to replace any of these items, the operating road would know the basic specs of these items and would be able to replace them without too much difficulty.

Also listed on the card would be emergency telephone numbers from which information could be obtained.

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journal bearings,
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GOVERNOR	PC REGAL OIL	GEAR CASES	JET LUBE	
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3. TRENDS IN MATERIAL CONTROL:

In last year's paper, we showed where a reduction in inventory could be made, particularly under conditions where there was material previously charged out to job locations and identical material in Stores stock.

A. WORKING STOCK POINTS: There seems to be a trend on some of the bigger railroads to reduce the number of Stores Department locations for locomotive and freight car material and to transfer this material into a number of "working stock points" at various locations on the systems. These working stocks are maintained by personnel reporting directly to the Mechanical officer or foreman on line location.

B. CLUSTERED WORKING STOCKS: Clustered working stocks at District store locations are maintained by personnel reporting directly to the District Storekeeper. Working stocks are controlled by establishing a maximum quantity for each item at each location. This maximum quantity is considered the "frozen level" and can only be increased or decreased by the District Storekeeper. Usually fifty percent of the "frozen level" becomes the minimum balance, or re-order point. Charges are made only when material is replaced. Transfers can be effected from one point to another, and Stores personnel handle documentation for the charges and credits. The success of this system is dependent in a large part on cooperation between Mechanical and Stores Departments. The Mechanical Department officers or foremen on line locations become more cognizant of the material overages and surplus, as well as shortages, as

these affect the cost performance of their individual operations.

C. JOINT INSPECTION BY DISTRICT STOREKEEPERS AND MECHANICAL OFFICERS: The District Storekeepers travel their territory, usually with a Mechanical Department officer, to resolve any material problems that may exist at their working stock points.

D. CHARGING OUT OF MATERIAL: As with any stores system, you have a select and a non-select type of material; and how you handle the charging out or the payment for this material varies greatly.

Under select material would be large components such as traction motors, power assemblies, pistons, governors, etc. Non-select material would consist of gaskets, air, lube and fuel oil filters, traction motor brushes, nuts, bolts and other items commonly referred to as "bread and butter" items.

E. MATERIAL CARRIED ON CONSIGNMENT: There seems to be a definite trend on many railroads, especially the bigger ones, to carry many of the non-select items on consignment. Mechanical people feel that by receiving many of these items on consignment:

1. The railroad's money is not tied up in inventory.
2. Material is available for programs.
3. It results in better performance by vendors.
4. There are no material delivery problems by vendors.
5. It aids in vendor planning.

They also feel that with adequate inventory control at the local supervisory level, consignment can be controlled and not abused.

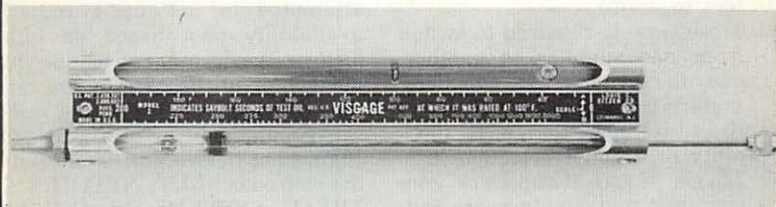
Some of the potential objections contemplated are the following:

1. Charges do not fall in the cur-

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- rent month, adversely affecting Mechanical Department budgeting.
2. Additional work is necessary in counting stock each month, preparing consignment reports showing balance on hand, quantity to be billed and suggested replacement quantity.
 3. Consignment items are usually more plentiful and more subject to waste.
 4. More time is required to switch from one supplier to another, due to the current suppliers' material on the property. In short, it tends to hinder flexibility in supplier selection.
 5. Larger stocks of suppliers' consignment material increase railroad responsibility in cases of loss due to theft, fire, etc.
 6. As most so-called consignment arrangements are simply deferred billing purchase orders, consignee may be forced by contract, to purchase the consigned material on his property if same is not used in a specified period of time.

Each side, we feel, has valid reasons for its stand; when you consider the amount of money that could be tied up in lubricating oil filters or brake liners, on some of today's huge railroad systems, then you are talking about an enormous sum of money that could probably be spent or invested in another manner to bring a greater return to the railroads by handling these items on consignment. This would be a big, valid argument in favor of consignment material.

The secret, to repeat, is adequate control by good supervision; and this good supervision must not only be in the Mechanical Department, but also in the Stores Department. The supervision must exercise the

principle of "MINIMUM INVENTORY WITH MAXIMUM AVAILABILITY."

4. **WARRANTY MATERIAL AVAILABLE IN BUILDERS' WAREHOUSES:** Material availability, particularly with engines under warranty, in the builders' warehouses, has long been a problem.

To be fair to the builders, they attempted to set up a material availability pool based on either historic performance of previous models, or in the case of one manufacturer, an extensive road test of a particular unit or of a particular component before unit is offered to the railroads. **BUT, NEITHER OF THESE SYSTEMS IS INFALLIBLE.**

This problem could be alleviated if the railroads would put in stock some of the items shown on the recommended spare parts lists prepared by the builders.

However, most railroads in the United States today are hesitant about purchasing lists as submitted by the builders. This stems from abuses in the pre 1950 era where the builders' lists showed the quantity of each piece that should be ordered to protect the number of locomotives being ordered.

At that time neither the builder nor the railroad had much previous experience as to the life of diesel parts and consequently, some large surpluses were built up.

It was the builders' aim to recommend parts that would help keep the locomotive in service, but at the lowest possible investment in spare parts; for that reason, recommended spare parts lists never exceeded 2% of the locomotive order. This applied to railroads who were buying their first diesels; if

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they already owned some diesels from this builder, the percentage would be much lower.

Since 1951, quantities have not been recommended on the builders' list. Instead, a builder's representative confers with the railroad about the items that are new and fit only the new locomotives and a desirable quantity is jointly determined. Parts that also fit older units can usually be drawn from existing stock. Inevitably, some surplus will be built up as parts perform better than was originally expected. After a reasonable time these surplus parts should be listed with the manufacturer on their "Surplus Parts Plan."

One suggestion made was that if the railroads would accept a manufacturers' list of recommended spare parts and tools and none of these items were used during the warranty period or shortly thereafter, or even a year thereafter, that the manufacturer would take these parts back and reimburse the railroads at full price plus stores handling expense. It was also suggested that if the manufacturers thought it was so necessary that the railroads have these parts, that they send them out on a consignment basis. **NEEDLESS TO SAY, NONE OF THE MANUFACTURERS SHOWED ANY INTEREST IN EITHER OF THESE IDEAS.**

One manufacturer feels that this consignment would require duplication of stock in many locations. They believe they can provide better service to all railroads by using the same amount of money to build up larger stocks of these and many more items in their eleven branches where they will be available to all railroads.

Parts requirements in the manufacturers' warehouses are forecast

yearly; and manufacturing orders are placed for this material and rates established on how fast the material should be shipped to the warehouse. These rates on the key items are reviewed monthly, and adjustments, upward or downward, are made to meet the existing and near-future market requirements. In addition to the annual forecast, a long-range forecast is made each year, looking to the next five years. This is based on the number of units in service and the anticipated new locomotives to be added. All of the manufacturers have developed computer time sharing programs to do this job. **DESPITE ALL THE THINGS THE MANUFACTURERS HAVE ATTEMPTED TO DO WITH THEIR WAREHOUSING, THEY ALWAYS SEEM TO FALL SHORT ON SOME ITEMS, SPECIFICALLY THE TURBOS.**

One manufacturer has increased the supply of material in his warehouse by 34%; and we feel he is taking definite steps to improve the situation. One thing that is particularly irritating to the manufacturer is that routine purchases are made from outside vendors. They feel if all the purchases of material were made through them, they would be able to better forecast the use of material. **BUT, IF THE RAILROADS AGREED TO PURCHASE ALL THE MATERIAL FROM THE ORIGINAL MANUFACTURER, THEY WOULD BE STRANGLING THEMSELVES BY ELIMINATING COMPETITION FOR THE BUILDERS, AND SETTING UP A SITUATION IN WHICH THEY WOULD BE AT THE MERCY OF THE BUILDERS.**

A. ANNUAL REPLACEMENT PARTS AGREEMENT: One sug-



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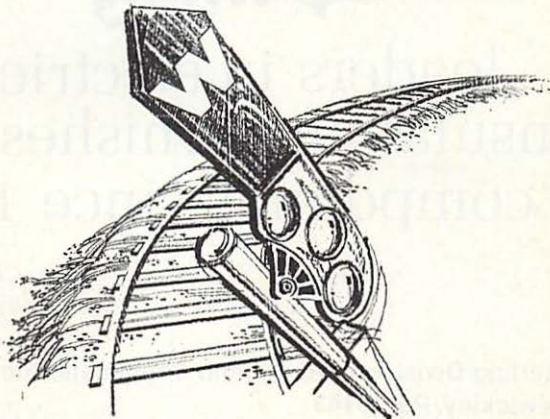
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gestion by a builder was a recommendation that the manufacturers and the railroads sign an "Annual Replacement Parts Agreement." Such an annual agreement could detail parts requirements by months, and would permit the builder to schedule material well in advance of the actual requirement cycle, thereby guaranteeing that all parts would be available when needed. This recommendation could have some merit. We suggest that the builder develop this with individual railroads.

5. LOCOMOTIVE WARRANTY TO BE BASED ON MATERIAL AVAILABILITY BY THE BUILDERS:

Locomotive warranties, remanufactured parts and components warranties and new parts and accessories warranties, are all based

on material and workmanship as set out in detail by the individual manufacturers.

Each of you is familiar with what these warranties entail, and we do not deem it necessary to reproduce the warranties here. Discussions within the Committee and with other railroads throughout the country, seem to indicate that there is little dissatisfaction with the warranty itself; **BUT THERE IS A GREAT DISSATISFACTION WITH LOCOMOTIVE TIME OUT OF SERVICE WAITING A REPLACEMENT OF WARRANTY ITEMS, AND WITH THE MANUFACTURERS' STORIES OF HOW PROMPT THEY ARE IN HANDLING THIS SITUATION. IT WAS PROPOSED THAT A PENALTY BE LEVIED ON THE MANUFACTURER WHEN PARTS ARE NOT**

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The builders are aware of the railroad's need for reliable locomotive performance and long life component parts and stand behind the product through warranty protection and the rapid supply of new and Unit Exchange parts. As you know, the price of manufactured products which are warranted usually includes the cost of warranty protection.

The manufacturers are not in agreement with this penalty proposal as it would be in addition to the warranty expense they now bear and would, therefore, require an increase in the price of a locomotive. They have no past experience from which the cost of the penalty program can be forecast.

When a builder sells a railroad a locomotive through his sales team, his advertising, and the many other means he has to impress the higher management on the rail-

roads, there is much made of the fantastic availability of the particular model; and, in some cases they are right. When the builder is wrong and a unit is out of service, penalty charges could accumulate rapidly.

In 1967 one railroad represented on this committee purchased five SD-45's; five U-30s; and five Alco 630's. A close record was kept of these locomotives, and a study was made on time out of service awaiting warranty material.

The study was then pro-rated to all the locomotives built by the manufacturers of this particular high horsepower for the year 1967.

From the results of this study (refer to Page 172), it is interesting to note that the manufacturer who lost the most days in shopping for warranty items, is no longer in the locomotive building business.

The other two manufacturers are fairly equal in the time out of service; and the increase or difference in price is only due to one having higher horsepower than the other.

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Unit Nos.	5307 - 5311		6300 - 6304		7600 - 7604	
	Shopping Days	Shopping Cost	Shopping Days	Shopping Cost	Shopping Days	Shopping Cost
		\$		\$		\$
1967	0	0	4	1,200	1	360
1968	42	12,600	23	6,900	13	4,680
1969	32	9,600	5	1,500	16	5,760
TOTAL	74	22,200	32	9,600	30	10,800
No. of Locoos	5	22,200	5	9,600	5	10,800
No. Locoos Built	29	128,760	37	71,040	321	693,360
Cost Per Unit Built	1	4,440	1	1,920	1	2,160

Based on one railroad's established rate which allows 10 cents per day per horsepower for out-of-service time, the following is the cost per day for their three classes of locomotives:

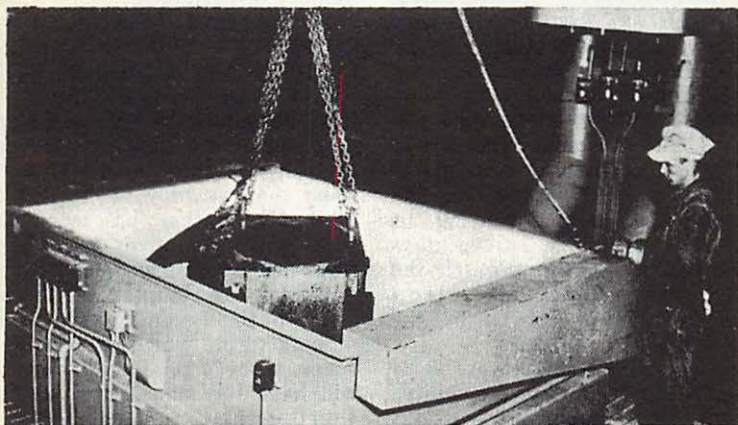
- A. 5307-5311 3000 H.P. = \$300.00 per unit per day
 B. 6300-6304 3000 H.P. = \$300.00 per unit per day
 C. 7600-7604 3600 H.P. = \$360.00 per unit per day

To find the total out-of-service time cost figure for any number of locomotives, use the following formula:-

$\frac{\text{Total Days out of Serv.}}{\text{Total Units}}$ (equals) average days each unit is out of serv. (times) out of serv. cost per unit per day

(equals) unit cost for out of serv. time (times) number of locoos. (equals) TOTAL COST FOR out-of-service time during warranty, account awaiting material.

EXAMPLE: $\frac{74}{5} = 14.8 \times \$300. = \$4,440 \times 5 = \$22,200$ total cost for out-of-service time during warranty account awaiting material.



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A. MANUFACTURER'S INSURED LOCOMOTIVE AVAILABILITY POLICY: The Committee's recommendation to avoid an increase in locomotive prices, even if small as shown on the foregoing exhibit, is to have a "service policy". Under this policy the cost of having a locomotive unavailable for service could be insured, and the cost of a locomotive being out of service five, six or ten days could be reimbursed through the policy. The cost of the policy would be equally shared by the builder and the railroad.

One of the manufacturers feels that this idea has some possibility; but the other manufacturer states that they are not experienced or qualified enough to provide an insurance program of the magnitude

indicated and with such a great number of variables.

6. STANDARDIZATION OF LOCOMOTIVES AND LOCOMOTIVE COMPONENTS THROUGH ELIMINATION OF COMPETITION: We have attempted to give some recommended solutions to several problems in this paper. It would seem that we may be headed for a standardization of locomotive parts and locomotives by elimination; and by that we mean by the elimination of competition.

If we finally end up with one manufacturer, which at this stage seems to be a possibility, then we will have the standardization that we all desire.

BUT, THE ELIMINATION OF COMPETITION—IS THAT WHAT WE REALLY WANT?

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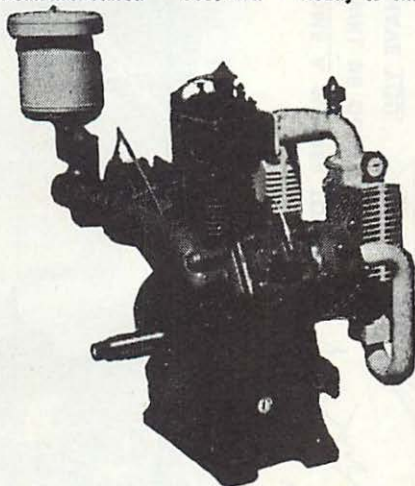
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Locomotive Maintenance Officers Association Shop Equipment Committee
 Speakers' Table at Denver Pre-Convention Presentation April 27

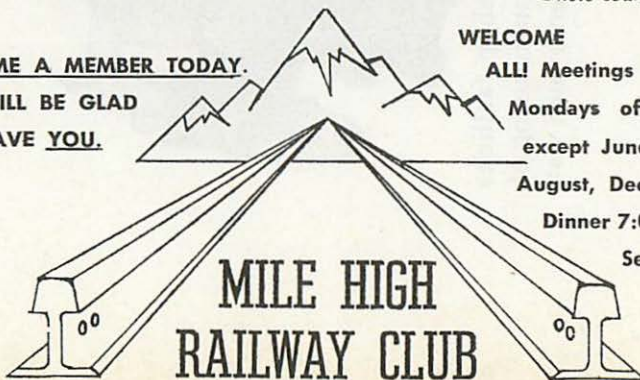


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Pre-Convention
Presentation:
MILE-HIGH
RAILWAY CLUB



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Committee on Shop Equipment
Manager Production Standards—Motive Power
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St. Paul, Minnesota

Vice Chairman

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A. C. Zagotta, Asst. Mgr. Engr. & Res., C. R. I. & P., Kansas City, Kan.



1970 TOPIC:

"EVALUATION AND REPAIR OF DAMAGED LOCOMOTIVES"

PERSONAL HISTORY OF K. AXELSON

Kjell Axelson was born on June 21, 1920, 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 apprenticeship.

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, Wyo., 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 Offi-

cer of the Burlington Lines (CB&Q, C&S and FW&D), out of Chicago, Illinois, prior to his present position as Manager Production Standards—Motive Power, Burlington Northern, Inc., St. Paul, Minnesota General Office.

Mr. Axelson also serves as a committee member on the A.A.R. Wheel and Axle Committee, as well as being a 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 son.

1. INTRODUCTION:

Much emphasis from varied sources, has been directed toward the need for locomotives having greater operating reliability with reduced dollar expenditure for running repair maintenance.

It would seem that the key word in these efforts is "running", but what about the many damaged locomotives today that do not fall in the category of just having a "bellyache" and require more than an electronic or mechanical aspirin to get them back on their feet?

Gentlemen, this Committee would like to probe an area that represents a multimillion dollar business about which very little open discussion of record can be found. We feel that this is a very timely topic and a fertile field for exchange and dissemination of information, as a mutual endeavor to minimize the use of non-productive dollars that erode the true value of the maintenance dollar.

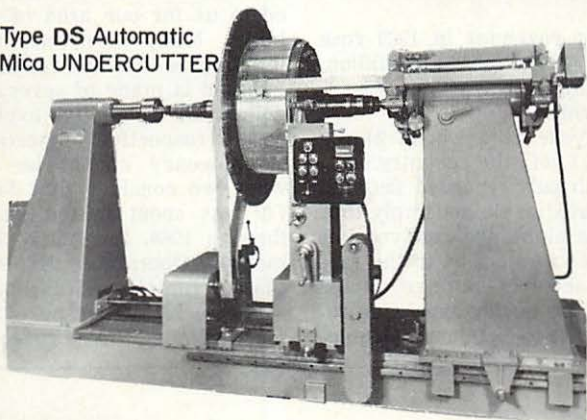
A somber note affecting all of us that further emphasizes the urgent need to face realistic spending, is the fact that earnings on the nation's railroads last year fell to the lowest level since 1961, despite rec-

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ord revenues!

The Association of American Railroads says net railway operating income fell 3.5% to \$659 million from \$683 million in 1968. The rate of return on net investment was 2.38%, down from 2.46% in 1968.

Ordinary net income dropped 10.4% from \$570 million to \$511 million.

Operating revenues in 1969 rose 5.4% over 1968, to \$11.5 billion, but operating expenses rose 5.6% to \$9.1 billion.

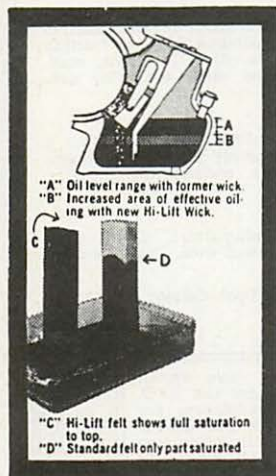
For the year as a whole, 21 (or about 28%) of the country's 74 Class I railroads recorded deficits.

Those statistics do not imply that locomotives alone are involved but serve rather to alert us to the fact that the accident/damage factor appears to be on an expensive increase, with proportionate loco-

motive damage to consider. This brings into sharper focus, the importance of the need for sound **EVALUATION AND REPAIR OF DAMAGED LOCOMOTIVES!**

The name of the game is money and as good managers, planners or participants, it is felt that we are ever mindful of the dollars entrusted to us for our area of responsibility. Many of us are no doubt immune to inward reflexes when mention is made of several million dollars for locomotive expenditures on our respective properties, but—complacency cannot be tolerated when we consider that \$4,351,589,749 was spent in ten years, 1959 through 1968, for Acc't. 311 Locomotive Operating Expenses on Class I Line-Haul Railroads alone.

These ICC Transport Statistics for the United States reveal that an



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average of \$435,158,975 known dollars per year are being spent. This does not include locomotive expenditures by other than Class I Line-Haul Railroads nor does it take into account locomotives that are damaged or "Totaled" in a train accident and not repaired but are "written out" of the investment.

Lacking factual source data, we conservatively estimate that some \$500,000,000 (that's ½ billion) per year is the attributable cost to perpetuate the nation's existing locomotive fleet. This is the collective monetary responsibility that we share, and now that we are talking closer to \$1,000 per minute for locomotives alone, maybe some inward reflexes are in order!

Statistics are useful but sometimes startling. In this case, the

startling fact is that this Committee cannot find supporting data to separate locomotive accident damage costs from routine maintenance costs. Apparently, this item of expense is being treated much like the Road Foreman's pants that were damaged at a derailment. He entered them as a specific item of expense on his expense account but was turned down. His revised expense account bore the notation "the pants are in there, now you find them!"

No doubt some Mechanical Departments may now know exactly how much the item of accident damage amounts to, while others may be startled by a realistic figure if called to their attention. Such information can be a useful tool for use in "Evaluation and Repair of Damaged Locomotives," as

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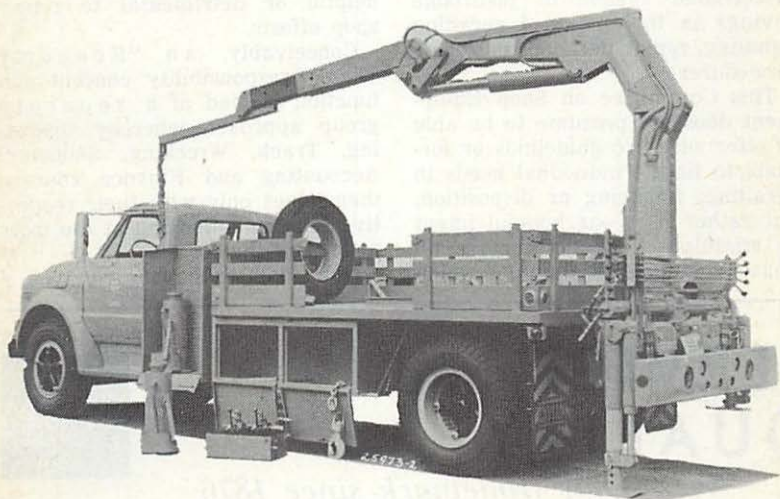
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dollar targets are brutally frank when involved in management recommendations or decision. For those of you that have not looked upon accident damage as a singular cost factor deserving of special review, we as a Committee enjoin those of you concerned to request such data from your respective accounting sources. A good look at your "hole cards" may provide a discernable avenue of justifiable savings in the areas of rerailling handling, repair decisions or repair procedures.

This Committee on Shop Equipment does not presume to be able to offer sure-fire guidelines or formats to fit the individual needs in rerailling, financing or disposition, but rather it is our hopeful intent to stimulate your thinking in all phases of accident damage which

effect the ever important end cost or monetary advantages. When the damaged locomotive is to be appraised, the true intent of this Committee comes into play as a problem common to all of us, regardless of the monogram on the locomotive or whose shop it is in. It was felt that we would be remiss in not calling to attention all possible contributing factors that can be helpful or detrimental to repair shop efforts.

Conceivably, an "Economy Team" responsibility concept can function instead of a separate group approach whereby Operating, Track, Wrecking, Shopping, Accounting and Finance concern themselves only with their respective segments—looking at the trees instead of the forest!

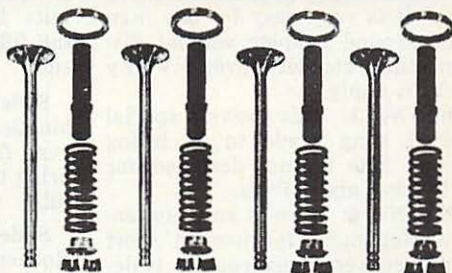
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Slide No. 2: This is a very flexible endless sling with no metal fittings. It is very easy for one man to fit around coupler without disconnecting coupler lever. Very quick to apply.

Slide No. 3: This shows a special braided sling made to fit lifting lugs on side frame, designed for EMD GP-7 and GP-9's.

Slide No. 4: Here is an emergency arrangement for use on short boom wrecker where coupler is destroyed and emergency lifting point is used. To prevent hook opening up, a Rochester No. 507 special alloy steel hook is used to ensure safe operation.

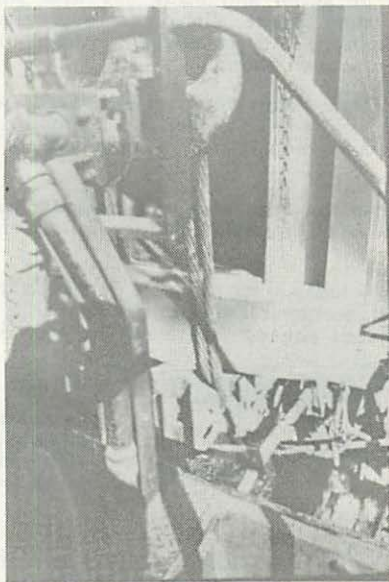
Slides No. 5, 6 and 7: The next 3 slides show a Rochester Knuckle Eye, designed to permit either pulling or lifting locomotives, with or without trucks. These scenes show

locomotive 90' down fill, right angle to track. Using knuckle eye permits both pulling locomotive up the fill and lifting to turn it on its side.

Slide No. 8: Here you see a combination of a knuckle eye and a very flexible endless sling used to bring the nose of this F unit up the fill.

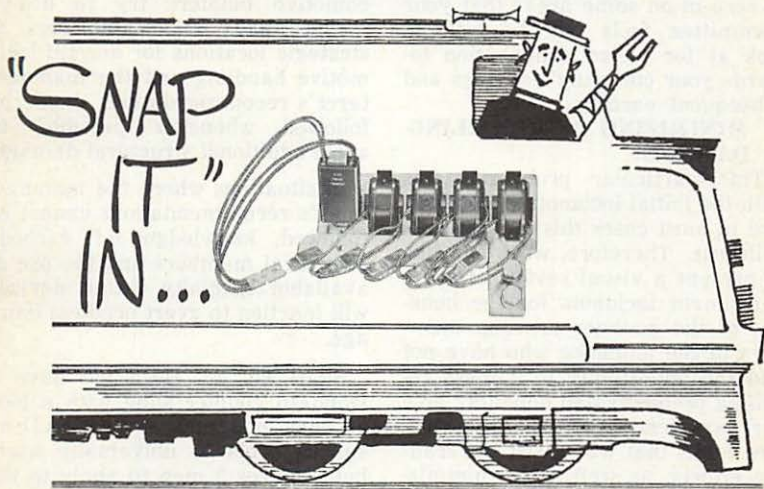
Slide No. 9: This is a special Rochester locomotive sling, type GP-30, designed for use as a rolling sling and lifting sling. This has a spreader designed for use between sling legs to prevent compression damage.

Slide No. 10: This shows a locomotive in a river with only part of one side out of water. This presents a real sling attachment problem.



Slide 2

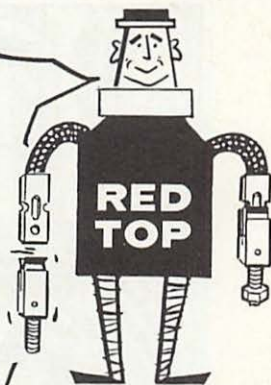
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general scope of the reason for monetary concern, we would like to zero in on some areas that your Committee feels will be well to look at for added contribution towards your company's savings and subsequent earnings picture.

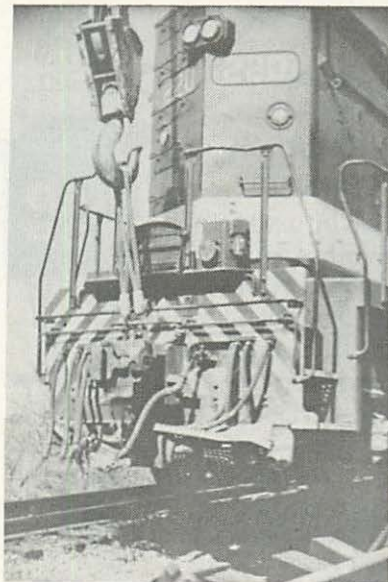
2. MINIMIZING OF RERAILING DAMAGE:

This particular problem starts with the initial locomotive accident, and in most cases this means a derailment. Therefore, we would like to present a visual review of some derailment incidents for the benefits of the younger or shop members in the audience who have not had the opportunity to witness rerailling problems and hopefully give our experienced members some new ideas that will assist in rerailling efforts, as well as in minimizing rerailling damage.

As you view the following slides, it should be borne in mind that locomotive builders try to design jacking pads and cable lugs at strategic locations for normal locomotive handling and the manufacturer's recommendations should be followed whenever possible, to avoid additional structural damage.

In situations where the manufacturer's recommendations cannot be followed, knowledge of carbody structural members and the use of available specialty lifting devices will function to avert needless damage.

Slide No. 1: Here we have a standard coupler sling with a loop at each end and mechanical splices. This is universally used, but requires 3 men to apply to the coupler.



Slide 1

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and
SHOP LIFTING
PROBLEMS

(See Items Mentioned in this Report)

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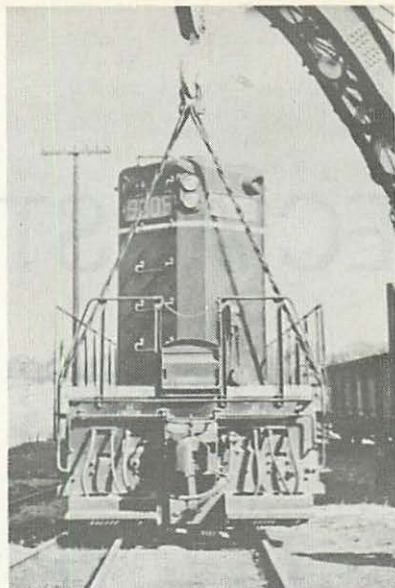
CULPEPER, VIRGINIA 22701

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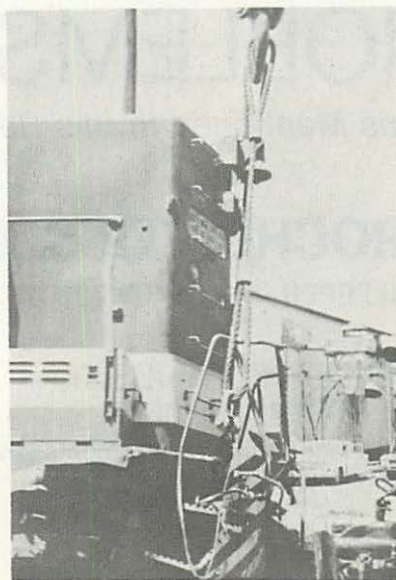
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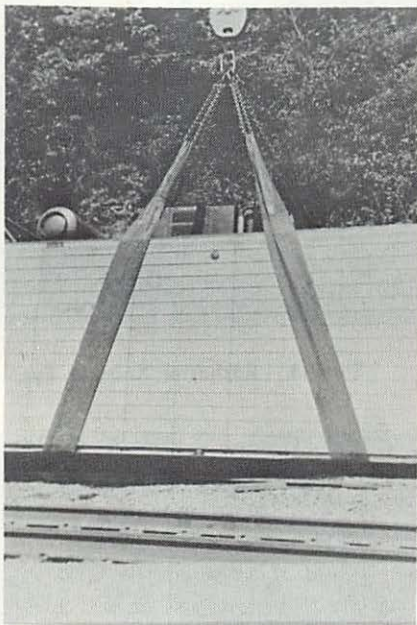
Slide 3



Slide 4

At A Derailment—

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Slide 5 — Rochester Knuckle Eye



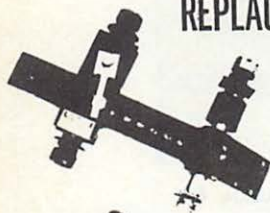
Slide 6 — Rochester Knuckle Eye



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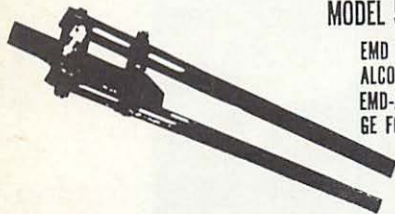
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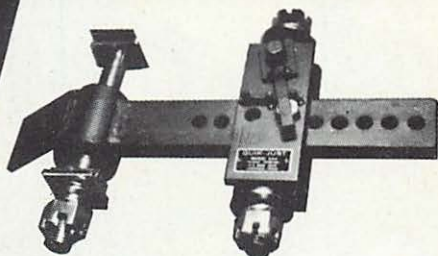
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Slide 7 — Rochester Knuckle Eye



Slide 8



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Slide 9



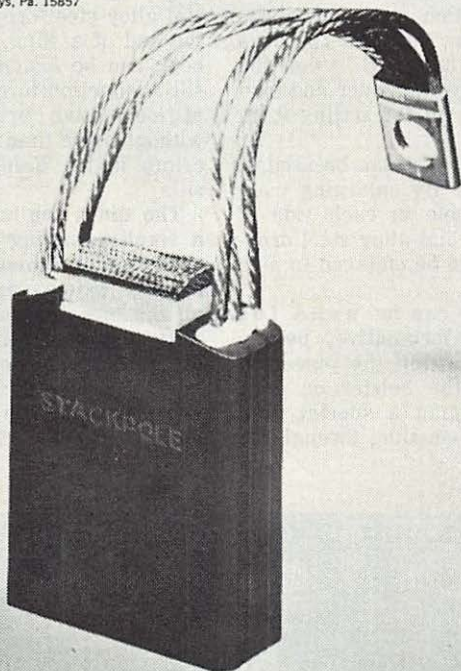
Slide 10



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**ROAD
RUNNER**

Slide No. 11: The two legs of the GP-30 sling, together with the knuckle eye permits this unit to be brought out of the river without the use of a marine diver, using a double application at the coupler.

Slide No. 13: Now the two legs of GP-30 sling are used to pull the locomotive out of the river and turn the locomotive up for setting it on a flat car.

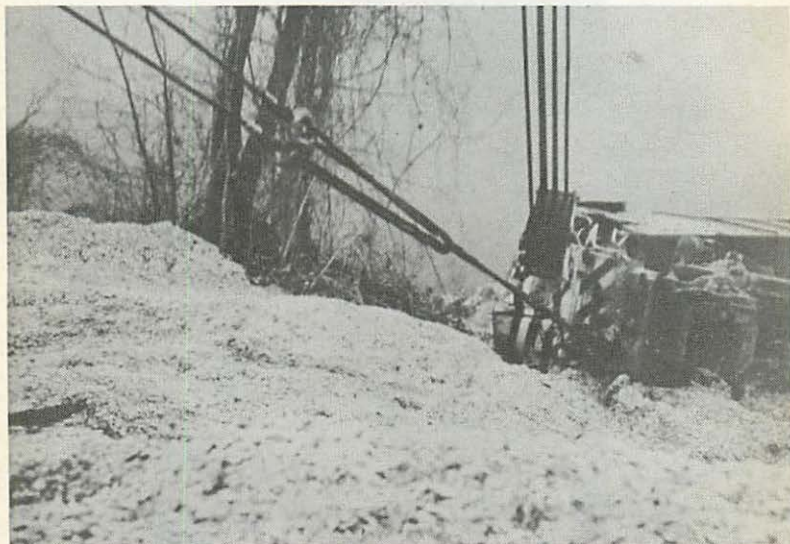
Draft gear pocket can be used to lift locomotive. By enlarging train line passage hole in each side of pocket, the special alloy steel drop-forged hook can be engaged to pick locomotive up.

Body bolster can be used for picking up a locomotive, bottom side up. By cutting the pipe running through the bolster on each side and inserting a special very flexible wire rope sling through the

pipe holes in the form of a basket hitch, the locomotive can be picked up with a bridle or "A" hitch.

Locomotive can be picked up a fill by the center sill. Using a special alloy steel drop-forged hook on the end of a sling, the point of the hook can be fastened to the center sill at junction to end sill and body of locomotive brought up a fill without more than possibly a slight crimp in the flange of the center sill.

The slides you have just seen are a small sampling of the fact that no two derailments and accident damage extents are alike. This is all the more reason why this committee strongly recommends the use of an experienced locomotive man to advise the wreckmaster of acceptable pick-up or jacking point on a locomotive. There are gener-



Slide 11



Slide 13

BEST WISHES

From

JOHN W. MAHON CO.

(Manufacturers' Representative)

1912 TERMINAL TOWER

CLEVELAND, OHIO 44113

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ally plenty of operating and Track Department officers at a derailment who can determine if there is sufficient time available to properly handle a locomotive and wrecking crews are generally comprised of men with carmen background to expertly man the hooks, and slings, but the natural tendency to see how fast the job can be done, regardless of additional damage, should be discouraged.

A competent and qualified locomotive officer should be available to appraise the other members of the on-site team of the fact that the difference of many thousands of dollars in repair costs and lost revenue due to added out-of-service time, are at stake because of haste and guess work. Some unnecessary things are being done such as the burning off of an equipment

support instead of unbolting, which causes additional rework or replacement and on truck removals, the CARBODY leads to the traction motors are being cut instead of unbolting the terminals or cutting the motor leads, which are shorter and less expensive to replace.

In many cases, jacking with the help of traversing jack bases instead of pulling a locomotive over rerailers will avoid needless drag and shock damage to running gear, pilots and traction motors, also, failure to pick up and include with the locomotive going to the shop, small components that often could be repaired at considerably less than replacement cost. In addition, some of these components may have a long lead time to procure,

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causing the unit to be out of service longer than necessary.

It is here that an "economy team" can start to function by determining if pick-up time is more valuable than added locomotive repair costs.

It is felt that whatever the added cost, if any, for this education factor in locomotive handling, it will be offset many times over by reduced repair costs and increased locomotive availability.

Many experienced locomotive men who go to derailments may be short-changing their company and the industry as a whole, when they realize that improvements could be made in adding or modifying pick-up points and jacking pads, but fail to recommend them or, complain to the wrong people. Owing to the almost yearly design

changes in locomotive models, field experience should be passed on to the locomotive builders; and insisting on changes in these specifications will pay dividends in the form of less carbody damage and reduced handling time. Such changes do not necessarily mean added initial cost. We suggest that you confer with your wrecking personnel for encouragement in this line of thought for added savings.

The Committee believes that a good start in this direction would be to move or add lifting points closer to the ends of the underframe or carbody as shown in these slides, to eliminate the possibility of cab or carbody compression damage.

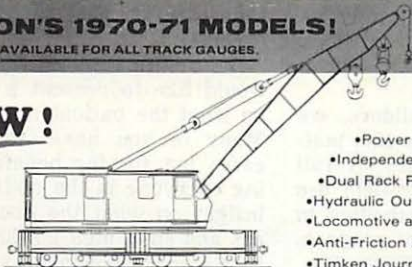
Line spreaders are not a completely satisfactory answer when the carbody is sitting at a severe



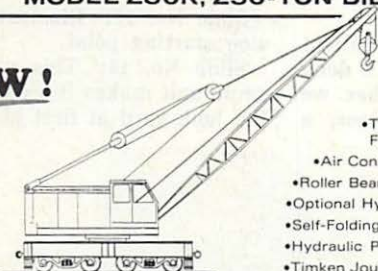
Slide 16C

WHAT'S NEW IN RAIL CRANES?**ORTON'S 1970-71 MODELS!**

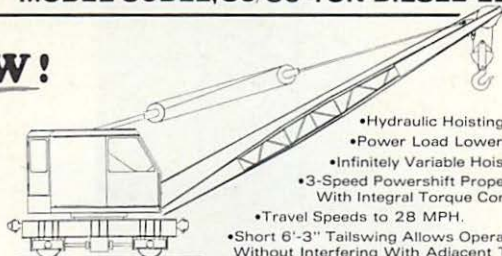
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86-70

angle and the couplers are missing, or on models where a coupler hitch is not recommended.

We also believe that such a move would permit the use of shorter boom wrecking derricks for improved lift stability and safety by reducing rolling momentum stock after the carbody angle has been overcome on a lift.

To the locomotive builders, we request that you look into this matter as part of a voluntary overall product improvement for field use even though you lift carbodies in your shops for a different purpose.

3. ECONOMIC EVALUTION TO REPAIR, TRADE-IN OR SCRAP:

After we have the ailing patient back on its temporary feet, a decision has to be made whether we should knock on a Shop Door, a

Builder's Door or a Junk Dealer's Door. As many of you know, such a decision is not always an easy one and a hasty diagnosis could lead to a "live" burial or the harnessing of a dead horse. **Costly mistakes are not easy to admit or overcome.**

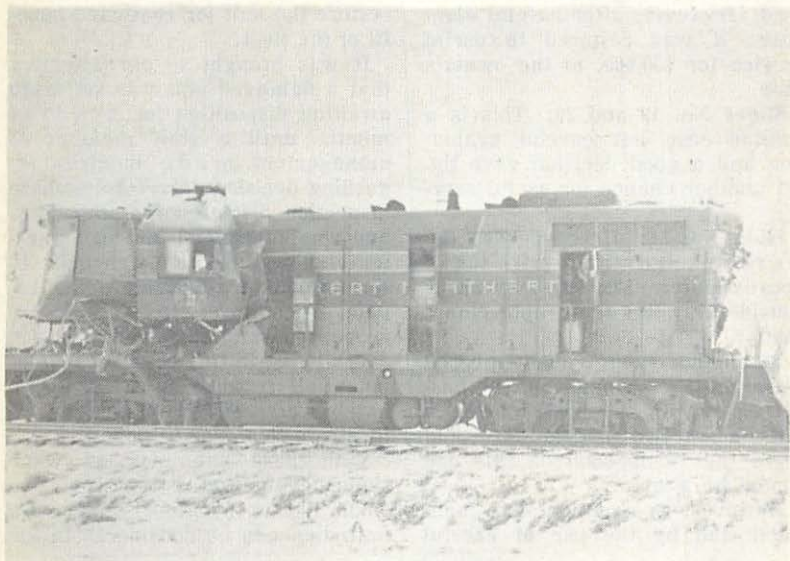
Before we discuss diagnosis, we would like to present a few slides on what the patient may look like. Many of you have seen similar cases but for the benefit of insuring everyone in the audience some insight on what the decision makers and shop men go through, let's take a look at what is knocking on the door.

Slide No. 17: Illustrates a decision starting point.

Slide No. 18: This view of the same unit makes it a candidate for the junk yard at first glance if the



Slide 17



Slide 18

Reliability and Service

HUGHES RAILWAY SUPPLIES, Inc.

987 Suburban Station Building

Philadelphia, Penn. 19103

eeny-meeny-miney-moe system is used. However, after careful diagnosis, it was restored to useful service for \$60,000, in the owner's shop.

Slides No. 19 and 20: This is a similar case but careful evaluation and a good decision gave the 641 another chance for useful service.

Slide No. 21: Here you see the 641 ready to go with a price tag of approximately \$25,000, which is considerably less than replacement cost.

At another shop, a dismembered diesel unit was brought in as a basket case, with the basket being a flat car and two gondolas. It would seem that a decision on this one should be a snap.

However, by avoiding snap judgment and by the use of careful

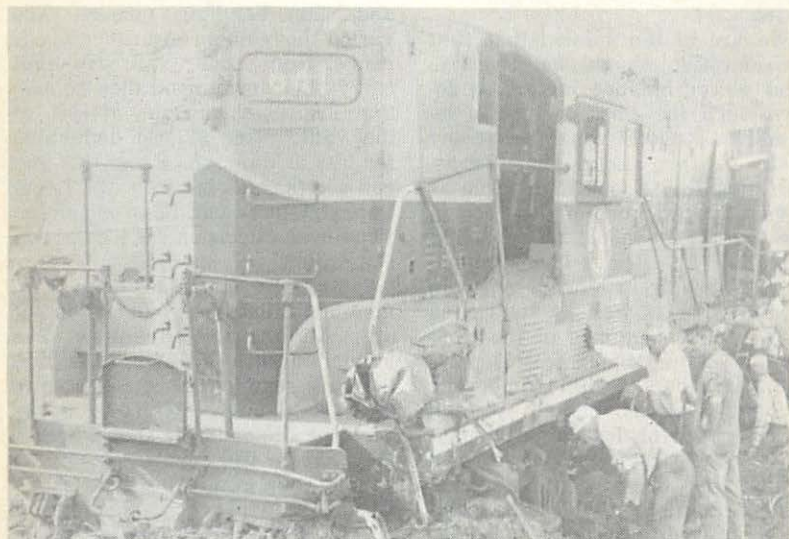
evaluation, economics prevailed to restore the unit for continued benefit of the fleet.

It was brought to our attention that a damaged unit was set aside awaiting disposition for several months until a staff member of management made inquiries regarding decision delay. Immediate inspection disclosed that the damage was superficial and in a matter of days, the unit was back in service with a relatively minor repair expenditure. Delayed or improper guesstimates increased the overall cost in this case because of potential revenue loss. Unfortunately we could not obtain slides to illustrate this case in point.

With these examples of why sound evaluation is stressed, we would like to bring out some of the ingredients to be considered in the



Slide 19



Slide 20



Slide 21

course of arriving at a proper decision.

We are of the opinion that first consideration should be given to fleet power balance factors to determine if the class or type of locomotive is worth repairing at any cost. At this stage, your Transportation Department can serve as a valuable member of the "economy team". It should be consulted with full knowledge of estimated costs to repair in kind or upgrade modification as well as knowledge of the life expectancy of the locomotive. As a Mechanical Department member of the team, your recommendations should include consideration of the age of locomotive, future replacement parts availability, future maintenance costs and whether upgrading modification would create an "orphan" that could grow into a maintenance/servicing monster at some date in the near future prior to normal obsolescence.

Regardless of whether or not a locomotive can be restored to service, your Financial Department team member can give expert advice on how monetary advantage can best be deployed. These people are best qualified to weigh the factors of cash position, cash flow, depreciated values, tax benefits, insurance values, influence on capital expenditure vs. operating expenditure and, return on investment.

Don't overlook the Legal or Claim Department team members, as claim judgements can be critical to company economy when the accident incurs public involvement or insurance credits. You should request their assistance immediately after the accident and assist them with photographic records ranging from time of accident

through the progressive rerailling and shop handling phases. The varied thoughts on insurance needs range from some railroads that carry their own insurance to one that insures their units at 80% of the value after \$25,000 deductible for loss or damage. From this you can see that advice from the Legal Department cannot be over-emphasized in the decision for locomotive disposition.

Sometimes a valuable team member called the "builder" is not utilized to the best advantage. The builders assure this committee that they are ready, willing and able to assist in damage estimates at the accident site or in the shop whether they handle the repair job or you handle your own. This type of assistance can prove invaluable and greatly influence locomotive disposition decisions to repair, scrap or trade-in. These people are experts in their own right and we should take advantage of their availability to assist us in determining if the dollar can best be spent for a like-new warranty locomotive, an upgrading modification, or do only necessary damage repairs. They also can help to weigh your shop workload and capability factors against valuable revenue time by expediting repairs.

Another important "economy team" member is your Purchasing and Stores Department. This source of talent should very definitely be employed to the fullest as those people not only know where they can get the repair or replacement material but they can help determine the cost and out-of-service time—they may even get it for you wholesale! This Department is an important pressure point in the savings structure.

At this point, the Committee

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would like to make a joint request for greater assistance in the procurement of so-called obsolete material needed many times to run a locomotive for a few more years. We are advised that some builders and railroads salvage somewhat high usage parts that are out of production, from older scrapped locomotives to avoid special parts penalty manufacturing costs. Some of these parts may lie dormant at point "A" when there is a crying need for the same parts at point "B". We believe that in this computerized age, a central information center concept can prove to be a very definite avenue of savings in accident repair costs. Such a concept would serve to save on inventory investment, reduce parts costs and expedite repairs to increase locomotive availability for corresponding revenue increase.

Among the relatively new assets available for evaluation teamwork is a Department called "Management Information Services." It is felt that accident damage evaluation would greatly benefit by having mechanized historical data available for a comparative base, by locomotive class factors, in order to make sound and rapid decisions. This base data also can be programmed for use by the other team members. This relatively new technology is here to stay so it behooves us to get all the exposure possible to remove the mystery out of what can be a valuable decision tool.

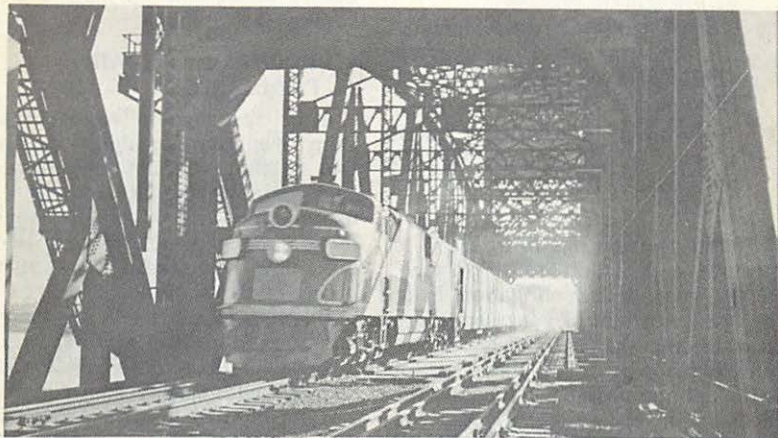
Now let's get down to where your team responsibility, as Mechanical Department members, extends itself beyond your expertise at the accident site. Do not underestimate your importance to the end dollar saved or lost. As locomotive experts, you are more

aware of the expensive internal goodies and repair requirements than any other member of the team. For that reason, your talent and judgment usually serves as the most important basis for all the other "economy team" members to act on. Your damage estimates should carefully include concealed damage on such items as batteries, engine and main generator alignments, wheels and axles, shock damage to carbody structural members, etc. This committee does not know of a standard formula that will suit all conditions but one seat-of-the-pants method is to estimate one dollar per pound for material replacement and fifty cents per pound for repair labor with a 25% additive on the total for concealed damage. For the sake of tempering your recommendations from the Mechanical Department point of view, you should have a general idea of what a locomotive is worth to your company. This general knowledge coupled with your damage repair cost estimate will provide a reasonable basis to support an initial recommendation for locomotive disposition. One suggested method of obtaining locomotive value is to obtain the latest full year gross freight revenue and divide it by your total freight locomotive ownership, use a profit ratio factor of say 20% to obtain net revenue value per year and multiply the annual net revenue value times the number of remaining life expectancy years.

Slide No. 24A:

For example:

1. a. Gross Freight Revenue equal \$300,000,000.
b. 1969 Freight Loco. Ownership equal 500.
2. Annual value of one freight locomotive in gross revenue



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available — \$300,000,000 divided by 500 equals \$600,000.

3. Annual value of one freight locomotive in net revenue available — \$600,000 times 20% profit ratio equals \$120,000.
4. Remaining expected life value of one freight locomotive — 10 yrs. times \$120,000 equals \$1,200,000.

If the decision has been made to restore a locomotive to service, again your dollar obligation is to determine which of your shops are best oriented in terms of capability and outshop time for the type of accident damage involved. This decision involves judgement areas of present shop workload, material availability, personnel qualifications, tooling and shop equipment. It is questionable if overall money can be saved by sending a locomotive dead to a centralized (in terms of workload) accident repair shop many hundreds of miles away in cases where minor or superficial damage is involved. **It may prove less costly to ship the material (if needed) to the locomotive's assigned running repair facility to avoid excessive out-of-service time and heavy repair shop overhead expense.** We concede that some railroads have progressed far in cost control and work measurement to obtain realistic people who have pre-judged scientific management procedures as Mickey Mouse, we admonish you to update your thinking and take an honest look at such things as Responsibility Accounting Systems, Critical Path Methods, Data Processing Programs, Production Standards, etc. Today's margin of error is more critical than ever before so let's take full advantage of the Management tools available to even help decide where

accident damage repairs should be made, instead of ignoring such a savings possibility.

4. ECONOMIC REPAIR PROCEURES:

After the locomotive is in the shop, your responsibility is two-fold in that you not only have a cost estimate target but also the use of procedures, tools and equipment factors which vitally determine how the repair dollar is spent.

One of the shopmen's biggest problems is the extensively damaged underframe so we will show you a few versions of how various shops handle this type of repair.

A locomotive with extensive frame damage was repaired by cutting the frame into 5 pieces after the superstructure was removed. It was straightened, rewelded with 5/8" camber and only 1/16" twist which is nearly ideal dimensions. The frame straightening track consists of 8 slots made of rail laid side by side and secured in the floor. Into these slots are inserted 2" "T" nuts and bolts or turn buckles. The underframe is secured to the floor by means of beams made of 15" car channel stiffened in the middle with 2" to 3" of plate steel to create an oversize "I" beam. **By using various combinations of ties, beams and 75-ton jacks, the underframe can usually be straightened cold.**

Slide No. 26:

Here we have underframe fixture used in the General Electric shop. You will note the heavy steel floor plates, which are of a particular aid when working on damaged underframes. Though this slide actually shows a new underframe being fabricated, it is also used to repair damaged underframes with the type of clamp control shown.

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Slide No. 27:

Very often in a collision of two locomotives, the main frame or bed gets bent either up or down. This bending usually takes place ahead of the center casting. One method of handling this area of repair is as follows:

- Step 1. The unit is mounted on shop trucks.
- Step 2. Figure 1 shows two guide strings are run as indicated on slide. The blue string indicates where bed or frame should be when straight. The red string is mounted as shown so it will follow the bent portion of bed when straightening takes place.
- Step 3. The "I" beams are cut at the band from bottom up through web but not

- through the top part of beams as indicated by dotted line in figure 2.
- Step 4. Using jacks at both front sides, bend is removed by jacking. The weight of the engine usually is enough to hold the frame down. If the engine has been removed, it will be necessary to put on equivalent weight on the bed to hold it down. Bent end should be straightened about one-half inch over plane, as when "I" beams are welded and reinforced, welding has a tendency to pull the bent portion down a little. The portion where the "I" beam cut was made should then be trimmed of bent metal to smooth sur-



Slide 26

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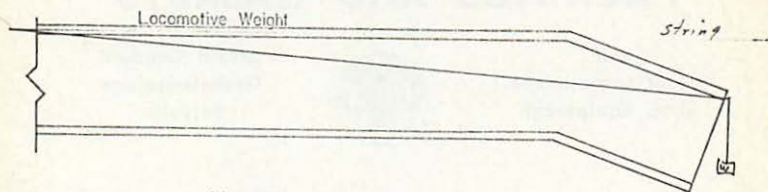


Figure 1

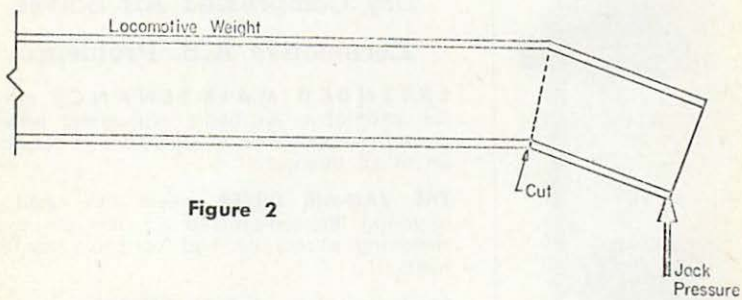


Figure 2

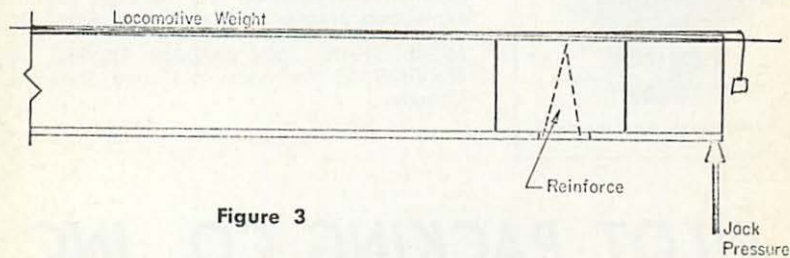


Figure 3

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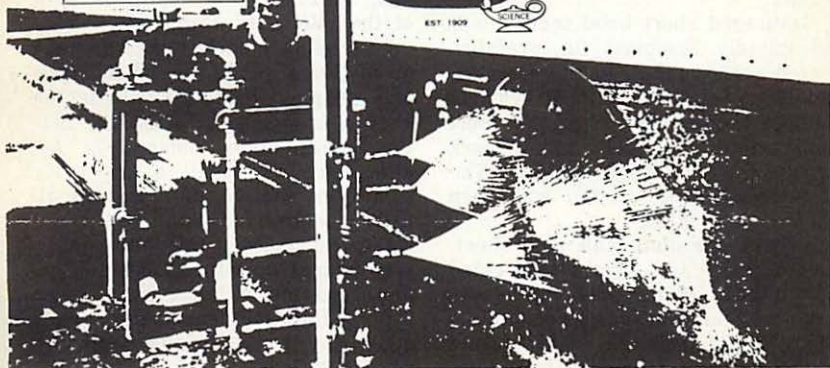
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face and filled by welding. Reinforcing plates as shown in figure 3, are applied to both sides by welding or use of "Huck" bolts.

- Step 5. If the nose has been bent up instead of down, cut the same way. With shop crane, pick up a heavy weight (an engine) and lower onto deck to bend deck back down. Do not overbend in this case. Fill cut with weld and reinforce as before.
- Step 6. This procedure saves time as well as eliminating possibility of wrinkles in the frame.

Another frame straightening procedure employs a hold down jig located in a shop pit. Through the use of high tonnage air jacks with the untrucked locomotive placed on stands, the frame is brought back to proper dimensions.

Body work presents many problems areas but we believe that the many techniques which can be employed, will allow an effective selection to meet your respective needs.

Damaged short hood section was completely removed for prefabricated replacement, as the most expeditious and economical way to handle the repair. With the short hood removed in-place repair work was done on the cab proper. The new short hood section was then welded into place.

Precut complete cab side sheet, in another case, was also welded into place. Many times such procedures can be more economical than trying to patch repair only a portion of a section due to the fitting, grinding and filler labor that can offset any material savings. If

damage is only slight, newly developed plastics such as "Bondo" or "Mister Mechanic" can fill holes, creases, dents or scratches without replacing a steel section. Such materials can easily be sanded and painted to produce a like new finish when structural strength is not the prime consideration.

Slide No. 32:

If the replacement component cannot be purchased from a vendor due to being obsolete or a specialty item, and shop fabrication of a new one is expensive, repairing in place and kind is a necessity. For example, the bent portions of this pilot were cut away and straightened under a press. The edges were beveled, a full penetration weld made and after grinding, both appearance and strength were as good as new. At times, possibly we build in our own troubles due to non-standard specifications. GE advises that they have furnished at least six distinct designs of snowplows, which makes stocking quite a problem. The Illinois Central has developed a split pilot concept for GP-28's and SD-40's, which gives them a repair cost advantage, as many times only one-half of the pilot gets damaged.

Upgrading modification has been an historical prerogative of mechanical peoples' ingenuity. Reaching back a few years to illustrate that the modification concept is not new, here we recall a former steam locomotive that was modified or converted into a powered rotary snowplow. Economic progress caught up with that modification resulting in an even greater savings improvement, where steam gave way to electricity with the result that the aforementioned steam powered rotary is now driven by four in-line traction motors

Terminal Test in 1/3rd the Time



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QRB

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The Brake Cylinder Release Valve was conceived and developed by New York Air Brake Company. QRB Brake Cylinder Release Valve Kits (Left Hand or Right Hand) can be readily mounted on ALL existing AB Valve pipe brackets. Immediately available from stock.

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:

"In order to produce the potential savings which brake cylinder release valves can produce... Interchange Rule 3 (a) (11) be broadened to include all cars rebuilt on and after January 1, 1969". That's what the regulations say.

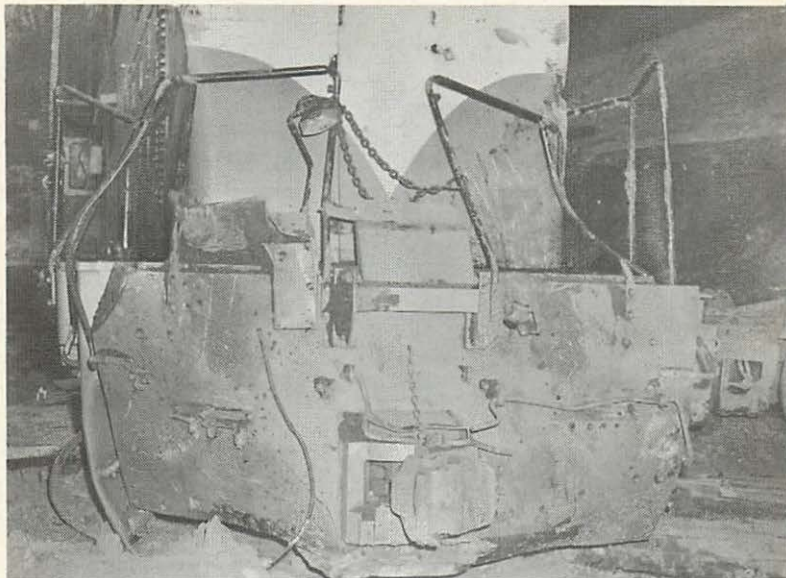
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Slide 32

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When economics dictate that upgrading modification is in order, to take advantage of accident damage repairs, many shops have found it to be economically advantageous to have prefabricated components available, using complete replacement procedures instead of making modifications in place by using nose, short hood and cab assemblies, low-profile noses, hi-voltage cabinets pre-wired on the floor before application to the locomotive.

Adding labor saving devices such as battery skid containers also adds to the savings potential thru easier application and removal. In addition, items such as "Mister Mechanic" or "Kant Skid" cab deck covering, New York Air Brake "Portorack" air brake pan-

els, seven element lube oil filter tank, EMD No. 8356717, large fuel filters, electric emergency fuel shut down systems, etc., are other types of items that should be considered, as modification provisions can easily be made while repairing accident damage.

FASTENERS:

Slides No. 39 and 40:

We now move into an area that we feel deserves more attention than it has been given in the past. That is, the proper use of the proper fastener in the proper place. Too many times any type fastening available is used just to fill a hole or tie pieces together. You have all seen instruction sheets of the type shown here and there is a very good reason for them, so use them.

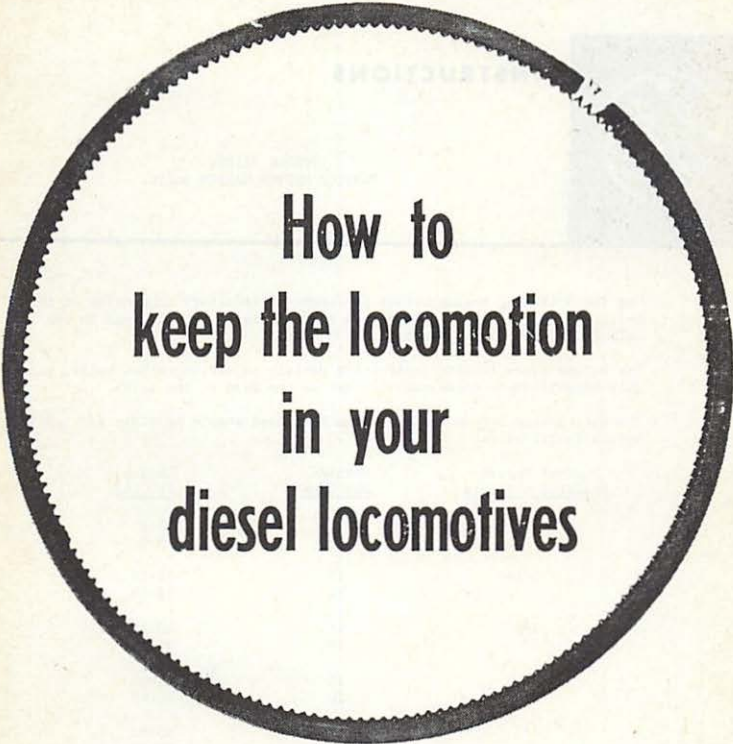
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INSTRUCTIONS

TORQUE VALUES VARIOUS MEDIUM CARBON BOLTS

Use the following torque values to insure satisfactory tightening of the bolts, studs and their nuts where a specific value is not given in the DATA SECTION of the instruction.

The values given in this instruction pertain to medium carbon bolts, generally identified by three radial lines on the head of the bolts.

The threads and the underside of the bolt head should be clean and lubricated before installation.

<u>Nominal Thread Diameter - Inches</u>	<u>Threads Per Inch</u>	<u>Torque Ft. Lb.</u>
1/4	20	5-8
	28	5-8
5/16	18	12-15
	24	12-15
3/8	16	20-25
	24	25-28
7/16	14	35-40
	20	40-45
1/2	13	55-60
	20	60-70
9/16	12	75-80
	18	90-100
5/8	11	105-115
	18	125-140
3/4	10	185-205
	16	220-245

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

2-68 (2000)

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INSTRUCTIONS

TORQUE WRENCH APPLICATION FOR TIGHTENING IMPORTANT ENGINE BOLTS AND STUDS GE 7FDL DIESEL ENGINES

To ensure satisfactory performance of engines and to avoid costly failures, it is extremely important that vital bolts and studs have their nuts tightened at assembly according to the values given in the Engine Instruction Manual. When torque wrenches are not available, it may be assumed that a man can exert a pull of about 125 pounds on the end of a wrench handle which, when multiplied by the wrench length in feet, will give torque in foot-pounds.

It is often necessary to use adapters with the torque wrench in order to reach inaccessible bolts and nuts. When these adapters are used, the reading of the torque wrench dial is not the actual torque exerted on the bolt or nut. The ratio between the actual torque on the bolt or nut and the torque shown

on the wrench dial is determined by the length of the adapter and the location on the torque wrench handle where the pull is applied. (Fig. 1 and 2)

IMPORTANT: It is very important that the pull on the torque wrench handle be concentrated, as much as possible, at the position marked "P" on the following drawings, as a shift in this position will cause considerable error in the effective torque at the end of the adapter. It is also very important that the threads of both parts be clean, free of burrs, and lubricated with Lubriplate No. 130A or similar extreme-pressure lubricant. The washer face of the nut or bolt must also be lubricated with the same type of lubricant.

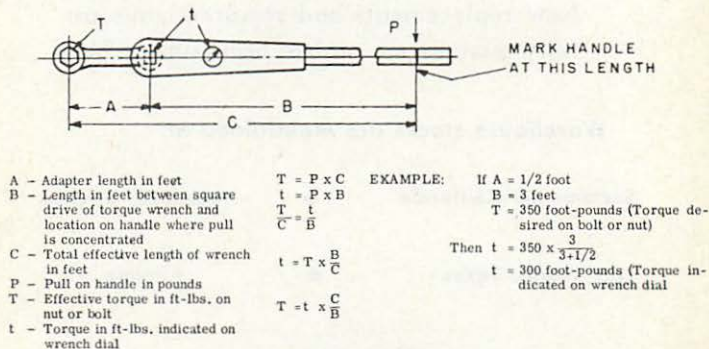
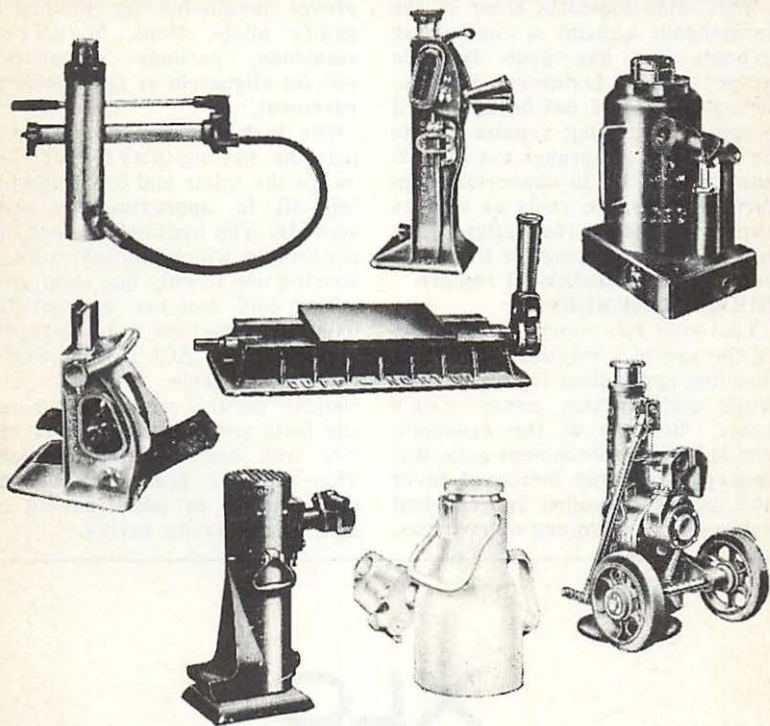


Fig. 1. Torque wrench with straight adapter

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.



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Slide No. 41:

This slide indicates some of the tremendous amount of engineering expense that has gone into the proper use of fasteners. This information should not be ignored if proper and lasting repairs are to be achieved. Improper use of fasteners will result in unnecessary future maintenance costs as well as cause an expensive failure that will bring the locomotive back into your shop for additional repairs.

HUCK FASTENERS:

Last year this committee discussed the use of a relatively new cold fastener application for locomotive truck and traction motor gear cases. Because of the economic and holding improvement gain, this concept has found increased favor and its use expanded into accident damage repair among other areas.

The simple insertion procedure proves invaluable for pulling together pilots, steps, hand rail stanchion, carbody components, etc. for alignment or permanent securement.

The hydraulic tool is applied to pull the mating parts together, swage the collar and break the pin-tail—all in approximately seven seconds. The hydraulic power unit is portable, which eliminates its restricted use to only one shop area.

The cold fastener concept has found expanded use in truck repair, application of ACI plates, welded cable receptacle brackets and coupler pocket, while proper tensile bolts are used for coupler carrier iron and pinlifter brackets. This selective procedure will not only provide an initial saving but also a long range saving.

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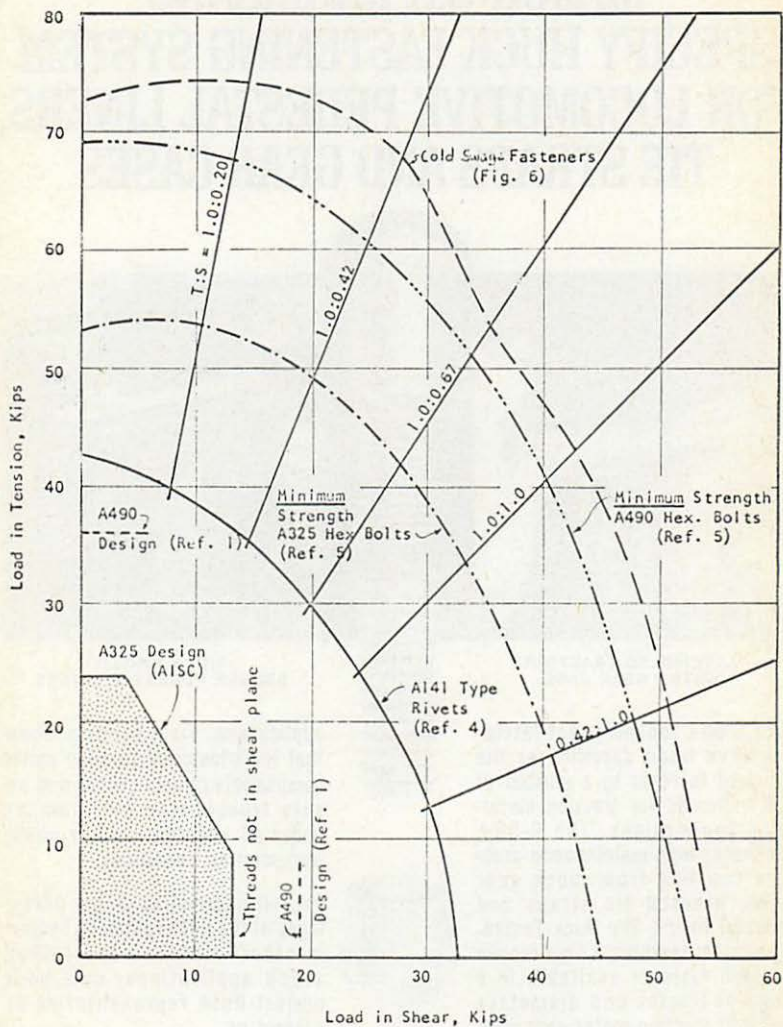
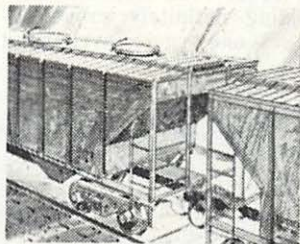
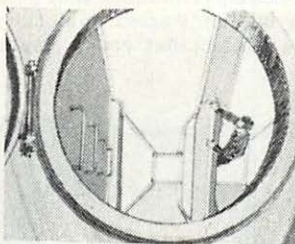


FIG. 9 COMPARATIVE BEHAVIOR OF VARIOUS 7/8 IN. DIAMETER STRUCTURAL FASTENERS UNDER COMBINED TENSION AND SHEAR

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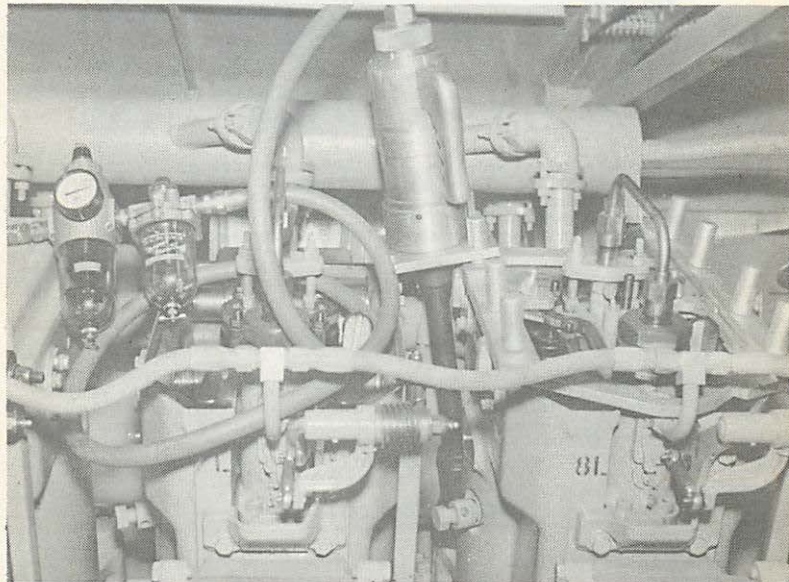
**POWER TORQUE
CONTROL WRENCHES:**
Slide No. 52:

In past years this committee has stressed the need for powered torque control wrenches and the tool manufacturers have responded to an improved degree each year. In addition to the innovations brought out in last year's presentation, here you see a Daiber Co. Pneu-Torque air operated wrench and introduced to the industry through General Electric. This wrench, operates on the principle of a smooth and steady torque which would seem to be an improvement over the impact type stresses on other types of wrenches. This wrench claims a highly precise torque and repeatability. Such tooling definitely proves itself as a money-saver over hand

torque procedures as well as lending a valuable assist towards our stress on the importance of proper fastener application.

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The use of welding cannot be underrated for accident repair damage. Welding techniques, quality and materials have undergone very noticeable improvements in recent years and offer a definite avenue of savings. The use of stick electrode application versus modern semi-automatic wire feed equipment should be as carefully reviewed as any other fastener application. Take a good look at your shop floors and if you find yourself skating on stick electrode stub ends, remember that you are skating on wasted material and production that could just as well be



Slide 52

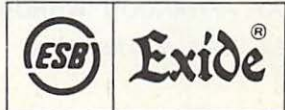
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avoided and brought into the savings picture. If you have any volume type welding at all, a 25% to 50% savings, in addition to improved quality, can be achieved through the use of modern welding equipment being offered today.

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uous wire feed provides an uninterrupted bead which eliminates the possibility of having structural weakness points due to stop and start on the same bead as experienced with stick electrode if the run requires more than one stick electrode. The power supply can be mounted on wheels, generally carries a 25-lb. wire supply spool and has its own torch cooling water supply tank for portability if desired for other than fixed station work.

CONCLUSION:

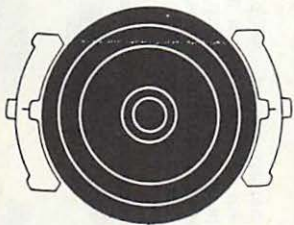
We hope that we have stimulated your thinking sufficiently for an increased talent utilization factor to a degree for handling accident repair damage more efficiently.

PLEASE DO THESE THREE THINGS TODAY!

- A. GET A NEW SUPPLY MEMBER AT THIS MEETING.
- B. TURN TO PAGE THREE (3) OF THIS PRE-CONVENTION REPORT.
 1. THANK these Advertisers as you visit their room. (Where consistent.)
 2. INVITE those NOT LISTED AS ADVERTISERS to participate as Advertisers in the Annual Proceedings. (Where consistent.)
- C. **Special Notice:** We have been challenged to "put more business" in our meeting; accordingly we have scheduled the **Tuesday Afternoon Session to start at 2:00 p. m.**

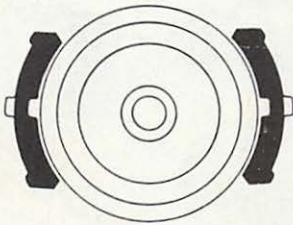
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Tuesday Afternoon, Sept. 15, 1970

2:00 P. M.

REPORT OF THE COMMITTEE ON ELECTRIC M. U. TRAINS

Pre-Convention
Presentation:
PHILADELPHIA RY.
M.U. CAR CLUB



R. P. TURNBULL, Chairman
Committee on Electric M. U. Trains
Manager of Mechanical Engineering
Long Island R.R.
Jamaica, N. Y.

6:00 P. M.
MAY 11
Engineers Club,
1317 Spruce St.
Philadelphia, Pa.

Vice Chairman

R. L. Brittin, Asst. Electrical Engineer-Equipment, Illinois Central, Chicago, Ill.

Committee Members

- W. Butuk, Senior Elec. Engr., Hawker Sideley, Canada, Box 67, Fort William, Can.
H. G. Doyle, Supt. Mech. Dept., Chicago So. Shore & S. B., Michigan City, 46360
P. S. Earley, Assistant Elec. Engr.-Car, Penn Central, Philadelphia, 19104
J. P. Gaughan, Manager - Customer Service, Budd Company, Philadelphia, 19115
J. Byrne, Eastern Mgr., Rail Transp. Dept., ESB, Inc., 25 W. 43rd St., New York 10036
L. J. Hoffman, Elect. Control Sec., Westinghouse Electric, Ave. "A" & West St., E. Pittsburgh 15112
T. H. Moore, Mgr. - Prod. Services, Transit Sys. Dept., Gen. Elec., 2901 E. Lake Road, Erie, 16501
J. R. Pier, Manager - Prop. Equip. Sales - Westinghouse Air Brake, Wilmerding, 15148
R. C. Powers, Supt. - Eqpt., Port Auth. Transit Corp., Lindenwold Car Shop, Lindenwold, 08021
J. H. Ray, Chief Electrical Engr., Erie Lackawanna, Cleveland, 44115
A. P. Stickers, Technical Services Manager, Vapor Corporation, Chicago, 60648
J. L. Swarner, Mgr. Elec. Engr.-Transit, Pullman Standard, Chicago, 60628
C. D. Van Seiver, Mech. Supt.-Transit, Reading, Reading, 19604
G. Vogel, Elec. Engr., St. Louis Car Div., Gen. Steel Inds., 8000 Hall St., St. Louis, 63147



1970 TOPIC:

"EFFECT OF POWER SYSTEM CHARACTERISTICS
ON TRAIN PERFORMANCE"

PERSONAL HISTORY OF R. F. TURNBULL

Robert P. Turnbull, for 15 years, has been with the Long Island Railroad where the emphasis is quite naturally on passenger movement. The Long Island ratio of passenger to freight is about five to one.

Bob is Manager of Mechanical Engineering. In past years, he was Master Mechanic and Superintendent of Shops. He has studied in many schools including Haverford College, Drexel Institute, Gove City College, Lehigh University from where he obtained a degree in Electrical Engineering and C. W. Post College Graduate School of Business Administration.

In addition to his engineering duties, the Long Island also has Bob helping as an in-house instructor, teaching management principles to the middle management of the Long Island.

Bob believes in getting involved. In his church, he is a licensed lay reader. In the local school system, he is chairman of a committee on a Study Team for Educational Progress. He is program chairman of the New York section of the Institute of Electrical and Electronic Engineers. He also serves on the board of the Eastern Car Foreman's Association.

1. **SUMMARY:** Modern electric cars are designed for very high performance. Power supply system is not greatly changed when new equipment is added, often resulting in worse environment for the new equipment. The knowledge and understanding of this environment is essential to the designers and builders of railroad equipment so that they can design more reliable equipment.

This report examines the nature

of the electrical environment encountered in everyday operation of a railroad. It is shown that the power supply and distribution systems are subject to wide and frequent fluctuations from the norm and this, in turn, affects the carborne equipment. The effect of these power irregularities on the propulsion and auxiliary equipment is examined in some detail.

The transient phenomenon in electrical circuits, the voltage spikes and current surges, their sources of initiation, the magnitude and frequency of these transients and the methods to control them are then discussed in considerable detail.

2. **INTRODUCTION:** We are all aware of the problems that have been connected with so many of the newly constructed commuter car fleets. Many of these troubles have been associated with devices whose application are relatively new to railway service. It has also been the case that many of the engineers who design and specify these items were not familiar with railway environment and although their product performed very well in the laboratory, it either did not function properly or promptly failed when placed in field service. Due to the specialized complexity of these devices, most railroad men could not foresee the problems and even though they were in daily contact with the environment, they were not able to warn the designers. Consequently, there have been bitter experiences for both groups.

It is now clearly indicated that education and experienced by both parties is important to the successful operation of these new systems. It is well then that the operators and suppliers become well acquainted as much as possible with

the SALEM line

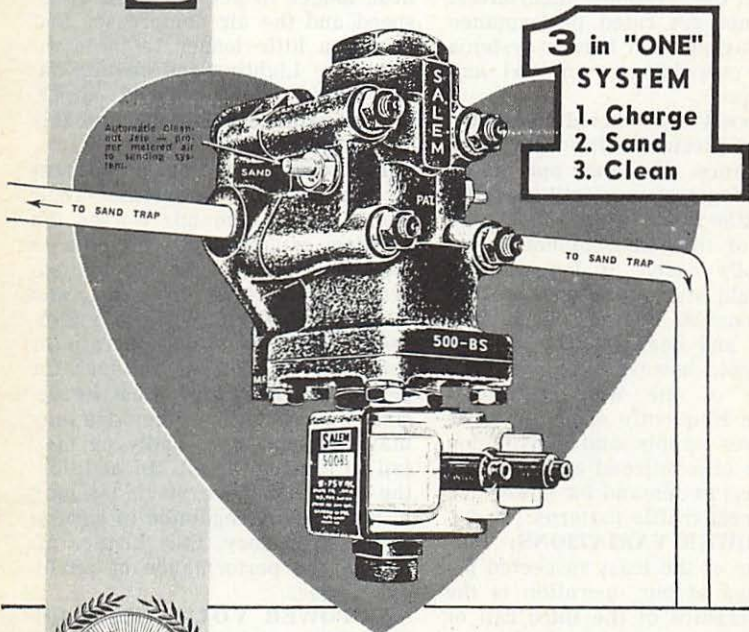


SALEM ELECTRIC SANDING

REPORT
NO. 500-BS

ISSUE OF
JAN. 1, 1965

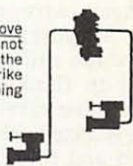
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the normal hazards of our operation.

Almost all systems on M.U. cars are designed to provide rated performance on a certain fixed nominal voltage. However, due to many inherent problems of supplying this constant voltage power at the source, the problems of current collection and also the problems in the systems themselves, we do not get rated performance from various car-borne systems such as propulsion, control and auxiliaries.

The newly constructed commuter cars are designed for very high performance. Yet, they operate on the existing system. Until recently, very little was known about the nature of this environment as no one really cared as long as the cars could start, stop and provide a reasonable degree of interior lighting and heating. The modern equipment, however, is not very tolerant of the wide variations that are frequently encountered in the power supply and distribution systems of a railroad and the wide variations in demand for power due to different traffic patterns.

3. POWER VARIATIONS: Perhaps one of the least suspected peculiarities of our operation is the characteristics of the third rail or overhead wire power supply system. Suppliers who are relatively new to the railway field may be inclined to think that all power sources are rarely interrupted, adequately sized, reasonably well regulated and free of spurious characteristics. This is not the case of course, and a little research on your railroad may produce information that will be valuable to the manufacturer when he is designing the product he expects you to use.

4. LOW VOLTAGE: Take for example, system power voltage. Until the advent of the high-performance cars, no one really cared what the actual value was as long as they could start and stop and get over the road and provide a reasonable degree of interior lighting and heating. If the voltage was not up to standard, it took a little longer to get the train up to speed and the air compressor had to run a little longer to maintain pressure. Lighting and heating devices operated at reduced output, but no damage was done and this was the way of life.

The new cars are not as tolerant to low voltage conditions. Their higher power demands worsen the existing environment. Perhaps most severely affected are line operated converters, inverters and motor alternators. When it is foreseen that these must operate at less than rated input voltages for periods of time, they must be designed accordingly. Otherwise they may overheat very badly or may fail to function at all. In addition, the output of these machines may become poorly regulated in voltage and/or frequency, thus further affecting the performance of auxiliary devices.

5. POWER VOLTAGE FLUCTUATION: Voltage of the system is generally set at the sub-station and it is not difficult here to maintain a tolerance of plus or minus 10 percent. This is not at all the condition that car-borne equipment will find. Voltage drop, in the rails and line, affect this value by as great as 50 percent. The best way to get a clear understanding of the problem is to record "on car" voltage continuously for a period of several weeks. One such record made on a typical section of the



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railroad is shown in Figure 1. The extended low plateaus occurred during the time when a large fleet of cars was on pre-heat in an out-lying yard. Simultaneously the bus voltage at the sub-station three miles distant was also being charted. The extreme condition found there was a 50 volt drop, just a little over 3 percent. During this 30-minute period from 6:10 a.m. until 6:40 a.m., the line potential averages 1223 volts.

Refer now to the constant KW curve of Figure 2. This represents the input amperes to a motor alternator which has a regulated output of 50 KW. At 1500 volts the calculated input current is 44.4 amperes. At 1223 volts, this current value increases to 54.4 amperes. Obviously, this wide deviation from nominal needs to be considered when choosing the size of copper which will be used in motor windings. This point takes on added importance when you consider that heat losses in the armature are proportional to the square of the input current. Of course, armature heating is only one of the problems, motor alternator speed must be compensated over these wide excursions. To do this, the designer must give serious consideration to the magnetic structure of the machine which, along with the copper, is going to affect the total weight and cost.

A constant KW auxiliary system will take the first load off the top of the system and leave the remaining supply for propulsion of the car. This makes the auxiliary system critical of line voltage. In contrast, the constant resistance curve which is typical of a heat load the current varies directly with the voltage.

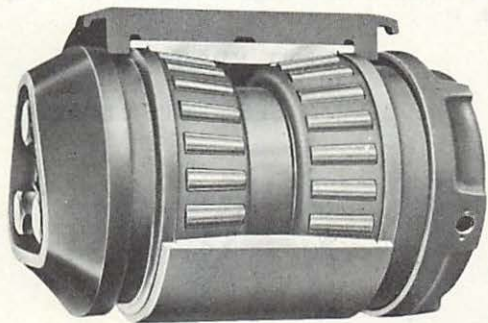
6. INSUFFICIENT AMPERAGE: The second point that we would like to cover is insufficient amperes. This may be a limitation of the sub-station capacity, but conversely may not be. Circuit breakers on the down-stream side of a sub-station are often set to protect the catenary, third rail, and equipment, and must be low enough so that they will not sustain a short circuit or electrical arc to ground at any point in the system. This is a function of the electrical impedance of the system and is generally equated down to a practical figure of how many amperes will flow as a result of a short circuit occurring half way between two sub-stations. Impedance upstream of the sub-station may contribute to these calculations if it allows the output to sag under heavy load.

If system impedance has placed a serious limit on available amperes, your supplier needs to know. He will need to design within this limit or recommend that you firm up your power supply. "Firming up" will also improve the low voltage situation.

A deficiency in amperes will dictate the maximum available amperes per train and the maximum number of cars that can operate simultaneously on a given section of line. The combination will limit traffic flow. Maximum available amperes per train will set the acceleration rate and the speed to which that rate can be maintained unless wheel slip occurs first. However, the latter is not generally found to be the case on properties of long existence since the original systems were designed to power cars which by today's standards offered less performance. Higher rates of acceleration are now de-

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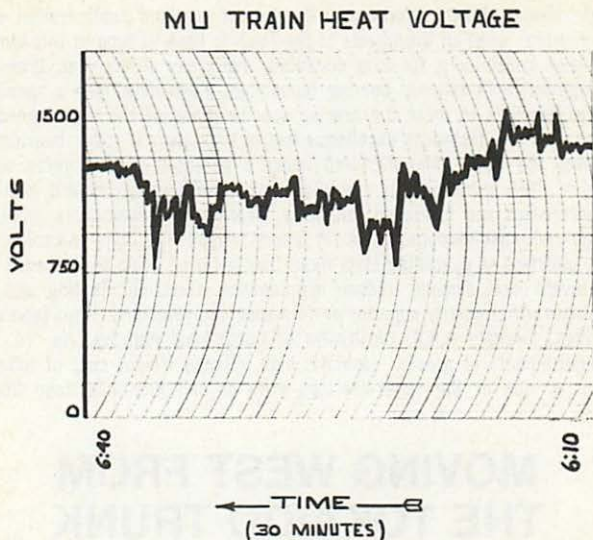


FIGURE 1 — This is the voltage fluctuation as seen by a lay up train on standby heat.

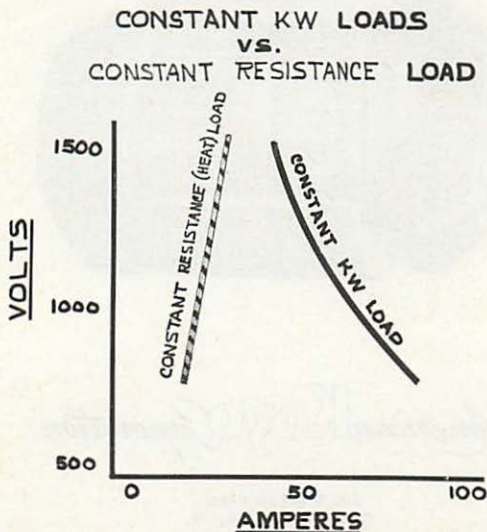


FIGURE 2 — With constant KW load, the current increases as the voltage drops. With constant resistance load (heat load) as the voltage drops, the current decreases.

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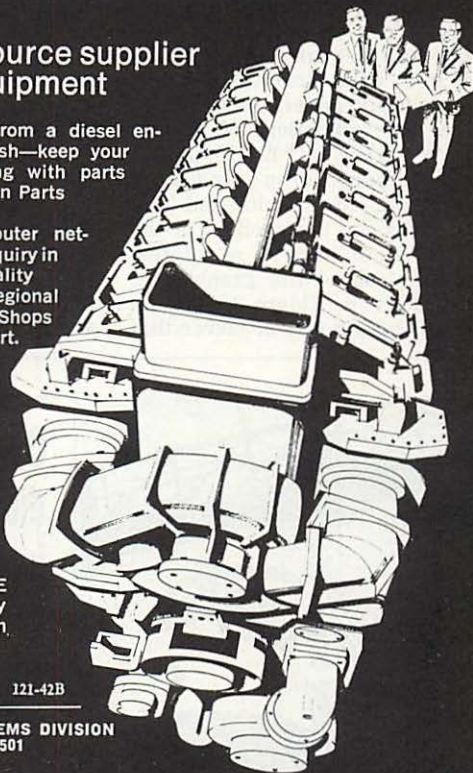
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sired and the increased auxiliary demands such as air conditioning and better lighting and heating add to the load.

The result of insufficient amperes may show up as a new problem with new cars in areas where they are concentrated prior to rush hour traffic. In order to anticipate and possibly forestall trouble, the calculated loads of preheating, pre-cooling and reheat should be investigated with your traffic and fixed property departments to see if there are indications of limits.

7. INSUFFICIENT KILOWATTS: Inasmuch as we have been talking about volts and amperes and since the product of the two is KVA, it may be of interest to you to look at the graphic example shown in Figure 3. This illustrates the amount of power that

is available from the catenary wire at the location where the low voltage conditions occurred on Esterline charts. The straight diagonal line represents the power limit due to electrical resistance of the rails and catenary system extending from the storage yard back to the sub-station which is three miles distant. In this case, the value is .127 ohms. The curved lines represent various levels of calculated KVA. Those portions of the KVA lines which are shown below the diagonal line are available power. The portions shown above the limit line are beyond the capabilities of the system. It is interesting to note that although the sub-station that feeds this system has a rating of 7500 KVA, the resistance of the system limits the available power to 4420 KVA at this location.

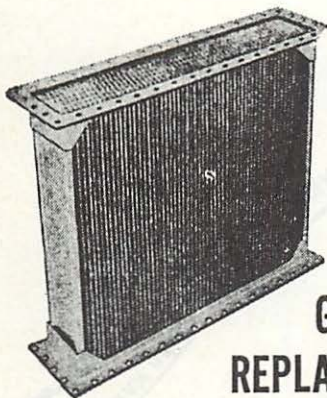


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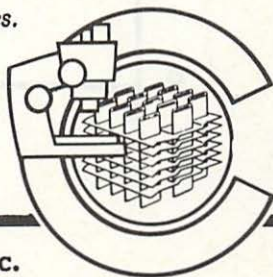
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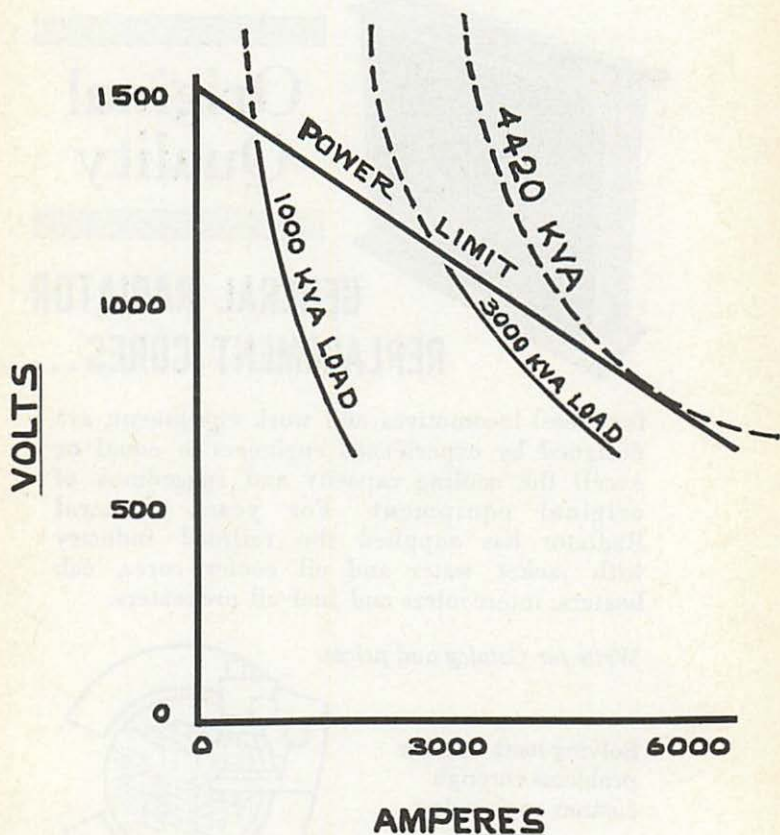
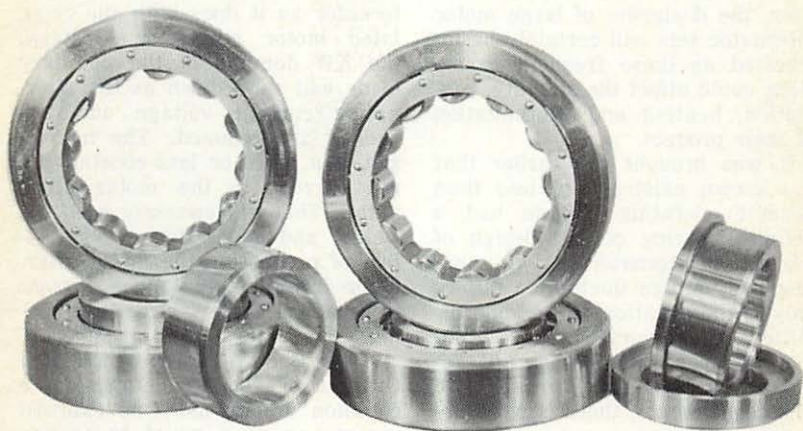


FIGURE 3 — Power available at the car is shown below the Power Limit line. As the car moves further from the sub-station, there is less power available to the car.

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8. SHORT-TIME VOLTAGE FLUCTUATION: There are so many variables that enter into voltage fluctuations such as the number of cars in a consist, the number of trains in a section, and the particular location fluctuation other than that caused by the acceleration current of the train. However, such charts are of value to the supplier since it does furnish him with additional environmental data. Propulsion systems have operated successfully under these conditions down through the years and there is little reason to believe that they will not continue to do so. However, the designers of large motor alternator sets will certainly be interested as these frequent excursions could affect the stability, regulation, heating and commutation of their product.

It was brought out earlier that the known existence of less than normal operating voltage had a definite bearing on the design of the motor alternator set. In some respects voltage fluctuation differs only in the duration of the abnormalities. At the very least, the problem of speed regulation still remains. In an effort to alleviate this requirement, there is work being done now on a motor alternator system that would be free-running, allowing the RPM to change with the line voltage. Rather than attempt to regulate the alternating current output for frequency and voltage, they too would be free-running with the exception that the ratio of voltage to frequency would be held constant within limits. Constant volts per hertz systems are not new, having been used for years on Diesel locomotive auxiliaries and on mechanically refrigerated freight cars. However, the rate of fluctuation is not as great

or as frequent as it will be on commuter cars. It remains to be seen how the induction motors will adapt to these sudden swings. Also to be considered is the battery charger. Since it will no longer enjoy a constant input voltage, it will necessarily be regulated over the operating range. Although this is an added expense, it is possible to regulate more closely than is normally done on a constant voltage system and this will result in better battery performance.

Line voltage drop will not cause the input current to rise on the constant volts per hertz motor alternator as it does with the regulated motor alternator. Instead, the KW demand of the auxiliary loads will slide down as the alternating current voltage and frequency are reduced. The net result is a more or less constant input current to the motor alternator. This will conserve cost and weight and has a desired side effect of preventing the motor alternator from hogging more current from a line that is already drooping.

9. SUB-STATION OUTAGES: Outages or section outages are common among us. One railroad reports an average of 70 section outages for every 24 hours and records a peak day of over 200. The duration of each extends from 8 seconds to one minute. These occur at all hours around the clock, but mainly during rush hours. It is possible for one outage to effect 40 cars and it is possible for one train to experience two to three outages in a single trip. These are sometimes due to traffic flow and sometimes due to defective motors and malfunctioning equipment. The situation pyramids when a number of trains in a dead section all try

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to start at once after the power is restored. Again, it can be said that propulsion systems have learned to live with this, but it may be a new trick for the motor alternator supplier and certainly is a new experience for people furnishing hermetically sealed air conditioning compressors, induction motors and their controls. It would seem that the outage duration and repetition rate would be important as well as the total count. If the interior lighting system takes its supply direct from the motor alternator, it can be expected to blink out when the power fails. This arrangement is not uncommon, nor is it the rule as some properties feel that their customers would not permit this inconvenience. Many new cars will employ all battery lighting. Direct current fluorescent

ballast inverters will be employed in this case. Of course, the battery and charger must be sized to handle the load. The total additional cost per car can amount up to \$3,000 depending on the amount of lighting involved and the protection time desired.

The comments of one railroad's Engineering Department, when reviewing specifications for new cars, includes the following:

"Electrical suppliers are saddling the operating companies with unreasonable requirements. For example, in one proposal for the electrical equipment for new cars, the cars will not function when the voltage drops from nominal 1500 volts to 860 volts. Even when each car is automatically derated from 500 amps to 250 amps to keep the voltage from sagging severely, the

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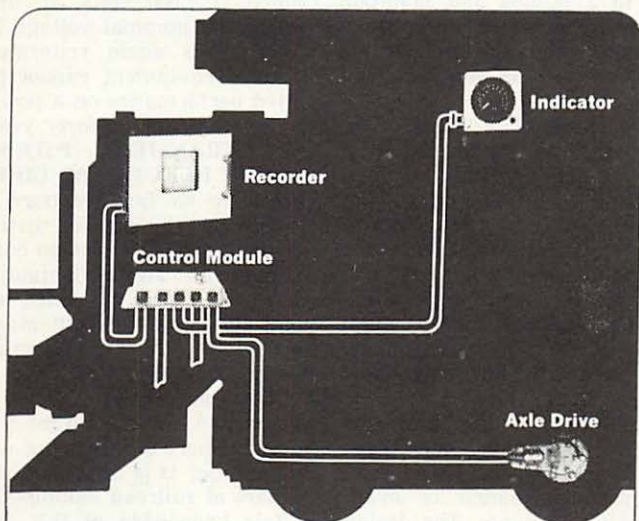
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cars will simply swamp our present power supply. At 500 amps, these cars will only accelerate at 2 mphps but our present equipment which is 40 years old, can accelerate up to 2 mphps and maintain this acceleration up to 30 mph and the voltage can sag all it wants and the car will not stop functioning.

In the course of a typical day, many current demands are of a high order and are only momentary with a resulting voltage sag which is also only momentary. But this new design car which stops functioning at 860 volts, will not tolerate this and puts an unreasonable demand upon capital expenditures for substation capacity that is needed for only short intervals.

Old equipment simply performs at less than maximum under these adverse conditions but normal maximum performance is available most of the time. The design presently put forth by electrical suppliers simply forces an operating company to choose between a horse and buggy day car performance or a gigantic outlay in substation capacity that is used only for peak demands.

Furthermore, it is impossible to visualize all the adverse conditions that will ensue from bunched trains, sub-stations off the line, etc., which will momentarily affect the voltage level when an unusually large number of trains in close proximity try to start at the same time.

WE THINK IT IS TIME THAT THE SUPPLIERS TAKE A HARD LOOK AT THEIR DESIGN AND COME UP WITH SOMETHING LESS THAN OR AT LEAST NO MORE RESTRICTIVE THAN OUR 40 YEAR OLD CARS."

However, it should be pointed out that the IEEE standards indicate that traction equipment should not be expected to operate at 33 1/3 per cent below the nominal voltage which is 1,000 volts, in the case where the nominal voltage is 1,500 volts. This again reiterates that modern equipment cannot provide rated performance on a power supply system that is forty years old.

10. TRANSIENT PHENOMENON IN ELECTRICAL CIRCUITS: We have so far discussed power variations in power distribution systems and its effect on car-borne equipment. These fluctuations in the power are sustained over a long period of time but magnitude of deviation from the norm is relatively small.

There are, however, voltage spikes and current surges that are of very short duration but of large magnitude. It is important that designers of railroad equipment have a fair knowledge of this environment for a more reliable design of the equipment.

"Faults" occur in a power system because insulation at point of fault is momentarily subjected to voltage stress in excess of its dielectric strength. The list of causes of power fluctuation is long and varied. Switching surges from nominal operation is one of the more frequent causes of fault initiation and subsequent line and apparatus outages.

We shall, however, concern ourselves with consequences of occurrence of a fault as far as the system itself is concerned. The circuit is normally energized and carrying load until a fault suddenly occurs. The fault then corresponds to closing of a switch (or switches) in electrical circuit. Closing of this switch changes the circuit so that

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a new distribution of currents and voltages is brought about. This redistribution is accompanied in general by a **transient period** during which resultant currents and voltages may momentarily be relatively high.

As switching circuits (such as modern control and propulsion systems on electric cars) become more complex, nature of these transients becomes more complex and protection against such multiple transients is difficult to carry out. **This makes it clear why this subject of power transients is of**

utmost importance in modern electric cars.

To determine the nature of this transient electrical environment, a number of tests have been performed on several electrified railroads. Several important parameters were evaluated by using various recording instruments. These parameters and data are tabulated along with some conclusions and comments where they seem appropriate.

Following is a list of instruments used and the circuits that were monitored.

Parameter	Instrument	Comments
1. Control voltage	Indicating voltmeter	Manual readout
2. Control transients	6-chnl. transient counter	
3. Third rail voltage	Magnetic tape	Read at car heater
4. Third rail transients	a) Peak reading voltmeter b) Transient recording oscilloscope c) High speed camera	See Figure 6 for Arrangement
5. Traction motor volts	Magnetic tape	
6. Traction motor amps	Magnetic tape	
7. Car speed	Magnetic tape	
8. Car acceleration	Magnetic tape	

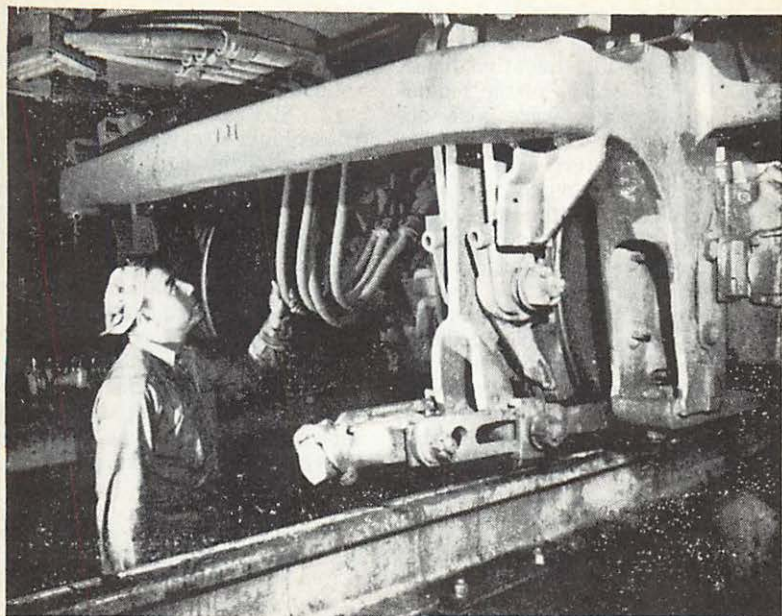
Results obtained from the above instruments are discussed in some detail on the following pages.

11. CONTROL VOLTAGE TRANSIENTS ON M.U. CARS:

Purpose of these tests was to investigate nature of transient voltages encountered in various control circuits. Tests were performed on a 10-car train and a 2-car train to determine if consist of a train has any bearing on magnitude of voltage transients.

Ten-car train was equipped with G. E. SCM control. A peak reading oscilloscope was connected to each terminal of car controller. Control circuits at each terminal were actuated by moving Master Controller handle to an appropriate position.

In monitoring control voltages in a 10-car train, it is important to note that when tests were conduct-



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ed on the plus control line, spikes of 800 to 1,000 volts were observed. These were in the negative direction. Positive spikes of the magnitude of 100 volts were also observed.

On a similar test with a 2-car train, spikes of 1600 to 2000 volts were observed. In attempting to explain why the 2-car train showed higher voltage circulating currents were set up between the 10 cars which acted to reduce inductive transient voltage or that impedance of the wires between the first car and the fifth reduced transient voltages by acting as a voltage divider. Whatever the reason, it is important to note that high voltages do

exist at one point or another under some conditions and are factors to be considered in applying semiconductor devices to these cars.

12. SUPPRESSING SPIKES: These higher transient voltages on a 2-car train can be effectively suppressed. This was done by placing a diode in inverse parallel with the load on a two car train. See Figure 4. In another laboratory test, using a similar arrangement, an 1800 volt spike was reduced to 2 volts.

Since the transients could be suppressed, a semiconductor switch, with arc suppressing diode as shown in Figure 4, was inserted in the controller as shown in Figure 5.

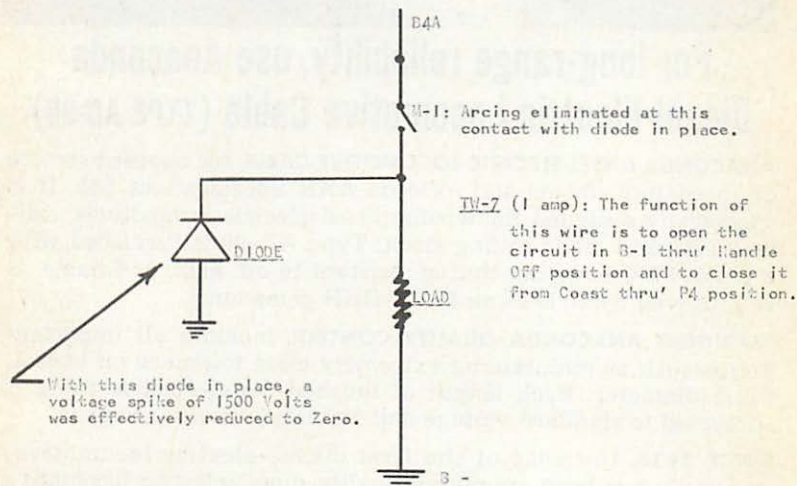


FIGURE 4 — Spike Suppressing Circuit Using A Diode.

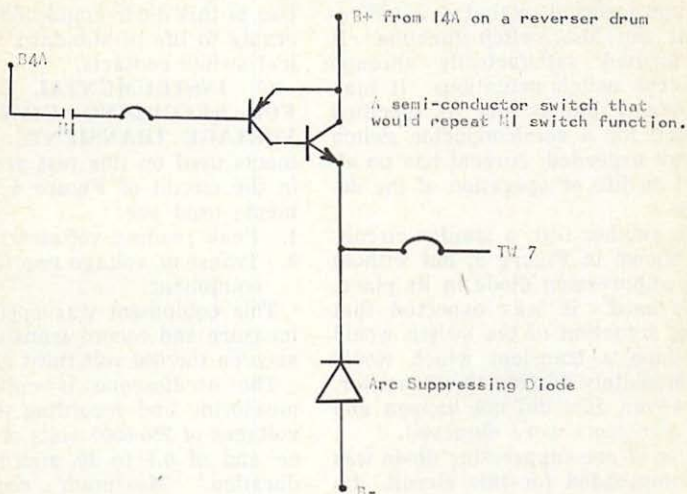


FIGURE 5 — Switching Circuit With Spike Suppressing Diode in Place.

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To accomplish this, TW7 connection was opened and semiconductor switch inserted so that it would repeat the M-1 switch function. It performed satisfactorily through several switch actuations. It may be noted that as long as specified rating for a semiconductor switch is not exceeded, current has no effect on life or operation of the device.

In another test, a similar circuit, as shown in Figure 5, but without arc suppressing diode in its place, was used. It was expected that first actuation of the switch would produce a transient which would immediately destroy the transistor. However, this did not happen and no transients were observed.

Use of arc suppressing diode was recommended for this circuit. Its absence may allow transients to

destroy the semiconductor device operating into an inductive load. Use of this diode could add considerably to life of standard mechanical switch contacts.

13. INSTRUMENTAL CIRCUIT FOR RECORDING CONTROL VOLTAGE TRANSIENTS: Instruments used on this test are shown in the circuit of Figure 6. Instruments used are:

1. Peak reading voltmeter.
2. Transient voltage recording equipment.

This equipment was operated to measure and record transient voltages on the 600 volt third rail.

The oscilloscope is capable of measuring and recording transient voltages of 250-6000 volts crest value and of 0.1 to 10 microseconds duration. Maximum recordable duration of voltage transient was

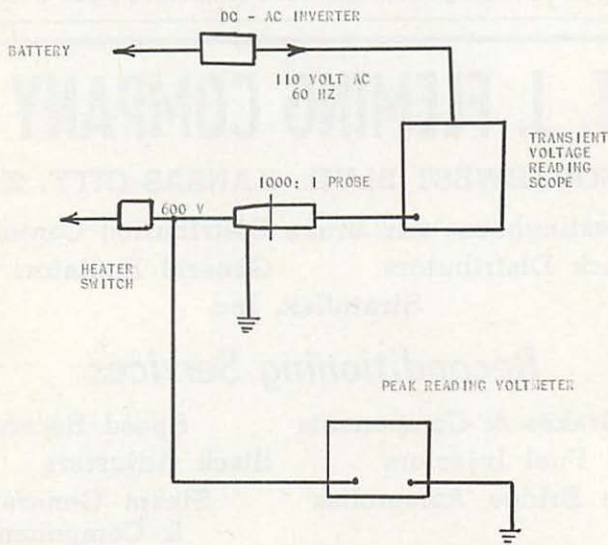


FIGURE 6 — Schematic Diagram for Measuring Control Voltage Transients.

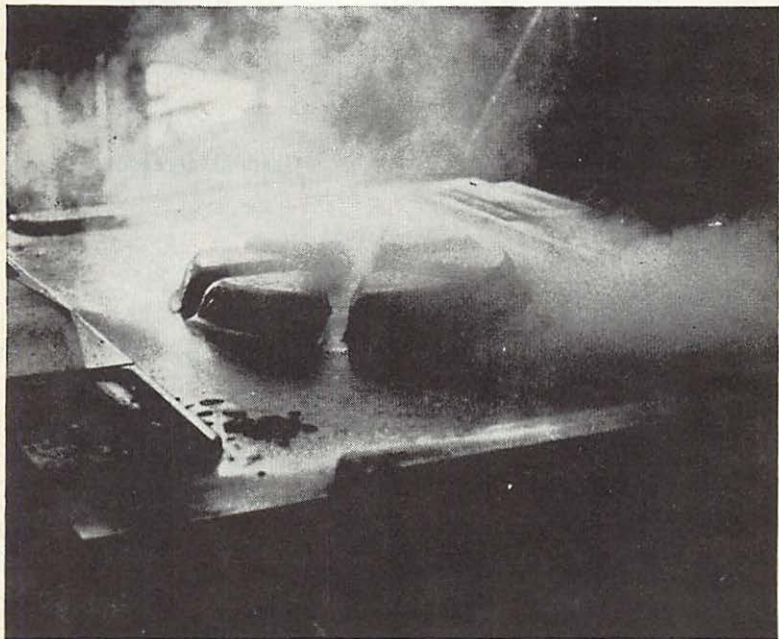
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20 or 100 microseconds depending on preselected sweep speeds.

Peak voltmeter had a measuring range of 300 to 30,000 volts. This meter operates such that transient voltages of positive or negative polarity charge a capacitor and apply it to grid of an inverted triode such that negative charge at plate of triode reduces current drawn by the positive grid. 0 to 1000 volt range setting was used during these tests.

14. **THIRD RAIL TRANSIENT VOLTAGE (NOMINAL 600 VOLTS):** Following table shows magnitude of transient voltage peaks observed on third rail. Time note for a single pulse is for one complete cycle while those for oscillatory type pulse is for one-half cycle only.

It would appear, in general, that single pulse transients are of much shorter duration than those of oscillatory type.

TABLE 1—Transient Spikes From the Power Circuit

Peak Voltage	Duration Micro-secs.	Single Pulse	Oscillatory Pulse	Comments
710	1.0		X	
710	20.2	X		
730	3.65	X		
750	2.73	X		
750	0.1		X	
750	100	X		Gradual Increase & Decrease
760	15.1	X		
780	1.0	X		
790	3.1		X	
800	2.1	X		
800	5.02	X		
800	0.3	X		
810	2.7	X		
810	29.6	X		Slow decay
820	3.7	X		
840	3.3	X		
850	1.9	X		
850	15.0		X	Slow decrease
930	9.5	X		
970	5.8	X		
980	0.12		X	
1000	1.13		X	
1010	1.6		X	
1020	1.47		X	
1060	2.1	X		Slow build up
1120	44	X		
1220	100	X		Slow build up
1230	11.1	X		Slow build up
1240	65	X		Slow build up
1280	20	X		Slow build up
1660	21	X		Gradual increase

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15. **THIRD RAIL VOLTAGE FLUCTUATIONS AS READ ON PEAK READING VOLTMETER:** Following readings were manually read from a peak reading voltmeter. It may be noted that these are the transient readings with a pre-

set sweep. Obviously, it cannot be determined from voltmeter readings if transients are of a single pulse or oscillatory type. Data in Table 1 complements the following data in this respect.

TABLE 2—

Sweep (micro seconds)	Range of Voltage Read	Sensitivity
100	600 - 620	1 Kv/cm
100	610 - 740	1 Kv/cm
100	590 - 740	1 Kv/cm
100	650 - 900	1 Kv/cm
20	725 - 825	1 Kv/cm
20	675 - 800	1 Kv/cm
20	550 - 850	1 Kv/cm

16. **TRACTION MOTOR ENVIRONMENT:** In Tables 1 and 2 we have noticed extent of voltage spike and fluctuation on a third rail.

In the following table, note that peak current drawn by each motor is fairly constant, whereas difference between meter voltage and

line voltage is as much as 200 volts. Currents recorded are those for two motors. This was due to space limitations in installation of current measuring transducers.

17. **TRACTION MOTOR ENVIRONMENT (CURRENT MEASURED FOR TWO OF FOUR MOTORS):**

TABLE 3—

Max. Third Rail Voltage (600V nominal)	Min. Third Rail Voltage (600V nominal)	Max. Motor Voltage for One Motor	Max. Motor Armature Amps	Max. Speed M.P.H.
565	440	440	900	39
460	320	340	900	30
600	460	440	900	47
490	260	380	900	62
620	600	480	900	24
560	430	420	880	33

18. **CONTROL VOLTAGE TRANSIENT WAVE FORMS:** In data summarized in these tables, we have seen nature of transients at the source and manner in which this "Fault" at source affects Pow-

er System. However, nature of these transients is not limited to the source and the power systems alone. Consequences of power fluctuations in low voltage circuits are even more pronounced.

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Figures 7, 8, 9 and 10 show typical wave forms observed for battery noise, P-6 switch operation, door operation and emergency relay.

19. CONCLUSION:

1. All manufacturers of component parts that go to make up an electric car, must design their equipment so as not to reflect back onto the electrical ecology any rubbish in the form of electrical noise. This is a 2-way street. It is just as important that they do nothing to reflect any spikes or surges into the environment as it is that they must be self-protecting against any of the spikes already on the system.

2. All sub-components on cars must be self-protecting so far as voltage spikes and current surges are concerned. All cars are put to-

gether as a group of black boxes. The vendors who build these black boxes must be more aware of the electrical environment in which their hardware must operate. It is up to these vendors and the car builders to see to it that they know what this environment is.

3. In all car construction, it is important that the "ohms to ground" be specified in finite terms. The total electrical system has now become so comprehensive that the enormous scope of it makes it mandatory that components be specified rather than the entire system. Because all electrical components of any system are placed in parallel, total resistance continues to decrease in accordance with law for resistances in parallel. This is why it is important that we specify the resistance

BATTERY NOISE

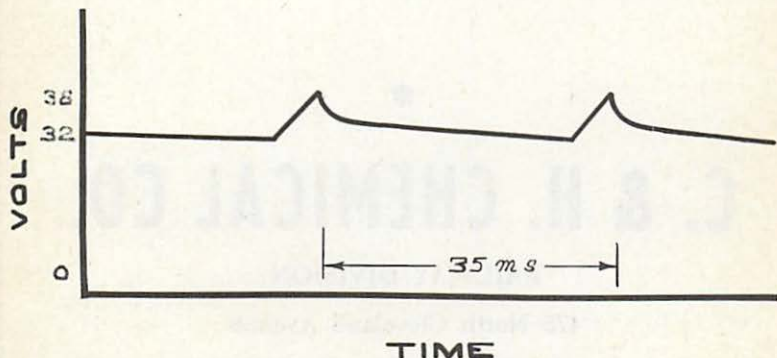


FIGURE 7 — There were 6 volt spikes recurring at 35ms interval.

P-6 SWITCH OPERATION

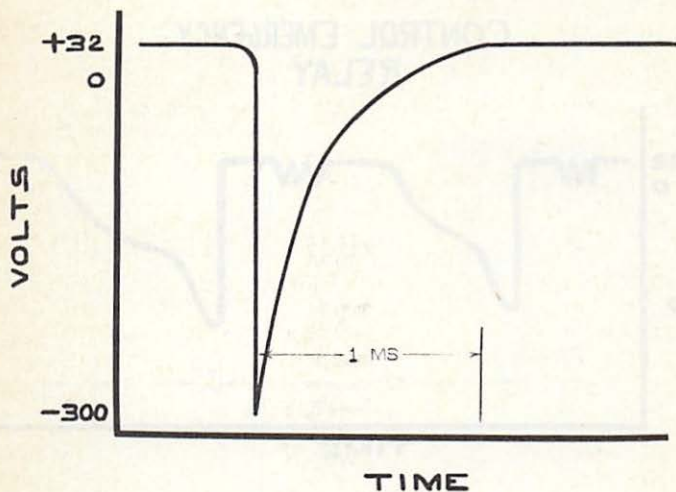


FIGURE 8 — The P-6 switch was turned 'on' and 'off' with the resulting wave form as shown above. The TW-26 was grounded from opposite end of car by turning Cineston 'on' and throwing reverser key on.

DOOR OPERATION

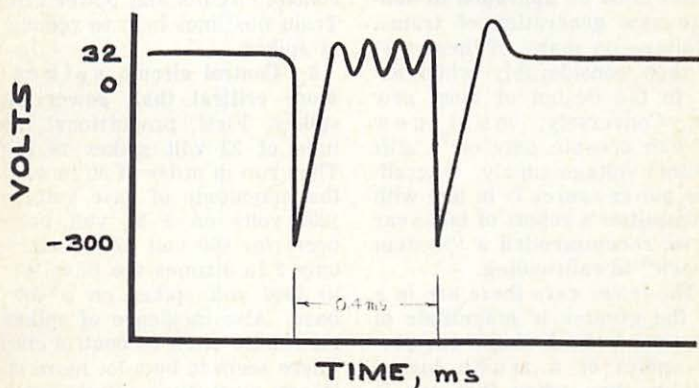


FIGURE 9 — Control voltage spike caused by a single pair of doors.

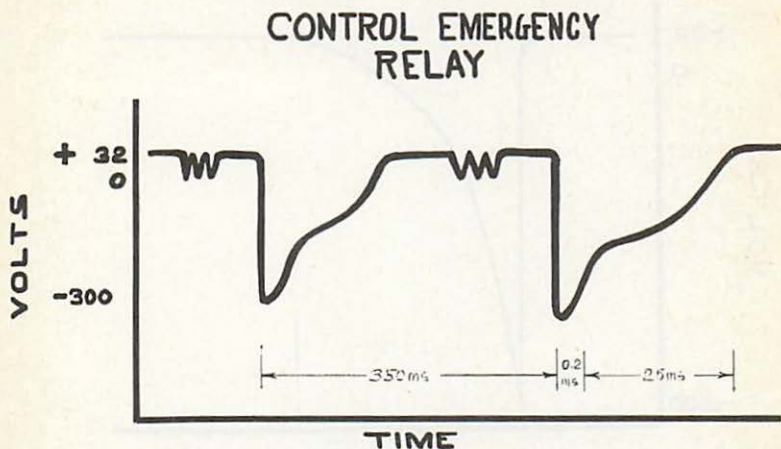


FIGURE 10 — With emergency trip held in emergency and Cineston in re-set position, the above cyclic wave form was observed. Something seems to be cycling, perhaps a relay in the emergency line.

of the components. What we are trying to control is the total resistance of the car.

4. Present power systems (Sub-Stations) must be upgraded to handle the new generation of trains. The voltage on many of these systems sags considerably when exposed to the design of most new trains. Conversely, most new trains can operate only on a stiff (constant) voltage supply. Upgrading the power source is in line with this committee's report of last year when we recommended a "System Approach" to railroading.

5. The fewer cars there are in a train, the greater is magnitude of spikes produced. A single car produces spikes of a much higher magnitude than when that car is in a train. In trainlined circuits, magnitude of spikes is inversely

proportional to train length. Where cars are in pairs, their spikes are greater than the same cars in a ten car train. This is true in both control circuits and power circuits. Train bus lines help to reduce size of spikes.

6. Control circuit spikes are more critical than power circuit spikes. First, proportional magnitude of 32 volt spikes is higher. They run in order of 30 to 40 times the magnitude of base voltage ie: 1200 volts on a 32 volt base. A norm for 600 volt power circuit is only 2 to 3 times the base ie: 1200 to 1800 volt spikes on a 600 volt base. Also incidence of spikes occurs more often on control circuits. There seem to be a lot more spikes in any given time. Perhaps one of the reasons for higher amplitude of spikes is that there is less hard-

ware in the circuit to absorb the energy and the voltage continues to rise without some sort of a sink to absorb them.

7. It may become necessary in the future that some railroads will change from 25 cycles to 60 cycles as a source of power. It will be necessary that adequate testing be done in order to discover any elec-

trical disturbance in advance in order to avoid switch over problems when they take place.

8. Before the Car Builders can be held responsible for the proper equipment, it is necessary that the railroads themselves study the environment that exists on their property.



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Mr. R. G. Clevenger, Chairman L.M.O.A. Committee, Diesel Electrical Maintenance, gave our Club in regular meeting May 4, 1970, a very interesting Pre-Convention Presentation on "Major Locomotive Electrical Problems — 1970." He was assisted by 12 members of his committee in a lively discussion period. Registered attendance 101. We thank the L.M.O.A., Mr. Clevenger and his committee for the excellent program.

For full information as to membership and schedule of meetings, write to the Secretary-Treasurer.

Tuesday Afternoon, Sept. 15, 1970

3:30 P. M.

REPORT OF THE COMMITTEE ON DIESEL ELECTRICAL MAINTENANCE

Pre-Convention
Presentation:
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6:00 P. M.
MAY 4, 1970
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Union Station,
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Committee on Diesel Electrical Maintenance
Supvr. of Locomotive Maintenance,
A.T.&S.F. Ry. System,
Topeka, Kan.

Vice Chairman

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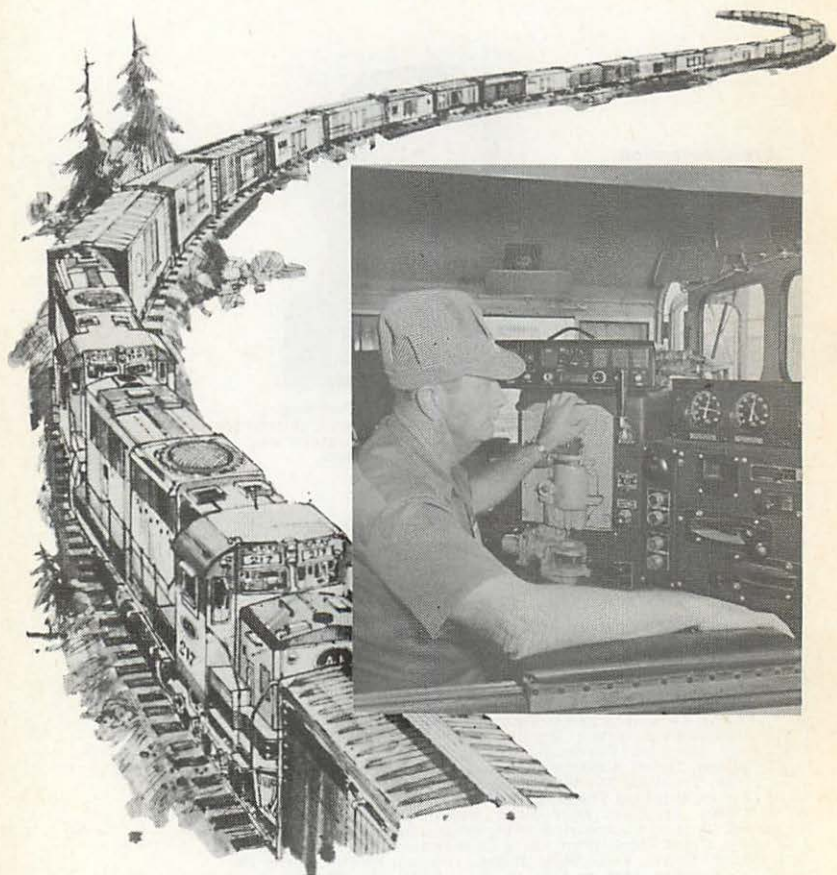
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J. H. Ray, Chief Elect. Engr., Erie Lackawanna, Cleveland, Ohio
D. I. Smith, Supvr. Field Serv. Engrs., General Electric, Erie, Pa.
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PERSONAL HISTORY OF R. G. CLEVINGER

Chairman of the Diesel Electrical Committee, R. G. Clevenger, was born on December 4, 1922 in Kansas City, Kansas. He attended different schools in this city, graduating from Wyandotte High School in 1940. While attending Kansas City Kansas Junior College in 1941, World War II started and cut short all formal education because of enlistment as a Naval Aviation Cadet, with training being done at different bases around the country. On May 17, 1944, Mr. Clevenger was awarded his naval wings and commissioned as Ensign in the U. S. Navy with primary duties as a Naval Pilot. On this same day he married his wife, the former Mary Evelyn Nirschl and they now have three children. After being commissioned he was assigned to a Patrol Squadron operating off Attu Island in the Aleutian Islands, Alaska, as a Naval Pilot of a four engine patrol plane.

After being discharged at the end of World War II he went to work as an Electrical Apprentice for the Santa Fe Railroad in San Bernardino, California. He completed his apprenticeship in March 1950 and worked as a Journeyman Electrician until August 1, 1953 when promotion to Electrical Foreman was made. On January 1, 1964 he became Foreman in charge of the Traction Motor Shop second shift at San Bernardino and remained there until December 1, 1966. On this date he was transferred to Chicago, Illinois as Assistant to General Supervisor Diesel Engines (System) and on February 1, 1969 was promoted to Supervisor of Locomotive Maintenance with headquarters at Topeka, Kansas which is his present position.

1. DIESEL ELECTRIC LOCOMOTIVE: As we start into the last one-third of the 20th Century, the diesel electric locomotive dominates the prime mover picture completely. The gas turbine electric locomotive threatened for awhile but fell by the wayside because of its voracious appetite for fuel, high initial cost of the prime mover and unreliability of accessories. The straight electric locomotive has become increasingly attractive, but continues to stand off to one side waiting for the right combination of economics to justify the original large investments.

The diesel electric is dominant and will continue in this position for some time, but it does not give the railroads the performance that is desired and sorely needed by them, in their constant endeavor to lower operating costs.

The D-C electrical system has always been complicated, requiring time consuming trouble-shooting which is often less than effective. Many of the problems develop after the locomotive has passed beyond the warranty limits with the result being a further burden on the railroads and a raising of their cost for maintenance.

This year this Committee will endeavor to suggest means of performing certain phases of this maintenance. The railroads in the past have usually gotten helpful information the hard way with the result that many railroads often spend a considerable amount of money before they hear of a possible fix for a particular problem.

Availability is still the key word with locomotive maintenance personnel and with the present day locomotives of 4000 horsepower (M LW Worthington), 5000 horsepower

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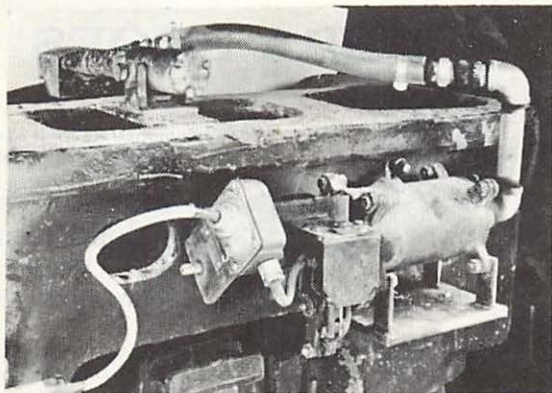
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(GE) and 6600 horsepower (EMD) it becomes increasingly more so.

2. POWER CIRCUITS: MAIN GENERATORS: Although the alternator is beginning to replace the DC generator on new locomotives being manufactured, there are still a considerable number of generators in service on the railroads today.

3. SHORT ARMATURE LIFE: EMD D-32 GENERATORS: One of the mostly widely used models in use today on EMD locomotives is the D-32 generator and several railroads have been reported as experiencing short life on the armatures in these generators.

After approximately 600,000 to 700,000 miles of service, the failure rate caused by grounding of the armatures has increased at a higher rate than other types of failures.

The armatures showed signs of being overheated for a considerable length of time and coil wedges could be removed from coil slots by shoving on them with your fingers.

EMD was contacted in regard to this problem on GP-35 locomotives, which resulted in their issue of Advance Memo No. 35 that removed the PTR function and reduced the D-32 continuous current in parallel.

This in a sense would lower the continuous current being experienced during the life of these generators, that was resulting in overload and overheating.

THIS COMMITTEE RECOMMENDS THAT RAILROADS USING THIS TYPE OF GENERATOR, CONTACT THE MANUFACTURER AS SOON AS POSSIBLE SO CORRECTION OF THIS PROB-

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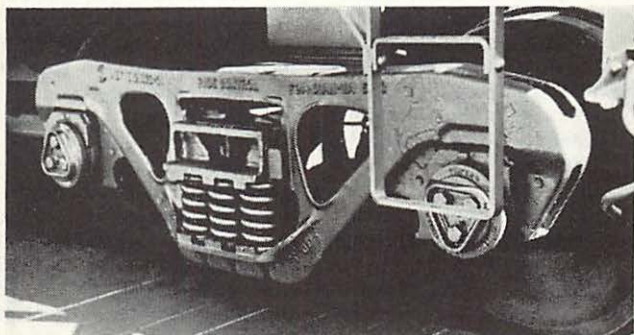


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4. BRUSHHOLDER TROUBLE ON EMD D-32 MAIN GENERATORS: Another source of trouble reported on the D-32 main generator centers around the use of the original constant pressure brushholders. Many railroads complained of trouble with these brushholders and they are looking to EMD for recommendations as to what to do about them.

One railroad represented on this Committee reported they presently have several D-32 generators operating with the old style brushholders. No problem has been had with this set up and further operation will show whether this is a possible solution. Since additional new locomotives are being purchased utilizing this type of generator,

your Committee feels that EMD should definitely do something towards the elimination of this problem.

5. BRUSH GROOVING ON GE-GT 598 MAIN GENERATOR: On the General Electric GT569 main generator being used on the U-28 locomotive, concern was expressed by one railroad because of the brush grooving experienced on the commutator. A method of staggering the brushes was devised to overcome this problem. Six brushholders were modified as to the spacing of the brushes on each brushholder which resulted in the loss of one brush per holder. These brushholders were then placed in alternate positions in the main generator thus creating a brush pattern that overlapped and eliminated the brush grooving.

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It is thought that the added load placed on the remaining brushes after eliminating one brush on every other brushholder has resulted in better commutation. All commutators were jig stoned to remove previous brush grooving before the modified brushholders were applied.

6. EMD-AR10 ALTERNATORS — LOOSENING OF WEDGES ON ROTOR COILS: The alternator as presently used in the diesel electric locomotive, has resulted in the manufacture of locomotive units capable of delivering horsepower not possible with the D.C. generator. These alternators have proven to be an extremely reliable machine to date and relatively free from failures.

One of the railroads represented on this Committee, has recently

experienced four (4) failures of the AR10 alternator with approximately 600,000 miles on each one of them. The wedges holding down the coils on the rotor have loosened up allowing the rotor coil to slip off of the pole piece and strike the stator of the alternator. EMD has been contacted in regard to this problem and they feel that a loss of cooling air is causing the flaring of the coil, resulting in it striking the stator.

7. G.E. ALTERNATOR — FAN FAILURES ON GTA-11: The alternator presently used on General Electric and MLW locomotives has proven as reliable as the AR-10 used on EMD locomotives. One railroad has experienced some fan failures on their MLW locomotives while another railroad has lost two (2) alternators and three (3) sets



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of diode panels due to the loss of cooling air. This loss of cooling air was caused by failure of the drive shaft between the alternator and the equipment blower. Because of this problem, all locomotives in their fleet required the change-out to an improved drive and coupling between these components. This coupling is being applied to all G.E. units being built at this time.

8. TRACTION MOTOR FLASH-OVERS: Traction motors have been discussed in previous papers and, because of their importance to the successful operation of the diesel electric locomotive, deserve additional discussion at this time.

One railroad is still encountering a large number of flashovers on their GP and SD-40 units, some with field shunting and some with-

out. It is their thought that a lot of their trouble was connected with the brush being used and they are presently making a change in this direction.

THE RAILROADS AS A WHOLE REPRESENTED ON THIS COMMITTEE FEEL THAT THE ELIMINATION OF FIELD SHUNTING BOTH IN SERIES-PARALLEL AND PARALLEL MOTOR CONNECTIONS, ALONG WITH A CHANGE TO A HIGHER SPEED GEAR RATIO, HAS BEEN THE ANSWER TO THE PROBLEM OF FLASHOVERS AND TRANSITION TROUBLES.

Several railroads are modifying their older locomotives to full field operation and at the same time are applying the 2400 volt diodes to the AR-10 to compensate against

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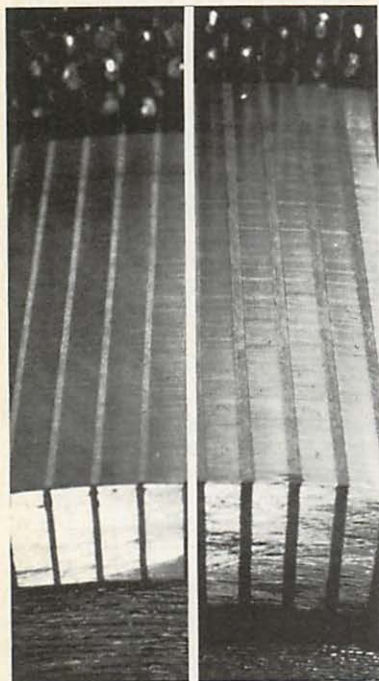
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loss of horsepower at the higher end of the speed range.

9. CHANGE OF GEAR RATIO — THE ANSWER TO MANY TRACTION MOTOR PROBLEMS:

As stated previously, the change in gear ratio is regarded by many railroads as the way to go to eliminate many traction motor problems. One railroad that has made quite a study of traction motor failures stated that on SD-40 locomotives with a 59/18 gear ratio they removed 1% of the traction motors in a twelve (12) month period. On a group of SW-40 locomotives with a 62/15 gear ratio they removed 22.7% of the traction motors in a twelve (12) month period. It was also shown that about a 20% increase in brush mileage per 1/8-inch of wear could be expected when going to the 59/18 gear ratio.

10. TRACTION MOTOR BEARINGS:

In last year's report, we discussed a method of testing and reclaiming bearings as done by one of the member railroads. This year another railroad has furnished information relative to bearing problems being encountered on the SD-40 locomotive being used in heavy drag service. A total of seventy-nine (79) motors were checked with a total mileage of 17,196,928 miles or 2,263 months of service. The average service mileage was 217,683 miles or 28.6 months. All the traction motors removed experienced some form of bearing problem, with the majority of them being seized bearings. Figures one (1) thru four (4) illustrate the condition of some of the bearings removed during this reporting period. Two traction motors that had ac-

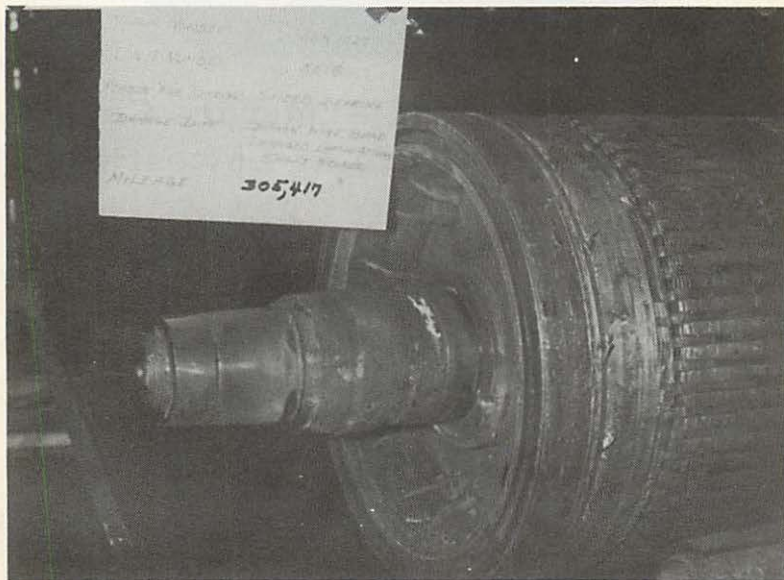
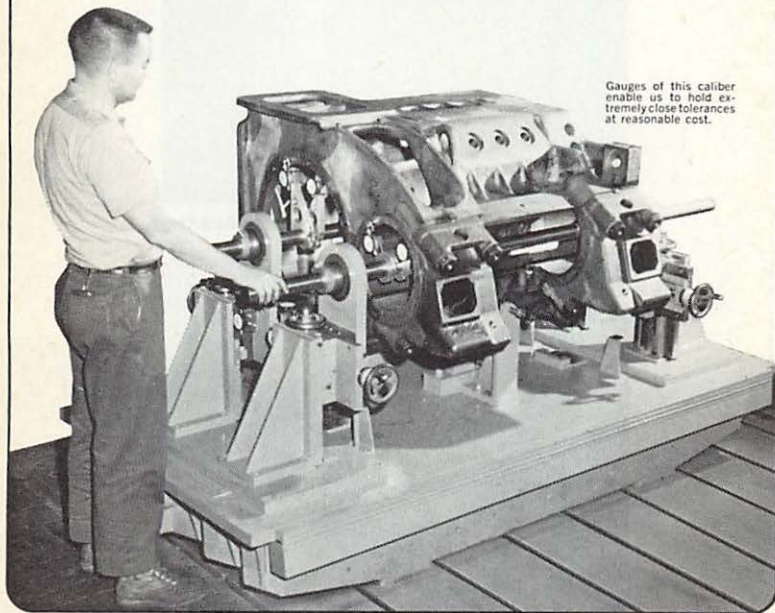


FIGURE 1 — No. 11 Traction Motor Bearings.

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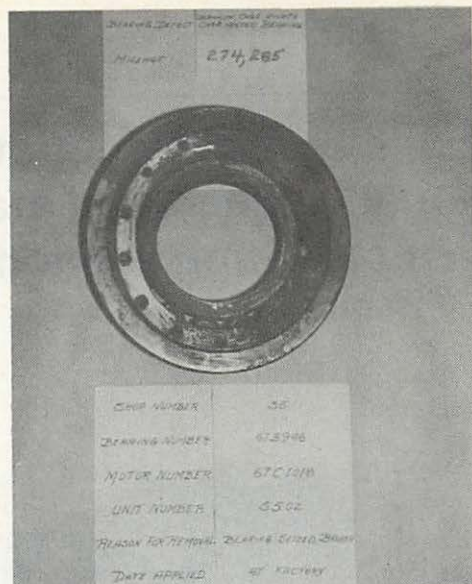
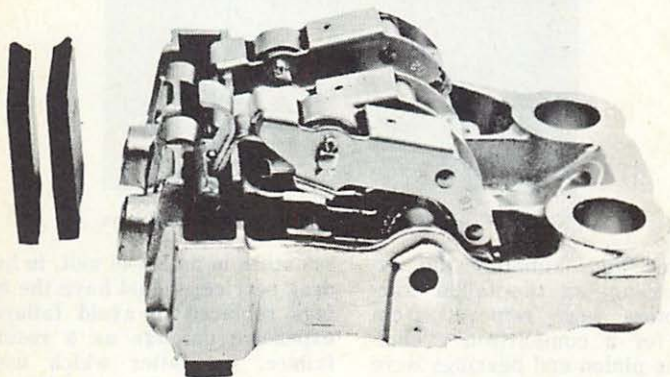


FIGURE 2 — No. 11 Traction Motor Bearings.



FIGURE 3 — No. 11 Traction Motor Bearings.

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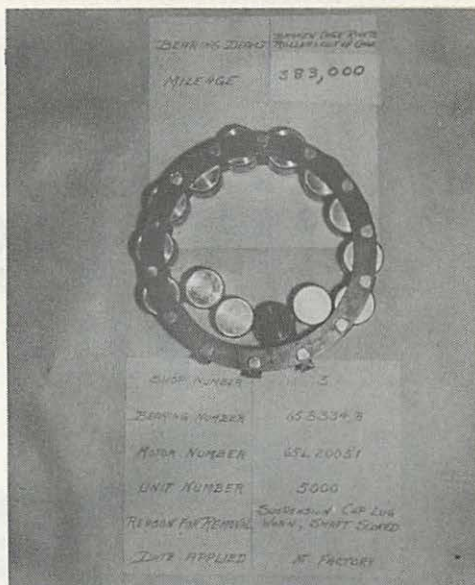


FIGURE 4 — No. 11 Traction Motor Bearings.

cumulated approximately the average mileage of the failed traction motors were removed from service for a comparison evaluation. The pinion end bearings were found to have all the rivets loose, some rollers out of cage but rollers and inner races in good serviceable condition. The commutator bearings had pitted races and rollers with indentations and the inner race showed signs of shelling. On one of the pinion end bearings, the inner and outer races were good, but a very sharp build-up of metal on the outer extremities of the trapezoidal trunnions, indicated that the rollers had been running with the loose trunnions for a considerable time.

In view of these findings, this railroad feels that traction motors having accumulated 200,000 to 250,-

000 miles in an SD-40 unit, in heavy drag service, should have the bearings replaced to avoid failure or expensive damage as a result of failure, the latter which usually results in train delays and necessitates costly replacement. This Committee asks, "What is being done by the manufacturer to correct this problem?" and "What is a respectable mileage to expect from a traction motor bearing?"

IT WAS NOTED DURING INVESTIGATION THAT IF THESE MOTORS ARE USED TO ANY DEGREE IN A STANDARD UNIT, MUCH LONGER LIFE COULD BE EXPECTED FROM THE BEARINGS. THIS INDICATES THAT THIS TYPE OF OPERATION IN CONJUNCTION WITH WHEEL SLIP PROBLEMS AND RESULTANT WHEEL SHOCK MAY BE

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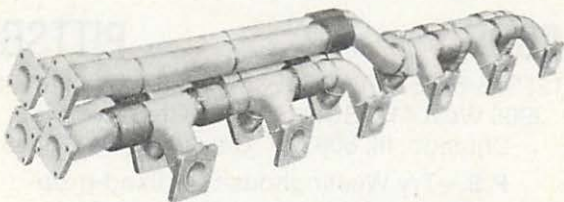
11. **DYNAMIC BRAKING:** On those railroads on which the use of dynamic braking is a necessary and important part of their operation, considerable concern is expressed over the failure rate of grid blower motors. This practically always results in the destruction of the grids resulting in high maintenance costs and out of service time for the unit during the repair process.

On one western railroad, this has been an extremely critical point in regard to their operation and has resulted in several modifications being performed on their SD-45 locomotives. Failure of the lower bearing in the grid blower motor is believed to be the reason for practically all of the motor fail-

ures. This is the result of the extremely high temperatures found at this point, brought about by its close proximity to the engine exhaust manifolds.

12. **SOLUTION TO GRID BLOWER MOTORS:** At the present time, these grid blower motors are being encased with a metal cover with air from the traction motor blower being blown over the grid motor thus lowering the ambient temperature at this point. At the same time, all grid motors are overhauled and have the lower bearing applied utilizing a much higher temperature grease. The constant pressure brushholder is removed and replaced with the old style brushholder, which is much better built brushholder and able to withstand a higher heat range. **ALTHOUGH THESE OLD STYLE**

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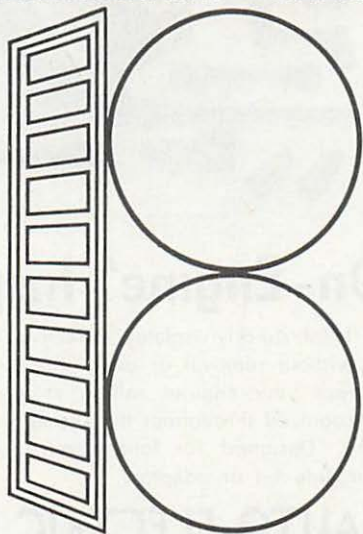
BRUSHHOLDERS CAN BE PURCHASED FROM EMD AND ARE RECOMMENDED BY THEM, WHY DO NEW GRID MOTORS ON NEW LOCOMOTIVES CONTINUE TO BE EQUIPPED WITH THE CONSTANT PRESSURE BRUSHHOLDER?

A very simple modification was made by one of the railroads represented on this Committee, which is believed will help in lowering the ambient temperature at the grid blower motor. A 6" x 12" hole was cut in the bulkhead between the engine compartment and the radiator cooling fans directly over the engine governor. This was done on an SD-35 locomotive and allowed the radiator cooling fans to pull the hot air and gases from the engine room, which resulted in a lower temperature in the engine

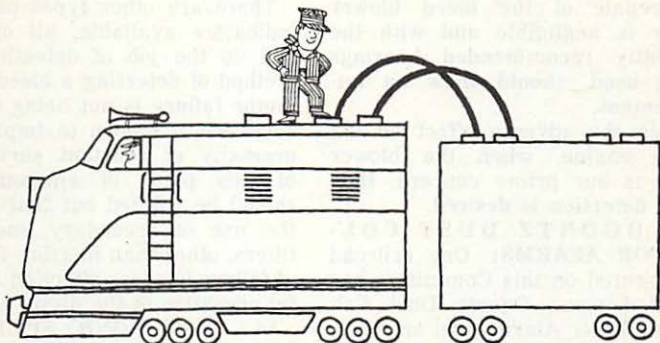
room. A unit modified in this fashion was placed on load test and temperatures taken before and after modification. The result was a temperature of 320°F before modification at the grid blower motor and a temperature of 200°F after modification. The 120°F drop in temperature, it is believed, will afford a cooler running grid blower motor with the final result a longer running motor.

13. CONTROL AND SUPPORT EQUIPMENT.

14. AIR FILTER BLOWER MOTOR FAILURES: Many railroads have been plagued with failures of the inertial air filter blower motors or commonly called "bleed blower motors." The failure of this one motor, if not detected in time, can cause damage to the diesel engine requiring a considerable amount of



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time and money to repair.

Practically all the failures of this motor are the result of bearing failure. The cost and down time for the repair of the bleed blower motor is negligible and with the presently recommended bearings being used, should show an improvement.

Since the adverse effect on the diesel engine, when the blower quits, is our prime concern, then early detection is desired.

15. **OGONTZ DUST COLLECTOR ALARMS:** One railroad represented on this Committee has installed some Ogontz Dust Collector Blower Alarms and are presently testing them. The device is installed in the discharge side of the blower fan and will protect against both motor failure and reversal of rotation. There is a two

indicator light panel installed near the engineer, a white light indicating power to the alarm and a red light to indicate failure.

There are other types of failure indicators available, all of which will do the job of detection. The method of detecting a bleed blower motor failure is not being dictated here, but is shown to impress the necessity of constant surveillance of this piece of equipment. It should be pointed out that through the use of secondary engine air filters, other than inertial, this type of failure has less effect on successful operation of the diesel engine.

16. **ELECTRONIC SPEED RECORDERS:** Electronic speed recorders are now being used on many railroads, but like many things in the electronic field, have not been free from problems.

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There are a number of different types on the market, namely, General Electric, Barco and Vapor Speed Log, with similar difficulties showing up in each type. The General Electric type mentioned is a speed indicator only.

Practically all railroads using electronic speed recorders are satisfied with the speed indicator part of the equipment, **BUT ALL EXPRESS THE NEED FOR MORE RELIABILITY IN THE RECORD-ER PART OF THE EQUIPMENT.**

17. VAPOR SPEED LOG: One of the railroads represented on this Committee was instrumental in the development of the Vapor Speed Log and presently have 179 units equipped with them.

One of the major problems they encountered was the loosing of the gear case mounted sensor. After

several modifications to correct this, they are now equipping their units with the axle mounted sensor which is a much more satisfactory arrangement.

18. ANALOGUE SPEED INDICATOR: There have been many complaints from the crews in regard to digital type speed indicators and it is the opinion of this Committee that the Pointer Type Speed Indicator is the one desired by most people. **THIS COMMITTEE RECOMMENDS THAT THOSE COMPANIES PRESENTLY MANUFACTURING ELECTRONIC SPEED RECORDERS SHOULD PROVIDE THEM WITH A POINTER TYPE SPEED INDICATOR.**

19. GROUND PROTECTIVE RELAY:

Operation of a diesel electric lo-



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comotive without a Ground Protective Relay (GPR) should never be considered for obvious reasons. However, the proper method of resetting this relay is not so obvious, yet this reset function is very much a part of the protection cycle. In order to establish a reset procedure, causes of relay trip must be investigated.

GPR trips can be divided into two general classifications; transient faults and permanent faults. Reset following transient fault will result in normal operation while reset against a permanent fault will result in additional tripping and maintenance is required before normal operation is resumed. In fact, the difference between the two types of conditions is usually determined by the results of GPR resetting. It must, therefore, be concluded that after a trip, the GPR must be reset to resume normal operation in the case of a transient fault and reset enough times within a given period of time to establish the existence of a permanent fault. The reset procedure should, therefore, meet these qualifications:

- A. Time between trip and reset.
 1. Sufficient to allow diesel engine run down to return to idle speed.
 2. Sufficient to allow cooling of parts in case of high power flashover.
 3. Minimum amount of time to satisfy 1 & 2 but no longer, so that tractive effort of locomotive is regained as soon as is safely permissible.
- B. Number of trips necessary to define a permanent fault.
 1. A definite number of trips within a fixed period of time should define a per-

manent fault, and further reset of the relay should be prevented.

2. Trips spaced beyond a certain time interval should not be accumulated toward the definition of a permanent fault. Methods in use and proposed, deserve consideration and are grouped as follows:

- A. Manual operation on a per unit basis.
- B. Manual operation through the use of a train line.
- C. Automatic operation on a per unit basis.

Manual operation on a per unit basis requires a man to walk through the consist to reset the GPR. If the engineer does the resetting or law prohibits moving from locomotive to locomotive while train is in motion, train stoppage is necessary. This type of operation meets requirements A1 & A2, fails to meet A3 and with diligent record keeping will meet B1 & B2.

Train line resetting fails to meet any of the qualifications. Information and control, concerning individual units is completely lacking. Consider a four unit consist crossing a rough section of track. Unit #1 has a flashover, the bell rings and the engineer presses the reset button. While he has the button pressed #3 flashes, trips the GPR, but the reset circuit is closed. The relay chatters with all sorts of transients being developed, which can result in damage to control circuits and other parts. **TRAIN LINE INSTALLATION IS ECONOMICAL BUT THE OPERATION CAN BE COSTLY.**

The automatic ground protective relay reset (AGPRR) applied on a per unit basis, meets all the re-

quired qualifications. The reset timer is adjusted to meet requirements A1, A2 and A3. The lockout memory circuits meet requirements of B1 & B2. Operating power is applied only when the BPR trips, so life of the unit equals the shelf life of solid state components. Operation eliminates the human factor and assures consistent operation for maximum utilization of the locomotive. When the AGPRR locks out, the manually operated reset button must be pressed to recycle the unit.

Several recommendations have been brought forward for the manufacturers to consider in the design of new and more effective ground relay systems. These are:

1. Able to detect AC grounds.
2. Able to detect single phase operation.
3. Able to protect as much equipment as possible preferably not placed at positive, negative or center power circuit extreme positions.
4. Connected as close to generating power plant as possible to eliminate possibility of short circuit nullifying ground detection.
5. Fast action—to reduce flash-over damage.
6. Sufficient sensitivity to protect equipment but not allowing nuisance grounds such as moisture leakage to cause ground relay operation.

20. **POWER DIODES:** There has been a question for some time regarding the requirements of a routine check of power diodes on the AC powered locomotives, with emphasis being placed on the U-33 power.

The use of the indicating fuse in EMD units gives the maintenance man a reasonable visual indication

of the condition of the diodes. With the General Electric units, four (4) to six (6) diodes can be out-of-service, with no visual indication of any defect. If the defective diodes are all in one panel, the remaining diodes are overloaded and can be expected to have accelerated failure rate.

Defective diodes can be located by an individual check, but one railroad reports the quickest method is to use a "Tong" test ammeter on the lead of each diode, using a short circuit cable across the DC positive and negative terminal of the panels. It must be noted that care must be exercised during this operation since dangerous voltages may exist.

With throttle in #1 position a current of about 2000 amps will be developed in the diodes with approximately 75 to 80 amp load on each diode circuit.

This test along with an open circuit voltage test on a 90 day inspection, should provide a reasonable means of diode inspection and failure control. The labor time involved should not exceed one man hour per test.

The loss of cooling air to diode panels can result in a complete failure of the diode panel as explained previously in this report. **THIS MUST NOT BE ALLOWED, BECAUSE SOME FAILURES OF THIS SORT HAVE RESULTED IN EXPENDITURES OF \$20,000 OR MORE WITHOUT COUNTING THE LOSS OF SERVICE TIME OF THE LOCOMOTIVE.**

There are three ways of detecting the loss of cooling air, as follows:

1. A simple air flow or vacuum switch, such as used with direct fired gas burners.
2. A rotation switch, such as used

to stop and position heavy electrical rotating units. Each unit to have a signal and cut out circuit to warn and cut off equipment power.

3. A 1% temperature switch mounted on Generator Frame or Diode Panel to sense rising temperature.

21. **GE-U33 LOAD CHARACTERISTICS:** It has been determined by load box testing of U-33 General Electric locomotives, that some units will not deliver full horsepower due to the restriction of excitation caused by the governor load potentiometer being pinned in the maximum excitation position caused by control limitations.

This condition results in the governor backing off on the fuel control limits to balance the horse-

power output of the unit to a value below its rating.

To correct this condition, the following check and setting procedures are suggested:

1. Check all cards
2. Check ACCR
3. Check battery charging voltage and set at 74 volts.
4. Check engine speeds.
5. Set General Electric Type #17EM55 engine load box in Position 2-4.
6. Engine fuel rack should be set to 21.5 MM for standard operating conditions at 3300 horsepower.
7. With throttle in Position #8 and engine loading, the voltage current reading should be 3200 amps and 1155 volts plus or minus 3% with load pot at the 5° position.

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8. The reference current can be checked and will usually be found to be between 32 and 36 milliamperes, for a U33 locomotive. Other model locomotives may have slightly different values. If the excitation adjustment rheostat, MLR, is set at this time the load pot can be positioned to the 5° position, with 3300 horsepower input to the alternator.
9. If necessary to increase the reference current above 36 mills in an effort to position the load pot at 5 o'clock, the current limit should be checked to determine the performance of the ACCR reactor.
10. To make a check of the current control, set the load box to position 8-8, represent the IR line, and increase loading until the proper current limiting is observed. For a B unit, the current will be between 4250 and 4500 amps. Voltage will be about 100 volts. On a C unit, there will be slightly different performance figures, as shown in the builder's manual. With the current control properly set by means of MLR, the reference current can be noted and recorded. If current control is above the maximum and cannot be set properly, change out the ACCR and recheck the unit.

Some railroads have installed a spare control reactor ACCR in the load box cables, at the locomotive. Thus, if trouble is experienced, the locomotive control wiring can be transferred to the spare reactor to compare its performance with the one installed on the locomotive. This is much simpler than changing out the locomotive reactor if it is thought to be defective.
11. A final open circuit voltage check should always be made, checking and setting maximum voltage, after MLR has been properly set.
 - A. Open circuit load box — close generator field switch.
 - B. Advance throttle to position #1 and observe meters.
 - C. Advance throttle slowly, watching main voltmeter. Do not let voltage exceed the desired limit. If excess voltage is reached in a notch less than notch 8, it usually means that the voltage control system is not in the circuit. Make sure that the GA high voltage feedback wiring has not been disconnected or damaged when load box cables were attached to the locomotive. If voltage is present at the load box connections, but not at the excitation panel itself, (terminals BE plus and AK minus) the test must be discontinued until this fault is corrected. If full excitation is applied, with no voltage control action, the voltage will rise to a value that will cause extensive damage to the rectifier panels.
 - D. With control properly functioning, the control point can be noted and adjustment P22 can be set on the voltage control card. This adjustment is most easily made if a card extender is used, but it

can be done without one, by returning the engine to idle and the adjustment made on a cut and try basis.

22. **FAILURE DETECTION:** A reliable means by which shop maintenance personnel can establish what malfunctions have occurred in a diesel unit during over-the-road operation is needed, keeping in mind that one of the biggest problems in trouble shooting on inbound reported problems is defining what the engine crew has reported on their work reports; such as bells ringing while in dynamic braking or unit not loading properly "etc." The information provided is vague, at best.

Annunciators and monitoring equipment is very important and this equipment can be placed on

board the locomotive for continuous analyzing of various functions during normal operation over the road. With the ever increasing costs of labor and materials the value of on board indicating equipment should prove to be invaluable by permitting ready track operations to be manned with the minimum personnel possible.

Although several manufacturer's names are included in this report, we in no way endorse any particular product, but only point them out as an aid to more reliable operation of our maintenance facilities.

23. **ANNUNCIATORS — G. E.:** Annunciator type alarm systems have been developed by both EMD and General Electric Company to monitor various locomotive fault conditions and to provide mainte-

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nance personnel with ready information as to what type of faults have occurred on the locomotive during its most recent operation.

The General Electric system does not incorporate a separate annunciator panel. It consists of the installation of relays in the control compartment which have, as a part of themselves, an indicating light. The installation also includes a master indicating light located on the engine control panel in the operator's cab. When an event occurs, the latching type relay in the control compartment is energized and an indicating lamp on the relay is lighted. The operation of the relay in the control compartment also lights the master indicating light in the operating cab. There is a latching relay for each event and each one will cause the master

indicating light to turn on and remain lighted.

When a maintenance crew finds the indicating light on in the operating cab they can determine in the control compartment which one or more of the latching relays has been activated by a particular fault and thus are aided in determining what corrective action is needed on the locomotive. Typical events which can be recorded in this fashion are generator overload relay operation, ground relay operation, dynamic brake warning, blower failure, hot engine alarm, low oil pressure, crankcase overpressure, engine paper filters plugged, low water and locomotive overspeed.

The signals to trigger the latching type relays are presently initiated by the devices which furnish

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alarm lights or signals to the engineman. However, other events using various types of transducers to furnish an alarm signal can be incorporated in the system.

24. ANNUNCIATORS: E M D : The EMD system differs from the General Electric system in that all of the fault indications are grouped together in one compact annunciator panel, which also includes a light test switch and a reset switch. Each event on the panel is incorporated on a plug in type light and relay board. Two lamps in parallel are used for indications as an extra safety factor. A picture of a panel installed in a locomotive electrical compartment is shown in figure five (5).

As with the General Electric System most of the signals are initiated by existing alarm devices or

transducers on the locomotives.

25. IBM 1800 DATA ACQUISITION & CONTROL SYSTEM: One of the major railroads in the United States today has recently contracted with IBM for equipment to go on twenty (20) new locomotives being built for them. This equipment is designed to record the performance of 96 operating functions of a diesel locomotive and eventually will be extended to cover its entire fleet of 1,247 locomotives. This equipment involves an IBM 1800 data acquisition and control system and is referred to as "the little black box." It can record such items as exhaust gas temperature, lubricating oil temperature and pressure, engine cooling water temperature, frequency of electronic component functions, throttle position, "etc."

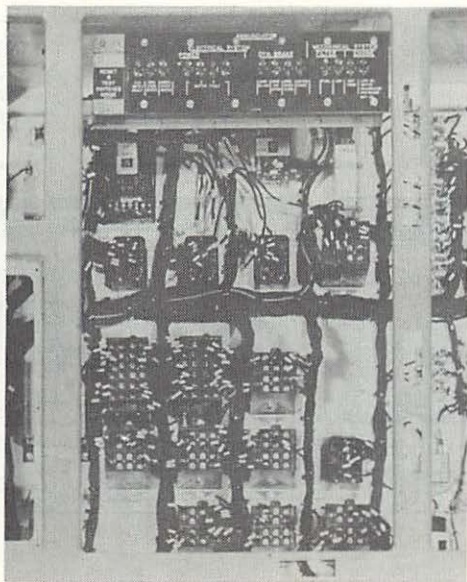


FIGURE 5 — No. 24 Annunciators—EMD.

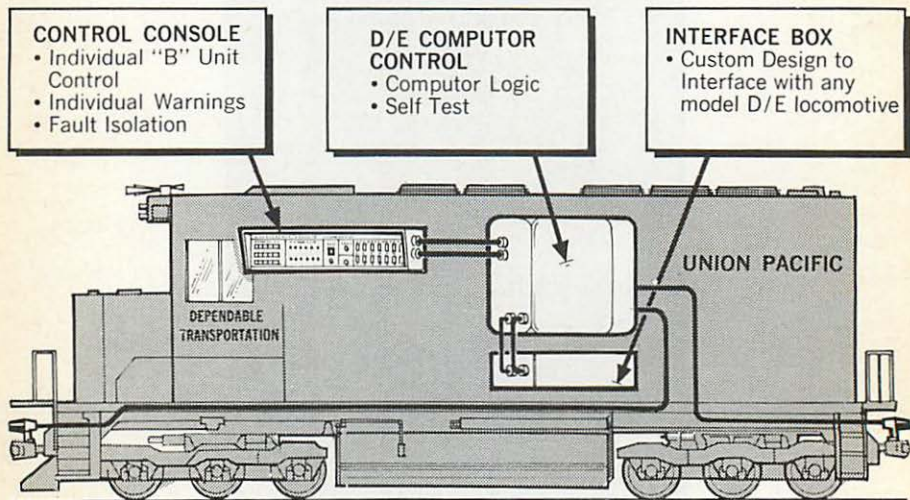


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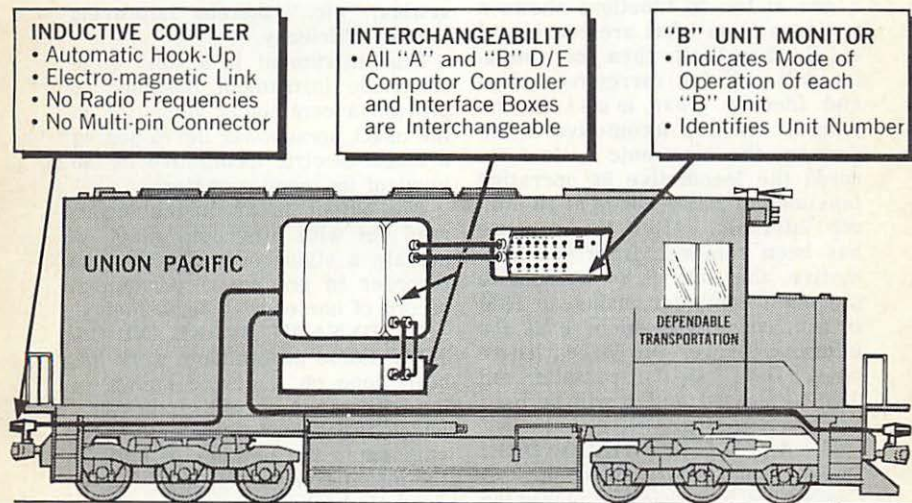
AUTOMATIC LOCOMOTIVE COUPLING eliminating jumper cables and train lines . . . reducing operating costs.

ENGINE ISOLATION for individual control of "B" units in a consist . . . any one may be reverted to "IDLE" Mode with others operational . . . assures safe operation.

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ISOLATED GROUNDS in each unit to prevent inter-unit short circuits and ground problems.



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Information will be recorded on magnetic tape utilizing the cassette or cartridge type tape packet. The cassette or cartridge will be removed from the on-board installation at strategic locations and transferred to computer tape for storage and further use. It is intended that the equipment will provide means for determining not only the condition of the equipment, but the extent to which the equipment is used to the fullest capability. It is expected to be able to determine future power requirements, as well as to establish more realistic maintenance schedules.

This system will work on the exception basis, in other words, the computer will monitor all of the information contained on a cassette and if everything is satisfactory there will no print out. However, if one of the 96 functions shows a variance from what are considered satisfactory limits then the computer will call for corrective action and identify what must be repaired. When a locomotive is underway, the electronic system records the locomotive 96 operating functions in 2.25 seconds at 30 minute intervals. After the cassette has been removed from the locomotive, the data is to be sent to the main computer, using an IBM transmission unit which reads the information over the telephone lines. Data on the cassette will then be erased and it will be used again.

26. AUDN POWERFINDER: One railroad represented on this Committee has recently placed an order for the Audn Powerfinder, a

horsepower indicating — recording instrument, which they feel will offer considerable versatility to their operations.

The regional diesel supervisors, with the aid of this instrument, will be able to reliably confirm the operation of the power plants during over-the-road operations, from which they will be able to shop units when required and proceed directly to the repair function, rather than lose the time currently being encountered connecting, analyzing, disconnecting from the load box, thus enhancing locomotive availability.

With this type of equipment and proper coordination, all annual form units could be checked out under operating conditions several days prior to shopping, thus eliminating the need for mechanics performing pilot valve injector rack setting, "etc.," thereby improving overall efficiency.

This instrument is a solid state electronic instrument designed to provide a continuous indication of the exact horsepower developed by a diesel electric locomotive at the input of its traction motors.

The output is an instantaneous read out with provisions made to actuate a stylus or magnetic tape recorder to produce a permanent record of horsepower performance.

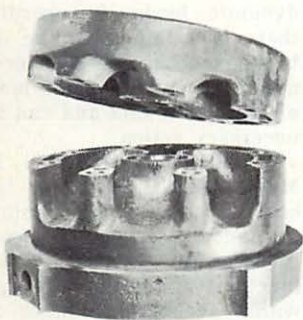
27. DYNAMIC BRAKE INDICATOR: Some preliminary work has been done on a device known as the "Dynamic Brake Indicator," which is designed to indicate to the engineman the number of units in the locomotive consist in which the dynamic brake is functioning. Similarly, the device may be made to

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also indicate the number of units which are loading.

The device would operate on the principle of the magnetic field surrounding a current carrying cable operating a magnetic reed type switch, causing the switch to close when current passes through the cable. Two reed type switches are attached to the cables from the pairs of traction motors to the dynamic brake grids. A third switch is necessary in the case of the SD locomotive (and a switch is required for each motor on some of the older power). The reverser must be in either the forward or reverse position to energize either the RHS-F or RHS-R line, which in turn triggers a 2N2270 transistor, bringing the indicating meter into the circuit. Thus, the indicating meter on the control unit will be the only one in the locomotive consist which will be in the circuit.

For each unit in which the dynamic brakes are operating, continuity is established through the reed switches attached to the dynamic brake cables and a certain current flows in trainline wire #19 and through the indicating meter on the control unit. For each additional unit in the consist in which the dynamic brake is operating, a like additional amount of current will flow through the indicating meter. The indicating meter, being a current type meter, will give a deflection proportional to the number of units in which the dynamic brake is operating.

The reed switches (sensing unit) may be adjusted to actuate on any desired amount of current flowing in the dynamic brake grid cables, by the alignment of the switch with respect to the cable. A value of 200 amperes would be a suggested actuating value for the dynamic

brake sensing units. If the unit loading indicating feature were desired, a value of 600 to 800 amperes output of the main generator would be a suggested value to actuate the sensing device.

The Dynamic Brake Indicator would advise the engineman of the number of units in which the dynamic brake is operating, from which information, he could make the necessary air reduction where conditions require. With this device, the operation of the dynamic brake would be known and would be applicable to an operation wherein maximum operating speeds are dependent upon the number of units upon which the dynamic brake is operative. If there is a failure of the dynamic brake on one of the locomotive units, the engineman is made cognizant of this fact and can take the necessary action.

28. FLAGGER-ON BOARD MONITORING: Flagger is an on board system which monitors performance of a running locomotive. It determines that various key functions of the unit are operating within acceptable ranges and records on a Visual Display when a malfunction occurs. The Flagger system also has the capability to flag ahead to report the status of the running equipment by means of an optional External Indicator mounted on the side of the locomotive which is read and handled by the ACI Scanner.

A Flagger system consists of the following:

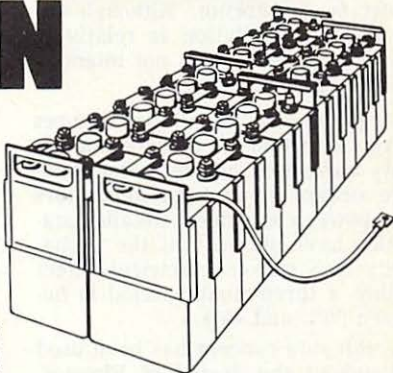
- (1) Signal Processing Unit for nine functions.
- (2) Display Unit with ten indicators (one to advise trouble in another unit of the consist).
- (3) External Indicators (optional).

For complete technical data on —

EDISON

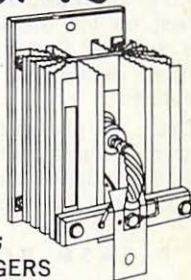
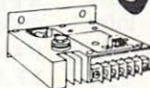
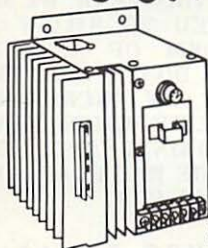
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In use, the Flagger system would be permanently installed in a locomotive for the purpose of real time, constant monitoring. Although the system installation is relatively straight forward, it is not intended to be a portable tester.

A permanent installation insures early detection of defects and allows correction before major damage occurs to motors, generators and power contactors. Detailed statistics have shown that the probability of a serious electrical defect within a three-month period is between 30% and 40%.

A fail safe concept has been used throughout the design of Flagger. The system monitors motive power performance on a passive basis. A circuit failure in the Flagger electronics will not impact motive power performance.

29. **SEARCH:** Although Search equipment is not an on board locomotive analyzer, it has been reported on for the last two years, and we feel that up-to-date information should be given on this equipment.

There are presently nineteen (19) Search operating sites with a total of 3,100 equipped locomotives. Approximately 7,600 locomotive tests

have been completed at a rate of 400 tests per month.

Although this is not a complete picture of how the use of Search equipment is increasing, it does show that the use of technical equipment for trouble shooting the electrical system of today's locomotives is increasing.

It might be pointed out that any new locomotive purchased with Search equipment can be checked out completely before leaving the manufacturing plant. Both General Electric and EMD have Search machines in operation and are capable of doing this.

— S U M M A R Y —

IN CONCLUSION, THIS COMMITTEE FEELS THAT IN THE PAST, TOO MUCH HAS BEEN SAID ABOUT PROBLEMS AND THEIR CORRECTION AND NOT ENOUGH ON HOW TO POSSIBLY FIND AND CORRECT THESE PROBLEMS BEFORE THEY HAPPEN. THIS YEAR, WE HAVE ATTEMPTED TO SHOW HOW SOME FORM OF ANALYZING CAN BE DONE THAT WILL LEAD TO AN INCREASE IN AVAILABILITY WHICH IS WHAT EVERY MAINTENANCE OFFICER ON THE RAILROAD TODAY IS STRIVING FOR.

PLEASE DO THESE THREE THINGS TODAY!

1. GET A NEW SUPPLY MEMBER AT THIS MEETING.
2. TURN TO PAGE THREE (3) OF THIS PRE-CONVENTION REPORT.
 - A. **THANK** those Advertisers as you visit their room. (Where consistent.)
 - B. **INVITE** those NOT LISTED AS ADVERTISERS to **participate** as Advertisers in the Annual Proceedings. (Where consistent.)
3. PUT MORE BUSINESS IN OUR MEETING.

Special Notice: We have been challenged to "put more business" in our meeting; accordingly we have scheduled the **Wednesday Morning Session** to start at 9:00 A. M. SHARP!

LET'S SHOW THE INDUSTRY WE ACCEPT THE CHALLENGE BY BEING IN THE GRAND BALL ROOM AT 9:00 A. M. READY TO GO TO WORK WEDNESDAY MORNING **WITHOUT FAIL. BE THERE! THIS MEANS EVERY MEMBER. THIS MEANS YOU!**

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REFERENCE: Any user.

WORK WEEK:* Seven, 24 hour days—no holidays.

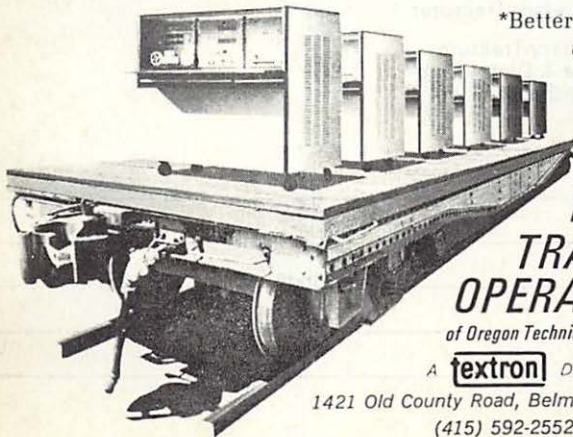
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MID-SOUTH AIR BRAKE AND RAILWAY DIESEL CLUB

Our Club, now in its 26th year, is gaining momentum each year, having representatives from more than 20 states this year. Our meeting this year was very outstanding and everyone present was surely able to gain much technical knowledge from the fine presentation of the highly trained technicians. Our thanks to everyone that made this meeting successful. We will continue to gather more information to be presented at our meetings in the future and continue toward the

ultimate of more knowledge in the Diesel Locomotive with the technical help from such men as Mr. B. D. Venable, Asst. to the Vice-President (Mech.), and Mr. N. E. Lahndorff, General Supt. Motive Power. In order to synchronize our own meeting with the other participating clubs we will continue to have our Annual Meeting in May of each year.

Anyone desiring to become affiliated with our Club, please send two dollars to our Secretary-Treasurer.

K. H. WYATT, Secretary-Treasurer
Mid-South Air Brake & Diesel Club
Office of Master Mechanic
Illinois Central R. R.
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Wednesday Morning, Sept. 16, 1970

9:00 A. M.

REPORT OF THE COMMITTEE ON NEW DEVELOPMENTS IN MOTIVE POWER MAINTENANCE

Pre-Convention
Presentation:
MID-SOUTH
AIR BRAKE AND
DIESEL CLUB



J. TAGGART, *Chairman*
Committee on New Developments
in Motive Power Maintenance
System Mechanical Officer - Motive Power
Canadian National Rys.
Montreal, Quebec, Canada

9:00 A. M.
MAY 6, 1970
Downtown Motel,
Memphis, Tenn.

Vice Chairman

V. L. Smith, Chief of Motive Power and Purch. Agt., Belt Rwy., Chicago, Ill.

Committee Members

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1970 TOPIC:

"UNIFORM REPORTING OF LOCOMOTIVE FAILURES"

PERSONAL HISTORY

James Taggart was born in Glasgow, Scotland on March 28th, 1917, arrived in Canada in 1922 and attended school in Transcona and Winnipeg.

He joined the Canadian National Railways in 1936 as a Machinist apprentice in Transcona Shops.

While on leave of absence from the Railway he served in the Royal Canadian Navy from 1942 to 1945 and upon discharge attended the University of Manitoba where he graduated with a Bachelor of Science Degree in Mechanical Engineering in 1949.

He then returned to the railway and from 1949 to 1956 worked as Mechanical Inspector, Assistant Mechanical Engineer and Assistant Diesel Supervisor at Winnipeg. He then transferred to System Headquarters at Montreal as Mechanical Engineer—Diesel. In 1958 he was appointed Senior General Foreman of Turcot Roundhouse and Montreal Yard Diesel Shop, then was transferred to Battle Creek, Michigan in 1959 as Assistant General Superintendent M.P. & C.E. for the Grand Trunk Western Railroad. He returned to System Headquarters at Montreal in 1961 as Mechanical Officer M.P., then in 1968 became System Mechanical Officer M.P. In 1969 he was appointed Project Officer (Equipment) for the Toronto Redevelopment Project involving Canadian National and Canadian Pacific Railways property in downtown Toronto. In 1970 he returned to his position as System Mechanical Officer—Motive Power at Montreal.

Mr. Taggart is an active member of the Corporation of Engineers of Quebec.

He was married to Dorothy

Humphrey of Winnipeg in 1951; they have two sons.

1. INTRODUCTION

On most railroads the subject of locomotive failures is considered of prime importance. Invariably when Mechanical Officers meet, the discussion gets around to the question, "Are you having much trouble with such and such?" Often the conversation will produce technical information that can be used for remedial action on a particular component, but the question that each would really like to have answered is, "How do my locomotive failures compare with yours?" Sometimes there is an exchange of information on this subject but because there is no common basis of measurement the mechanical officer is reluctant to draw comparisons.

Unfortunately, officers in other departments and sometimes in top management are not so discriminating. To them the identification and measurement of locomotive failures appears to be a rather simple process, and when they talk to their opposites on other railroads about train performance it seems quite natural to make such comparisons. As a result, occasions may arise where the performance of a motive power department is compared unequally because of the different standards used.

Obviously there would be rather limited justification for establishing a common basis for reporting failures if it were only to reduce or eliminate this criticism. It is felt, however, that there would be additional benefits derived from a uniform reporting system for the following reasons:

- (1) It would permit a better assessment on an industry-wide

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basis of locomotive road performance by individual types.

- (2) It would enable the mechanical officer to see the trends in his locomotive road performance compared with that of other railroads.
- (3) It would provide the locomotive builder with a much more comprehensive survey on the performance of locomotives of his and other manufacture.

It is essential in introducing a uniform reporting system to draw the distinction between the measurement aspect and the analytical aspect. The first involves the quantity of road failures while the second deals with their causes. If we can get agreement on what constitutes road failures and on the common basis against which they are to be measured, it would be feasible to arrange for published comparisons between railroads under AAR auspices. On the other hand, we do not see any way of relating the causes of these failures to such reporting in a way that would be meaningful. Rather, this aspect should be dealt with mainly as an internal matter by each railroad until such time as a suitable "Locomotive Information System" is developed. Later in this report we will see that a draft specification for such a system has been prepared and submitted to the AAR.

2. WHAT IS A LOCOMOTIVE FAILURE? It is universally accepted that a locomotive comprises one or more coupled diesel units. Thus any defect which affects the ability of the complete locomotive to handle its train might be considered a locomotive failure. Obviously, the effect on performance will vary considerably depending

on the number of units in the locomotive consist. For this reason, it is not feasible to establish definitions that take into account this variable effect. A tentative approach is to define a failure as occurring when:

- (a) A unit in the locomotive consist has to be isolated or shut down.
- (b) A locomotive has to be assisted by the addition of another unit or units or a tonnage reduction is made due to its failure to produce required output.
- (c) Over-the-road time is in excess of scheduled time for trains being measured, due to a defect.
- (d) Over-the-road time is in excess of anticipated running time for unscheduled trains due to a defect.
- (e) Part or all of the locomotive consist has to be removed from the train because of defective operation.
- (f) Delay to a train at initial terminal resulting from a defect occurring in a locomotive that has been released for service.

It is informative to compare the above definitions with those now in use by several railroads represented on this committee:

FEC—Any defects occurring when locomotive is coupled to a train, even if no time is lost on scheduled run.

BELT RAILWAY CO. OF CHICAGO

- (a) Transportation definition: Any loss of time after locomotive leaves the engine terminal to road train (transfer) or hump yard operation of 10" or more due to locomotive.
- (b) Mechanical definition: Any

delay due to locomotive of 30" or more.

SP—That event which causes a locomotive to be removed from the train, moved in the train dead or isolated in multiple, or operating in the train but not performing to full capacity, which results in over-the-road time in excess of scheduled time for trains being measured.

IC—A locomotive has failed when it will not run or deliver a reasonable percentage of its rated load. Generally this is of greatest significance if it occurs while in the hands of the train crew, particularly if a train delay results. A condition which prevents or delays locomotive dispatching is next in importance. All delays of a few minutes or more are counted.

CMSt.P&P—Failures are reported only if a train is delayed, with no minimum stipulated time.

CRJ&P—A failure occurs when an electrical or mechanical malfunction delays a freight or passenger train 10" or more, or a suburban train 1" or more, or when a suburban train is delayed at the terminal waiting power due to such malfunctions.

C&O - B&O—Any defect occurring when a locomotive is coupled to a train which results in some delay time to the movement of the train. The amount of delay time may or may not be defined.

N&W—In our present system of reporting locomotive delays (failures), the locomotive department is charged with any delay of 30" or longer caused by a locomotive defect.

MP—A failure comprises:

- (1) Delays waiting for an engine at initial terminal caused by a breakdown or any defect

necessitating repairs after locomotive has been OK'd for service.

- (2) All delays account an engine or unit breaking down or any defect that results in:

(a) Passenger Trains—

Loss of time in excess of 10" that results in train arriving at terminal 10" or more late; or a delay that causes delay to another passenger train, resulting in that train arriving at terminal 10" or more late.

(b) Freight Trains—

Any defect that causes a reduction in tonnage. Delay of 30" or more that is not overcome prior to arrival at terminal; or a delay that causes delay to another scheduled freight train which results in that train arriving at terminal 30" or more late.

L&N—All malfunctions occurring enroute, whether or not they result in a delay are classified as failures.

CN—All defects or malfunctions occurring enroute are classed as

- "Defects" and categorized under
- (a) "minor effect on transportation" which includes those defects which delay a train 5" or less or do not result in a delay
 - (b) "major effect on transportation" which includes all defects or malfunctions causing delays over 5".

It will be seen that there is very little uniformity in reporting among the railroads represented and presumably this is typical of the industry as a whole. This is rather surprising when it is realized that the AAR adopted as recommended

practice in 1958 a "Definition Covering Failures of Diesel-Electric Locomotives". The variations in practice are so pronounced that it leads to these alternative conclusions:

- (a) The operating requirements of these roads vary so much that each requires a failure reporting system which is unique.
- (b) Individual railroad policies on reporting systems have developed over the years with no attempt at standardization.
- (c) The reliability of operation in pulling a string of cars over the road between two terminals with a locomotive consist is essentially comparable for all railroads.

The committee feels the last statement is most appropriate to the real situation. Therefore it should be possible to develop a uniform reporting system for all railroads.

In the foregoing you will note frequent references to delays and the length of time involved. Granted that a four hour delay may have more significance than one of five minutes, we must not lose sight of the fact that the length of time is greatly affected by chance. If the defect occurs when another unit is readily available for changeoff or when maintenance personnel are near at hand, the delay may be minimized. If there is a surplus of horsepower in the consist due to operational requirements or the engine crew can take corrective action, the delay may be avoided or made up. Conversely, a minor defect occurring in an isolated location may result in a lengthy delay or the location may be such, due to high traffic density, as to have

a pronounced impact on train performance.

It is considered therefore that the length of delay is a very unreliable indicator as it is not consistently dependent on the type of defect. Rather, we should be looking at the locomotive's performance and asking, "Did it do the job for which it was dispatched?" If not, it is a locomotive failure and this should be the sole measure of its road performance reliability.

In this connection there are some associated areas to be considered:

- (a) Engine crew default resulting in delay
- (b) Delays at servicing facilities
- (c) Effect of natural forces such as snowstorms or excessive cold on electrical and mechanical equipment.

It may be argued that none of these have to do directly with the quality of locomotive maintenance. However, they are controllable to some degree by the extent to which a mechanical department presses for good engine crew training and supervision, ensures that servicing facilities are in good working order and properly staffed, and does its utmost to make sure units are properly winterized. An analogy might be drawn with some other aspects, i.e., we may blame the builders for failure to design properly or supply reliable material, or management for not supplying adequate maintenance funds, or even use as an excuse the difficulties of obtaining trained staff, but this does not relieve us of responsibility for the performance of the locomotive.

From this it is our conclusion that delays to trains in the category of these associated areas should be included in the list of failures along with those directly

pertaining to the locomotive's operation insofar as a railroad's internal reporting is concerned. However they should be excluded from external reporting as they have no real connection with locomotive performance as it reflects on design and maintenance.

In the case of locomotives leased from other railroads, it would seem appropriate to include their failures in the using railroad's statistics since it is responsible for the running maintenance during the period of lease. Similarly failures of so called "foreign" locomotives would be properly chargeable to the using railroad.

3. WHY ARE LOCOMOTIVE FAILURES IMPORTANT? The cost of repairing the defect may be negligible in comparison to the loss of motive power utilization through failure of the diesel unit to stay in the cycle and while waiting repairs. Thus there is a detrimental effect on all trains running behind the one involved and sometimes on a train ahead which has yet to be dispatched. Some of the costs that may be incurred as a result of failure are:

- (1) Crew penalty payments
- (2) Terminal delay payments
- (3) Per diem costs for freight cars
- (4) Emergency road repair costs
- (5) Penalty payments due to not meeting commitments to shippers
- (6) Unscheduled repair costs
- (7) Lost traffic due to unreliable service and failure to make connections with other trains
- (8) Need to carry additional units on the roster to protect against units lost through failure
- (9) Damage to lading from improper train handling arising

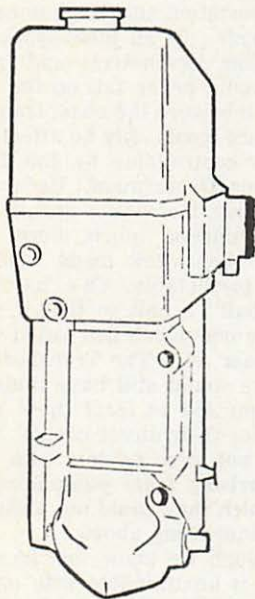
from defective equipment.

Most if not all of these costs can be measured but there is another affected area that is not so readily apparent. This is the effect on the efficiency of management in both Transportation and Mechanical Departments. In an ideal equipment operation, locomotives and freight cars would never fail on the road, and if this were the case, train performance would only be affected by factors controllable by the Transportation Department. Under such a situation, locomotive repair shops would function much more effectively, shop work loads would be more predictable, the need to "Highball" a unit so that it would replace one which had failed would disappear, etc. The Transportation Officers would still have their own problems but at least these would be under their direct control. **They would not have to deal with problems arising from equipment failure which they could not anticipate or do something about.**

Although we know this ideal situation is unattainable with current equipment, it is an objective to which we should, and to some degree are, working. The user of the equipment, Transportation, however, has been led to believe that it is attainable if only his particular Mechanical Department would do its job. It would be very enlightening to the user to find from published comparisons that **ALL** railroads suffer from the effects of unreliable equipment. In turn, there would be a better understanding of the other fellow's problems and hopefully this would result in better working relationships between departments.

4. ANALYZING FAILURES: If we were to follow the road performance of a particular diesel unit

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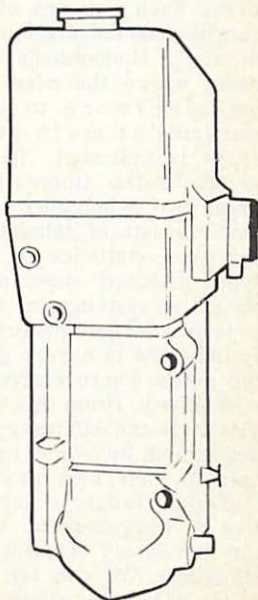
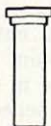
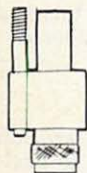
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and examine its repair history for a period of one year, we might find that it failed on the road 4 times and was given a defect repair in the shop 80 times. Thus if we only analyzed the causes of road failures, we would be dealing with a 5% sample of the total occurrences.

Some railroads appear to have reached the conclusion that this sample is not truly representative and are looking for other data that is more detailed. Others are convinced that causes of failures can be analyzed and used as a basis for changes in maintenance practices, design, or material. We do not see any immediate solution to resolving those divergent viewpoints.

In reviewing some of the failure reports now used, the most striking feature is the great variety of things that go wrong with locomotives. Such patterns of failure as can be detected are few and small in size. Undoubtedly, there are cases where the need for checking adherence to maintenance standards at main and running shops is indicated. It is difficult to avoid the impression that a great deal of so called failure analysis consists of tabulating performance statistics by locomotive type, assigned shop, major component or system, etc. Such an approach is largely historical and only indicates in a very general way the areas where corrective action is required. From this we conclude that it is the intensive "followup" performed by some railroad officers in their own shops for each individual failure which is productive of improvement, rather than the "analysis" of assorted general statistics. We can see no way of using the descriptions of failure

"cause" shown in typical current railway reports to effect improvement in performance.

5. PRESENT APPROACH TO FAILURES: The maintenance philosophies of railroads vary widely depending on such factors as availability of money for maintenance, the age and type of units involved, the pressures for good road performance and high availability, the skills of mechanics and supervisors, etc. Thus each railroad has to some extent to decide what its standard should be.

In measuring the performance of a motive power fleet there are three factors to be considered:

- (a) Costs
- (b) Availability
- (c) Reliability.

Although these factors are interdependent, we are going to deal at this time only with the third, reliability. Going one step further, we are treating only that aspect of reliability which affects locomotive performance, i.e., locomotive road failures.

As you are all well aware, locomotive failures affect train performance, resulting in lost availability and utilization, and incur repair costs of varying magnitude. They also can take up an excessive amount of the mechanical officer's time in (a) trying to find out what happened (b) trying to do something about preventing a repetition. Where the failures are frequently repetitive over a short period of time, it is sometimes possible to perform an analysis that indicates the cause. Where the cause is controllable by maintenance, the appropriate action can be taken if funds are available. If they are not available, the correction may be made at the expense of letting something else go.



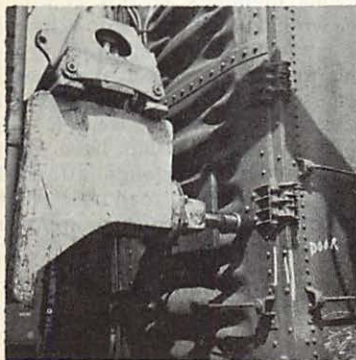
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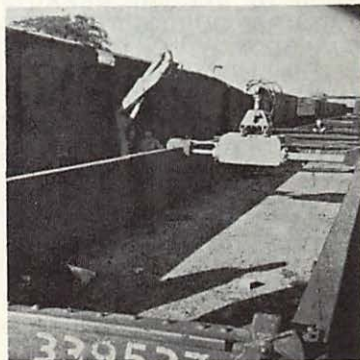
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Unfortunately, failures are often sporadic and vary greatly in nature. They may arise from engineering design or material deficiencies or the effects of natural forces for which there is no ready answer. While this is going on the railroad operation is affected and management looks at the motive power department for a solution. Sometimes this is as simple as a change in the weather or a change in the type of defects occurring so that they do not result in road failure.

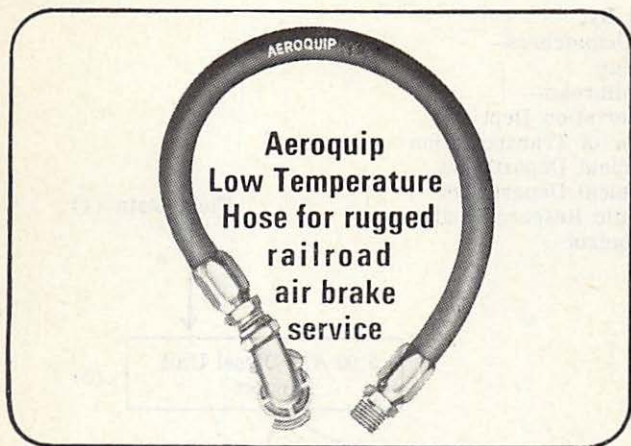
Sometimes the reassignment of a train dispatcher will reduce the number of reported defects and ease the pressure.

FROM THE FOREGOING YOU MIGHT WONDER WHETHER IT IS A VERY VALID APPROACH TO MEASURE PERFORMANCE BY ROAD FAILURES, WHICH IN EFFECT REPRESENT ONLY A SAMPLE OF ALL THE DEFECTS OCCURRING DURING THE LIFE OF A LOCOMOTIVE. IS IT FAIR TO COMPARE THE PERFORMANCE OF DIFFERENT RAILROADS BY THIS MEANS? IS IT VALID TO GROUP VARYING TYPES OF SERVICE, EVEN ON ONE RAILROAD, UNDER A STANDARD DEFINITION? CAN WE RELY ON UNBIASED RE-

PORTING FROM OTHER DEPARTMENTS WHEN IT MAY BE TO THEIR ADVANTAGE TO ASSESS THE BLAME TO THE LOCOMOTIVE RATHER THAN OTHER OPERATING INADEQUACIES?

THE ANSWER SEEMS TO LIE IN THE FACT THAT COMPARISONS ARE DRAWN BETWEEN RAILROADS AND IF THIS IS SO, THEN IT WOULD BE DESIRABLE, AS FAR AS POSSIBLE, TO ENSURE THAT THE BASIS FOR COMPARISON IS REASONABLY CONSISTENT. ALSO, SINCE ON SOME ROADS THERE APPEARS TO BE TWO REPORTING SYSTEMS, ONE TRANSPORTATION AND THE OTHER MECHANICAL, IT SHOULD BE THE OBJECTIVE TO PRODUCE A SYSTEM THAT MEETS THE REQUIREMENTS OF BOTH DEPARTMENTS.

From the submissions made by various members of this committee, we have selected an outline of the current failure reporting practices followed on one railroad and included in their "Daily System Status Report" which we feel are fairly typical. This has been done to show the importance attached to failures by this road and what they are looking for in a uniform reporting system:



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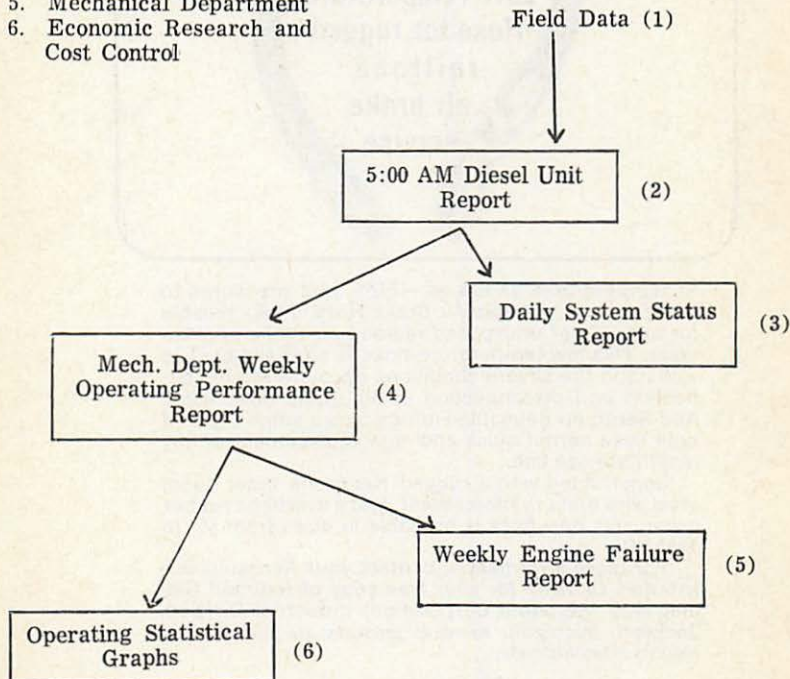
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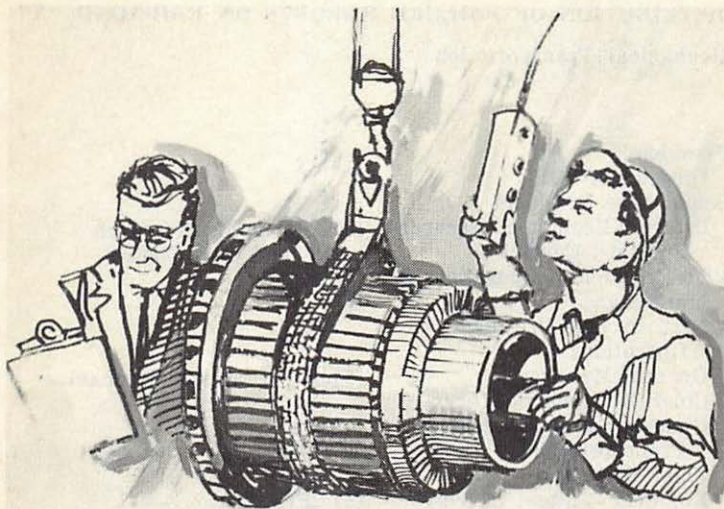
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REPORTING: 5:00 AM Diesel Unit Report is generated using the Transportation Department's definition of a locomotive failure. From the 5:00 AM report and other input reports, such as signal interruptions, slow orders in effect, weather conditions, etc., the Daily System Status Report is generated.

The Mechanical Department will analyze the 5:00 AM report to determine, where possible, those failures that fall under their defini-

tion; all other failures are omitted. The Daily Status Report is not updated showing the Mechanical Department's findings. In cases where the Mechanical Department feels that action should be taken, the Division Master Mechanic, on whose division the unit is currently being used, is contacted as to possible cause of failure. The Division Master Mechanic to whom the unit is assigned is also contacted as to possible cause. Any repairs



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required directly related to the cause of failure are transmitted both back to the CMO's office and the Master Mechanic to whom the unit is assigned. Where the CMO's office see cause trends developing (by a manual inspection of the reports) they will assign staff officers to investigate the problem and recommend solutions.

Management assigns importance to locomotive failures mainly by type of train delayed. Comparisons of locomotive failures are made between a current weekly period and a corresponding previous year week period for freight service, passenger service and suburban service. On the Weekly Operating Performance Report, comparisons are made between high horsepower (2500 HP and above), regular horsepower (less than 2500 HP) and switching units for each of the three (3) services. The Weekly Engine Failures by Class Report also makes a rough comparison of failures by type of power.

The Mechanical Department feels that the different standards should be used for fast freight, passenger and suburban service as the second group.

From the question "Should the frequency of failure be related to mileage or time?", we feel that this relationship may not be a consistent data base. Mileage and time are probably the easiest measurements to determine for reporting purposes, but may not measure criteria directly related to failure. For example, the product of the locomotive is work. It would seem more significant to measure the force expended over distance than mileage and time. Since railroads vary in assigned horsepower per ton trains and terrain, the measurement of mileage

and time loses its significance. Weather conditions also vary by railroad (and within roads), therefore, to compare electrical failures between Northern and Southern roads during winter months may be valueless. We feel that the above are just a few of the many variables which should be considered when defining the criteria to measure locomotive failures uniformly.

We do not feel that the above variables make a general definition impossible, but conversely, a logical definition clearly stating the other factors which should be considered in all evaluations of failure performance will greatly aid all railroads.

When the evaluation of the 5:00 A.M. report is made, the Mechanical Department attempts to clearly define cause as to electrical, mechanical or man failure. Due to the technique in input reporting, finding an exact cause is not always possible. The majority of the input occurs after the fact and, therefore, proving other causes may not be feasible from an economic view point. Whenever a major train seems to have an extraordinary number of locomotive failures, a staff officer is designated to ride that train to determine possible cause.

At the present time we break down failures by locomotive builders and class in a general way for high horsepower units. The Weekly Engine Failure By Class Report shows the GP-40 unit failures separate from the GP-35 and other failures for example. There is no detailed segregation by horsepower range or locomotive age groups at this time. With the proposed locomotive failure reporting system, the Mechanical Department

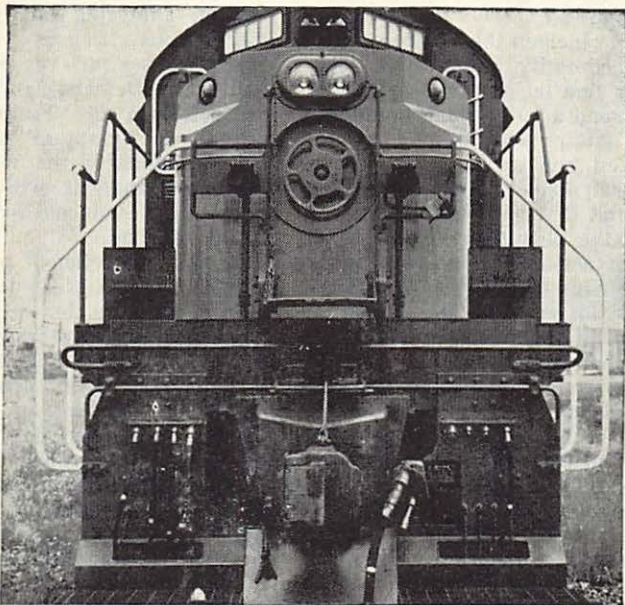


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will have the detail required to group locomotives by some of the above criteria and general failure cause. We do feel that it is desirable to have the ability to detect cause trends by builder, horsepower range, etc.

We do include the number of foreign locomotive failures that occur on our line on our failure reports. If we send a foreign unit home that has a failure and do not make the required repairs we will contact the foreign road. If we have a foreign unit that has a failure and we make the required repairs we do not contact the foreign road unless the repairs are major. We do not charge for running repairs but we do charge for major repairs. It has been our practice to have very close contact with locomotive builders. Through this contact the Mechanical Departments locomotive staff and the builders work toward the solution of problems caused by inadequate design of locomotives or materials. The CMO also encourages his officers to discuss our locomotive problems not only with the builders but with other railroads which may have similar problems.

In the remainder of this paper we will show to what extent this requirement can or should be met.

6. PROPOSED APPROACH TO FAILURES: IT SHOULD BE EMPHASIZED THAT THE REPORTING SYSTEM ENVISAGED IS NOT INTENDED TO PROVIDE INFORMATION THAT LEADS DIRECTLY TO CORRECTIVE ACTION. RATHER IT IS AN INDICATION OF TRENDS WITHIN AN INDIVIDUAL RAILROAD AND ALSO WITHIN THE INDUSTRY, WHICH MAY BE USED AS AN AID TO MANAGEMENT IN SETTING MAINTENANCE POLICY

OR POSSIBLY EVEN LOCOMOTIVE PURCHASING POLICY.

Insofar as the requirements of a railroad's Mechanical Department are concerned, we see no need to change the present methods of collecting, analyzing, and acting on the various "Causes" of failure. These causes are usually classifiable as "Defects" and are thus distinct from the "Failure" which is really a "Symptom" of the "Defect." Similarly the method and extent of analysis will be determined by the internal requirements of the railroad.

In this connection it is timely to point out that a great deal of work has been done by a committee comprised of a few large railroads and the locomotive builders on a Specification for a Locomotive Information System and this has been submitted to the AAR. The Specification has been developed so that the railroad industry will have the capability for locomotive and locomotive component performance data interchange. Put very simply, it will provide the means for effecting improvements in locomotive design, maintenance and performance, while our proposed system would supplement it by providing a measure of the effect on road performance.

This Information System has been made adaptable to suit the requirements of North American railroads varying from those using manual methods of data collection and analysis to the most sophisticated computerized systems. Thus in the years ahead, it is anticipated the solving of maintenance problems will not be done in isolation on each railroad, but rather as a united effort between railroads and locomotive builders. From this we would expect that there will be a

trend away from the present type of analysis of individual locomotive failures and a much greater emphasis on taking all the data available on shop work reports to permit corrective action.

In line with the above, we should be aiming at the following degree of uniformity for external use:

- (a) Adopt a standard definition to identify locomotive failures.
- (b) Relate the incidence of these to a time base and adjust for variations in diesel unit assignment by showing the performance of the overall fleet in terms of "Failures per unit per month, and per year."
- (c) Breakdown the figures shown in (b) in terms of type of diesel unit, i.e., "Failures per U-30-c unit per month, and per year" and similarly for other builders types.

Two further points should be emphasized:

- (a) We will need maximum cooperation from Transportation to get reliable source data. To achieve this it will be necessary to ensure that all concerned are aware of the requirements, and this will have to be monitored frequently. In addition, mechanical officers will have to arrange for a check of each reported incident to determine whether it is properly assessable as a locomotive failure.
- (b) The system as envisaged will probably be more valid for self comparison than for comparison with other railroads, but still will be an improvement over the cur-

rent situation in both cases.

MEASUREMENT BASIS FOR DIESEL "UNIT" PERFORMANCE: Theoretically, the frequency of failure can be related to time, mileage, fuel consumption, H.P.—hours or ton miles. Each of these bases has some validity and may be particularly appropriate to a specific railroad operation. However, it would be extremely difficult if not impossible, to determine which is the most representative insofar as the majority of railroads is concerned. It was felt that by process of elimination the most practical approach could be taken.

Although mileage is not completely representative of work done, it has long been used by many railroads in various statistics such as costs of repair, fuel consumption, lube oil consumption, etc. We are under the impression, however, that several roads, perhaps as many as half, cannot provide current accurate mileage figures without a great deal of research. Hence the use of mileage or ton miles has been ruled out at this time, but with the hope that eventually mileage figures will be utilized as they become more readily available. In the case of fuel consumption it is not feasible to relate this to the type of unit involved.

A reasonably acceptable basis is time. If it is used, the need for compiling mileage or tonnage figures disappears, the principal requirement then being to collect and verify the number of failures. To the best of our knowledge most railroads work on a time basis, usually consisting of monthly and annual statements, which can be compared against data for previous months or years.

From our review of reports now

in use there is obviously a wide fluctuation in monthly figures, hence comparisons drawn with immediately preceding months do not have much significance. The annual figures do tend to level out the "peaks" and "valleys" in performance and are more reliable, but they do not provide sufficient up-to-date information.

A partial solution to this problem is to graph the number of failures in each month for current and previous years. Comparisons can then be made which take into account seasonal factors.

It may be objected that the time basis does not take into account changes in traffic volumes, which can be represented better by diesel unit miles. For most roads this variation probably does not exceed 10% or 15% from year to year. Hence compared to the wider variation encountered, owing to the element of chance, it is felt that the time basis is reasonably accurate.

If we were to use horsepower in conjunction with time, it is claimed this would take into account the variations in unit size. At the present time, units used in road service usually range in size from 1500 HP to 3600 HP. If switchers are taken into account, the spread becomes even greater. It might thus appear that a railroad having a preponderance of larger and newer diesel units should be in a better position failurewise than a comparable one having a majority of smaller and older units. However, the railroad with the smaller units will be more likely to run them in larger multiple consists. **THUS THE FAILURE OF ONE HAS LESS IMPACT ON TRAIN PERFORMANCE THAN WHEN A LARGE UNIT FAILS IN A SINGLE OR**

TWO-UNIT CONSIST, AS HAS BEEN CONFIRMED BY THE DISAPPOINTING EXPERIENCES WITH NEW HIGH HORSEPOWER UNITS IN THE PAST FEW YEARS FROM A RELIABILITY STANDPOINT.

In line with the above we might also give weight to the fact that failures, irrespective of unit size, may have side effects detrimental to performance for other trains. We have therefore decided to use only the time basis.

8. **SUMMARY:** In this paper we have attempted to review the variables involved in measuring locomotive performance and from this develop practical criteria which can be used in a Uniform Reporting System. The system proposed is simple and adaptable to use by all railroads. No doubt there may be some who feel it does not provide all the information that was anticipated, but we are hopeful that they will also appreciate the reasons why this is not feasible.

The suggested system comprises:

1. **Definition of Locomotive Failure**—"That event which causes a locomotive or diesel unit to be (a) removed from a train (b) moved in a locomotive consist dead or isolated in multiple (c) perform at less than full capacity thus resulting in over-the-road time in excess of scheduled time or anticipated running time for unscheduled trains. (d) responsible for delay to a train at an initial terminal after the locomotive has been released for service."
2. **Basis of measurement**—
 - (a) Time
 - (b) Number of assigned diesel units on the railroad by class and total. (Ex-

cluding those stored.)

3. Reporting Formats—

- (a) Individual Railroads prepare monthly and annual reports to AAR showing number of failures per unit assigned and number of failures by builder's type.
- (b) AAR prepare similar reports on quarterly and annual basis comparing railroad performances.

The advantages of this system are:

1. It will enable all railroads to participate with little additional effort beyond what they are now doing.
2. They will be able to continue with their present internal reporting and analytical practices.
3. The proposed system will not conflict with the Information System now in use or under development.

CHICAGO RAILROAD
DIESEL CLUB



J. R. WILLIAMS, President
Chicago Railroad Diesel Club
Superintendent Locomotives
Burlington Northern, Inc.
Chicago, Ill. 60606

We of the Chicago Railroad Diesel Club were again happy to be hosts to the Locomotive Maintenance Officers Association for their first Pre-Convention paper.

On April 6, 1970, Mr. J. J. Dwyer, Chemical Engineer, of the C&O Ry. B&O R.R., presented the paper entitled "1970's Major Locomotive Maintenance Problems."

This most interesting paper certainly showed signs of many hours of hard work and research. We just know that will be one of the MUSTS for those attending the Convention.

MEETINGS: We meet on the first Monday of each month except July, August and September.

PLANT TOURS: Will be announced. (Had two last year.)

MONTHLY PUBLICATION: Issued to all members.

MEMBERSHIP: For all Railroad and Supply personnel. Dues are \$4.00 for Railroad and \$5.00 for Supply.

FISCAL YEAR: October through June.

E. C. FOSDICK, Sec.-Treas.

225 Illinois Boulevard

Hoffman Estates, Ill. 60172

Wednesday Morning, Sept. 16, 1970

10:15 A. M.

ANNUAL MEETING PANEL ON:

WHAT'S YOUR PROBLEM?

Here is a really special feature on our program: Chairman J. J. Dwyer and his panel of the seven Technical Committee Chairmen shown below will, at the Annual Meeting ONLY, ANSWER ANY AND ALL DIESEL MAINTENANCE QUESTIONS.

Mail Mr. Dwyer your "REALLY-TOUGH PROBLEMS" (not covered by the Program Topics).



C. P. STENDAHL
Vice Chairman
Gen. Supt. Motive Power
Burlington Northern, Inc.
St. Paul, Minn.



J. J. DWYER, Chairman
What's Your Problem
Committee
Engr. Environ. Control
C. & O. Ry. - B. & O. R.R.
P. O. Box 907
Huntington, W. Va. 25712



F. N. HOUSER, Co-Chmn.
What's Your Problem
Panel
Editor
Railway Locomotive & Cars
30 Church Street
New York, N. Y.

**Pre-Convention Presentation: Chicago Railroad Diesel Club, 6:00 P. M.,
April 6, Hartford Bldg., 365 W. Monroe, Chicago, Ill.**

WHAT'S YOUR PROBLEM PANEL MEMBERS

R. G. Clevenger, Supvr. of Loco. Maint., A. T. & S. F. Ry. Sys., Topeka, Kan.
K. Axelson, Mgr. Production Stds.-M. P., Burlington Northern, Inc., St. Paul, Minn.
K. D. Reed, Mgr. Research Laboratory, Penn Central Co., Cleveland, Ohio
J. Taggart, Sys. Mech. Officer-M. P., Canadian National Rys., Montreal, Quebec, Can.
N. A. Buskey, Supt. Shops, C. & O. Ry. - B. & O. R.R., Russell, Ky.
R. P. Turnbull, Mgr.-Mech. Engr., Long Island R.R., Jamaica, N. Y.
J. J. Butler, Chief Mech. Officer, Reading Company, Reading, Penn.

EXTRA SPECIAL: SOMETHING NEW HAS BEEN ADDED!

IT IS VERY IMPORTANT THAT EVERY MEMBER STAY FOR THE

10:15 A. M. SESSION WEDNESDAY MORNING!

In addition to Chairman J. J. Dwyer and his Committee members, we will also have on hand the members of all other seven Technical Committees. **WE EXPECT TO BE ABLE TO ANSWER ANY QUESTIONS YOU ASK. WE WANT TO KNOW OF ANY AND ALL NEW DEVELOPMENTS ON YOUR RAILROAD.**



1970 TOPIC:

"1970'S MAJOR LOCOMOTIVE MAINTENANCE PROBLEMS"

**PERSONAL HISTORY OF
J. J. DWYER**

Mr. Dwyer is well known in railroad and engineering circles for his interest and work in pollution abatement. He has been chairman of the American Railway Engineering Association Committee on Environmental Engineering since its inception about three years ago. He is also chairman of the Locomotive Maintenance Officers Association Committee on "What's Your Problem?" and edits a department by that name each month in Locomotives and Cars, a national railway magazine.

In his new position Mr. Dwyer will deal with Federal, State and Local officials in matters pertaining to water, air and land pollution, industrial hygiene and sanitation. His headquarters will remain in Huntington.

Mr. Dwyer is a registered professional engineer, and a past president of the Engineers Club of Huntington and the Huntington

Chapter of the West Virginia Society of Professional Engineers.

He is a chemistry and physics honor graduate of Marshall University at Huntington and started his railroad career with the C&O there in November 1936 in the Water Department laboratory. In 1943 he was appointed Chief Chemist in the Water Supply Department and in 1955 was made Chief Chemist for the C&O System. He has been Chemical Engineer for the C&O Railway/B&O Railroad since May 1963.

On March 16, 1970, the Chesapeake & Ohio/Baltimore and Ohio Railroad announced the establishment of a new office to deal with the problems of pollution and its control on the 11,000 miles of their system.

J. J. Dwyer, C&O/B&O Chemical Engineer at Huntington, West Virginia was appointed to head the new office with the title of ENGINEER ENVIRONMENTAL CONTROL.

Wednesday Afternoon, Sept. 16, 1970

12:30 P. M.



COORDINATED MECHANICAL ASSOCIATIONS LUNCHEON



HONORING ALL RAILROAD PRESIDENTS

2:30 P. M. to 5:00 P. M.

*TOUR OF A. A. R. RESEARCH CENTER

*See Transportation Instructions
On Next Page



The A. A. R. Laboratory will hold "Open House" for your convenience from 2:30 p. m. until 5:00 p. m. Come out and see:

Bearing Tests — Brake Studies
Impact Evaluation—Car Truck Model
Diesel Axle Fatigue Tests
Isotope Laboratory
Electron Microscope



PLEASE DO THESE THINGS TODAY!

- A. GET A NEW SUPPLY MEMBER AT THIS MEETING.
B. TURN TO PAGE THREE (3) OF THIS PRE-CONVENTION REPORT.
1. **THANK** these Advertisers as you visit their room. (Where consistent.)
2. **INVITE** those NOT LISTED AS ADVERTISERS to participate as Advertisers in the Annual Proceedings. (Where consistent.)



SPECIAL NOTICE TO ALL MEMBERS:

Through the courtesy of the Hotel, **REGULAR CHECK-OUT HOUR HAS BEEN EXTENDED** so you may attend the **President's Luncheon, and tour the A. A. R. Research Center.** No special arrangements are necessary, when checking out, simply tell the cashier: "I stayed for the Luncheon and A. A. R. Tour."

**SPECIAL ATTENTION
ALL MEMBERS:**

**FEEL FREE TO
GET INTO THE
FLOOR DISCUSSIONS!**

Be assured that **every** remark **you** make will be sent back to **you** for **your** correction, **before** it is printed in the Annual Proceedings.

NOW WE NEED YOUR HELP. We are **making** special arrangements to get this discussion transcript to you at the earliest possible date after the meeting.

These special efforts are just wasted if just **one** speaker delays and fails to return **his** transcript **immediately**.

Your remarks are very valuable to the officers in setting up next year's program.

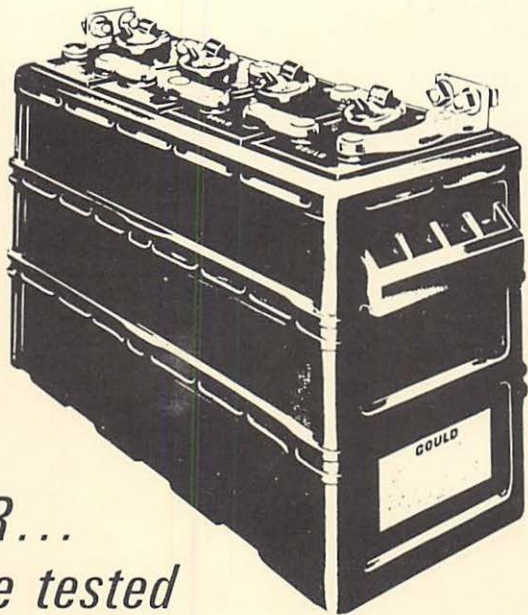
—SO—

PLEASE CORRECT AND RETURN YOUR ANNUAL MEETING TRANSCRIPT TO THE REPORTING COMPANY IMMEDIATELY UPON RECEIVING IT.

1. Important Things To Do Now.

- A. Write your boss a report on the things of value you learned at this meeting. Remember, he already has a copy of the Pre-Convention Report.
- B. Get a New Member **TODAY**.
- C. Secure an Advertiser where consistent to do so.
(Any Supply Firm **NOT** listed on page three (3) of this Pre-Convention Report is a prospective Advertiser. Those listed are already in as advertisers, of course.)
- D. Write or call your Congressman to support and fight for fair and equal treatment of the railroads. (Study page 4 again.)

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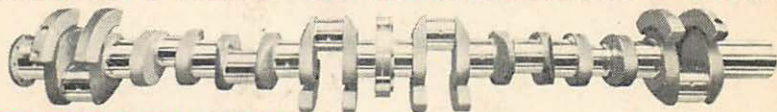
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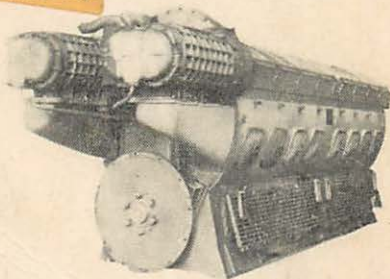
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