Locomotive Maintenance Officers' Association

J. E. Goodwin,
President

The problems of those responsible for the maintenance of motive power are discussed in three reports to the association which deal with the selection and training of supervisory personnel, wartime maintenance of locomotive air-brake equipment, and a survey on metal cutting tools

With locomotive mileage soaring each month to new heights the necessity of restoring that run-out mileage through repair programs has placed on the repair forces of the back shops and enginehouses a responsibility of such proportions as to leave very little time to devote to matters other than running the railroads. Recognizing, however, that the only substitutes for shortages of men, facilities and materials are the more efficient utilization of those we now have, the Locomotive Maintenance Officers' Association committees and members collaborated in the preparation of reports, which are presented here, on several subjects of vital importance at this time.

The report of the Committee on the Selection and Training of Supervisory Personnel covers this important phase of mechanical-department work in a comprehensive manner, including many suggestions of real practical value. The maintenance of air brake equipment, contributing as it can to the elimination of road failures, is treated in a second report.

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General Superintendent Equipment,
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Wartime conditions, with the resultant shortages of materials and supplies, is causing many a hardship and in the railroad shop, where such a large and important part of the work depends upon machining operations it was but natural to expect that, with defense industries demanding an ever-increasing supply of the high-production metal-cutting tools, the railroads might have to take the short end, so to speak. However, the conditions that have existed in the past year have proved to be a blessing in disguise and the report of the Committee on Shop Tools, dealing with the cutting-tool problem, presents a survey of a situation in the shop field that can be used to advantage by every shop man who has anything to do with the machining of metals.

A fourth committee has in preparation a report on the facilities required for the maintenance of Diesel-electric locomotives. Unfortunately this report could not be completed in time for presentation in this issue.

Officers of the Association

Under the terms of the association's constitution the elective officers and executive committee members will hold over. The officers of the association are: president, J. E. Goodwin, mechanical superintendent, Missouri Pacific, St. Louis, Mo.; first vice-president, F. J. Topping, master mechanic, Chesapeake & Ohio, Hinton, W. Va.; second vice-president, S. O. Rentschler, shop superintendent, Missouri Pacific, Sedalia, Mo.; third vice-president, C. D. Allen, master mechanic, Chesapeake & Ohio, Silver Grove, Ky., and secretary-treasurer, C. M. Lipscomb, assistant to production engineer, Missouri Pacific, North Little Rock, Ark. The members of the executive committee are : F. J. Topping, (chairman) George Crowder, superintendent motive power, Georgia & Florida, Douglas, Ga.; E. J. Kueck, mechanical engineer, St. Louis, Southwestern, Pine Bluff, Ark.; W. P. Buckley, shop superintendent, Chicago, St. Paul, Minneapolis & Omaha, St. Paul, Minn.; W. E. Vergan, supervisor air brakes, Missouri-Kansas-Texas, Denison, Tex.; G. A. Silva, shop superintendent, Boston & Maine, North Billerica, Mass., and G. E. Bell, general foreman, Illinois Central, McComb, Miss.

The association's advisory board consists of P. O. Christy, general superintendent equipment, Illinois Central, Chicago; D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, Pere Marquette and Nickel Plate, Cleveland, Ohio.; O. A. Garber, chief mechanical officer, Missouri Pacific, St. Louis, Mo.; J. Roberts, managing director, National Railways Munitions, Ltd. (formerly chief of motive power and car equipment, Canadian National) Montreal, Que., and D. J. Sheehan, superintendent motive power, Chicago & Eastern Illinois

* Mr. Roberts is now managing director of National Railways Munitions, Ltd.

Wartime Maintenance of Air Brake Equipment

Standards of inspection and maintenance should be higher under present conditions to insure against failures

By A. Malmgren

Road Foreman of Equipment, St. Louis-San Francisco, Springfield, Mo.

A. Malmgren

The necessity of meeting the transportation demand of the present, wherein the railroads of the United States are a part of our national defense system, requires that locomotive air-brake equipment be given more rigid tests preliminary to being despatched, that the representatives of management and the operators of equipment know that it is functioning properly within a range of insured safety. We cannot, at the present time, relent in our efforts to maintain a high degree of efficiency in the maintenance of brake equipment, because later we may be called upon to release trained personnel to the armed services and replacement will take months, even years of special training. During this training period, there will be a lower standard of maintenance. Too, we are being called upon daily to repair and keep in service more of the older equipment due to material shortage.

Maintenance means the dismantling, cleaning, repair and replacement of any of the working parts that are not functioning regularly or that can not be depended upon to function at all. It has been suggested by some that we ease up on tests at inspection periods so that equipment can remain in service during these troubled times, when material and man power are badly needed in other fields. No other field is any more important than the transportation field. I once heard a prominent speaker say, "There is no such a thing as a shortage of food, when one half of the world is starving for things that the other half of the world is over-producing. What is needed is a better system of transportation." To get better transportation, we must maintain our locomotives at a high standard so the operator of the equipment can place dependency on the equipment to function properly.

The most disheartening task confronting an engineman when handling the fast trains of today, is to have the brake equipment fail to apply properly or apply in emergency when only a service application was intended. An engineman may be ever so clever in his practical knowledge of the air-brake system—every feature of its construction, function, relation and operation—but if the equipment is not properly maintained, all his experience, knowledge and training go for nothing. Faulty functioning of equipment results in the loss of schedule time, reflects on the low standard of maintenance and encourages the repairman to continue to neglect his duty.

Here is a list of the various tests of the locomotive air-brake equipment that has proved helpful on our railroad and will prove helpful to others.

Before despatching a locomotive, the supervisor in charge must know that the engine and tender air brakes, signal equipment and air-operated devices have been inspected and tested and are in a safe and suitable condition for service; that the compressors are in condition to provide ample air for the service for which the locomotive is to be used; that the devices for regulating or controlling pressure are functioning properly; that brake valves work properly in all positions; and that all the water has been drained from the air-brake system. Examine carefully the cab cards, noting that cleaning dates of the various parts of the equipment are not past due. Measure the piston travel and examine the foundation brake rigging, reporting irregularities which must be corrected. At least once each month, unless otherwise instructed, all compressors, except the 8½-inch cross-compound compressors, should be laundered, strainers cleaned on locomotives not equipped with the Type C filters, and orifices checked.

Periodic Inspections

In addition to daily and monthly inspections and test, the following quarterly inspection and test should be made. Test all air gages on the dead-weight tester, dismantle, clean, test and adjust compressor governor and feed valves, dismantle, clean, and test the vent valves.

In addition to the preceding inspections, the following inspections must be made on each six months' period. Dismantle, clean and test brake valves, control valves, distributing or triple valves, emergency relay valve, double checks, safety valves and signal equipment.

On annual inspection dates in addition to the tests outlined in daily, monthly, quarterly and semi-annual inspections, all the reservoir must be subjected to a hydrostatic test and hammer test.

Classified Repairs

All brake cylinders must be overhauled when locomotives are undergoing classified repairs. Brake cylinders must be replaced when the diameter of the cylinder exceeds the original diameter 3/32 in.

Daily Comparison Test

Apply standard test devices to the brake pipe and signal hose; see that the locomotive air gages are tight on the brackets and that the dial glasses are clean and tight; make sure that the dials are readable and that pipes are properly connected and have no leakage. Place the automatic brake-valve handle in release position and note whether or not there is more than 2 lb. variation between main-reservoir, brake-pipe, equalizing-reservoir and test-device gage hands. Should there be more than 2 lb. variation, gages must be removed and corrected. Brake-pipe and equalizing-reservoir gage hands should compare within 2 lb. of that of the test gage at the following

pressures: 90 lb., 70 lb. and 50 lb. Make a 10-lb. brake pipe reduction and brake-cylinder gage hand should indicate approximately 25 lb., increase brake-pipe reduction to 20 lb. and note that the brake-cylinder gage hand increases to approximately 50 lb. A more accurate method for testing the brake-cylinder gage is to attach a test gage to the pressure head of the brake cylinder and compare the engine brake-cylinder gage reading with that of the test gage. Locomotive air gages must be tested at least once each three months; also when any irregularity is reported. Gages found incorrect in reading should be corrected before they are returned to service.

Automatic Control, Distributing and Triple Valve Tests

(a) Have the automatic brake valve in running position and know that the equipment is fully charged. (b) Open 3/64-in. orifice in the test device; then place the automatic brake valve in lap position. (c) Engine and tender brakes should apply within the first 5 lb. of brake-pipe reduction. If the brakes do not apply, repeat the above test except that the automatic brake valve should not be in lap position; instead, close the double-heading cock and see that the brakes apply within the first 5 lb. of brake-pipe reduction. Should the automatic control valve, distributing valve or triple valve fail to pass the above test, it should be removed and repaired. Control valves, distributing valves and triple valves should be cleaned as often as conditions require to keep them in a safe condition for service, but not less frequently than once each six months.

Brake Rigging

Note that the foundation brake rigging is maintained in a safe and suitable condition for service; that all levers, rods, brake beams, hangers, and pins are of ample strength; that they do not foul in any way that will affect the proper operation of the brakes and that they clear the rail at least 2½ in., and preferably 3 in. or more. See that all pins are properly secured in place with cotters, split keys or bolts. See that brake shoes are properly applied; not worn out; secured by a brake shoe key and are in line with the tread of the wheel.

Brake Valves

Automatic, independent and straight air: Move the handle to all positions to make sure that the handle operates easily. If it does not, lubricate the valve, key gasket, and handle latch. In case the brake valve is hard to operate after being lubricated, it should be removed, cleaned and repaired. The brake valve should be securely anchored and pipe connections tight. A constant blow at the service exhaust port of the automatic brake valve when the handle is in release or running position, indicates that the equalizing discharge valve has dirt under its seat or the valve is defective. In many cases the dirt can be removed or blown off the valve seat by making a heavy service application and then releasing. To test the rotary valve leakage, make a 20 lb. reduction and lap the brake valve. If the brake-pipe pressure increases, it indicates that either the rotary valve, brake-valve gasket or dead-engine feature is leaking.

Release Position

With the brake valve in this position, a warning port blow should be heard from the exhaust at the back of the brake valve. Open the front or rear angle cock and a strong continuous blow should be obtained at the hose and main-reservoir pressure should fall at a rapid rate.

Running Position

The compressor governor and brake-pipe feed valve should maintain the proper pressure in the main reservoir and brake pipe for the service to which the locomotive is assigned.

Lap Position

The brake-pipe pressure and equalizing-reservoir pressures should not increase above the predetermined pressure for the service to which the locomotive is assigned when the brake-valve handle is in running position. The brake-cylinder pressure should not build up and the main-reservoir pressure should be controlled by the maximum head of the governor.

Service Position

The equalizing piston should raise promptly after the handle of the brake valve is moved to service position and seat properly when the handle is returned to lap position. Also, there should be no leaks from the brake-valve service exhaust port. When making a service application, the time required to reduce the equalizing-reservoir pressure 20 lb. should be noted and must be maintained within the following limits: From 70 lb. pressure to 50 lb., 9 to 11 sec.; from 90 lb. pressure to 70 lb., 7¼ to 8¼ sec.

It should be noted while making a 20-lb. continuous reduction that an intermittent exhaust of air is obtained at the brake pipe exhaust. If only one long drawn out exhaust of air is obtained, it is an indication that the equalizing-piston ring or bushing is leaking.

Emergency Position

Note that emergency action is secured and that the discharge from the brake valve is regular. Brake-cylinder pressure should increase at a more rapid rate than that obtained with a service application and the safety valve should be functioning with the E-T or L-T equipment.

Compressor Tests

All compressors must be given an orifice test in accordance with I. C. C. Rule 107. Close the main-reservoir drain valves and start the compressor slowly; close the compressor drain valve and start the lubricator feeding. Gradually open the steam throttle to the compressor and note that the main-reservoir pressure builds up at a normal rate. Observe the performance of the compressor for even strokes; correct any leakage at the piston-rod packing; note that the compressor does not pound; see that the air-valve cages are tight; note that the steam-cylinder heads are tight and not leaking and that the air strainers are clean and tight. Know that lubricating devices are working properly for the steam and air ends of the compressor.

Feed-Valve Test

Reduce brake-pipe leakage to minimum. At no time should it exceed 3 lb. per min., using the brake-pipe gage to check. Charge the brake pipe to standard pressure with the brake valve in running position. Open the 3/64-in. orifice in the brake-pipe test device. The feed valve should not show a fluctuation of more than 1 lb. from standard adjustment on the test gage. At the completion of range test, close the 3/64-in. orifice, empty the brake pipe and leave the handle of the automatic brake valve in lap position. Open the 9/32-in. orifice in the rear brake-pipe hose test device, close the double-heading cock and place the handle of the automatic brake valve in running position. Open the double-heading cock and note that it does not require more than 3 sec. to restore

the brake-pipe pressure from 0 lb. to 65 lb. on the locomotive gage. Observe the test gage and note that the pressure is retained above 65 lb. on the test gage.

Compressor Governor Test

To test the excess-pressure-head (low-top) and single-top governors be sure that the steam throttle to the compressors is wide open before starting the test. The automatic brake valve handle should be in the running position. See that the proper excess pressure is maintained and that the governor responds within a 3-lb. range. To test the maximum-head (high-pressure-top) E-T or L-T equipment, place the handle of the automatic brake valve in lap position. Observe that the compressor stops at the pressure to which the maximum pressure head is adjusted and that it responds within a 3-lb. range. Be sure that the governor vent port is open and not blowing excessively and know that the pipe connections are not leaking.

Signal-System Test

Determine by inspection that the signal system is free from leakage by closing the signal cut-out cock. Check the leakage with signal test-device gage. Leakage should not exceed 3 lb. per min. from a standard pressure of 42 lb. and this pressure must be maintained. Signal equipment is considered in good condition when four whistle blasts can be obtained in 30 sec. or less by opening the $\frac{3}{64}$-in. orifice in the test device intermittently.

Vent-Valve Test

Start all tests with the handle of the automatic brake valve in running position; the main-reservoir pressure at 110 lb. and equipment charged to 70 lb. Open the $\frac{9}{32}$-in. orifice in the test device and leave it open. Then, with as little lost time as possible, the operator should move to a position where he can operate the automatic brake valve easily. Move the handle of the brake valve to lap position. The rapid drop of brake-pipe pressure should cause the vent valve to open. Close the rear angle cock or orifice test cock. Move the brake-valve handle to lap position long enough to permit the main-reservoir pressure to increase to 135 lb. Then move the brake-valve handle to release position only long enough to permit the brake-pipe pressure and main-reservoir pressure to equalize. Move the brake-valve handle to service position and reduce the brake-pipe pressure to 50 lb. in one continuous reduction. The vent valve should not operate. Vent valves failing to pass the above tests should be removed, cleaned and repaired.

Cleaning and Repair

Any part of the locomotive air-brake equipment that does not meet the various tests, must be removed from the locomotive, cleaned and repaired. Cleaning does *not* mean that the operating parts just be wiped off with a clean cloth but instead the part must be dismantled, the castings put through a cleaning solution, rinsed and then allowed to stand in a vat of hot paraffin. This permits the filling of the porous part of the casting and prevents small leaks. The moving parts of the equipment should be run through a cleaning solution, the valves faced and the seats trued. Pistons and piston stems or rods are put in lathe to see that they are true. Piston-ring grooves are trued; bushings ground and rings of proper size applied. With the use of proper tools and intelligent training of repairmen, a fine finish can be applied to all frictional surfaces. By the use of a good lubricant, leakage past the sliding surfaces as well as frictional resistance between moving parts, will be greatly reduced. After assembly of the air-brake equipment, it should be given more rigid tests on a test rack than that required in service.

These are methods that are being successfully employed on our road and they have been a help not only in keeping motive power in daily service, but in bringing about a reduction in the cost of air-brake maintenance. This much every engineman, repairman, foreman and supervisor owes the management, public and government.

Report of Committee on Shop Tools

Tool conservation and the use of carbides has centered attention on the necessity for proper tool room facilities

Anneman-Mott Studio

E. A. Greame,
Chairman

The report of this Committee at the 1941 meeting dealt with the experiences of a group of 23 railroads with respect to the use of high-production tool steels in the machining of locomotive and car parts. The data which were presented in that report indicated that the railroads were utilizing high-speed, alloy and carbide cutting tools on a wide variety of machining operations and were either effecting material economies in production time or extending tool life, between grinds, to entirely new limits.

In presenting last year's report to the Association, it was recognized that priority control of tool steel by the War Production Board would, in all probability, operate to limit the extension of the use of high-production tool steels, particularly of the carbide type, and that the railroads would experience such difficulties as to warrant early experimentation with substitute cutting tools. The present report was planned with the idea of finding out what substitutions have been and could be made and the manner in which they are performing.

In order to confine the scope of the Committee's survey to questions of maximum value under war-time conditions, the answers to four questions were sought. These were: (1) What difficulties have been experienced

in securing tool steels ordinarily used; (2) to what extent have the roads been able to secure carbide tools; (3) what tool steels are being used as substitutes for those formerly used, and (4) has experience with the substitutes been satisfactory?

Results of the Survey

Question No. 1—Practically all of the replies indicated that difficulties are being experienced in securing tool steels of high tungsten or cobalt content. Deliveries of supplies have been slow thereby creating a condition where means have had to be taken to solve immediate problems. That our shops and tool rooms have been equal to this task may be seen by some of the comments contained in this report. It is apparent that one of the first jobs done was a thorough house cleaning with the result that many roads found excess and discarded tools, all of which were gathered up and sent to the central tool rooms. Where solid shank tools were, in many cases, made up of high-grade steel these tools have been drawn down and applied as tips to carbon shanks with the result that the ultimate supply of tipped tools has been greatly increased. Many machine tools are equipped with tool holders of types for which it is now difficult to get tool bits. The tipped tool has helped to solve this problem. Many pieces formerly looked upon as scrap are now utilized as tips. This helps to conserve stocks of new tool steel on hand.

Question No. 2—There seems to be some conflict of opinion as to the ability to get carbide tools. In the case of some roads which reported their inability to secure carbide tools further questioning leads to the conclusion that a sufficiently strenuous effort had not been made for other roads report that, to date, they have had no difficulty whatever in getting carbide tools in reasonable quantities. One road reported a rapid expansion of the use of carbides since last year and, in replying, stated that "the use of these tools is limited only to the extent to which we can train our men in their proper grinding and use. In several shops carbides are used almost exclusively on tire boring, driving-box bearings, turret-lathe work and vertical-turret-lathe work.

Question No. 3—Replies to this question indicated that practically all substitutions have been in the nature of tool steels of low tungsten content replacing those of higher content such as a tungsten molybdenum high-speed steel with approximately five per cent tungsten in place of the 18-4-1 type. It is interesting, however, to note the fact that some shops report the substitution of carbides for high-speed steel.

Question No. 4—All replies indicated a general satisfaction with the performance of substitute steels and in some cases the substitutes have proved to be even better than the cutting tools formerly used. A shop which has installed special equipment for grinding carbide tools reports such satisfaction with present performance of carbide tools that a return to the use of high-speed tools is doubtful. Many replies stressed the importance of modern tool heat-treating equipment and the efforts now being made to obtain such equipment. The many references to the proper grinding of tools and the proper equipment with which to do it indicate that the campaigns of recent years on the part of manufacturers of tool steels to promote the idea of proper tool grinding are now bearing fruit in the form of better machine and tool performance.

How One Shop Meets the Situation

The reply from one shop superintendent summarizes the situation with respect to tool steel so well that it is quoted, in part, as follows:

"Now that high-speed steel is practically unobtainable for railroad shops, it is both surprising and gratifying to note how quickly our shop forces are adapting themselves to the new conditions, making the most of the existing stocks of high-speed steel and the substitutes which are available. Up to a year ago, solid tools, worn-out cutters, dies and reamers, etc. could be found around all machines and in tool boxes; now anything larger than vest pocket size is taboo.

"The life of cutting tools is being multiplied several times by the development of cements and fluxes for the cementing of high-speed tips onto carbon steel shanks, with proper care there being no excuse for scrapping any piece weighing more than a few ounces. Most all shops have had experience in cementing tool bits for lighter work, but it is only recently that this practice has been developed satisfactorily for heavy-duty tools. For example, it is not so long ago that solid high-speed tools 3½ in. by 1½ in. by 18 in. long were considered necessary to turn tires—now we are using a piece 1½ in. round by 1 in. thick, weighing only a few ounces, cemented on to a forged tire-steel shank, with excellent results. Experience has taught that forged tire steel of any size makes an ideal tool shank, as a separation is liable to occur between the bit and shank on the heavier cuts if a softer steel is used.

"If properly heat-treated, there is no reason to make any change in the feeds, speeds and depth of cuts from what were previously used with the solid tools; also, the tips can be ground down almost to the shanks before failure occurs. Another advantage is that there is no wear-out at all to the shank. Tool bits of standard sizes can be forged and kept in stock ready for application and can be put back in service just as quickly as by reforging a solid tool.

"We are not forgetting the fact that if the emergency exists for some considerable time, even by these methods of using up every ounce of steel available, there is going to be a time when these stocks are going to be depleted. Considerable experimenting is being done with molybdenum steels in order not to be caught short. On light work, such as turning and boring steel pins and bushings, there are no complaints with molybdenum, but on heavy or intermittent cuts, especially on cast steel where sand is encountered, we have not been so successful. Our experiences along this line, however have been limited.

"To date we have had no difficulty in procuring carbide tool bits and since they have been in constant use for several years in the local shops, our foremen and men are fairly well trained in adapting the various grades to suit the conditions.

"It has been found that while the manufacturer's manual usually gives the grade to be used in cutting different metals, to get the best results there are other conditions to be considered, such as the condition of the machine. For instance, a hard grade bit might be satisfactory on one machine and would break down on another machine cutting the same metal. Frequently carbide tools have been condemned because sufficient thought has not been given to the machine condition in selecting the grade.

"Proper grinding of tool bits to suit the metal to be cut is important; on intermittent cuts, entirely different top rakes and side angles are required to take the shock away from the point of tool. There is an article entitled "Using Carbide Tools On Large Machine" in the August, 1942, issue of the *Railway Mechanical Engineer,* page 357, by Fred. W. Lucht which covers this subject thoroughly.

"In the past the cost of carbide tools was almost prohibitive, but now that the price is considerably lower and high-speed steel is unobtainable, there is no doubt

that the use of carbides as a substitute will be increased. Briefly, our present practice is as follows:

"*First*—Collect all solid pieces of high-speed steel and forge into tool bits. Results: No loss in cutting time.

"*Second*—Use carbide tool bits wherever machine and work conditions will permit. Results: Cutting time frequently decreased.

"*Third*—Molybdenum steels have been found quite satisfactory on light work, using the same speeds, feeds and depth of cut, but our experience is limited on heavier work."

Centralized Tool Control System Needed

The present situation with respect to cutting tools is serving to show the importance of a centralized tool control method for a shop, or a railroad system. The very shortage of high-production cutting tools has increased their value to a point where every effort is being made to conserve them; to use them properly and to get from them the full measure of their capacity to cut metal. Scarcity has made obvious the fact that certain practices, indulged in when materials were plentiful, can no longer be tolerated.

Among the facts that experience of the past year has developed are: (1) That cutting tools, regardless of type can do a better job of producing if they are properly designed, properly heat treated and properly ground; (2) that the wider experience of tool steel manufacturers qualifies them to make recommendations which the railroads, as users, can well afford to follow in the effort to conserve these vital materials; (3) that it is not possible to furnish machine operators with tools of maximum efficiency unless the tool room is adequately equipped with heat-treating and tool-grinding equipment at least as modern as the tools which are now being used, and (4) that every effort should be made to secure such equipment as a guarantee that production will not be curtailed because of a bottleneck in the tool room.

The report was submitted by a committee composed of E. A. Greame, (chairman), tool foreman, Delaware, Lackawanna & Western, Scranton, Pa.; W. W. Brown, shop supervisor, Boston & Maine, N. Billerica, Mass.; W. Hurst, supervisor shop machinery and tools, New York, New Haven & Hartford, Readville, Mass.; E. J. Kueck, mechanical engineer, St. Louis Southwestern, Pine Bluff, Ark.; F. Perkins, shop superintendent, Grand Trunk Western, Battle Creek, Mich., J. I. Stewart, supervisor shop machinery and tools, New York Central, New York, and J. P. Christiansen, Chicago, Indianapolis & Louisville, Lafayette, Ind.

Finding and Training Good Supervisors

Potential supervisors are usually found in the ranks but it requires a carefully planned training program to develop them

F. K. Mitchell,
Chairman

The committee, selected to prepare this report, has considered that its obligation to produce a worth while work is accentuated by the acute need arising through the present war emergency. It felt that while the subject has always been pertinent, the load on industry and railroads alike, placed there by the demands for production and transportation incident to the war effort, will only be met as successfully as is the supervisory personnel problem. With that obligation assumed, it herewith proceeds to present for your consideration the best plan and procedure its members are capable of formulating.

Basically, the first element of the problem is raised in the question—"What kind of material must be obtained, what qualifications must be present in the candidate for a supervisory position?"

Personality the Vital Factor

Contrary to the usually accepted premise, the committee feels that the first necessary attributes are found in the realm of that almost indefinable qualification called "personality." We hold that above all, in the selection of a candidate for a supervisory position, such a one as will not only be successful in handling a minor job, but as may also be depended on to be equally successful in the discharge of duties through a range of successively more important positions, should be appointed, and that no candidate without personality can be expected to fill that requirement. We shall not attempt fully to define this so-called "personality," but only to give you those components which in our opinion constitute its most important elements. These we have designated in what we believe to be the order of their importance from the point of view of this discussion. They are, first, honesty and sincerity; second, the ability of the candidate to get along with his fellowmen; third, appearance; fourth, address; fifth, alertness and enthusiasm; and sixth, initiative.

The next group of qualifying attributes in order of importance might be classed under the general heading of "background," or those good indications out of the past that may well point toward the possibility of equally good or better things in the future. Realizing full well that many a fine character has come from a family of ne'er-do-wells, we still feel that the best selection in the long run will be that of one who comes from a good substantial family. Following almost the same line of logic and experience, one with at least some religious conviction might well be chosen. Now, more than ever in the past, we feel that at least a high school education is essential. Further, it is desirable that our future

supervisor should have evidenced a keen interest in diverse affairs and even more desirable that he have evidenced some tendency to leadership in one or more fields, be it social, religious, athletic or civic.

The man we are looking for must be valuable over a long period of years, and to be so he must have good health and physical stamina. We expect to invest a great deal in him, and it is logical that if we expect to profit through such investment, he should have those attributes. Since he will be called upon to use his eyes a great deal, it is not too much to demand that they should test at least 20/20 without glasses. He should have no objectionable deformities or any hereditary or communicable diseases and his general health should be good. It might even be well for him to be moderately participant in some athletic activity.

Since the man we are looking for is to serve as a mechanical department supervisor, he should have a natural liking for things mechanical. It is essential that he be fairly good in mathematics, for his every day problems will involve their use. It is also desirable that he be mechanically analytical, and likewise mechanically creative.

Where Shall We Look For Supervisors

Having reached some definite conclusions as to the kind of material we are looking for, it will not be amiss to consider where we are apt to find it. Generally speaking, it is going to come from one of two sources. The first, and most desirable source, from many points of view, is within the ranks of our own organizations. If it can be found there, the esprit de corps of any organization will be benefited. It may come from the ranks of mechanics already employed as such, from among the regular apprentice group, or from the special apprentice group where technically trained men are afforded such special training. If not found at all in these groups, then we must look outside our own organizations, to high schools, trade schools, co-operative schools, colleges and in exceptional cases to outside industries.

The next phase of our problem is the procurement of the kind of material we know we want from the sources available. Here again two distinct problems are presented. First, let us consider the procurement from among our own ranks.

The Importance of Personnel Records

Essentially, adequate personnel records must be maintained. Often the material we are seeking is buried just under our noses. A parallel might be drawn from the experience of one railroad when the supply of scrap iron and steel became inadequate. One official remembered that an old site where a car shop had been operated for years and then abandoned, had been filled in without any attempt to remove the old rail and other scrap. They ploughed up the site at his suggestion and tons of scrap were brought to light. Adequate personnel records will perpetually turn up the much needed supervisory material which might otherwise become buried in any organization.

Secondary to such records in value to our problem comes the supervisor who knows intimately the men who work for him and their qualifications and possibilities. Such a supervisor can be of untold value in keeping management advised as to the potential supervisors in the ranks. In order to make all supervisors equally valuable, it is suggested that each and every supervisor be required to recommend to his immediate superior at least two men in his gang or department who are qualified to act in his stead or succeed him in event his position becomes vacant through promotion or otherwise. One means of making such selections less difficult is to make the supervisor s job attractive to others. To this end, the establishment of proper rates of pay and spread of rates should be under constant consideration. Another method is to accord the supervisor proper deference and prestige. A third is to design apprentice courses so that every apprentice will be inspired to desire more than a mechanic's job.

The problem of procurement of supervisory material from outside sources has a large element of salesmanship involved in it. Your company must be sold to those agencies from which the procurement can be made and to those candidates brought to your attention by such agencies. This may be done in a number of ways. Apprentice instructors and shop superintendents should keep in close contact with local high school and college personnel officers. Furnish them with information concerning your training courses and chances of advacement. Through them contacts may be made with students having the proper qualifications.

It is suggested that such methods as the encouragement of inspection trips by students of local schools through company shops in order to instill interest might well be productive of favorable results. Through interviews, by properly qualified officers with prospective apprentices while they are yet in school, both parties will benefit. If such interviews are properly conducted—not merely made a quiz—the student will learn better whether he is fitted for the kind of work being offered and the interviewer will have a chance to find out whether the candidate can qualify. Carry the procurement to the candidate, don't wait for him to come to you! In this day and age if you wait, the other company will get the best and you will get what is left. This principle will apply equally as well where the rules require sons of employees to be given preference.

Some thought should be given here as to how extensive procurement effort should be. The endeavor to locate satisfactory supervisory material among the ranks of your existing employees should, of course, be diligent and unceasing. The effort to secure it from outside sources should be gauged by your success within your own organizations. Procurement from outside sources should only be in numbers necessary to augment the deficiency from within. At all times the proper balance between technical and non-technical graduates should be maintained.

Training of Supervisors

Assuming that we are able to procure from the available sources potential supervisors in required numbers, the next step is, of course, properly to train them for positions of responsibility. This problem logically divides itself into two phases—the development of supervisory ability before and after the initial appointment.

It has been aptly said that "as a twig is bent, so the tree is inclined." The same applies to the development of a supervisor. The initial stages of his service with your company, which usually will be during his apprenticeship, may well be considered as all-important. Hence, too much thought and effort cannot be directed toward developing an apprentice training system which will not only inspire the desire to become supervisors, but also inculcate in the apprentice those traits and ideas which are known to be essential to good supervision.

With that idea in mind we offer the following suggestions: First, that all problems put up to the apprentice both in school and in the shop be related to some phase of shop or railroad activity which he may need to know about in the future. For instance, rather than have him figure the area of a circle 11 in. in diameter let the prob-

lem be to find the cross sectional area of an axle bearing 11 in. in diameter; and in the shop, rather than have his first lesson on a shaper be to plane a piece of steel to ½ in. by 5 in. by 8 in., let him make a crosshead liner of the same dimensions, explaining to him where, how and why it is to be used. Provide lectures on shop problems and operations based on the same general idea, avoiding the abstract and emphasizing the practical. Do not restrict his advance nor the nature of his work to the average of all apprentices, but let him advance as rapidly as his capabilities will permit. Subtly, yet continually, keep each reminded of the successes of former apprentice school graduates. Reward fittingly each apprentice for his interest and progress. When he is sufficiently advanced, let him act as an assistant instructor during the school hours and in the shop assign him special work which will cause him to feel that his foreman believes him to be trustworthy.

Apprentice Clubs

No greater help in the creation of supervisory material at this stage can be devised than the apprentice club. Management should sponsor the clubs but the apprentices should be allowed to run them. By observation of how they are managed—who takes the leading parts—valuable information as to the ability as leaders which various boys possess can be obtained. It has been suggested that one logical scheme might be to suggest that the club offices be given names corresponding to railroad positions, and while a boy holds such an office he be sponsored by the shop supervisor having the same title. To maintain interest in club matters at the proper height, and, at the same time, show its appreciation of the activities, management might well sponsor such activities as club trips to other shops, model building, and so forth. Finally, management should give the apprentice club all possible publicity in local, railroad and national publications.

Extra-curricular work for apprentices should be made available. They should be encouraged to take advantage of correspondence courses and night courses offered by schools and universities in the vicinity. After-hour shop forums on vital railroad problems and operations, if wisely conducted, will likewise afford an opportunity for development of address and the ability of the apprentice to express himself clearly before others.

Consultation between the apprentice and his sponsor has been found to be of eminent value. Here both may profit. The apprentice, through this medium, has a chance to find the answers to problems which are vague to him and the sponsor has an opportunity to learn more and more about the latent abilities in the apprentice and how best they can be developed.

Two Important Suggestions

All of the above suggestions may be of little or no avail unless two very important additional things are done. The first of these is to establish, by suggestion and example, that all supervisory appointments are made on the basis of qualification and merit. The second is that an adequate system of reports and records, covering all activities and qualifications of candidates, be maintained so that no error in judgment is likely when the candidates for any position are being weighed.

Often an extended period of time may elapse between the time of an apprentice's graduation and the occurrence of a supervisory vacancy. During this period his interest and desire for a better position must be maintained. He should be encouraged to participate in safety, first aid, social club and other activities. He should be consulted by his immediate superior on any matters pertaining to his gang or department and, where possible, his ideas used and he be given credit for them. As the occasion arises, he should be given an opportunity to fill in on temporary minor supervisory vacancies and an accurate record kept as to how he conducts himself.

Proper Procedure in Making Appointments

The committee does not feel that the question of the actual mechanics of appointment of the supervisor is essentially a part of its problem but would, however, like to suggest that in all cases the original recommendation should come from the candidates' immediate supervisor, if such supervisor is known to be qualified to make the recommendation. Next, that the head of the department in which the appointment is to be made have opportunity to approve and do so only after satisfying himself that the candidate has the necessary qualifications and that his recommendation was made on that basis and under no consideration on the basis of personal friendship, relationship, religion or politics. The officer charged with final approval should not only consider the merit and qualifications of the candidate as reflected by personnel records and what personal knowledge he has of these, and on the basis of impressions obtained by interview, but should consider how the candidate's personality will fit with that of the man to be his immediate superior.

The final consideration, and by no means that of least importance, which we wish to deal with, is the development of the supervisor after his appointment as such.

Our first thought here is really tied up with the actual appointment, and that is the important fact that any supervisor should be appointed only to a job which is within his capabilities of handling. Many a fine prospect has been ruined by failure to consider that too great a step forward may break the spirit of some candidates by imposing more of a load than they are yet ready to carry, and in other cases may cause the candidates to get an exaggerated opinion of themselves. Either situation is highly undesirable.

Coaching New Supervisors

Our next thought is that it should be recognized that he will need help. To this end we urge that he be given a complete understanding of his new duties and responsibilities. This may be done by conference with his new superior, but perhaps can best be done by leaving the man he is to relieve with him a few days so that the one can pass on to the other the benefit of each man he is to supervise. The new supervisor should also be given such literature as is pertinent to his job, such as shop schedules, working agreements, etc.

Our next thought is that the probable route of each supervisor's advancement should be pointed out to him in order that he may have opportunity to prepare himself. Urge that he do so through observation of others and study. Many roads are finding that help in this direction, by making available to all foremanship conferences and refresher courses, is highly beneficial. These are also found beneficial to management because of the opportunity they afford for observation of those who take advantage of them by senior supervisors who are constantly alert to spot such men as merit further advancement.

Here it might be well to offer an admonition against a practice which has often been followed more through shortsightedness and selfishness than for any other reason. It is—don't hold a supervisor, who is qualified for more highly responsible positions, on a job just because he is exceptionally valuable on that job. A diversity of experience will not only keep up his interest, hearten

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trical equipment, having an abrasive effect on the commutator and motor bearings. Its accumulation on the equipment will conduct the high voltage circuit to ground particularly when wet. Sand must never be used when wheels are spinning. While this is a lesson learned with steam-locomotive operation, it is more important with Diesel-electric as the fly-wheel action of the motor armature will overstress the pinion gear when the wheel to which it is geared is too suddenly brought to rest. Overstressing of the gears also occurs when brakes are used while power is applied.

On some Diesel switchers, through a scheme of wiring in the control circuit, the reversing drum and power switch are synchronized with the reversing lever and, with this arrangement, if the motor fields are reversed while the locomotive is moving, considerable damage might occur to the electrical equipment by regeneration from the traction motors. Therefore, never shift the reverser until the locomotive is at rest. Where the air compressor is connected to the crank shaft and it is necessary to pump up air while the locomotive is in motion, kill the excitation on the main generator before opening the throttle as this will disconnect the motors.

Slid-flat power wheels have a very detrimental effect on traction-motor windings. Therefore, skidding can and must be avoided. There is nothing inherent about a Diesel which will contribute to sliding wheels. On the contrary the fly-wheel action of the traction-motor armatures tend to keep the wheels rolling against braking force. While this is more or less true there have been many flat wheels on this type of locomotive. Invariably they are caused by improper brake manipulation. The engineman, in switching off cars, should endeavor to stretch the slack with light cylinder pressure before developing the maximum obtainable. By so doing there will be no heavy change of slack to shift the weight from the locomotive wheels to reduce the adhesion; it is a lack of adhesion which will cause the wheels to slide with a given braking force under normal conditions. With bad rail conditions the engineman should apply that same good judgment which he was taught to apply when handling other types of power. All should understand that with any electrical transmission a derailed power truck must never be rerailed by aid from the derailed truck as the wheels would ordinarily spin when power is applied, and all traction motors being of the series type, having certain inherent characteristics, this sudden spinning of the unloaded wheel is liable to cause the motor armature speed to increase to dangerous proportions, wrecking the entire motor. While switching locomotives are mentioned, the foregoing is applicable to Diesel freight or passenger operation.

The road foreman of engines in steam locomotive operation had the problem of the human equation in getting enginemen to handle steam engines so as to get maximum efficiency from the machine by co-ordination of the reverse lever and throttle manipulation. Some enginemen seemingly could not make the time or negotiate the ruling grade with a tonnage with which others experienced no trouble whatever. This difference in enginemen was somewhat narrowed by the valve pilot and back-pressure gauge. With Diesel power there is no difference between enginemen in this respect as the Diesel engines respond the same for any engineman in a given throttle position. However, the road foreman of engines does have a problem in the Diesel operation far greater than that of steam. It is true that the Diesel engine is protected from overloading by automatic electro-mechanical devices, but there is no protection afforded the electric transmission. The road foreman is faced with the problem of protecting this by training enginemen never to stop with the power applied and never attempt to start until the brakes are fully released and always to operate with the traction motors in the correct operating characteristic corresponding to the speed.

Traction motors used for Diesel-electric motive power are almost invariably of the series type. In operating a train with this type of motor any increase in grade which causes the train to slow down results in an increase in current flow. Increase in current flow causes increases in temperature. If the motor and generator are then subjected to temperature higher than the critical for the insulation, the insulation becomes charred. It is this overheating which the engineman prevents when complying with operating instructions and with which the road foreman must insist on full compliance.

The report was signed by W. D. Quarles (chairman), general mechanical instructor, A. C. L.

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him for greater responsibility, but make him even more valuable as his career advances.

Make Supervisor Part of Official Family

The final thought this committee would like to leave with you is that as soon as a man is made a supervisor, he should be made to feel that he has become a part of the official family. To this end, treat him so that it will be evident to him and to all other employees. See that he is given full information on the company's policies in all matters which he handles. Let him know that he is to be the advisor of his immediate superior. Don't countenance one supervisor going over the head of another in giving orders, seeking advice or in the administration of discipline. Give him a place at your production, routing, safety and other shop activity conferences. Encourage him to express his opinions. Where they are not sound, explain the fallacy in them to him patiently but thoroughly. When they are sound, let him know that they are appreciated and if it is possible to put them into effect see that he is credited with them. Increase his responsibilities as he shows himself able to assume them and let his promotion be in the same proportion.

It is our firm belief that the recommendations heretofore expressed on the selection, procurement and training of supervisors, if followed, will produce an organization which will function smoothly and efficiently, will be amenable to rapid expansion under increased load and at the same time be loyal and understanding in adversity.

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