apparatus in a condition that will result in failures later on. It is not advisable for anyone to have access to signal cases, excepting those directly connected with signal work. To protect the maintainer, the officer making the surprise tests should send a message, immediately after the tests have been made, to the superintendent, the signal supervisor and the maintainer, stating that the test was made, and giving the number of the signal, the apsect shown, the time, and the number of the train that was tested.

Suggests that Signal Inspector, Maintenance Foreman, or Supervisor Co-operate with Operating Officer in Conducting Efficiency Tests

By J. H. Oppelt
Signal Engineer, New York, Chicago & St. Louis, Cleveland, Ohio

The term, "surprise test," does not seem to cover the situation as well as "efficiency test," which more clearly defines the purpose for which the test is conducted.

Under no circumstances should an operating department officer be allowed to open instrument cases or signal mechanisms or in any way to disconnect any apparatus pertaining to the operation of signals. The signal department is held responsible for the operation of signals and a responsible member of that department should be the person to do what is necessary to bring about conditions or signal indications desired by the operating officers making the test.

It is not desirable to have the maintainer handle the matter unless he had been thoroughly instructed by his superior as to exactly what is to be done. Efficiency tests are more often made at night and in isolated locations and extend over such a period of time that the maintainer's services would mean payment for his time at punitive rates.

The average railroad makes tests not oftener than every thirty days and there is no reason why the operating department cannot arrange on short notice, or have a standing arrangement with the signal department, to furnish the services of a designated responsible member to handle the test. An inspector, maintenance foreman, supervisor or other responsible employee should be the one to act with the operating officer.

Maintainer Can Assist in Surprise Tests Without Serious Interference with Other Duties

By W. L. Connors
Signal Engineer, Buffalo, Rochester and Pittsburgh, Rochester, N. Y.

Numerous surprise tests of enginemen can be made without access to signal relay or mechanism cases. Where access to these cases is necessary, it seems advisable to have the maintainer present. Ordinarily, in conducting surprise tests it is desired to check the performance at both ends of the train, at the front end to see that the stop is made before passing the signal, and at the rear to see that proper flag protection is provided. Where this is done and the maintainer's other duties will permit, he can check one end of the train while the operating officer checks the other. If the maintainer's presence is not required while the test is being made, he can go about his work in that vicinity, returning to restore the signals to normal when the test is completed.

To serve the purpose intended, surprise tests are necessarily conducted at locations well distributed over the division, and will not occur frequently on any one maintainer's section. We have found that, with proper co-operation between the operating and signal departments, the maintainers can assist in making surprise tests without serious interference with their other duties.

Signal Maintainer Should be Present When Signal Mechanisms or Relay Cases Are Opened

By J. R. Coles
Signal Engineer, Western Pacific, Oakland, Cal.

In my opinion, operating department officers should not be permitted to open relay cases or signal mechanisms. If it is necessary for such cases to be opened, the signal maintainer should be on hand and should make the necessary connections under the direction of the officer making such tests, and should not be held responsible for any stop indications given. Before making surprise tests, when the signal maintainer is not on hand, the dispatcher should be notified, so that the maintainer will not be called out unnecessarily.

Maintainer Should at Least be Notified of Proposed Test

By A. M. Gilbert
General Signal Inspector, Cleveland, Cincinnati, Chicago, & St. Louis, Cincinnati, Ohio

A representative of the signal department should accompany anyone making surprise tests of enginemen, where signal apparatus is involved. The maintainer should either assist in making the tests or should be notified when and where they are to be made to prevent unnecessary work on his part and, in many cases, to save the expense of a call. It is not good practice for the man making the test to change or tamper with the apparatus for which the maintainer is responsible. Delays and sometimes accidents result in making tests of this nature, when made by someone not properly qualified.

The A-C. D-C. Track Circuit

"What progress has been made with the special a-c/d-c. track circuit in which alternating current is transmitted through the rails and is rectified at the relay end to energize a d-c. relay? Are the shunting characteristics of such a track circuit satisfactory? Is such a track circuit reliable in operation? What are its advantages and limitations?"

Experience with This Type of Track Circuit Entirely Satisfactory

By C. E. Stryker
Manager, Industrial Division, Fansteel Products Company, Inc., North Chicago, Ill.

Several hundred units of this type have been in service for three or more years. To the best of our knowledge little or no trouble has been experienced in their use. The shunting characteristics of the circuit are entirely satisfactory, and are in some cases much better than those circuits which use an a-c. relay. As to the reliability of such a track circuit, we believe that the fact that several hundred of these units have been in service for three or more years proves their reliability beyond a doubt. The advantages of this type of installation are its low cost and low power consumption. The disadvantage is that it is not subject to control by changing the polarity of the (a-c.) track circuit.

Open Line or Aerial Cable for Coded C. T. C.

"When installing the three-wire coded-control line circuits for a centralized traffic control system, should the line control wires be in cable or should they be open wires? Should strength or conductivity be the controlling factor in deciding on the material and size of the wire, and is weatherproof protection desirable?"

Cable Withstands Sleetstorms Better - Defects Detected More Easily in Open Line

By G. A. Rodger
Assistant Signal Engineer, Wabash, Decatur, Ill.

The use of cable as compared with the use of open line wire is a question which reverts to an economic study. The factors to be determined are the original costs and the maintenance costs, as well as the increased expense of train operation in the event that the line service is interrupted by sleet or storm.

Cable would, no doubt, be a more permanent installation, and perhaps, in some particular cases, it might ultimately prove more satisfactory and less expensive. However, the first cost of installing cable on a centralized traffic control territory the length of that on the Wabash, 93 miles, would be almost prohibitive, and it would be difficult, if not impossible, to show a fair return on the investment if cable were used.

Probably the greatest determining factor is the possibility of train operation being interrupted in case the line were put out of service by sleet storms. The probability of this type of interruption occurring is greatly reduced by the use of cable. Conclusions may be based on past records of lines in the territory where the project is proposed to be installed, as certain localities are more susceptible to sleet and windstorms than others.

The cost of maintaining an open line is considerably more than that of maintaining a cable. There are, however, advantages in maintaining an open line, in that opens and breaks are more readily detected by inspection and can more easily be repaired. Troubles in a cable can be detected only by some method of testing and are often difficult to repair.

The frequency with which the system is put out of service, resulting in interruptions to traffic, and the resultant cost of such interruptions must be balanced against the difference in cost between cable and open line. It was our belief, after a review of past line troubles in our centralized traffic control territory that the extra cost of installing cable over such a long territory would not be justified. The predicted saving in reducing line interruptions by the use of cable was not considered sufficient to warrant the extra cost. For the above economic reasons, it was decided to use open line wire, with reasonable confidence that a well constructed line would not break down often enough to interrupt operation to a serious extent.

In open line construction, even though a small conductor would satisfactorily operate the system, the strength of the conductor must be such that it will reasonably withstand sleet and storms. On the Wabash No. 8 weatherproof solid copper wire was used to obtain the necessary conductivity and consequently the necessary strength was also believed to have been attained. This is the smallest size wire we would consider using in order to get the necessary strength with a margin of safety. Weatherproof covering is desirable as it prevents minor grounds and crosses due to wires and other objects falling across the line.

The problem is really reduced to whether or not the extra cost of installing cable, and thereby reducing the possibility of interruptions to traffic, can be justified and still permit a fair return on the investment.

Prefers Open Line

By A. H. Rice
Signal Engineer, Delaware & Hudson, Albany, N. Y.

We believe that a well-built open line, with safety factors adequate for the type of country and weather conditions encountered, is the most satisfactory line construction for a three-wire centralized traffic control system. The material and size of the conductors in such a line will usually be fixed by the mechanical strength required. Weatherproof insulation provides a fair degree of protection for several years, against low-tension crosses and grounds such as are caused by broken telegraph, telephone, signal and other wires, and branches of trees, and its use will be justified if centralized traffic control lines are exposed to these conditions.

Conductivity Basis in Determining Size

By E. T. Ambach
Assistant Signal Engineer, Baltimore & Ohio, Cincinnati, Ohio

When installing three-wire coded-control line circuits for a centralized traffic control system, the line control wires should be placed in the center of a cable and the size of the conductors should be determined by conductivity rather than by strength. The cable should be carefully erected on a pole line having not less than 130 ft. spacing with every fifth pole side-guyed, all terminal poles both side-guyed and head-guyed, and all timber in the pole-line sound. Weather-proof protection of coded control wires should be avoided whenever possible. The size of poles which carry the cable should be determined by the climatic and storm conditions of the territory in which the system is to be installed.

Cites Many Advantages For Cable

By T. C. Siefert
Assistant Signal Engineer, Chicago, Burlington & Quincy, Chicago.

It is desirable to install cable, for three-wire coded control systems, for the following reasons: The use of cable reduces the load on the pole line and, in fact, materially strengthens the pole line through the presence of the messenger upon which the cable is supported. A properly guyed pole line is a very dependable storm-proof structure, and the installation is, therefore, immune to failures due to line trouble. With the messenger strand carefully grounded, and the cable rings forming a "cage," the line is freed from static electrical charges and failures caused by lightning.

The use of cable is desirable, as it has high insulation qualities, thereby lessening the probability of crosses or grounds occurring. With centralized code control wires, it is desirable to have a certain amount of resistance in the circuits to reduce induction. Therefore, a No. 16 B. & S. gage (copper) wire can be used in the cable. The effect of this resistance, then, is offset by the use of a line relay of higher resistance, which, in turn, effects a slight saving in the cost of power. The use of No. 16 B. & S. gage conductors in a cable brings the cost of cable about on a par with open weather-proof line wires, thus making it possible to secure all the advantages of a cable installation without an unnecessary outlay of money.

G. H. Dryden, signal engineer, Baltimore & Ohio: "The Baltimore and Ohio has no coded control circuits in service, but has 98 miles of three-wire coding under construction. The ruling factors are sufficient conductivity, high strength and perfect insulation. We are using No. 12 gage wire in cable, supported by 3/8-in. messenger. All crossing poles are being side- and head-guyed. For open line construction, we would recommend No. 6 double-braid weatherproof Copperweld or its equivalent in mechanical strength. Weatherproof insulation is necessary to prevent interference due to other wires breaking and falling across the coding wires."

Locks for Mechanical Levers*

"Electric locks—for use on mechanical interlocking machines—, which lock the lever instead of the latch, have recently been placed on the market. The mechanical force-down feature is operated by the latch, thus providing mechanical locking for a mechanical machine. In your opinion, what are the merits of the new lock with respect to safety, reliability of operation, and economy of maintenance?"

Reliability of Lock of Utmost Importance

By S. P. Hull

Signal Supervisor, New York Central, Poughkeepsie, N. Y.

The safe use of electric clocks on mechanical interlocking machines pre-supposes proper design and manufacture of the lock, proper design and installation of the controlling circuits and proper insulation of all circuits and appurtenances involved.

But still another vitally important condition must be correct and must be maintained so, in order that the operation of the lock may be safe at all times, and that is the provision that necessitates the placing of the lever or its latch in the position in which the electric lock will engage it before it releases other levers. With the electric lock so adjusted, it is clear that, until the electric lock has become effective, no conflicting route can be set up, nor can an indication be given.

Assuming that the electric lock is applied to the lever latch, reliable operation requires that the electric lock be adjusted to engage the lever latch before it has been lowered enough to release its mechanical locking; this, on most levers of new machines, is a very simple matter. With the electric lock adjusted so that it becomes effective with the latch block approximately one-half way down the quadrant, and the mechanical locking so that the latch cannot be raised more than approximately one-third up the quadrant, a proper condition exists. This proper condition will continue, however, only as long as the wear and lost motion in the mechanical locking do not increase to a point where the latch block can be raised more than one-half up the quadrant; for, if this condition occurs, it is evident there is no longer anything to force the latch block to be lowered far enough to engage the electric lock.

It would then be quite reasonably possible that with the locking parts not moving freely, the latch block, when lowered, might stop at a point too high on the quadrant for the electric lock to engage, and still low enough to release the mechanical locking. Also, the lever latch could, of course, be intentionally manipulated to bring about the same result, and this possibility seriously reduces the reliability of the lock, as the electric lock is depended upon to prevent the operation of switches under trains and to force the correct operation of signals. It can be claimed that if mechanical locking parts are maintained at all times so as to keep the lost motion and wear to within proper limits, this undesirable relation between mechanical and electric locking cannot occur. But several years' experience has shown that while proper limits can be maintained between the levers directly locking each other, it is extremely difficult to maintain these limits where one or two "specials" intervene; where there are more, it is none too easy to secure this proper adjustment when the machine is newly installed; and to maintain it is practically impossible—in any case it is uneconomical. This difficulty could be overcome by re-designing the machine so as to have a longer latch block stroke, but this would involve some vital and expensive changes.

A very effective way and, it is believed, the only practical way to solve the problem has been extensively applied. This method consists of designing and installing the electric lock so that it controls the movement of the lever directly instead of the lever latch, as now extensively practiced. This arrangement does away with the close relation between the adjustments of the latch block for mechanical and electric locking limits required for reliable operation, but without sacrificing the necessity of moving the lever to the position in which the electric lock engages it.

With this arrangement, lost motion in the mechanical locking in no way affects the reliability and effectiveness of the electric locking. While this application of the electric lock does not affect the latch movement, it utilizes it for operating a battery-saving contact, and, which is far more important, it utilizes it also mechanically to force the locking member of the electric lock to the locked position if the dog of the electric lock should "stick," thus effectively safe-guarding against the serious possibilities that might result.

This type of lock has already been installed quite extensively on mechanical interlocking machines, and has been found so reliable and satisfactory that greater wear tolerance has been permitted in the mechanical locking. This cheapens its maintenance without in any way sacrificing its reliability.

This type of electric lock is much better in principle, simpler and more rugged in design, more economical in maintenance and more reliable in operation, and that it will eventually almost entirely replace latch locks on mechanical machines.

*Other answers on this subject are given in the March number.