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 ⅜-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
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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.