with the maintenance of the plants, shall report "once in every 60 days."

It is quite evident from the comparison of items that the desired result is the same in all cases, i. e., protection. There is this common principle underlying all of the specifications, and it may be read between the lines without difficulty, but there appears to be no definite expression of the principle in any of the rules. The only place where it appears at all is in the general statement of "General Requirements," and here it is inadequately expressed. A simple statement requiring "proper devices" which would "provide completely" against evident and "collateral dangers" would, it seems, cover the entire scope of the rules. The working out of the details would naturally be left to the signal engineers, and in the presentation of their plans it would devolve upon them to prove that they provided completely against the dangers, and gave the desired protection.

THE MECHANICS OF THE COMPENSATOR

BY W. E. FOSTER.

The question has frequently been asked, "Why did subcommittee No. 1 of the Railway Signal Association change the design of the lazy-jack compensator?" No explanation was made in detail to the association and the subject is not generally understood.

It is the purpose of this article to explain, for purposes of comparison, the two designs (old and new) graphically and mechanically, presupposing a slight knowledge of plane geometry on the part of the reader.

Fig. 1 shows the old design in outline. A and B are the centers, X and Y the operating points, XAC the obtuse or 120 deg. crank, YBD the acute or 60 deg. crank, and CD is the connecting link.

The operating arms AX and BY are shown perpendicular to the center line AB. In this position angle EAC = angle EBD = 30 deg. and the link CD bisects the center line AB. Angles ACE and BDE are equal and CE = ED. Angle FAC, being

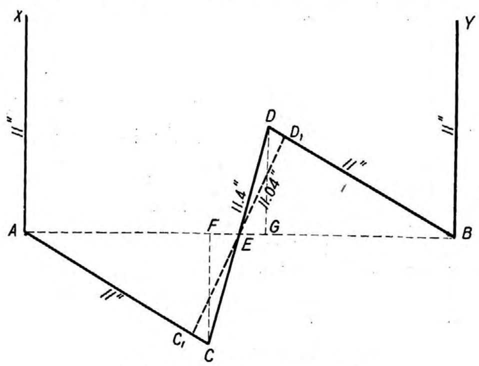


Fig. 1. Arms on Center.

30 deg., then FC, perpendicular to AB, $= \frac{1}{2}$ AC = 5.5 in. (FC = AC × sin 30 deg. = 11 × .5 = 5.5).

Since $(AC)^2 = (AF)^2 + (CF)^2$;

$AF = \sqrt{(AC)^2 - (CF)^2} = \sqrt{11^2 - 5.5^2} = 9.526$ in.;

$FE = AE - AF = 11 - 9.526 = 1.474$ in.;

$CE = \sqrt{(FE)^2 + (CE)^2} = \sqrt{1.474^2 + 5.5^2} = 5.7$ in.;

$DE = CE$; $CD = 2 \times 5.7 = 11.4$ in.,

when X and Y are on center as shown in the diagram.

Since the old design had an 11-in. link, if X was put on center, Y would be thrown about ⅜ in. to the left of center, or vice versa.

The first time the writer set a compensator and placed the arms 22 in. apart they did not look right, and he laid it to defective work on the part of the signal company in the usual way, and dismissed the subject from further thought.

In the new design AC and BD are made 10 in. and the link 11 in. as before.

Referring again to Fig. 1, AC_1 and BD_1 represents the new arms and C_1D_1 the link. Working out the length of C_1E in the same way as above we find it to be 5.52 in., or the link is 11.04 if the arms AX and BY are on center. Right here it should be noted that if an 11-in. link is set at right angles to AC and BD it will be right if AC and BD are made 9.526 in. long. If we do not consider the other positions of the cranks this would seem to be the right dimension for the arms.

In Fig. 2 the compensator is shown with AX and BY moved 30 deg. outwardly, which is equivalent to a line movement of

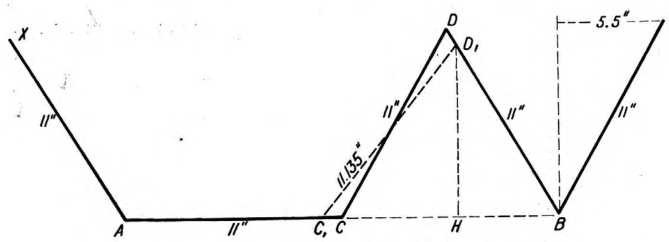


Fig. 2. Arms at 30 deg. Outside of Center.

5.5 in. of X and Y. This would ordinarily be an extreme position for ordinary strokes and considerable variation in temperature. In this position X and Y will be symmetrical, with AC, BD and CD each 11 in. long. With AC_1 and BD_1 each 10 in., we find HB = 5 in., HC_1 = 7 in., HD_1 = 8.66 in., C_1D_1 = 11.135 in. when X and Y are symmetrical, or if X is 30 deg. from center, Y will be thrown about ⅛ in. to the left with an 11-in. link, and vice versa.

It should be noted now that if AC and BD are made 9.526 in. long the link would have to be 11.29 in. long to have AX and BY symmetrical.

In Fig. 3 the compensator is shown with AX and BY moved 30 deg. inwardly, equivalent to a straight line movement of 5.5 in. of X and Y and giving the other extreme position. In

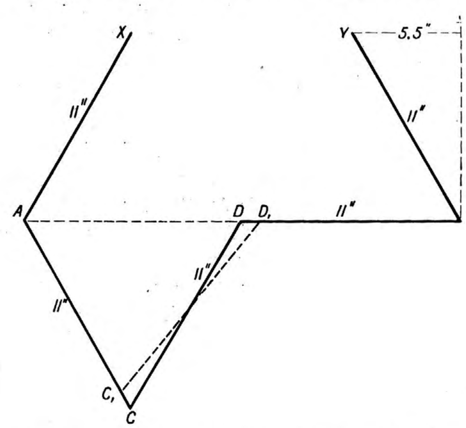


Fig. 3. Arms at 30 deg. Inside of Center.

this position X and Y will be symmetrical with AC, BD and CD each 11 in. With AC and BD each 10 in. the link CD will be the same as in Fig. 2, 11.135 in.

If X is 30 deg. from center Y will be thrown about ⅛ in. to the left with an 11-in. link. If Y is 30 deg. from center X will be thrown about ⅛ in. to the left with an 11-in. link.

SUMMARY.

In the old compensator with 11-in. crank arms and an 11-in. link if we start in the position Fig. 2 and move to position Fig. 3 and set AX at 30 deg., then Y will be 5½ in. off center at the start. When X moves the first 5½ in. Y moves 5⅞ in. and when X moves the second 5½ in. Y moves 5⅛ in. The total stroke of X and Y is 11 in. for each.

If X is moved at a uniform speed throughout the stroke, Y will travel faster during the first half and slower during the second half. The only point where they will travel uniformly will be when angle ACD = angle CDB, which is when the arms are close to center (Fig. 1). The further the arms are off center the greater will be the difference in speed; and the greater the difference between the angles ACD and CDB the greater will be the difference in speed.

In the new compensator the difference between these angles is less in the central position and in either of the extreme positions than is the case in the old one, and it therefore compensates more closely throughout its stroke. Starting from the position Fig. 2 with AX 30 deg. (5½ in.) off center Y will be 5⅝ in. off center. When X travels the first 5½ in. Y travels 5⅝ in. When X travels the second 5½ in. Y travels 5⅜ in. Total stroke of X and Y 11 in. for each.

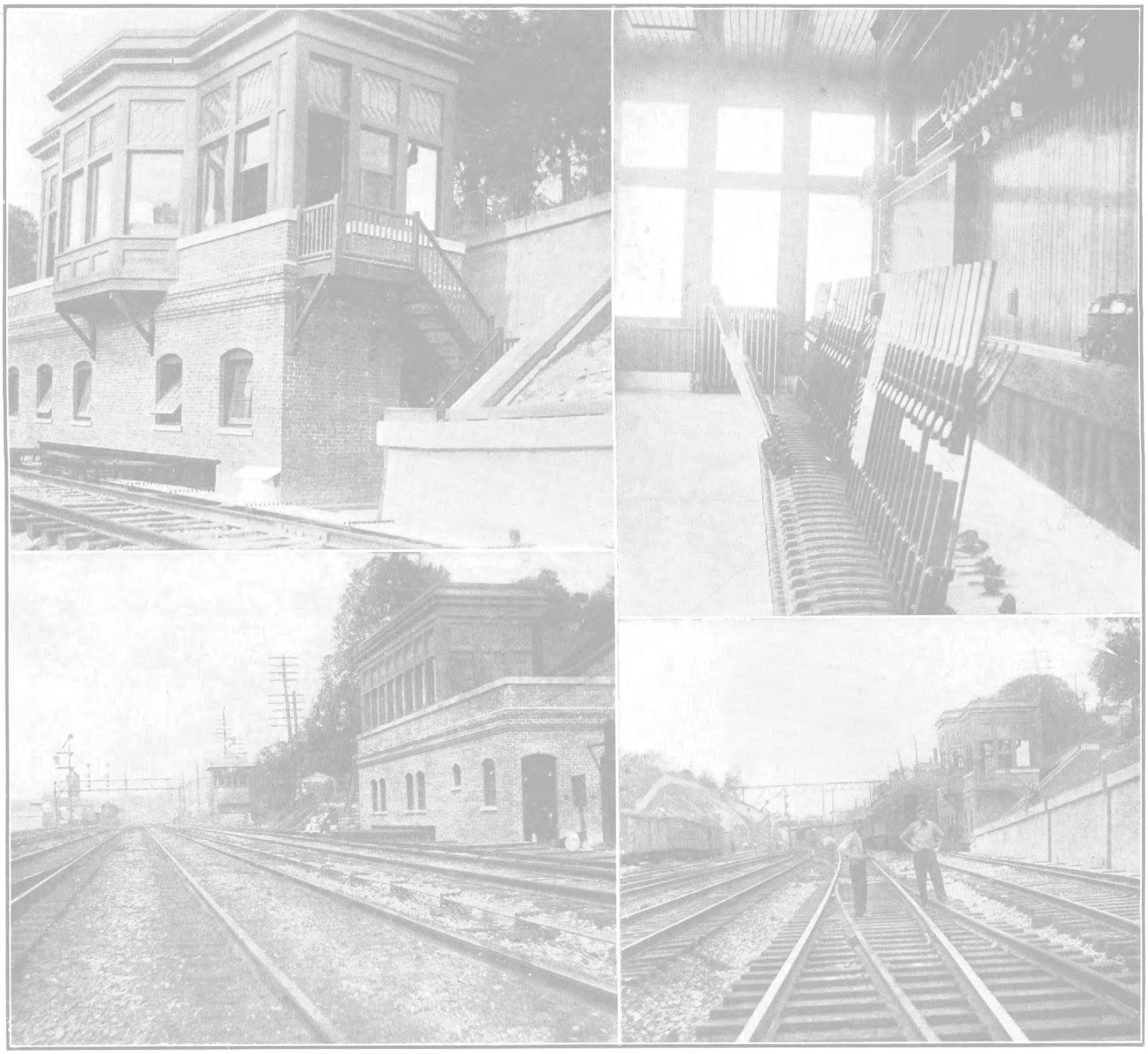
With the operating arms AX and BY longer than 11 in. the angular deflection for a given stroke is much less and the compensation more perfect, as X and Y will normally be closer to the central point, which is the point of perfect compensation. The error for rapid changes of temperature is so slight, when 13-in. operating arms are used for strokes of 8 in. to 10 in., as to be practically negligible.

It is evident that when long-stroke switch-and-lock movements are used the compensation will be better if the stroke of the line is kept down and the increase in stroke made very close to the movement itself.

NEW SIGNALING AND INTERLOCKING ON THE NEW YORK CENTRAL

BY C. C. RINKER.

On Monday, November 21st, the automatic block signals recently installed between block stations 56 and 59 on the Hudson River division of the New York Central & Hudson River were put in service. The signals are of the three position upper-quadrant type manufactured by the Hall Signal Company, and



Views at Block Stations 58 and 58½, on the Hudson River Division, New York Central.

the installation comprises the signals for 11 locations. On the same day new Block Stations 58 and 58½ were put in service and old Block Station 58 was abandoned. The upper left-hand figure shows an exterior view of new Block Station 58½ and the upper right-hand figure an interior view of new Block Station 58½. A 52-lever style A machine having 42 working levers was installed at this plant. The main-line home signals are electrically-operated, and calling-on arms are used. The dwarf signals are mechanically operated and both dwarf and home signals are upper-quadrant. Electric switch lock and approach locking circuits were put in at this plant.

The lower left hand figure shows new Block Station 58 just previous to being put in service. Old Block Station 58 may be