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American Railway Signaling Principles and Practices

CHAPTER XVII

Mechanical and Electro-Mechanical Interlocking

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mechanically or power operated. Experience has shown that it is difficult to operate wire-connected signals at a distance greater than 1500 feet. With high-speed operation this distance does not provide proper stopping distance and consequently mechanical distance signals are being replaced by power signals.

Compensation.

A pipe line is a solid connection between the leadout and the operated unit. It is subject to expansion and contraction due to temperature changes. The amount of expansion due to a rise in temperature of a given length of pipe line is equal to the amount of contraction for a corresponding drop in temperature. The amount of expansion or contraction is dependent upon the length of the pipe line, the coefficient of expansion of the material of which the pipe is constructed, and the temperature change. Thus, long lines have an appreciable change in length between the highest summer and lowest winter temperatures and, if not compensated, would result in serious difficulties in maintaining proper adjustment of the units controlled by such pipe lines. It is, therefore, necessary when constructing pipe lines to compensate for such temperature changes as are common to the locality where the installation is made, and in such a manner that the compensation will take place automatically.

The Signal Section, A.R.A., defines Compensator as: A device for counteracting the expansion and contraction caused by changes of temperature in a pipe or wire line, thereby maintaining a constant length of line between units.

Figure 55 illustrates a compensator which is generally used in a pipe line; it is known as a lazy jack compensator. The compensator consists of one 60-degree and one 120-degree angle crank mounted on a common metal base, each crank being held in position by a steel center pin located with 22 inch centers. These two cranks are connected by a link. Any movement or thrust applied to one crank will result in an equal movement or thrust in the other crank but in the opposite direction. Figures 56 and 57 illustrate charts approved by the Signal Section, A. R. A., for finding compensator centers and the setting of cranks toward or away from the fixed point. Right-angle cranks are at times used to compensate pipe lines at turns by setting the crank so that the movement of the pipe line is changed from a thrust to a pull or vice versa. Figure 58 illustrates typical examples of compensation. These charts are self-explanatory.

Another type of compensator is known as a straight-arm compensator or equalizer. It is used primarily where it is necessary to make considerable offset in the pipe lines, such as at drawbridges; its use is not general on account of the required offset. With the lazy jack compensator the pipe line is run in a continuous line. A straight-arm compensator is illustrated in Fig. 59.

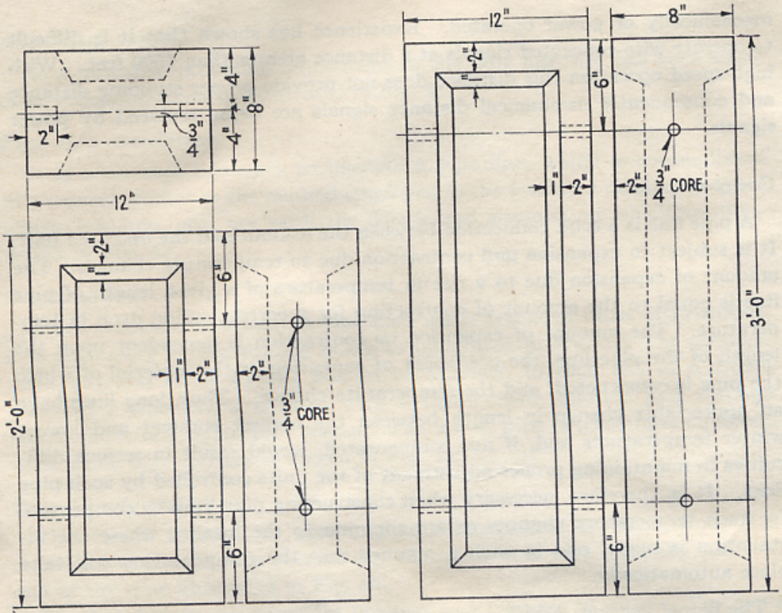


Fig. 54.
Pipe Carrier Foundations.

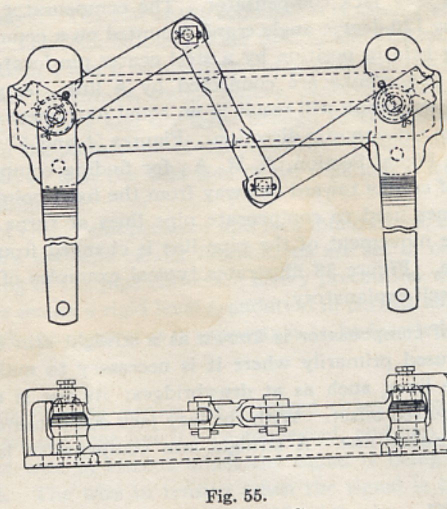


Fig. 55.
One-Way Horizontal Pipe Compensator.

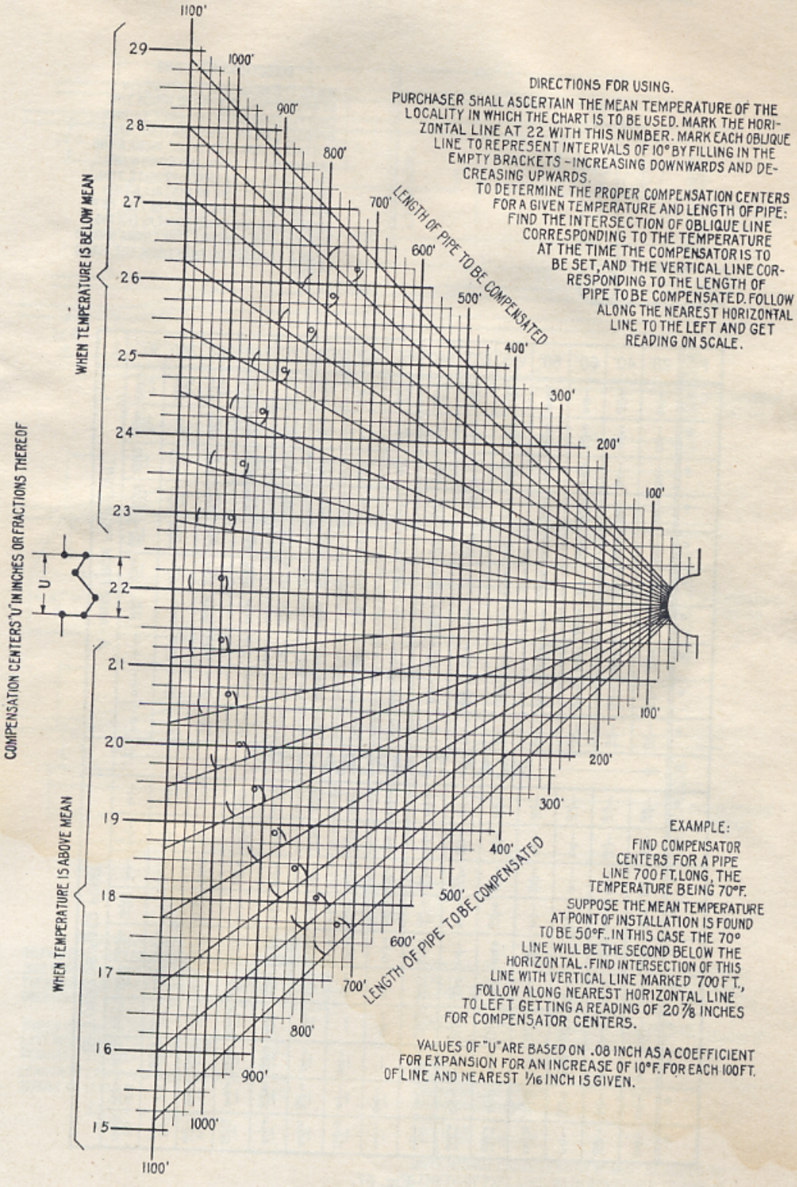
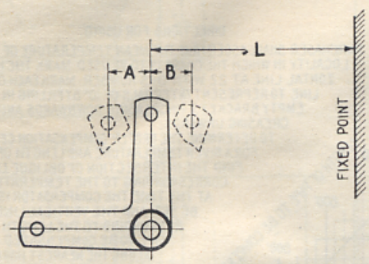


Fig. 56.
Compensation Chart.

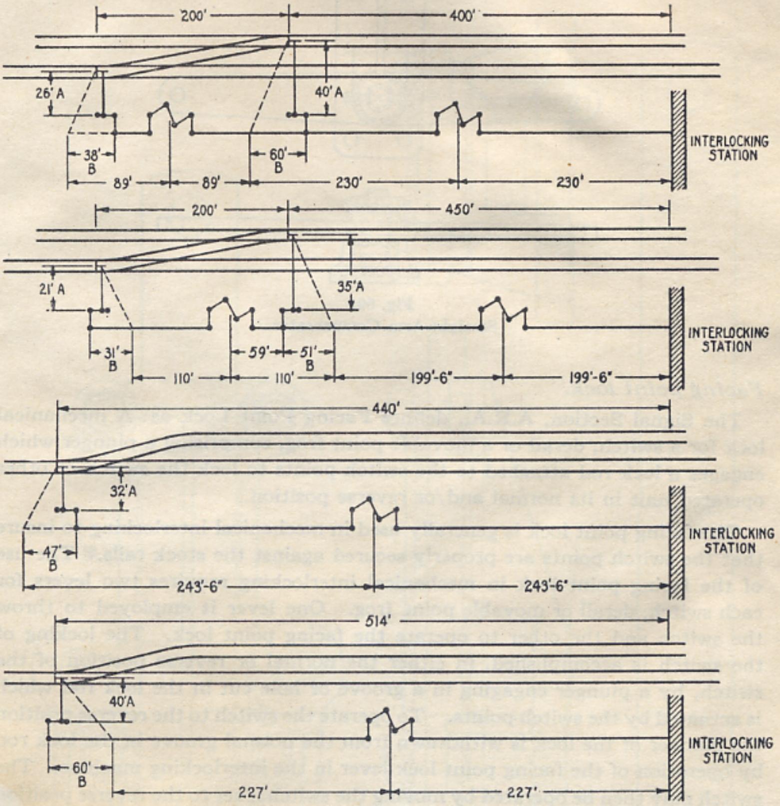


DIRECTIONS FOR USING

WRITE THE MEAN TEMPERATURE (IN F. DEGREES) FOR LOCALITY IN WHICH THE CHART IS TO BE USED, IN DEGREE COLUMN OPPOSITE "MEAN TEMPERATURE", GRADUATING 10° FOR EACH SPACE, INCREASING UPWARD AND DECREASING DOWNWARD. THE FIGURE IN SQUARE OPPOSITE TEMPERATURE AT TIME OF INSTALLATION AND UNDER THE NUMBER OF FEET (L), BETWEEN CRANK AND FIXED POINT, IS THE DISTANCE (A OR B), IN INCHES, THE CRANK SHOULD BE SET TOWARDS OR AWAY FROM THE FIXED POINT.

F°	20'	40'	60'	80'	100'	120'	140'	160'	180'	200'	220'	240'	260'	280'	300'	L
°	1/8	5/16	1/2	5/8	13/16	15/16	1 1/8	1 1/4	1 7/16	1 5/8	1 3/4	1 15/16	2 1/16	2 1/4	2 3/8	A-AWAY FROM FIXED POINT
°	1/8	1/4	7/16	9/16	3/4	7/8	1	1 1/8	1 1/4	1 7/16	1 9/16	1 3/4	1 7/8	2	2 3/16	
°	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 7/16	1 9/16	1 11/16	1 13/16	1 15/16	
°	1/8	1/4	5/16	7/16	9/16	11/16	13/16	7/8	1	1 1/8	1 1/4	1 3/8	1 7/16	1 9/16	1 11/16	
°	1/8	3/16	5/16	3/8	1/2	9/16	11/16	3/4	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 7/16	
°	1/16	3/16	1/4	5/16	3/8	1/2	9/16	5/8	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 3/16	
°	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	
°	1/16	1/8	1/8	3/16	1/4	5/16	5/16	3/8	7/16	1/2	1/2	9/16	5/8	11/16	3/4	
°	1/16	1/16	1/8	1/8	3/16	3/16	1/4	1/4	5/16	5/16	3/8	3/8	7/16	7/16	1/2	
°	1/16	1/16	1/16	1/16	1/16	1/8	1/8	1/8	1/8	3/16	3/16	3/16	3/16	1/4	1/4	
°	← MEAN TEMPERATURE →															
°	1/16	1/16	1/16	1/16	1/16	1/8	1/8	1/8	1/8	3/16	3/16	3/16	3/16	1/4	1/4	B-TOWARDS FIXED POINT
°	1/16	1/16	1/8	1/8	3/16	3/16	1/4	1/4	5/16	5/16	3/8	3/8	7/16	7/16	1/2	
°	1/16	1/8	1/8	3/16	1/4	5/16	5/16	3/8	7/16	1/2	1/2	9/16	5/8	11/16	3/4	
°	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	
°	1/16	3/18	1/4	5/16	3/8	1/2	9/16	5/8	3/4	13/16	7/8	15/16	1 1/16	1 1/8	1 3/16	
°	1/8	3/16	5/16	3/8	1/2	9/16	11/16	3/4	7/8	15/16	1 1/16	1 1/8	1 1/4	1 3/8	1 7/16	
°	1/8	1/4	5/16	7/16	9/16	11/16	13/16	7/8	1	1 1/8	1 1/4	1 3/8	1 7/16	1 9/16	1 11/16	
°	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 7/16	1 9/16	1 11/16	1 13/16	1 15/16	
°	1/8	1/4	7/16	9/16	3/4	7/8	1	1 1/8	1 1/4	1 7/16	1 9/16	1 3/4	1 7/8	2	2 3/16	
°	1/8	5/16	1/2	5/8	13/16	15/16	1 1/8	1 1/4	1 7/16	1 5/8	1 3/4	1 15/16	2 1/16	2 1/4	2 3/8	

Fig. 57.
Crank Chart.



DRILLING OF CRANKS

LEVER SIDE 11.75"
SWITCH SIDE 8"

NOTE 1

DRILLING OF CRANK ARMS FOR SWITCH

TO FIND DRILLING FOR LENGTH OF CRANK ARM ON SWITCH SIDE WHICH WILL GIVE THE REQUIRED STROKE: MULTIPLY THE REQUIRED STROKE AT SWITCH BY LENGTH OF CRANK ARM ON LEVER SIDE AND DIVIDE BY THE STROKE OF THE LEVER.

EXAMPLE.

THROW OF SWITCH POINTS	4.5"
LOST MOTION IN SWITCH ADJUSTMENT	1.5"
REQUIRED STROKE AT SWITCH	6"
LENGTH OF CRANK ARM ON LEVER SIDE	11.75"
STROKE OF LEVER	8.75"

$\frac{6 \times 11.75}{8.75} = 8"$ APPROX.

NOTE 2

SETTING OF COMPENSATORS

WHEN DRILLING OF CRANK ARMS AT SWITCH ARE OF UNEQUAL LENGTHS, THE LENGTH OF PIPE "B" TO BE COMPENSATED WILL NOT BE EQUAL TO LENGTH OF PIPE "A". TO FIND LENGTH "B" USE THE FOLLOWING FORMULA:

$$\frac{\text{LENGTH "A"} \times \text{LENGTH OF CRANK ARM ON LEVER SIDE}}{\text{LENGTH OF CRANK ON SWITCH SIDE}} = \text{LENGTH "B"}$$

OR

GIVEN:

LENGTH "A"	32'
CRANK ON LEVER SIDE	11.75"
CRANK ON SWITCH SIDE	8"

THEN:

$\frac{32 \times 11.75}{8} = 47$ FT.

WITH NORMAL CRANK LENGTH "B" MUST BE ADDED TO LENGTH OF PIPE LINE; WITH REVERSED CRANK IT MUST BE SUBTRACTED.

Fig. 58.
Instructions for Applying Compensation.