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American Railway Signaling Principles and Practices

CHAPTER XVII

Mechanical and Electro-Mechanical Interlocking

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Pipe and Wire Lines

Pipe line.

The Signal Section, A.R.A., defines Mechanical Pipe Line as: A connection made with pipe with its supporting apparatus from the operating lever to the operated unit.

The pipe line is constructed of 1-inch pipe of convenient length, joined together by a coupling and a steel plug through which two ¼-inch soft iron rivets are passed at each end and riveted after the pipes have been drawn to abut within the coupling, as illustrated in Fig. 43.

Pipe carrier and support.

The Signal Section, A.R.A., defines Pipe Carrier as: A device used to support, guide and facilitate the longitudinal movement of a pipe line.

The pipe carrier consists of a grooved wheel and a roller between which the pipe moves, supported in a frame providing support, a definite direction of motion and a reduction in the amount of friction encountered by the pipe line in motion. The carriers are arranged in multiple to carry the required number of pipes and are termed one-way, two-way, etc., depending upon the number of pipes in the line. The center to center dimension of multiple carriers is 2¾ inches.

The specifications of the Signal Section, A.R.A., require that carrier supports be spaced not more than 7 feet center to center on tangents and not over 6 feet on curves exceeding 2 degrees.

The proper arrangement of the pipes is such that they will lead off on the track side in regular order to prevent any unnecessary crossing over or under other pipes. The pipe couplings are so located that with the levers in the center position they will be not less than 12 inches from the pipe carrier. Figure 44 illustrates various methods of supporting pipe carriers.

When it is necessary to run pipe lines across the tracks, transverse pipe carriers, as illustrated in Fig. 45, are used. These are spaced not more than 7 feet apart and are fastened to the ties by ¾ inch by 4 inch lag screws. Transverse carriers are so placed as to permit proper tie spacing and not interfere with track tamping operations. Not more than two pipe lines are usually placed in the same tie space.

Crank.

The Signal Section, A.R.A., defines Crank as: A lever, the arms of which form an angle, with the fulcrum at the vertex of the angle, which is used to transmit motion from one part of a line to another part. The alignment of the pipe line generally follows that of the track.

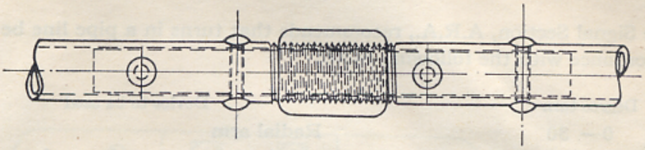

Fig. 43.
One-Inch Signal Pipe and Coupling.

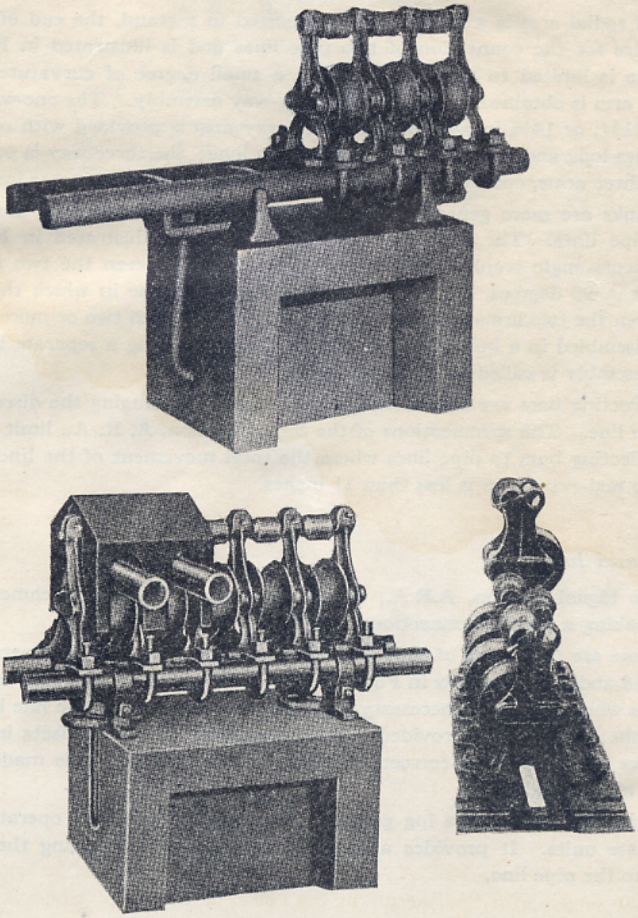

Fig. 44.
Pipe Carrier Supports.

The Signal Section, A.R.A., recommends that turns in a pipe line be made in accordance with the following table:

Degree turn	Device to be used
0— 30	Radial arm
30— 75	60-degree acute-angle crank
75—105	90-degree right-angle crank
105—140	120-degree obtuse-angle crank
140—180	180-degree equalizing arm

The radial arm is a pivoted arm supported in a stand, the end of which provides for the connection of two pipe lines and is illustrated in Fig. 46. Its use is limited to pipe-line turns on a small degree of curvature. The radial arm is obtained in one, two or three-way assembly. The one-way arm is 9, 11¾, or 14½ inches long; the two-way arm is provided with one arm 9 inches long and the other arm 11¾ inches long; the three-way is provided with three arms, one 9 inches, one 11¾ inches and one 14½ inches long.

Cranks are more generally used for changing the direction of motion of the pipe lines. The 90-degree right-angle crank is illustrated in Fig. 47. The acute-angle crank is one in which the angle between the two arms is less than 90 degrees, and the obtuse-angle crank is one in which the angle between the two arms is greater than 90 degrees. When two or more cranks are assembled in a box-shaped frame, each crank having a separate bearing, the assembly is called a box crank.

Deflecting bars are also used to some extent for changing the direction of a pipe line. The specifications of the Signal Section, A. R. A., limit the use of deflecting bars to pipe lines where the total movement of the line due to stroke and expansion is less than 11 inches.

Jaw and lug.

The Signal Section, A.R.A., defines Jaw as: A forked attachment used for making a pivotal connection.

There are two types of jaws in general use: the solid jaw as illustrated in Fig. 48 and the screw jaw in Fig. 49. The solid jaw is always used except at points where it may be necessary to adjust the length of a pipe line in which case the screw jaw is provided. When necessary to place offsets in a pipe line for the purpose of correcting alignment or elevation, it is made in the body of the solid jaw.

Figure 50 illustrates a lug generally inserted in a pipe line operating two separate units. It provides a convenient means of connecting the second unit to the pipe line.

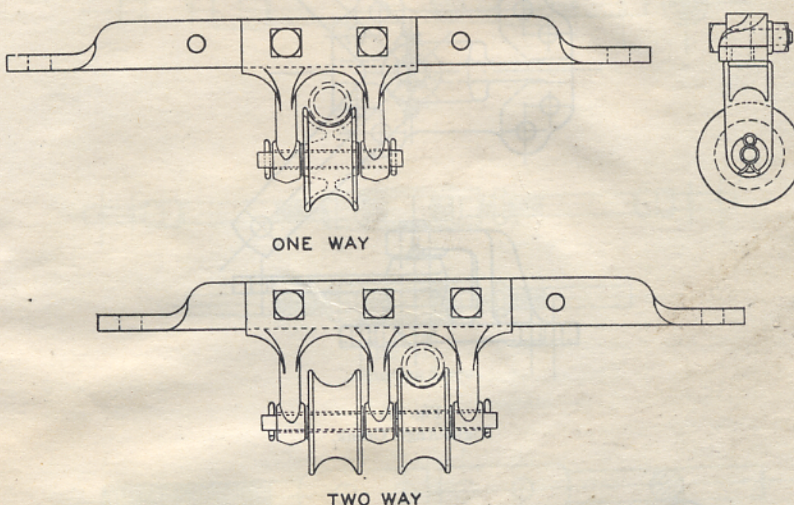

Fig. 45.
Transverse Pipe Carriers.

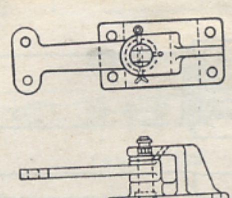

Fig. 46.
Radial Arm and Stand.

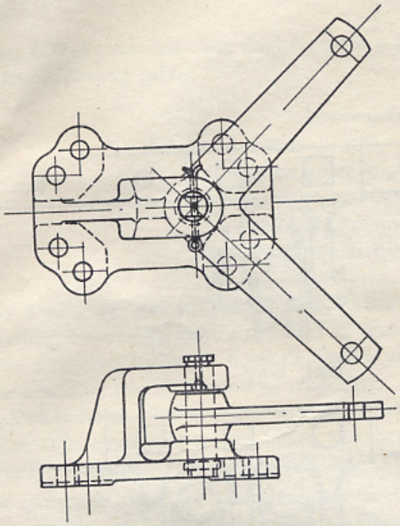

Fig. 47.
Right-Angle Crank.

Fig. 48.
Solid Jaw.

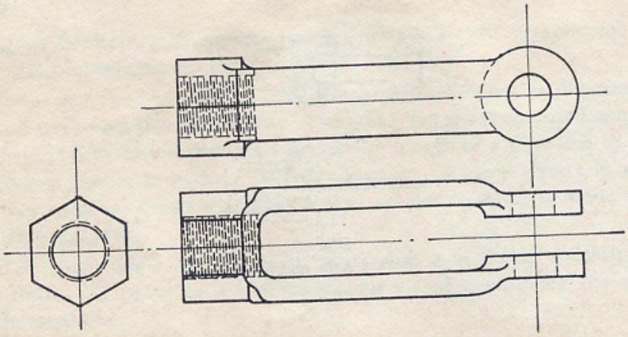

Fig. 49.
Screw Jaw.

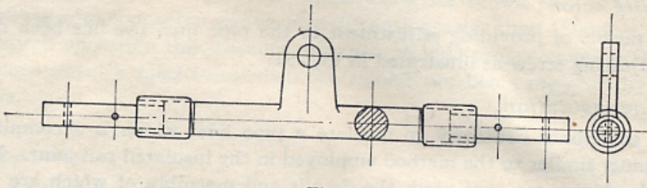

Fig. 50.
Lug.

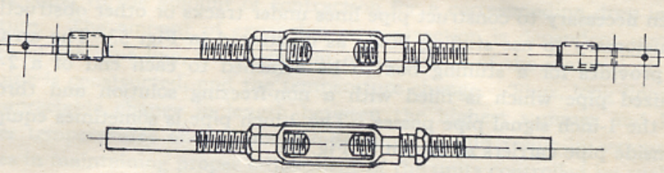

Fig. 51.
Adjusting Screw.

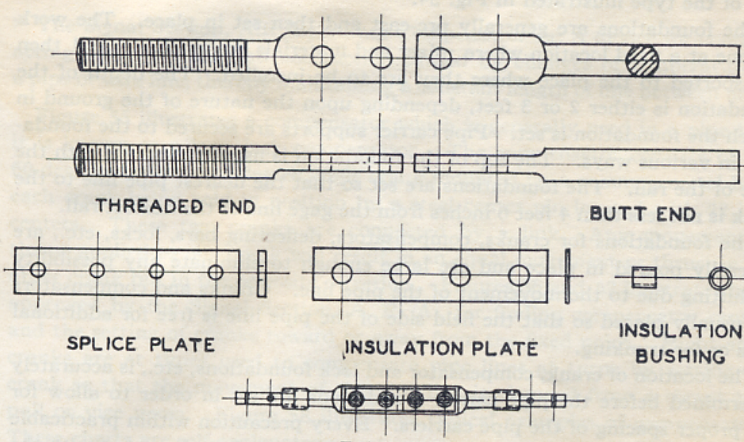

Fig. 52.
Pipe-Line Insulation.

Fig. 53.
Stuffing Box with 2-inch Pipe Equipped with Inside Pipe Carrier.

Adjusting screw.

As a means of providing adjustment in the pipe line, use has been made of an adjusting screw as illustrated in Fig. 51.

Pipe-line insulation.

It is sometimes necessary to insulate a pipe line, which is accomplished in a manner similar to the method employed in the insulated rail joint. Fibre plates, bushings, etc., are used, the details and assembly of which are illustrated in Fig. 52.

Stuffing box.

When necessary to construct pipe lines under tracks or other obstructions, it is customary to use stuffing boxes as illustrated in Fig. 53. The arrangement provides for a stuffing box to be attached to each end of a 2-inch galvanized pipe which is filled with a non-freezing solution and through which the 1-inch signal pipe passes. The 2-inch pipe is sometimes equipped with inside pipe carriers as shown in Fig. 53.

Pipe-line foundation.

Pipe carrier foundations were originally constructed of wood, iron, or a combination of both, but present day construction is very generally concrete and of the type illustrated in Fig. 54.

The foundations are generally pre-cast and then set in place. The work is done at a fixed location where mixer and materials are available, and then transported to the place where they are to be installed. The depth of the foundation is either 2 or 3 feet, depending upon the nature of the ground in which the foundation is set. Pipe carrier supports are secured to the foundation in various ways. The top of the foundation is usually set level with the base of the rail. The foundations are set so that the nearest pipe line to the track is not less than 4 feet 6 inches from the gage line of the nearest rail.

The foundations for cranks, compensators, deflecting bars, locks, etc., are generally poured in place and are large enough to eliminate any possibility of shifting due to the movement of the pipe line. Cranks and compensators are usually placed so that the field side of the pipe line is free for additional lines or for trunking.

The location of crank, compensator and lock foundations, etc., is accurately determined before the pipe carrier foundations are set in order to allow for the proper spacing of the pipe carriers. Every precaution within practicable limits is taken to secure a rigid level foundation in perfect alignment with the pipe line in which the apparatus it supports is to be inserted.

Wire line.

Mechanical interlocking signals are operated either by pipe or wire lines. Each arm requires one pipe line if pipe-connected, and two wire lines if wire-connected. The wire in tension when the signal is being cleared is called the "pull" wire. The wire in tension when the signal is being returned to its most restrictive position is called the "back" wire. Distant signals are usually located stopping distance from the home signal and may be either 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.