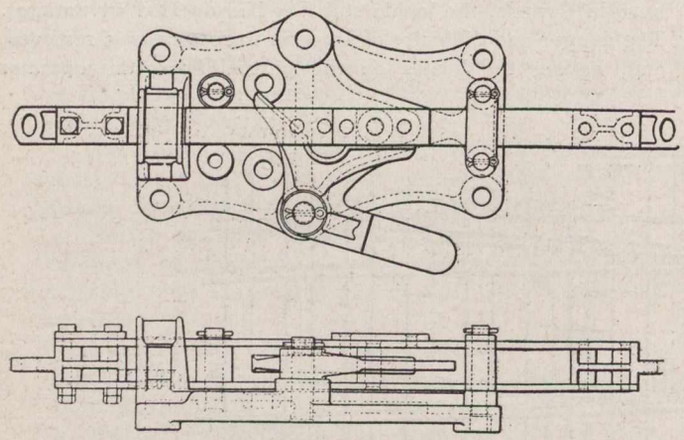
engineer of the train as to whether he may, or not, proceed across the diamond. The mast is 30 feet in length, of which 5 feet is below the level of the ground when it is erected, and to add rigidity, a footing of 3-in. x 12-in. hemlock is built to it. It is made of 10-in. x 10-in. timber, tapered to 7-in. x 7-in., and the arm is 5 feet in length, made of well-seasoned ash. The casting into which the blade fits extends back of the mast and contains two spectacles on each side—one red and the other green. This constitutes the means of communication at night, for it can be seen from the drawing that with the blade in the horizontal, or normal, position, the spectacle covering the lamp is the red one, whereas if the arm is lowered to the "clear" position, the green one covers the lamp.

The arrangement of semaphores on a single track grade crossing is as follows:—A home signal is erected in each of the four different directions from the diamond, 50 feet beyond the derail point, which usually brings this signal 550 feet from the intersection of the two lines. This signal governs movements of trains advancing toward the diamond and indicates when horizontal that the trains must stop, and that the derail is open. The home semaphore is distinguished from the distant semaphore by having a square ended blade, whereas the distant blade has a fish-tail end. When the home signal is "cleared," that is, when the arm falls to an angle of about 60 degrees below the horizontal, it indicates that the engineer has a clear line to proceed. When the distant



Switch and Lock Movement.

semaphore is in the horizontal position, it indicates that the engineer must bring his train under control and be ready to stop at the home semaphore. These same signals are communicated at night by the green and red lights in the manner already described.

It is worthy of note that the Railway Signal Association, a few months ago, adopted the green light as the only "clear" signal. This provision is a wise one, as it overcomes the difficulty of ordinary house lamps, lanterns and other such lights being mistaken for a "clear" signal. The red light, as in the past, indicates the danger signal.

Semaphore posts are made usually of wood, although some companies, as in the case of the Grand Trunk Pacific Railway, have a standard post of iron. Such construction, however, is only possible under exceptional conditions as few companies can afford such a heavy charge against initial construction.

The methods of connecting the semaphores with the tower are varied according to the specifications of the various companies. With the distant semaphore only wire is possible, as the distance is too great for the operation of rod connection. There are, however, two methods in the use of wire connections, namely, single and double lines. In the case of the former, a counter weight is used to keep the signal in the horizontal or normal position. The wire line connects with a lever, the outer end of which carries the counterweight, and when the cabin lever is reversed, the wire connection pulls this lever down and the counterweight rises, permitting the semaphore blade to drop to the "clear" position. The double wire method has a wire controlling each movement. The disadvantage in this, however, lies in the fact that if trees or other obstacles fall across the wire lines and break them, the semaphore becomes useless and may or may not register a "danger" signal. In the case of a single wire breaking, the counterweight always carries the blade to "danger." This is in accordance with the requirement of the Board of Trade, the governing board of railway operation in Great Britain, and is certainly an important argument in favor of its use.

Pipe connections to the home signals are a requirement in many of the American Specifications, and a description of them will follow in connection with derails. Whether they are an improvement on wire connections, or not, will be taken up later in bringing forth certain points which are at present in doubt in Canadian practice.

The class of wire used in Canada is mostly of the stranded variety, which has some advantages over the solid wire. They are thoroughly galvanized, and in making a splice the result is much better than in the case of a solid wire connection.

To carry the wires, from the lead-out to signals, posts are used with pulley wheel connections. Some companies require square posts, but the ordinary, round cedar post is generally used. They are about three to four feet above the grade level, and usually about six inches in diameter.

Derails and Connections.

In order to protect a train while crossing the diamond, from the approach of another train on the other tracks, semaphores are used as already described. This does not, however, control the actions of the engineer in his cab, but only acts as a signal to him, and in case these should be disregarded, other means had to be employed to insure safety. This is accomplished by the use of derails. A derail consists of a switch-point placed in the track and connected with the machine in the tower. In its normal position, it has already been stated that the derail is open, and it can, therefore, be seen that, if the signals are disregarded, and the engineer takes his train on, the result is derailment. There is one principle in the derail which should not be overlooked, namely, the effect the knowledge of its existence has upon the engineer. The man knows that it is open, and that derailment is certainly awaiting him at that point. This alone will make him keep a close eye on his semaphores for self-preservation, if for no other reason.

The position of the derail is governed by the regulations of the Board, and must not be less than 500 feet from the diamond. In places where heavy grades exist approaching the diamond, the derail must be placed so as to give the equivalent of 500 feet on a level grade. This increased distance, of course, will depend upon the class of rolling stock and speed of trains as well as the percentage of grade.

Guard rails are used to keep the wheels from jumping off the ties as soon as they are derailed. The requirements of these are that they extend from a point six feet in advance of derail and extend thence toward the diamond, a distance of not less than 400 feet. The guard rails should always be properly connected throughout and spiked as ordinary track. From the latest regulations of the Board of Railway Commissioners, it will be noticed that the guard rail is to be placed on the inside of the curve where practicable. This seems to be questionable practice as it must not be forgotten that the fundamental idea of the derailing point is to derail. The tendency on a true curve is to have greater stress on the outside rail, and as there is generally a certain amount of rocking motion, especially near the end of the curve, it is questionable whether the wheels may not jump the derail point in some isolated case of peculiar circumstances. The duty of the derail is plain, and it would be well to insure its work by placing it in the outside rail. If the derail point is successful on the inside of the curve it would indeed be a difficult matter to estimate what the difference in damage to roadbed would be as compared to the point in the outside rail. When an engine leaves the rails, its enormous weight, together with its momentum, reduces ties to a useless mass of broken tim-