the interlocking mechanism receives an initial movement prior to the stroke of the lever, and receives a final movement after the stroke is completed. These features of interlocking are common to all successful machines, although the machines by which these are accomplished may differ. The spring latch is the small handle set at the side of the handle of the switch of signal lever, and is connected to a lug or stop which drops into a slot in the sector bar of the lever frame when the lever is at either end of this stroke, thus holding the lever in position. The signal-man grasps the lever handle and the spring latch at the same time, but must grip them so as to bring the latter close against the former, and this movement raises the lug or stop, so that the lever can then be moved to the other end of the sector, when by releasing his grasp on the handle the spring latch forces the clasp down into the other notch. It is this movement preliminary to the stroke of the main lever, which is used to actuate the interlocking mechanism, and thus no strain can be put on this mechanism by an attempt to throw the wrong lever, since the lever must be unlocked by its spring latch before it is free to move.

Each home signal, lever, in that position which corresponds to the "clear" signal, must lock the operating levers of all switches and switch locks which by being moved during the passage of a train running according to that signal, might either (a) throw it from the track, (b) divert it from its intended course, or (c) allow another train moving in either direction, to come into collision with it.

Each lever so locked must, in some of its two positions, lock the original home signal in its danger position, that position of lever being taken which gives a position of switch or switch lock contradictory to the route implied by the home signal when "clear."

Each home signal should be so interlocked with the lever of its distant signal that it will be impossible to "clear" the distant signal until the home signal is "cleared."

Switch and lock levers should be so interlocked that crossings of continuous tracks cannot occur, where such crossings are dependent upon the mutual positions of switches.

Switch levers and their lock levers should be so interlocked that the lever operating a switch cannot be moved while that switch is locked.

When it is desired to install an interlocking plant, the first thing is to have a plan of tracks, which is then signalled up, that is, all the switches to be operated are noted, the derails, signals, tower and run of connections are located. In planning the connections, the first principle is to reduce to a minimum the number of cranks between levers and points to overcome lost motion as far as possible. This is essential to an efficient and smooth running plant and should receive the closest attention of the designer.

The size of the machine and functions of each lever are determined, and a diagram of the lead-out made. From the signalling plan, a locking sheet is then made, that is, the proper interlocking to be done between levers is determined, and from this locking sheet a dog sheet is made, which is a diagram showing the arrangements of the interlocking parts as they are placed in the machine.

The plan, as shown in Fig. 2, is a typical lay-out of tracks, showing a single track grade crossing protected by derails, home and distant semaphores. When no movements are being made over the crossings all the derails are open, all semaphores are in the horizontal (danger-stop) position, and when in such position they are known as being normal and the levers in the machine are normal also. When a derail is closed or a semaphore "cleared," they are known to be in the reverse position, and the lever by which the operation is performed is then also known as being in the reverse position.

When a movement is desired over any one of the tracks, it is necessary to set all switches and derails in the right position for such movements, then lock them in such position, after which the signal governing traffic over that particular track may be "cleared."

A "Manipulation" chart should always be framed and hung in the cabin for use of the operator. This chart gives the numbers of the various levers which govern movements in any one direction. The closing of either derail in the route locks all the derials of conflicting routes normal, and they in turn hold the signals normal. Therefore, it will be seen that where two or more routes conflict, the signals of but one can be "cleared."

Diamonds.

The first portion of an interlocking plant ordered for a crossing is the diamond, and it is of some importance that care be exercised in its selection. It is important not only from the standpoint of efficiency in performing the functions of a crossing, but in the matter of future maintenance charges. The annual cost of maintaining grade crossings forms sufficient reason for the expenditure of large sums of money to obtain over or under crossings instead.

When two tracks intersect crossing frogs must be used to give a flangeway in both directions, and as there is no uniformity in the angles the crossings or diamonds have generally to be specially made for each case. They are built up of rails bolted together with filling pieces between and heavy connections in the angles. They should be rivetted to base plates at the corners, or in some cases these plates may extend continuously under the rails. The rail ends may be bevelled off to a miter joint at the frog point, or have one rail butted against the other. The inner wing rail, or guard

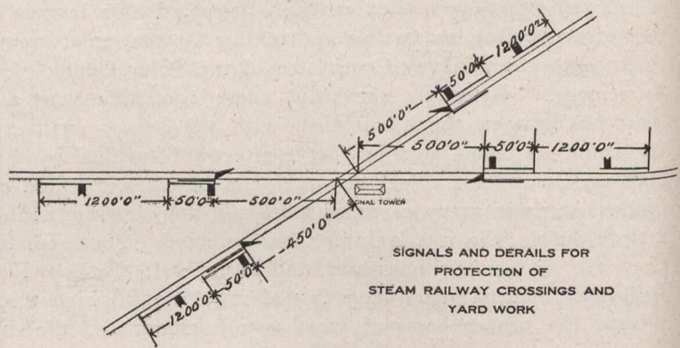

Fig. 2.

rail, is generally continuous in crossings having an angle of 45 to 90 degrees, but is sometimes stopped and flared out at each corner, as in Fig. 3. Where one track is the more important, the rails may be continuous, having the heads grooved to form flangeways for wheels crossing them. At crossings on busy tracks, a third rail is generally placed against the outside of the track rail to carry the false flanges of badly worn wheels and prevent them from battering the rails at the flangeways. The ends of these "easer" rails are inclined, so that wheels will take a bearing on them without shock. Crossings are sometimes built up without a joint between the frogs, but this makes a very heavy section for transportation, and does not admit of repairs without taking up the diamond. As a rule it is better to have a joint in two sides. The sharper the angle of crossing, the greater will be the wear on the frogs, due to the battering effect of the wheels in jumping over the flangeways.

Railway grade crossings are exceedingly hard to keep in proper condition, largely due to the frequent disturbance of the old grade at time of installation of diamond, and also to the unsettled banks of the new line; all of which result in uneven settlement and pounding on the diamond during the passage of a train. It frequently happens that the first diamond lasts but a short time before some portion becomes broken or the points badly battered, and a spare diamond should always be kept on hand to prevent delays to traffic in case of accident.

Within the past few years it has been found to be exceedingly advantageous to use manganese diamonds instead of the ordinary type. The properties of manganese steel are hardness and toughness, and a bar of this metal can be bent through an angle of 180 degrees without showing signs of fracture. Messrs. Haddfields, of Sheffield, England, were the originators of this metal as applied to railway crossings,