grooves N, Ο, Ρ, carry dogs, such as J. Two dogs may be con­nected together by bars, R. The dogs are held in place by straps Y (fig. 6). Locking is effected by sliding the dogs horizon­tally; for example, dog J has been pushed into the notch in tappet 1, holding it in the normal position. If tappet 2 were raised, its notch would come opposite dog J; and then the lifting of 1 would lock 2 by pushing J to the left. By means of horizontal rod R, the lifting of 1 also locks 4. If 4 were already up, it would be impossible to lift 1.

■Switch and signal machines are sometimes worked by com­pressed air, or electric or hydraulic power. The use of power makes it possible to move points at a greater distance from the cabin than is permissible with manual power. The most widely used apparatus is the electro­pneumatic, by which the points and signals are moved by compressed air at 70 lb per sq. in., a cylinder with piston being fixed at each signal or switch. From a compressor near the cabin, air is conveyed in iron pipes buried in the ground. The valves admitting air to a cylinder are controlled by electro­magnets, the wires of which are laid from the cabin underground. Each switch or signal, on completing a movement, sends an electric impulse to the cabin, and the interlocking is controlled by this “ return.” In the machine the “ levers ” are very small and light, their essential function being to open and close electric circuits. This is performed through the medium of a long shaft placed horizontally with its end towards the operator, which is revolved on its axis through 60 degrees of a circle. This shaft actuates the interlocking, which is in principle the same as that already described; and it opens and closes the electric circuits, governing the admission of air to cylinders, by means of simple metal contact strips rubbing on sections of its surface. The high-pressure machine has been used with hydraulic power instead of pneumatic, and with electrical interlocking instead of mechanical.

Interlocking apparatus worked by compressed air at low pressure (15 lb per sq. in.), and with no electrical features, is in use on some lines in America and has been introduced into England. In place of an electromagnet for admitting compressed air to the cylinders, a rubber diaphragm S in. in diameter is used. This is lifted by air at 7 lb pressure, this pressure being con­veyed from a cabin, distant 500 ft. or more, in one or two seconds. As in the electro-pneumatic machine, the lever of a switch cannot complete its stroke until the switch has actually moved home and conveyed a “ return indication ” to the cabin. Pneumatic apparatus of other designs is in use to a limited extent.

Pneumatic interlockings are costly to instal, and, depending on an unfailing source of power, have not been much used at iso­lated places, except on railways where an air-pipe is installed for block signals; but at large yards the pneumatic machines have been made a means of economy, because one attendant can manage as many levers as can two or three in a manual power machine. Moreover, a single lever will work two or more switches, locks, &c., simultaneously, where desirable. The absence of outdoor connexions above ground is also an advantage.

Since about 1900 electric power has come into use for working both points and signals. A motor, with gearing and cranks, is fixed to the sleepers at each pair of points, the power is conveyed from the cabin by underground wires, the locking is of common mechanical types, and, in general, the system is similar to pneumatic systems except in the source of power. By using accumulators, charged by dynamos run by gasoline engines, or by a travelling power-car, the cost of power is reduced to a very low figure, so that power-interlocking becomes economical at small as well as large stations.

The essence of block signalling is a simple regulation forbidding a train to start from station A until the last preceding train has passed station B; thus a space interval is maintained between each train, instead of the time-interval that was relied upon in the early days of railways. As the introduction of the telegraph was almost or quite contempor­aneous with the advent of the railway, the possibility of a block system was early recognized; but its introduction was retarded by the great cost of employing attendants at every block station. But as traffic increased, the time-interval system proved in­adequate; and in the United Kingdom the block system is now practically universal, while in America it is in use on many thousand miles of line. In “ permissive blocking ” a second train is allowed to enter a block section before the first has cleared it, the engine-man being required so to control his speed that if the first train be unexpectedly stopped he can himself stop before coming into collision with it. It thus violates the essential condition of true block signalling.

The manual "block ” system in use at the present day in no way differs from that devised by W. F. Cooke in 1842, except so far as the details and designs of the telegraphic instruments are con­cerned. Cooke used a single-needle instrument giving two indications—the needle to the left signifying "line clear,” to the right, “line blocked”; the instrument was also available for speaking purposes. The instruments employed in Great Britain consist of two dials—one for the up line and one for the down—and a bell. They may be divided into two main classes, those requiring one wire, and those requiring three wires for each double line of rails. The dials of the one-wire instruments give only two indications, namely, “ line clear ” and “ train on line ” or “line blocked,” the latter being the normal indication, even when there is no train in the section. The three-wire instrument has the advantage of giving three indications on the dial, namely, “ line clear,” “ line closed ” and “ train on line,” the normal indication being “ line closed.” The one-wire instru­ment differs from the three-wire in that the indicator is moved over to the different positions by a momentary current, and is then held there by induced magnetism, the wire being then free for any suc­ceeding signals. In the three-wire apparatus there is a separate wire, with an instrument at each end for the up line; the same for the down line; and a wire for the bell, which is common to both lines. When no current is flowing, the indicator is vertical, meaning ” line blocked or closed.” When a current is sent along one of the wires, the deflections to the right or left, according to the polarity of the current, mean “ line clear" or “ train on line ” respectively. Some dial instruments are made with needles, some with small disks, some with miniature semaphores to give the necessary indications, but the effect is the same. The block instruments and bells should not, as a rule, be used for speaking purposes; but on a few subsidiary railways, block working is effected by means of ordinary single­needle telegraphic instruments, or by telephone, the drawback to such an arrangement being that the signalman has no indication before him to remind him of the condition of the line.

Fig. 8 shows the signals at a typical English station, which may be called B. Notice having been received over the block telegraph that a train is coming from A (on the up track), the signalman in the cabin, *b,* lowers the home signal *h*; and (if the block section from B to C is clear of trains) he lowers the starting signal, *s,* also. The function of a distant signal *d* has already been described; it is mechanically impossible for it to be lowered unless *h* has previously been lowered. The relation of the signals to the “ crossover road ” *xx* is the same in principle as is shown in fig. 5. Dwarf or disk signals such as would be used for the siding T or the crossover *xx* are omitted from the sketch. Where the sections are very short, the starting signal of one section is often placed on the same post as the distant signal of the next. Thus, supposing B and C to be very close to each other, B’s starting signal would be on the same post as C’s distant signal, the latter being below the former, and the two would be so interconnected by “ slotting ” apparatus that C could not lower his distant signal unless B’s starting signal was "*off,”* while B by the act of raising his starting arm would necessarily throw C’s distant arm to “ danger.” In America many block stations have only the home signal, even at stations where there are points and sidings, and on double-track lines the block