CHAPTER VII.

PREECE'S THREE-WIRE SYSTEM.

110. MR. PREECE'S three-wire system is a permanent current system only as regards the rendering of the *clear* signal. The *block* or *danger* signal is produced by gravity. The apparatus employed consists of four parts, viz., the *semaphore*, the *switch*, the *bell*, and the *bell-key*.

111. Fig. 26 is a transverse section of the **semaphore** instrument showing its internal arrangement. E is an electro-magnet, C a rocking lever, centred at B, at which point it is rigidly connected with the armature A. At *d* it is connected with the arm by means of a small wire-rod *e*, which is eccentrically attached to the arm H at *f*. G is a small movable weight, the object of which is to so influence the lever arrangement, that in its normal condition, the armature A shall be carried away from the electro-magnet E, and the arm H, raised to *danger*.

If now a current be passed through the coils E, A will be attracted, the lever C will be raised at its extremity *d*, the rod *e* will receive an upward movement and the arm H, will be depressed to the all clear position. On the cessation of the current, the coils will lose their attractive power, the armature A will be released, and the

weight G, now coming into operation, will again raise the arm to danger.

The extent of the movement of the lever C, is con-

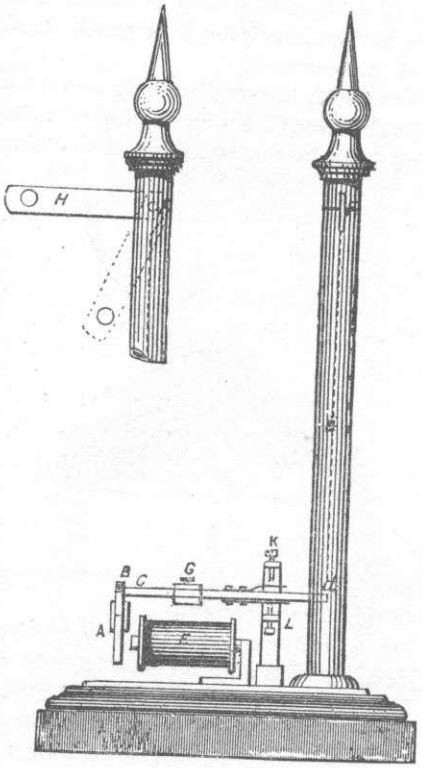

FIG. 26.

trolled by two cocks, provided with necessary adjusting screws, L which regulates its downward action, and K,

which controls its upward motion. It is necessary that the influence of the weight should be sufficiently pronounced to insure the small spring attached to C for that purpose, making good contact with L; and that the adjustment of K should be such as to secure an equally good contact when the lever C is raised at *d*, by the attraction of A towards E.

The two cocks K, L, serve, not only as a means of adjustment for the lever C, but are requisite for the purpose of repeating back to the signalling station the position

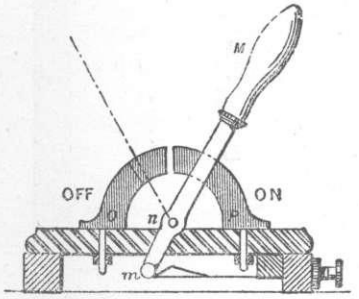

FIG. 27.

of the arm. It will not, however, be necessary to refer to them further for the present.

112. Fig. 27 is a transverse sectional representation of the **switch,** and Fig. 28 is an outside front view of the same. The lever or handle M, centred at *n*, is free to move backwards and forwards within the slotted segments O, P. At its extremity *m*, it is fitted with a small steel roller, which on the movement of the lever from one side to the other, traverses a spring provided with a double inclined plane, the object of which is to exercise such influence over the lever M, as to admit of its move-

ment from the position in which it has been last placed,

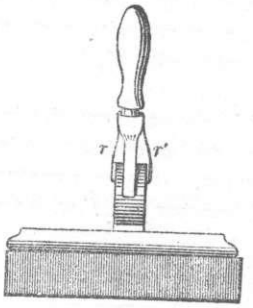

FIG. 28.

only under the exercise of some slight force. The lever M is provided with two springs, *r*, *r'*, Fig. 28, one on

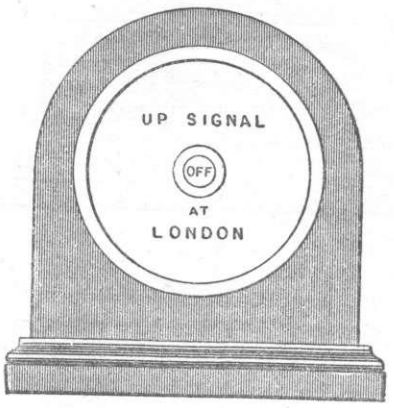

FIG. 29.

either side, so arranged that they shall press against the segments O, P, according to the position of M, and so

secure good contact between it and the segment. The segment O is lettered OFF, and that marked P, ON. The instrument is provided with three terminals, one of which is in connection with M, another with O, and the third with P.

113. The **bell** is shown in exterior in Fig. 29; inside section in Fig. 30; and in end section in Fig. 31. Q Q′ is the electro-magnet. R, the armature centred at *r*, carrying the bell-hammer rod *r′* with the hammer at its

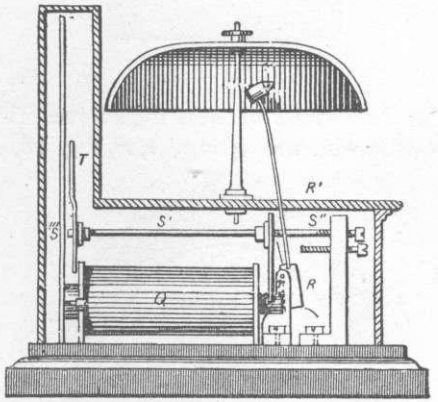

FIG. 30.

extremity. S is a small magnet fixed upon a spindle *s′*, pivoted at *s″* and *s‴*. Affixed to this spindle at the opposite end to S is a shield T, carrying the words [ON, OFF]. The movement of the magnet S is so arranged that one of the sentences, "ON" or "OFF," shall be shown at the aperture in the face of the instrument (Fig. 29), in whichever position S may be placed. To R is attached a small locking pin *u*, which when the

armature is at rest passes on one side of the magnet S, as indicated in Fig. 31, and so locks it in that position. To R is also affixed a steel spring, not seen in the figures, which, on the armature being attracted by Q, presses against the adjusting screw seen immediately below s″, the object of which is to restore the armature to its normal position on the cessation of every current passed through the coils.

If now a negative current be sent through the coils Q, R will first be attracted and the bell dome struck; the

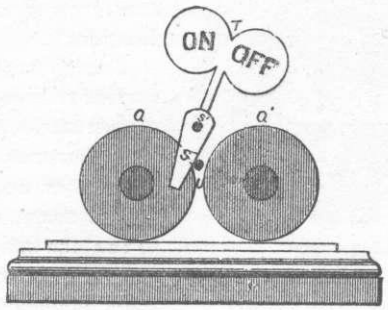

FIG. 31.

locking pin *u* having freed S, it will assume the position shown in Fig. 31, exhibiting the word ON at the aperture in the face of the bell, which will thus read, "Up signal ON at London." On the cessation of the current, R will be restored to its normal position and the small magnet S, locked to the ON signal. If we repeat this current there will be no change in the *indication* of the bell, but another stroke will be struck on the bell dome.

But if now we send a positive current through Q, the attraction of the armature R, will be the same, and the

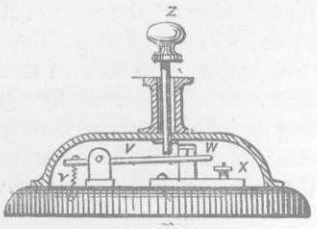

FIG. 32.

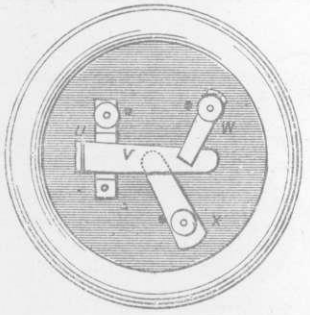

FIG. 33.

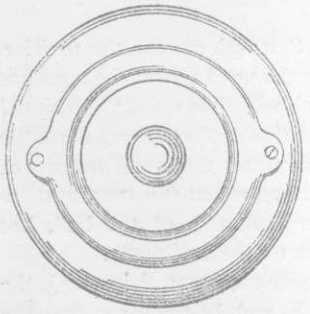

FIG. 34.

bell dome will be sounded as with the copper current, but S will, in this instance, on being released by the locking pin *u*, pass over to the core of Q′, and now the word OFF will take the place of the word ON at the aperture in the face of the bell, and the indication will read, "up signal OFF at London."

Thus (§ 103) for each current received from the distant station, whatever its character, whether positive or negative, the bell is sounded; whilst (§ 104) the indicator, ON and OFF, is, on the contrary, influenced by the direction of the current, that recognized as the positive current exhibiting the word OFF, and that as the negative, the word ON.

114. The **bell key,** or **"Plunger,"** is the instrument by which the bell is worked. It is shown in section in Fig. 32, in plan in Fig. 33, and with its case on in Fig. 34. V, is a small lever capable of being moved from the stop-piece W, in forcible contact with which it is kept by means of the spring *v*, to the lower contact X. The lever V, is in connection with the bell-line wire; the lower contact X, with the semaphore; and the upper contact W, with the bell. The plunger knob, Z, is fixed upon a rod surrounded by a spiral spring within a small tube, the object of the spring being to raise the rod free of the lever V when not in use. On pressing Z the lever V is carried away from W, and brought into contact with X.

115. Fig. 35 shows the **electrical connections** between the several portions of the apparatus for one end of a section for both up and down trains. One wire is devoted to the up-line, another to the down-line, and the third to the bell, which is thus common to both.

Fig. 35A is an outward representation of two complete sets of these signals, showing their arrangement for an intermediate signal box. The shelf or frame supporting the switches, bell-keys, and semaphores, stands just above, and free from, the levers by which the out-door signals are operated.

116. The following is the **method of signalling** usually adopted. A train is about to start from **A** to **B**. A warning signal is first sent to **B** to say "train coming." This is done by signalling twice two beats on the bell. The train then—provided the semaphore arm indicates that the road is clear—leaves, and its departure is signalled by **A** to **B** by two beats on **B**'s bell. **B** acknowledges this by raising the semaphore arm at **A**, and so blocking the road against any following train. **A** acknowledges this by one pressure of his bell-key which sounds **B**'s bell once, and causes the indicator on its face to read, "Down signal ON at **A**." On the

arrival of the train at **B**, the semaphore arm at **A** is lowered and his bell sounded three times by **B**. **A** acknowledges this by one stroke on **B**'s bell, which also causes the indication on its face to read—

DOWN SIGNAL
OFF
at
STATION **A**,

which terminates the transaction, and restores the instruments to their normal position.

117. We will now, by the aid of Fig. 35, trace certain of these transactions in order to observe the working of the several portions.

It may be assumed that the warning signal has been sent and acknowledged. The departure signal is now given. **A** presses the knob of his bell-key twice. The lever V is brought into contact with X, X is in connection with the weighted lever C of the semaphore, which is in contact with the cock K, and this cock is in connection with the copper pole of a battery, the other pole of which is to earth. Thus we have, on pressing V, a copper or positive current flowing from the battery to K, from K to C, and by the wire connecting it with the bell-key, to X, with which V is, by the pressure of the bell-key knob, in contact. From V the current passes into the bell line wire, and so on to station **B**, where it enters by the bell-key at V, which in this case would rest, as is shown in the diagram, against the stop piece W, and which is in connection with the bell coils, through which it passes, operating the bell as explained in § 113.

Corresponding with the number of currents sent, which depends upon the number of times the bell-key is pressed, will the bell be sounded. The position of the

indicator on the face of the bell however, depends upon the *nature* of the current. In the present case a positive

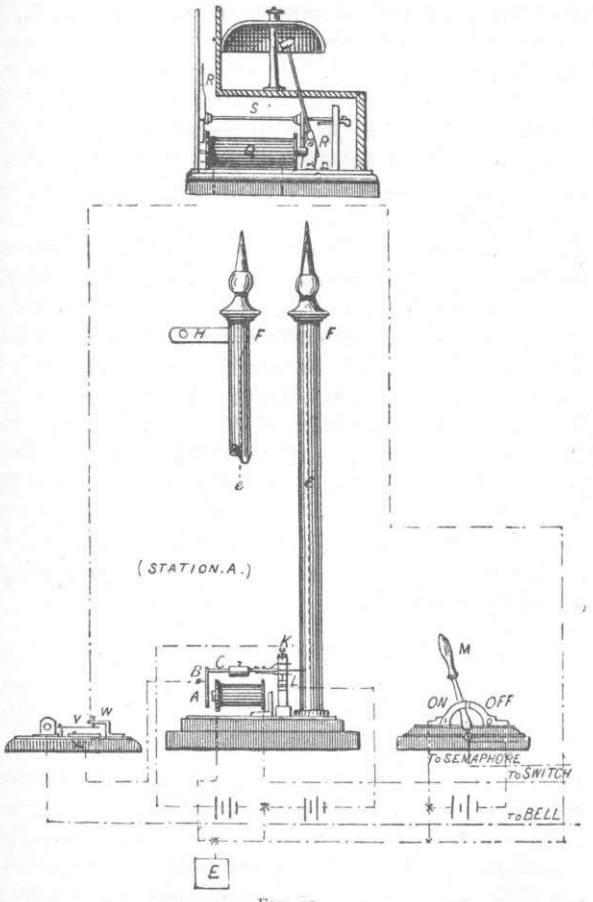

FIG. 35.

current has been sent, and the indicator will read, "Signal OFF at **A**," the semaphore arm there being at *all clear*.

B now understands the train has left **A**, and in order to prevent another following it till it arrives at **B**, he passes his lever handle over to ON. M is now in contact with P, and P is connected with the "earth." No current passes out by the switch; the electro-magnet E of the semaphore at station **A** is no longer excited and the weight *g* carries A away from E, and raises the arm to the *danger* position as shown in the figure.

Station **A** acknowledges this by pressing V once. But **A** no longer sends to **B** a current of the same character as that previously transmitted. The position of the semaphore arm has been changed by the movement of the lever C, which previously rested upon K, and which now rests upon L, L is in circuit with the zinc pole of the battery, and thus a negative current is brought up to X, and on the pressure of V passes into the bell wire and so on to **B**. Arrived at **B**, it passes through V and W to Q, which it excites and again rings **B**'s bell. The current is of a reverse character to that formerly sent, and the magnet S, Fig. 31, is consequently carried over towards Q, and the indication on the face of the bell now reads—

DOWN SIGNAL
ON
at
STATION **A**.

On the arrival of the train at **B**, he draws his lever, M, over to OFF. M now comes into contact with O, to which is connected the switch battery wire. A current then traverses the down semaphore line wire to station **A**, and passing through the semaphore coil, E,

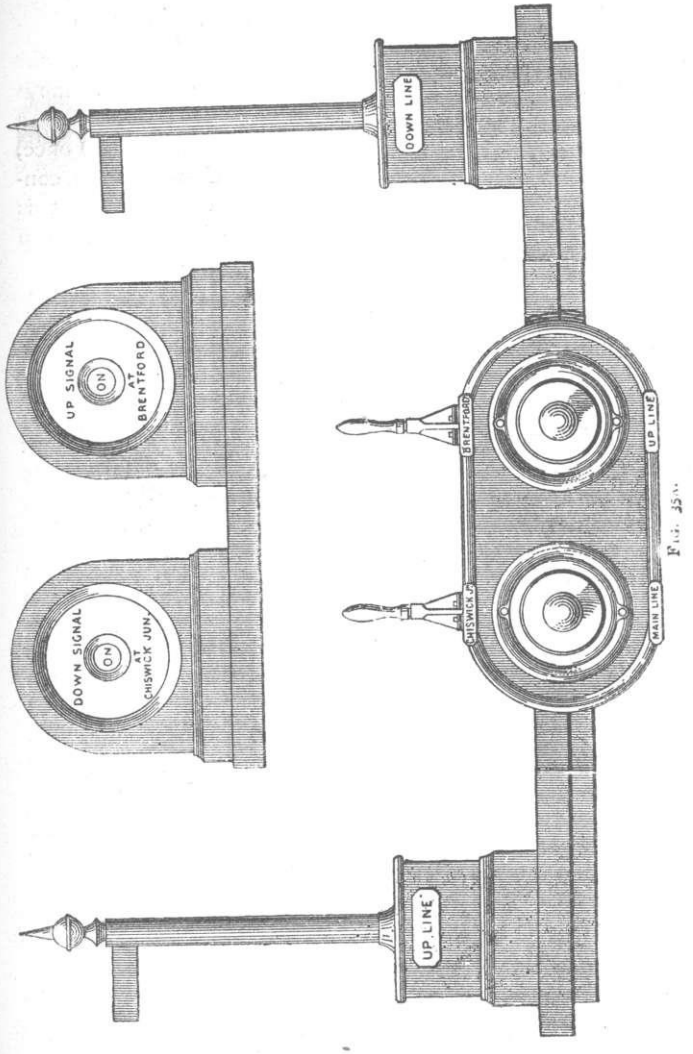

FIG. 35.

attracts the armature A, centered at B, which raises the rod *e*, and so depresses the arm, indicating the line is *clear* to **B.**

A acknowledges this by pressing his bell-key (V) once, and the position of C having again changed from contact with L, to contact with K, a copper current is transmitted to **B,** which in sounding the bell there also reverses its indicator, causing it to read—

DOWN SIGNAL
OFF
at
STATION **A.**

The "clear" signal is thus obtained by a constant current from the distant station. Neither station has any control whatever of its *blocked* or *clear* signal, *both are wrought from the distant station, that to which the train is proceeding.* The repetition or record of the condition of the block signal (the semaphore arm), whether ON or OFF, *is obtained automatically from the semaphore signal itself, and is beyond the control of both the signalman who renders it and the signalman by whom it is received.* The interruption of either semaphore wire at once places the signal at danger. Atmospheric electricity has no effect, the connection between M and P opening up a road for it direct to "earth."