CHAPTER XII.

SIEMENS'S SYSTEM.

141. THE above system is not employed in England, but has been established on several continental lines. Its present improved form is shown in Fig. 70. The lower portion of the case is occupied by a magneto-inductor, from which the necessary current is obtained by turning the handle H. Thus when a signal is required to be sent it is necessary to turn this handle. No battery is needed, the inductor taking its place.

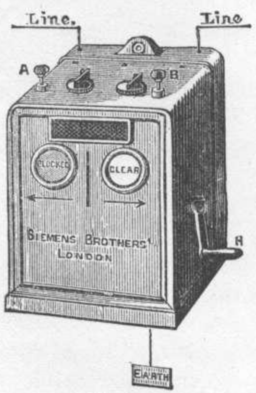


FIG. 70.

The protecting case is entirely of iron, and may be put in connection with the earth, should there be any fear that lightning may injure the signalman when working the apparatus.

The handle, H, of the inductor is at the right-hand side, and two plungers, A and B, are at the top of the protecting case. The signal plate "clear" is on white ground, and "blocked" on red ground, both apertures

being protected with strong glass covers, and each corresponding to one track, the direction in which the trains proceed being marked by arrows. A greater number of signal plates may, however, be combined with a single magneto-inductor at stations where there are branch lines, or more than two tracks.

The apparatus can be worked with only one wire for a double line of rails.

142. If the handle, H, of the instrument be turned, and at the same time the plunger A, at the left-hand side of the apparatus, pressed down, the word "clear" (which in the normal condition of the instrument appears at both apertures), changes into "blocked," thus showing the "up line" blocked, whilst the right-hand aperture would show the "down line" blocked, if the plunger B were pressed down.

When a signalman blocks his instrument in the manner described, the same operation causes the word "clear" to appear at the station immediately preceding; thus the signals of one station are always depending on the signals received from the stations on either side, so that if in the one station the signal "blocked" is visible, the signal "clear" appears at the station immediately preceding it.

Practically speaking the block signals inform the guard of the train whether the preceding train has reached the next signal station or not, thereby instructing him whether it is safe to proceed.

143. In order to prevent a signalman "clearing" the preceding block station before he has placed his own standard signal at "line blocked," Messrs. Siemens provide a winch, which in connection with the block apparatus is placed in any convenient position inside the signal-box (Fig. 71).

The mechanical combination between this winch and the standard signals is such that while the latter stands at line clear (placed so by means of the handle

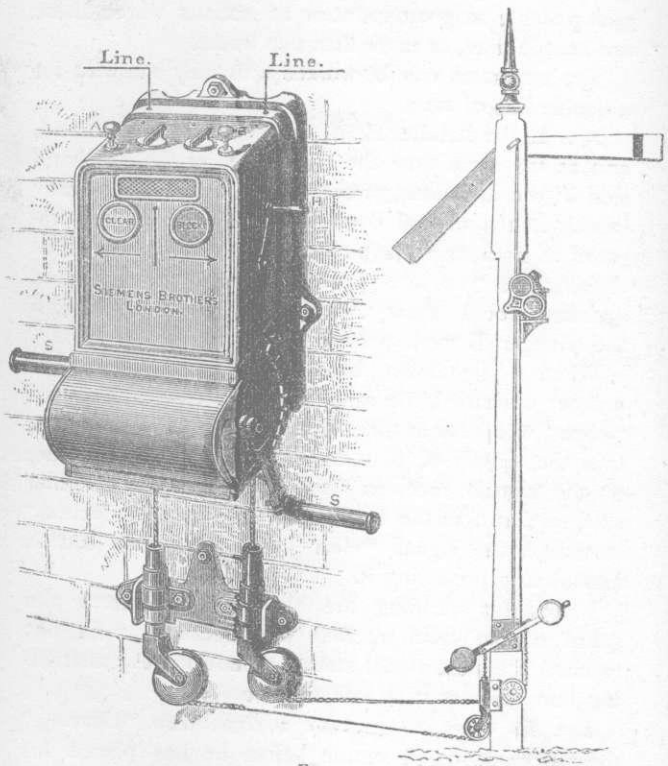


FIG. 71.

S, or a lever if preferred), it is *impossible* to give an electrical signal. In order to send an electrical signal to the preceding station (which is always the "clear"

signal) it is indispensable that the standard signal be first placed at "blocked."

An electrical clear signal sent to the preceding station during this "line blocked" position of the standard signal not only blocks the electrical apparatus, but also interlocks the standard "blocked" signal, so that the standard "clear" signal can only be given after the electrical "blocked" signal has been changed into "clear" by the forward station.

This winch is situated in an iron case underneath the block apparatus, and is provided with two handles, S S, corresponding with the "up" and "down" lines. By turning these handles right, or left, the corresponding standard signals are either raised or lowered. Should the semaphore arms only require a small force to work them, simple rollers or levers, instead of winches, are used.

These instruments are provided with or without alarum-bells, according to requirements.

The alarum-bells are not an essential part of the block apparatus, as it can be worked without their aid. Similarly, it can also be worked without placing the standard signals in dependence with the electrical signals.

144. **The working of the electrical block apparatus** is explained in the following:

Fig. 72 is a diagram representing two indices constituting one of the signalling instruments. As the two indices are alike it will suffice to describe the working parts of one marked I. R^1 is a movable arm, pivoted at z^1, and provided with teeth on its periphery. The movement of this index, "up" or "down," shows the signals "blocked" or "clear" through the aperture of the iron case, and this movement may be accompanied by the ringing of a bell. The pallets of an escapement, a^1 (similar to the anchor escapement employed in clocks), engage in the teeth of the semaphore arm R^1. This escapement is attached to, and worked by the armature of an electro-magnet, E^1, and is caused to oscillate by a number of successive alternating positive and negative electrical currents. The arm R^1, by its own weight, has a tendency to fall in a downward direction, but being held by the pallets of the escapement, a^1, when they are at rest, it can only fall tooth by tooth when these pallets oscillate. Thus a number of successive alternating positive and negative currents are required to give a number of oscillations sufficient to change the signal; an accidental current, a succession of currents of the same direction, or a discharge of atmospheric electricity, cannot change the signal.

The armature, connected to the escapement a^1, is polarized, so that the alternating positive and negative currents transmitted through the coils of the magnet, E^1, cause it to oscillate. This oscillation, besides working the escapement, causes a hammer attached to the armature to strike the bells placed near it.

The arm R^1 shows the two signals, "blocked" on red ground, and "clear" on white ground.

In order to move the arm R^1 up again, a plunger, T^1, with a sliding weight, G^1, bearing upon the tail of the indices arm, R^1, is pressed down, thus giving the indices arm a tendency to rise, as soon as the armature a^1, oscillates.

This plunger, T^1, also acts upon a commutator, and determines the course the electrical currents have then to take.

The reciprocal operation between the block apparatus of two neighbouring stations may be understood from the following example:—

In Fig. 72 the "up line" stands at "blocked," a train

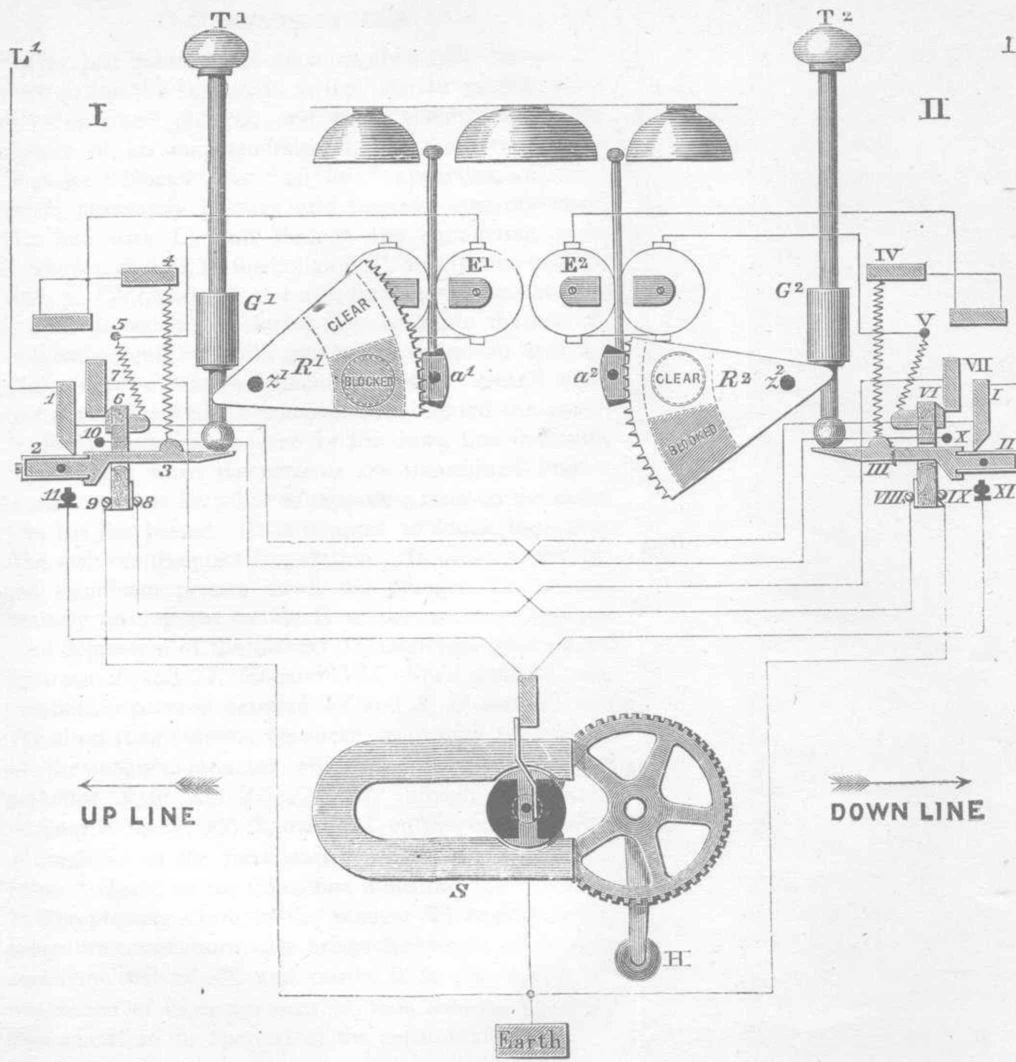

T 1
T 2
L 1
L 2
I
II
E 1
E 2
G 1
G 2
CLEAR
BLOCKED
R 1
R 2
z 1
z 2
a 1
a 2
IV
V
VI
VII
UP LINE
DOWN LINE
S
H
Earth

FIG. 72.

having just passed. As soon as that train passes the next station the signalman at that station presses down his "up line" plunger, and turns simultaneously the handle of his magneto-inductor. By these two operations he "blocks" his "up line" apparatus, and also sends alternately positive and negative currents along the line wire L^1, and through the conducting parts marked 1, 2, 3, 4, to the coils of E^1, and thence through 5, 6, 7, *VIII*, and *IX*, to earth, thus causing the escapement a^1 to oscillate. During this oscillation the arm R^1 descends, tooth by tooth, and brings before an aperture in the cover of the instrument the word "clear," while the word "blocked" becomes hidden behind the cover. A similar action takes place for the down line indicator, marked I I, when the currents are transmitted from a station towards L^2. Let us suppose a train on the down line has just passed. It is required to block the down line and free the preceding station. In order to do this the signalman presses down the plunger T^2, simultaneously turning the handle H of the magneto-inductor. The depression of the plunger T^2, interrupts the contacts between *I* and *II*, *VI* and VII, *VIII* and *IX*, but establishes contacts between *VI* and *X*, *II* and *XI*, and the alternating currents produced by turning the handle of the magneto-inductor will pass from earth through inductor *S* to *XI*, *II*, *III*, IV, through the electromagnet E^2, to V, *VI*, *X*, over to I on the opposite side, through L^1 to the next station, which will receive the signal "clear" on the down line indicator.

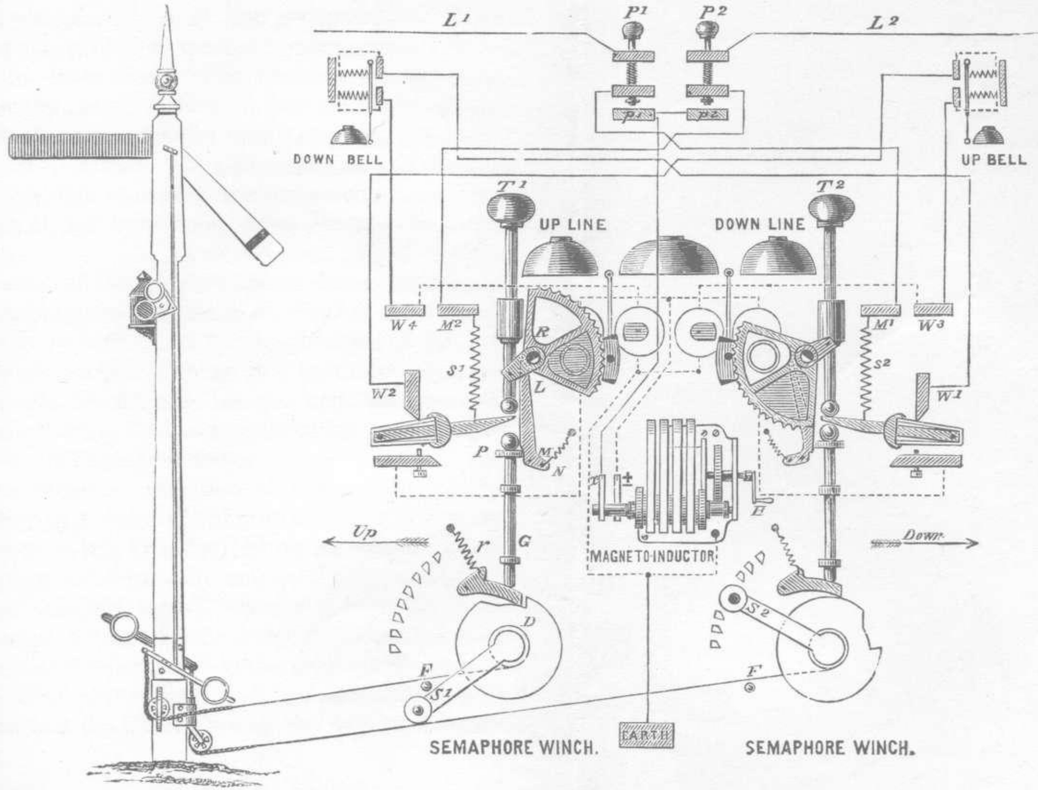
The pressing down of the plunger T^2, besides acting upon the commutator, also brings the weight G^2 to bear upon the tail of R^2, and causes it to rise during the oscillation of its escapement, a^2, thus showing the word "blocked" in the aperture of the apparatus.

The action, therefore, of depressing the plunger T^2, and turning the handle H, removes the block signal from the preceding station, and at the same time shows it on the operator's own instrument, which block signal can only be removed by a similar operation at the *succeeding* station. The commutators therefore are so arranged that each instrument sends currents by the line opposite to that by which it receives currents.

145. **In order to transmit warning signals in a forward direction,** to announce the approach of a train (but without acting upon the ordinary signals), the inductor is provided with a contact maker, so arranged, that it will pass only positive *or* negative currents into the line, which act upon a warning bell at the forward block station. A separate key or plunger is placed between the line wire and the signalling instrument whereby the latter is cut out of the circuit, and the aforesaid single current contact maker brought into communication with the wire.

This arrangement is shown at Fig. 73.

P^1 and P^2 are the plungers or contact makers, the depression of which cuts either the up or the down index out of circuit, and brings the line wire of either side into direct communication with the magneto-inductor. The latter is so constructed, that of the two currents which are produced at each revolution of the bobbin, only one is permitted to enter the line. To obtain this result, the spindle of the revolving bobbin is for a short distance cut in half, one half being taken away and replaced by a piece of insulating material. One contact spring, x, is in communication with either terminal, p^1 or p^2, and receives the currents produced during half the revolutions of the bobbin, that is when the spring x bears against the metallic part of the



L1
P1
P2
L2
DOWN BELL
UP BELL
T1
T2
UP LINE
DOWN LINE
W4
M2
M1
W3
S1
S2
W2
W1
R
L
P
M
N
MAGNETO-INDUCTOR
Up
Down
G
D
F
EARTH
SEMAPHORE WINCH.
SEMAPHORE WINCH.

FIG. 73.

spindle. The contact spring $\pm$ is however in constant metallic contact with either line, *viâ* the springs s^1 or s^2, when the plungers T^1 or T^2 are pressed down. This latter contact spring $\pm$ therefore communicates both currents to either line. The currents of like kind passing by the spring x cause a bell to sound at the forward block station, thereby warning the signalman of the approach of a train. By pressing down the plunger P^1, these currents pass from the magneto-inductor into the up line L^1, and by pressing down P^2 into the down line L^2.

The course of the single currents being from earth through the magneto-inductor x, p^1, P^1, L^1 to the *forward* station, into P^2, M^2, s^1, W^2, through coils of up bell W^3, through bobbin of down line index to earth, the index will not be affected, but the bell will give any number of vibrating strokes corresponding to the manipulation of the magneto inductor.

146. An important extension of this system consists in **combining the electrical signalling instruments with the switches or other such apparatus,** as are usually employed for working the points and standard signals, whereby it is impossible to give electrical signals unless the standard signals are set at danger, and the points are in the required position.

This is accomplished by providing a cam and pawl in connection with the levers working the standard signals or points.

The pawl is moved by the plunger, which the attendant presses down when he works the electrical signalling instrument. It is held engaged in the notch by a detent, until by the working of the electrical instrument from the station beyond, the movement of the electrical signal releases the detent, and permits the pawl to be disengaged from the cam by the action of a counter spring. When this is effected the point or signal is set free.

This arrangement is'shown in Fig. 73. By turning one of the handles S^1 or S^2 the standard semaphore arms are moved up or down. When the arm is up or at "danger," the handle S^1 will press against the stop *F*. In this position a notch in a disc *D* which turns with the winch handle S^1, is brought to face a spring pawl, which if depressed, prevents the turning of the handle, and therewith the moving of the standard signal. Thus the depression of the plunger T^1 for giving electrical block signals is only possible when the standard signal stands horizontally, showing "danger." When the position of the winch handle S^1 permits the depression of the plunger T^1, the spring pawl is depressed and held down into the notch of the disc *D* by means of the rod *G*. The shoulder *P* fixed to the rod *G* descends, and permits the lever *L M N* (which turns round the centre *M*, subject to the tension of the spring *N)* to take the position shown in respect of the up-line commutators to the left of the figure. If now alternating currents be sent by turning the inductor, the segment carrying the white and red discs ascends and shows, behind the aperture of the instrument cover, the "danger" or red disc, while at the same time the currents pass through line Z^2 to the preceding station, and there remove the danger signal.

When the segment *R* has ascended, its axis (half of which is cut off) having turned, prevents the lever *LM*TV .from returning. In consequence whereof, the shoulder *P* with the rod *G* cannot rise, and therefore the signalman cannot alter his standard signal as long as the electrical index shows the "danger" signal. If, however,

the signalman at the next or succeeding station removes this danger signal, then the segment *R* descending, brings the axis of *R* into such a position that the shoulder *P* gets clear of the lever *L M N*, permitting the rod *G* to ascend by means of the spring *r* being stronger than that of lever *L M N*.

In consequence thereof the pawl is withdrawn from the notch of the disc *D*, and the winch handle .S^1, and standard signal are set free.

In this manner the standard signals and electrical signals are made to depend upon each other.

Fig. 74 shows a sliding bar *Z>*, by which the points are moved and interlocked by the electrical block signals,

FIG. 74.

in the same manner as explained with the standard signals.

Such interlocking of electrical instruments with the points, or standard signals, can be modified so as to * suit particular conditions in the working of sidings, junctions, &c.