CHAPTER VI.

INSTRUMENTS AT PRESENT IN USE.

ELEMENTARY PRINCIPLES.

WITH the exception of the needle form of instrument already described (§ 13), all the block-signal instruments of the present day are worked by *electro-magnetism.*

100. An **electro-magnet** is formed by winding a quantity of insulated wire around a piece of iron. Let

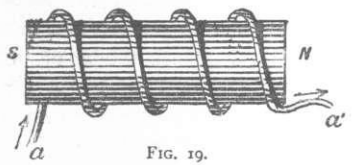

FIG. 19.

N S, Fig. 19, represent such a piece of iron, and *a a'* an insulated wire wound around it. If a current of electricity be passed through this wire, its influence upon N S will be such as to impart to it magnetic powers, and it will assume a polarity *subject to the direction of the current.* If the current be in the direction indicated by the arrows, the polarity will be as shown by the letters S (south), N (north). If the direction of the current be

reversed, the polarity will also be reversed ; S will become north, and N south.

101. The piece of iron N S is called a **core.** If it be of the best annealed soft iron, the magnetism acquired by the passage of the current will, practically for the purpose in view, cease to exist with the cessation of the electric current. If, on the other hand, the iron be of inferior manufacture, it will retain its magnetism, but in a reduced degree, for a period governed by the purity or

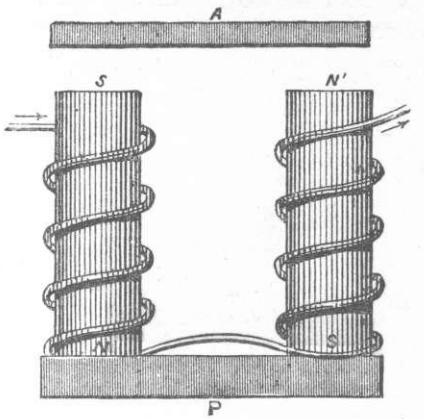

FIG. 20.

impurity of the metal. The best and softest iron should as a rule be used, as, ordinarily, an electro-magnet is only required to be active during the passage of the current through the coils of wire by which it is surrounded.

102. Two cores N S, N' S', coupled by a soft iron plate P, and wound with insulated wire in the manner represented in Fig. 20, form a more powerful electro-magnet than that described, and it is the form generally employed.

If, during the passage of the current through the coil wire, the iron bar A be brought within the immediate neighbourhood—termed the **magnetic field**—of the cores S N′, it will be attracted towards them and forcibly retained in that position until the current ceases to flow through the coils, when it may be readily withdrawn.

103. If A, Fig. 21, be hinged at one extremity *b*, and its other extremity *c*, be placed under the control of a spiral spring *x*, the tendency of which shall be to withdraw it (A) from the neighbourhood of S; during the passage of every current A will be attracted towards S, so

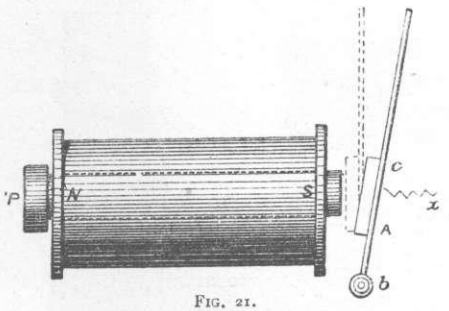

FIG. 21.

as to assume the position indicated by the dotted lines; but on the cessation of the current, S being no longer magnetic, the influence of the spring *x* will predominate, and A will be withdrawn from the dotted to the normal position.

A being simply a piece of soft iron, and in no way of itself possessing magnetic powers, will be attracted by the electro-magnet N S on the passage of *every current* of electricity *whatever its direction.*

The bar A is termed an **armature**. Hence we have the means of producing a backward and forward **move-**

ment, with the passage of every electric current through the coils of the electro-magnet. This movement may be employed to ring a bell, move a semaphore arm, or do other work of a like character.

104. If now, Fig. 22, we take a small permanent magnet *n s*, pivoted at A, and place it in the neighbourhood of the electro-magnet, so that it may be free to move between the poles S N, as shown in the figure, we shall find, on passing a current through the coils, that it will be attracted by the one pole and repelled by the other. If the coils be wound as indicated in Fig. 20, and the current passing through them be in the direction

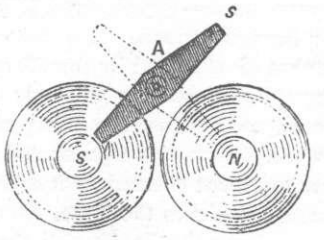

FIG. 22.

indicated by the arrows, the position of the magnet will be that shown in the figure. If the current be passed through the coils in the opposite direction, the magnetism of the cores and the position of the permanent magnet will be reversed; S will become N, N will become S, and the position of *n s* will be that indicated by the dotted lines. Hence, then, we obtain a means of producing **motion, governed by the direction of the current.**

In the former case (§ 103) we have **motion, independent of the direction of the current,**

but here we have **motion, subject to the direction of the current.**

Upon these principles are mainly based the action of all modern electrical block signals.

105. The different forms or systems of recognised block-signalling instruments, at present in use in Great Britain are six, viz :—

Cook and Wheatstone's needle instrument.
Preece's three-wire semaphore system.
Walker's semaphore.
Tyer's semaphore.
Spagnoletti's disc.
Preece's single wire semaphore system.

106. The first of these—**Cook and Wheatstone's**—has already been described. It is the ordinary double needle instrument (§ 18) used by the Electric and International Telegraph Company in its early days for commercial purposes, and still used on many railway systems for message work. It has, however, shared with the single needle, the improvement effected in it at the time of the transfer of the telegraphs to the State. One of its defects was the liability of the small needle magnet inside the coils to be partially, sometimes entirely, demagnetised, or even to have its polarity reversed, by lightning. In this manner the movement of the needle entirely failed, or the signals were reversed—in the latter case "Line clear" being represented by "Line blocked," and "Line blocked" by "Line clear."

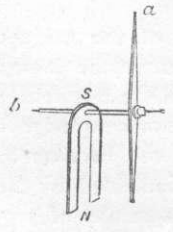

FIG. 23.

107. To remedy this a soft iron needle *n s*, of the shape shown in Fig. 23 is fixed

to the spindle *b* carrying the indicating or outer needle *a*, in the place of the small permanent magnet formerly used.

To the upper portion of the inner coil cheeks are fixed two permanent bar magnets NS, N'S', Fig. 24, so that their similar poles shall be adjacent to each other. *n s*, being within the magnetic field of these permanent magnets, acquires from them magnetic properties, with a polarity as indicated by figure 23, and performs precisely the same functions as the permanent magnet which it replaces. The two-bar magnets NS, N'S', will in course of time require remagnetizing. It is possible, although unusual, for them to become demagnetized by lightning, but no case is recorded of their polarity having been changed under atmospheric influences.

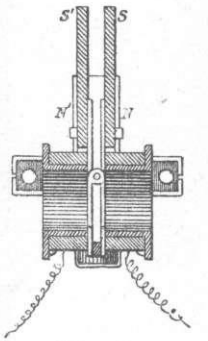

FIG. 24.

108. Fig. 17 represents the complete instrument. It may be used for block-signalling purposes in the manner previously described (§§ 90, 91). It is better for the *block* and *clear* indications to be rendered by permanent than by momentary currents. With a permanent signal there is always an object of reference, but with a momentary, or transient signal, there is nothing beyond the book record ; and although every signal ought to be recorded as rendered, it is not, and cannot be, where the signalling has to be carried on, and the records made, by one and the same person, always done. With a momentary current system "Line clear," may be rendered by

atmospheric electricity or contact. With a permanent signal, produced by a permanent current, this can only be effected when the magnetism of the needle becomes reversed by atmospheric electricity.

The instrument is available for speaking purposes, and

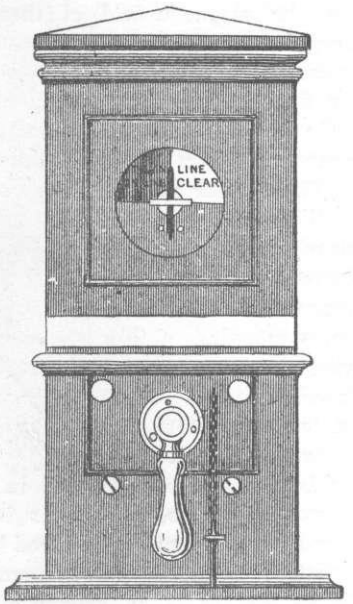

FIG. 25.

on this account is objectionable as a block-signalling instrument. Men are prone to relieve the monotony of a perhaps tedious duty by a passing remark with their neighbouring station. Conversation of this character leads to forgetfulness, and an error is easily made at such

moments. It is not desirable to place in the hands of men means, which even under remote circumstances, may admit of error.

109. Where one needle only is required a single needle instrument, such as is represented in Fig. 25, is employed.