DIVISION I.

SPEAKING TELEGRAPHS.

CHAPTER I.

SIGNALLING INSTRUMENTS.

8. **Telegraphy** is the art of conveying signals from one point to another. When the engine-driver gives his three short sharp whistles, he *telegraphs* to the guards of the train to put on their brakes. When a signalman desires an approaching train to stop, not to pass a certain point, he places his distant and home signals, for trains coming from that direction, at Danger, and by this means he telegraphs the driver of the train in question to stop at that point. But telegraphy of this kind has its limits. The whistle of the engine can be heard, and a distant signal can be seen and can be worked, only at a certain distance. Beyond the reach of the ear and the eye, electricity steps in, and supplies the want felt by the failure of such a means of communication. By its aid, letters, numerals, or sentences, can be conveyed, by certain preconcerted signals, to distant points.

9. The electric telegraph is mainly indebted for its

early success to railway companies and railway enterprise. To railways it promised, as it has since proved to be, of incalculable value. The earlier form of telegraph instrument—the *double needle*—first took root on the railway system, and there, to a great extent, it still exists. The Morse printing-instrument, the Sounder, and the Bell, systems universally adopted by the British Postal Telegraph Branch, are in the main, objects of the future to the railway telegraph service. In Ireland the Sounder is

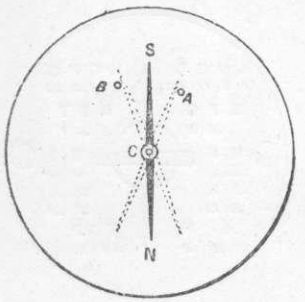

FIG. 3.

much in use, but in England and Scotland the needle is retained. The needle-instrument is undoubtedly well-fitted for railway purposes. Almost any number of them may be connected with the same wire. They are worked with but small battery power; require the least possible adjustment at the clerk's hands; seldom get out of order, and are cheaply maintained.

10. It will have been gathered from paragraph 8 that signals are of two kinds—**Visible and Audible.**

Visible signals are either *Permanent* or *Transient, recording* or *non-recording.*

Audible signals are always *transient*, and differ from each other in tone and duration.

11. The **Needle** is a **visible system,** and its signals are transient, or non-recording. Fig. 3 represents a needle *N S* pivoted at *C*, free to move as indicated by the dotted lines in the direction of the stop-pins *a* and *b*. It has thus two distinct indications; one from *S* to *b*, and back to *S*; the other from *S* to *a*, and back to *S*. These two motions can be employed, singly or com-

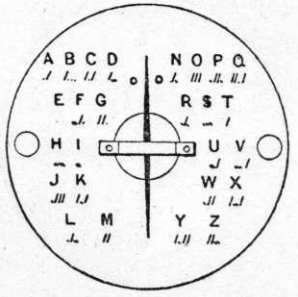

FIG. 4.

bined, to represent the letters of the alphabet, or any other preconcerted signal.

12. Either one, or two, needles and dials may be employed. Where only one is used, the instrument is termed the **single needle;** where two are employed, the **double needle.**

13. Although the double needle claims priority, with regard to the date of its introduction, over the single needle, it may be attended with convenience if we deal with the latter first.

Fig. 4 represents the dial or face of a single-needle

instrument. The motions (§ 11) of the needle are limited by the stop-pins shown to the right and left of its upper portion. The combination or arrangement of the signals, for the representation of the letters, is such that that letter most frequently used is represented by that motion most readily produced, which involves the least

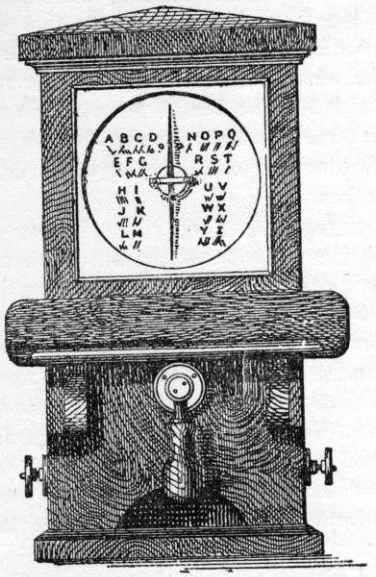

FIG. 5.

labour, and which consequently occupies the least time. Thus with *E* and *T*, the letters most frequently in use, one movement of the needle from its position of rest to *a* (Fig. 4) and back again, represents *E*, and the opposite movement *T*. The same two movements combined, that is one to the left and one to the right, form the letter *A*;

one to the right and three to the left, *B;* and one to the right, one to the left, another to the right, and another to the left, the letter C, and so on; the movements and direction of the needle corresponding to the figures representing the several letters as shown on the face of the dial.

14. The **movement of the needle on the face of the dial** is produced by that of a small magnetic needle fixed upon the same spindle to which is attached the outer needle. This magnetic needle is so arranged that it shall be free to move within two vertical coils of fine wire, in such a manner, that when the upper portion is within one coil, the lower portion shall be within the other.

15. The **movement of the inner** or **magnetic needle** is produced by the action or influence of the electric current upon it when passing through the coils, and the *direction* in which the needle moves depends upon the *direction of the current.* Thus when the current passes into an instrument by the right-hand terminal (Fig. 5), and leaves it by the left-hand terminal, the top portion of the needle (Fig. 4) is inclined to the right, forming the letter *T;* and when the current enters by the left-hand terminal, and leaves by the right-hand terminal, the opposite movement is obtained and the letter *E* is formed.

16. The direction and the duration of the current is controlled by a **Commutator** or **Key,** placed in the front of the instrument, below the dial, and under the writing desk. There are two forms of commutators for single-needle instruments, viz., the tapper or pedal form, chiefly used in the Postal Telegraph Department; and the drop handle, that mostly used on railways. The principle is the same in both. When the pedals of the former, and

the handle of the latter, are in their position of rest, the line circuit is complete through the coils of the instrument; when the right-hand tapper is depressed, or when the lower portion of the drop handle is moved to the left, the indication of the needle is to the right; whilst the opposite movement of the handle, or the depression of the left-hand tapper, produces the opposite movement of the needle.

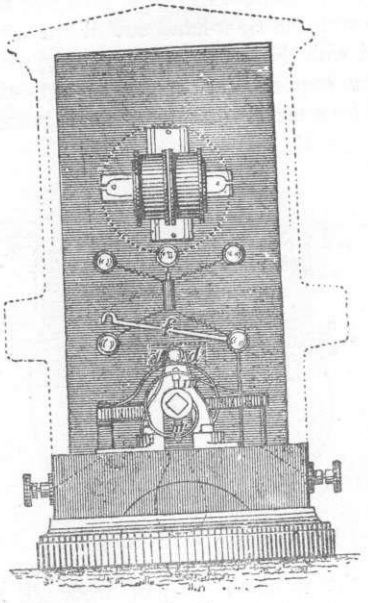

FIG. 6.

17. Figs. 6, 7, and 8 will enable us to follow out these two actions and to trace their effect. The handle by which the instrument is worked is fixed upon an arbor, *D E,* which is insulated as shown in Figs. 7 and

8, at a point midway between those letters. To either of these insulated portions of the arbor is attached a metallic projection, that at *m'* Fig. 6 extending downwards, and that at *m* upwards. *d d'*, are two steel springs in connection with the brass plates *a a'*, fixed to the base of the instrument. The tendency of these two springs is to press against a bridge-piece *f* (Figs. 6 and 8). Four terminals (*A*, *B*, *C*, *Z*) are attached to the instrument. *A* is in connection, externally, with the line wire, and internally with the right-hand coil of the instrument. *B*, externally, with the earth and, internally, with the plate *a'*. *C* with the copper pole of the battery externally, and internally by a metal spring band, or a piece of stranded

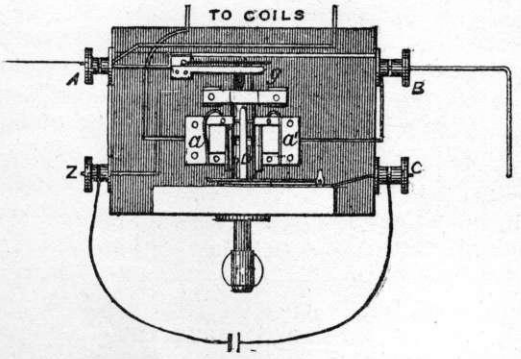

FIG. 7.

wire, with the insulated half of arbor *D*, and *Z*, externally, with the zinc pole of the battery, and internally with the other portion, *E*, of the arbor through the tweezer springs *g* seen in Figs. 7 and 8 at the extremity of the arbor *D E*, the object of which is to form metallic contact with it, and at the same time to influence the

handle, when not in use, to resume its (vertical) position of rest. *F* is a lightning protector interposed between the coils and the line wire. If now we move the handle to the left, we shall, in doing so, place the projection *m'* in contact with the brass plate *a*. At the same time the projection *m*, on the other portion of the arbor, is not only brought into contact with the spring *d'*, but also

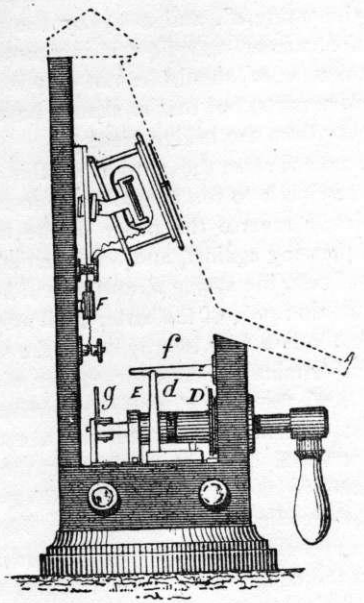

FIG. 8.

carries it away from its position of rest against the bridge *f*, the connection between which is thus broken. The battery current is now in action. That from the copper pole passes in, at the terminal *C*, to that portion of the

arbor marked *D*, and thence, by the projection *m'*, to the plate *a*, whence it passes through the coils to terminal *A*, and so out on to the line wire and to the other instruments in circuit. Precisely at the same moment the zinc pole of the battery is brought in connection with the earth, or *B* terminal of the instrument, by way of the spring at the extremity of the arbor, whence it passes to that portion of it marked *E*, and thence through the projection *m'*, to the spring *d'*, and away by the plate *a'*. In order that the current may flow it is necessary that the two projections, *m*, *m'*, should be, not only in contact with their respective parts, but that *m* should have carried the spring *d'* away from the bridge piece *f*.

But if we now reverse the motion of this handle, and instead of carrying it to the left, move it to the right, we shall completely reverse the order of the contacts. *m* will now be pressing against, and have carried away from its position of rest, the spring *d*, and *m'* will be in contact with *a'*. The zinc pole of the battery will now be in connection with the line wire by way of *E*, the spring *d*, the coils, and the terminal *A;* and the copper with the earth by way of *D*, *m'*, the plate *a'*, and the terminal B.

In the first case the current entered the coils by the right-hand terminal (Fig. 7), deflecting the needle to the right; and in the latter by the left-hand terminal, deflecting the needle towards the left. The course of the current may be regarded, in the former instance, as starting from the copper pole of the battery, through the coils of the instrument to the terminal *A*, and on to the line wire, through the instruments in circuit to the earth at the other end, and thence by the earth back to the zinc pole. In the second case we may still regard it as starting from the copper through *m'*, the plate *a'*, and the terminal *B*, to earth, along which it passes to the earth

connection at the distant end of the circuit, where it enters, passes through the instruments in circuit, and so back to the sending instrument, which it enters at *A;* thence it passes through the coils to the plate *a*, the spring *b*, the projection *m*, and so to the terminal *Z*, where the circuit is completed.

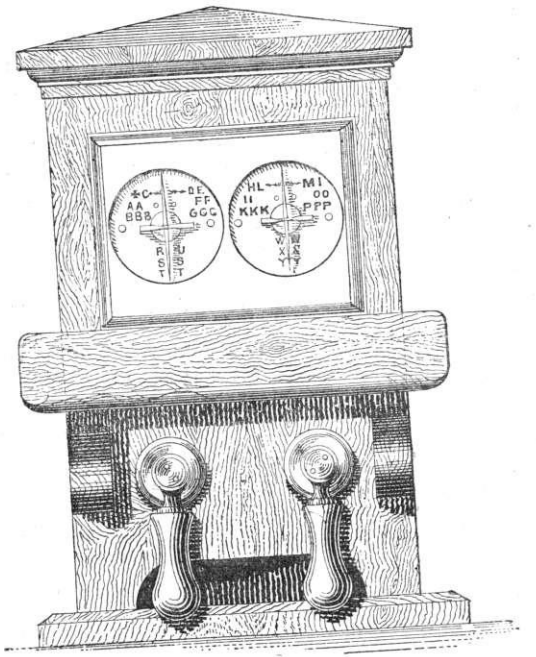

FIG. 9.

18. Duplicate this arrangement and we have the double-needle instrument.

The **action of the double needle** is precisely

the same as that of the single needle. The mode of working the handles, the means by which the currents are made to pass, and their action upon the needles, are identical with that described, the only difference being the duplication of the instrument and the employment of two wires instead of one. One set of batteries, however, serves the two wires, the current being divided between them when both handles are in use.

Unlike the single needle, the combination of the movements of the needles which represent the several letters of the alphabet, are not so arranged that those letters most in use shall be most readily rendered. Its letters are formed in regular succession in the direction of the first indication; thus the left-hand needle moved from its zero position in the direction of *A* (as shown in Fig. 9) twice would form the letter *A;* the movement repeated three times would form the letter *B;* one movement of the right-hand needle in the same direction once, would represent *H;* two movements *I;* three *K*. For the letters not shown above the axis of the needles, that is for *Q* and the following letters, both needles are used, their movements being made to correspond; thus for *R* the lower portion of both needles is directed once towards that letter; for *S* the movement is twice, and for *T* three times. For *W* they take the opposite direction. For the letter *C*, seen to the left of the left hand needle, the needle is carried once to the right and back to the left, thence resuming its position of rest; for *D* the movement is reversed; for *L* it is similar to that for *C* except that in this case the action rests with the right hand needle. *M* is also formed by the movement of this needle, but it is of an opposite character to that for *L*. For *U* and *V* both needles are used, the proceeding being, with regard to *U*, to first carry the lower portion

of the needles to the right and then to the left, and with regard to *V* the opposite. *Q* and *Z* are formed, the former by inclining the upper portions of the needles inwards, the latter by extending them outwards.

It will thus be seen that, ordinarily, the needles are required to take the direction of the letters as shown on the dials; that for the letters above the axis of the needles only *one* needle is used, and that the one on the dial on which the letter appears; that for the letters below their axis, both needles are worked *together;* and that the

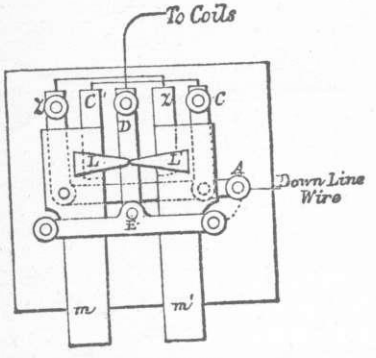

FIG. 10.

number of movements, or *beats*, which they are required to render for the respective letters are regulated by the number of times the letter is represented on the dial.

19. **The principle of the tapper or pedal commutator** is shown in Figs. 10 and 10*a*. Fig. 10 gives it in plan. *A* is a brass bar, fixed to the base board of the key, extending beneath the tappers or pedals *m*, *m'*, which are made of insulating material. These pedals

m, m', are connected to the base board by two flat springs Z, C', and Z', C, which are connected as shown in the drawing, and are projected beneath the tappers so that, with regard to m, Z is so continued as to find its termination immediately above the plate A; whilst C' ends at a distance somewhat short of this, at which point it is brought into metal contact with a spur piece L fixed at right angles to the spring and projecting beyond it, so as to, when pressed down by means of the pedal piece, make contact with a fifth and central spring D, which, in its normal condition, rests, by the upward

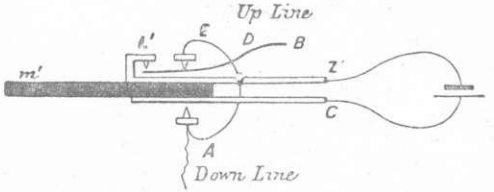

FIG. 10a.

tendency imparted to it, against the bridge piece E. The springs Z' C, in connection with the tapper m', are arranged after a similar manner.

E is now connected with A. The line wires are joined, the down line usually to A, the spring D to one end of the coils, and the up line to the other end of the coils. The battery is connected up to C and Z, respectively.

If we follow out these connections in the action of the symbolical sketch, Fig. 10a, we shall gain some idea of the manner in which the current passes. In its position of rest the current enters, say at A, passes to the bridge piece E, thence to the spring and to the coils, by way of the

terminal in connection with D, and so out at B. When we depress the tapper m', the spring C is brought into contact with the plate A, the spring D is carried away from the bridge piece E by the projection L', and L' being in connection with the spring Z', we have copper in connection with the down line wire, and zinc with the up line through the coils. The action of the tapper m is the same, except that as the position of the springs Z C', is reversed to those in connection with m', the direction of the current is reversed; so that, on its being depressed, we have zinc in communication with the up line, and copper with the down line.

CHAPTER II.

REGULATIONS FOR SIGNALLING.

20. In **signalling,** the needles should be allowed to return between each beat to the *vertical position,* a slight pause should be visible between the formation of each letter, and the completion of the word should be indicated by one beat of the left hand needle in the direction of the ✠. The mode of acknowledging the receipt of a word or signal is—

If understood, to give *E* (one beat of the left-hand needle to the right).

If not understood, ✠ (one beat of the left-hand needle to the left).

Thus *E* represents **understand,** and ✠ **not understand,** or *repeat.* With the single needle the termination of a word is indicated by a pause. "Understand," or "Not understand," is indicated by a movement similar to that in use on the double-needle system. Good readers not unfrequently receive without making use of either signal, merely indicating to the signalling station "Go on," by directing both needles to the left, thus \\ and giving the acknowledgment on the completion of the communication. The practice is not a desirable one,

and should only be permitted under exceptional circumstances, and with the concurrence of the senior officer on duty, who will be the best judge of the ability of the operator.

21. Too much care cannot be bestowed upon the **instruction of beginners or learners.** The novice should be content to advance by degrees, and to learn each step thoroughly as he or she proceeds. A hasty and impatient sender will never make a good signaller. Every beat, and every signal, should be made clearly, distinctly, and uniformly. Impatience of every kind should be checked at the outset, and under no condition allowed to pass unnoticed, whether observed in a senior or a junior. Impatience on the part of seniors, or those who have acquired experience in the manipulation of the instrument, frequently produces a nervous irritability in beginners, which clings to them ever afterwards, renders their sending hurried and indistinct, is the occasion of more errors than is generally believed, and in addition affords the worst possible example to the juniors themselves.

22. Upon speaking instruments, or instruments devoted to signalling messages, devolves much of the commercial correspondence of railway work. By their aid many of those irregularities, oversights, and errors, inseparable from a large business, scattered throughout a large tract of country, and passing through various channels, are corrected. Time is gained, confusion avoided, and pressing public demands are met. But all this can, at a minimum of cost, be secured only by a thoroughly organized system, defined rules, and careful supervision. The telegraph is for use in cases of emergency, and only in cases of emergency should it be employed.

Communications, whose end would be obtained by a letter sent by train, should follow that course, and so leave the wires free for communications which really require their service.

23. As, in order to meet the pressing demands of a large railway traffic, it is necessary to divide it into its several classes, and to work it accordingly, so is it found desirable to classify, and to give precedence and pre-eminence to certain communications which have to occupy the wires for their transmission. Thus it is desirable the telegraph branch of every railway service should be provided with a recognized list of **prefixes, indicating the order of precedence, and character,** of the communication. Priority should of course be given to that communication required for moments of the highest emergency.

24. Probably no greater emergency will be found than that in which a station has to be warned of impending danger, for instance, to a passing train so that it may be stopped on approaching that station, or, in case of accident when the road is obstructed, to warn or to stop all approaching trains. On occasions such as this, every moment, and indeed every fraction of a moment, is of the utmost importance, and the communication cannot be too brief so long as it conveys the necessary information or instruction. In like manner, the prefix should be as short and expressive of the character of the message as is possible, say for instance **DR** (**Danger**). Where, as in a case of this kind, the safety of many may be concerned, the communication may well dispense with code time, number of words, or even the name and station from and to. It will be sufficient for the signalling station merely to call the station required, on receiving attention

to give his own station, and then proceed with the message—as for instance,

"**DR.** Stop all (down or up) traffic."
"**DR.** Look out for runaway engine."
"**DR.** Stop (inserting the name of train) train."

This done, a more formal and explanatory message may be addressed, by the one agent to the other, confirmatory and explanatory of his former proceeding.

This prefix, of such paramount importance, should have the power of stopping *any and every communication* passing, no matter how important or in what stage, whether just commenced, in the middle, or on the point of completion; and care should be taken to impress upon every clerk and officer on the line the importance of its character. Its employment should in every case be reported, by both stations, to the General Manager, or Traffic Superintendent.

25. The next most important demand will be for a communication more complete in its form than that just dealt with. One where the emergency, although great, is not yet *so great* as that provided for under the prefix *DR*. It would be a **special service message,** and might take the prefix **SP.** Its use would be in cases of accident, stoppage of the line, movements and notices of specials. Before this prefix also, everything, except a *DR* message, must give way, whether in course of transmission or not.

26. On some lines a prefix is devoted to *signalling the departure or passing of a* **royal or other important train.** Its employment should be subject to, and under the direction and control of, the Traffic Superintendent of the line. **SPA** might be appropriate for this purpose.

27. **Single line working—crossing orders** will next lay claim to some provision. These messages are of a special character, and should come under the class *SP*, but with a further distinguishing letter. It is intended further on to devote some special remarks to crossing orders: here it will be sufficient to mention, that messages coming under this head must be of two kinds—one, an order to stop the train proceeding in one direction, and the other, an order to send forward that travelling in the opposite direction. Two prefixes are required, and, for reasons which will become evident hereafter, it may be desirable to allot to them the letters **SPR**, and **SPG**.

These prefixes also, affecting the safety of the traffic of the line, should take precedence of everything passing, with the exception of *DR*, *SP*, and *SPA*.

28. It not unfrequently happens that the Telegraph Engineer requires, or has important communications to make which suggest the propriety of affording such the next position. **DS** has for many years been the recognised prefix for communications of this character. It should only be employed under urgent circumstances, and under the direction of the Engineering Officer.

29. It is very necessary, especially in single line working, that the running of certain trains should be reported from certain points to the District Superintendent. By this means he is enabled, in the case of single lines, to consider and arrange beforehand his crossing orders; and in other cases to decide on starting, or keeping back, trains ordinarily working in connection with that whose running has to be reported. **TA—Train arrival** or **Train signal**—is generally used for this purpose It should take precedence after *DS*.

30. Another demand yet arises before we come to the

ordinary message work. There will be a class of messages, of no special, but rather of a very general character, which may still come under the term **On urgent service. SG** when sent direct to the station to which it is addressed, and **XG** when sent to another station for transmission beyond it, is the prefix usually employed; and its application will for the most part be in reference to telegraph work, as, for instance, when it is found necessary to ask for a repetition of a message, the correctness of which appears doubtful. Such a prefix, having reference to messages already transmitted, should naturally have precedence of the ordinary traffic.

31. The **ordinary traffic messages** now take their turn. **DB** for messages sent direct to a station for delivery, and **DL** for messages for transmission, have been the recognised prefixes for this character of message for years.

This completes the order of prefixes. It is possible that under special circumstances others may be found necessary, but where such is the case, their position should be clearly defined in the code of regulations for any service by which it may be adopted.

The number of words in all messages, with the exception of those bearing the prefix *DR*, should be counted, and signalled, in order that the receiving office may be able to check its correctness in this respect.

32. All ordinary traffic messages should carry a **Code time** immediately after the prefix. The code time is obtained by appropriating the letters *A* to *M* (not including *J*) to the hour sections on the face of a clock; and the letters *R*, *S*, *W*, *X*, to the minute sections between these, as shown in Fig. 11. The "code time" of a telegram will thus consist of from one to three letters, viz., one for the hour, and, where necessary, one

or two others for the minutes. 2 o'clock would be represented by *B*, 2.45 by *BI*, and 7.12—the time shown in Fig. 11—by *GBS*, that is, *G* for 7h., *B* for 10m., and *S* for 2m. The code-time is the time at which a

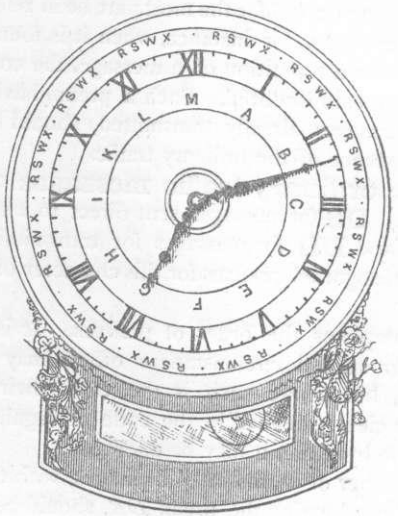

Fig. 11.

message is handed in to the telegraph office for transmission, and its use secures the transmission of messages in the order in which they have been handed in, no matter at what office.

Thus the ordinary message consists of prefix, code-time, number of words, and the written subject; as for example—

Prefix_____ Code Time_____ No. of Words_____

Station from which the Message is received.	Receipt. Fin.	Receiving Clerk's Signature.	Station to which the Message is transmitted.	Time transmitted. Fin.	Transmitting Clerk's Signature or Messenger's Name.
	h. m. ,, —m.			h. m. ,,	

_____ *Station*_____ 187

*From*_____ *Station.*) *To*_____ *Station.*

_____

_____

Received at H. M. „ m. Signature_____

The person to whom this telegram is delivered is requested to fill in the time at which it is received, and to sign it.

33. All telegraph stations have a distinctive **code** or **call signal.** Thus, Aberdeen may be represented by *AB;* Cardiff by *CF*, and so forth. The message having been prepared for transmission, the code of the station required is steadily repeated with a slight pause between, as *AB—AB—AB*, until *AB*, or whoever is called, answers by holding over the needle until it is observed to be still, and then giving the call signal once. The sending station now signals its own code,

which is repeated by the station called, and the message is then proceeded with. First comes the prefix, then the code-time, number of words, name and address from and to, and then the contents of the message. The receiving office should then read over, and count the number of words. Satisfied as to its correctness he acknowledges its completion by the understand (*E*) signal, or by giving "*gd*," when the transaction is complete.

Station calls should be clearly and slowly rendered. Rapid calling is not so readily recognized, and hence less successful in procuring attention.

34. **All telegrams should be written** on forms provided for that purpose, and **signed by the sender.** Where the proper form is not to be had, the message should still be written on paper and duly signed. Messages sent under verbal instructions give rise to error and confusion, and prevent localization.

Care should be observed to write all messages in a *clear and legible manner. Abbreviations* are undesirable. The clearest and briefest language should be employed.

35. All **conversation** on the instrument, and **frivolous** or **unnecessary messages** should be strictly forbidden.

36. At many railway stations the telegraph duties are not unfrequently combined with others, so that occasions may arise when the telegraphist is unable to attend to a call. It is obvious if he were to allow the call to continue he might be depriving others of the use of the wire. To meet this a code **MQ—"wait, engaged"**—is made use of. The station called should answer the call, ascertain whom it is calling, and the nature of the message, with its code time, before giving **MQ.** No MQ should be accepted for a longer period than ten

minutes. If it is not relieved by that time, the station should be called again.

37. **Inattention** will be found to exist on every system to a greater or less extent. The necessity of a prompt response to every call cannot be too strongly impressed upon the staff generally. To occupy a circuit by continuous calling for a period of some thirty or forty minutes is to greatly prejudice any other work which may be waiting its turn. Where inattention from any cause arises, it may be found convenient, when the circuit is required for other purposes, to call only for periods of ten minutes, allowing an interval of a similar duration for the despatch of other messages.

38. **Wrangling and quarrelling** for the possession of the circuit should be suppressed. To obtain possession of a circuit, it is merely necessary for the office requiring it, to hold over the needle or needles—that is, supposing some other station is being called—until attention has been secured, and then to give the prefix, if it is one taking precedence, or the code time of the message. If it should be of an earlier date than that having possession of the circuit, the circuit should be given up to it. But such interruptions on a busy circuit are most undesirable, and are to be avoided by *watching* the circuit and only seeking possession of it when a later code is offered.

39. A **message** should be **regarded as commenced** when its prefix, code-time, and number of words, have been signalled, and it should not then be interrupted except by a *DR* or *SP* message.

40. Care should be taken to see that the instrument is disengaged before taking possession of it. For this purpose it is desirable, before commencing to call a station, to give the "not understand" signal two or three times.

Should a message be in the midst of transmission, the word last signalled will be repeated, and it will thus be seen that the circuit is engaged.

41. Every instrument should be examined and the **condition of the signals** tested with, and reported to, its chief transmitting office every morning at the time the office is recognized as open for business.

When the communication is interrupted, the apparatus should be carefully examined, in order to see if any derangement exists which it may be in the power of the officer on duty to rectify. The instrument should be put on short circuit and the handles moved. If the needle does not respond, the fault is probably in the sending portion of the instrument, and may be found in the batteries, or wires connecting them with it. To prove if it is in the receiving portion of the instrument, remove the battery wires and apply them to the *AB* and *CD* terminals of the double needle respectively; or to the *AB* terminals of the single needle. This should pass a current through the coil under examination, and thereby produce a deflection of the needle to one or the other side of the dial. The presence of this deflection proves the correctness of the receiving portion of the instrument.

The *double needle* instrument is put on *short circuit* by joining the middle to the back terminal on either side of the instrument. The *single needle* by joining the terminals *A* and *B* (Fig. 7).

Nothing should be allowed to rest against the handle of the instrument, and no one should be allowed to touch it except the responsible officer. Care should be taken to leave, and to keep, the handles in the vertical position, and where the tapper form is in use, to leave them free to rise to their normal position. Nothing should be placed upon the terminals of the instrument; it is a convenient place for pens or pencils, and metal pens have not unfrequently, by being so placed, brought the coil wires into contact and so cut the instrument out of circuit. To avoid all possibility of interruption from this cause, or the breakage or disconnection of wires from dusting or other causes, the wires, both line and battery are sometimes brought up through the base-board of the instrument and are by this means inclosed within its case. The practice, although convenient for this purpose, is inconvenient when requiring to test the wires or apparatus, and it is questionable if it is attended with any great advantage.

42. **Batteries** should be kept in a dry place and free from books, papers, and rubbish. It is desirable to give them some protection—a cupboard or a covering of some description—so that the wires and battery cells may not become broken.

43. The free circulation of "**Time**" once a day is necessary to the due regulation of every system. It is usually sent at 10 A.M. by arrangement with the Postal Telegraph Department under which a current, known as the "*Time current*" is signalled, direct from Greenwich, to such offices as it is thought necessary to provide for in this way. From these offices it is distributed to all telegraph stations in the following manner:—

At three minutes before ten the terminal or transmitting station calls the attention of all other stations on the circuit, or, on each circuit radiating from that office, by moving the needle or needles backwards and forwards several times, and then signalling slowly and distinctly "time." All work should then cease (unless the circuit be required for *DR* or *SP* purposes), and the terminal station will hold over—if it be a double needle—the ▸╋◂ *E*, or left hand needle to ╋, and the office at the other extremity of the circuit the *HN*, or right hand needle, to *H*.

On the receipt of the Greenwich "Time signal," the terminal or transmitting station, on the instant, carries the ▸╋◂ *E* needle over to *E*, and the station at the other extremity of the circuit should on observing this also carry the *HN* needle over to *N*. The movement of the ▸╋◂ *E* needle, from ▸╋◂ to *E*, is the ten o'clock signal and all clocks should at once be corrected by it. With single needle circuits the entire duty devolves upon the terminal or transmitting office, but the action is the same, the needle is held over to the left as an indication that "time" is being signalled, and its movement to the right-hand side is the "time" signal.

Occasionally the time signal is not received. When this is so, the needle should not be carried over to the right, but in the place of it, the signal, "no current," should be rendered.

44. Not only is it desirable that station clocks should be kept regulated by the daily time signal, but also that the clocks of all signal boxes should in a like manner be set to it. At stations there is no difficulty in this, but at outstanding signal-boxes it is not so easily effected. Still it may be arranged by a preconcerted signal—a given number of strokes on the bell as a warning that "time" is to follow, succeeded by one stroke, which should be sent at the moment of time required to be signalled.