

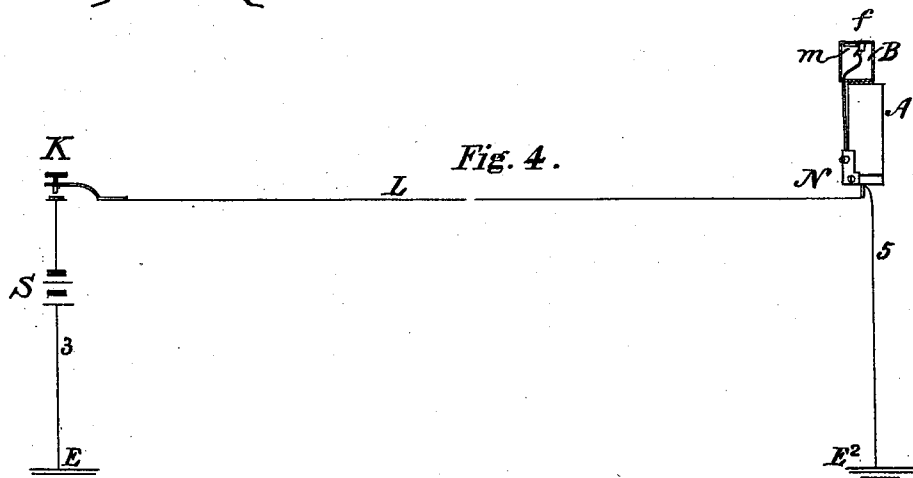
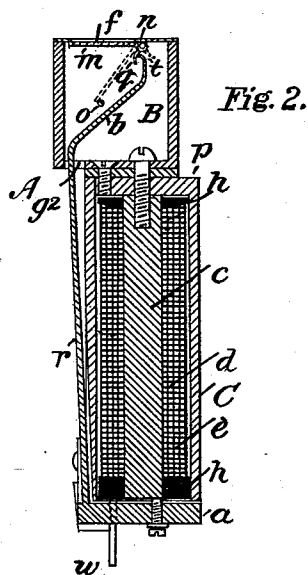
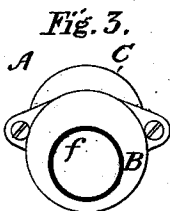
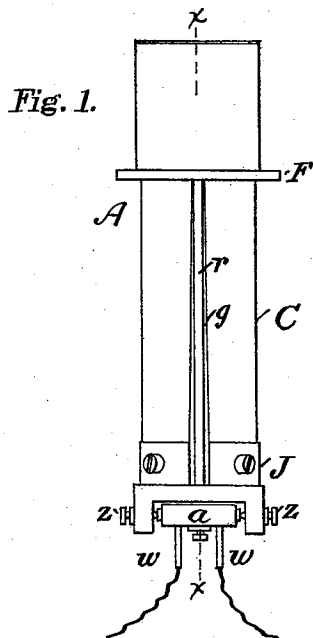
(No Model.)

2 Sheets—Sheet 1.

T. SPENCER.
ELECTROMAGNETIC SIGNAL.

No. 536,104.

Patented Mar. 19, 1895.



Attest.

Joseph A. Gately
Grover Willis Pierce

Inventor.

Thodore Spencer

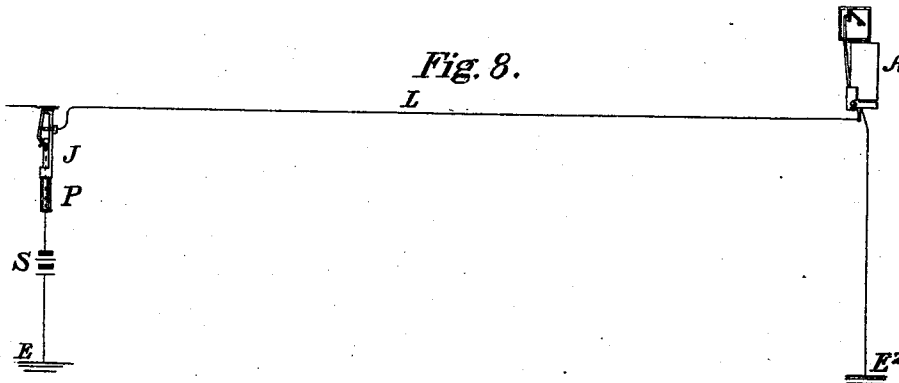
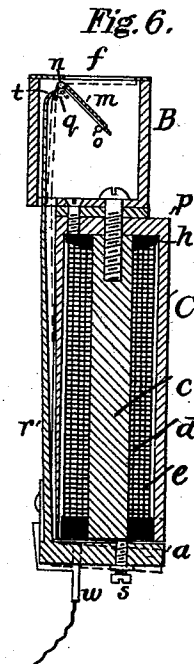
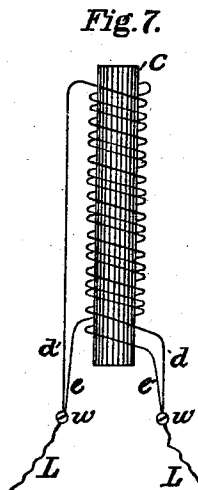
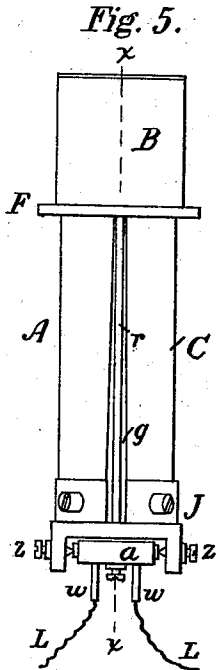
(No Model.)

2 Sheets—Sheet 2.

T. SPENCER.
ELECTROMAGNETIC SIGNAL.

No. 536,104.

Patented Mar. 19, 1895.



Attest.

Joseph A. Gately
Grover C. Pierce

Inventor.

Theodore Spencer

UNITED STATES PATENT OFFICE.

THEODORE SPENCER, OF CAMBRIDGE, ASSIGNOR TO THE AMERICAN BELL
TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

ELECTROMAGNETIC SIGNAL.

SPECIFICATION forming part of Letters Patent No. 536,104, dated March 19, 1895.

Application filed September 10, 1894. Serial No. 522,612. (No model.)

To all whom it may concern:

Be it known that I, THEODORE SPENCER, residing at Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Electromagnetic Signals, of which the following is a specification.

This invention relates to electro-magnetic signals, annunciators, or indicators; and especially to that class of such devices wherein the withdrawal as well as the exhibition of the signal plate block or disk is automatically performed. Such annunciators may be usefully employed in a variety of ways; and are convenient for association with telephone switchboards, not only to announce the call and the order for disconnection, but also to indicate at any one switchboard, or section of a switchboard, engaged in a given connection, changes made at another switchboard, or section, concerned in the same connection; or changes desired by the operator at such switchboard. Such signals in contradistinction to call bells and similar devices, are properly termed "visible signals," and it is to be understood of course that a definite signification may be attached to the display of the signal plate; while an entirely distinct, but equally definite meaning, may attach to its disappearance or absence. It is often desirable that visible signals of this class shall be placed with the signal plate, or target in a horizontal plane, and in arranging this position it is found convenient to place the actuating electromagnet on end in a perpendicular position. When so placed, it has been found difficult to devise simple mechanism which should operate as a reliable signal prompt both in the appearance and disappearance of the signal plate or target, but this difficulty is overcome by my invention.

In the signal devices of my present invention the signal plate is actuated in the direction of display, by a force exerted upon it by the working end of the armature lever, but such operation may be performed by means either of the closing or breaking of the signal circuit, and the consequent attraction, or retraction of the armature, carrying the said lever. On the other hand, the signal plate invariably moves in the direction of disappear-

ance or withdrawal by its own weight. In virtue of this arrangement its action is positive in both directions and is very prompt.

In the exemplification I prefer, the signal plate is forced into its visible position on the attraction of an armature by its controlling magnet. This magnet is that of a tubular annunciator, and is provided with a signal chamber attached to its heel, which in practice is mounted uppermost, the said chamber having at its upper or outer end an aperture or window, which, if desired, may be glazed.

The signal plate or target, (which is preferably painted or colored white for the sake of a marked contrast with the ordinary appearance of the window,) is delicately hung in pivots at one edge of the window, and constitutes the working end of a lever; the pivot forming the fulcrum, and a short curved actuating arm projecting from the plate at a downward and forward angle, forming the power or complementary arm or end of the said lever. The armature of the magnet is hung at the lower end thereof, and is normally retracted by its own weight, which is considerable. It is fitted with a long lever rod which extends along the outside of the device and into the signal chamber, across which it passes with a diagonal bend; its end being thus brought into engagement with the concave side of the curved signal plate arm. This engagement is simply a light contact while the armature remains unattracted, but, when the magnet is excited by its magnetizing coil, and attracts its armature, the said end of the armature lever rod moves sharply forward, carrying with it the curved arm of the signal plate which is itself thereupon forced swiftly into a horizontal position at the window of the signal chamber. When the current is withdrawn from the circuit, the armature falls back in virtue of its own weight; and the signal plate no longer supported thereby, instantly falls away and disappears, also under the influence of gravity. Thus the force exerted upon the signal plate arm by the armature lever is controlled by the movement of the armature. I show also however a modification in form, in which the signal plate is pivoted or hinged on that side of its exhibiting window which is in line with the

armature lever; and the bend of the latter across the signal chamber is dispensed with. In such modified form, the end of the armature rod is slightly curved forward to a mechanical contact with the short signal plate arm, and when the armature under the influence of gravity (the magnet being unexcited) is retracted, its lever presses against the short arm of the signal plate, holding it in a forward position, and displaying the said signal plate. On the contrary, when the magnet is vitalized and attracts its armature the end of the armature lever retreats, and is followed by the signal plate which by its own weight withdraws itself from the display aperture. The essential difference between these two forms, is that the former displays the signal plate at its window when the magnet becomes excited, while the latter displays the signal plate while the magnet is unexcited. The two forms of signal may therefore be termed respectively "closed" and "open circuit" signals. Under certain conditions the electromagnet of these signal devices is required to be placed directly in a conversation circuit, and its reactance is liable to oppose the passage of the rapidly varying voice currents, and distort the signals or the reproduced speech, unless some means be adopted to prevent. To avoid this difficulty, I add a non-inductive shunt-winding of suitable resistance to the device, connected between the terminals of the magnetizing helix; and for compactness and convenience I wind the double wire constituting the same, around the magnetic core, and inclose it within the magnetic tube, forming the casing, and the complementary magnetic pole. The voice currents by this means are provided with a path of low impedance, yet the efficiency of the magnetizing coil remains unimpaired.

In the drawings which accompany and illustrate this specification, Figure 1 is a front view of my preferred form of signal device, and Fig. 2 is a longitudinal cross section thereof on the line xx of Fig. 1. Fig. 3, is a perspective view of the signal chamber and its window or aperture. Fig. 4, is a simple diagram of an electric circuit containing my signal device, and means for its operation. Fig. 5, is a view similar to Fig. 1, of a modified form of appliance; and Fig. 6 is a longitudinal and vertical cross-section thereof through the armature lever, and on the line xx of Fig. 5. Fig. 7, is a diagram, illustrating the association of the magnetizing and shunt windings; and Fig. 8, is a diagram of a slightly modified electric circuit in connection with which, either form of signal may be operated.

In the drawings like parts are uniformly indicated by the same reference characters.

Referring to Figs. 1, 2, and 3, A indicates the signal receiving annunciator as a whole. c is a soft iron core having spool heads h , and wound with a magnetizing helix d , and sur-

rounded by a tubular iron casing C, which is united with the core at its heel, by an iron heel-plate p , so that the opposite ends of the central core and tube constitute respectively the two poles of the same electromagnet. The proportions of the magnetizing helix depend of course upon the conditions under which it is to be operated. Where employed as a trunk line signal, and connected directly within the telephonic circuit, as contemplated, satisfactory results have been reached by winding the magnetizing helix with No. 28, single silk covered copper wire to a resistance of seventeen ohms. Under the same conditions, in order that the impedance of the signal device shall be low, so as to obstruct the passage of voice currents as little as possible, I form a non-inductive shunt circuit e around the said magnetizing helix and parallel therewith, connecting its ends respectively to the terminals $w w$ thereof, and for compactness and convenience, I wind this also around the core outside of the said magnetizing helix, and inclose it within the tubular casing C. For this shunt winding, e , I have obtained good results by using No. 30 silk covered German silver wire, wound to a resistance of twenty-five ohms, and formed into a loop so as to be wound double for the neutralization of self-induction as indicated in Fig. 7.

Secured in any convenient way to the heel of the magnet is a signal chamber B, supported upon a flange F and provided at its outermost end with an aperture f which may be glazed and formed into a window, at which, when desired, the disk or signal plate m may be displayed.

The armature, a , of the electro-magnet, is a heavy plate and hung in pivots, z , on a bracket, J, secured to the armature end of the tube, C. It carries a long rod, r , serving as an armature lever and extending upward in a groove, g , cut in one side of the tube, C, and through a slot, g^2 , in the flange F into the chamber B. Within the said chamber it bends into a diagonal extension, b , leading across and to the outer end of the chamber, where it bends again into its original line and terminates in a slightly curved or hooked end t . The signal disk or plate m , is shown in full lines in its position of display, while the broken lines indicate its position of rest where it is supported by a limit stop o . It is pivoted or hinged at n , to the under side of the edge of the window f , at a point just above the curved end t , of the armature lever and is provided with a short curved arm q , constituting the power end of a lever of which the pivot n forms the fulcrum, and the signal plate itself the working arm and also the work.

The signal plate, n , as shown is displaying itself at the window f , it having been brought into a horizontal position immediately behind the said window, by the advance of the curved end, t , of the rod r , and the pressure exerted thereby upon the arm q of the signal plate,

brought about by the excitation of the magnet, and the consequent attraction of the armature, a , to its poles.

The signal plate may be made of any suitable material, but is preferably made of aluminium and colored white. By being so colored it affords a marked contrast in appearance to the wood work or material of the switchboard frame whereby it is surrounded, and the rim, or edge of the window may be colored black, to accentuate this contrast. Moreover since the signal chamber has no means of illumination, the window itself is dark when the signal plate is withdrawn, so that the difference between its appearance when the signal plate is displayed, and when it is not, is very marked.

The signal appliance A is mounted vertically in the switchboard frame so that the signal window is on the same horizontal plane as the switch table; and the flange F may be secured to the under side of the said table, the signal window being flush with the surface thereof.

When the current is withdrawn from the circuit, containing the annunciator, the electro-magnet of the latter loses its vitality, and no longer attracting its armature, the said armature falls back by its own weight, causing the curved end of its lever to retreat; and the signal plate no longer forced upward thereby, disappears under the influence of gravity, its short arm q following the lever end close in its rearward movement. The device thus is very prompt in its response to the make and break of the signal circuit.

In Fig. 4, L is the line conductor of an electric circuit containing the electromagnetic signal A; and provided with a generator, S, and a circuit controller, K, in the present instance shown as a key. The circuit leads from E by way of wire 3, generator S, key K, line L, to the signal receiving point N where it passes by the indicator A and conductor 5 to E^2 . The points E and E^2 represent connections made at the sending and receiving points with the earth or other return.

In practice, instead of employing a special key, the continuity of the signaling circuit is usually controlled by a circuit controller, placed in, or associated with a spring jack, and the act of inserting the plug connector in or withdrawing it from the socket thereof, sets also, or withdraws the signal. This practice is illustrated in Fig. 8, where the signal circuit L is shown as being closed through the sleeve conductor of the plug P and the signal plate not represented at the window of the annunciator A. In this case, the signal shown in Fig. 6, which withdraws itself when the circuit is closed is employed. In other respects, this arrangement is not different from that of Fig. 4.

The electromagnetic signal of Figs. 5 and 6 differs from that of Figs. 1 and 2, only in that it is constructed and adapted to bring the signal plate into view when the circuit is opened

or the current taken from it and to withdraw the same when the current circulates in the magnet winding. The signal plate is hinged or pivoted in line with the armature lever rod. The armature rod r is substantially straight, and does not, as in the former case, bend diagonally across the signal chamber, but is curved at its extreme end at t , and held in engagement with the short arm q of the signal plate lever. When the current flows in the circuit, the armature a being attracted to the magnet poles, pulls back the end t of its rod r , which, relaxing its pressure on the short arm q of the signal disk, permits the latter to fall out of view; but when the current ceases, the armature falls into its retracted position, and the armature lever, r , moves forward, pushing the arm q , and elevating the signal plate m into its position of display. In neither form of signal device therefore is manual intervention required to change the position of the signal plate.

I claim—

1. In an annunciator or visible signal indicator, a signal disk or plate having an actuating arm, and pivoted or hinged at a point between said disk and arm, the said disk being arranged to occupy a horizontal position when displayed and to be moved in that direction by force or pressure exerted on said arm, and to automatically withdraw itself on the discontinuance of said pressure; combined with an electromagnet adapted for inclusion in an electric circuit; an armature therefor; and a lever or rod attached to and controlled by said armature, engaging by its farther end the actuating arm of said signal, and adapted to exert force thereon, or to relax the same, as the controlling armature is attracted by, or retracted from, the said magnet, substantially as hereinbefore specified.

2. In an automatic annunciator or electromagnetic signal, the combination substantially as hereinbefore described, of a signal plate or target provided with a complementary actuating arm fulcrumed between the said plate and arm, and normally retracted by gravity; an electromagnet adapted to be included in a signaling circuit; an armature therefor; and an armature lever or rod secured at one end to said armature and controlled thereby, and engaging the said complementary actuating arm by its farther end, with a light pressure during the retraction of said armature, and thus permitting the signal plate to remain out of view, but with sufficient force to elevate the signal plate into a horizontal position for the purpose of display when the said armature is attracted to the poles of the magnet.

3. The combination in a visible signal indicator, of a vertically mounted electromagnet; an armature therefor pivoted to the lower end thereof; a signal chamber with a horizontal window or aperture mounted on the upper end thereof; a disk or plate signal mounted on pivots therein and provided with an actu-

ating arm projecting beyond the pivots, the
said plate being adapted to remain by its own
weight in a position retracted from the said
window, but to assume a horizontal position,
5 and display itself at the said window by
pressure exercised on the said actuating arm;
and an armature lever or rod attached to the
said armature extending into the said signal
chamber, and engaging the signal plate actu-
10 ating arm, lightly, while the said armature
remains retracted, but adapted to exert
thereon the force required for the elevation

of the signal plate into its said position of
display, on the attraction of said armature,
substantially as specified herein.

15 In testimony whereof I have signed my
name to this specification, in the presence of
two subscribing witnesses, this 1st day of Sep-
tember, 1894.

THEODORE SPENCER.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.