(No Model.)

A. G. SAFFORD.

ELECTRO MAGNETIC TELEGRAPH APPARATUS.

No. 485,334. Patented Nov. 1, 1892.

FIG. 1.

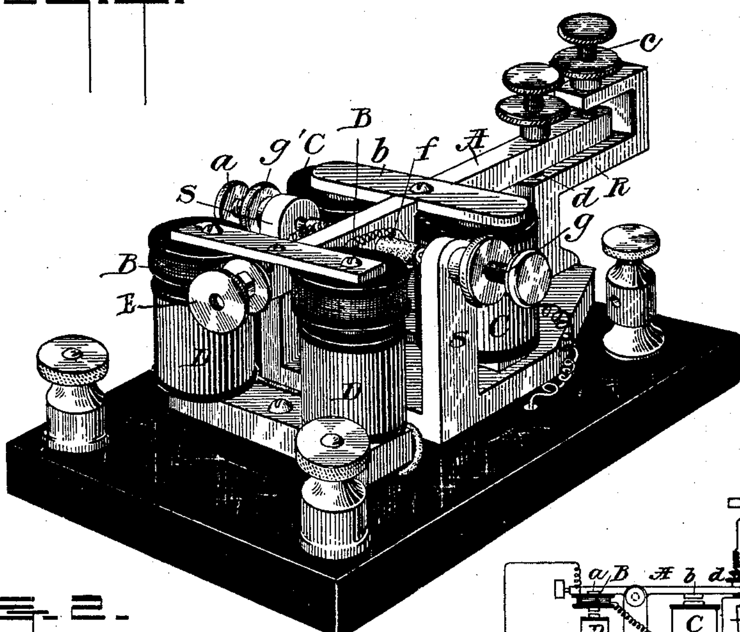


FIG. 4.

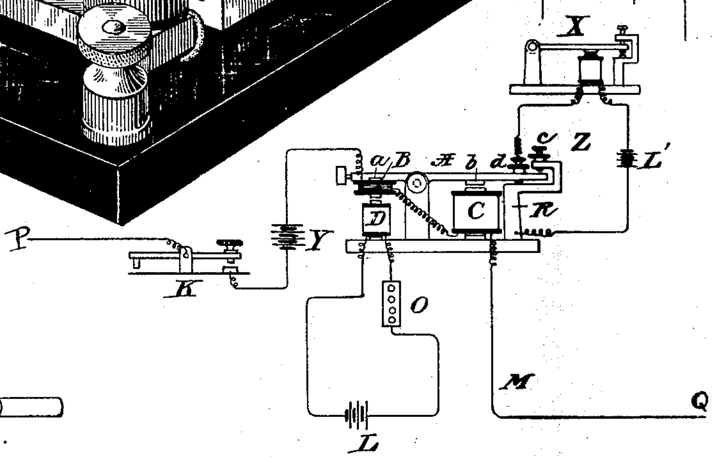


FIG. 2.

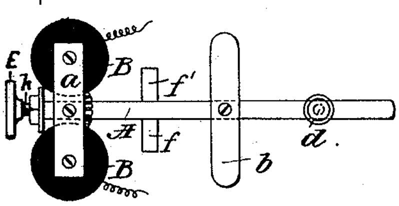
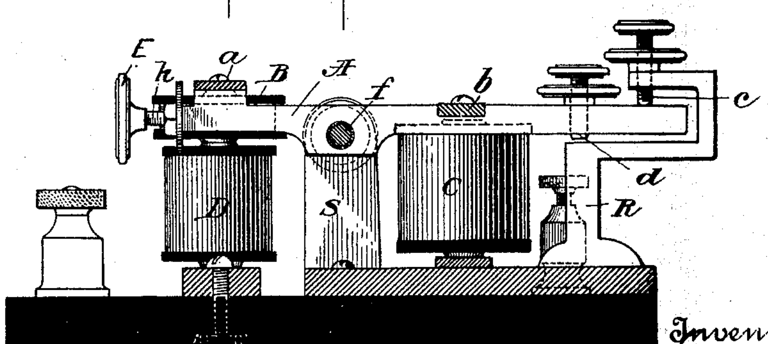


FIG. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

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ELECTRO-MAGNETIC TELEGRAPH APPARATUS.

SPECIFICATION forming part of Letters Patent No. 485,334, dated November 1, 1892.

Application filed March 16, 1892. Serial No. 425,101. (No model.)

To all whom it may concern:

Be it known that I, ALFRED G. SAFFORD, a citizen of the United States, residing at the city of Washington, in the District of Columbia, have invented certain new and useful Improvements in Electro-Magnetic Telegraph Apparatus; and I do hereby declare the following to be a full, true, and exact description thereof.

My invention relates to that class of electro-magnetic telegraph apparatus in which electrical impulses intermittent and of the same polarity sent out from the transmitting-station actuate the armature of an electro-magnet at the receiving-station, and has for its object the reduction of resistance on the main circuit and increased sensitiveness in the receiving-instrument, as well as its ready adjustment to the varying pressure of the current.

Referring to the accompanying drawings, wherein the same indicating-letters point out the same parts in the different figures, Figure 1 is a view in perspective of the whole machine. Fig. 2 is a top plan view of the reciprocating armature; and Fig. 3 is a vertical section showing the relative placement of one of each pair of the electro-magnets on either side of the instrument, also the reciprocating armature, with its electro-magnet, its placement, and regulation. Fig. 4 shows the method of connecting up the instrument with the main sounder and local circuits.

A is a reciprocating armature supported by the trunnion *f f'*, working in the set-screws *g g'* of the standard S. It is provided with the adjustable set-screw *d*, which strikes upon the head of the standard R and limits the motion of the armature in one direction, as well as forming a contact-point for an independent or sounder circuit Z. It is also provided with the cross-piece *b*, of soft iron or other suitable inductive material, so arranged as to be under the influence of the electro-magnet C. It is also provided with the yoke *a*, to which are permanently attached the cores of the electro-magnet B. It is also provided with the counterpoise E, whose office is to bring the armature A into exact equilibrium, it being adjustable on the screw *h* for that purpose.

B is an electro-magnet of high resistance, whose cores are affixed to the armature A by means of the yoke *a*, and is electrically connected with the main battery Y, the key K, and the main line M directly upon the one side, and with the line on the other side through the electro-magnet C. The coils surrounding the cores of this magnet may be supported by the cores, as shown in the drawings, or they may be supported independently, the central perforation being in such case made large enough to permit the free vertical movement of the cores through the coils.

C is an electro-magnet acting upon the cross-piece *b* of the armature A of high resistance, and is connected on the one side directly with the main circuit M and upon the other side through the electro-magnet B, and may be so attached as to be adjustable vertically.

D is an electro-magnet of low resistance, connected with the local battery L through the rheostat O, and acts upon the cores of the electro-magnet B, and may be so attached as to be adjustable vertically. A convenient modified form of construction is one in which a permanent magnet adjustable vertically takes the place of the electro-magnet D, rheostat O, and local battery L.

S is the standard which supports the armature A.

R is a standard which receives the blows of the set-screw *d* of the armature A, and is provided with the set-screw *c*, which limits the motion of the armature in one direction. The set-screws *d* and *c* are provided the one with a platina point and the other with an insulated point, the same being connected, in the method in common use, through the local battery L' with the sounder X.

Having thus described the various parts of the apparatus, the method of its operation is as follows: The magnets B and C are connected together in series and placed in the main circuit. The magnet D is connected through the rheostat O with the local battery L in such a way that the polarity of its cores, which are in apposition to the cores of the electro-magnet B, will be continuously of the same polarity as are the said cores of magnet B when the same become energized under the intermittent impulses of the main circuit M. When no current is passing on the

main circuit, neither magnet B nor C are energized, and the magnet D will draw down the armature A as far as the set-screw *c* will permit; but when the current is passing over the main line the cores of the magnet B are rendered magnetic and the polarity is the same as that of the magnet D. Magnets B and D then repel each other, and simultaneously magnet C is energized and attracts the cross-piece *b* of the armature A, and it is drawn downward toward magnet C so far as the stop *d* will permit, at the same time making the necessary contact for operating the independent circuit actuated by battery L'.

From the foregoing the advantage of the apparatus is evident. It is only necessary to have resistance enough in the coils of the magnets B and C to overcome the inertia of the armature A and the magnetism induced in the cores of magnet B by the presence of the constantly-excited cores of the magnet D. It frequently happens that there is an escape of the main circuit owing to imperfect insulation. Referring to the drawings, suppose such an escape to exist between stations P and Q, the battery being at P. Under such circumstances all of the battery energy does not reach Q, but returns in part to P through the defective insulation and the ground, and although the circuit may have been opened at Q there will be a constant circuit from the battery at P through the instrument at P, thence without passing as far as Q back to P through the defective insulation and ground. The coils of the instrument at P are therefore constantly energized from the escaping current. In the instruments commonly in use the magnetism resulting in the coils at P from this escaping current is balanced by a retractile spring, and unless the spring is tightened up, so that its force overcomes the force of the magetism in the coils, the armature will not vibrate when the circuit is opened and closed at Q, and when the spring is tightened up, so as to receive the impulses sent out by Q, the instrument will not respond to the opening and closing of the circuit at P or any other station between it and the escape without a loosening of the spring. So that it happens that where there is an escape, such as is described, the retractile spring has to be tightened or loosened, according to the effect of the escape on the instrument. This places a mechanical obstruction in the way of the vibration of the armature. In my instrument under such circumstances it is only necessary to adjust the instrument so as to receive the impulses from Q by increasing the pressure of the current in the coils of the magnet D through the rheostat O until the magnetism resulting in the cores of magnet B is neutralized by the induction of the cores of magnet D. When that is accomplished, the instrument responds to the opening and closing of the circuit at Q, as well as to such opening and closing of the circuit at P, or other stations between that station and the point of escape.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In electro-magnetic telegraph apparatus operated by intermittent impulses from the transmitting-station, the reciprocating armature A, limited in its motion by the stops *c* and *d*, provided with the permanently-attached cores of the electro-magnet B in apposition to the electro-magnet D, and the inductive cross-piece *b* in apposition to the electro-magnet C, as and for the purpose intended, substantially as described.

2. In electro-magnetic telegraph apparatus, the combination of the electro-magnets B and C, arranged and connected in series and receiving their energizing-current from the main line in intermittent impulses, the cores of the former being attached to the reciprocating armature A and the cores of the latter acting upon the inductive cross-piece *b*, also attached to the armature A, with the electro-magnet D constantly excited by the local battery L in apposition to the cores of electro-magnet B and so arranged that it shall be of the same polarity as magnet B, as and for the purpose intended, substantially as set forth.

3. In electro-magnetic telegraph apparatus, the combination of the electro-magnet B, permanently attached to the reciprocating armature A, connected in series with the stationary electro-magnet C, controlling the cross-piece *b*, also attached to the armature A and the main line, the electro-magnets B and C, receiving the same intermittent electrical impulses from the transmitting-station, with an adjustable permanent magnet N, the electro-magnet D, underlying the electro-magnet B and receiving its electrical energy from a local battery of such polarity that the cores of said magnet D will be energized similarly to the cores of magnet B, which are directly opposite to each other, the pressure of the current from the battery L within the magnet D being regulated and controlled by the rheostat O, as and for the purpose intended, substantially as described.

4. In electro-magnetic telegraph apparatus, the combination of the electro-magnets B and C, operating in conjunction with the electro-magnet D under control of the rheostat O to impart motion to the armature A, as hereinbefore described, and the contact-points *d* and *c*, the former upon the armature A and the latter upon the standard R, said armature and contact-points being a part of the independent circuit Z, as and for the purpose intended, substantially as described.

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