(No Model.)

2 Sheets—Sheet 1.

E. S. C. MAY.

TRUNK LINE SIGNAL.

No. 509,477. Patented Nov. 28, 1893.

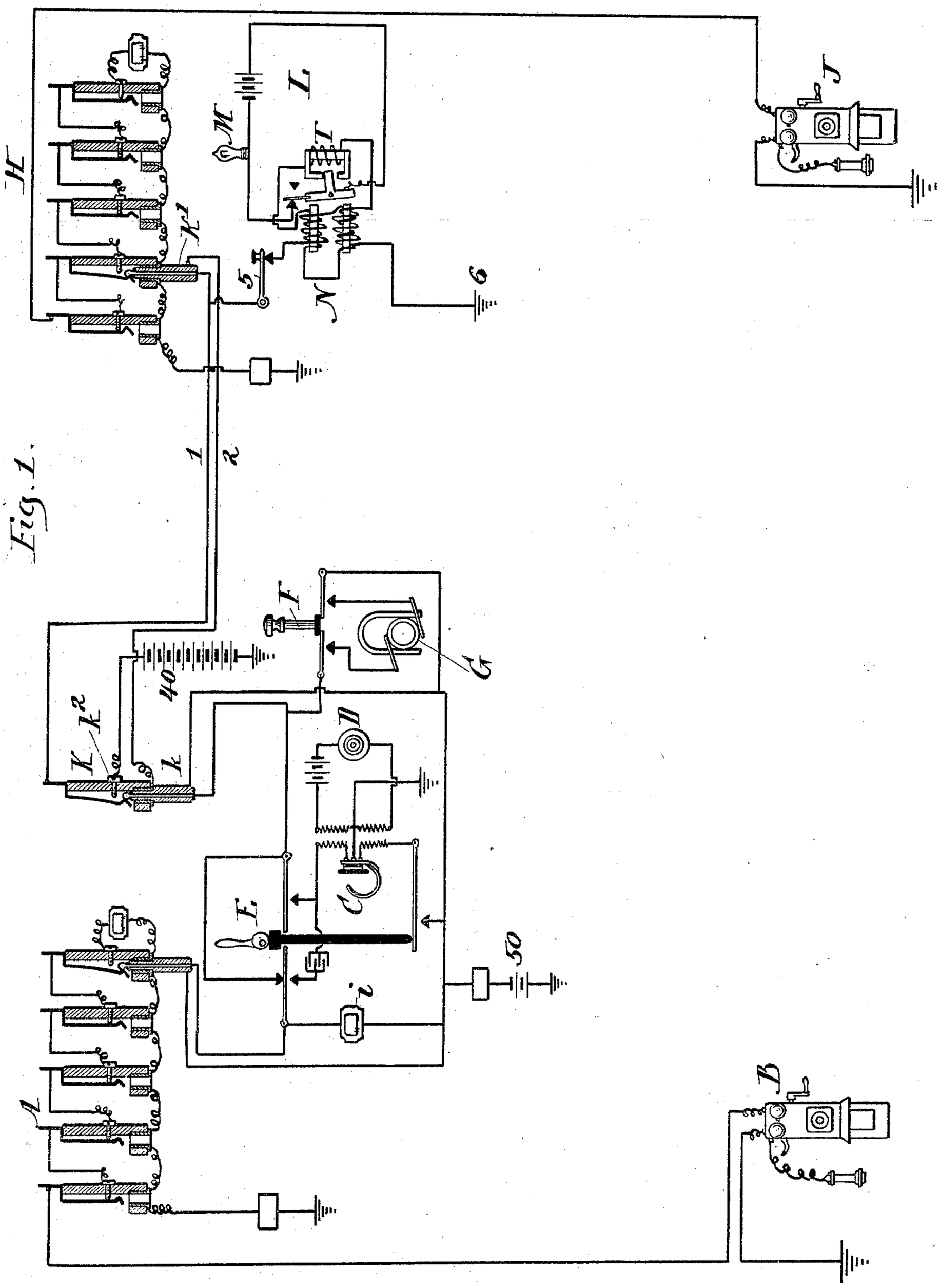

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

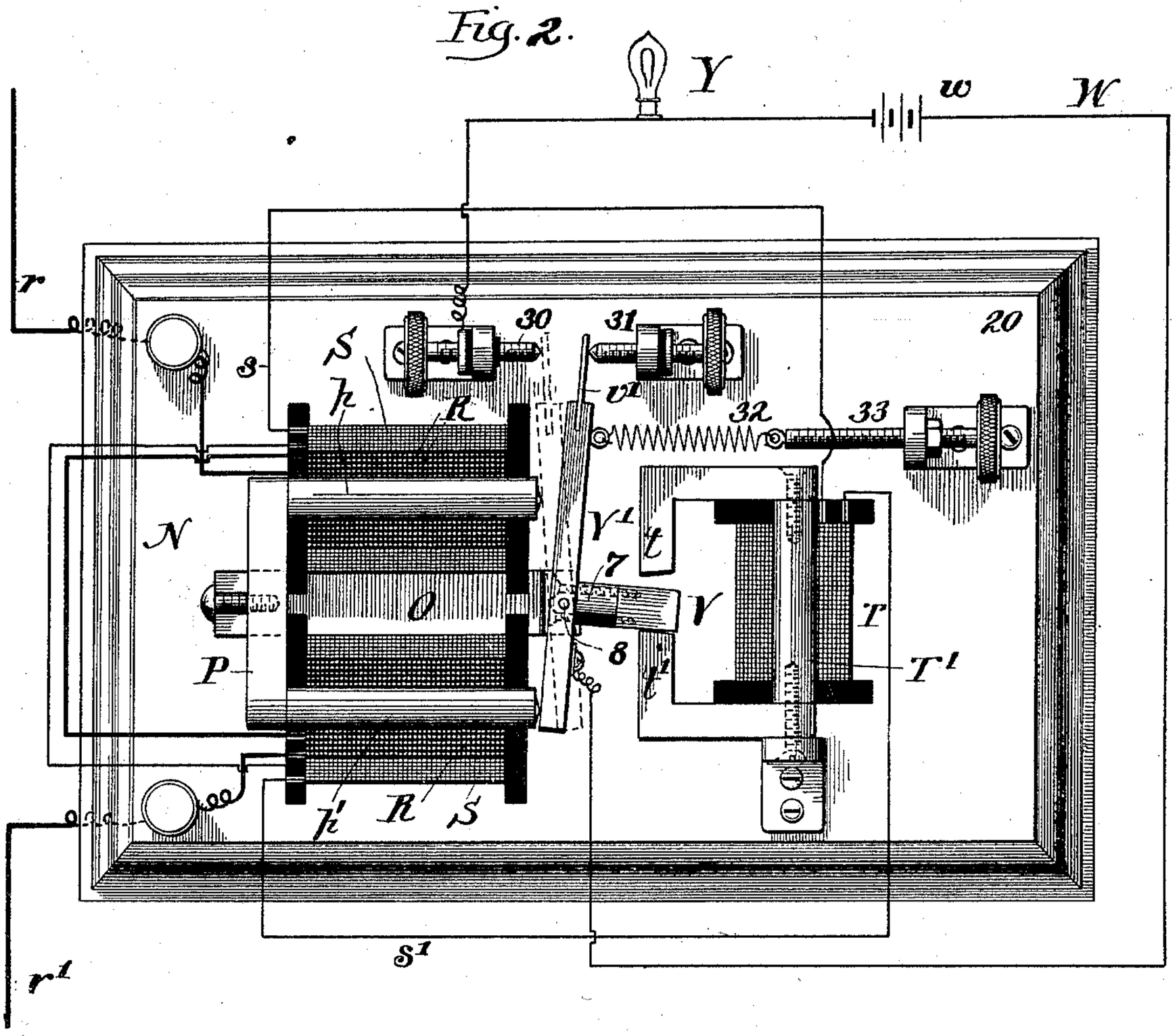


Fig. 3.

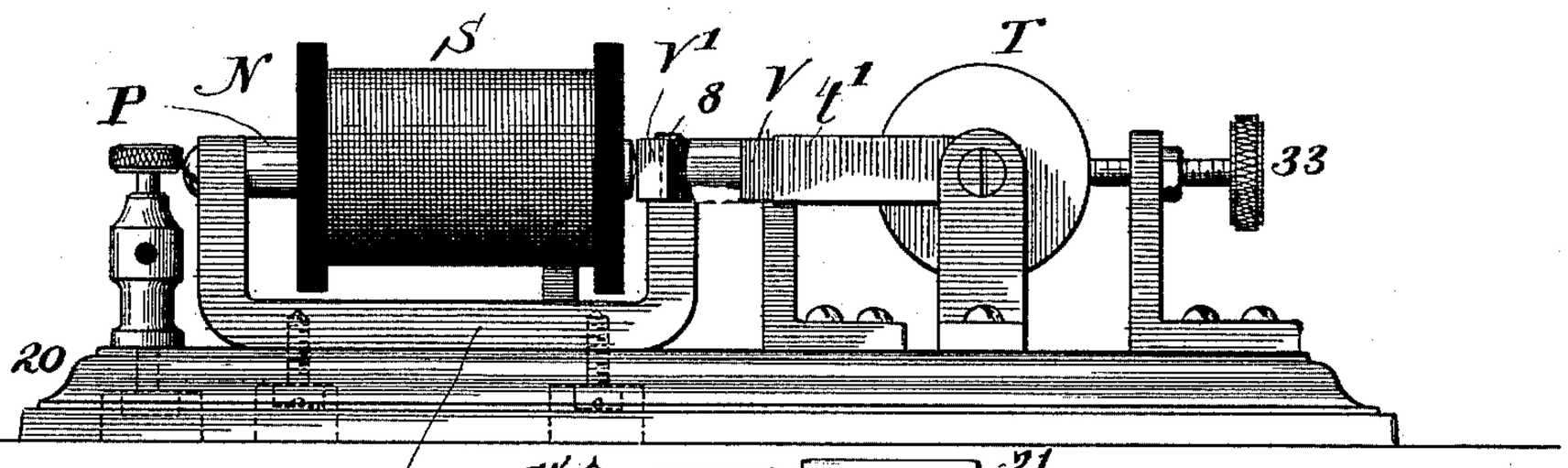
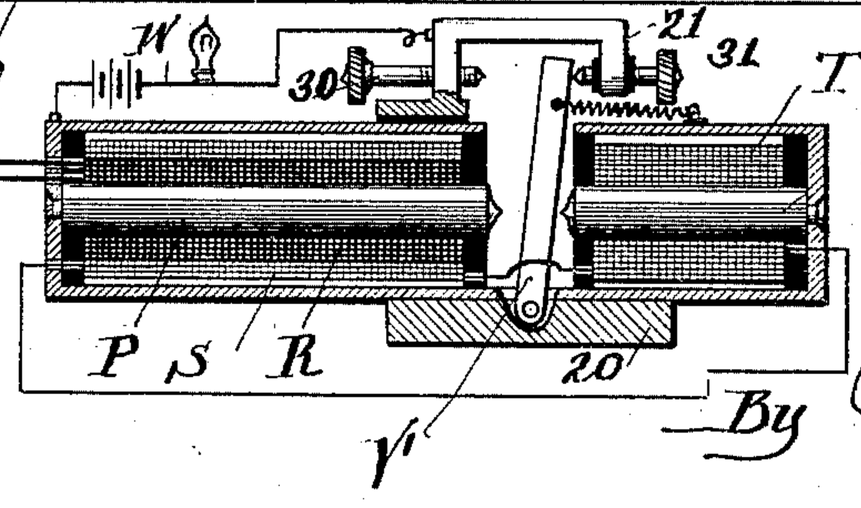


Fig. 4.



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TRUNK-LINE SIGNAL.

SPECIFICATION forming part of Letters Patent No. 509,477, dated November 28, 1893.

Application filed April 17, 1893. Serial No. 470,607. (No model.)

To all whom it may concern:

Be it known that I, EDMUND S. C. MAY, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Electrical Apparatus, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

In the operation of telephone circuits between exchanges it is common practice to employ a number of trunk lines which connect such exchanges, and in order to inform the operator at any exchange when the connection between the subscribers using any trunk line is to be broken, a series of signals, for example incandescent lamps, are employed in correspondence with the trunk lines, these signals being so arranged as to exhibit numbers in keeping with the wires with which the signals correspond. These trunk line signals are placed in local circuits adapted to be connected up with the corresponding trunk lines, relays being so interposed in such local circuits that when the subscriber's signal to dis-connect and the operator at the exchange at which the call originated removes the plug from the trunk line jack, a battery will be thrown into circuit of such trunk line and into the local circuit of its corresponding lamp or other signal, thereby causing such signal to come into play and show to the distant operator that the conversation is finished and that the corresponding trunk line may be dis-connected to be in readiness for subsequent service. It has been the practice to close the normally open local circuits of the trunk line signals by means of relays so arranged that when current was passed through the coils of any relay its armature would be shifted so as to close the local circuit and exhibit the signal to dis-connect.

A difficulty experienced with the apparatus heretofore employed for controlling the local circuits for the lamps or other signals has been that the relays would be operated not merely by the placing in circuit of the battery designed to operate such relays but also by the alternating current produced by the generators at the subscriber's telephone. Consequently, if a subscriber for any cause operated his generator before the conversation was finished, the current due to such operation would pass over the trunk line wire and through the relay causing it to close the local signal circuit and light the lamp and indicate to the exchange operator that a dis-connection was to be made. It is to overcome this difficulty and insure that the signal to dis-connect shall be exhibited only by the originating operator that my invention is primarily directed, although the relay whereby this object of invention is accomplished, is susceptible of use for a variety of other purposes than the specific one in connection with which it is herein illustrated.

My invention consists primarily in providing the signal circuits of a telephone exchange system with selective relays which shall be capable of being operated by the steady current of a battery but will not be operated by the alternating current from the generators or by a current from a battery connected up in such manner as to send current in direction opposite to the current of the battery designed to control such relay.

My invention also consists in the construction of the relay hereinafter described, illustrated in the accompanying drawings and particularly pointed out in the claims at the end of this specification.

Figure 1 is a diagrammatic view showing a telephone system for a main office and a branch exchange having my invention applied thereto. Fig. 2 is a plan view (parts being shown in section) illustrating one form of my improved relay, connections being shown between such relay and the circuit of a signal lamp. Fig. 3 is a view in side elevation of my improved relay. Fig. 4 is a view of a modified construction of relay.

In the diagram, Fig. 1, A designates the multiple switch-board of the main office, and B denotes a subscriber's telephone connected with its appropriate spring-jack of such switch-board. The switch-board A is of familiar construction, as is also the operator's circuit at the main office in which circuit is

interposed the operator's telephone C and transmitter D, "listening key" E, a "ringing key" F, a generator G and usual adjunctive apparatus of such circuit.

H denotes the multiple switch-board at the branch exchange office, a single subscriber's telephone J being shown as connected to its spring-jack of such switch-board. At the main office there is provided a trunk line switch-board K provided with spring-jacks or other suitable connections corresponding in number with the trunk lines. Each of the trunk lines is shown as consisting of a metallic circuit formed by the wires 1 and 2 which at the branch exchange office terminate at the plugs K'. Each of the series of trunk lines is adapted to be connected by key 5 with a local circuit L in which is interposed an incandescent lamp M or other signal, each of the various lamps M of the several circuits being arranged to exhibit a number corresponding to the trunk line with which it can be placed in circuit. In the local circuit L is interposed my improved relay N, the construction of which is illustrated more particularly in Figs. 2, 3 and 4 of the drawings.

In the preferred embodiment of the invention (see Figs. 1, 2 and 3) my improved relay comprises a permanent magnet *o* mounted upon a suitable base 20, one pole of this magnet being connected to the soft iron core P of an electro magnet. The arms *p* and *p'* of the core P are wound with primary coils R and R', the terminals *r* and *r'* of these coils leading respectively to the key 5 and to ground at 6. The arms of the core P are wound also with secondary coils S, the terminals *s* and *s'* of which connect with the spool or coil T of the locking magnet. The soft iron core T' of this locking magnet is preferably so formed that between its arms *t* and *t'* may project an extension V of the armature V', this extension being insulated by a non-magnetic body 7 from the armature V'. This armature is pivotally mounted as at 8 upon the upper end of the permanent magnet O.

W denotes the battery wire of the local circuit, *w* is the battery, and Y designates the incandescent signal lamp of the local circuit. The terminals of the wire W connect respectively to one end of the armature V' and to the contact screw 30. The tongue *v'* of the armature V' extends between the contact screw 30 and a set screw 31 which serve to limit its range of movement and a coil spring 32 that is controlled by the set screw 33 serves to normally draw the tongue of the armature V' against the screw 31.

The operation of my invention will be seen to be as follows: When a subscriber, B, signals the main office for connection with a subscriber, as for example J, at a branch exchange, the main office operator, by the use of a "working wire," or by one of the trunk lines with which her telephone is connected, will notify the exchange to place the exchange subscriber J upon the trunk line to the spring-jack of which the main office operator has connected the switch-plug *k* of the subscriber B. The branch exchange operator will then connect the plug K' of such trunk line with the spring-jack corresponding to the subscriber's telephone J and will at the same time, by means of the key 5, throw the relay N of the corresponding local signal circuit L in connection with the trunk line. The position of the parts will then be that illustrated in Fig. 1 of the drawings, as well understood in the art. It will be observed that at such time current can pass from the generator of either of the subscriber's telephones, or from the generator G of the main office over the trunk line, part of this current being free to pass through the terminals *r* and *r'* of the primary coil R of the relay. Assuming that the permanent magnet O has imparted to the branches *p* and *p'* of the core P its polarity, (for example north) and assuming that the armature V' is in the position illustrated in Figs. 1 and 2 of the drawings, being normally drawn to such position by the spring 32, then when current from the generator passes through the primary coils R and R' the reversal of the polarity of the branches *p p'* of the core P will not affect the armature V' because the current induced in the secondary coils S will through the coil T so energize the arms *t t'* of the core T' as to counteract any tendency of the branches *p p'* of the core P to shift the armature V'. As a consequence, it will be seen that the passage of the alternate current from the generators will not disturb the position of the armature V', and the local circuit of the signal lamp Y will remain broken. When, however, the conversation between the subscribers is finished and the "clearing out" signal has been given to the main office by the "clearing out" drop *i*, the main office operator will withdraw the plug *k* from the spring-jack K, thereby disconnecting the main office subscriber from the trunk line. As the operator thus withdraws the plug *k*, the spring of the spring-jack K closes upon the screw k^2 that is connected up with the relay battery 40 thereby throwing this relay battery into the circuit of the trunk line. Under this condition current will pass over the trunk line, through key 5 and terminal *r* to the primary coils R and R' and inasmuch as the coil R is so wound upon the branch *p* of core P as to impart to such branch a polarity in keeping with the polarity of the permanent magnet (for example north) and the coil R' is so wound as to impart to the branch *p'* of the core P a polarity the reverse of the permanent magnet, it will be seen that the steady current from the battery 40 will confirm the north polarity of the branch *p* and tend to impart a south polarity to the branch *p'*, thus neutralizing the normal polarity of such branch. Consequently, the armature V' will be shifted from the position shown in full lines in Fig. 2 to the position shown by dotted lines, and when so shifted the tongue of the armature V' will bear against

the contact screw 30 and will complete the local circuit through the wire W, the armature V′, the signal lamp Y and battery *w*, and the lamp Y will be lighted and thus signal to the branch exchange operator that the trunk line is to be dis-connected.

In a telephone system such as that indicated in Fig. 1 of the drawings, it is customary to provide the operator's circuit of the main office with a test battery 40 and inasmuch as this test battery is in communication with the relay of the local circuit at the branch exchange during the time that the parts are in position illustrated in Fig. 1, it is important that provision be made so that the relay shall not be operated by the test battery, since otherwise current from this battery might shift the armature of the relay and complete the local circuit through the signal lamp before the subscribers had finished conversation. In order to guard against any operation of the relay by the test battery I connect the test battery in manner reverse to that in which the relay battery is connected. Consequently, it will be seen that the passage of current from the test battery over the trunk line and to the primary coil of the relay will not serve to shift the armature V′. In other words, if the steady current from the relay battery was such as to effect a shifting of the armature V′, in manner before defined and the steady current from the test battery was arranged to pass in opposite direction the tendency of current from the test battery would simply be to maintain the armature in the position shown in Fig. 2 of the drawings and hold the local battery *w* out of circuit.

In the form of my invention illustrated in Fig. 4 of the drawings, I have shown a selective relay adapted to be used for controlling local signal circuits in situations in which it is required to distinguish only between a steady current and an alternating or unsteady current, and in which it is not required to guard against the operation of the relay by a battery other than the one specifically designed for such purpose. In this form of the invention the armature V′ which controls the local signal circuit is arranged between the core P of the operating magnet and the core T′ of the locking magnet. In this form of the invention also as in that hereinbefore described, the core of the operating magnet is wound with a primary coil R and a secondary coil S. The terminals *r r′* of the primary coil will connect respectively with the trunk line wire and with the ground, while the terminals of the secondary coil S will lead to the spool of the locking magnet, with the coil T of which they will connect. It will be observed that the armature V′ is pivotally mounted upon the case 20 and upon the top of this case is mounted an insulated bracket 21 which carries a contact screw 30 and also a set screw 31, this latter screw being insulated from the bracket. The local battery wire W is connected with the bracket 21 and through the medium of the case 20, with the armature V′.

From the foregoing description it will be seen that if an alternating or unsteady current is passed over the trunk line and through the terminals of the primary coil R, the effect of this current upon the core P of the operating magnet, tending to attract the armature V′ from the position shown, will be counteracted by the energization of the locking magnet incident to the induced current generated in the secondary coil about the core of the locking magnet, and the armature V′ will consequently remain unmoved. When the steady current of battery is passed through the primary coil of the operating magnet the core P will be energized, while the core of the locking magnet will be unaffected, and consequently the armature V′ will be attracted by the operating magnet thereby causing this armature to bear against the contact screw 30 and complete the local circuit through the signal lamp Y, the battery *w* and wire W.

It is manifest that my selective relay while particularly adapted for controlling the local signal circuits of telephone systems, can be used in a variety of other situations and for any other purpose in which the shifting of the armature may be utilized to effect a desired function such for example as tripping an indicator drop, operating an automatic switch or the like.

I do not wish the term relay as herein employed, to be understood as in any wise restricting the invention to its use for controlling local circuits.

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

1. In a telephone exchange system comprising a series of local signal circuits, the combination with such circuits of selective relays for controlling the same adapted to be operated solely by a substantially steady current of uniform direction.

2. In a telephone exchange system comprising a series of signal circuits, and comprising also a relay battery, the combination with the local signal circuits of selective relays for controlling the same, said relays being responsive solely to a current developed by said battery, the said current being steady, of determinate value and of uniform direction.

3. A telephone exchange system comprising a series of local signal circuits and comprising also a test battery, and a relay operating battery, said batteries being oppositely connected to the system, selective relays for controlling said circuits, said relays being responsive solely to the normal current of said relay battery.

4. A selective relay comprising an operating magnet having a primary and secondary coil, a locking magnet connected with said

secondary coil and an armature adapted to be controlled by said operating and locking magnets.

5. A selective relay comprising an operating magnet having a primary and a secondary coil, a locking magnet connected with said secondary coil, an armature arranged to be controlled by said magnets, and a permanent magnet connected to the core of said operating magnet.

6. A selective relay comprising an operating magnet, the coil of which is provided with primary coil sections reversely wound thereon, and with a secondary coil, and comprising also a locking magnet with the coil of which said secondary coil is connected and an armature adapted to be controlled by said operating and locking magnets.

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