No. 680,024. Patented Aug. 6, 1901.

J. E. CORDOVEZ.

TELEGRAPH RELAY.

(Application filed Aug. 14, 1900.)

(No Model.) 4 Sheets—Sheet 1.

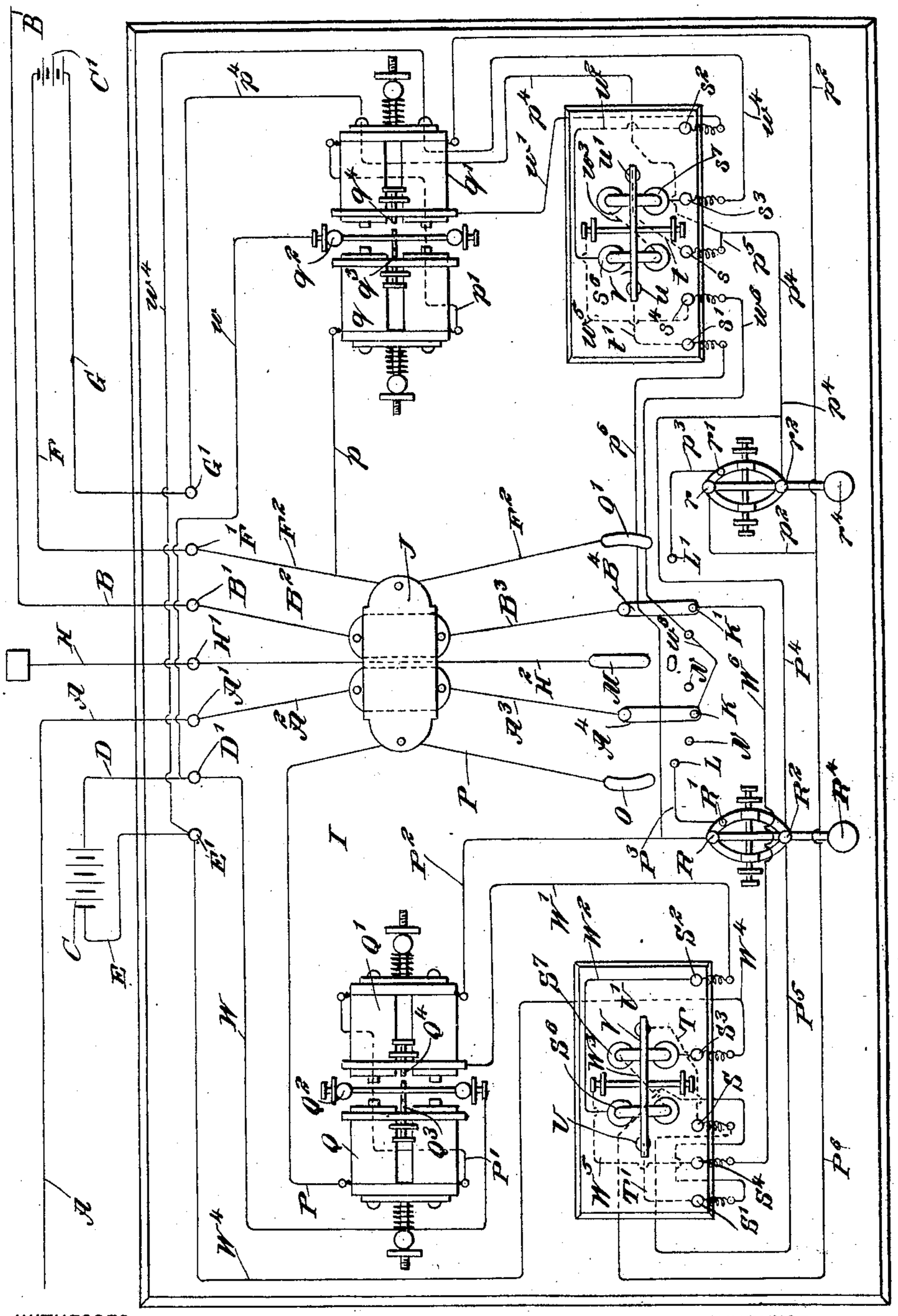

FIG. 1.

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4 Sheets—Sheet 2.

Fig 2

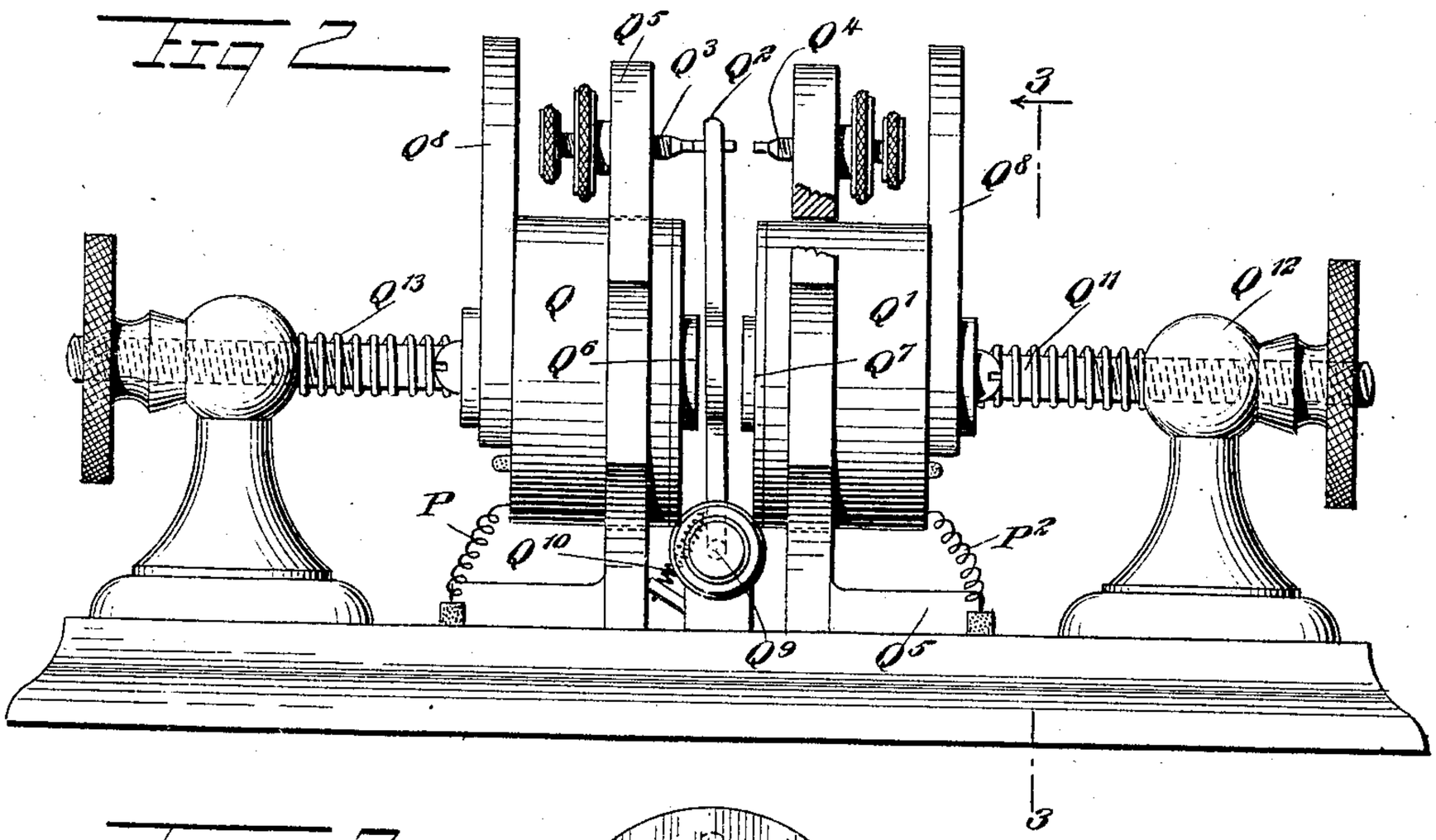

Fig 3

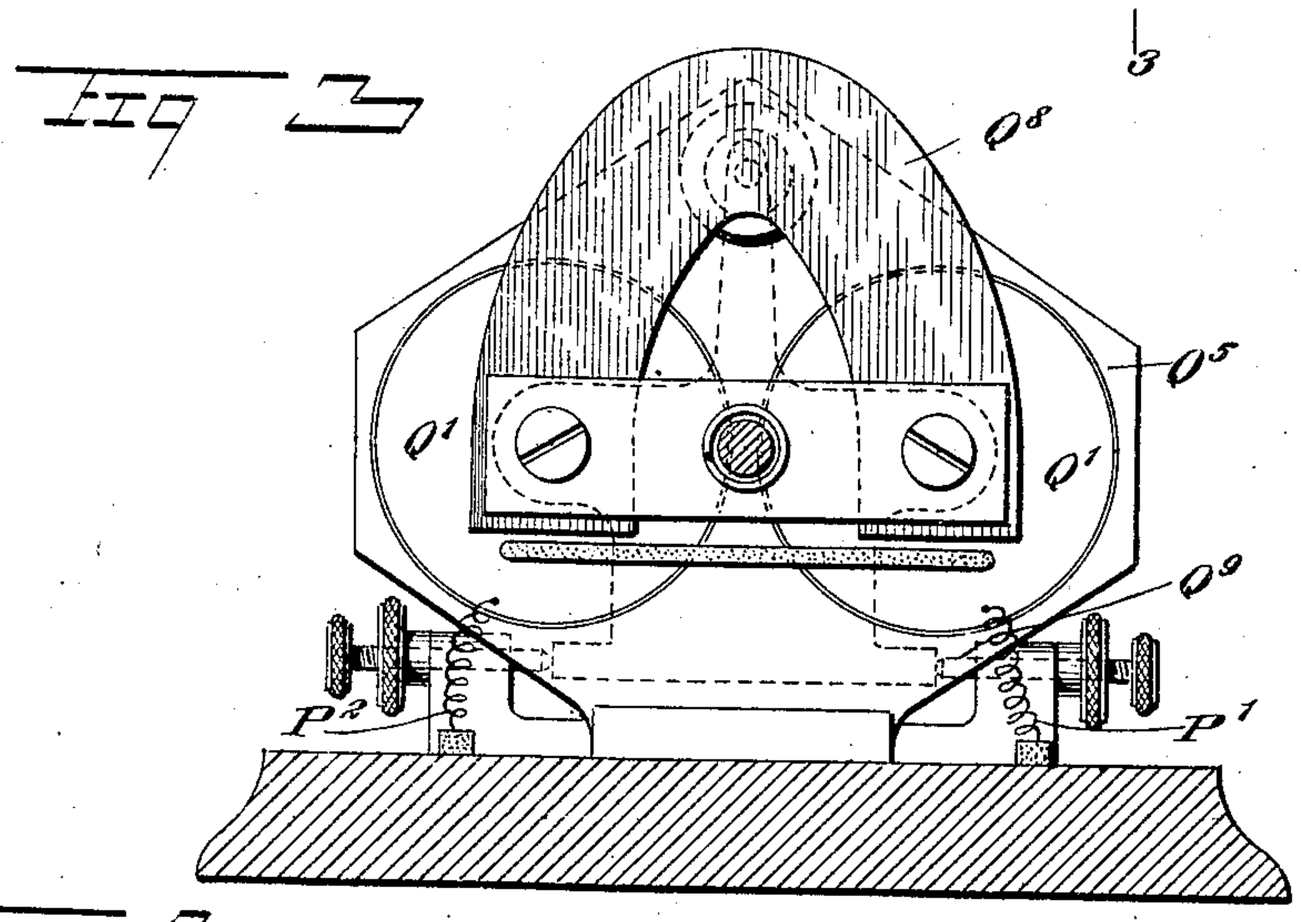

Fig 4

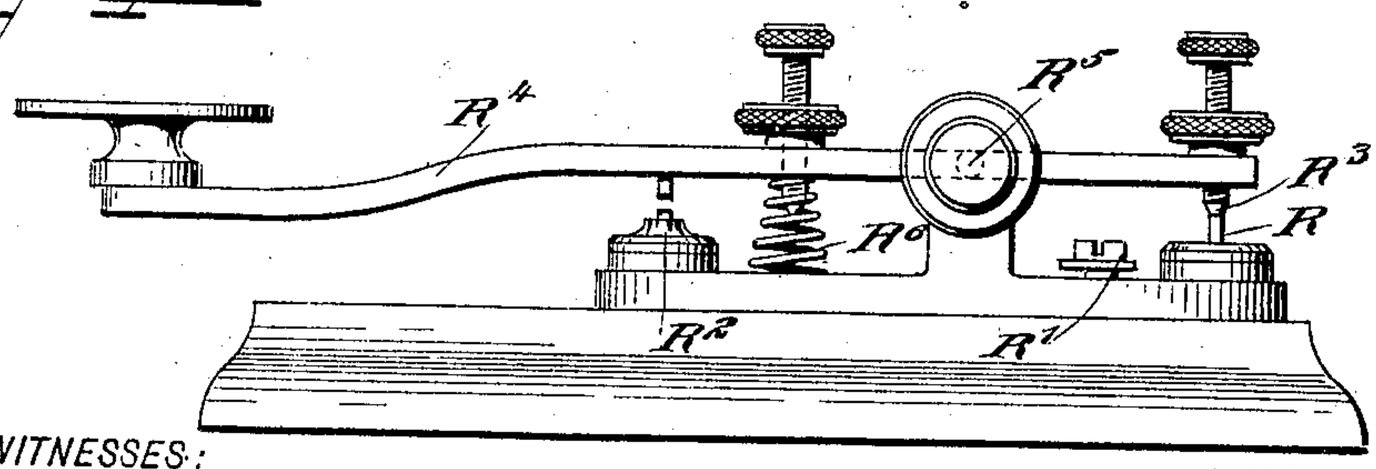

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Fig 5

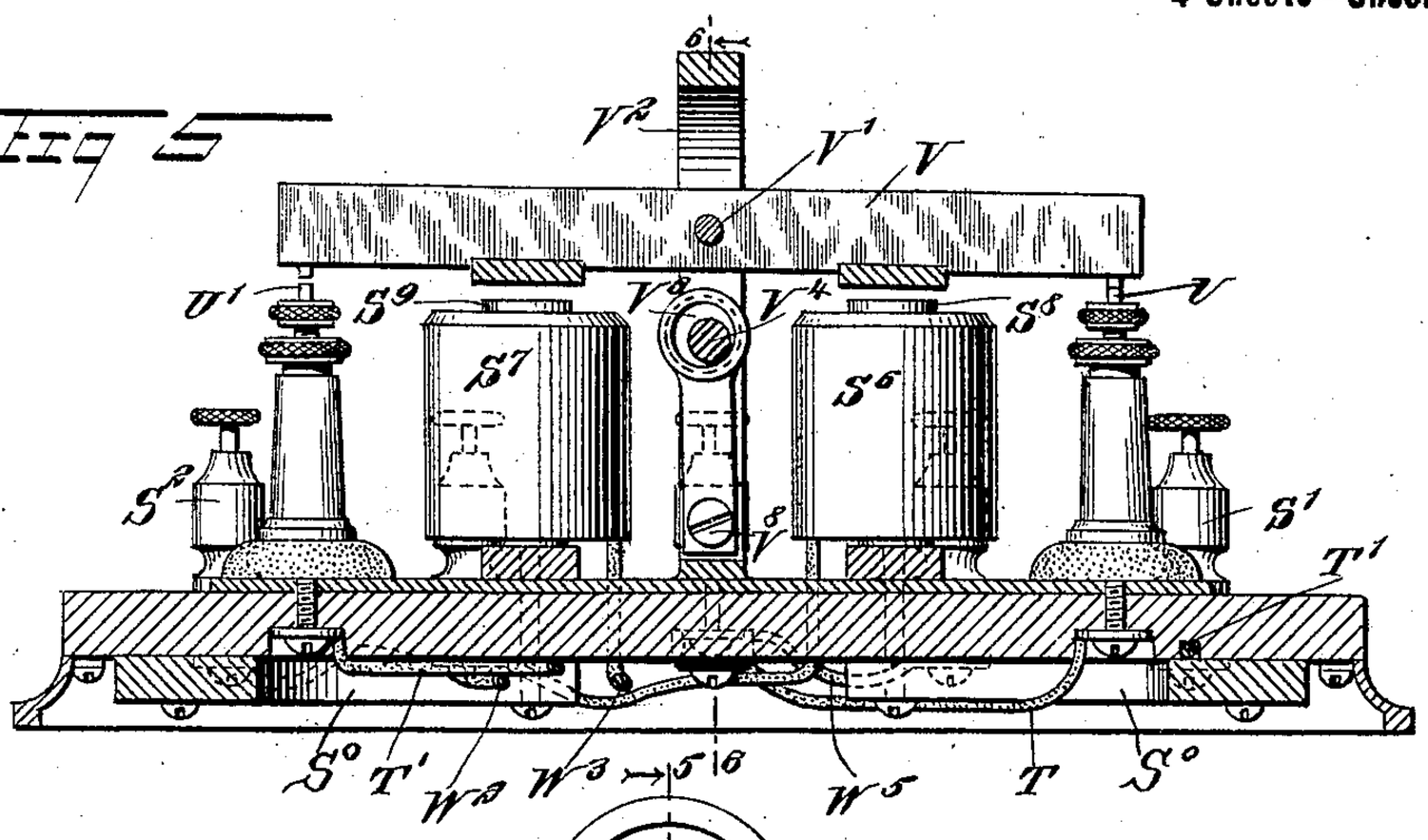


Fig 6

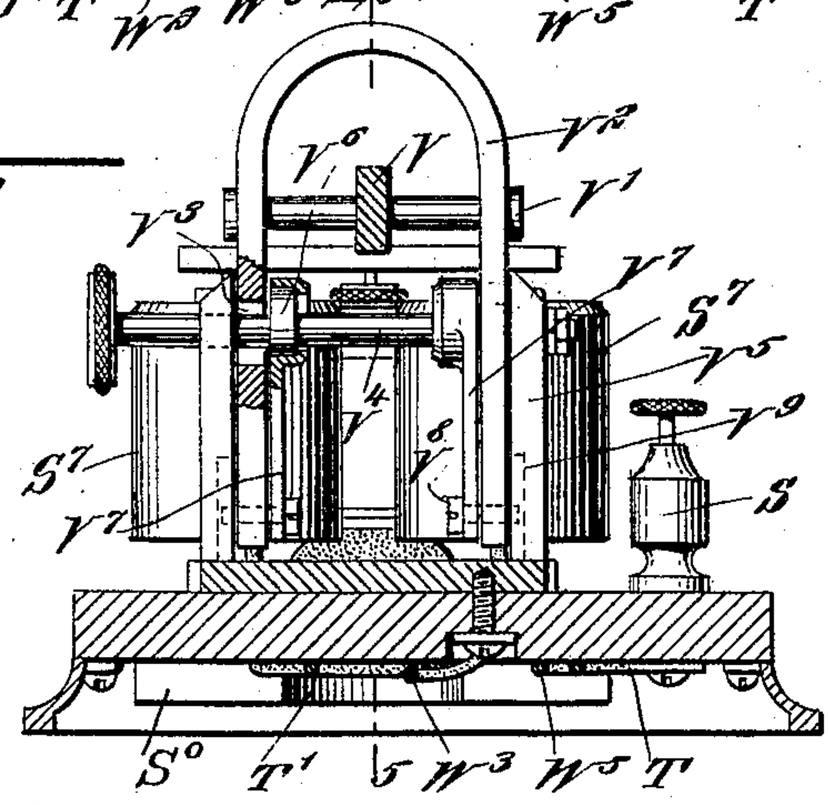
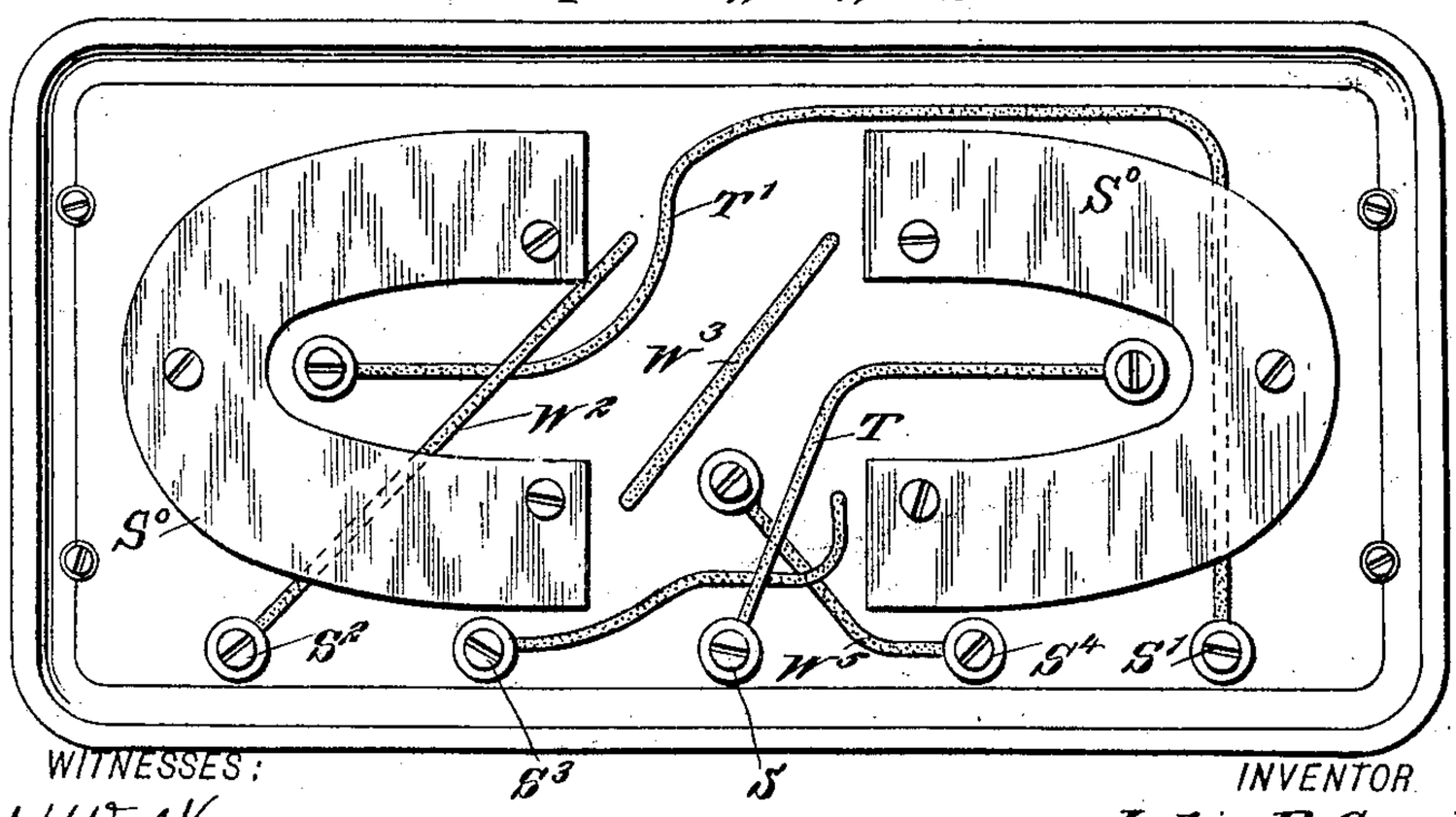


Fig 7



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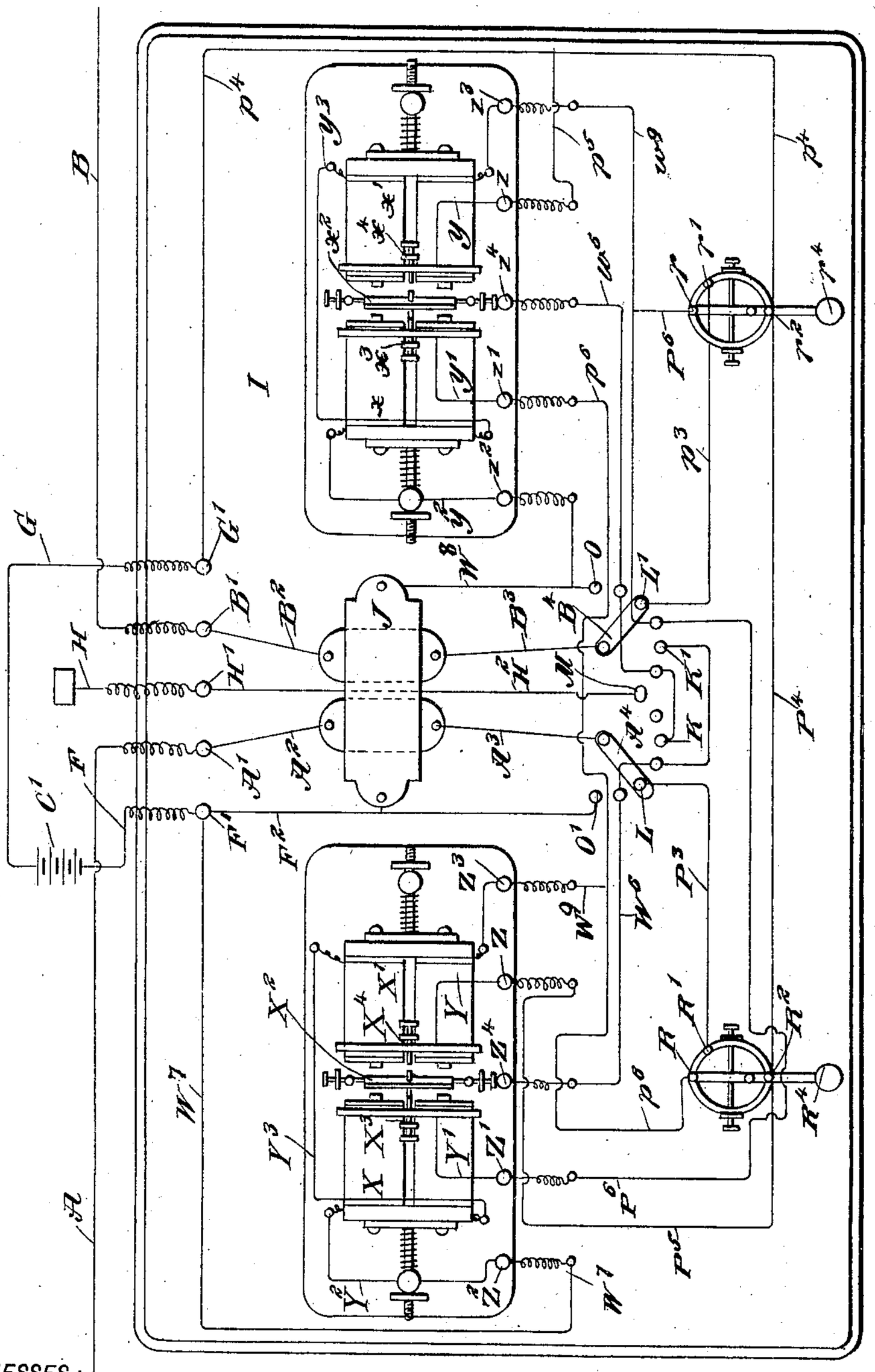
4 Sheets—Sheet 4.



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UNITED STATES PATENT OFFICE.

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TELEGRAPH-RELAY.

SPECIFICATION forming part of Letters Patent No. 680,024, dated August 6, 1901.

Application filed August 14, 1900. Serial No. 26,856. (No model.)

To all whom it may concern:

Be it known that I, JULIO E. CORDOVEZ, a citizen of the United States of Colombia, and a resident of Panama, in the United States of Colombia, have invented certain new and useful Improvements in Telegraph-Relays, of which the following is a full, clear, and exact description.

My invention relates to telegraph-relays, and has for its object to provide an efficient and sensitive construction for repeating telegraphic messages both with and without the use of sounders or other receivers at the intermediate stations and allowing the use of the apparatus either for repeating purposes or for those of ordinary communication from station to station.

To this end my invention consists in certain arrangements, connections, and constructions of parts by which I secure the above-indicated results without the use of springs or like delicate and rather uncertain devices.

The invention will be fully described hereinafter and the features of novelty pointed out in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a diagram of a station provided with my improved apparatus. Fig. 2 is a front elevation of the relay proper with parts broken away. Fig. 3 is a cross-section on line 3 3 of Fig. 2. Fig. 4 is a side elevation of the key. Fig. 5 is a longitudinal sectional elevation of the sounder on line 5 5 of Fig. 6. Fig. 6 is a cross-section taken substantially on line 6 6 of Fig. 5. Fig. 7 is an inverted plan of the sounder-base; and Fig. 8 is a diagram showing a station with an arrangement of apparatus similar to Fig. 1, but with the sounders omitted.

As illustrated in Fig. 1, A is the line-wire from one station, and B is the line-wire from another station, connected, respectively, with the binding-posts A′ and B′.

C is the local battery, connected by wires D E to binding-posts D′ E′.

F G are wires connected with the respective poles of the main battery C′ and with binding-posts F′ G′.

H is a wire connected with any suitable local apparatus, such as a telephone or a testing instrument, and with a binding-post H′. These binding-posts are all secured upon a board or base I. From the posts A′ B′ continuation-wires A^2 B^2 lead to a lightning-arrester J of any suitable construction, and then wires A^3 B^3 connect with switches A^4 B^4, which in Fig. 1 are shown in engagement with contacts K K′, but may also be engaged with another set of contacts L L′ or with a central contact M or with rests N, the latter serving to hold the switches A^4 B^4 out of connection and also to keep them from catching in the various wires during their movement. A wire H^2 connects the central contact M with the binding-post H′. The switches A^4 B^4 may also be engaged with grounding-plates O O′, connected with the earth.

The ground-plate O′ is connected by a wire F^2 with the binding-post F′. From the grounding-plate O a wire P leads to coils of a relay-electromagnet Q, connected by a wire P′ with the coils of an opposing electromagnet Q′. The detail construction of the relay will be fully described farther on. A wire P^2 connects the coils of the electromagnet Q′ with a contact R on a telegraphic key of the usual type. No novelty is claimed for this key, which is shown in detail in Fig. 4. The key has three contacts R R′ R^2, insulated from each other. The contact R, as stated, is connected with the wire P^2 and is normally engaged by a screw R^3 on the end of the key-lever R^4, pivoted at R^5 and pressed by a spring R^6 to hold the screw R^3 against the contact R. The contact R′ is in electrical connection with the lever R^4 and also connects by a wire P^3 with the contact L. The contact R^2 is connected by wires P^4 p^4 with the corresponding contact r^2 of another telegraph-key, the connections of which are similar to those described with reference to the first-mentioned key, as has been clearly indicated by the use of similar characters for the left-hand and the right-hand half of the apparatus, so that it will be unnecessary for me to repeat the description of such connections. The wire p^4 connects with the binding-post G′ and also by a wire p^5 with a binding-post *s* of a sounder or circuit-closer, which post is connected by a wire *t* with a contact *u*′, adapted to be engaged by the armature *v* of said

circuit-closer, but normally out of engagement therewith. Exactly the same construction and connections are provided on the left-hand side of the apparatus, where they are indicated by the corresponding capital letters. The details of the circuit-closer will be fully described hereinafter. The armatures v V normally engage contact u U, connected by wires t' T' with binding-posts s' S', from which wires p^6 P^6, respectively, lead to the wires P^2 p^2. The binding-post D' is connected by wires W w with the relay-armatures Q^2 q^2, respectively, normally in engagement with the stops Q^3 q^3. In their other position the said armatures are adapted to engage contacts Q^4 q^4, respectively, connected by wires W' w' with binding-posts S^2 s^2 of the respective circuit-closers. From these posts wires W^2 w^2 lead to the coils S^6 s^6 S^7 s^7 of the electromagnets of said circuit-closers, the coils of the two electromagnets being connected by wires W^3 w^3. These coils are then connected with the binding-posts S^3 s^3, from which wires W^4 w^4, respectively, lead to the binding-post E'. Finally the armatures V v of the circuit-closers are connected by wires W^5 w^5, respectively, with binding-posts S^4 s^4, from which wires W^6 w^6 lead to the contacts K' K, respectively.

The construction of the relay proper, as shown in Figs. 2 and 3, is as follows: The stop Q^3 and contact Q^4 are carried by stationary plates or brackets Q^5, formed with slideways, in which the coils Q Q', with their cores Q^6 Q^7, are adapted to move toward or from each other. The cores are connected with the poles of permanent magnets Q^8, preferably of horseshoe shape, and the polarity of these magnets, as well as the direction in which the coils Q Q' are wound, is such that a current passing through the coils in a predetermined direction will increase the magnetism which the cores Q^7 receive by induction from their permanent magnet, while at the same time the magnetism imparted by induction (from the permanent magnet) to the cores Q^6 will be decreased. Thus practically upon the passage of the current through the coils Q Q' one of them will have a much stronger attractive action than the other, which will virtually repel the armature Q^2. This armature is pivoted at Q^9, and the magnets Q^8 may be of different strength or unequally placed with respect to the central position of the armature, so that normally the armature will lie against the stop Q^3, or a spring Q^{10} may be used for this purpose, or both expedients may be employed together. To adjust the magnets, I provide screws Q^{11}, working in brackets Q^{12}, and preferably springs Q^{13} are added to prevent lost motion.

The circuit-closer is shown in detail in Figs. 5, 6, and 7. The armature V is pivoted at V' to a support V^2, which is adjustable, so that the distance from the armature to the cores S^8 S^9 of the coils S^6 S^7 may be varied. For this purpose the support V^2 has slots V^3, through which passes a shaft V^4, journaled in the stationary frame V^5 and provided with eccentrics V^6. These eccentrics engage openings in links V^7, the lower ends of which are pivoted to the support V^2, as by screws V^8. These screws also engage guideways V^9 in the support V^2. The cores S^8 S^9 are connected magnetically with permanent magnets S^0, and the relation of these magnets to the cores and to the coils S^6 S^7 is the same as that described with reference to the coils Q Q', cores Q^6 Q^7, and permanent magnets Q^8—that is, when the coils S^6 S^7 are energized one of them increases the magnetic force of its core and the other reduces it, the result being practically the same as if one core exerted an attractive force and the other a repelling action.

The operation of the apparatus shown in Fig. 1 is as follows:

First. With the switches A^4 B^4 (or one of them) on the grounding-plates O O', the current passes from the line A (or B) to the binding-post A' (B',) wires A^2 A^3 (B^2 B^3) and switch A^4 (B^4) to the ground. This grounding connection might be used, for instance, for the purpose of detecting and locating a leak in the line or for connecting the line with the earth during thunder-storms.

Second. With the switch A^4 or B^4 on the central contact M, the current will pass, say, from the line A to the binding-post A', wires A^2 A^3, switch A^4, contact M, wire H^2, binding-post H', and wire H to any local instrument, as a telephone, ordinary sounder, testing instrument, &c. I provide this connection particularly for use upon lines where the same wire is used at times for telegraphing and at others for telephoning.

Third. With the switch A^4 on the contact L, the current will pass from the line A, binding-post A', wires A^2 A^3, and switch A^4 to the contacts L and R', lever R^4, contact R, wire P^2, coils Q', wire P', coils Q, wire P, and to the earth at 0. This will energize the coils Q Q', causing the powerful action above referred to, in consequence of which the armature Q^2 will leave the stop Q^3 and swing against the contact Q^4. This closes the following local circuit: from the battery C by the wire D and binding-post D' to wire W, armature Q^2, contact Q^4, wire W', binding-post S^2, wire W^2, coils S^6, wire W^3, coils S^7, binding-post S^3, wire W^4, binding-post E', and wire E back to the battery C. The coils S^6 S^7 being thus energized they will exert the peculiar attraction and repulsion on the armature V to swing it into engagement with the contact U'. This engagement does not close any circuit, but produces the customary click, this part of the apparatus acting as a sounder in the case under consideration. When the circuit is broken at the distant station, the armatures Q^2 and V will return to their original positions. This describes the action when the station illustrated by Fig. 1 receives the message. When the message

is sent from the station shown, the action at the distant station will be as has just been described, while at the sending station the path of the current will be as follows when the key-lever R^4 is depressed to engage the contact R^2: from the ground-plate O′ to wire F^2, binding-post F′, wire F, line-battery C′, wire G, binding-post G′, wires p^4 and P^4, contact R^2, lever R^4, contact R′, wire P^3, contact L, switch A^4, wires A^3 A^2, binding-post A′, and line A. The above explanation will apply equally, *mutatis mutandis*, to the other half of the apparatus—that is, the portion connected with the line B, with the switch B^4 resting on the contact L′.

Fourth. With the switches A^4 and B^4 engaging the contacts K and K′, as shown, a message sent over the line A will be automatically repeated and forwarded over the line B, or vice versa. For instance, a current sent over the line A will act as follows: It will pass from the line A to the binding-post A′, wires A^2 A^3, switch A^4, contact K, wire w^6, binding-post s^4, wire w^5, armature v, contact u, wire t', binding-post s', wires p^6 P^2, coils Q′, wire P′, coils Q, wire P, and grounding-plate O. This energizes the coils Q Q′ and closes the local circuit of the battery C, energizing the coils S^6 S^7 in exactly the same manner as described under "Third," bringing the armature V into engagement with the contact U′. This closes the repeating-circuit as follows: from the grounding-plate O′ to wire F^2, binding-post F′, wire F, line-battery C′, wire G, binding-post G′, wires p^4, P^4, and P^5, binding-post S, contact U′, armature V, wire W^5, binding-post S^4, wire W^6, contact K′, switch B^4, wires B^3 B^2, binding-post B′, and line B. The current of the line-battery C′ is therefore sent over the line B in impulses corresponding to those received over the line A, thus repeating the message automatically. Should the message be received from the line B, the current will travel as follows: line B, binding-post B′, wires B^2 B^3, switch B^4, contact K′, wire W^6, binding-post S^4, wire W^5, armature V, contact U, wire T′, binding-post S′, wires P^6 p^2, coils q', wire p', coils q, wire p, wire F^2, and grounding-plate O′. The coils q q' being energized, the armature q^2 will swing into engagement with the contact q^4, closing the following local circuit: battery C, wire D, binding-post D′, wire w, armature q^2, contact q^4, wire w', binding-post s^2, wire w^2, coils s^6, wire w^3, coils s^7, binding-post s^3, wire w^4, binding-post E′, wire E, and back to battery C. The coils s^6 s^7 being thus energized to bring the armature v against the contact u', the repeating circuit is closed as follows: from the grounding-plate O′ by wire F^2 to binding-post F′, wire F, line-battery C′, wire G, binding-post G′, wires p^4 p^5, binding-post s, wire t, contact u', armature v, wire w^5, binding-post s^4, wire w^6, contact K, switch A^4, wires A^3 A^2, binding-post A′, and line A.

In Fig. 8 I have shown an arrangement in which the local battery C is dispensed with and in which only one armature is used on each side of the apparatus. In this case the construction of the relay is almost exactly the same as shown in Figs. 1, 2, and 3, the coils X X′, armature X^2, and stops X^3 X^4 corresponding to those lettered Q, Q′, Q^2, Q^3, and Q^4 in said figures; but the connections are substantially like those of the binding-posts S S′ S^2 S^3 S^4 in Figs. 1, 5, 6, and 7, binding-posts Z Z′ Z^2 Z^3 Z^4 being provided in corresponding locations and being connected correspondingly. The connections of the line-battery C′ and of the keys R^4 r^4 are also substantially the same as in Fig. 1, (the relay connections P p, P′ p', P^2 p^2, W w, and W′ w' being of course omitted,) and the posts Z Z′ Z^4 and z z' z^4 are connected with the same wires as in Fig. 1; but the binding-post Z^2 is connected by a wire W^7 with the binding-post F′, and the binding-post z^2 is connected by the wire W^8 with the grounding-plate O and with the lightning-arrester J. Further, the posts Z^3 z^3 are connected by branch wires W^9 w^9 with the wires p^6 P^6, respectively. The stops X^3 X^4 x^3 x^4 all form contacts corresponding in connection and function to the contacts U U′ u u' of Fig. 1. The wires Y Y′ Y^2 Y^3 y y' y^2 y^3 therefore are the equivalents of the wires T T′ W^2 W^3 t t' w^2 w^3. The armatures X^2 x^2 are normally in engagement with the contacts X^3 x^3. The other parts will explain themselves by the reference-letters applied thereto and denoting the same parts as in Fig. 1.

The operation with the switches A^4 B^4 on the grounding-plates O O′ or on the central contact M is exactly the same as described with reference to Fig. 1.

With the switches on the contacts L L′ the apparatus is adapted to exchange messages with the stations on the lines A and B, respectively, without automatically repeating the message, so as to cause it to pass from one line to the other. When repetition is desired, the switches A^4 B^4 should be placed on the contacts K K′.

First. If with the switch A^4 in the position shown a message comes in over the line A, the current passes from the binding-post A′, the wires A^2 A^3, and the switch A^4 to the contact L, wire P^3, contact R′, lever R^4, contact R, wires p^6 W^9, binding-post Z^3, coils X′, wire Y^3, coils X, wire Y^2, binding-post Z^2, wire W^7, binding-post F′, wire F^2, and grounding-plate O′. The coils X X′ being energized, the armature X^2 swings against the stop or contact X^4, acting as a sounder; but no circuit is closed by this movement. When the current in the line A is interrupted, the armature X^2 swings back against the stop X^3. Supposing it is desired to send a message from the station shown over the line B, this is effected by manipulating the key-lever r^4 in the usual manner, the switch B^4 being upon the contact L′. The current will then pass from the grounding-plate O′ through the wire F^2 to the binding-post F′, wire F, line-battery C′, wire G, binding-post G′, wire p^4, contact r^2, lever

r^4, contact r', wire p^3, contact L', switch B^4, wires B^3 B^2, binding-post B', and line B. The circuits in receiving a message from line B or sending one over the line A are analogous, and I therefore deem it necessary to describe them fully.

Second. If the switches A^4 B^4 are placed, respectively, on the contacts K K' and a telegram comes in over the wire A, the action will be as follows: The line-current will pass from the line A to the binding-post A', wires A^2 A^3, switch A^4, contact K, wire w^6, binding-post z^4, armature x^2, contact x^3, wire y', binding-post z', wires p^6 W^9, binding-post Z^3, coils X', wire Y^3, coils X, wire Y^2, binding-post Z^2, wire W^7, binding-post F', wire F^2, and grounding-plate O'. The coils X X' being thus energized will shift the armature X^2 into engagement with the contact X^4. This will close the repeating-circuit for line B as follows: from grounding-plate O' to wire F^2, binding-post F', wire F, battery C', wire G, binding-post G', wires p^4 P^4 P^5, binding-post Z, wire Y, contact X^4, armature X^2, binding-post Z^4, wire W^6, contact K', switch B^4, wires B^3 B^2, binding-post B', and line B. Should the message come from line B to be forwarded to line A, the operation will be analogous, and its description is deemed unnecessary.

It will be understood that I attach especial importance to the particular construction of the magnets of my apparatus, as by said construction I secure a very sensitive and comparatively powerful action.

It will be understood that the armatures which close the repeating-circuit are in Fig. 8 (armatures X^2 x^2) directly in the field of the coils (X X' x x') which are connected with the telegraph-keys (at R r.) In Fig. 1 the armatures (V v) which close the repeating-circuits are not directly in the field of the coils (Q Q' q q') which are connected with the telegraph-keys (at R r;) but they are controlled by said coils through the medium of the armatures Q^2 q^2 and the local circuits, which incline the coils S^6 S^7 s^6 s^7. In both forms of my apparatus, therefore, the coils which are connected with the telegraph-keys control the position of the armatures which close the repeating-circuits.

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

1. In an electric telegraph, a movable armature, cores arranged on opposite sides of the armature, permanent magnets connected with said cores, coils surrounding the cores, said magnets and coils being so arranged that a current passing through the coils will increase the magnetism of the core on one side of the armature, and decrease the magnetism of the core on the other side of the armature, a movable support to which the armature is pivoted, a shaft journaled in a stationary part and carrying an eccentric, and a link engaging said eccentric and pivotally connected with the said support.

2. In an electric telegraph, two lines, two sets of contacts, two switches adapted to connect the lines with either of the respective contacts, telegraph-keys each connected with one of the contacts of one set, electromagnet-coils connected with the keys and through them, normally, with the said set of contacts, a ground connection or equivalent connection from said electromagnet-coils, armatures controlled by the coils, a connection from each armature to one of the contacts of the other set, two contacts for each armature, a source of electricity connected with one of the contacts of each armature and with contacts which the telegraph-keys engage when depressed, and a connection from each of the other armature-contacts to the same end of the coils of the other armature which is connected with the telegraph-key.

3. In an electric telegraph, two lines, two sets of contacts, two switches adapted to connect the lines with either of the respective contacts, telegraph-keys each connected with one of the contacts of one set, two relays each comprising electromagnet-coils connected with the keys and through them, normally, with the said set of contacts, a ground connection or equivalent connection from the other terminals of said relay-coils, relay-armatures, a source of electricity connected with each of the relay-armatures, stops for limiting the movement of said armatures, a circuit-closer for each relay, said circuit-closer comprising electromagnet-coils connected at one terminal with one of the stops of the corresponding relay, a connection from the other terminal of said circuit-closer coils to said source of electricity, a circuit-closer armature, two contacts adapted to be engaged by said armature alternately, another source of electricity connected with one of the contacts of each circuit-closer and with contacts which the telegraph-keys engage when depressed, a connection from the other contact of each circuit-closer to the same end of the coils of the other relay which is connected with the telegraph-key, and a connection from each of the circuit-closer armatures to one of the other set of switch-contacts.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JULIO E. CORDOVEZ.

Witnesses:
JOHN LOTKA,
EVERARD BOLTON MARSHALL.