(No Model.) 4 Sheets—Sheet 1.

W. C. MOORE.

ELECTRIC SIGNALING APPARATUS.

No. 475,334. Patented May 24, 1892.

Fig. 1.

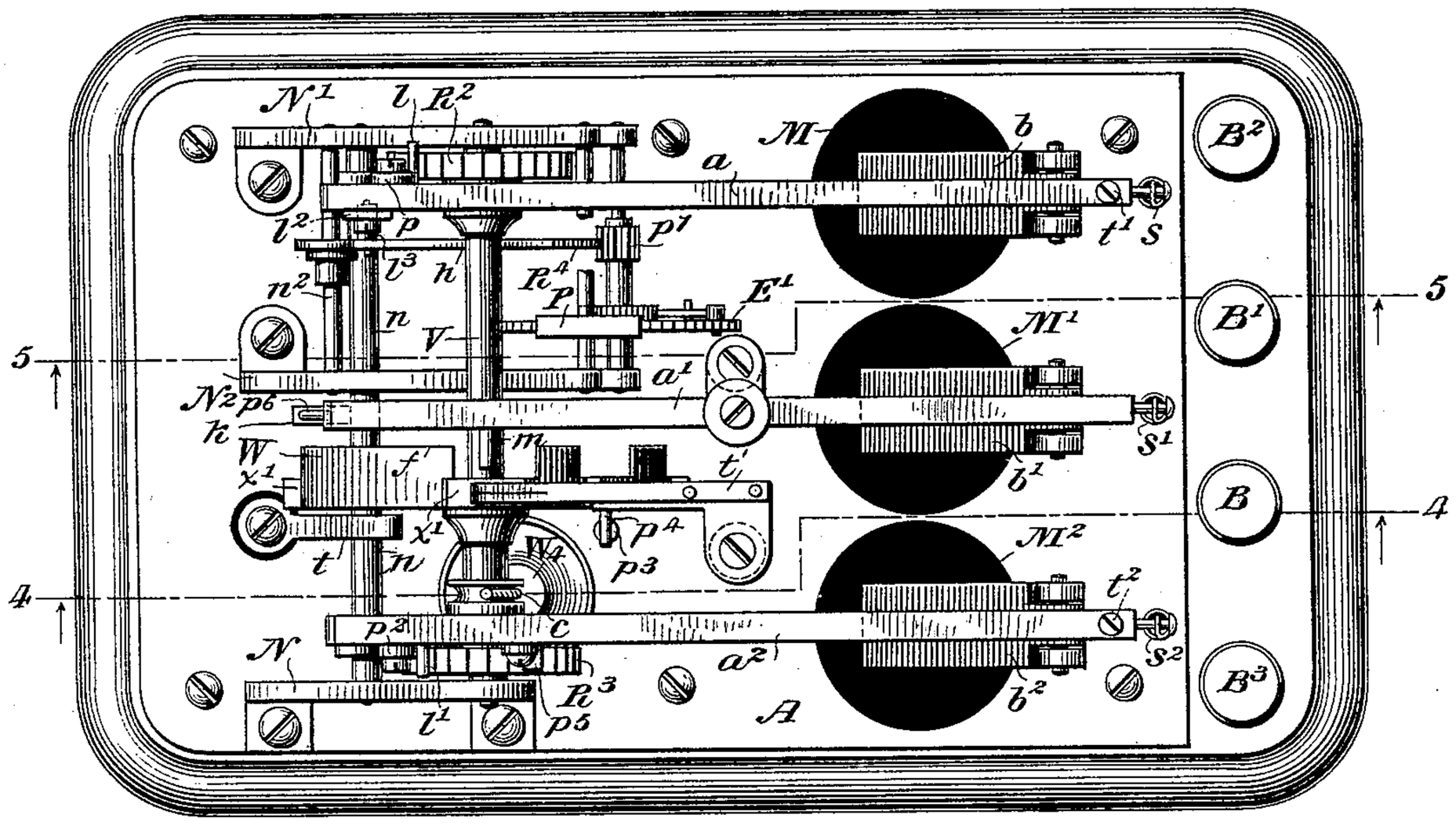
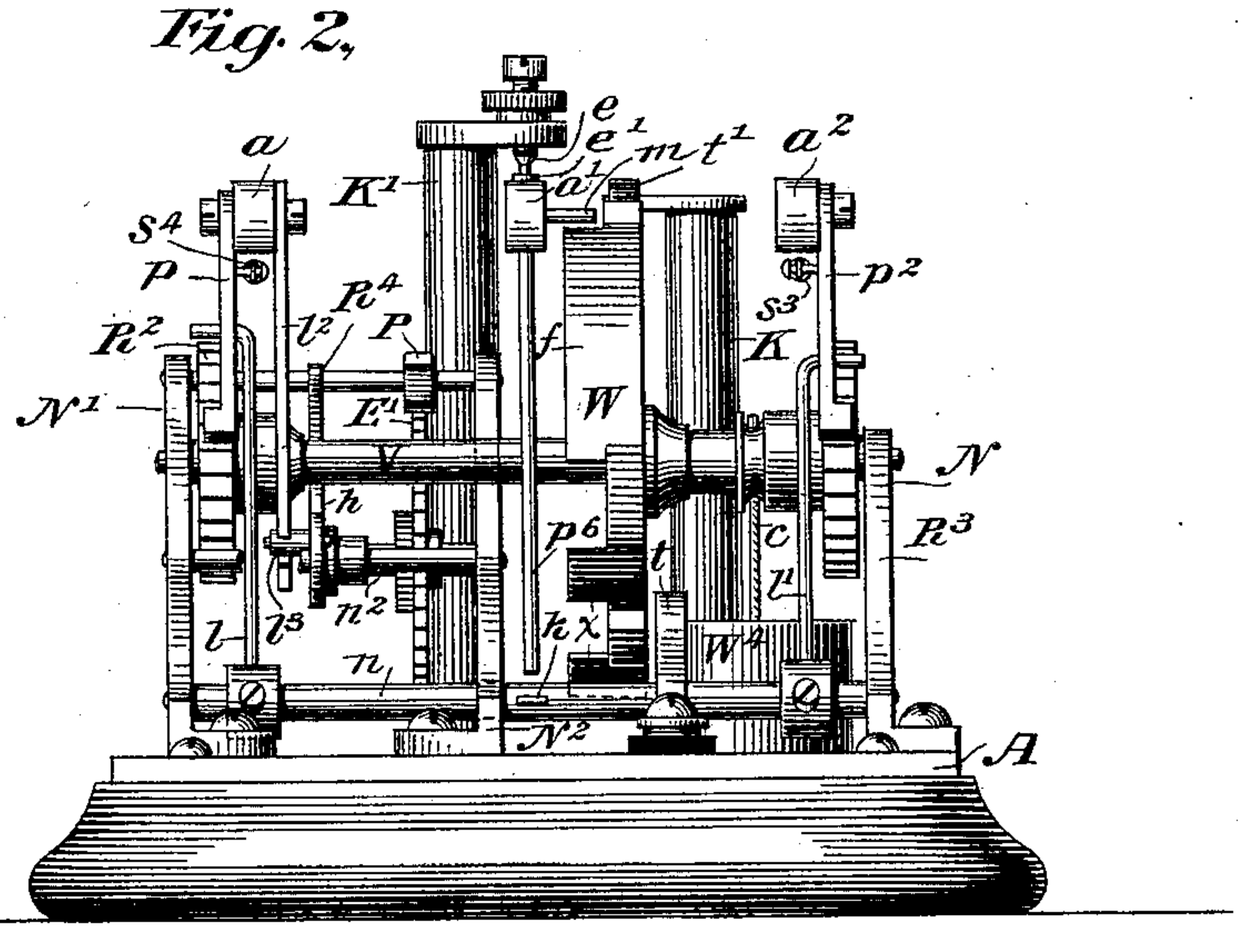


Fig. 2.



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(No Model.) 4 Sheets—Sheet 2.

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Fig. 3.

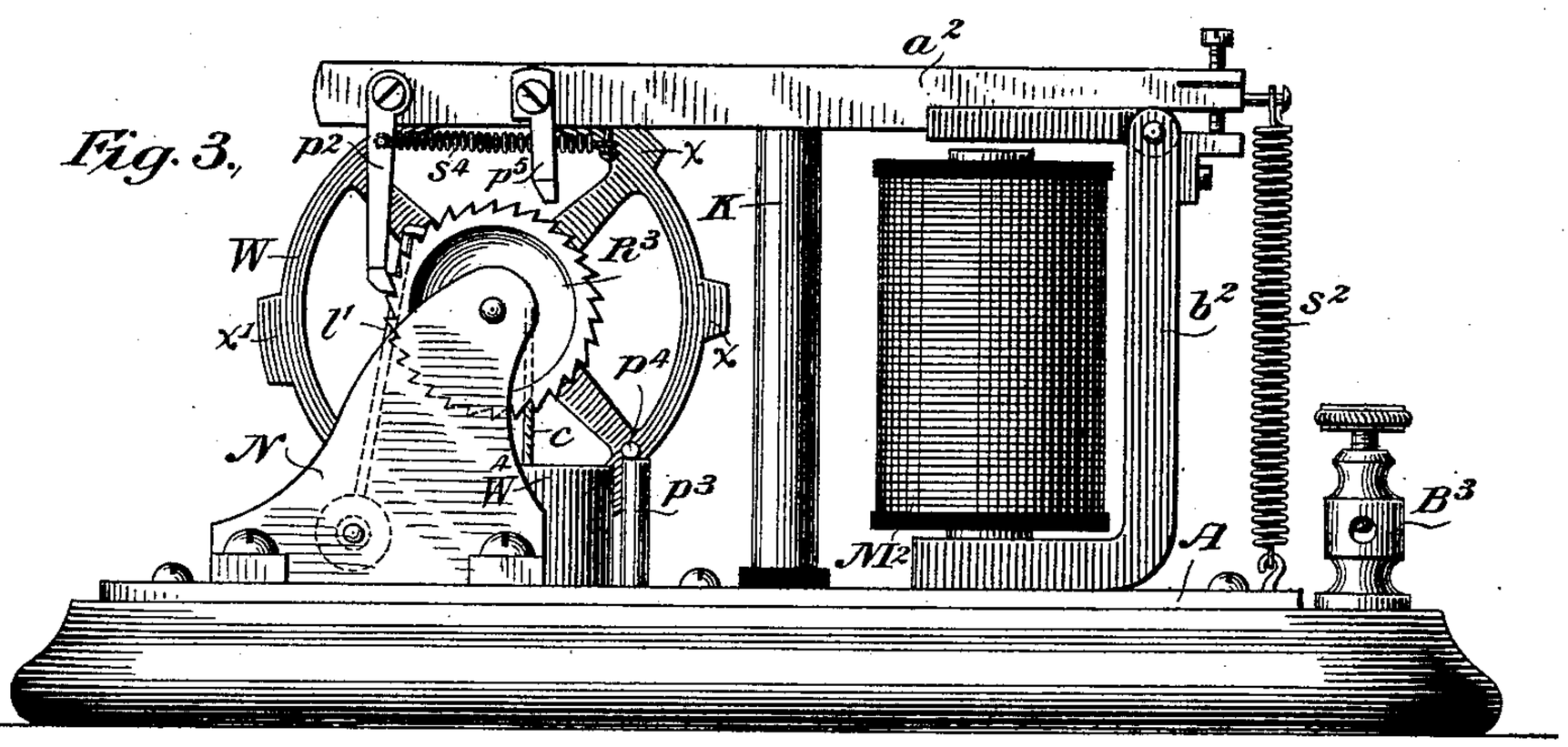

Fig. 4.

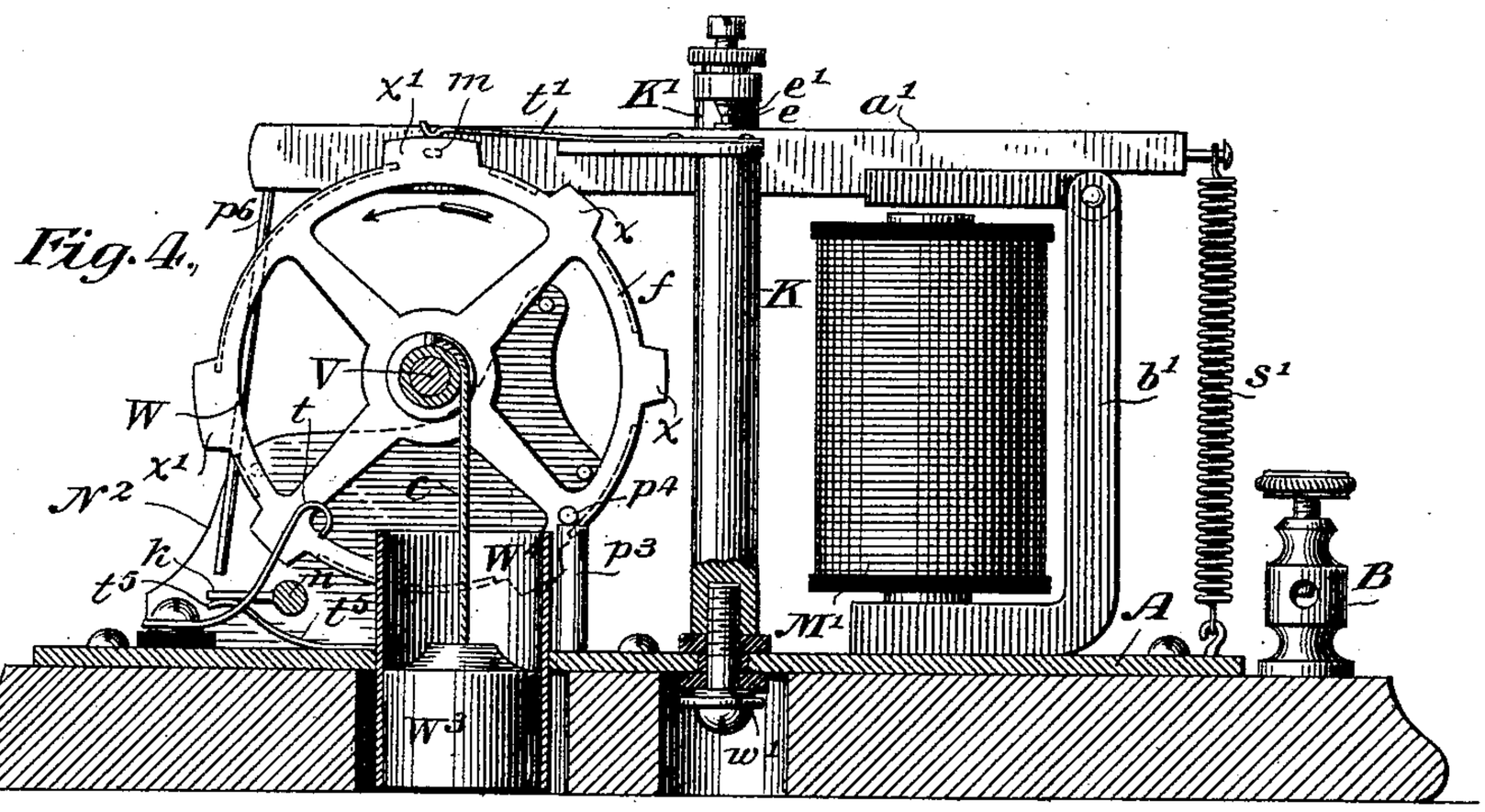

Fig. 5.

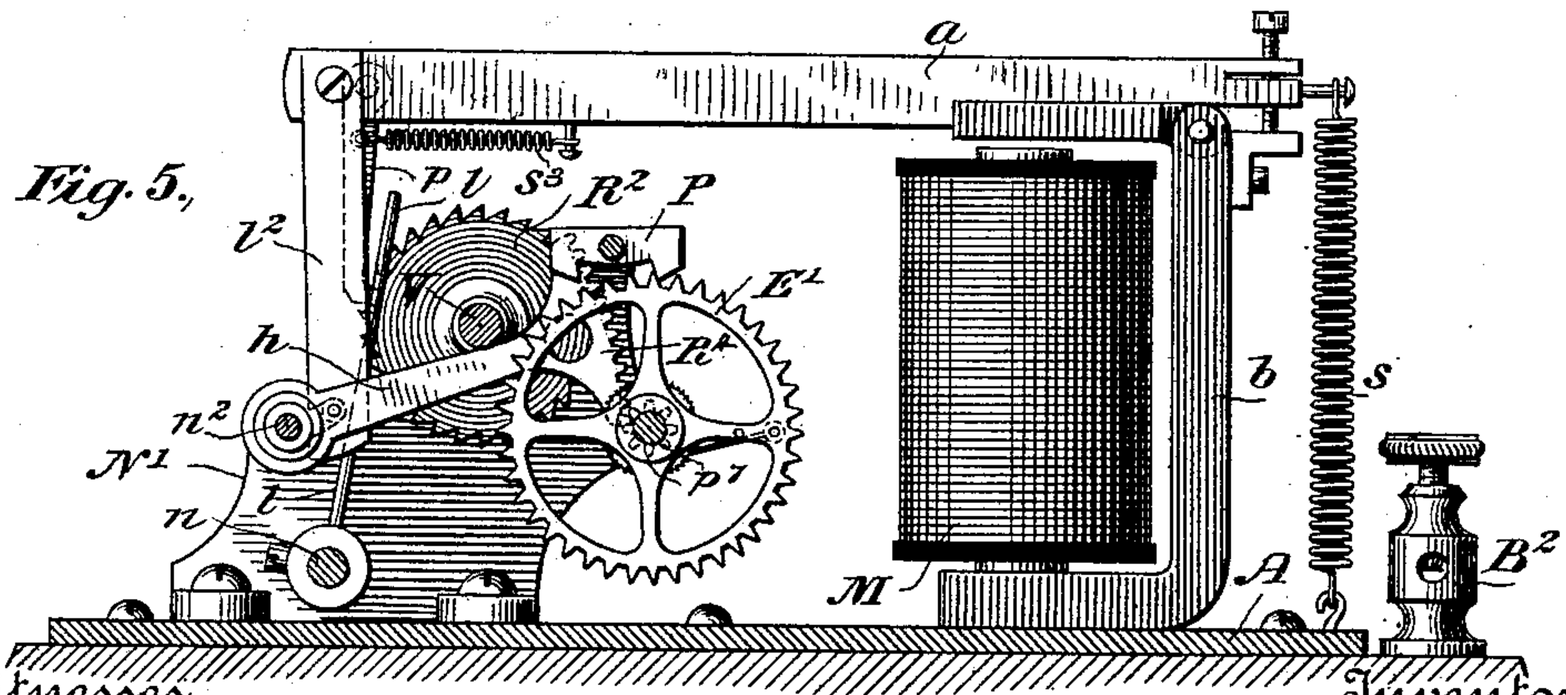

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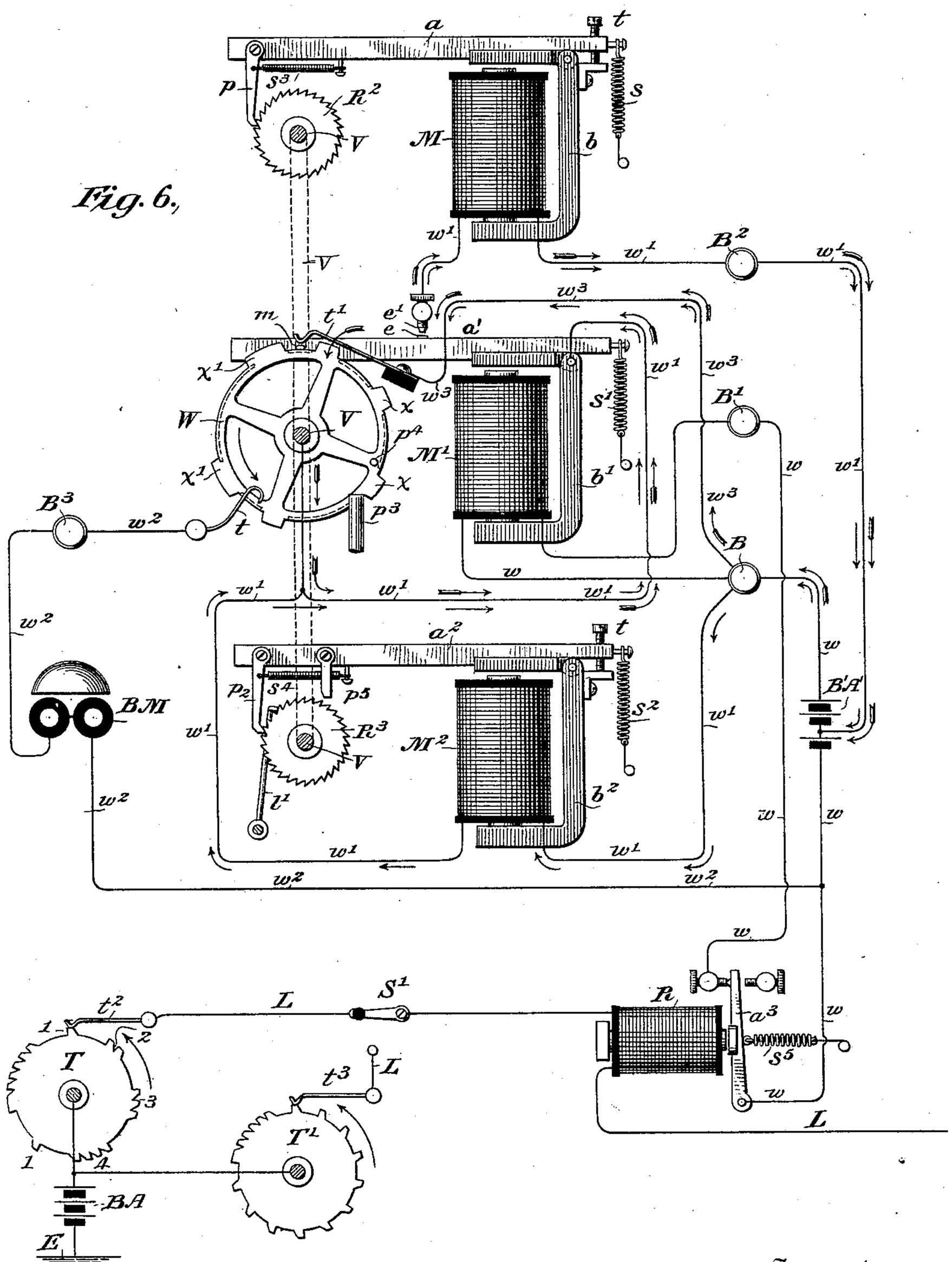
Fig. 6.



Witnesses

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(No Model.) 4 Sheets—Sheet 4.

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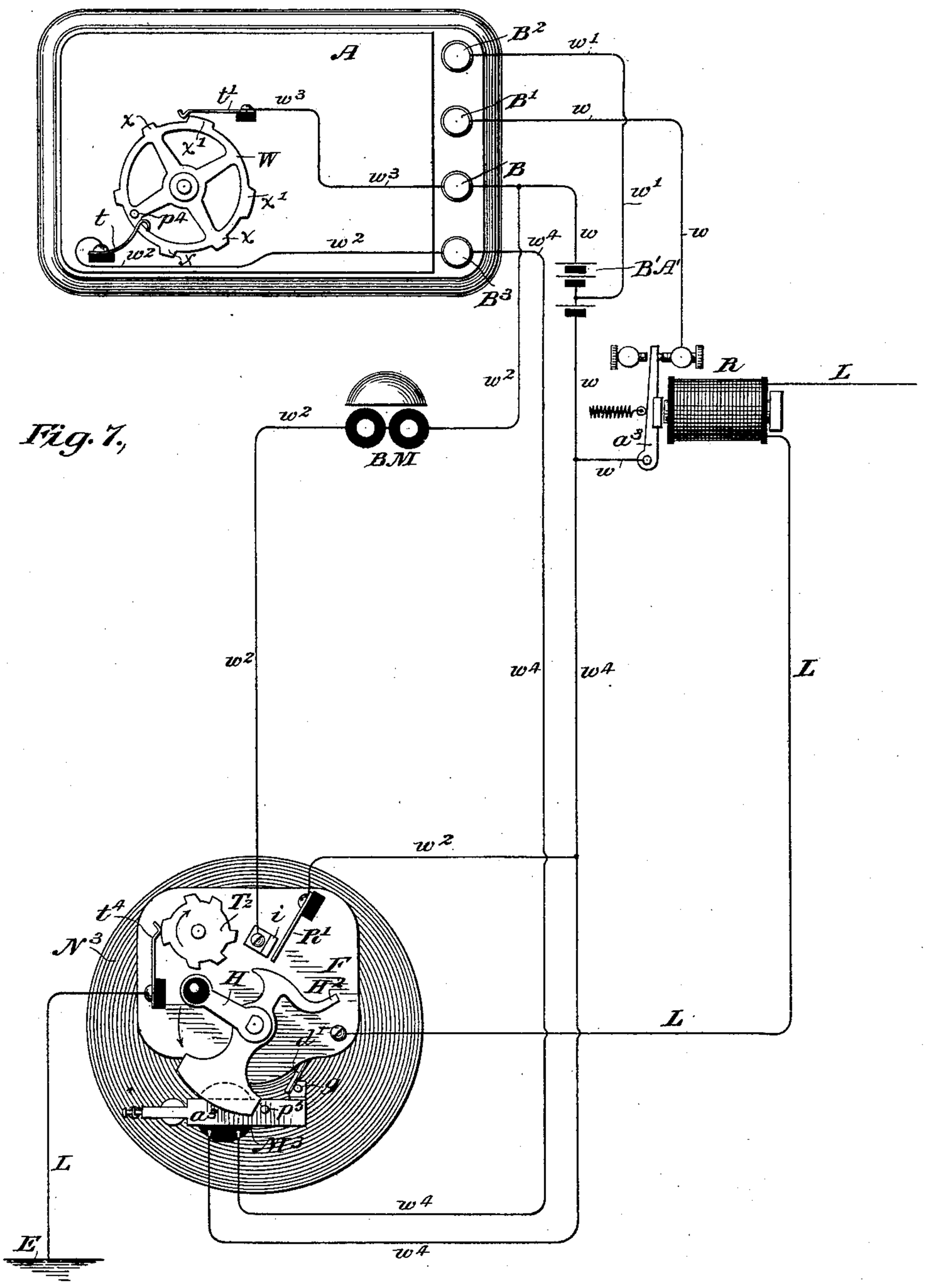

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM C. MOORE, OF KANSAS CITY, MISSOURI, ASSIGNOR TO THE ELECTRIC SECRET SERVICE COMPANY, OF NEW YORK, N. Y.

ELECTRIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 475,334, dated May 24, 1892.

Application filed June 19, 1891. Serial No. 396,836. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM C. MOORE, a citizen of the United States, residing at Kansas City, county of Jackson, and State of Missouri, have made a new and useful invention in Electric Signaling Apparatus, of which the following specification, taken in connection with the accompanying drawings, constitutes a complete and full description.

My invention is directed particularly to improvements in electric signaling mechanism known in the art as "individual-call apparatus"—such, for instance, as is used in telephonic, telegraphic, and analogous electric signaling systems for transmitting a particular signal to an outlying station, which shall indicate to the subscriber or operator at that station, and to him alone, that he is wanted.

My invention has for its objects, first, the greater certainty of operation of apparatus of this general nature at all times, under all conditions of weather, peculiarities of electrical-circuit disturbances, &c.; second, the utilization of an answer-back signaling device with the apparatus at each operator's or subscriber's station, which shall respond to the signal sent out and only after it has been correctly received at that station; third, the construction and arrangement of a signaling apparatus which shall be capable of transmitting individual signals to the individual outlying subscribers or operators, and shall also possess the qualification of enabling the transmitting-operator to call up all of the subscribers or operators at one and the same time; fourth, the accomplishment of the several features hereinafter referred to in connection with the description of the apparatus and of its mode of operation. I accomplish these several objects by the use of the apparatus hereinafter described, but particularly pointed out in the claims which follow this specification.

My invention belongs to that special type of individual-call apparatus well known in the art in which the signals transmitted are not only adapted to actuate all of the receiving apparatus at the several outlying stations, but to cause the mechanism located at those stations not wanted to assume their normal or original conditions during some point of their forward advancement toward the completion of the signal, while the mechanism at the station which is being called is caused to pass completely through its operative phase and indicate to the subscriber or operator that he is wanted.

Apparatus of the general nature referred to and upon which the present invention is an improvement is disclosed in patent to Adin A. Hatch, No. 435,894, patented September 2, 1890. In the aforesaid Hatch patent the signals transmitted were in the nature of a series of short electrical impulses, each of a definite length, followed by breaks in the circuit of varying length, while the apparatus at the receiving-station was operated through the agency of a movable circuit-closer, which was propelled in its advancement by a weighted or gravitating arm and controlled in this movement by the impulses sent over the line, the circuit-closing device being restored to its normal condition through the agency of an electro-magnet either at the end of the completed phase, if the signal was transmitted correctly, or at an intermediate point if any variation in the impulses from those intended were transmitted.

In my invention I make use of a prearranged order of electrical impulses sent over the line to positively impel a circuit-closing device in a forward direction to the completion of its phase, so that an alarm is sounded if the correct signal has been transmitted, and I cause an abnormally-long break in the circuit to give to the circuit-closing device two forward steps or movements. During the forward advancement of the circuit-closing device energy is stored up in the nature of a weight or spring for suddenly returning it (the circuit-closing device) to normal position either at the completion of its phase or at any intermediate point.

For a full and exact understanding of the invention reference is had to the accompanying drawings, in which—

Figure 1 is a plan view of one of my improved individual-call-receiving devices, and Fig. 2 an end view thereof; Fig. 3, a side view, while Figs. 4 and 5 are sectional views taken, respectively, on lines 4 4 and 5 5, Fig. 1, and as seen looking in the direction of the ar-

rows upon said figure. Fig. 6 is a diagrammatic view showing the operative portions of the circuits, main line, relay, and one of my improved transmitters in connection therewith, while Fig. 7 is a diagrammatic and plan view illustrating my novel form of answer-back signal in connection with my improved individual-call apparatus.

It will be understood at the outset that there would be in practice a number of these individual-call devices controlled by a single circuit, with an individual answer-back apparatus for each instrument.

I have shown in Fig. 6 one apparatus with a single transmitter and in Fig. 7 the answer-back signal, which may be applied thereto.

Referring to the drawings in detail, A represents the base of the receiving apparatus, and N N′ N² the side supports or standards secured thereto and, in which are journaled the operative parts of the mechanism.

M, M′, and M² are electro-magnets attached to the base A and having cores provided with magnetic extensions *b*, *b′*, and *b²*, to the upper or extended ends of which are pivoted armature-levers *a*, *a′*, and *a²*, provided with armatures extending over the poles of the electro-magnets, each having an independent and adjustable retractile spring *s s′ s²*.

V is a shaft journaled in the side supports N N′ and carrying a movable circuit-closer device or wheel W, which is provided with a series of conducting teeth or contacts *x x′* at its outer edge and an inwardly-projecting flange *f* with openings or notches corresponding to the teeth or contacts *x*, this flange and its notches serving the same function as do the "detent stops or notches" in the Hatch patent above referred to, the aforesaid notches in said Hatch patent being in the nature of loops, staples, or eyes. Upon the opposite ends of the shaft V are located ratchet-wheels R² R³, having their teeth so inclined as to receive the free ends of propelling-pawls *p p²*, pivoted, respectively, to the ends of the armature-levers *a a²* and provided with retractile springs *s³ s⁴*.

n² is a shaft journaled in the standards N′ N² and carrying near its center an arm *h* and a curved rack R⁴, the teeth of which mesh with a pinion *p⁷* upon a second shaft journaled between said standards. (See Figs. 1 and 2.) Upon the same shaft with the pinion *p⁷* is a gear-wheel, which meshes with an additional pinion geared through intermediate shafting, with an escapement-wheel E′, provided with an escapement-pallet P, carried by a shaft, also journaled in the standards N′ N², the intermediate gearing between the escapement and the rack R⁴ being provided with the usual pawl and click or ratchet mechanism, which permits the application of power through the arm *h*, rack R⁴, and pinion *p⁷* in one direction and the return of said rack under the stress of the armature retractile spring *s* in a reverse direction, the function of this apparatus being in the nature of retarding mechanism, as will be more fully described in connection with the description of the mode of operation of the instrument.

n is a rock-shaft journaled in the side standards N N′ and provided at its opposite ends with a pair of arms *l l′*, curved at their upper ends outwardly, so as to lie behind the free ends of the pawls *p p²*, as clearly shown in Fig. 2. Near the center of this rock-shaft *n* is secured and at right angles thereto an arm *k*, located in the path of the free end of a pin *p⁶*, attached to the outer end of the armature-lever *a′*.

m is a pin carried also by the free end of the armature-lever *a′* and adapted to rest upon the upper surface of the inwardly-projecting teeth of the flange *f*, or pass through the openings much in the same manner as does the hook or stop in connection with the eyes or loops in the aforesaid Hatch patent.

e e′ are electrical contacts, the former adjustable and carried by an upright post K′ and the latter by the free end of the armature-lever *a′*.

p⁴ is a stop or pin carried by the movable circuit-closing device or wheel W and lying in the path of a fixed stop *p³*, attached to the base of the instrument, while *t* is a spring located in the path of the pin *p⁴* when it is rotated in the direction of the arrow shown in Figs. 4 and 6.

W³ is a weight suspended from the shaft V by a cord *c* in a protecting tube or guide W⁴, as clearly shown in Fig. 4, the function of this weight being to rotate the circuit-closing device or wheel W in one direction after the cord has been wound up under the influence of the ratchet-wheels R² R³, pawls *p p²*, armature-levers *a a²*, and magnets M M², as will be described later on.

The electro-magnets M M′ M² are operatively connected with a local battery B′ A′, situated in the local circuit *w w*, connected through the armature *a³* of the relay R in the main line, the magnet M′ being energized always when the armature *a³* is on its front stop, the other magnets being energized only when the armature *a³* of the relay R is on its back stop. The circuit connections from the battery B′ A′ through these several magnets and the magnets of the call-bell or indicating apparatus B M will be pointed out in connection with the description of the mode of operation.

Referring now to Fig. 7 of the drawings, N³ represents my improved answer-back signaling apparatus, having a transmitter, disk T², operatively connected through a clock-driven train of gearing (not shown) to a handle H, the interior mechanism of the apparatus being substantially the same as that of well-known district call-boxes. H² is a cross bar or arm carried by the same shaft which supports the winding-handle H of the apparatus, and is provided at one side with a curved projecting end adapted, as the handle rotates in the direction of the arrow, to come

into contact with the free end of an electrical contact-spring R′, connected at its other end to the conductor w^2, i being a fixed contact-stop near the free end of the spring R′ and connected to the conductor w^2 on the other side. d' is a portion of an escapement-pallet operatively connected with escapement mechanism (not shown) controlling the movement of the answer-back signaling apparatus, held normally by a pin g on the free end of an armature-lever a^3, which armature is controlled in its movement by a magnet M^3 and a local circuit w^4. p^5 is a pin located on the upper side of the armature-lever a^3 and in the path of an enlarged portion of one end of the cross bar or arm H^2. t^4 is a contact-spring resting normally on a transmitter-disk T^2 of the answer-back signal and connected through the main line L to earth at E. The local-circuit connections w^4 with the local battery B′ A′ and the signaling magnets B M will be fully pointed out in connection with the description of the mode of operation.

Referring now to Fig. 6, T and T′ illustrate diagrammatically my improved form of transmitter adapted to operate any one or all of a series of outlying signal receiving apparatus of the nature or type described at will. I have shown in this figure of the drawings only one signal-transmitting disk T as applicable to one receiving-instrument, the circuit-closing device or wheel W of which bears a fixed relation to the contacting teeth of the transmitter—that is to say, the transmitting-disk T in this instance is designed to transmit a signal indicated by the numbers 1, 2, 3, 4, and 1, the series of teeth indicated on the left being for the purpose of bringing the apparatus all to unison before starting, in the same manner as is described in the aforesaid Hatch patent.

It will be noticed that the circuit-closing device or wheel W is provided with projecting teeth x x', adapted to contact electrically with a contact-spring t', and that the projections x are of equal length, while the spaces between said teeth are of variable length; also, that the notches or openings in the inwardly-extended flange f of the wheel W are directly opposite these teeth, the arrangement being such that so long as the proper sequence of impulses is transmitted the inwardly-projecting portions of the flange f lying in the path of the pin or finger m (see Figs. 1 and 2) will prevent the armature-lever a' from being drawn forward to the extent of its full stroke, and will also cause the pin or finger m to act as a brake upon the wheel W. The projections 1, 2, 3, 4, and 1 of the transmitter T bear a fixed relation to the contact-teeth x and the intervening projecting teeth of the flange f, which transmitter-disk and its corresponding receiving-wheel or circuit-closing device W differ from every other one in the system in the arrangement or order of these parts, so that each receiver will respond only to its own transmitter. The relation between all the transmitters, however, and all their individual receiving-wheels or circuit-closing devices W is such that if a regular series of individual impulses be transmitted over the line following each other at stated intervals all of the signal-receiving wheels or circuit-closing devices will be operated to the completion of their phases, thereby operating all of the signal mechanism. In other words, the contacting teeth 1, 2, 3, 4, and 1 may be arranged upon the several transmitters in any preferred order, reading from left to right, and so long as the intervening spaces between said teeth are equal it matters not what the order of arrangement may be, provided each receiving-wheel or circuit-closing device W be adapted to its own particular transmitter.

All of the transmitters might be arranged upon a common shaft connected with the battery B A, and the switch S′ shifted out of circuit with the transmitting-spring t^2 into circuit with any other transmitter, or to the universal transmitter T′ and contact-spring t^3, which when actuated would call up all of the operators or subscribers.

The operation of the apparatus is as follows: Referring first to Fig. 6 of the drawings, the transmitter is presumably being rotated from right to left in the direction of the arrow, the instruments having all been brought to unison by a series of electrical impulses transmitted by the several unisoning contacts shown on the left. Under this condition of affairs the transmitting contact-spring t^2 rests upon the first contact 1 of the transmitter, and a single impulse is sent from battery B A to line L through the relay R, thus closing the local circuit w in all of the outlying subscribers' or operators' apparatus, thereby causing the electro-magnet M′ to actuate its armature a', which causes the pin m to be drawn forward and to rest upon one of the projecting teeth of the flange f. As the transmitter advances the circuit is broken between the points 1 and 2 for a definite interval of time, and hence the relay R permits its armature a^3 to be withdrawn under the influence of the spring s^5, thereby interrupting the circuit of the local battery B′ A′ through the local circuit w and magnet M′, permitting its armature a' to be retracted and the contact e to rest against the fixed contact e', thus closing a second circuit from the battery B′ A′ in the direction of the tailless arrows through the wire w, binding-post B, wire w', electro-magnet M^2, polar extension b' of the magnet M′, armature-lever a', contact-points e e', electro-magnet M, binding-post B^2, back to battery, thus energizing both electro-magnets M M^2 and causing the armature-lever a^2 and its pawl p^2 to suddenly give to the ratchet-wheel R^3 and shaft V one step forward, the stop p^5 on the armature-lever a^2 acting as a check to insure always the same advancement of the ratchet-wheel R^3. At the same time the armature-lever a and pawl p are retarded in their forward movement under the influence of the same current

and magnet M by reason of the retarding action of the rack R^4, pinion p^7, and escapement mechanism. Hence the ratchet-wheel R^2 is caused to advance one tooth under the action of the first armature-lever a^2 and pawl p^2, as already described, while the armature-lever a is retarded, so that if the current is continued through the magnet M after the magnet M^2 has caused its armature-lever to thus impart this single step, the armature-lever a and pawl p will finally advance against the retarding influence of the escapement mechanism and give to the ratchet-wheel R^2 an additional forward step, so that if there is a break in the circuit through the relay R of considerable length said break will permit the two magnets M^2 and M to give to the shaft V a rotation due to the double action of the pawls p^2 and p in sequence, as described, each advancement of the shaft V causing the cords c to be wound thereon and the weight W^3 to be lifted. Consequently the circuit-closing device or wheel W has been now advanced until the free end of the contact-spring t' is in electrical connection with one of the contact-teeth x, so that while the contact-spring t^2 of the transmitter is passing over the space between the first and the second set of contacts 2 and the circuit to relay R is broken the current of battery B′ A′ will be passing through the magnet M only in the direction of the tailed arrows, thus giving to the shaft V a forward movement after the magnet M has fully overcome the retarding influence of the escapement mechanism, the magnet M^2 having been shunted from the circuit, the current having taken, as already described, the short path, by way of wire w^3, contact-spring t', circuit-closing wheel or device W, wire w', armature-lever a', through magnet M. In other words, whenever the contact-spring t' is resting upon one of the teeth x of the wheel W and the local circuit of battery B′ A′ is broken at the relay contact-points the magnet M^2 will be shunted out of circuit and the magnet M will impart to the shaft V a single forward step when the contact-spring t^2 of the transmitter is at any point between any of the sets of transmitting- teeth 1, 2, 3, 4, and 1 on its circumference, and when the local circuit is broken at the relay-contacts two forward steps will be imparted to the circuit-closing device W, provided the interval of time is sufficient to permit both of the armatures a^2 and a to be actuated successively, this interval being dependent upon the transmitter solely. It will thus be seen that for every positive impulse transmitted from the battery B A through the relay R the local magnet M′ is actuated, and that so long as the pin m is caused to strike upon one of the teeth of the flange f there will be a continuous forward motion imparted to the circuit-closing device W, and this will continue as long as there is a fixed relation between the contacts of the transmitter T, the corresponding teeth x, and notched flange f. If the proper sequence of impulses and breaks occur, the circuit-closing device W will ultimately be rotated until the pin p^4 comes in contact with the spring t, thereby closing the local circuit from the battery B′ A′ to the bell or signal call apparatus B M as follows: by the wire w, binding-post B, wire w^3, contact-spring t', one of the long contact-teeth x', upon which it will rest when the pin p^4 is rotated to the position named, thence through the wheel W, pin p^4, contact-spring t, wire w^2, binding-post B^3, bell or signal magnets B M, wire w^2, back to battery, thus indicating to the operator or subscriber that he is wanted. Should any order of impulses be transmitted to line other than that designed to operate the particular receiving apparatus at some time during the forward progress of the wheel W or circuit-closing device, the pin m on the armature-lever a' would be drawn forward through one of the notches in the flange f, thereby permitting the pin p^6, carried at the outer end of the armature-lever a', to impart a forward motion to the arm k, carried by the rock-shaft n, and in turn causing the releasing devices or rods $l\ l'$ to release the pawls $p\ p^2$ from the ratchet-wheels R^2 R^3, thus permitting the weight W^3 to descend and suddenly rotate the circuit-closing device or wheel W in a reverse direction until the stop p^4 rests against the fixed stop p^3. Each time, therefore, that the pin or finger m passes through one of the notches in the flange f the circuit-closing device or wheel W will be automatically and instantly returned to its starting-point.

I will now describe the operation of the answer-back signal illustrated in Fig. 7 of the drawings. This device will only operate in the event of the transmitted signal having been correctly received by the operator or subscriber whom it was intended to call and is arranged directly in the main or signaling circuit L, so that after the signal has been transmitted to the particular subscriber or operator wanted a return signal indicating that fact will be received by the operator who sent out the call. The circuit-closing device or wheel W is the same as in the other figures of the drawings and is shown as having been advanced almost to the completion of its phase through the agency of the transmitter in the manner already described. When this phase is completed and the pin p^4 rests upon the spring t, with the spring t' upon the tooth x', a circuit is closed from the local battery B′ A′ as follows: by the wire w, binding-post B, wire w^3, contact-spring t', tooth x', wheel W, pin p^4, spring t, wire w^2, binding-post B^3, wire w^4, magnet M^3, wire w^4, back to battery. This causes the armature a^3 of the magnet M^3 to be drawn downward and to release the end of the escapement-pallet d' from its bearing against the pin g, thereby permitting the mechanism in the signal-box N^3 to impart motion to the handle H in the direction of the arrow and to the signal-disk T^2 in the direction of a second arrow, causing the circuit to be interrupted a

definite number of times, as will be clearly understood, the bar H^2 in the meantime passing over the pin p^5, thus holding the armature-lever a^3 in its lower position, so that, although the circuit may be interrupted between the pin p^4 and spring t by the restoring device after the magnet M^3 is demagnetized, the mechanism of the signal-box N^3 will be permitted to rotate the signal-disk T^2 through its complete phase and carry the curved end of the arm H^2 forward until the spring R′ is forced into electrical contact with the fixed contact i, thereby permanently closing the bell or signal-circuit through the signaling-magnets B M, conductors w^2, w, and w^4, and causing the signal-bell to be rung until the attendant restores the answer-back mechanism to its normal or locked position, as now shown. When it is desired to call up all of the subscribers or operators, the switch S′ is placed in connection with the universal transmitter T′, and after the unisoning impulses have been sent in the manner already described, the several contacts on the transmitter being arranged in regular order or regularly spaced, there being eleven such contacts, equal in number to the sum-total of all of the operating-contacts in each one of the transmitters as this transmitter rotates from right to left, there will be sent to line eleven equally-spaced impulses, and inasmuch as all of the circuit-closing wheels or devices W embrace contacts x, so spaced and provided with notches or teeth correspondingly spaced with relation to the individual transmitters, all of these signal-receivers will pass completely through their phases for the eleven equally-spaced impulses, so that all of the signal-receiving apparatus at all the stations will respond to this single transmitter.

I do not limit myself to the specific mechanism herein shown and described for accomplishing the results attained. I believe it is broadly new with me to cause a movable circuit-closing device to be positively advanced step by step and to simultaneously store up energy for restoring it instantly to its original position when released, either at the end of its phase or at various intermediate points, one portion of the step-by-step mechanism being operatively connected with a retarding mechanism, which prevents it from acting for simple current impulses, and my claims in this particular are of such generic scope as to include, broadly, mechanism for accomplishing this result. I believe it is also broadly new with me to provide an answer-back signaling apparatus for each individual receiving-instrument, which answer-back signaling-instrument will respond only when that particular receiver has been actuated, said answer-back apparatus, however, being located directly in the main circuit, so that it actually breaks or interrupts the main circuit through all of the relays in the line.

I am aware that answer-back mechanism is old in connection with fire and analogous signaling systems adapted to respond to special signals sent over a telegraph-line, and also that it is old to combine an answer-back signal with individual-call mechanism, the answer-back apparatus being located in a derived circuit around the signal-receiving instruments.

I am also aware that an individual-call apparatus has heretofore been devised in which a movable circuit-closing device is advanced through its phase to operate a signal-receiver through the agency of two electro-magnets, one of which operates for simple current impulses and the other for currents of abnormal length, both of which act to store up energy for returning the circuit-closing device to its normal position, either at the end of its phase or at intermediate points through the agency of a third electro-magnet. In the aforesaid apparatus, however, two local batteries are used and the apparatus is made dependent upon the transmission of what is known as "dot" and "dash" impulses, while my apparatus is made to depend for its operation wholly upon the transmission of "dot" impulses of equal length, and the second of the two propelling-magnets is operated only for a prolonged break in the transmitting-circuit, and my claims hereinafter made are not designed to cover or include any apparatus which is operated other than by current impulses of substantially the same length, it being one of the essential features of my invention that I avoid the evil effects of currents of the aforesaid variable nature.

I believe it is novel with me to provide a universal transmitter for a series of individual signal-receiving apparatus each responsive only to its own transmitter, but all responsive to the aforesaid universal transmitter, and to the combination of said universal transmitter with a series of individual transmitters and individual receiving apparatus, each adapted to respond only to its own transmitter or the universal transmitter, and my claims in this particular are designed to be of such scope as to include receivers which may be actuated each individually by a prearranged code with a Morse key.

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

1. An individual-call apparatus having a movable circuit-closing device operatively connected with the armatures of two electro-magnets, adapted each to give to it a forward step-by-step movement, a mechanical retarding device for preventing one of said magnets from acting for simple closures of the signaling-circuit, and a signal-receiver in circuit with the circuit-closing device, one of the propelling electro-magnets acting to advance the circuit-closer for simple current impulses and the other only for abnormal breaks of the circuit, substantially as described.

2. An individual-call apparatus provided with a movable circuit-closing device, an elec-

tro-magnet for controlling the direction of its motion, and two additional electro-magnets for controlling its forward advancement, in combination with a source of energy, as a weight, for returning the circuit-closing device to normal position, one of the propelling electro-magnets having its armature attached to a retarding mechanism, which permits said armature to impart to the circuit-closing device a forward motion only on an abnormal break of the current, substantially as described.

3. An individual-call apparatus provided with a movable circuit-closing device operatively connected with a local signaling-instrument and electro-magnetic means for giving to said circuit-closing device positive forward motion and simultaneously storing-up energy for moving it in the reverse direction, and additional electro-magnetic means for releasing it at the end of its journey or at intermediate points, and thereby allowing it to be returned to normal position, the operating electro-magnets and signaling-instrument being controlled by a single local battery, substantially as described.

4. An individual-call apparatus having a movable circuit-closing device electrically connected to a local signal or alarm mechanism, electro-magnetic step-by-step apparatus adapted to give to the circuit-closing device a positive step-by-step advancement, a source of energy operatively connected to the circuit-closing device and adapted to be brought into play as the latter advances, an additional electro-magnet, and intermediate mechanism which releases the step-by-step mechanism at the end of its phase or at intermediate points and permits the circuit-closing device to be restored to normal position, all of the local connections being through a single local battery, substantially as described.

5. An individual-call apparatus provided with a movable circuit-closing device operatively connected to a local signal mechanism, electro-magnetic means for giving to the circuit-closing device forward advancement either one or two steps, as desired, and additional electro-magnetic means for controlling the application of the first-named electro-magnetic means, all of the electro-magnets and the local signaling mechanism being under the control of a single local battery, substantially as described.

6. An individual-call apparatus provided with a local signal or alarm mechanism, a movable circuit-closing device connected through a local battery with said alarm mechanism, two electro-magnets having ratchet-and-pawl mechanism adapted to give to the circuit-closing device forward advancement, and a third or controlling electro-magnet having mechanical and electrical connections, whereby the circuit-closing device is positively advanced step by step, one of the propelling electro-magnets having retarding mechanism operatively connected with its armature-lever for preventing the advancement of the circuit-closing device for simple current impulses and permitting it to act only on abnormal ruptures of the circuit, substantially as described.

7. The described electro-magnetic means for giving forward advancement to a circuit-closing device, consisting of two electro-magnets electrically united in one circuit and having armatures provided with pawls adapted to act upon ratchet-wheels carried by the same shaft which carries the circuit-closing device, one of said armatures being connected to an escapement-retarding mechanism, whereby either one or two steps may be imparted to the ratchet-wheels either for a single electrical impulse or an abnormal break, substantially as described.

8. A step-by-step mechanism consisting of a rotary shaft carrying a pair of ratchet-wheels, two electro-magnets provided with armature-levers, which carry pawls adapted to actuate said ratchet-wheels, one of said armature-levers being connected to a mechanical retarding device, and both magnets being included in a single circuit, whereby the circuit-closing device is advanced either by current impulses or abnormal breaks, substantially as described.

9. In an individual-call system, a transmitter adapted to transmit a prearranged order of electrical impulses followed by spaced breaks, in combination with an electro-magnet adapted to respond to said impulses and a pair of electro-magnets which respond only for the breaks, the armatures thereof being operatively connected to a movable circuit-closer and adapted to impart to it a positive forward motion of either one or two steps at each break dependent upon the length thereof, all of said magnets being controlled by the same local battery, substantially as described.

10. In an individual-call system, a transmitter adapted to transmit a prearranged code in the nature of makes and breaks in an electrical circuit, including a relay-magnet, a local electro-magnet included in a local circuit controlled by said relay, and a pair of electro-magnets operatively connected to the same local circuit through step-by-step mechanism with a movable circuit-closer and electrically connected through contacts with the armature of the first-named magnet, in combination with a retarding device for the armature of one of said electro-magnets, and a source of power, as a weight, connected to the shaft which carries the circuit-closer, substantially as described.

11. In an individual-call system, one or more main-line relays located in a single main line, local electro-magnets, one for each relay, a pair of electro-magnets having electrical-circuit connections through the armature of the first-named local electro-magnet and mechanical and electrical connections between all of said electro-magnets, and a movable circuit-closing device operatively connected to a local

signaling-instrument, all of the local electro-magnets being controlled by a single local battery, substantially as described.

12. In an individual-call system, a local alarm apparatus or signaling-instrument at each of a series of stations, provided with mechanism adapted to actuate it, in combination with a series of individual transmitters adapted to actuate each its own signaling-instrument only, and an additional transmitter provided with a series of make-and-break contacts adapted to actuate all of said alarm or signaling instruments simultaneously, the transmitters and receivers being operatively connected in a single circuit and the additional transmitter normally out of circuit therewith, substantially as described.

13. In an individual-call system, a series of alarm or signaling instruments located one at each of a series of outlying stations connected by a single electrical circuit, a movable circuit-closing device operatively connected with each alarm-signaling instrument, and mechanism for causing it to complete a local circuit through the signaling or alarm mechanism, in combination with a multiple transmitter provided with a transmitting-disk for each alarm mechanism, and an additional transmitting-disk having a series of make-and-break contacts adapted to cause all of the alarm mechanisms to be actuated simultaneously, substantially as described.

14. A signal-receiving instrument responsive only to a prearranged call, in combination with an answer-back signaling-transmitter operatively connected with the receiving-instrument and located directly in the main line, and circuit connections whereby the receiving-instrument is actuated to the completion of its phase, after which an answer-back or return signal is automatically transmitted to the transmitting-station, substantially as described.

15. In an individual-call system, an alarm mechanism or signal-receiving apparatus located one at each of a series of outlying stations and each responsive only to a prearranged call or signal, in combination with an answer-back signaling mechanism located at each station directly in the main line and adapted to automatically transmit a signal over the line after the alarm mechanism has been actuated, thereby indicating to the transmitting operator that his signal has been correctly received, substantially as described.

16. In an individual-call system, a signal-receiving instrument or alarm mechanism located in a normally-open local circuit, electro-magnetic means adapted to close said local circuit for a prearranged call or signal, in combination with an answer-back transmitting-instrument controlled by the same local circuit, but located directly in the main line, and adapted to automatically indicate to the transmitting operator that his signal has been received, substantially as described.

17. In an individual-call system, a series of relays located in the main line, a series of movable circuit-closing devices provided with electro-magnetic means for causing them to close local circuits through alarm mechanism, and an answer-back signaling mechanism for each relay, provided with an electro-magnet for bringing it into operation, the transmitter of each answer-back mechanism being located directly in the main circuit, substantially as described.

18. In an individual-call system, a series of relays located in a main line, an individual-call apparatus for each relay, a movable circuit-closing device operatively connected in a local circuit with each call apparatus, electro-magnetic means for advancing the circuit-closing devices through their complete or operative phases, and an answer-back signal for each call apparatus, located directly in the main-line circuit and operatively connected through a local circuit with the circuit-closing device, whereby as each individual call is received its answer-back signaling mechanism automatically indicates the fact by transmitting a return signal, substantially as described.

19. In an individual-call apparatus, the combination of the following elements: a movable circuit-closing device carried by a rotary shaft, which carries, also, a weight suspended by a cord and a pair of ratchet-wheels, an electro-magnet provided with an armature having circuit connections through two additional electro-magnets, each provided with an armature and a propelling-pawl and adapted to impart to the rotary shaft forward motion, a releasing device in the nature of a pin on the free end of the first-named armature, and a rock-shaft carrying three arms and adapted to release the pawls from the ratchet-wheels when the first-named armature is drawn through its full stroke.

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Witnesses:
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