No. 668,967.

Patented Feb. 26, 1901.

J. A. BARRETT.

SELECTIVE SIGNALING APPARATUS.

(Application filed Sept. 20, 1900.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.

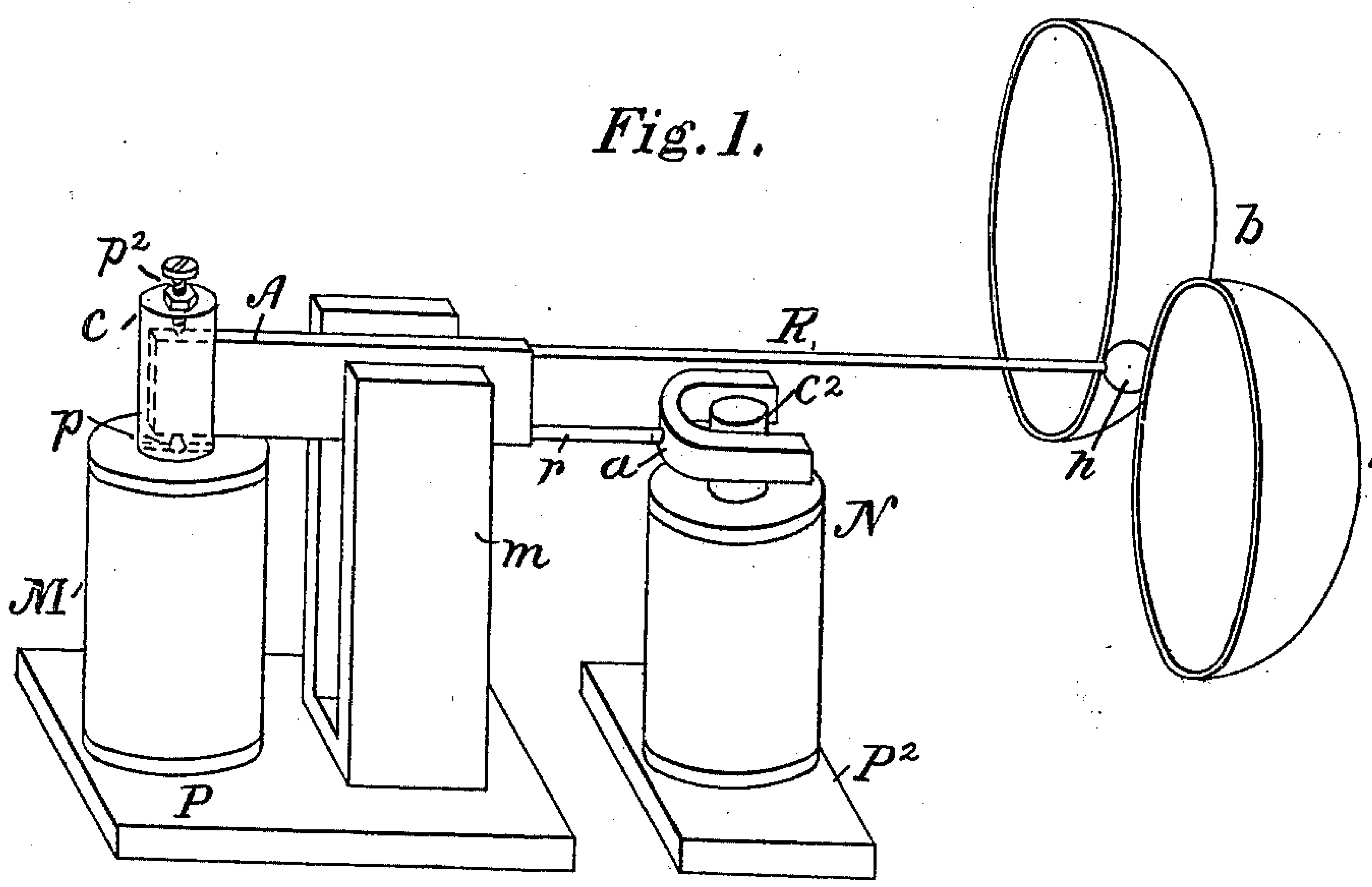
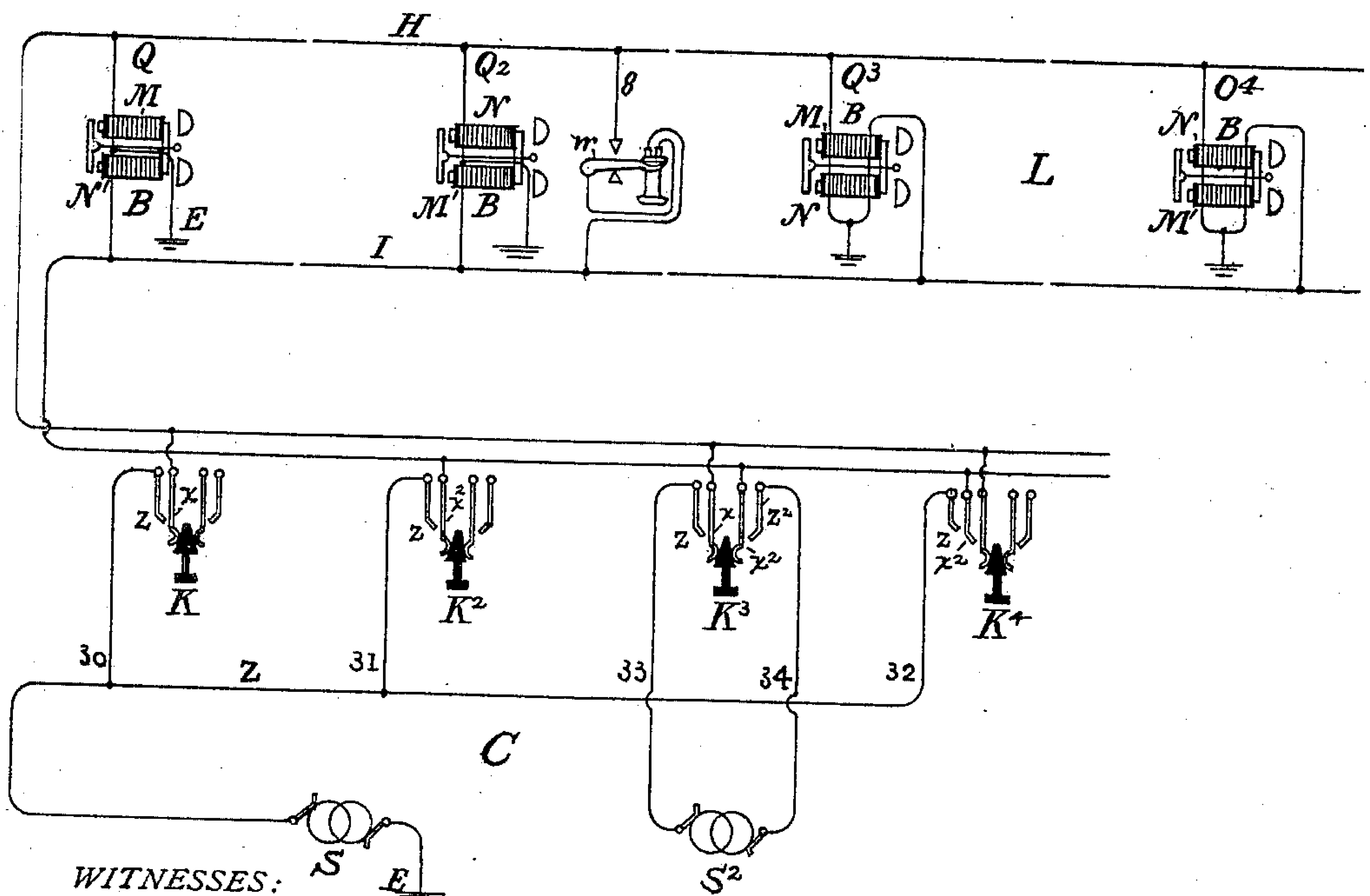


Fig. 2.



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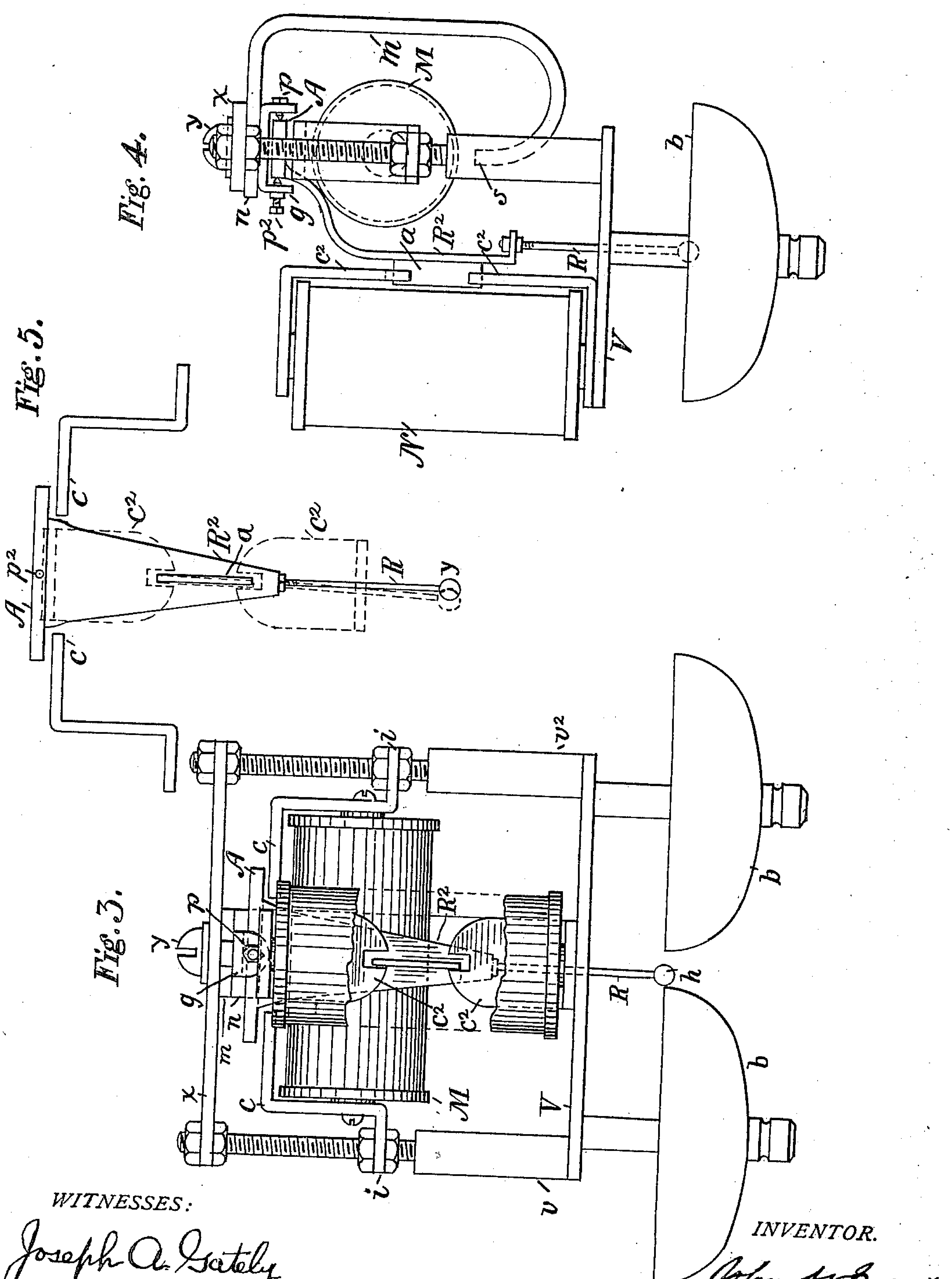

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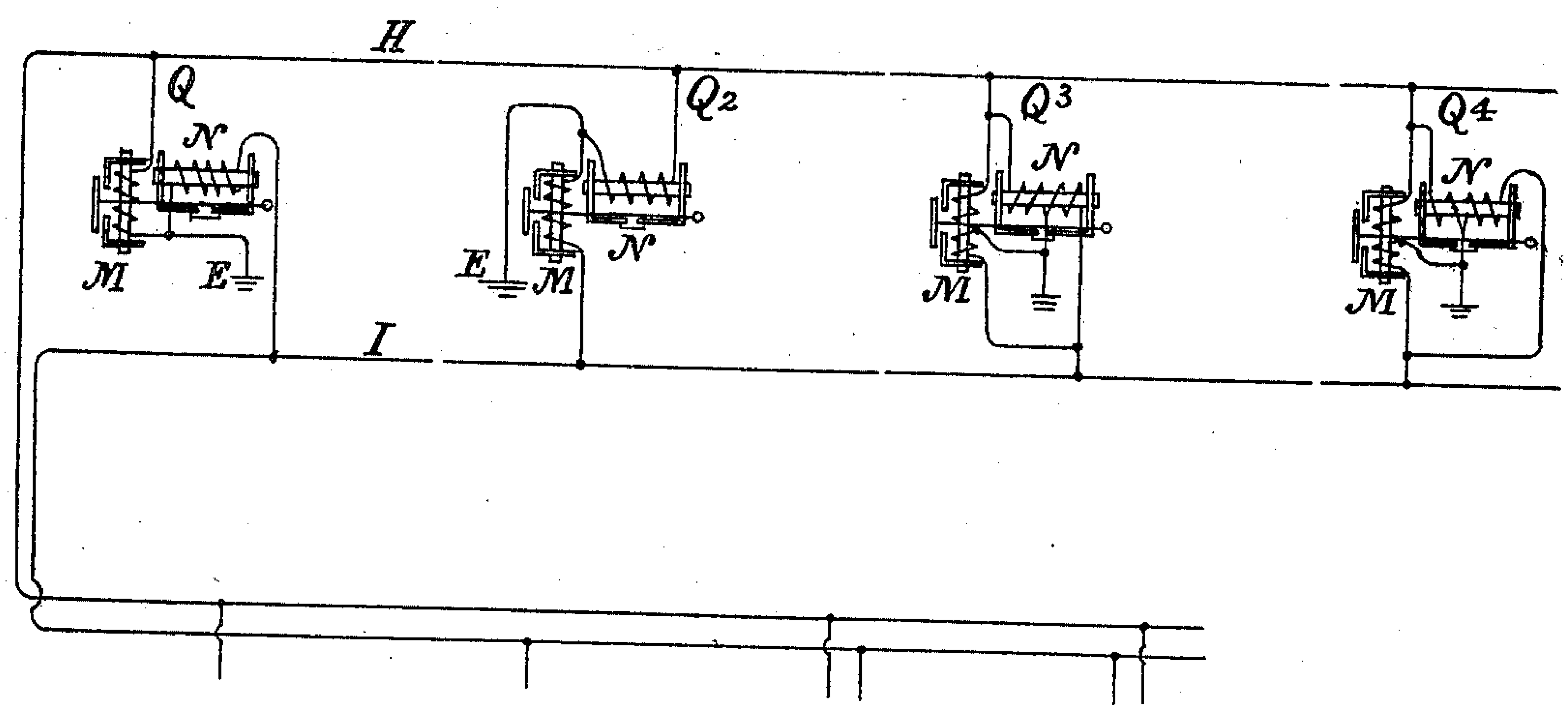
Fig. 6.



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SELECTIVE SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 668,967, dated February 26, 1901.

Application filed September 20, 1900. Serial No. 30,590. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. BARRETT, residing at Summit, in the county of Union and State of New Jersey, have invented certain Improvements in Selective Signaling Apparatus, of which the following is a specification.

This invention relates to the selective operation of the several call-bells of a polystation telephone-circuit extending outward from a central station to a plurality of substations, and more particularly concerns selective bells to be operated by alternating currents on main circuits extending between a central and four sub stations.

The object of the invention is to provide a system of telephone-station bells perfectly adapted for selective operation on a line having four substations, the bells of all of the stations being simple and substantially uniform in structure and having their selectivity determined by differences in the arrangement of their magnet-windings, in the mode of connecting the said windings with the main circuit, and in the mode of transmitting the ringing-current through the main circuit. In the attainment of this object I provide for each bell apparatus two electromagnets, both having armatures attached to the bell-hammer, one of the said magnets being arranged to operate the said bell-hammer, while the other is arranged under certain conditions to maintain the quiescence thereof. The first of these may be termed the "ringing" magnet and the second the "retaining" or "locking" magnet. The ringing-magnet or its armature is polarized; but the retaining-magnet and its armature are both neutral or non-polarized. When these two electromagnets are wound with an equal number of turns to an equal resistance, and alternating currents, such as are used in magneto-bell ringing, are passed simultaneously through the windings of both, either in series or multiple, the retaining power of the locking-magnet is greater than the motive power of the ringing-magnet and no movement of the armature of the latter occurs. From this experimental fact I deduce the following four corollaries: The bell will ring with alternating currents in the ringing-magnet only. The bell will not ring with similar currents in the retaining-magnet only. The bell will not ring with similar currents in both ringing and retaining magnets when arranged in series. The bell will not ring with similar currents in both ringing and retaining magnets when arranged in parallel.

In the drawings which accompany this specification, Figure 1 is a perspective view of an electromagnetic bell exemplifying the essential principles of my invention. Fig. 2 is a diagram representing conventionally a telephone-exchange circuit extending from a central station to four substations and provided at each of the said substations with selective bells containing the invention. Fig. 3 is a top or plan view of a practical form of my electromagnetic selective bell. Fig. 4 is a side elevation of the same. Fig. 5 is a detail view of the pole-pieces and armatures of the ringing and retaining magnets. Fig. 6 is a diagrammatic view of the circuit arrangements at the substations, showing particularly the winding of the electromagnets.

Referring now to Fig. 1, M is the ringing-electromagnet, and its core *c* is attached at its lower end to the iron plate P, which thus constitutes a portion of the magnetic circuit. The upper end of the said core is extended beyond the spool and is slotted or forked vertically. A is a soft-iron armature having one end within the slot of said magnet-pole and hung on pivots $p\ p^2$ in a vertical plane, so that its other end is capable of a lateral motion only. To the free end of the armature the rod R, carrying the bell-hammer *h*, is secured, the said bell-hammer being, as shown, mounted between the gongs or bells *b b*. A permanent **U**-magnet *m* is fastened to the iron base-plate P, and its limbs extend upwardly, one at each side of the armature A. This appliance so far as it has been described thus constitutes a simply-constructed polarized electromagnetic bell which I have found highly efficient and satisfactory in operation. If alternating currents are caused to traverse the winding of the electromagnet M, a corresponding lateral vibration or oscillation between the poles of the permanent magnet *m* will be imparted to the free end of the pivoted armature A, and such oscillation being participated in by the bell-hammer the bell is rung. To secure the selectivity of such a bell, I associate with it a second electromagnet N and its U-shaped armature a. The electromagnet N is fastened by the lower end of its core to the plate P^2, which is preferably of soft iron, but separated by an air-space from the larger plate P. The upper end of the core is extended to form the pole-piece c^2. The armature a is rigidly attached by an arm r, of brass or like material, to the armature A in such wise that its two limbs are steadily supported in a position where they bestride the pole-piece c^2. The extent of separation between the limbs of the armature a conforms to the working adjustment of the armature A and is such as to permit the proper oscillatory movement of the latter and to serve as a limiting-stop to such movements in both directions.

When the apparatus is not working, the armature A under the influence of the permanent magnet m rests indifferently on either side, one limb of the armature a, for instance, being pressed against the pole c^2, while the other limb of said armature will be separated from the pole-piece by a space equal to the amount of lateral movement desired and provided for. Under these conditions an electrical current circulating in the windings of the electromagnet N will tend to hold the limb of the armature a in its normal position with respect to the pole-piece c^2, and if the current in the coils of N be strong enough the said magnet N, serving as a locking or retaining magnet, will prevent the operation of the ringing-magnet M, even though an alternating current of otherwise appropriate strength and character were flowing through its winding, as well as through the coils of the magnet N. It thus follows that if four such bell mechanisms are connected with the same circuit any one of the four can be operated to the exclusion of the others by providing that in the bell to be rung the ringing-current shall excite the ringing-magnet only and that in the bells which are not to be rung either the retaining-magnet alone or both magnets shall be excited.

In Figs. 3, 4, and 5 is shown a form of mechanism containing equally with Fig. 1 the elements of my invention, but better adapted structurally for practical use. M is the ringing-magnet, having two pole-pieces c c, and A its polarized armature, pivoted at p p^2 and adapted to oscillate in front of and between the said pole-pieces. The polarizing-magnet m in this form of apparatus is at its pole n screwed into position immediately behind the center of the armature A, and the magnet itself is so bent or curved as to bring its other pole s opposite the middle part of the ringing-magnet M. When thus secured, the magnetic flux from the pole s is across the wire-space of the spool of magnet M to the core thereof and thence in both directions through the said core and the pole-pieces c to the armature A and the other pole n of the polarizing-magnet m. V is a plate, of brass or similar material, forming a base-plate for the entire structure, and extending rearwardly therefrom are two brass posts v v^2, formed into screws at their projecting ends. The reverse or heel ends of the pole-pieces c are turned outward to form the supporting-lugs i i, are perforated so as to slide over the screw ends of the posts v v^2, and are clamped each between two nuts upon the screw-posts. Near the outer ends of the posts v and clamped at each end thereto is the metal yoke x, and an iron angle-piece g supports in its lugs the pivots of the armature A. The screw y passes through a hole in the center of the yoke x and through a slot in the end of the permanent magnet m and screws into the angle-piece g, thus clamping the magnet, yoke, and angle-piece firmly together, and this arrangement forms a combined mounting for the polarizing-magnet and the armature A in such a relation to the ringing-electromagnet M that the said armature A overlaps by its ends the extremities of the pole-pieces c c. A polarized electromagnetic movement simple in structure and of high efficiency, having, moreover, only a single magnet-spool and capable of all necessary adjustments, is thus constituted. The yoke x may be raised or lowered on the posts v, increasing or diminishing, as required, the width of the air-space between the armature A and the pole-pieces c, or the spool of the electromagnet M may be raised or lowered on the screw-posts with the same effect, or one end of the spool of said magnet may be raised or lowered with respect to the other end, producing at will either a balanced or a biased relation between the armature A and the pole-pieces c. The rod or arm R, attached to or actuated by the armature and provided at its other end with the bell-hammer h between the gongs b, completes an advantageous form of polarized ringer. The retaining-electromagnet N, on which are based the selective characteristics of the apparatus, is secured at one end to the front plate V and has two angular pole-pieces c^2 c^2, which, attached by one of their ends to the ends, respectively, of the magnet-core, are bent over the side of the magnet, as best shown in Fig. 4, and are slotted or forked at their extremities, as indicated more particularly in Fig. 3. The said pole-pieces c^2 overlap their magnet-spool on the side facing the ringing mechanism and the slots of the two pole-pieces are in line with each other.

Upon the armature A of the ringing-magnet M is rigidly fixed the bent aluminium mechanical connection or plate R^2, which is projected forwardly and carries the armature a of the retaining-magnet, extending beyond the same and being turned up into a foot for the more convenient attachment of the bell-hammer proper, R. The said retaining-magnet armature forms a magnetic bridge between the pole-pieces c^2, nearly filling up the gap between them. It has a small lateral movement within the slots corresponding to the oscillations of the ringing-armature A, which oscillations in turn, as also the length of the bell-hammer stroke, are limited by the difference between the thickness of the armature a and the width of the slots in the pole-pieces c^2. The blade-armature a of Figs. 3, 4, and 5 is identical in function with the U-shaped armature a of Fig. 1, and, in fact, is the same device.

The apparatus as a whole is responsive to the passage of electrical currents through its coils exactly as is the form of Fig. 1. If alternating ringing-currents are sent through magnet M only, the polarized armature A is thrown into oscillation and the bell is rung; but if the currents are divided equally and simultaneously between the windings of the ringing and the retaining magnet the armature a of the latter is retained at that side of the slots where it initially rests and the bell does not ring. It is to be noted that both slots in the pole-pieces c^2 are of the same width; but from the fact that the slot in one pole-piece is located at a greater radius from the pivot p p^2 of the armature A than the slot in the other pole-piece the armature a actually strikes the sides of the slot only at the end farthest removed from the pivot, a slight gap remaining on either side at the nearer end of the armature. This does not adversely affect the operation of the mechanism and is, in fact, an advantage, since it shows that the said operation is not in any sense dependent on exact adjustments.

A circuit arrangement for a metallic telephone-circuit extending from a central station to four substations and fitted at each with one of my bell mechanisms organized for selective operation, together with corresponding signaling-keys, one for the bell of each substation, adapted, respectively, to transmit the appropriate current over the appropriate conductor combination, is illustrated in Fig. 2. L is the metallic substation telephone-circuit extending between a central station C and a plurality of substations, at each of which are the usual telephones, switches, and call apparatus. In the drawings the telephones and switch apparatus are indicated at one only of the substations—viz., Q^2; but it is to be understood that at all of the stations the telephones are placed and connected as usual. As shown, the telephone is connected in a normally open bridge 8 of the line controlled by the gravity-switch w. H and I are the two main conductors of the circuit. B at each substation indicates the entire bell apparatus. K, K^2, K^3, and K^4 are keys at the central station corresponding to the substation bell mechanisms, respectively. S is a source of alternating call-currents supplying current to the main circuit-conductors when three of the keys are manipulated. S^2 is a second source of like character, whose connection with the said conductors is controlled through a fourth key, and E indicates the several earth connections.

The winding of the electromagnets at the several substations can be best understood from Fig. 6 of the drawings. At station Q the electromagnets M and N each have a single winding, and these are connected with the circuit in such a way that the winding M is placed between the main conductor H and the station earth connection E, and the winding of N is included between the conductor I and the said earth connection. At the second station Q^2 also each of the magnets has but a single winding connected between its main conductors, respectively, and the ground connection. At substation Q^3 both of the magnets M and N have two equal windings, and these are so connected that for currents traversing the metallic circuit outward over one of the main conductors and inward over the other, so that the two conductors are in series, their effect in magnet M coincides or is cumulative and in magnet N is reciprocally or mutually neutralizing, and at station Q^4 each of the two magnets has two equal windings so connected that for currents traversing the main conductors H and I in parallel the effect in magnet M is cumulative or reinforcing and in magnet N is reciprocally neutralizing.

The central sources S and S^2 of calling-current are shown as being alternating-current generators. The source S is grounded at one terminal and united at the other to a bus-conductor Z, having branch conductors 30, 31, and 32, branching, respectively, into the signal-transmitting keys K, K^2, and K^4 and connected in said keys to the terminal contact-springs z. The source S^2 is not grounded, but has both of its poles connected with the key K^3, one pole being united by conductor 33 to the terminal contact-spring z and the other by conductor 34 with the spring z^2. A branch from main conductor H extends to the line contact-spring x in the key K and a similar branch from main conductor I to the contact-spring x^2 in the key K^2, the said springs being each mounted in such relation to the current contact-springs z that when a key is manipulated contact is established between the contact-springs x and z thereof. Branches extend from both main conductors into key K^3 and connect therein with line contact-springs x x^2, and in this case the operation of the key will bring both of the said line-springs into contact with the springs z and z^2, connected with the source S^2. Into key K^4 also there extend branches from both main conductors, and they end in the contact-springs x x^2 of said key. When, however, this key is pressed, both line-terminal springs are brought into electrical connection with the single-source terminal z of the grounded call-generator S. It is now evident that the operation of key K will transmit alternating currents over main conductor H only, that the operation of key K^2

will transmit alternating currents over main conductor I only, that if key K^3 be depressed the source S^2 will be introduced directly into the metallic circuit L and will transmit current over the two main conductors in series, using one as the outgoing and the other as the return conductor, and that the manipulation of key K^4 unites the two main conductors H and I in parallel and connects both to the source S. With structure and circuits thus described if alternating currents are sent as from key K on line H to ground the bell at station Q will be rung, because these currents will pass at that station through the M or ringing magnet only. The currents will pass through the retaining-magnet N only at station Q^2 and through one-half of M and N in series at the third and fourth stations. Consequently the second, third, and fourth bells will not ring with key K. In like manner key K^2, which sends currents on line I to ground, will ring the bell at station Q^2 only. Key No. 3 sends currents across the circuit between line H and line I. These currents will not ring the bells at stations Q and Q^2, because they pass through both magnets in series. They will ring the bell at Q^3, because their effect is cumulative in M and neutralized in N, and they will not ring Q^4, because their effect is neutralized in M. Key K^4 sends currents on line H and line I in parallel to ground. These currents will not ring the bells of stations Q and Q^2, because they pass through M and N in multiple at these stations. They will not ring the bell at station Q^3, because their effect is neutralized in M. They will ring the bell at Q^4, because their effect is cumulative in M and neutralized in N.

It is to be observed, although for the sake of clearness I have shown two sources S and S^2 of alternating current at the central station, that one source only in practice may readily be made to serve and may in accordance with the well-known principles of electrical engineering be associated with all of the keys, the key K^3 being provided with spring or other contacts, whereby the normal ground of the source S may be temporarily severed and the return conductor 34 substituted therefor. These bells up to four stations to the line work efficiently and without special adjustment over a wide range of line resistance, and from the fact that the bells are rung by alternating currents the bells are operative through condensers at the stations, and the system is therefore exceptionally well adapted for use in association with the four station-circuits of a central-battery exchange.

I claim—

1. In a selective signaling system for a four-station telephone-exchange circuit, the combination with the two main conductors of said circuit extending between a central station and the said four substations; a source of alternating current at said central station; and four keys at said central station organized to connect the said source with the said main conductors separately, with both in series, and with both in parallel; of four electromagnetic bell mechanisms corresponding and responsive each to a different one of the said keys, and placed one at each substation, each bell mechanism comprising a polarized ringing-electromagnet having an armature carrying the bell-hammer, and a non-polarized retaining-electromagnet having an armature also attached to said bell-hammer, the two magnets of the several bell mechanisms being diversely connected in relation to the said main conductors in such manner that the circuit of the central source completed by any key shall actively include the winding of the ringing-magnet alone in the bell mechanism corresponding to such key, and the winding of the retaining-magnet in the others; substantially as set forth.

2. A selective electromagnetic bell mechanism for the substations of a polystation telephone-exchange circuit, comprising a polarized actuating-electromagnet, an oscillatory armature therefor, a bell-hammer carried or actuated by said armature, and adapted to strike a gong or other sounding medium, a neutral retaining or locking electromagnet, and an armature therefor associated with the bell-hammer rod; the said two electromagnets having windings and resistance of like magnitudes, and the said bell mechanism being responsive to an alternating electrical current exciting the polarized magnet only, but irresponsive to a similar alternating current exciting both magnets, or the neutral magnet alone; substantially as hereinbefore described.

3. The combination in a selective electromagnetic bell apparatus for the substations of a telephone-exchange circuit, with a polarized bell comprising a polarized actuating or ringing electromagnet with overlapping and approximating pole-pieces, a centrally-pivoted armature therefor, a gong or sounding medium, a bell-hammer carried by a rod and adapted to strike said gong, a rigid mechanical connection uniting the said armature and bell-hammer rod, a polarizing permanent magnet determining opposite normal polarities to said magnet-poles and armature, a supporting-frame for the said magnets and armature, and means for their relative adjustment associated with said frame; of means for rendering the said bell selective, consisting of a non-polarized retaining-electromagnet, having a winding and resistance similar to those of the actuating-magnet, pole-pieces therefor overlapping its side and approaching one another in a plane parallel to that of the bell-hammer and its mechanical connection the said pole-pieces having slots in line with each other in their ends, an armature therefor mounted on the said mechanical connection, having its ends within the said slots, and forming a continuation of the magnetic

circuit of the said slotted pole-pieces; whereby the bell may be rung when the ringing-magnet alone is excited, and maintained quiescent when both magnets or the retaining-magnet alone is excited; substantially as and for the purposes specified.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 4th day of September, 1900.

JOHN A. BARRETT.

Witnesses:
GEO. WILLIS PIERCE,
JOSEPH A. GATELY.