3 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.

Telephone Switch.

No. 237,222. Patented Feb. 1, 1881.

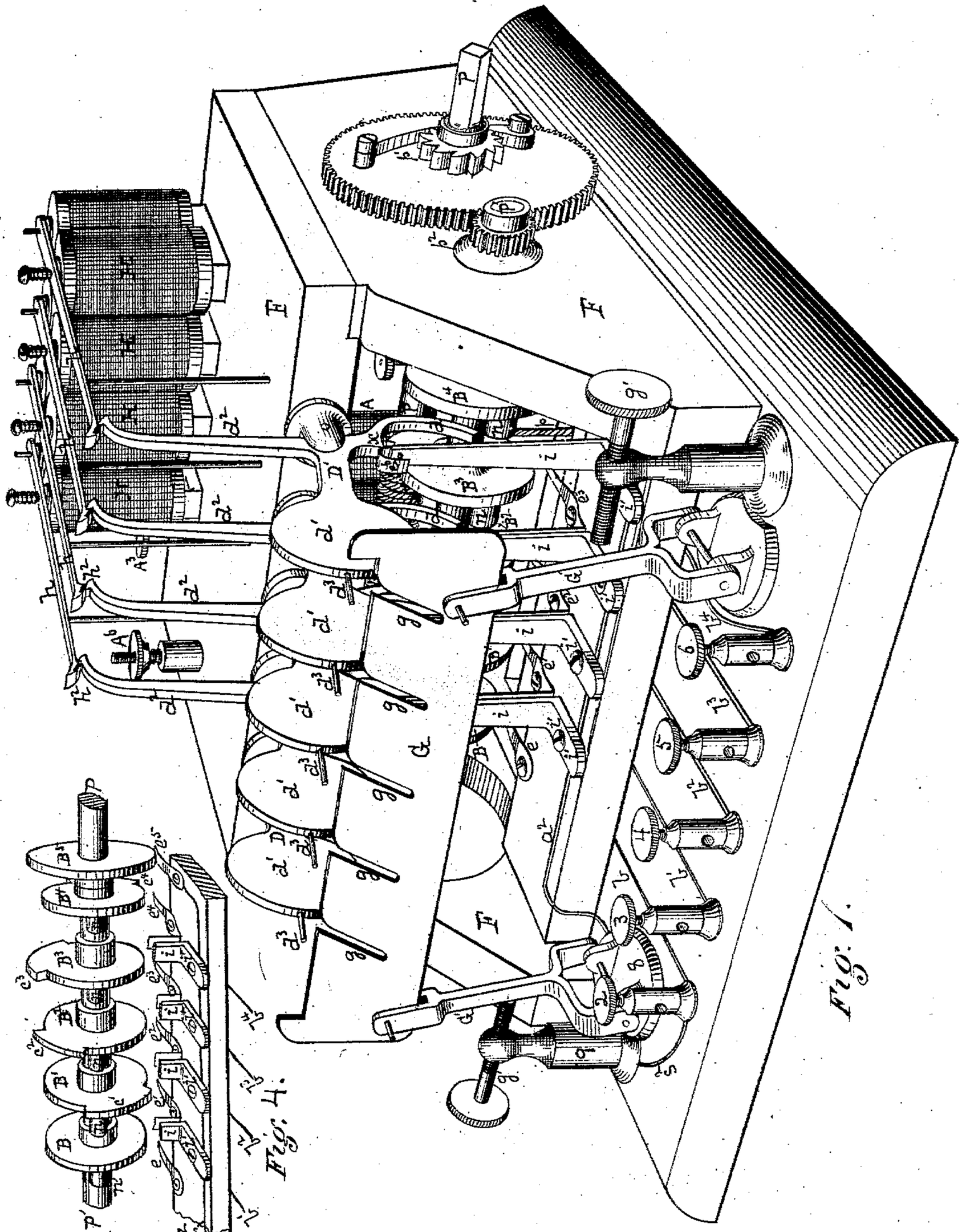

Fig: 1.

Fig: 4.

Witnesses
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By Attorney George H. Christy

3 Sheets—Sheet 2.

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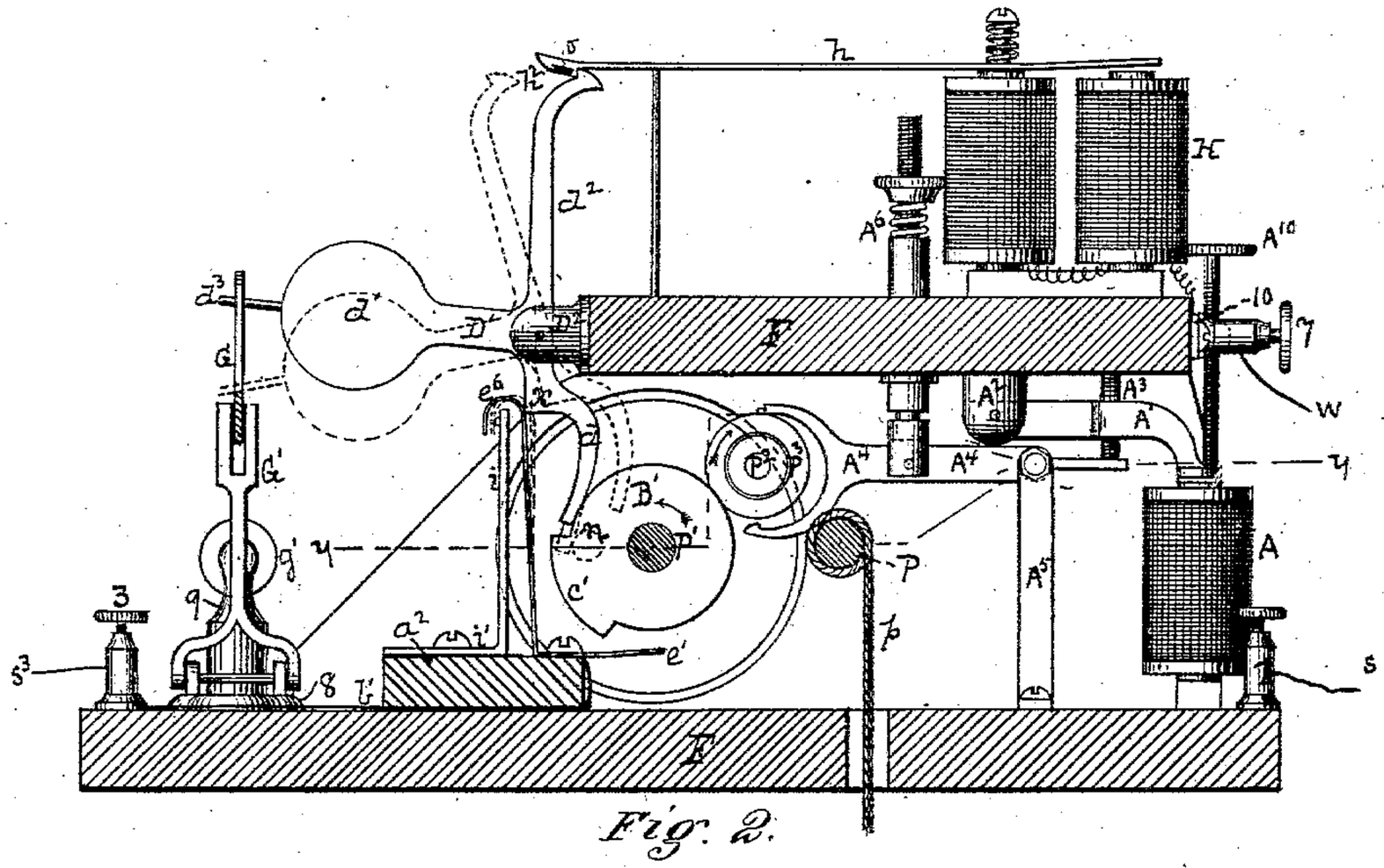

Fig. 2.

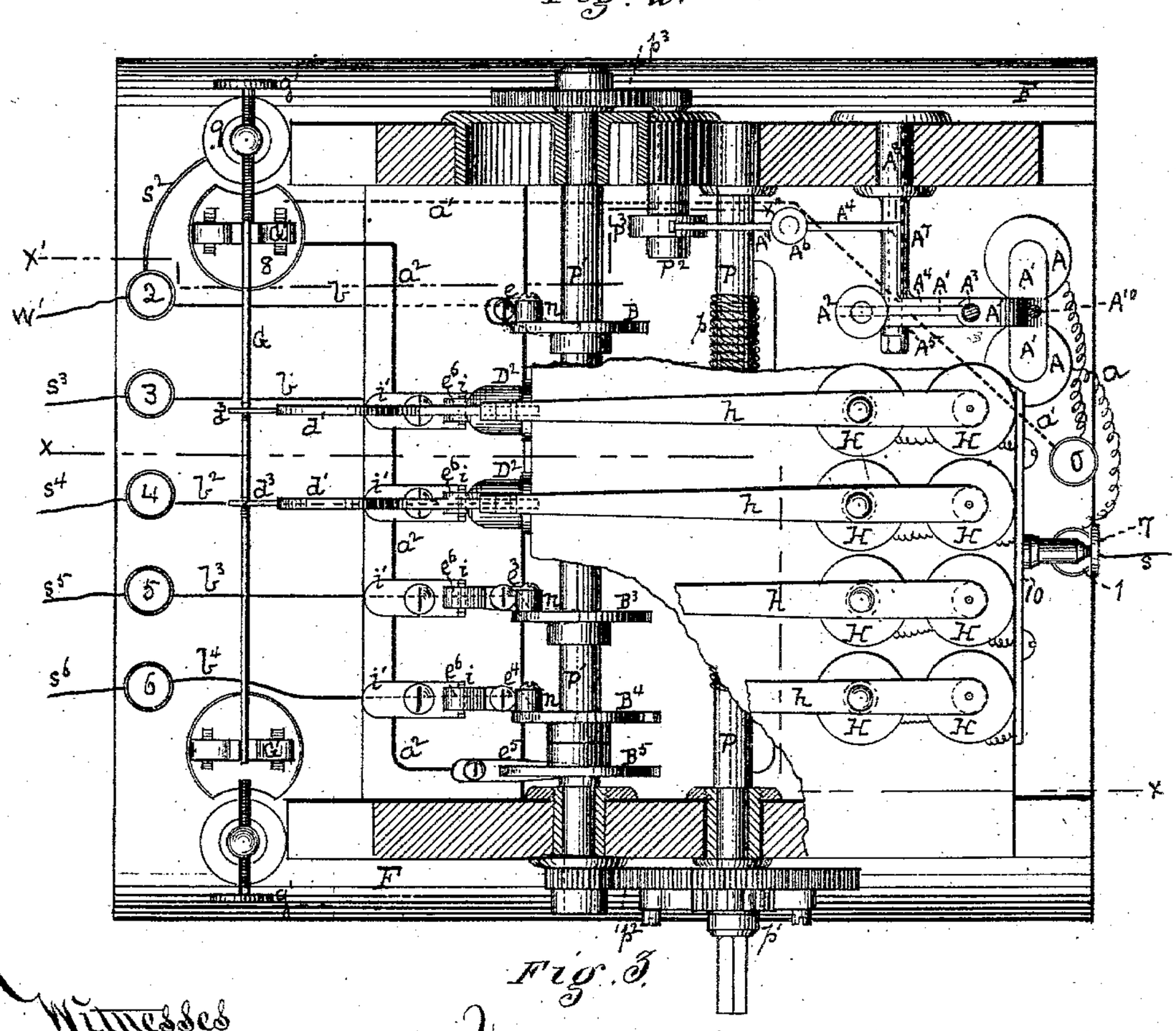

Fig. 3.

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3 Sheets—Sheet 3.

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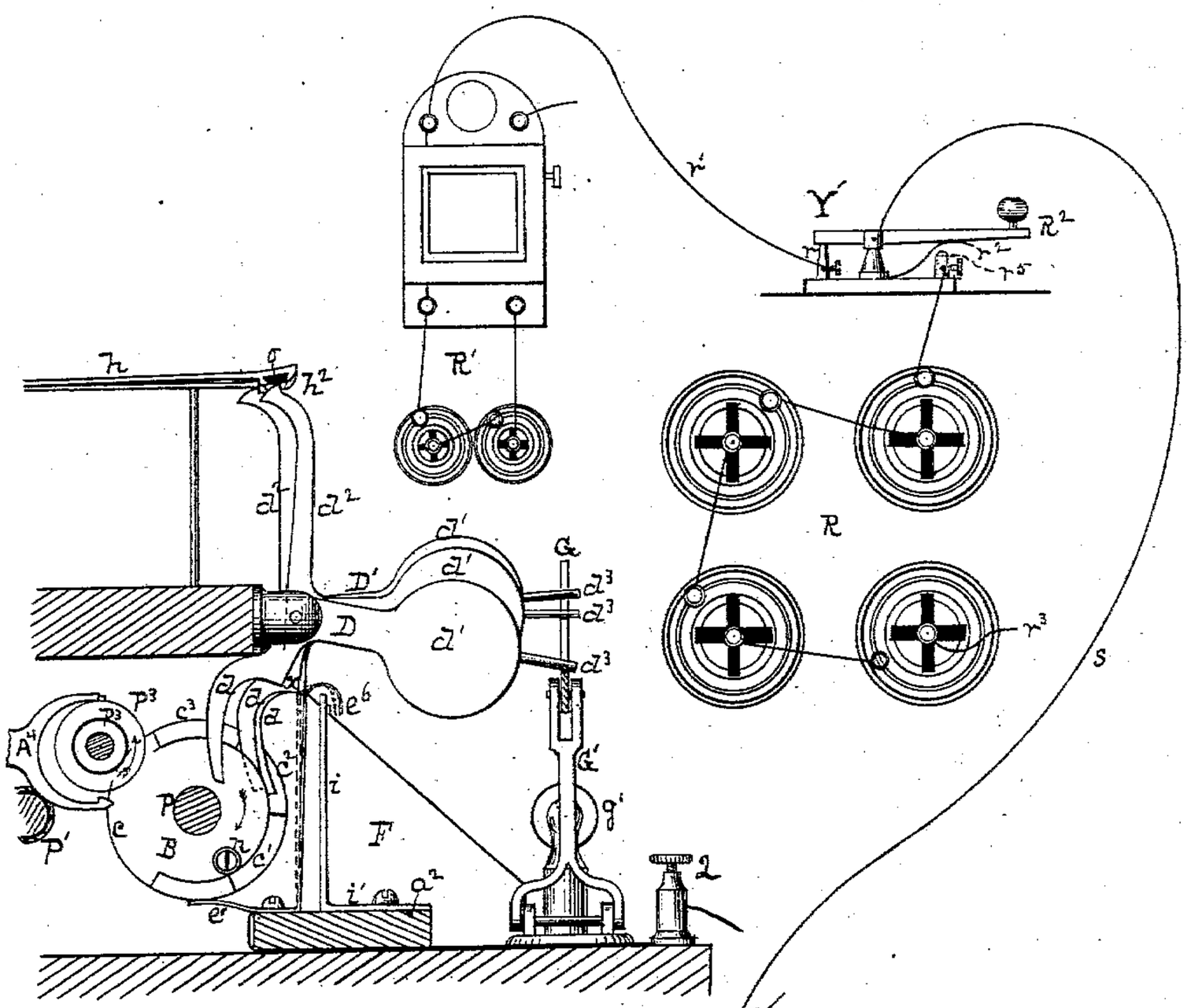


Fig. 5.

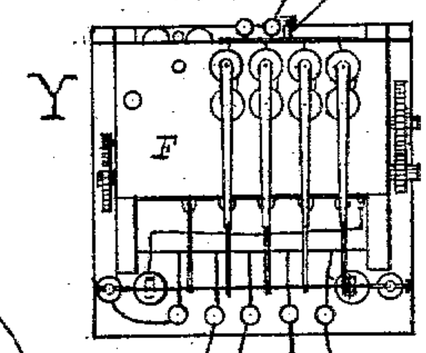
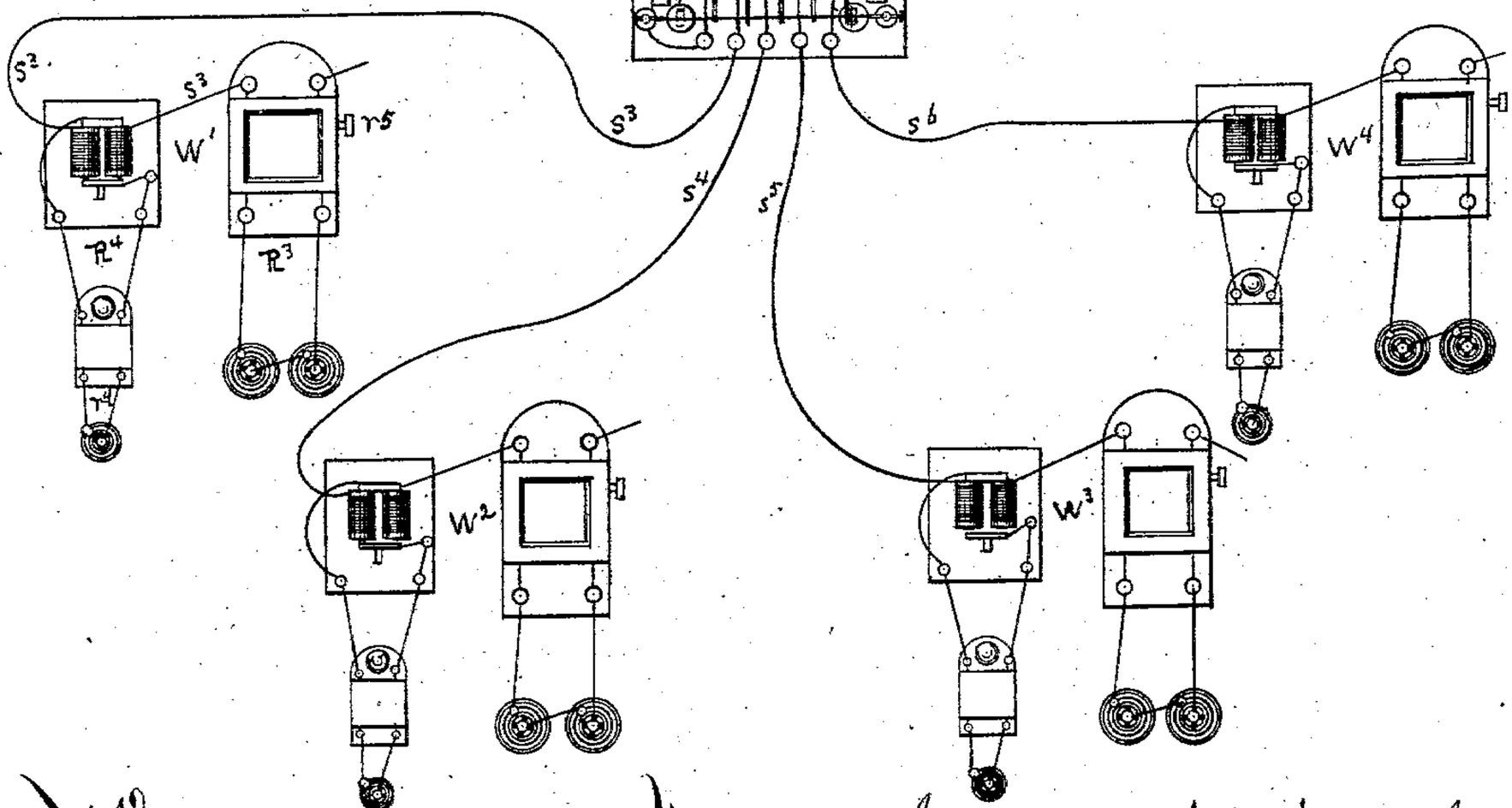


Fig. 6.



Witnesses.
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C. L. Parker

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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

TELEPHONE-SWITCH.

SPECIFICATION forming part of Letters Patent No. 237,222, dated February 1, 1881.

Application filed February 7, 1880.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Telephone-Switches; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1, Sheet 1, is a view, in perspective, of a telephone-switch apparatus illustrative of part of my present invention. Fig. 4 (on the same sheet) is a detached view, in perspective (but to a reduced scale) of the disks, contact-pieces, &c., and more particularly designed to illustrate the relationship to each other of the projections on the disks by means of which successive circuits are made and broken. Fig. 2, Sheet 2, is a transverse vertical section of the apparatus of Fig. 1 in the plane of the line *x x* of Fig. 3. Fig. 3 is partly a top or plan view of the same apparatus and partly a section in the line *y y* of Fig. 2. Fig. 5, Sheet 3, is a sectional elevation in the plane of the line *x' x'* of Fig. 3; and Fig. 6 illustrates, by outline diagram, the manner of embodying my present improvements into a telephone system.

In general terms, the apparatus embodying the present invention may be said to consist of a union or consolidation of the main elements of utility embraced in patents granted to me December 30, 1879, Nos. 223,201 and 223,202, together with the addition of certain features which go to perfect the union. The system of apparatus to which said patents relate, and to which the present improvement also relates, involves a main or central station or exchange, such substantially as is common in city telephonic systems, an outlying or auxiliary station or exchange, where the wires of two or more local users can conveniently and advantageously be brought together, and the apparatus so constructed and combined that the operator at the central exchange is subject to call from any one of the local users, and can also call one or more local users, and also can put any two local users in telephonic communication with each other, all the other users being then locked out. In my present invention I provide for the doing of this work by the use of a single wire, which I term the "main-line wire," between the central and the auxiliary exchanges; also, in the present apparatus I use, by preference, only a single battery, but that of considerable power, at the central station, by which to operate the auxiliary apparatus, and also make calls and hold conversation.

In the drawings, F represents any suitable frame-work, made of non-conducting material. This frame-work, with the appliances belonging thereto, is to be arranged at the auxiliary exchange Y, Fig. 6. The main-line wire *s*, which leads from the central exchange, Y, Fig. 6, is secured to the binding-post 1, Figs. 2 and 3. From this post a wire, *a*, leads through the magnet A to the binding-post O, and a wire, *a'*, leads thence (under the machine for convenience) to a metallic plate, 8. Wires s^3, s^4, s^5, and s^6 lead one from each local user to the binding-posts 3, 4, 5, and 6, respectively. Posts 2 and 7 are for ground-connections; also, post 2 has a wire connection, s^2, with a metallic post, 9, the function of which will be presently explained.

In the frame-work are two rotating shafts, P and P', one of which, P, has a cord and weight, *p*, for effecting its rotation, and a clock-work mechanism, *p'*, for winding it up. On a shaft, P^2, is an escapement-wheel, P^3, which operates in connection with the escapement-arms shown on the end of the lever A^4, by which to permit, as may be desired, the proper movement, step by step, of the shaft P'. The escapement-shaft is geared, as at p^3, to the shaft P', and P is also geared to P' by gearing, as at p^2. As the teeth and catches of the escapement go out of engagement with each other, the shaft P' is unlocked and the weight on the cord *p*, acting through gearing p^2, effects the rotation of P'; but as the teeth and catches of the escapement again engage they arrest the rotation of the shaft P^2, and consequently of the shafts P and P'. This escapement is operated from the magnet A by means of an armature, A', pivoted to a bracket, A^2. A set-screw, A^3, passes through the stem of this armature and bears on the free end of the escapement-lever A^4, which is pivoted to

a post, A^5, and its motion is regulated by a spring temper-screw, A^6. A set-screw, A^{10}, limits the upward motion of the armature A'. For convenience I have shown the lever A^4 as angular or crooked, Fig. 3, and it is fulcrumed by a tubular socket, A^7, on a bearing or shaft supported at one end, A^8, in the frame, and at the other end by the post A^5. The form of the lever, however, is not material.

On the shaft P', I arrange a series of disks, B B' B^2 B^3 B^4 B^5. The last of these disks, B^5, has a cylindrical periphery, and on each of the others is a projection, c c' c^2 c^3 c^4, Figs. 4 and 5, the function of which will be presently explained.

Under or opposite each disk is a contact-piece, preferably having a slight spring action, the same being lettered e e' e^2 e^3 e^4 e^5. The first contact-piece is connected by a wire, b, with post 2, and the successive posts 3 6, by like wires b' b^4, are connected with contact-pieces e' e^4 in order. Also, opposite the disks B' B^4, I arrange a series of switch-posts, i, one to each disk. The tail end of each corresponding contact-piece e' e^4 is carried up and over the end of its switch-post in a hook shape, as shown at e^6, Figs. 2 and 5, so as to form a series of switch-springs. This hook shape is such and the spring action is such that the escapement-levers D', presently to be described, when in one position, will be in electrical contact with the corresponding switch-springs, and the latter will be clear of the switch-posts, as shown in Fig. 2 by full lines; but when in their other position such contact will be broken and the switch-springs will come into electrical contact with the switch-posts, as shown by dotted lines in the same figure.

At D', I have shown a series of escapement locking and unlocking levers, corresponding in number with the local users, and arranged one opposite each revolving disk and switch-post. D is simply a locking and unlooking lever, and has a weighted locking-arm, d', and an unlocking-arm, d. Each of the levers D' has a like unlocking-arm, d, and a weighted locking-arm, d', and a hook-ended escapement-arm, d^2. The weighted locking-arms d' operate, by projecting pins d^3, on or in the slots g of a non-conducting locking-bar, G, in the manner substantially as described in Patent No. 223,201, above referred to. The hooks on the ends of the escapement-arms d^2 engage counter-hooks on the ends of armature-levers h. Each such lever is pivoted on and makes electrical communication with the adjacent arm of the core of a magnet, H, and the end of the lever over the other arm of the magnet has sufficient range of motion to be raised and depressed far enough for the hooks at h^2 to be engaged and disengaged thereby. These magnets, &c., correspond in number with the local users, and the ground-connection is made from them by carrying their ground-wires to a metallic plate, 10, in which is mounted the ground-wire post 7, from which a wire, w, Fig. 2, leads to the ground. The unlocking-arms d are thrown forward by means of wrists or projections n, one on each of the rotating disks B B^4, and each such arm has a shoulder, knob, or projection, x, through which contact is made or broken with the switch-springs e^6.

The locking-bar G is mounted in pivoted supports G', and its range of motion is limited, as may be desired, by means of set-screws g'. One of these supports, made of metal, is pivoted on the plate 8, so as at all times to be in electrical communication therewith, and when the apparatus is in its normal or zero position that support G' and its plate 8 are in electrical communication, by the metallic set-screw, with the post 9.

To complete the wire connections in this apparatus a wire, a^2, is run from the plate 8 to the contact-piece e^5, and in doing so passes under the feet i' of each of the switch-posts i, so as at all times to be in electrical contact therewith.

When the apparatus is in its normal or zero position the operator at the central station has a circuit through the main-line wire s, wires a, magnet A, wire a', plate 8, locking-bar support G', set-screw g', post 9, wire s^2, post 2, and wire w' to the ground, all other main-line connections being then broken at some point; for, although the wire a^2 also leads from the post 2 to contact-piece e^5, which is always in contact with disk B^5, all of the other disks on the shaft P' are clear of the corresponding contact-pieces e to e^4—that is, the projections c c^4 are away from the contact-pieces—and as the lever D has then no further electrical connection to put it into any circuit, it is practically insulated. Also, in the normal or zero position each local user has a circuit through the apparatus, to illustrate which I will take user No. 1, whose wire s^3 is connected with the post 3. The wire b' from that post goes to contact-piece e', which latter, by its tail-piece at e^6, is in contact with the knob or shoulder x of the unlocking-arm d of the corresponding lever D'. Thence electrical communication is through the engaged or interlocked armature-hooks at h^2, armature-lever h, magnet H, plate 10, and post 7 to the ground-wire w.

In Sheet 3, Fig. 6, is shown by diagram the relation of stations and connections, so far as is necessary in order to illustrate the operations to be described. The central or main exchange Y' has a battery, R, which has a considerable power or capacity, a telephone apparatus and battery, R', and a key, R^2. Ordinarily the main-line wire s, through the key R^2, post r, and wire r', will be in communication with the telephone, that connection being preserved by spring r^2. The ground-wire of the main battery is represented at r^3.

The auxiliary apparatus hereinbefore described is arranged at an auxiliary station represented by Y.

At W', I have indicated the station, house, or office of user No. 1, and at W^2 that of user No. 2, and so on in order.

It will be understood that the number of local users may be varied at pleasure, and

while in the apparatus I have shown connections for four local users, such number may be increased or lessened, as may be desired, by adding or taking off the appliances described as belonging to each local circuit and shortening or lengthening or keeping in proper proportion the contact-faces of the rotating disks. Each local user is to have telephone apparatus and battery, as indicated at R^3; but by preference a relay, R^4, is to be inserted in the line of his battery-wires s^3, and with a calling key or button at r^5. The relay will operate a bell-ringing apparatus, r^4, in the usual way.

That the operation of this apparatus may be fully understood, I will assume, first, that a local user—say No. 1—desires to converse with the operator at the main exchange, or to send some message through him. To do this he closes his circuit in the usual way, electrical action then taking place through his circuit, by wire s^3 to post 3, by wire b', contact-piece e', its tail-piece e^6, knob x, arm d^2 of lever D', armature-lever h, magnet H, plate 10, post 7, to the ground. This results in depressing the rear end of lever h, releases the hooks at h^2, and thereupon the lever D' turns on its pivot in the post D^2 to the position shown by the dotted lines in Fig. 2, with the following results: First, the pin d^3 on the locking-arm d', passing down the underlying slot g of the locking-bar G, shifts the latter to the right, so as to lock out all other co-users, substantially in the manner described in Patent No. 223,201, above referred to; second, the knob x ceases to bear on the switch-spring e^6 and moves clear of it, so as to break that line of electrical communication, and also let it spring over till the bent or hook end comes in contact with the switch-post i. From that point a new circuit is thus established for the local user through switch-post i, its foot i', wire a^2, plate 8, wire a', post o, magnet A, wire a, post 1, and wire s, to the central exchange. As a third result, the shifting of the locking-bar breaks the connection of the support G' with the set-screw g', and breaks the previously-existing main-line circuit. Hence one and only one circuit now exists—viz., from local user No. 1 to the main exchange, through the auxiliary exchange. Conversation may be had or messages sent over this circuit in the usual way, and if the local user desires it, he may be switched into communication at the main exchange with any other telephone user having a wire connection of any kind with such main exchange. After conversation is through, the main operator restores the apparatus to the normal or zero position by rotating the shaft P' until the wrist n on the disk B' engages the unlocking-arm d and shifts the lever D' back to its previous position, whereby the local circuit is restored through the re-engagement of the hooks at h^2, the locking-bar G is reversed, so as to unlock the connections of other co-users, the main-line circuit through G' g' is restored, and the circuit from the local user to the main exchange through the post i and switch-spring e^6 is broken.

Assuming, now, as a second operation that the main operator desires to call for any purpose any one of the local users—say, for example, No. 1—to this end he operates his key R^2 by a quick motion, so as to bring his main battery R into circuit. Making and breaking circuit in this way results through the intervention and action of the magnet A in giving one revolution to the escapement-shaft P^2, (the weight attached to the cord p, of course, being the actuating-power,) so that the shaft P' and the disks thereon (all being of metal) are rotated a distance which I term herein "one step." As a result of this, the wrist n on the first disk, B, Fig. 5, is rotated away from the unlocking-arm d of the lever D, so that the pin d^3 of the locking-lever D drops into the underlying slot g' of the locking-bar G and shifts it to the right, with the result already set forth, both as to locking out local users and, by shifting the support G' away from the screw g', breaking the previously-existing main circuit. The first half of the step which produced this rotation, or the movement of the escapement P^3 which results from depressing the key R^2 into contact with the contact-post r^5, and thereby closing the circuit at that point, also brings the projection c' of the disk B', which is properly arranged with reference to that end, into contact with the corresponding contact-piece e', whereby a new main-line circuit is made from the central exchange to the plate 8, as before, thence by the wire a^2, contact-piece e^5, disk B^5, shaft P', disk B', projection c', contact-piece e', wire b', post 3, and wire s^3, to the bell-ringing relay of user No. 1. By keeping the key depressed the bell will be caused to ring as long as may be desired. The projection c' is long enough to keep up contact with e', even after the key R^2 is raised and after the latter part of the rotary movement of the shaft P' is completed. The main exchange and user No. 1 are then in telephonic communication. At the same time, however, the electrical charge which rings the bell of user No. 1 will operate the armature-lever h, so as to unlock or disengage the hooks at h^2, as already described; but as the lever D' cannot turn far before being caught by the locking-bar G, (already shifted,) I leave room for it to drop a short distance—far enough at least to bring the upper end of the escapement-arm d^2 under an insulator, o, arranged for the purpose in the end of the armature-lever h. The local circuit or ground-connection of No. 1 is thereby broken. This position of the devices named is illustrated in Fig. 5.

To restore the apparatus to a zero or neutral position the main operator, by operating his key R^2 by quick motions, rotates the shaft P' until the wrist n on the disk B' engages the arm d of the disengaged lever D' and tilts it back to position, so as to restore the local circuit, and also by tilting back the lever D to

restore the locking-bar G to its normal position, and also restore the main-line circuit.

If user No. 2 is wanted, the main operator, instead of holding down his key R^2, as above described, releases it quickly, so that little or practically no alarm is sounded at No. 1. He then again depresses his key R^2, which causes the shaft P′ to rotate another half-step, clear the projection c' from its contact-piece e', and bring the projection c^2 of the disk B^2 to its contact-piece e^2; but the projections c' c^2, and so on through the series, are so proportioned and adjusted, as illustrated in Fig. 4, that at each successive closing of the circuit by the key R^2 one projection will be caused to clear its contact-piece, and the next to engage its contact-piece, but without any interruption between one contact and the next, so that the circuit shall not be broken at that place. The main operator, having thus made a circuit through c^2 and e^2 with user No. 2, holds his button down long enough to give the desired alarm, and so call user No. 2, after which he raises his button and talks through his telephone as may be desired. Other parts of this operation are already described with reference to user No. 1, and the apparatus is restored in like manner. Any other user may be called in like manner by further rotation of the shaft P′, the relationship of the projections c' to c^4 being, in succession, the same as already described.

If, as a third operation, any user—say No. 1—wishes to converse with a co-user—say No. 2—for this purpose he first puts himself into communication with the central exchange in the manner already described, and states his wishes. The main operator then, in the manner already described, causes the rotation of the shaft P′ until the projection c^2 of the disk B^2 is in contact with its contact-piece e^2, holds his key down until user No. 2 is called, and then advises him as to who wants him. As users Nos. 1 and 2 are then both in electrical communication, not only with the main office or exchange, but also with the same wire a^2, they are obviously in telephonic communication, not only with the main exchange, but also with each other. As soon as they are through, the main operator is so informed, and he restores the apparatus, in the manner already described, to its neutral position.

If local user No. 1 desires to converse with user No. 3 or 4, the same course is followed as in the case last supposed, except that the operator at the central exchange continues to cause the rotation of the shaft P′ until disk B^3 or B^4, as the case may be, comes around with its projection c^3 or c^4 in contact with the corresponding contact-piece e^3 or e^4. This being done, the appropriate bell is rung, as before described, and after the parties are through conversing the apparatus is restored to the neutral position. In this use of the apparatus it will be observed that the circuit from user No. 1 to the central exchange passes through wire a^2, and also that the circuit made from the central exchange to user No. 2, 3, or 4 passes, in the line of connections already described, through e^2 c^2 or e^3 c^3 or e^4 c^4, thence by shaft P′, disks B^5, contact-piece e^5, to the same wire a^2. Hence the latter forms a common intersection or connecting-link for all the circuits, of which three can be made and used at one time.

It will be understood that in order to restore the apparatus to the zero or neutral position the main operator must rotate the shaft P′ through or past all the contact pieces or connections; but this can easily be done, since he already has as an operating-circuit, which, while changing from the projection and contact-piece of one disk to those of the next, is in fact uninterrupted; but the motion or stroke that breaks the last circuit of the series through c^4 e^4 must first raise the unlocking-lever D and make a new or restore the old main-line circuit by shifting the locking-bar G so as to throw its support G′ against the set-screw g', as already described. This lever D, the first of the series, it will be understood, is simply a locking and unlocking apparatus, and does not form a part of any telephonic circuit.

Now, with a small number of local users—say, two to five, more or less—the disk B, Fig. 4, and its contact-piece e perform no function whatever, and I have shown them merely to indicate their place in the series. They may be wholly dispensed with, except in so far as relates to the wrist n and its connection with P′, so as to restore the lever D to its neutral position; but when the number of local users is increased to ten or fifteen, more or less, and the disks and connections correspondingly multiplied, it may be found that the power necessary to restore all the connections at h^2, or so many of them as may be broken, is greater than can readily be produced by the battery R unless its power be made unduly great. In order, then, that two, three, or more rotative steps of the shaft P′ may be employed for restoring the broken connections at h^2 and the power be distributed through a longer distance, I make the disk B, as shown in Fig. 5, with a projection, c, and so arrange and proportion it that as the last projection and contact-piece of the series breaks connection the projection c will engage its contact-piece e, and, making a circuit through it and through the wire b, post 2, and ground-wire w, will provide an operating-circuit through which the main operator can continue the rotation of P′ till the apparatus comes to the neutral position; and the circuit through c e must be kept up until the old circuit through support G′ and set-screw g' is restored by the unlocking and shifting of the locking-bar, as already described.

The form and arrangement of the devices described may be varied more or less at pleasure without any substantial departure from the scope of my invention, provided no mate-

rial change is made in function or in the method of operation by virtue of which such function is secured, and mechanical equivalents are hereby expressly included herein.

I claim herein as my invention—

1. In an auxiliary telephonic exchange system of apparatus, a main-line circuit through the supports of the locking-bar, and independent of the local circuits, a magnet, an armature, an escapement, a shaft rotated by the escapement, and a moving-lever, D, combined substantially as described, whereby, on the rotating of the shaft, a new circuit will be formed from the main exchange with a local user, and the locking-bar at the same time and by the same motion be shifted to lock out all other local users, substantially as set forth.

2. In an auxiliary telephonic exchange system of apparatus, having a main-line circuit terminating at the auxiliary exchange, and a series of two or more independent local circuits, also terminating at the auxiliary exchange, a magnet, H, for breaking the local circuit, and for releasing an apparatus by which to break the main circuit, and a switch-spring, e^6, automatically operating to make a new circuit between the local user and the central exchange on the breaking of the other circuits, substantially as set forth.

3. In a system of telephonic apparatus having a central exchange, an auxiliary exchange, and a series of two or more local instruments, a single main-line wire running from the central to the auxiliary exchange, and having there a ground-connection, and having also an interposed magnet arranged to effect, at the pleasure of the main operator, the rotation of the shaft P′, for breaking and restoring such circuit, and simultaneously making and breaking a circuit with a local exchange, in combination with a magnet arranged in each local circuit for breaking such local circuit at the pleasure of the user, and also breaking the main circuit, and making a circuit connection with the central exchange, whereby telephonic communications may be had and the apparatus be operated over such single main-line wire, substantially as set forth.

4. A series of two or more levers, D′, having each a connection by an arm, d^2, with an armature, h, an arm, d, operated in restoring connections by a wrist, n, rotating on a shaft, P′, a weighted arm, d', and pin d^3 to shift the locking-bar, in combination, by shoulder, knob, or projection x, with switch-spring e^6 and switch-post i, as a combination of devices to be used in changing circuits, substantially as set forth.

5. The combination of disks B′ B^3, in any desired number, having thereon projections c' c^4, contact-pieces e' e^4, switch e^6, switch-posts i, levers D′, wire a^2, and apparatus to rotate the disks, whereby a working connection can be kept up from one disk to the next, and electrical communication may be had through any switch-post by wire a^2 with the central exchange, substantially as set forth.

6. As a means to break the main circuit from the main exchange, and also to restore the apparatus to a neutral position, a lever, D, having arms d d', in combination with rotating shaft P′ and locking-bar G, substantially as set forth.

7. In an auxiliary telephonic exchange system of apparatus, having a main-line circuit terminating at the auxiliary exchange, and a series of two or more independent local circuits, also terminating at the auxiliary exchange, the lever D, having arms d d', in combination with disk B, having a projection, c, Fig. 5, whereby to preserve an operative circuit through contact-piece e, after the connection of the last local user has been passed and while rotating the shaft P′, in restoring the apparatus to its zero or neutral position, substantially as set forth.

8. In combination with a main-line circuit and a series of two or more local circuits, each terminating by ground-connections at the auxiliary exchange, and having means operative from the central exchange and from the instrument of the local user for breaking such connections and making a new circuit over the same wires in either direction, a rotating shaft provided with disks and projections thereon, adapted to engage and disengage contact-pieces in regular succession, and also provided with wrists for engaging the arms of escapement-levers, whereby the operator at the central exchange is enabled by his electrical connection over the same main-line wire to restore the apparatus to the zero or neutral position, and simultaneously restore the independent main-line and local circuits, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, Jr.

Witnesses:
R. H. Whittlesey,
George H. Christy.