No. 794,142. PATENTED JULY 4, 1905.

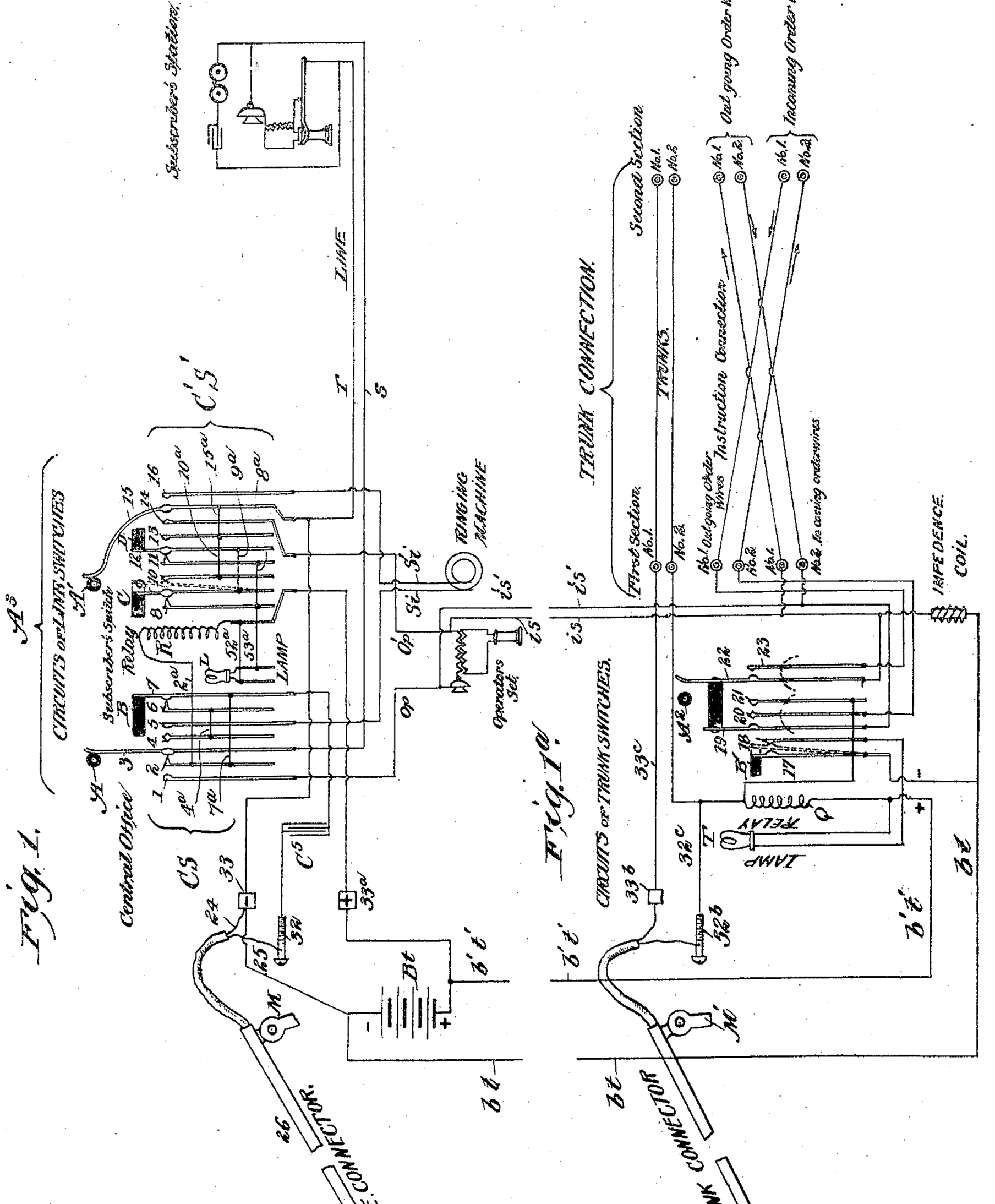
E. DARNELL.

TELEPHONE SWITCHBOARD.

APPLICATION FILED APR. 30, 1904.

9 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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Edw. W. Byrn.

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BY Munn & Co.

ATTORNEYS

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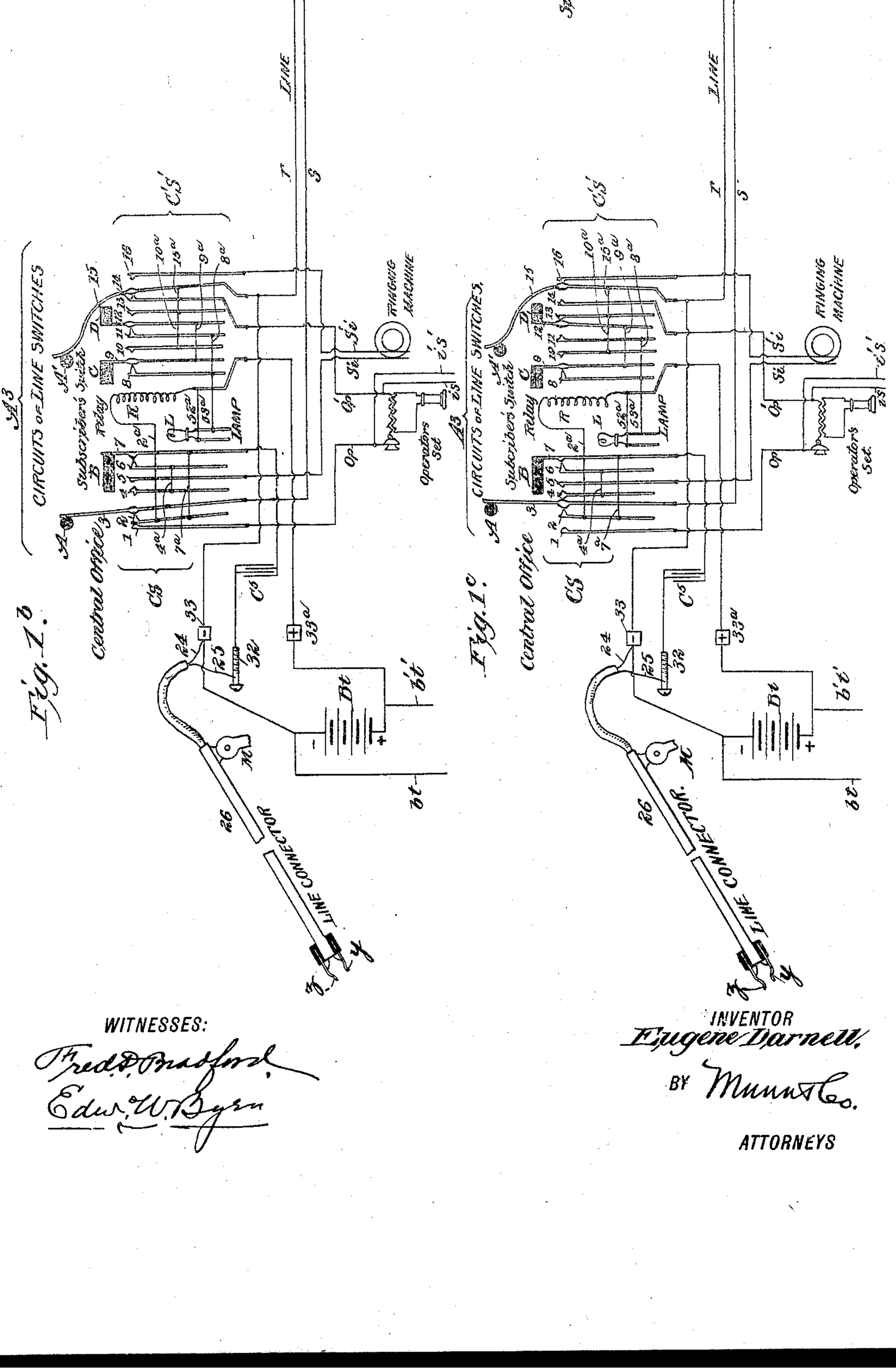

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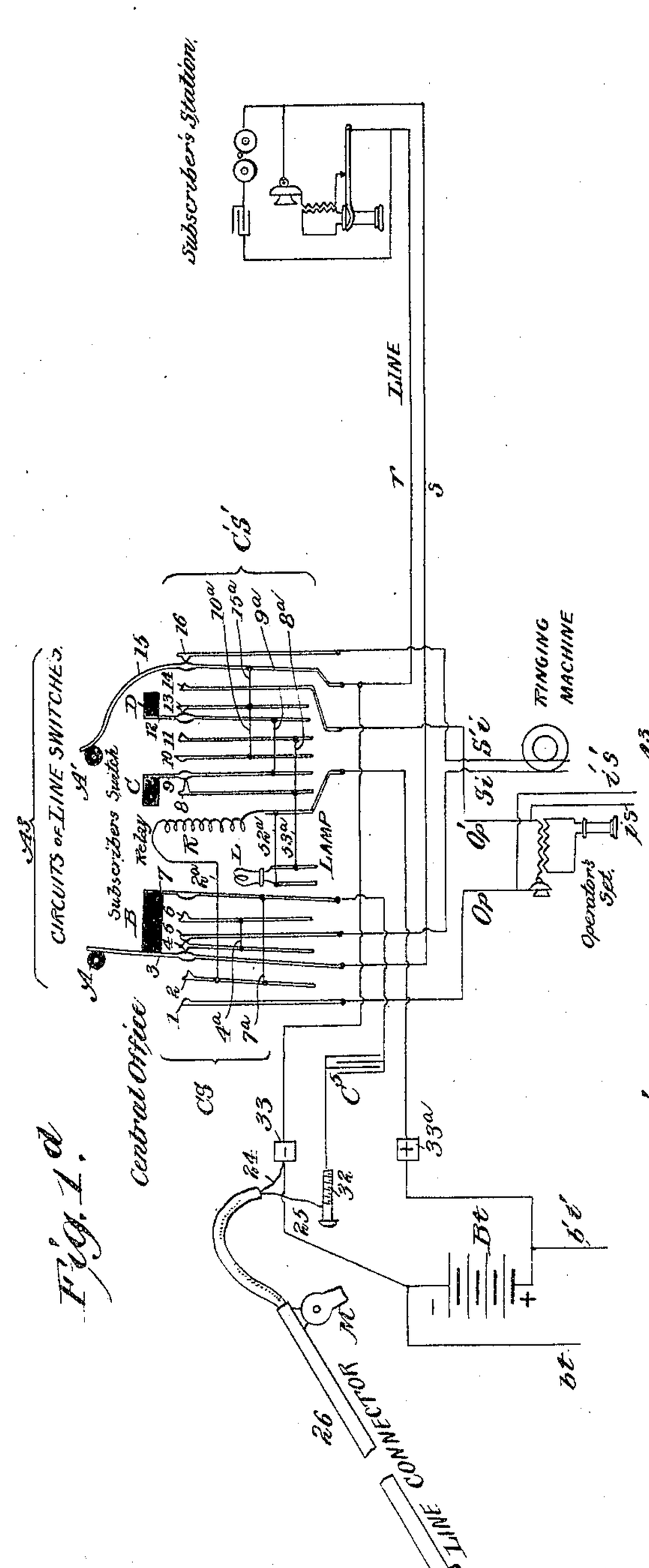

Fig. 1.

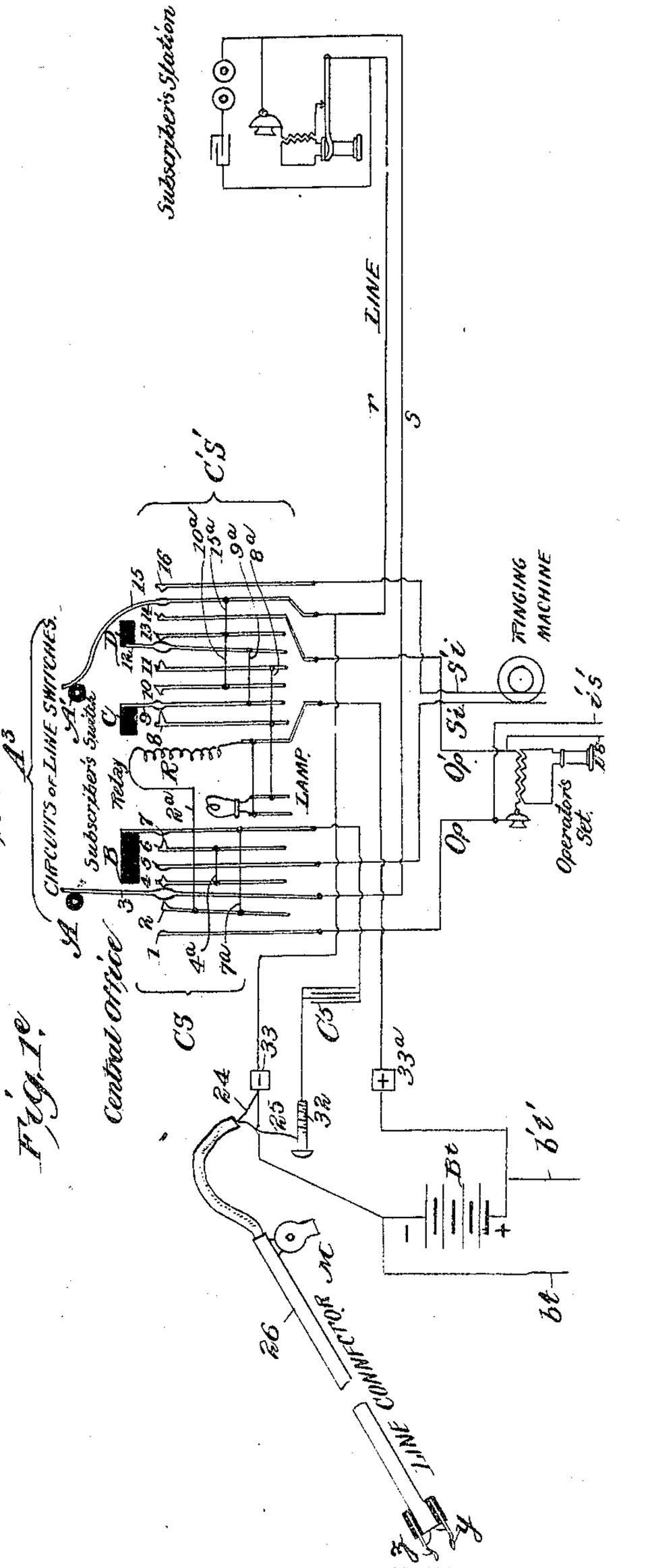

Fig. 1a.

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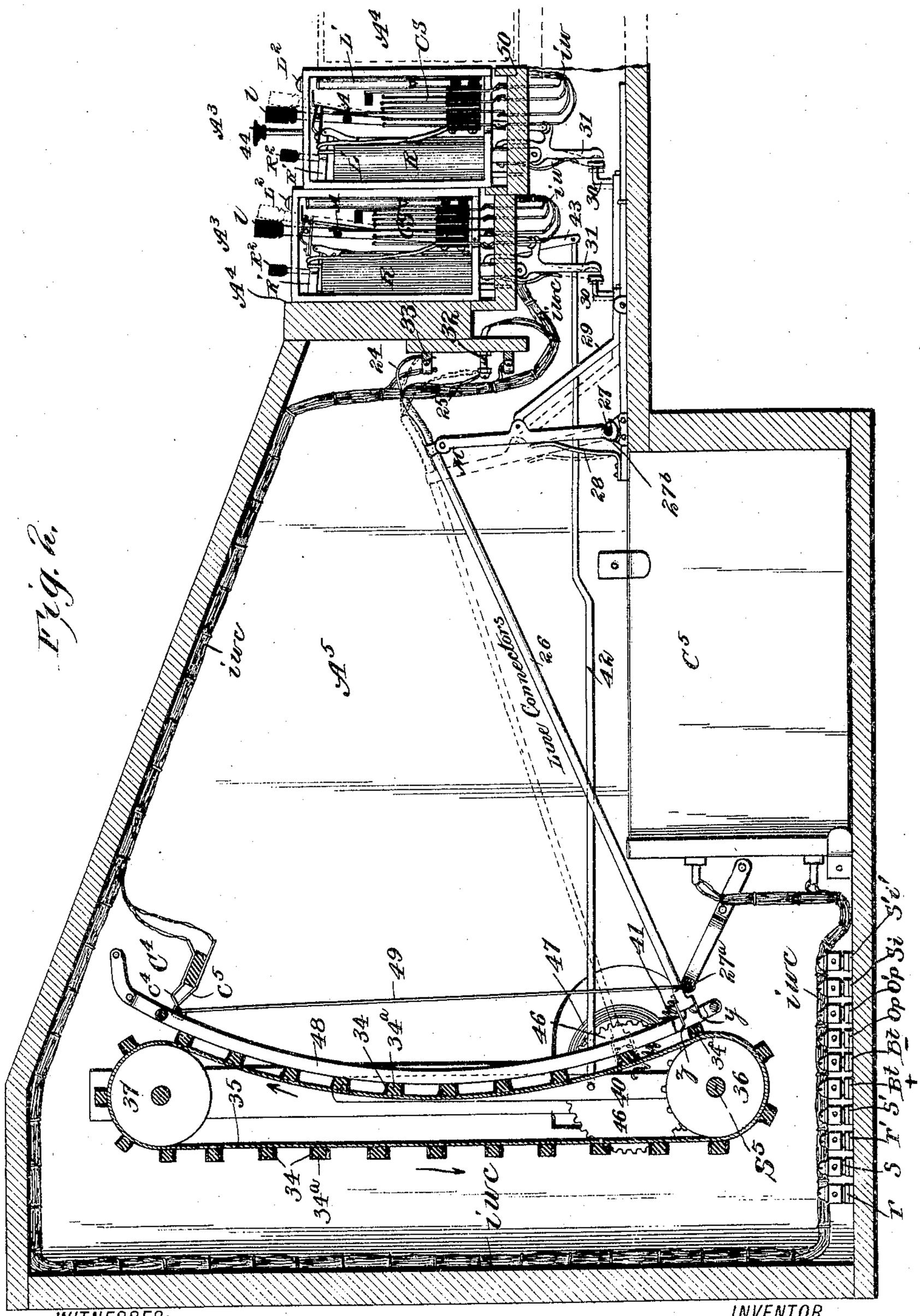

Fig. 2.

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9 SHEETS—SHEET 5.

Fig. 8.

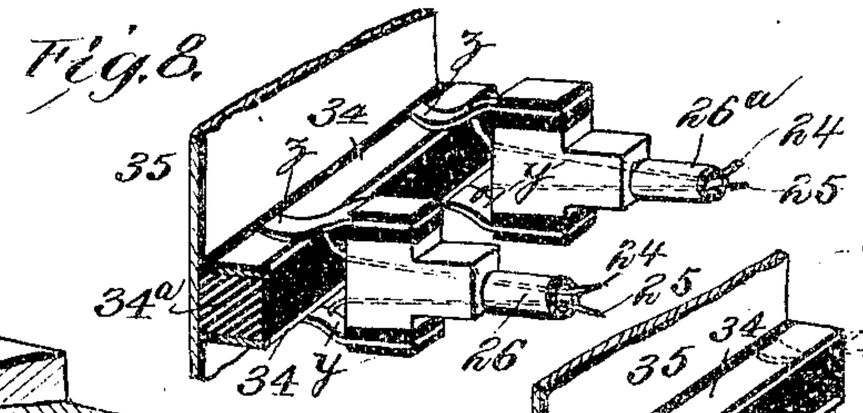
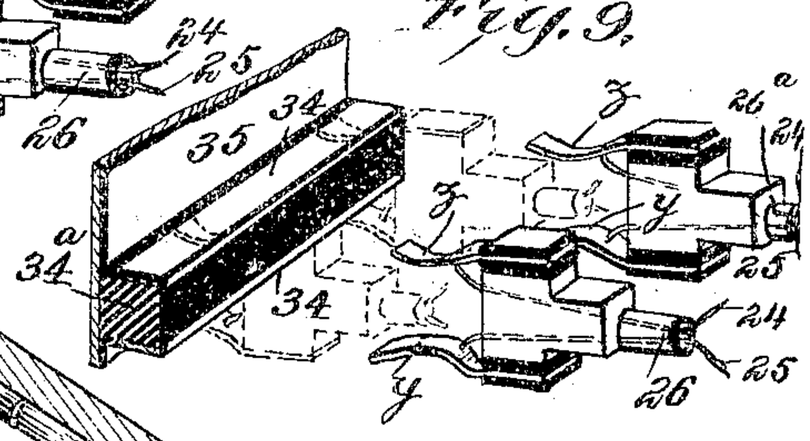


Fig. 8a.

Fig. 9.



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9 SHEETS—SHEET 6.

Fig. 1.

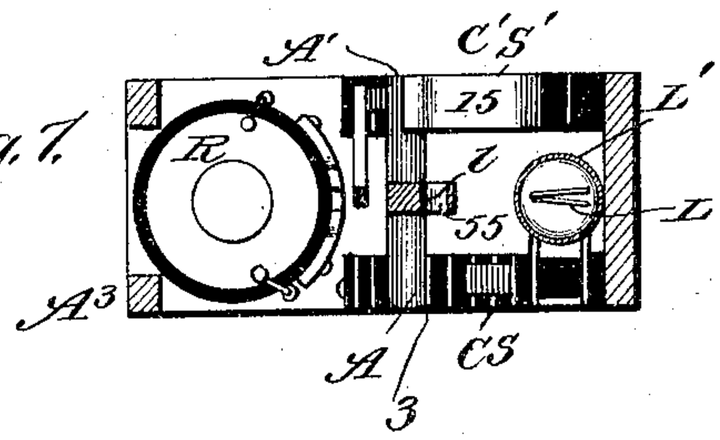
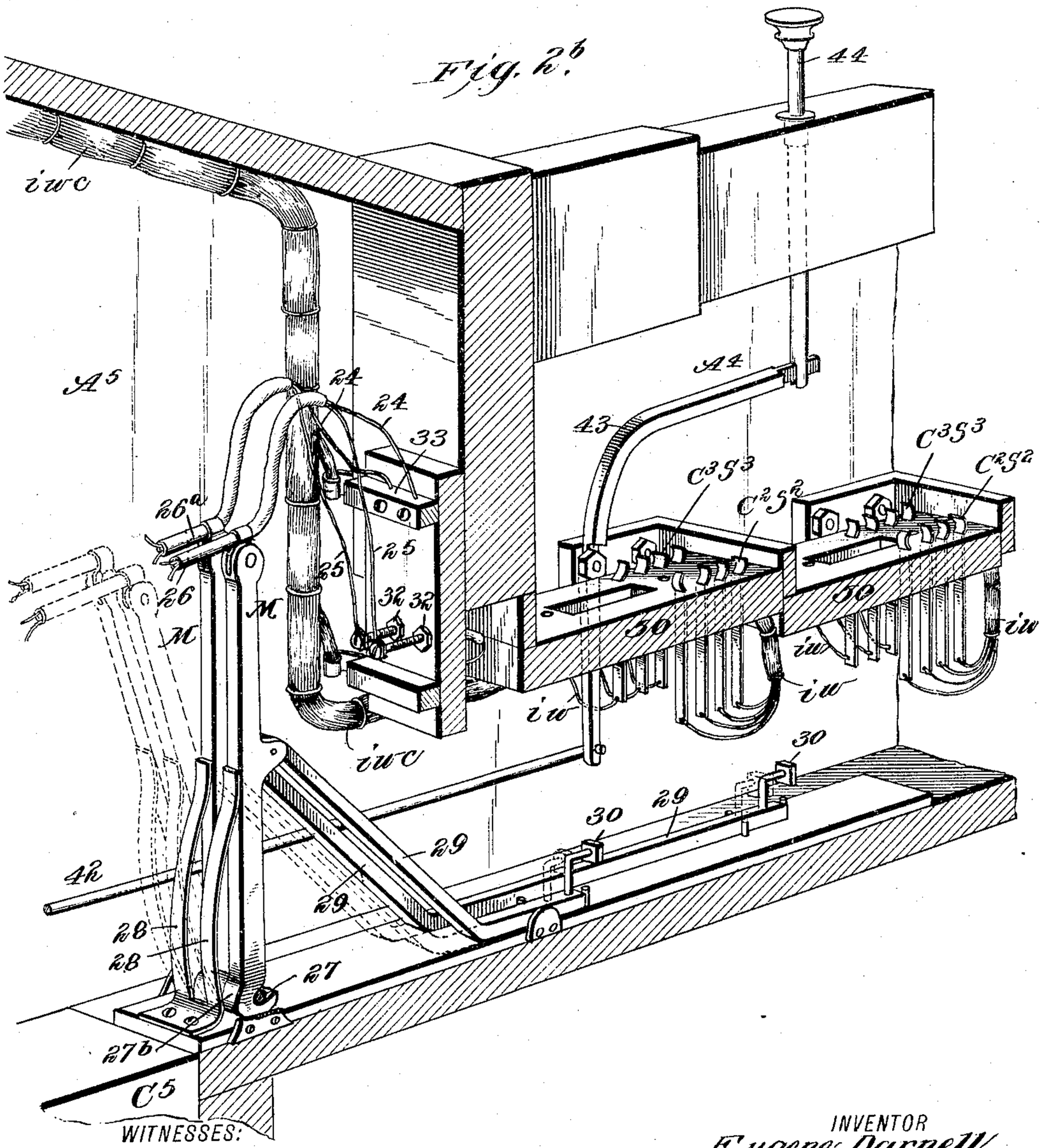


Fig. 2b.



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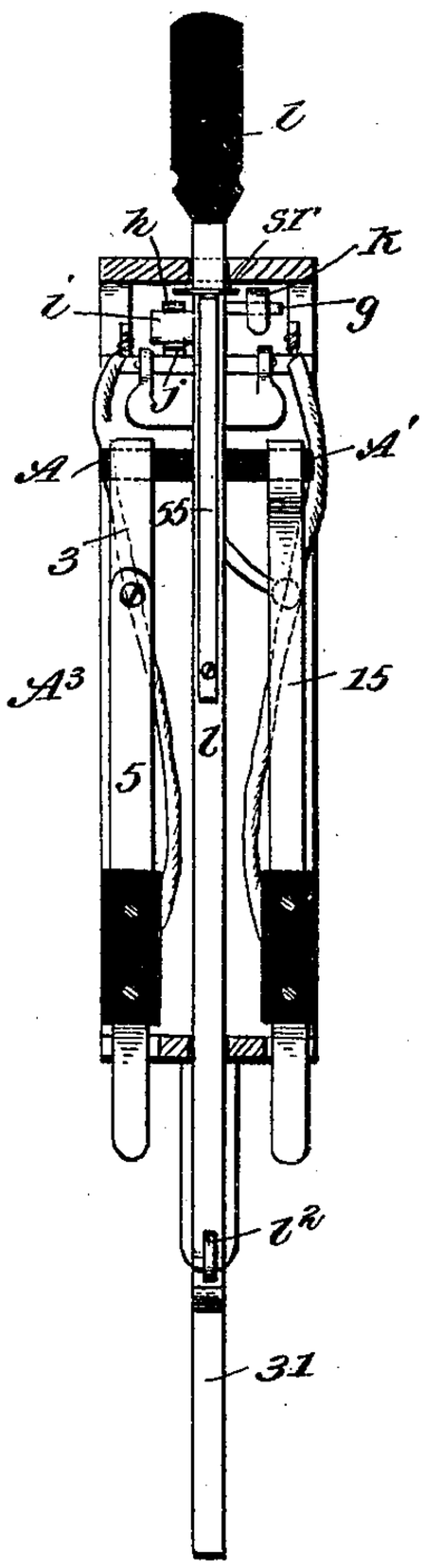
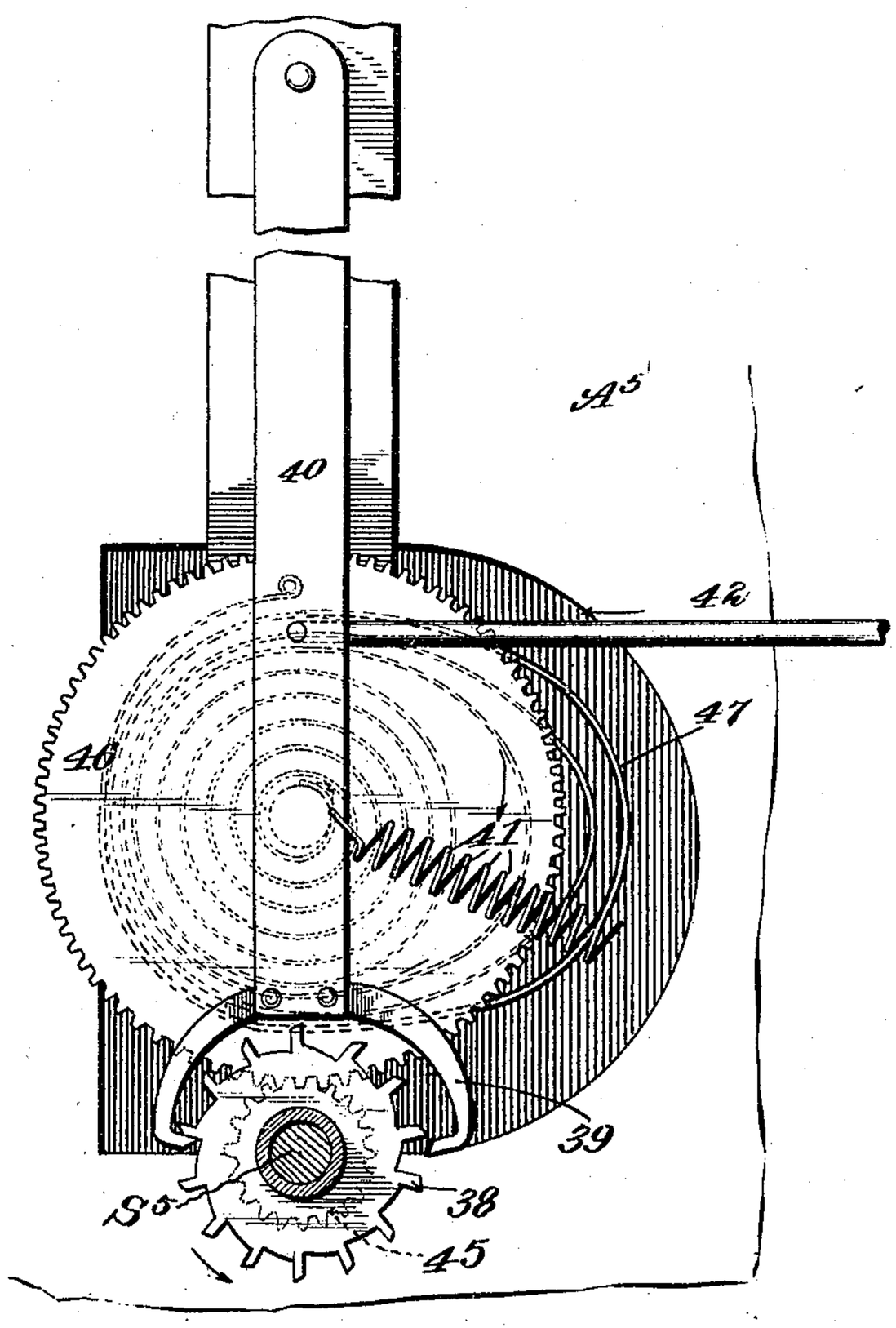
9 SHEETS—SHEET 7.

Fig. 2c.

Fig. 6.





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No. 734,142. PATENTED JULY 4, 1905.

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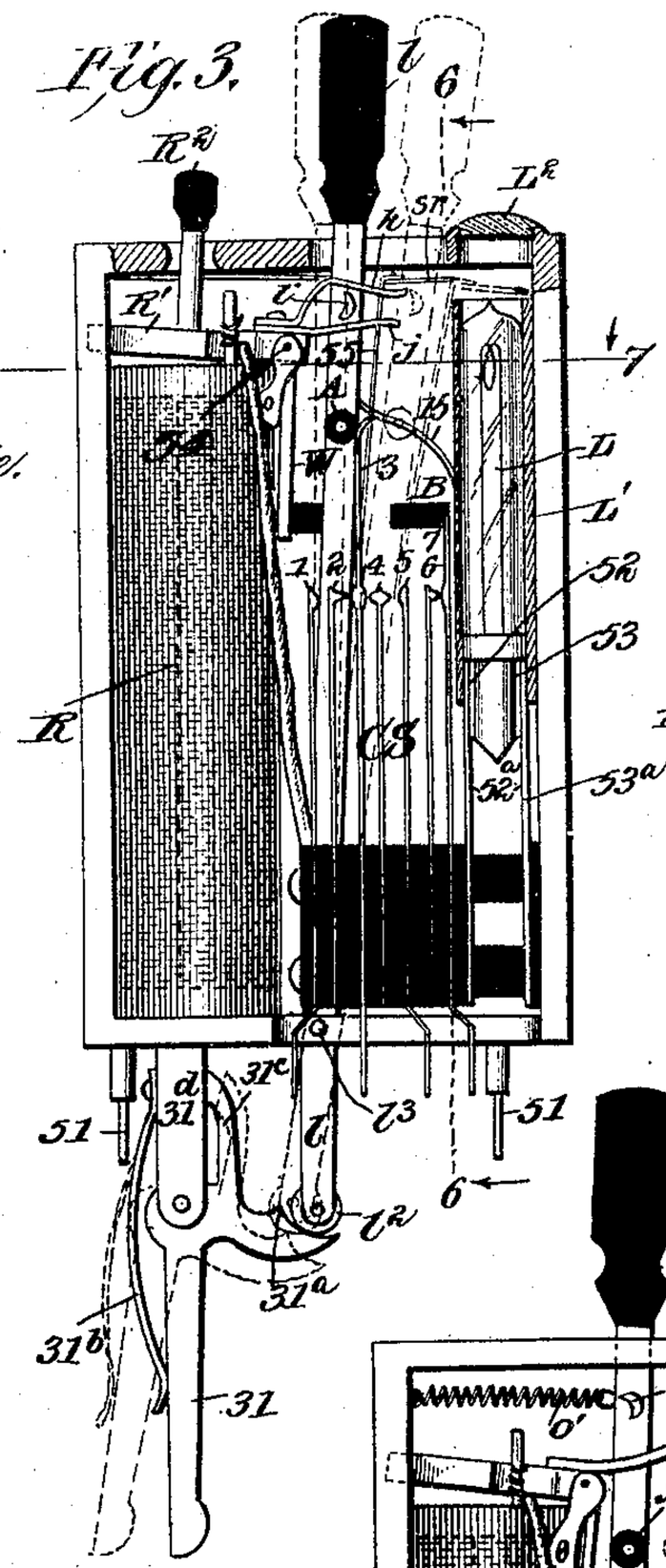
APPLICATION FILED APR. 30, 1904.

9 SHEETS—SHEET 8.

Fig. 3.



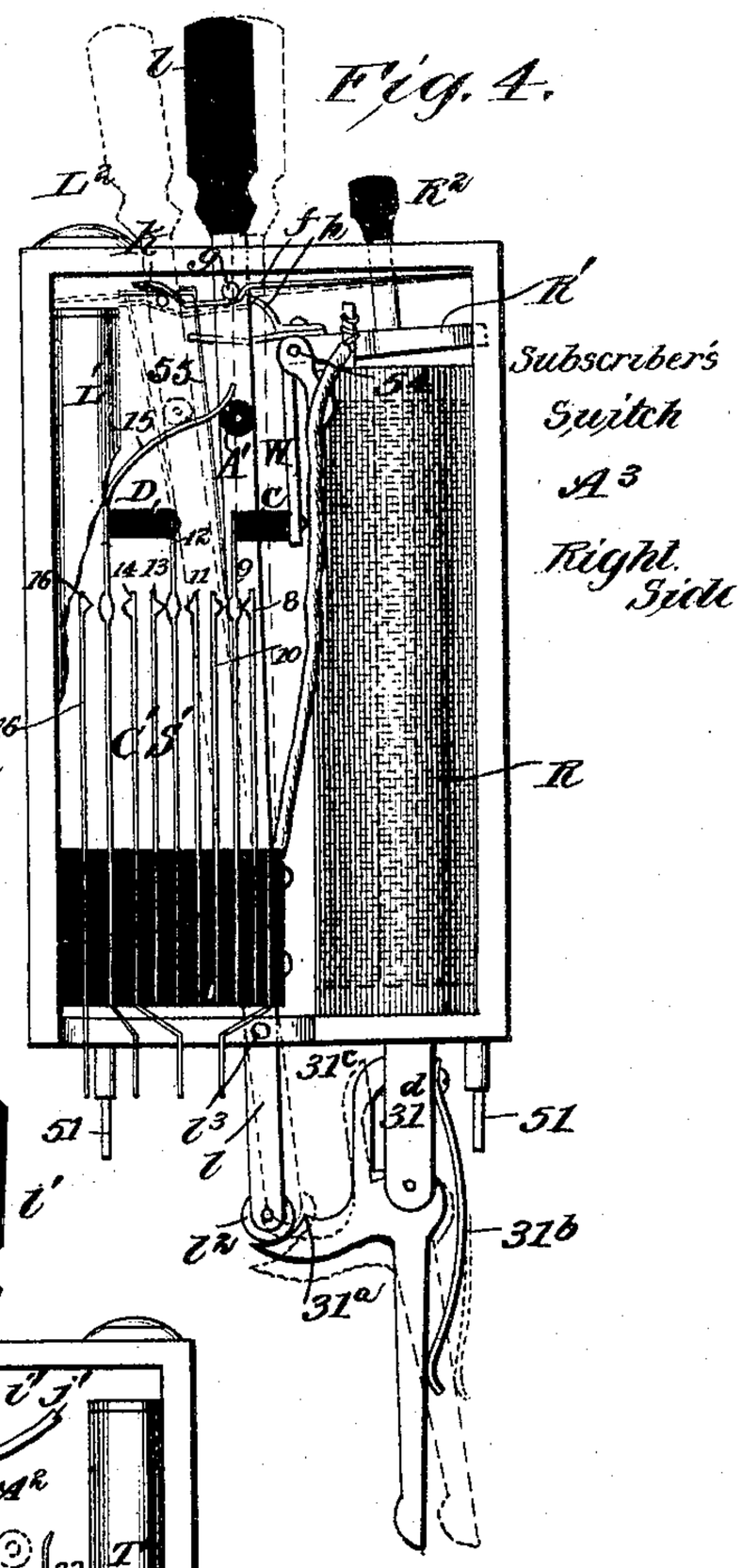
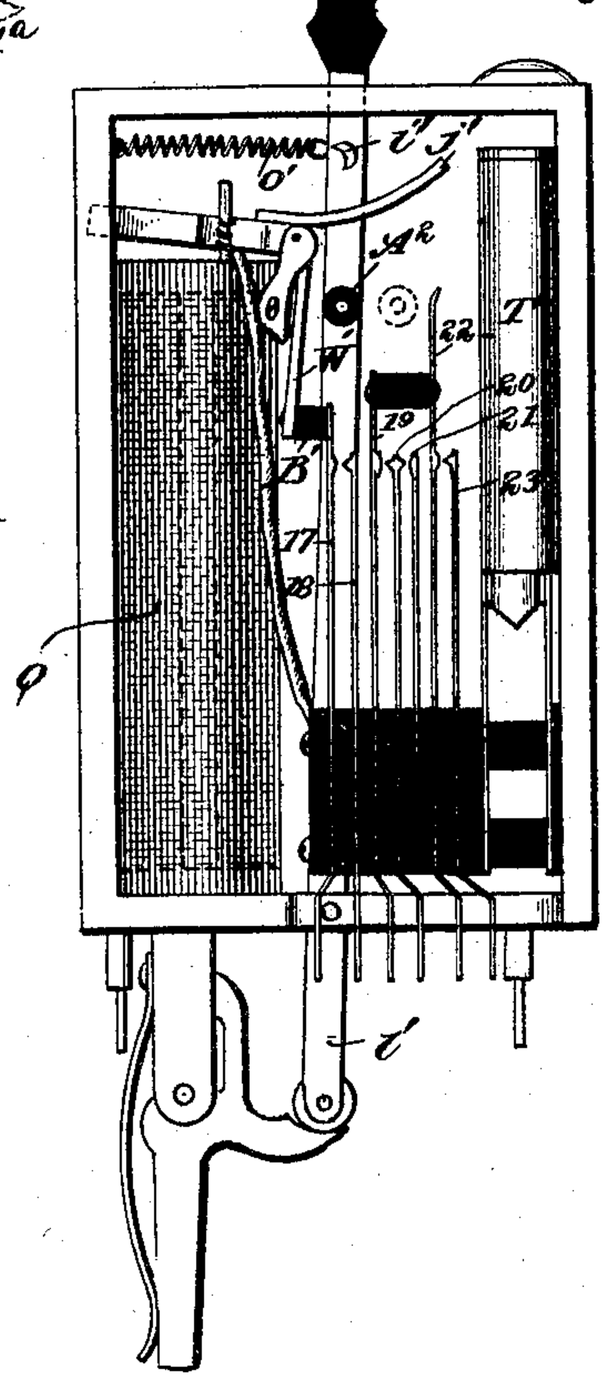


Fig. 5.



Trunk Switch
Left Side.

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9 SHEETS—SHEET 9.

Fig. 10.

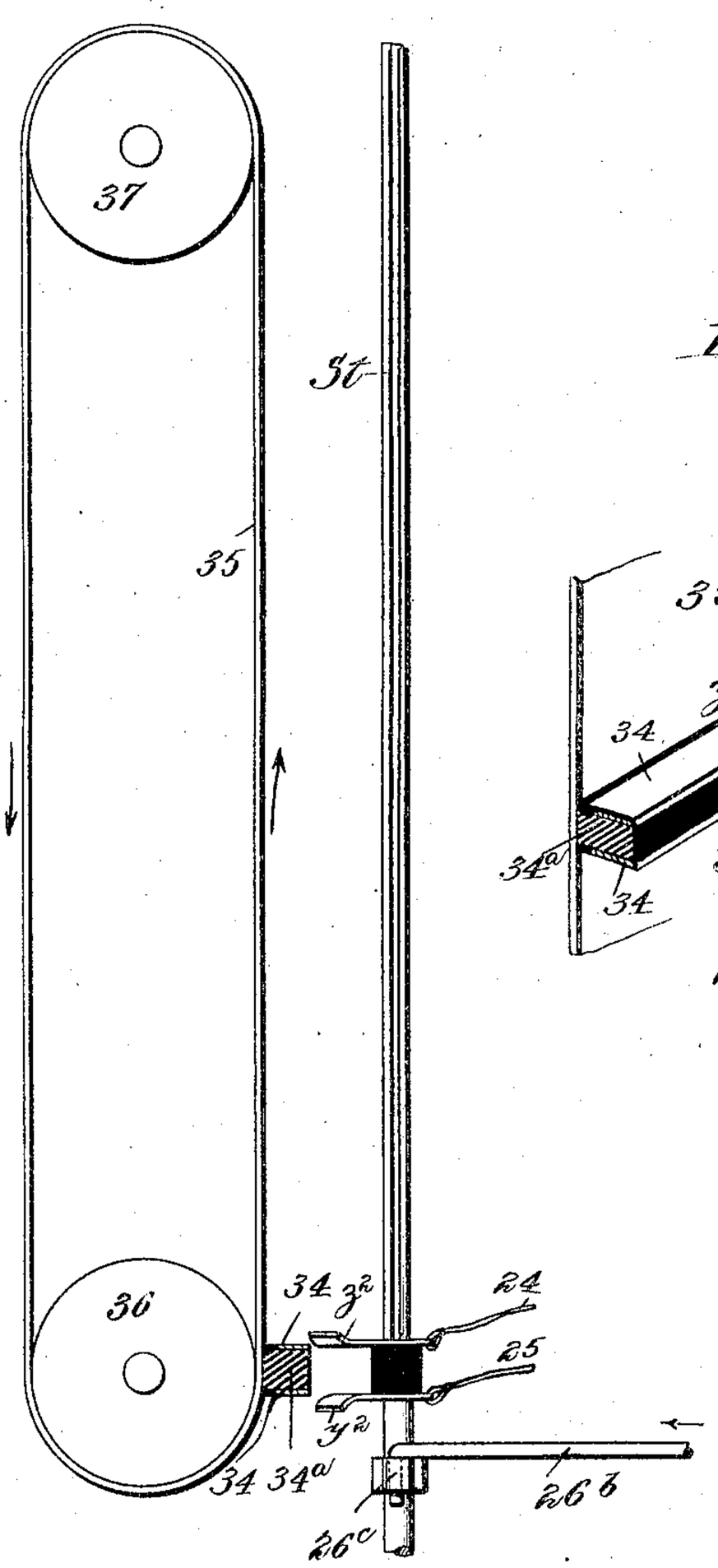
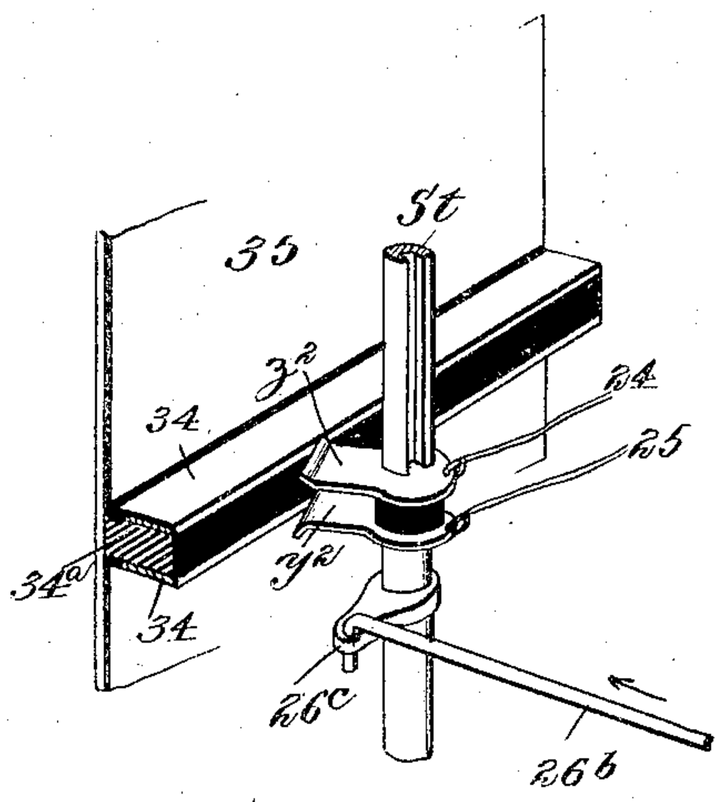


Fig. 11.



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No. 794,142. Patented July 4, 1905.

UNITED STATES PATENT OFFICE.

EUGENE DARNELL, OF CARROLLTON, MISSOURI, ASSIGNOR OF ONE-HALF TO HARRY H. WILCOXSON, LULU WILCOXSON, HARRY W. TULL, AND FRANK E. LOVELL, OF CARROLLTON, MISSOURI.

TELEPHONE-SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 794,142, dated July 4, 1905.

Application filed April 30, 1904. Serial No. 205,719.

To all whom it may concern:

Be it known that I, EUGENE DARNELL, a citizen of the United States, residing at Carrollton, in the county of Carroll and State of Missouri, have invented a new and useful Improvement in Telephone-Switchboards, of which the following is a specification.

In the manipulation of an ordinary telephone-switchboard a series of spring-jacks, plugs, and tinsel-core connecting-cords are employed for connecting one subscriber with another, and in making the necessary connections at least six different reaching movements by the switchboard operators are required to adjust these plugs and cords and complete the operation of signaling and connecting two subscribers and the parts to be adjusted are more or less widely separated.

My invention is designed to provide a compact telephone-switchboard in which the spring-jacks, plugs, and cords are all dispensed with with their incidental objections, and the movable parts to be adjusted are assembled within the limits of an easily-reached and conveniently-managed switch, whereby the reaching movements are reduced in number, and these movements are so restricted in extent of reach as to greatly economize the time of the operators, and whereby, also, the communication between subscribers is rendered secret as between the subscribers, so that the operators can hear nothing of the conversation after the subscribers are put into communication with each other, and whereby the disconnection between subscribers is placed under the control of the subscribers themselves.

My invention consists in the novel construction and arrangement of the various parts of the apparatus constituting the switchboard and in the arrangement of circuits in relation thereto, whereby the above objects and other incidental advantages are obtained, as will be hereinafter fully described with reference to the drawings and pointed out in the claims.

Figure 1 is a diagram of circuits connecting the subscriber's station with the subscriber's switch in the central office. Fig. 1^a is a diagram of circuits at the central office for the trunk-switch by which the separate groups of the switchboard are connected, so as to put a subscriber of one group into communication with a subscriber in another group. Fig. 1^b, Fig. 1^c, Fig. 1^d, and Fig. 1^e are diagrams showing different positions of the switches. Fig. 2 is a vertical sectional view taken through the switchboard and its mechanism, showing the same equipped for two subscribers only. Fig. 2^a is an enlarged view in perspective of the left-hand portion of Fig. 2. Fig. 2^b is an enlarged view in perspective of the right-hand portion of Fig. 2 with the two subscribers' switches removed from their seats. Fig. 2^c is an enlarged side view of the motor mechanism with parts broken away. Fig. 3 is an enlarged view of one side of the subscriber's switch removed from its seat. Fig. 4 is a similar view of the opposite side of the same switch. Fig. 5 is an enlarged side view of the trunk-switch looking at it in the same direction as in Fig. 3. Fig. 6 is a vertical longitudinal section through the subscriber's switch, taken on the line 6 6 of Fig. 3. Fig. 7 is a horizontal transverse section of the said switch, taken on the line 7 7 of Fig. 3. Fig. 8 is a detail in perspective of a part of two connectors of two subscribers projected into electrical communication with each other by a connecting bridge-piece. Fig. 9 is a similar view of the same parts disconnected, and Figs. 10 and 11 are detail views showing a modification of the means for connecting the subscribers' terminals.

Similar letters and numerals of reference indicate the same parts in all the figures.

In a preliminary way I wish to state that the leading distinction in the operation of my switchboard is to make the two terminals of each subscriber's line a movable factor, which terminals are projected onto relatively stationary bridge-conductors in connecting the subscribers in contradistinction to the ordinary method of making each subscriber's line end in a fixed anchorage in a jack, the connection in such case being established by a

movable factor in the shape of plugs and cords. Without waiting to describe the various circuits involved I will first describe the mechanical elements whereby this leading distinction of my invention is carried out.

Referring to Figs. 2, 2^a, and 2^b, there are shown on the right of Fig. 2 two units A^3 A^3, each of which is exactly alike and each of which represents its own subscriber and of which units there are as many as there are subscribers in the telephone-exchange. These units are therefore to be multiplied indefinitely, not necessarily in one group, but in several groups connected by suitable trunk-lines, as hereinafter described. Their extensions for each group will be toward the right in Fig. 2 in a gradually-descending series to, say, a depth of eight in one direction, and the other extension would be toward the observer in Fig. 2 to any desired reproduction at right angles of these eight in parallel rows of eight. As shown in the drawings, I have for simplicity illustrated but two, with all proper connections for putting these two subscribers into talking communication with each other. These units are arranged in seats in a compartment A^4, Fig. 2^b, descending to the right and are removable and interchangeable. Each unit is in the nature of a compound switch under the control of the operator and registering when seated in its place with the necessary contacts. Each switch while belonging exclusively to one subscriber is under the control of the central operator and is connected to and coöperates with movable line terminals or connectors for each subscriber, which connectors operate in an enlarged compartment A^5 behind the switch-compartment A^4. This compartment A^5 extends below the level of the switch-compartment A^4 and also extends above it, with an inclined upper surface sloping backwardly and upwardly from the top of the compartment A^4. Within this enlarged compartment A^5 are arranged side by side any desired number of the line-connectors 26, containing the two terminals leading from each subscriber's switch. These two terminals consist of two wires 24 25, housed within a long inclined tube forming connectors 26. Each tube is pivotally mounted at one end on the top of its actuating-lever M, which is fulcrumed at its bottom end on a shaft 27, is forced to the right by an individual spring 28, and is pushed to the left by a slide-bar 29, jointed to the lever M near its middle and sliding on a plate below the compartment A^4 and having an upwardly-projecting lug 30, arranged to be pushed sidewise to the left by an elbow-lever 31, extending down from the subscriber's switch A^3, as hereinafter described. The wires 24 25 of the movable line-terminals connect by a binding-post 32 and plate 33 with each subscriber's switch A^3 at one end, and after extending through the long tube 26 connect (see Figs. 8 and 9) with the two spring branches y and z of a fork at the lower end of the connector. These connectors 26 correspond in numbers to the number of subscribers, and they each lie when out of service side by side on a cushioned bar 27^a, held by brackets in stationary position near the bottom of the compartment A^5. These connectors 26 represent the movable terminals of the subscribers, and in connecting them they are projected forwardly to the left in the direction of their length, as indicated in dotted lines in Figs. 2^b and 9, tilting of the actuating-levers M against the springs 28 from the thrust of the slide-bars 29 from the action of the elbow-levers 31 of the switches A^3. (See Fig. 2.) To connect the two wires of one subscriber's connector 26 with the two wires of another subscriber's connector 26^a, each is pushed forward longitudinally, as just described, so that its jaws y and z pass on to conducting bridge-pieces 34 34, that connect the jaws y y together and the jaws z z together, which thus puts the terminals of one subscriber's connector into electrical connection with the terminals of the other subscriber's connector and completes the talking-circuit between the two subscribers. These conducting bridge-pieces are mounted on an endless belt or apron 35, which passes around a sprocket-wheel 36 below and a pulley or roller 37 above, said belt or apron being preferably made of sheet metal perforated to receive the teeth of the sprocket-wheel. This belt extends the full width of a group of connectors 26. On the belt 35 are arranged in close position the metal bridge-pieces 34 34, arranged in pairs one above and the other below insulation-strips 34^a, fixed to the belt in parallel position to each other and extending crosswise the belt or parallel to the axis of the sprocket-wheel; the purpose of this belt, with its traveling bridge-pieces 34, is to permit a considerable number of pairs of subscribers to be connected and be talking at the same time. It is obvious that as all the connector-tubes 26 lie normally in the same plane on the cushion-bar 27^a all of the connectors will be opposite the same pair of bridge-pieces 34, and after one pair of subscribers is connected to this bridge, so as to establish communication between them, it is necessary to move this connecting-bridge out of the way if a second pair of subscribers are to be connected, and so, also, the bridge for this second pair of subscribers must be moved out of the way if a third pair of subscribers are to be connected, and so on. For this reason the bridges are all carried on the traveling belt 35, and this belt is moved the space of one bridge each time a pair of subscribers are connected, so that each successive pair of subscribers have an unoccupied bridge to receive their connectors 26. As seen in dotted lines in Figs. 2 and 2^a, one pair of connectors have been projected to contact with a bridge, and

the bridge has been moved up one space, so that the other connectors below it resting on the cushioned bar 27^a are opposite an unoccupied bridge. To give intermittent progressive movement to the belt to thus advance the bridge-belt, this is effected by a motor mechanism and a step-by-step trip under the control of the operator as follows: On the same shaft S^5 with the sprocket 36 (see Fig. 2^c) is a toothed escapement-wheel 38, embraced by a double-clawed pallet 39, which straddles the escapement and is connected to the lower end of a vertical arm 40, pivoted at its upper end and pulled to the right by a helical spring 41 and forced to the left by a long horizontal push-bar 42. This bar extends to the front of the switchboard under the compartment A^4 and there connects (see Fig. 2^b) with the lower arm of an elbow-lever 43, whose horizonal arm is connected to a vertical key 44. Beside the escapement-wheel and rigidly connected to it is a pinion 45, in mesh with a large gear-wheel 46 above, and this gear-wheel is fixed to a shaft having a strong coil-spring 47 and the usual winding mechanism of a clock-gear. When the key 44 is depressed by the operator, the push-bar 42 shifts the vertical arm 40, with pallet 39, to one side, allowing the escapement-wheel 38 to turn one notch, the wheel being arrested by the claw of the pallet upon the opposite side, and when pressure on the key is released the spring 41 pulls the arm 40 and the pallet back again. The motor-spring mechanism through the gear-wheels therefore causes the sprocket-wheel and the belt 35 to move a space equal to the distance between the bridges and brings a new and unoccupied bridge into range of the idle connectors. In practice the operator's key 44 will be organized as a bar running the full length of a group of switches, like the spacing-bar of a type-writer, so that the operator may move up the bridge-belt from whatever position in front of the switchboard that she may happen to be in.

From the foregoing description it will be seen that as many pairs of connectors may be coupled in service at one time as there are bridges on one side of the belt between the sprocket-wheel below and the pulley above. As the connectors move as radii about centers, their outer ends move through the arc of a circle and the bridge-belt on the side adjacent to the connectors is guided in the path of a circle corresponding to the radius of the connectors by stationary circular guide-bars 48, and the connector-arms are spaced apart and kept in parallel position without interfering with each other by tension-wires 49, extending from the cushion-bar 27^a below to the horizontal cross-rod of the guide-bars 48 above. These tension-wires 49 form light and perfectly straight guides to separate the connector-arms and yet allow them a free and unrestricted rise. When the connectors 26 have been projected longitudinally to contact with a bridge, they are held to this contact by the elbow-lever 31 of the switch A^3 pressing against the lug 30 of the slide-bar 29 and the lever M; but when the elbow-lever 31 of the switch is released then the tension of the spring 28 against lever M throws back the lever and its connector 26 and withdraws the contacts *y* and *z* from the bridge, and then the connector or connectors drop down between the tension guide-wires to the position of rest on the cushion-bar 27^a out of action until again required. To permit the levers M and slide-bars 29 to be easily taken out, the lower ends of the levers are formed as hooks at 27^b, which hooks embrace the pivotal axis 27 and are held thereto by the pressure of the springs and are simply pressed back against the springs when said levers are to be removed.

I will now proceed to describe the construction of the compound switch A^3, each of which is a separate unit and each a duplicate of the other and one of which is used for each subscriber. These switches are detachably placed in seats side by side in the compartment A^4, and each comprehends (see Figs. 3, 4, 6, and 7) the following elements, viz: a relay R, an operator's lever *l*, a lamp L, two series of contact-springs C S and C′ S′, one of which series of contact-springs is arranged on one side of the operator's lever and the other set on the other side, and both sets are acted upon by the deflection of the operator's lever, as hereinafter described. There are also locking and tripping devices coacting with the armature of the relay and the operator's lever; also, a red signal and other accessories, which will be referred to hereinafter. The compound switch is inclosed in a rectangular metal frame, which frames fit snugly together side by side, but have no inclosing sides—*i. e.*, their sides are open. They rest upon the stepped seats 50, Fig. 2^b, and are firmly held thereto by dowel-pins 51, Figs. 3 and 4, which enter holes in the seats, so that the levers *l* project above and are easily accessible above the top of the compartment A^4, which is left open. The seats 50 have each two sets of permanent contact-springs C^2 S^2 and C^3 S^3, Fig. 2^b, which are connected below by insulated wires *i w*, which are assembled in the insulated wire cable *i w c*. The series of contact-springs C^2 S^2 of the seats corresponds to and connects with the separable group of contact-springs C S of the switch, and the series of contact-springs C^3 S^3 of the seats corresponds to and connects with the separable group of contact-springs C′ S′ of the switch, so that when the removable switches are in place their contact-springs C S and C′ S′ are in electrical connection with the wires of the cable leading to all the electrically-operated parts of the system.

The operator's lever *l*, Figs. 3 and 4, is fulcrumed at l^3 in the bottom of the switch-frame and projects below the same and is pro-

vided with a friction-roller l^2, which rides on to a toe 31^a on the horizontal arm of elbow-lever 31, the vertically-pendent arm of which extends down to and bears against the lug 30 of the slide-bar, Fig. 2, so that when operator's lever l is deflected to the right in Fig. 3 roller l^2 by riding on to toe 31^a throws the pendent arm of elbow-lever to the left and sets the tubular connectors 26, as before described. The elbow-lever 31 is fulcrumed to a hanger-bar 31^d, extending downward from the switch-frame, and the movement of the elbow-lever 31 is opposed in one direction by the spring 31^b and is positively arrested in the other direction by an upwardly-extending stop-arm 31^c, which comes to a bearing against the hanger-bar 31^d when the pendent member of the elbow-lever is vertical. The object of the toe 31^a of the elbow-lever is (after the elbow-lever 31 has been deflected by the operator's lever l) to cause this toe 31^a to come to a bearing in line with the center of the roller l^2 and in the line of the longitudinal axis of the lever, (see dotted lines, Figs. 3 and 4,) so that the pressure of the springs 31^b and 28 will come in the dead-center of the lever l and will have no tendency to throw back the lever l after it is adjusted to this position.

The operator's lever l has in the upper portion of the switch-frame a cross-pin, extending through the same and bearing on one side an insulated bushing A and on the other side an insulated bushing A′. (See Figs. 6 and 7.) The bushing A is adapted to press against the extended end of contact-spring 3 of the series C S, Fig. 3, and the insulated bushing A′ on the other side is adapted to press against the extended end of contact-spring 15 of the series C′ S′, Figs. 4 and 7. The movement of the lever l by the operator, it will thus be seen, serves to mechanically set the subscribers' connectors 26 and also adjusts the electrical contacts C S and C′ S′ to light an electric lamp L and to connect the line-circuit to the subscriber's connector, as hereinafter described. The lamp L is formed with terminals 52 53, Fig. 3, which slip between the terminal contact-springs 52^a 53^a, which are connected to the other contact-springs, as hereinafter described, and the lamp itself is surrounded by an opaque jacket or masking-tube L′, which prevents the light of one switch from illuminating the interior of an adjacent switch. This masking-tube, however, is open at its upper end, so that the light may shine up through the bull's-eye lens L^2 within range of vision of the operator.

Above the relay R is mounted the armature R′, pivoted at 54 and having a push-button R^2, which extends through the top of the frame of the switch. The armature R′ has a rigidly-attached and downwardly-projecting arm W, adapted to bear against a non-conducting lug C, Fig. 4, on the upper end of a contact-spring 9. The action of this arm W of the armature on the extended spring 9 is to light the lamp when the relay is energized by the call of the subscriber. On top of the armature are rigidly fixed one above the other two triggers h and j, Fig. 3, and between them and rigidly attached to the operator's lever l is a stop i, which is arranged to be caught behind the triggers h and j when the lever l is moved to the right in Fig. 3. When a subscriber calls the central office, the operator first moves the lever to the left (in Fig. 3) to make an adjustment of the spring-contacts below to get the number of the subscriber, as hereinafter described, and then moves the lever l to the right, which will cause the stop i to be caught against either one or the other of the triggers h and j. If the armature R′ is down or attracted, trigger j catches stop i. If the armature R′ is up and the relay is not energized, trigger h catches the stop i, as seen in dotted lines in Fig. 3. As the lever l is moved to the right a red transparent screen s r, which is attached to the lever by spring 55, is projected across the top of the lamp L and between it and the bull's-eye L^2. The purpose of this is as follows: When a subscriber calls the central office and the operator there has learned the number of the other subscriber that is wanted, the operator moves the lever l of this called subscriber's switch to the extreme right in Fig. 3, which projects the red screen across the top of the lamp of this called-subscriber's switch, and it remains there as a memorandum to the operator, as seen in dotted lines in Fig. 3. When the called subscriber answers, the lamp is extinguished, so that the operator knows that the called subscriber has answered. If after a reasonable time the red signal still continues to be displayed, the operator knows that the called subscriber has not answered and calls him again. In the adjustment of the operator's lever l it has three positions, and in order to differentiate these positions sensitively to the operator's touch I provide a special form of brake, which has practically no retarding influence on the lever during its middle range of movement, but which opposes with some force the last part of the movement to the right and also the last part of the movement to the left. This is accomplished as follows, reference being had to Fig. 4: A pin g is mounted on and projects laterally from lever l and rides along the upper surface of a bent spring f k, fastened at one end to the inner side of the top frame of the switch. This spring between the points f and k allows the free lateral movement of the pin g of the lever with little or no opposition; but when for the extreme movement to the left the pin g rides up on the upward bend of the spring at k it forces the spring down, whose resistance is made manifest to the sensitive touch of the operator. When in the extreme movement of the lever l to the right in Fig. 4, the pin g rides up on the elevated portion f of the spring and

a similar resistance is encountered in depressing the spring, which is in like manner made manifest to the touch of the operator. These three positions of the lever accomplish different results in the adjustment of the contact-springs below, as follows: During the middle range of movement of lever *l*, while pin *g* is passing between *f* and *k*, the work that is done is to mechanically adjust the subscriber's connector 26 and adjust the contact-springs below therefor, as heretofore described. When the pin *g* rides up on the part *f* of the spring, the work that is done by the lever *l* in moving to the right is to adjust the contact-springs below to enable the operator to get the number of the called subscriber from the calling subscriber. When the pin *g* rides up on the elevated part *k* of the spring on the left, the work done is to arrange the contact-springs below to enable the operator to ring the subscriber that is wanted and set the red signal. These movements are effected partly on the switch of the calling subscriber and partly on the switch of the called subscriber, as follows: For the calling subscriber the lever *l* of that subscriber's switch A^3 is moved first to the extreme right of Fig. 4, so as to ride up on part *f* of the spring in adjusting the contacts to get the number of the subscriber wanted, and is then moved back from *f* to *k* to adjust the connector 26 and its contacts of the calling subscriber to the bridge. Then on another switch A^3 of the subscriber to be called the lever *l* is moved in one sweep to the left in Fig. 4 from *f* to *k* and then up on the elevated part *k*. The movement of lever *l* during the traverse of pin *g* from *f* to *k* adjusts the connector 26 and its contacts of the called subscriber to the same bridge with the calling subscriber and also adjusts the ringing-circuit to the contacts of this subscriber to be called, so that the operator may signal him.

C^4, Figs. 2 and 2^a, is an automatic cut-out which limits the time of the first connected subscribers in case the full set of connectors are in use, and C^5 is a condenser, which parts will be more fully explained hereinafter.

Referring to Fig. 2^a, *r s* are the positive and negative binding-posts of one subscriber, *r′ s′* are the positive and negative binding-posts of another subscriber, B*t* B*t* are the battery binding-posts, O*p* O′*p* are the operators' binding-posts to which the operator's telephone is attached, and S*i* S′*i* are the binding-posts for the signal-bell-ringing circuits. These binding-posts are all suitably connected to the wires of the cable *i w c*, which latter also has a portion of its wires extended to the condenser.

The instrument shown, it will be remembered, comprehends only two units for two subscribers; but it will be understood that they may be extended indefinitely.

Having thus described the mechanical features of my invention and also their functions as far as possible, I will now proceed to give more minutely the circuits made in connection with the various electromechanical operations, reference being had more particularly to the diagram Fig. 1. In this diagram the left-hand portion represents the central office with switchboard connections, and the right-hand portion represents the subscriber's station. The line-connector 26 is the same as that shown in Figs. 2 and 2^a. *r s* are the same subscriber's line connection shown at *r s* in Figs. 2 and 2^a. B*t* of Fig. 1 is the battery whose connections are shown at B*t* in Figs. 2 and 2^a. O*p* O′*p* of Fig. 1 are the connections for the operator's set of instruments, which appear as similarly-lettered binding-posts in Figs. 2 and 2^a, and S*i* S′*i*, Fig. 1, are the signal connections for the ringing machine which connect with the switchboard at S*i* S′*i* of Figs. 2 and 2^a. A^3 of Fig. 1 is one of the units which has been designated as a "compound" subscriber's switch, being a diagrammatic expression of the switch shown in Figs. 3 and 4. This important fact, however, is to be noted and remembered, that while the group of spring-contacts C S corresponds to the similarly-lettered group in Fig. 3 and the group C′ S′ to the similarly-lettered group in Fig. 4 they are not both viewed in the same relation in Fig. 1 as they are in Figs. 3 and 4. The group C S in Fig. 1 is viewed the same as in Fig. 3; but the group C′ S′ is not viewed in the same relation as in Fig. 4, (from the exterior,) but is viewed from the interior. This is because there is but one lever *l* that actuates both of these groups of contacts, and the bushed pin A, which actuates one set of contacts C S, moves always in the same direction and at the same time as the bushed pin A′, which actuates the other set of contacts C′ S′, and it simplifies the reading of the diagram to make the pins A and A′ to operate together to the right and together to the left, as is actually the fact, since they are both carried on the same lever *l*. In the diagram Fig. 1 all contact-springs are shown in their normal positions—*i. e.*, the subscriber's receiver is on his hook and switch A^3 and connectors 26 are released.

Condition 1, for enabling the subscriber to signal the central-office operator: Springs 2 and 3, 6 and 7, 8 and 9, 11 and 12 are in contact, all other springs are open, lamp L is extinguished, and relay R is deënergized. This position furnishes a path when the receiver is removed from hook at the subscriber's station which may be traced as follows: from battery B*t* to negative fuse-bar 33, line *r*, subscriber's telephone, line *s*, spring 3, spring 2, wire 2^a, relay R, positive fuse-bar 33^a to battery B*t*. Current flowing through this path operates relay R, which by means of lever W, Fig. 4, engaging rubber bushing C opens contacts 8 and 9 and closes contacts 9 and 10,

as shown by dotted lines, Fig. 1. This furnishes a path from battery B*t* to negative fuse-bar 33, spring 15, wires 15ª and 10ª, spring 10, spring 9, wire 9ª, spring 12, spring 11, wires 8ª and 53ª, lamp L, wire 52ª, positive fuse-bar 33ª to battery B*t*, causing the current from the battery to light the lamp L, thereby furnishing the subscriber with means of signaling the operator.

Condition 2, for enabling the operator to place her telephone in communication with that of the subscriber who has called: Upon seeing this signal the operator pushes the lever *l* backward or to the left, as the position of the switch is shown in Figs. 1 and 3. This motion moves rubber bushings A and A′, Fig. 1, to the left, allowing springs 3 and 15 by their own tension to move to left, closing contact-springs 3, 2, and 1 and also 15 and 14, as seen in Fig. 1ᵇ. This position of contacts furnishes a path from subscriber's instrument, line *r*, spring 15, spring 14, wire O′*p*, primary wire of the operator's induction-coil, through the transmitter, wire O*p*, spring 1, spring 2, spring 3, line *s*, and to subscriber's instrument, across which circuit at points 2 and 15 between operator's and subscriber's instruments is bridged battery B*t* and relay R, (which latter acts as an impedance-coil,) as follows: from battery B*t* to negative fuse-bar 33, to spring 15, which is one terminus of the bridge, and from battery B*t* to positive fuse-bar 33ª, relay R, wire 2ª, to spring 2, which forms the other terminus of the bridge and which divided circuit furnishes a suitable talking-circuit over which the operator learns the desired connection.

Condition 3, for furnishing a talking-circuit between the calling subscriber's instrument and the connector-springs: The operator after learning the desired number reverses lever *l*, pulls it to left in Fig. 4, (to right in Fig. 1ᶜ) until pin *g* engages bend *k*, Fig. 4, to which point lever *l* moves with ease, during which motion stop *i* is carried past trigger *j*, Fig. 3, thereby holding lever *l* to this position, and during which motion rubber bushings A and A′ (see Fig. 1ᶜ) are forced to the right, breaking contacts 1 and 2, 14 and 15, and making contacts between 2, 3, and 4, 15 and 16 and allowing spring 12 to break contacts 11 and 12 and make contacts 12 and 13 by its own tension. This by breaking contacts 11 and 12 extinguishes lamp L and by making contacts 2, 3, and 4, 15 and 16 furnishes a path from subscriber's instrument, line *r*, negative fuse-bar 33, wire 24, to connector-spring *z* on one side, and from the other side of subscriber's instrument, line *s*, spring 3, spring 4, wire 4ª, spring 6, spring 7, condenser C⁵, post 32, wire 25, to connector-spring *y*, with battery and relay R (which latter acts as an impedance-coil) bridged across this circuit at points 2, and negative fuse-bar 33, as follows: battery B*t*, positive fuse-bar 33ª, relay R, line 2ª, to spring 2 on one side, and battery B*t* to negative fuse-bar 33 on the other side, thus furnishing a suitable talking-circuit between the calling-subscriber's instrument and connector-springs *y* and *z*.

Condition 4: By considering the same diagrams as applied to the equipment of the called-for subscriber it will now be shown how the operator signals and places the called subscriber in connection with the calling subscriber. The operator now (see Fig. 1ᵈ) on the called-subscriber's switch A³ pulls lever *l* to left of Fig. 4 and right of Fig. 1ᵈ until pin *g* engages bend *k* and forces it out of line, allowing lever *l* to assume its extreme position to left of Fig. 4 and right of Fig. 3. After pin *g* comes in contact with bend *k* it requires considerably more pressure upon the part of the operator to force lever *l* to its extreme position. While lever *l* occupies its said extreme position to right of Fig. 3 rubber bushings A and A′ are moved to the right, as shown in Fig. 1ᵈ, forcing springs 3 and 15 to their extreme right-hand positions, in which position contacts 2 and 3, 11 and 12, and 6 and 7 are opened, contacts 6 and 7, however, being forced open by the extended portion of spring 3 engaging rubber bushing B, and contacts 3, 4, and 5, 12 and 13, and 15 and 16 are closed. This arrangement of contacts produces three effects. First, by opening contacts 2 and 3 positive side of battery B*t* is removed from spring 3 and from interference with the following signaling-circuit. Second, by the making of contacts 3, 4, and 5 and 15 and 16 aforesaid, a path is formed from ringing machine to subscriber's instrument as follows: ringing machine, wire S*i*, spring 5, spring 4, spring 3, line *s*, subscriber's instrument, line *r*, spring 15, spring 16, wire S′*i*, and back to ringing machine, which path forms a circuit for signaling the subscriber. Third, this effect is to light the lamp of the called-subscriber's switch A³. By the closing of contacts 12 and 13 aforesaid a path is formed from battery B*t*, positive fuse-bar 33ª, wire 52ª, lamp L, wire 53ª, spring 8, spring 9, wire 9ª, spring 12, spring 13, wire 15ª, spring 15, negative fuse-bar 33, and battery B*t*. Current flowing over this path lights lamp L. While lever *l* is in its extreme right-hand position in Fig. 3, red screen *s r* is in position between lamp L and bull's-eye L², causing in this case a red signal to be displayed. It will be seen that as long as lever *l* is held in this position a ringing-current will pass out on line to subscriber's instrument, and the red signal is not obliterated until the called subscriber answers.

Condition 5: This condition is brought about by the called subscriber answering his call. After signaling the operator removes pressure from lever *l*, which by tension of springs 3 and 15 would tend to assume its

normal position. However, subscriber's receiver still remaining on hook, relay R is deenergized, and by tension of spring 9, Fig. 4, and rubber bushing C, engaging arm W, holds relay-armature R′ in such a position that trigger *h*, Fig. 3, engages stop *i*, thereby holding lever *l* in forward position, where pin *g* begins to engage bend *k*, Fig. 4. At this point, Fig. 1[e], contacts 4 and 5 and 15 and 16 are opened. Contacts 2, 3, and 4 and 6 and 7 and 12 13 are closed. While lever *l* is held in this position, lamp L continues lighted, with red screen *s r* still between it and the bull's-eye. With contacts in this position a path is furnished from subscriber's instrument, line *r*, negative fuse-bar 33, wire 24, to connector-spring *z*, and from the other side of subscriber's instrument, line *s*, spring 3, spring 4, wire 4[a], spring 6, spring 7, condenser C[5], post 32, wire 25, to connector-spring *y*, with battery B*t* and relay R, (which latter acts as an impedance-coil,) bridged across this circuit, as follows: from battery B*t* to negative fuse-bar 33 on one side and from battery B*t* to positive fuse-bar 33[a], relay R, wire 2[a], to spring 2 on the other side, thus furnishing a talking-circuit between subscriber's instrument and connector-springs *y* and *z*. When this called subscriber removes his receiver from the hook, the current from battery B*t* flows through following circuit: battery B*t*, negative fuse-bar 33, line *r*, subscriber's instrument, line *s*, spring 3, spring 2, wire 2[a], relay R, positive fuse-bar 33[a], back to battery B*t*, operating relay R, whose armature by arm W, Fig. 4, rubber bushing C, and spring 9, Fig. 1[e], opens contacts 8 and 9 and closes contacts 9 and 10, which in turn extinguishes lamp L. The rise of the armature also moves triggers *h* and *j* upward, allowing stop *i* to disengage trigger *h* and engage trigger *j* and allows lever *l* to move backward a slight distance, but not enough to change the position of any contacts. It may now be seen that the switch of the called subscriber is in the same position and condition as that of the calling subscriber. It may also be seen that a red signal will be displayed at the switch A[3] of the called subscriber after he has been signaled until he removes his receiver from the hook, but will then be obliterated, thereby furnishing a supervisory signal for the connection. Inasmuch as by the bridge-strips (hereinbefore described, but not shown in this diagram) the connector-springs *y* and *z* of the calling subscriber are placed in electrical connection with the connector-springs *y* and *z*, respectively, of the called subscriber, it may be seen that the calling-subscriber's instrument is furnished with a suitable talking-circuit to the called-subscriber's instrument. After the called subscriber has been signaled the operator depresses the key 44, connected with the motor-escapement for the bridge-belt, which allows the bridge-strip which is in use to rise, as in dotted lines in Fig. 2, and pass out of alinement with the inactive connectors 26 and permits another bridge-strip to occupy its former position in front of the idle connectors.

Condition 6: Upon completing conversation each subscriber restores his receiver to its hook, which opens the circuit at the subscriber's instrument through relay R and battery and deënergizes relay R, the armature of which, in turn, by arm W, rubber bushing C, and spring 9 is caused to assume the position shown in Fig. 3, which allows trigger *j* in each case to disengage stop *i* and lever *l* by tension of springs 3 and 15 to move backward to where pin *g* engages bend *f*. This is the normal position of the switch, and all contacts are in position as described in Fig. 1 at the beginning.

Trunking: When it becomes necessary to put up a connection between two subscribers whose equipments are not on the same section of switchboard, a trunk is used the ends of which terminate in switches, as shown in Figs. 1[a] and 5, and which occupy positions upon the separate sections between which a connection is desired. In Fig. 1[a] is shown a diagram of a combined trunk and circuit for instruction between operators, each switch having its connector similar in construction and operation to the line-switch shown in Fig. 1. This diagram, Fig. 1[a], shows the contact-springs in their normal position—*i. e.*, all contacts open, relay Q deënergized, and lamp T extinguished. In trunking a connection the calling-subscriber's switch is operated in the same manner as would be in case the called subscriber were on the same section. Instead, therefore, of operating the switch of a called subscriber a proper trunk-switch is selected and operated as follows: Switch-lever *l′*, Fig. 5, is pulled to the right and held in its extreme right-hand position while the first operator instructs the second operator, (in which section the desired subscriber's equipment is located.) As lever *l′* is pressed forward to the right trunk-connector springs *y′* and *z′*, Fig. 1[a], are pressed forward into electrical connection with the bridge-strip 34 on the belt and through the bridge with connector-springs *y* and *z*, respectively, of Fig. 1. This connection furnishes a path over which current flows from battery B*t*, negative fuse-bar 33, Fig. 1, wire 24, connector-spring *z*, bridge-strip 34, (not shown,) trunk-connector spring *z′*, Fig. 1[a], post 32[b], relay Q, wire *b′ t′*, and to positive side of battery B*t*, operating relay Q, which, by means of arm W′ and rubber bushing B′, forces spring 17 in contact with spring 18, as seen in dotted lines. This contact completes a path over which current flows to light the lamp T from positive side of battery B*t*, wire *b′ t′*, lamp T, spring 18, spring 17, wire *b t* to negative side of battery B*t*. While lever *l′* is held in aforesaid position rubber bushing

A^2, Figs. 5 and 1^a, engages spring 22, which in turn closes the contacts 19, 20, and 21 and 22 and 23. This closure of contacts (indicated by curved dotted lines) furnishes a path from the operator's set, Fig. 1, as follows: from operator's transmitter to wire i' s', to Fig. 1^a, spring 19, spring 20, outgoing-order wire 2 to the other section of switchboard, to its incoming-order wire 2. After passing through the second operator's telephone it leaves the second section from the incoming-order wire 1, thence back to outgoing-order wire 1 of first section, spring 23, spring 22, wire i s, primary induction-coil, Fig. 1, back to transmitter again. The circuits of the second section, to the right of the trunk connection in Fig. 1^a, are not shown, being duplicates of those shown on the left of Fig. 1^a. The circuit between incoming-order wires Nos. 1 and 2 of this second section is therefore exactly like that of incoming-order wires Nos. 1 and 2 of the first section shown on the left, and reading it on the left-hand part of Fig. 1^a it may be traced as follows: incoming-order wire No. 2, wire i' s', transmitter, primary of induction-coil, wire i s to incoming-order wire No. 1. Across said path between operator's instruments is bridged the battery, as follows, (see Figs. 1 and 1^a:) from positive side of battery Bt, wire b' t', relay Q, (which latter acts as an impedance-coil,) spring 21 to spring 20, and from negative side of battery, wire b t, impedance-coil, and to spring 22. This furnishes a talking-circuit between operators. After instructing the second operator the number of the desired subscriber the first operator allows lever l' by the tension of spring o', Fig. 5, to pass to the left until stop i'' engages trigger j'', which locks the key in that position. When rubber bushing A^2 is disengaged, spring 22, Fig. 5, contacts, 19, 20, 21, 22, and 23 assume their normal open position, disconnecting the operators' sets from each other. A suitable talking-circuit has been shown before between the first subscriber's instrument and the connector-springs y and z on his equipment, Fig. 1. This circuit can be further traced to trunks Nos. 1 and 2, Fig. 1^a, through the bridge 34 and trunk-connector springs y' and z' direct by wires 32^c and 33^c, which constitute the subscriber's talking-circuit through the trunk. It now becomes necessary for the second operator to pull forward to the right of Fig. 5 her lever l' (located at the other end of same trunk) until stop i'' engages a trigger j'', then to complete the connection by operating the switch of the called subscriber in the manner heretofore described. Inasmuch as both relays Q at opposite ends of the trunk are connected in parallel to the positive side of the battery Bt, it may be seen that when either trunk-connector spring z' of this trunk engages the negative side of the battery through some line-connector spring z both relays will operate simultaneously and will continue energized until both trunk-connectors are disengaged. For this reason also a lamp T at each end of the trunk is lighted and extinguished simultaneously and that both lamps continue to display a signal until the trunk is completely disconnected. It may now be seen when both calling and called subscribers have completed conversation and restored their equipments to normal position the electrical connections are severed between y' and z' and y and z, respectively, at both sections and the negative side of the battery connections are thereby opened and both relays Q will become deënergized, allowing both trunk equipments to assume their normal positions. This places the disconnection of all equipments entirely with the subscriber.

Referring now to Figs. 2 and 2^a for a fuller explanation of the circuit-breakers or cut-outs C^4, I would state that there is one of these for each connector-arm 26. Each of these circuit-breakers consists of an upper contact c^4, which is normally resting on a lower contact c^5, which are terminals of the subscribers' lines wired into the cable, and when one side of the bridge-belt has been fully occupied by the successive elevation of pairs of connector-arms 26 the uppermost one of the connector-arms strikes its contact c^4 and lifts it away from the lower contacts c^5, and thus breaks the circuits of the subscribers who have been longest in connection with each other, and thus allows new subscribers to be connected in.

In Figs. 10 and 11 I show a modified means for connecting the subscribers' terminals. The same endless belt 35 with bridge-strips 34 34 are used. The connector-arm 26^b does not have a radial swing, but only a thrust movement. The insulated terminal springs z^2 y^2 are connected to a sleeve slidable vertically on a rock-shaft St and arranged to rotate with it by a feather and groove. The connector-arm 26^b is jointed to a crank 26^c, rigidly fixed to shaft St. The longitudinal movement of the connector-arm 26^b rocks shaft St and causes springs z^2 y^2 to embrace the bridge-strips 34 34, and as belt 35 rises it drags springs z^2 y^2 upward on shaft St.

The leading features of my invention are—

First, the principle of substituting a connector apparatus in place or cords, plugs, and jacks, thereby enabling the operator by means of switch-levers to establish connection between subscribers.

Second, the ending of each subscriber's line in a movable connector, all connectors of each section of switchboard being arranged in parallel lines and in the same plane and providing bridge-strips which may successively be brought to a position at right angles to the lines occupied by connectors and in this same plane and successively passed out of this position after two or more connectors have been moved into engagement with a strip.

Third, by requiring fewer and easier mo-

tions upon the part of the operator in establishing a connection between subscribers and no motions or work in disconnection of same I claim an operator may handle a greater number of subscribers than by present systems.

Fourth, by placing the disconnection within the power of the subscriber this will allow him to signal central for immediately-succeeding calls with the same despatch as the first, inasmuch as he does not wait for operator to disconnect him.

Fifth, by grouping the different parts of each subscriber's equipment, which are liable to become deranged, into separate units interchangeable with every other subscriber's equipment these units are easily and quickly removed from the board and others substituted for them.

Sixth, absolutely secret service.

Seventh, providing a practical trunk system for extending my invention.

Eighth, adjusting a red screen over the lamp to make one lamp display two separate signals for the purpose described.

In carrying out my invention I would have it understood that I do not confine myself to the special construction and arrangement of parts shown, as these may be varied in many respects without departing from the scope of my invention as set forth in the claims.

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

1. A telephone-switchboard, comprising a series of individual switches, one for each subscriber, a movable connector for each switch, each connector having two terminals arranged to be simultaneously adjusted by the switch; combined with a relatively stationary connecting-bridge having two insulated faces adapted to connect the two terminals of one switch-connector to the corresponding two of any other connector substantially as described.

2. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-terminals for each switch, a series of connecting-bridges, said bridges being relatively stationary in relation to the connector-terminals, but being made progressively and intermittently movable to take one pair of connected terminals out of the way of the next substantially as described.

3. A telephone-switchboard, comprising a series of individual switches, one for each subscriber, and movable connector-terminals for each switch; combined with a relatively stationary connecting-bridge adapted to connect the terminals of one switch to those of any other switch and mechanical appliances connecting the movable connector-terminals with the switch for the simultaneous adjustment of the switch-contacts and the said connector-terminals substantially as described.

4. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-terminals for each switch, a series of connecting-bridges, said bridges being relatively stationary in relation to the connector-terminals, but being made progressively and intermittently movable to take one pair of connector-terminals out of the way of the next, and mechanical appliances connecting the movable connector-terminals with the switch for the simultaneous adjustment of the switch-contacts and the said connector-terminals substantially as described.

5. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-terminals for each switch, a series of connecting-bridges, said bridges being relatively stationary in relation to the connector-terminals, but being made progressively and intermittently movable to take one pair of connector-terminals out of the way of the next, and a circuit-breaker for each subscriber's circuit located at a predetermined point in the travel of the connector-terminals to be opened automatically to cut out the oldest connected pair of subscribers after a definite number of subscribers have been connected substantially as described.

6. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-terminals for each switch, a series of relatively stationary bridges adapted to connect the terminals of one switch to those of another, an endless belt carrying these connecting-bridges and motor mechanism for intermittently moving said belt and its series of bridges substantially as shown and described.

7. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-terminals for each switch, a series of relatively stationary bridges adapted to connect the terminals of one switch to those of another, an endless belt carrying these connecting-bridges, motor mechanism for intermittently moving the belt, and a tripping-key arranged at the front of the switchboard and connected to the motor mechanism to intermittently operate the same substantially as described.

8. A telephone-switchboard comprising a series of individual switches, one for each subscriber, and movable connector-terminals constructed as arms pivoted at one end and having two spring-contacts at the other and having both a longitudinal movement and a swinging radial movement, a series of progressively-movable conducting-bridges arranged to connect the contact-springs of one connector-arm to those of another connector-arm, means for projecting the connector-arms to contact with the bridge and means for advancing the series of bridges substantially as described.

9. A telephone-switchboard, comprising a series of individual switches, one for each subscriber, movable connector-terminals con-

structed as tubular arms containing conducting-wires, one end of each of which wires is provided with connections for the switch and the other end of which terminates in two contact-springs, a pivotal support for the connector-arms made movable to permit both a longitudinal thrust and a pivotal swing of said connector-arms, and a series of connecting-bridges for the contact-springs of the connector-arms, said series of bridges being made intermittently movable substantially as described.

10. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-arms having terminals for each switch and having both a longitudinal and radial swinging movement, an endless belt bearing a series of connecting-bridges for the connector-terminals and curved guides for the series of bridges arranged as a curve of a circle for which the connector-arm is a radius, said curved guides being arranged to bear against and hold the series of bridges to the curve of the radial connector-arms substantially as and for the purpose described.

11. A telephone-switchboard, comprising a series of individual switches, one for each subscriber, movable connector-arms having terminals for each switch, and having both a longitudinal and radial swinging movement, an endless belt having a series of bridges for the connector-terminals, curved guides for holding the series of bridges in constant relation to the sweep of the connector-arms, and guides for separating the connector-arms constructed as tension-wires with fixed anchorages at top and bottom substantially as described.

12. A telephone-switchboard comprising a series of individual switches, one for each subscriber, movable connector-arms having terminals for each switch and having both a longitudinal and radial swinging movement, an endless belt having a series of bridges for the connector-terminals, means for guiding the bridges and connector-arms and a cushioned rest along the bottom of the series of bridges for supporting all inactive connector-arms substantially as described.

13. A telephone-switchboard, comprising a series of individual switches, each having a series of circuit-controlling contact-springs and an operating-lever, a series of connector-arms forming terminals of each switch, bridge-pieces for connecting the connector-arms, and a mechanical connection between the operating-lever of the switch and the connector-arms, said mechanical connection being arranged as described to adjust the connector-arms from the deflection of the switch-lever and then pass to a position in which back thrust on the sensitive switch-lever is relieved substantially as described.

14. A telephone-switchboard comprising a series of individual switches, each having an operating-lever extending through the bottom of the same and provided with a friction-roller, a spring-actuated elbow-lever fulcrumed below the switch and having a horizontal arm with a toe adapted to be operated on by the roller, a sliding thrust-bar operated on by the other arm of the elbow-lever, a tilting lever fulcrumed at its lower end, connected to the slide-bar near the middle and provided with a spring opposing the movement of the slide-bar and a connector-arm pivoted to the top of this tilting lever and having both a longitudinal and radial movement as described.

15. In the telephone-switchboard as described the combination with the connector-arms; of the tilting lever pivoted to the same at the upper end and having its lower end constructed as a hook, an axial rod received in said hook and a spring arranged to hold the hooked end of the lever upon the axial rod, to permit easy removal of defective connector-arms from the other connector-arms of the switchboard as described.

16. A telephone-switchboard having a series of subscribers' switches constructed and arranged as separate interchangeable units, combined with a corresponding series of movable connectors having both a longitudinal and lateral movement and a series of connecting-bridges for the connectors substantially as described.

17. A telephone-switchboard having a series of subscribers' switches, each comprehending an operating-lever, a relay and circuit-controlling contacts with inclosing frame forming interchangeable units fitting side by side and combined with seats having corresponding spring-contacts substantially as described.

18. A telephone-switchboard having a series of subscribers' switches, each comprehending an operating-lever, a relay, circuit-controlling contacts, an electric lamp and an inclosing frame forming complete interchangeable units fitting side by side and combined with seats having corresponding contacts substantially as described.

19. A telephone-switchboard having a series of subscribers' switches each comprehending a rectangular frame, an upright operating-lever projecting above the rectangular frame, a relay and circuit-controlling contacts, said parts being constructed as separate interchangeable units combined with a compartment having seats with corresponding electrical contacts, said units being arranged side by side substantially as described.

20. A telephone-switchboard having a series of subscribers' switches, a rectangular frame for the switch left open on its sides and having a lamp-window in its top, and fitting side by side, an electric lamp within the switch-frame and a masking-jacket surrounding the lamp to prevent lighting the adjacent open-sided switches substantially as described.

21. A telephone-switchboard having a signal-lamp with circuits for lighting the lamp

by a subscriber's call; combined with a subscriber's switch having an operating-lever bearing a colored screen adapted to be projected in the path of the lamp's rays by the operator in calling, to apprise the operator of the failure of a called subscriber to answer substantially as described.

22. In a telephone-switchboard, a compartment having a series of seats provided with electrical contacts, removable and interchangeable switches fitting said seats and having contacts to receive calls, to call subscribers, and to connect subscribers, all contained within a single frame and combined with and operated by a single lever substantially as described.

23. As a separate unit of a telephone-switchboard, a subscriber's switch comprehending a rectangular frame with open sides and lamp-window in the top, an upright operating-lever arranged centrally in the frame and bearing laterally-projecting pins, a relay and lamp arranged upon opposite sides of the lever and contact-springs arranged in two groups on opposite sides of the lever and between the lamp and the relay, said contact-springs being arranged to be operated upon by the pin of the lever substantially as described.

24. The combination with the relay in the subscriber's switch and the circuit-contacts; of an armature having double detent-triggers and an operating-lever for adjusting the circuit-contacts, said lever having a lug playing between the two triggers arranged to catch and lock the lever in both positions of the armature, said armature also having an elbow-arm for controlling the contact-springs substantially as described.

25. The combination with the rectangular frame of the subscriber's switch, the contacts contained therein and an electric lamp; of an operating-lever bearing a color-screen connected to the said operating-lever and adapted to be projected in front of the lamp of the called subscriber substantially as and for the purpose set forth.

26. The combination with the rectangular frame of the subscriber's switch and the sets of contacts contained therein; of an upright operating-lever for these contacts fulcrumed on a horizontal axis and having a laterally-projecting pin and a bent spring arranged transversely to the lever and connected to the frame and having the pin of the lever playing in the middle portion of the bend without opposition and with the bent portions of the spring opposing the extreme movement of the lever to right or left as set forth.

27. The combination with the relay in the subscriber's switch, the line-circuits and the circuit-contacts; of an armature having double detent-triggers and an operating-lever for adjusting the circuit-contacts, said lever having a lug playing between the two triggers arranged to catch and lock the lever in both positions of the armature; whereby when said armature is attracted by its relay said lever is locked in a position in which said circuit-contacts are arranged in position for a connection between two subscribers, and when said armature is released, by the opening of the line-circuit through the said relay at the said subscriber's telephone, said lever is unlocked and allowed to assume its normal position, thus placing the disconnection under the control of the subscriber substantially as described.

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