

G. RITTER.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 24, 1897.

4 SHEETS—SHEET 1.

NO MODEL.

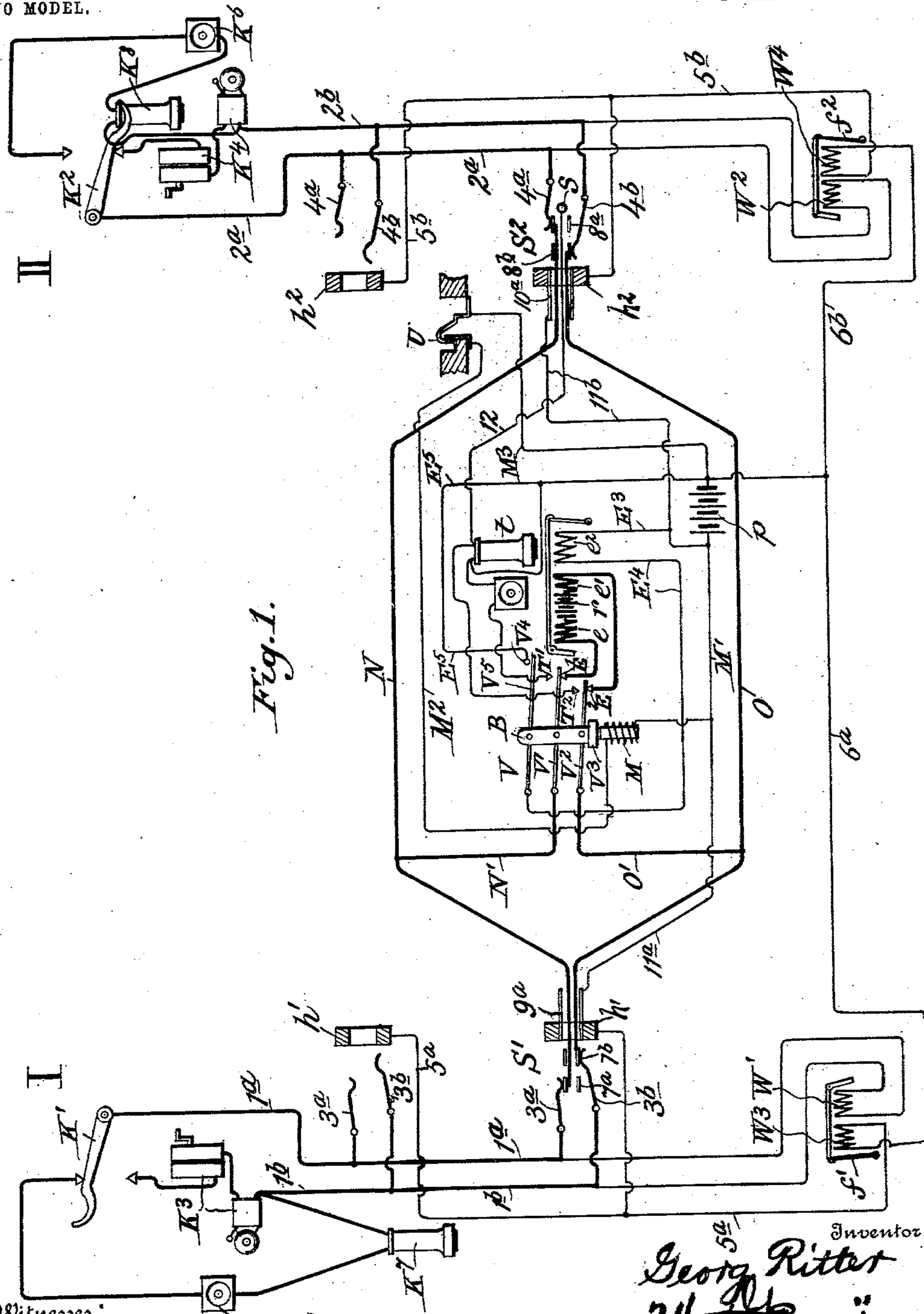


Fig. 1.

Witnesses:
F. H. Schott
M. C. Massie.

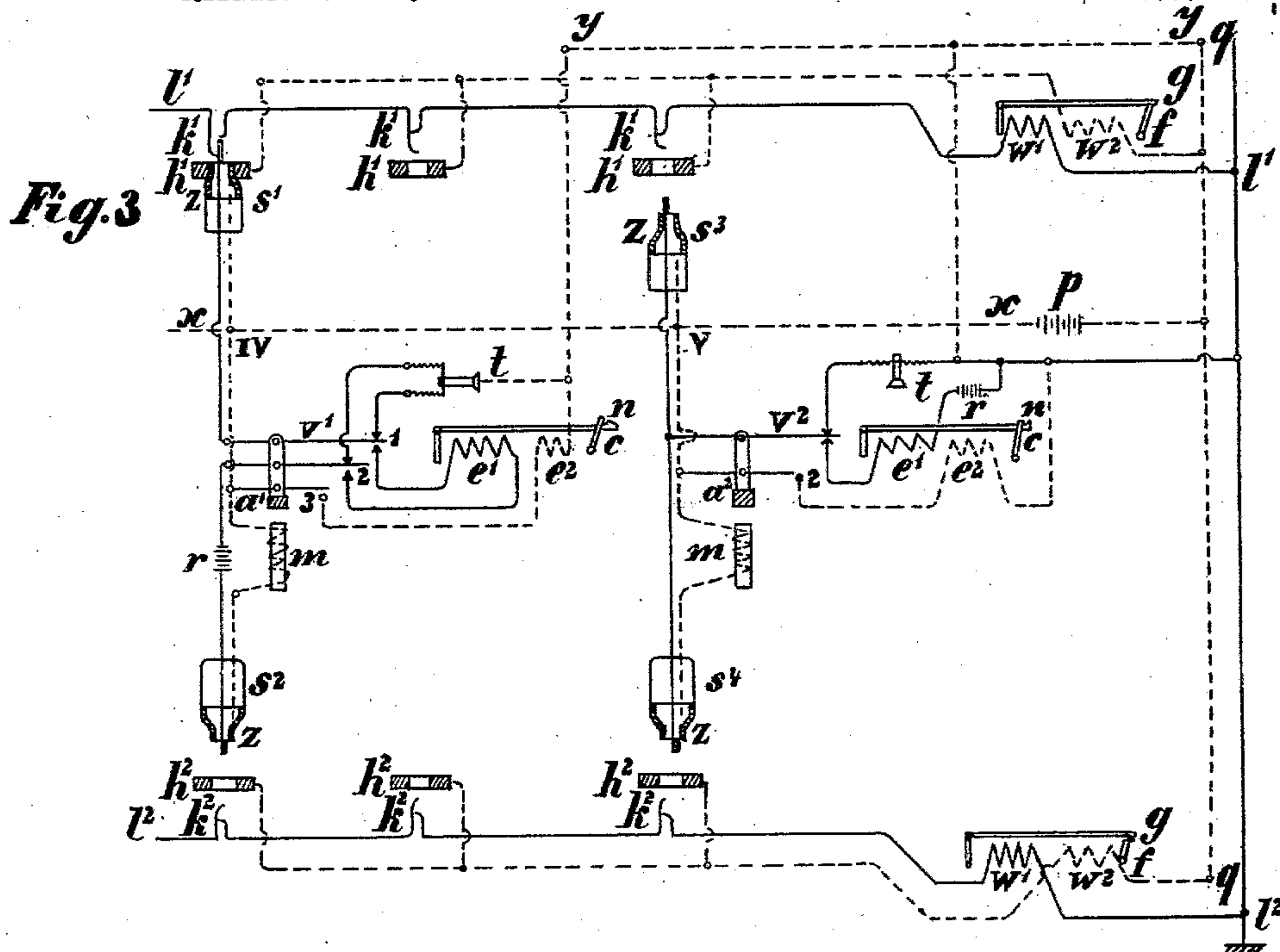
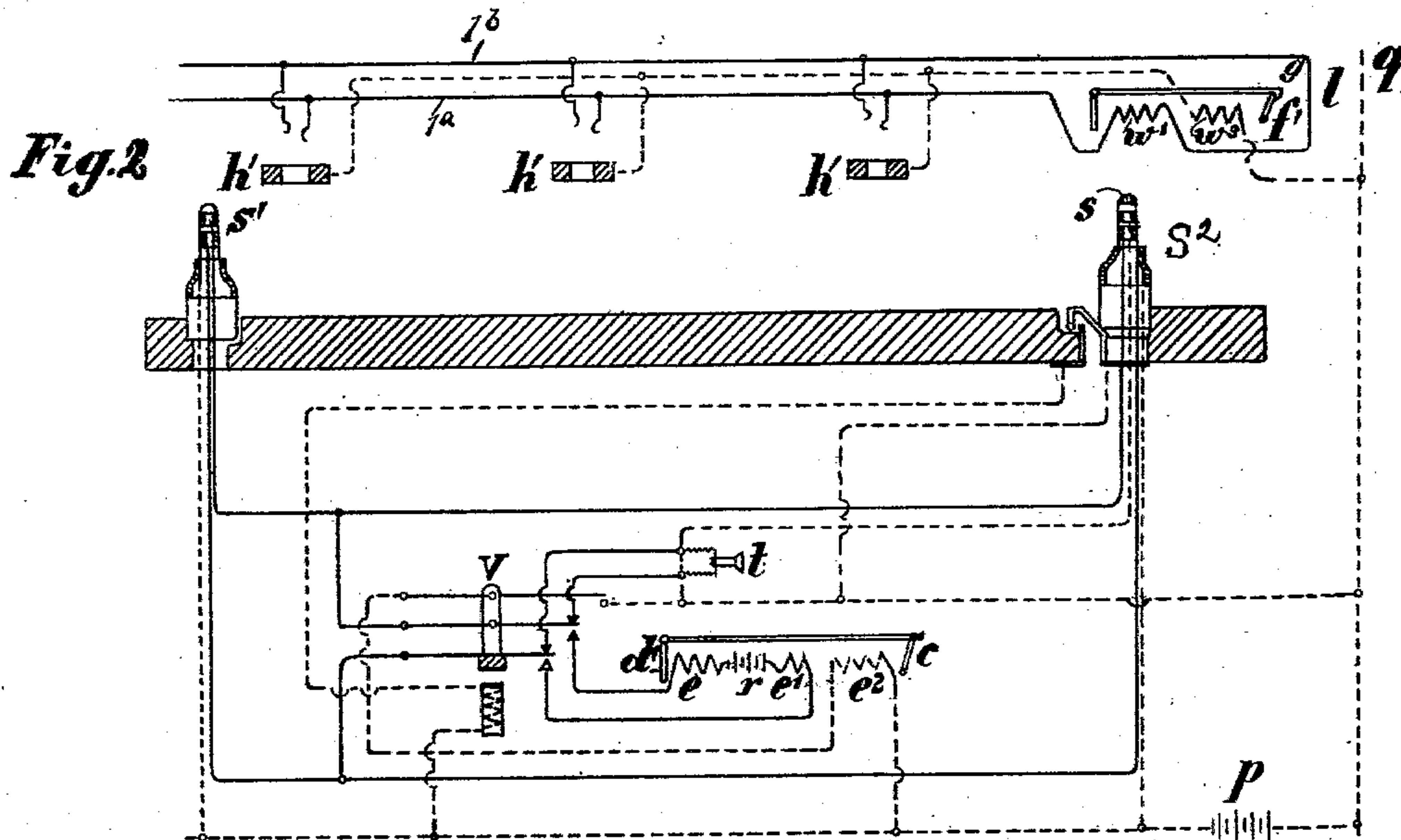
By
George Ritter
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4 SHEETS—SHEET 2.



Witnesses
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No. 745,523.

PATENTED DEC. 1, 1903.

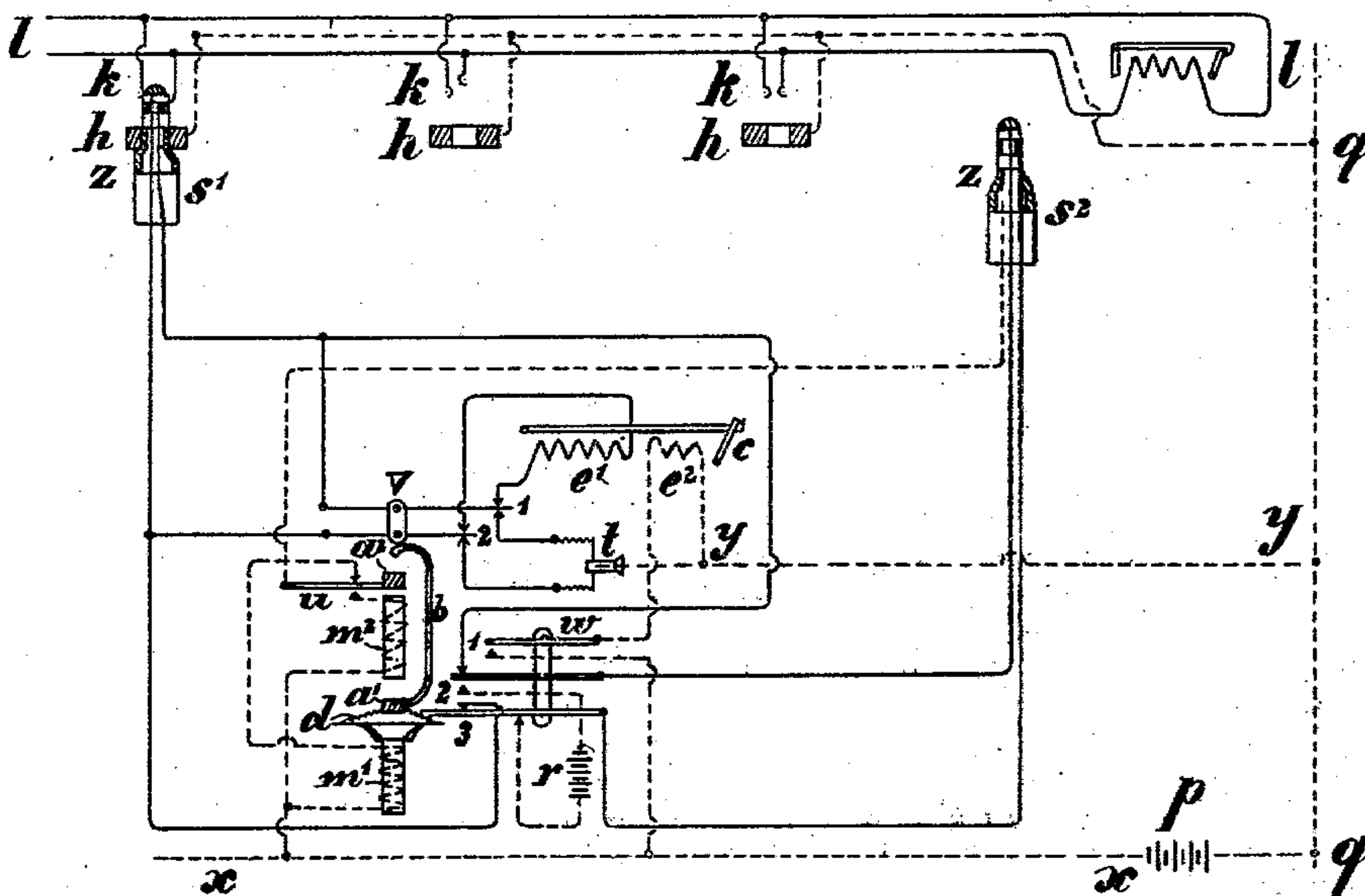
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4 SHEETS—SHEET 3.

Fig. 4.



Witnesses

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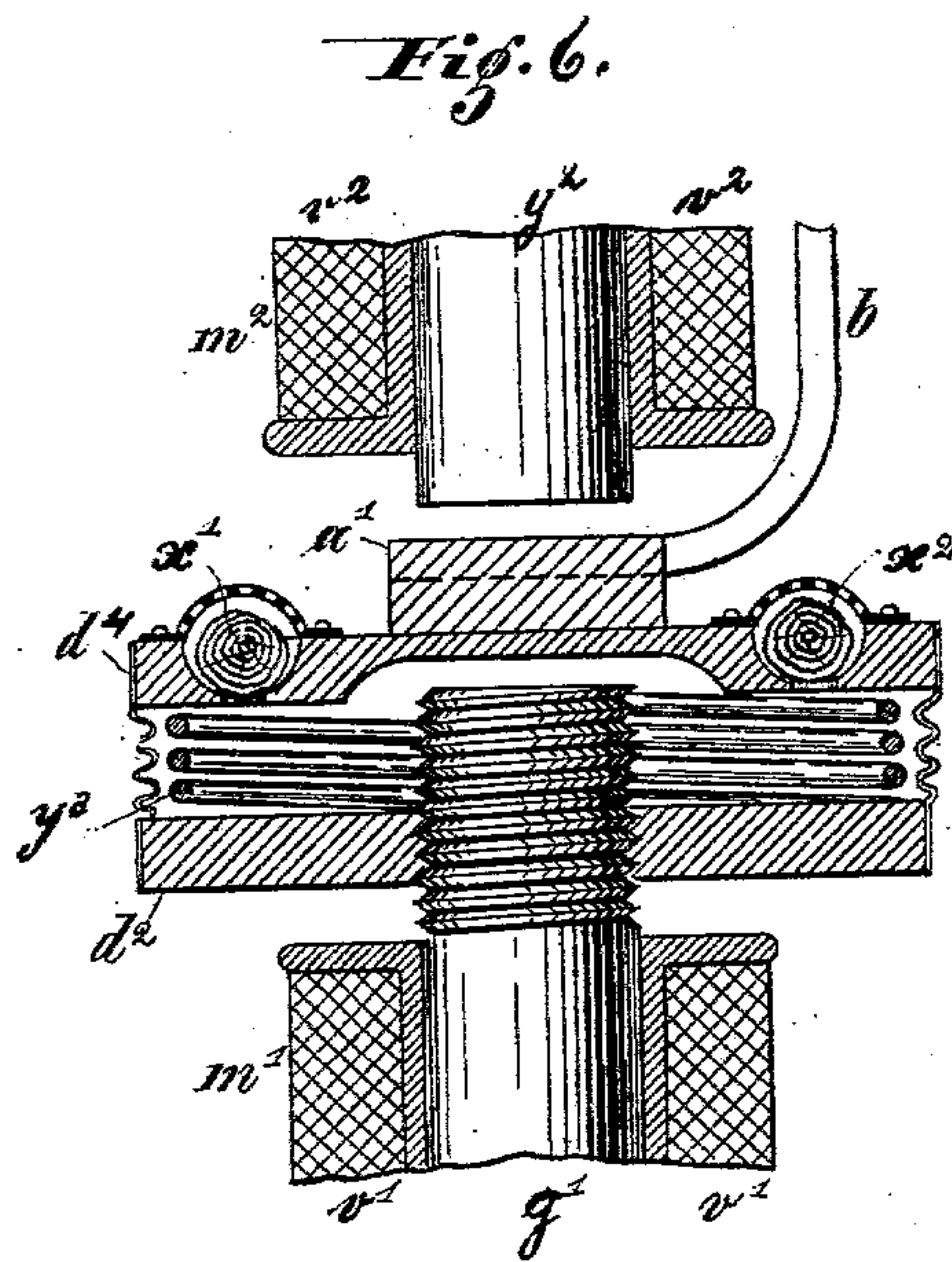
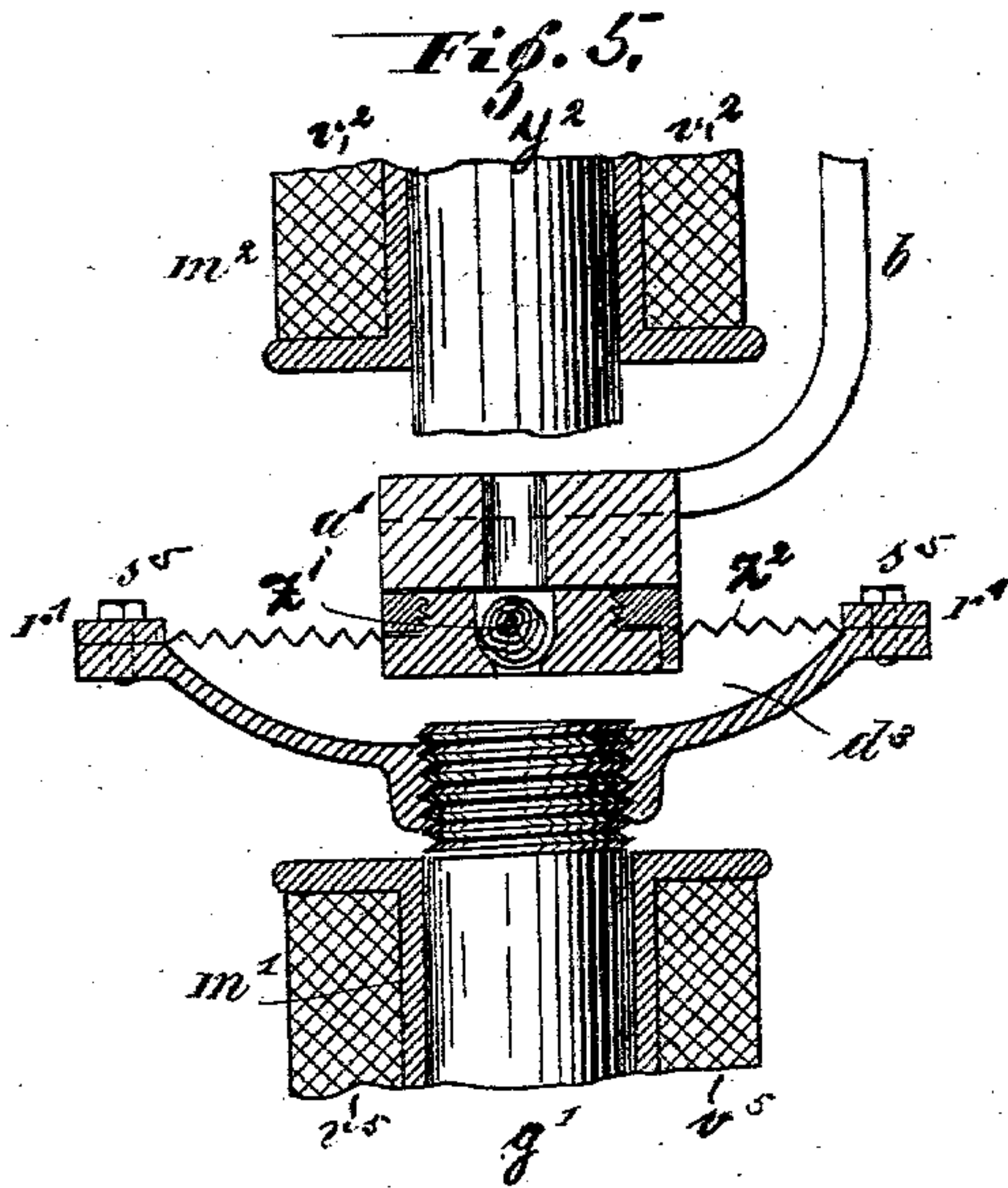
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G. RITTER.
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NO MODEL.

4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

GEORG RITTER, OF STUTTGART, GERMANY.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 745,523, dated December 1, 1903.

Application filed December 24, 1897. Serial No. 663,314. (No model.)

To all whom it may concern:

Be it known that I, GEORG RITTER, a subject of the German Emperor, residing at Stuttgart, Germany, (and whose post-office address is the same,) have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to improvements in telephone-exchange systems.

The object of my invention is to provide a system which will render automatic the interchanging of the operator's telephone and the clearing-out annunciator and the calling of the desired subscriber.

With this object in view my invention consists in the features, details of construction, and combination of parts, which will first be described in connection with the accompanying drawings and then more particularly pointed out in the claims.

In the drawings, Figure 1 is a diagrammatic view of a system embodying my invention; Fig. 2, a diagrammatic detail view of the operator's switchboard, showing one set of connecting-plugs; Fig. 3, a diagrammatic view of a switchboard with two sets of plugs and their circuit connections, one set of circuit connections being somewhat different from the other, as will be more fully explained hereinafter; Fig. 4, a diagrammatic view of another embodiment of my invention; and Figs. 5 and 6 detail sectional views, partly in elevation, of a portion of the switch-actuating mechanism of my device, illustrating means for retarding the movement thereof in one direction.

Referring to Fig. 1 of the drawings, two substations are shown at I and II, respectively. These substations are connected by the line-wires $1^a 1^b 2^a 2^b$ with the central station, thereby forming a metallic circuit from each substation to the central station, at which place the said line-wires are associated with the usual calling-annunciators and jacks, the calling-annunciators each having the usual operating-coil $W' W^2$ for throwing the respective shutters $f' f^2$, which coils $W' W^2$ are included in their respective substation-circuits. The jack-springs are indicated at $3^a 3^b 4^a 4^b$, respectively, and in front of each jack is located a jack-ring $h' h^2$. Each call-

ing-annunciator is also provided with a restoring-coil $W^3 W^4$, the restoring-coil of each calling-annunciator being connected with all the jack-rings of its respective line by a conductor $5^a 5^b$, respectively, the other terminal of each restoring-coil being connected to a common source of energy—as, for example, the battery p —by a conductor $6^a 6^b$.

At S' and S^2 are shown the plugs, the former being the answering-plug and the latter the connecting-plug. Each plug in addition to the usual terminals $7^a 7^b 8^a 8^b$ has a shell or ring terminal $9^a 10^a$, respectively, arranged to make an electric connection with the respective jack-rings $h' h^2$ when the plug is in its jack, the said shells being connected by conductors $11^a 11^b$, respectively, to that pole of battery p which is opposite to the pole to which conductors $6^a 6^b$ are connected. The connecting-plug S^2 differs from the answering-plug S' in having a tip-terminal s , which is connected by a conductor 12 with one side of the operator's telephone, the other side of said telephone being connected to the same pole of battery p as are conductors $6^a 6^b$.

The plug-connector conductors are indicated at N and O, these conductors being connected by a bridge conductor formed of the two parts N' and O' and including a main-circuit changer V, arranged to interchange the central-station telephone and the clearing-out annunciator in their connections with the talking-circuit, said central-station telephone being indicated at t and the operating-coil for the clearing-out annunciator being shown at $e e'$, this coil being divided and a calling-battery r inserted between the two parts. The said main-circuit changer V has two switch-arms $V' V^2$, the former being arranged to engage either the contact T' or the contact E' , while the latter arm, V^2 , is arranged to engage either the contact T^2 or the contact E^2 . The contacts $T' T^2$ form the terminals of the operator's telephone set, while the contacts $E' E^2$ form the terminals of the main coil $e e'$ of the clearing-out drop. The two switch-arms $V' V^2$ are connected to the respective parts $N' O'$ of the bridge conductor. The switch-arms $V' V^2$ are connected to an armature V^3 , arranged to be attracted by an electromagnet M, whose coil is included in a local circuit formed by the conductors

M' M² M³ and including a suitable source of electricity—as, for example, the battery *p*. The said local circuit is arranged to be closed automatically by a switch U, located at the holder for the connecting-plug, the construction being such that the plug when in its holder will keep the switch U open, said switch returning to its closed position immediately upon the removal of said connecting-plug. The two switch-arms V' V² are connected so as to move together—as, for example, by the frame or link B, of non-conducting material.

The clearing-out annunciator is provided with a restoring-coil *e*², included in a branch circuit from the battery *p*, said branch circuit being formed by the conductors E³ E⁴ E⁵ and including a switch-arm V⁵, connected to the link B of the main-circuit changer V, the switch-arm V⁵ being arranged to wipe over a contact-point V⁴, to which the conductor E⁵ is connected.

The substations have the usual telephone hook-levers K' K², the magnetos and bells K³ K⁴, transmitters K⁵ K⁶, and receivers K⁷ K⁸, respectively, the connections at each substation being such as to cut out the bells and magnetos when the telephone receiver and transmitter are in use.

The operation of the apparatus thus far described is as follows: Assume that substation I desires to communicate with substation II and has called the central station. The operator plugs with the answer-plug S' into the jack of the line to station I, which results in placing the operator's telephone *t* in circuit with the substation I, the talking-circuit being from said station I over the lines 1^a 1^b, thence over jack-springs 3^a 3^b and plug-terminals 7^a 7^b, the plug-conductors N and O, over the bridge conductor, the switch-levers V' and V², thence to the contact-points T' T², and thence through the central telephone. At the same time the insertion of the plug S' in the jack closes the circuit between the conductors 11^a and the jack-ring *h*', whereby the restoring-coil W³ of the calling-annunciator is energized to restore the drop, the circuit being from battery *p* along a part of conductor M', thence over conductor 11^a, terminal 9^a of the plug S', through the jack-ring *h*', over conductor 5^a, coil W³, and conductor 6^a, back to the other pole of the battery *p*. The number of the desired station being obtained by the operator, the calling-plug S² is inserted into the jack of the line to be called, in this case assumed to be the line to station II. The removal of the plug S² from its holder U allows the switch to close the local circuit over conductors M' M² M³ and magnet M, thereby energizing said magnet and causing it to attract its armature, whereby the main-circuit changer is moved to cut out the central-station telephone and cut in the main coil of the clearing-out annunciator. This position of the switch V is shown in Fig. 1 of the drawings. As soon as this is done

the battery *r* energizes the circuit to substation II, and thus rings a call at said substation. The call continues until the subscriber at said substation removes the telephone-receiver K⁸ from the hook-lever K², whereupon the call-bell is cut out in the usual manner. The connection is thus completed between substations. As the main-circuit changer moves from one position to the other the switch-lever V⁵ is drawn onto the contact-point V⁴ and then off again, thereby closing the local circuit of the battery *p* through the restoring-coil *e*² of the clearing-out annunciator, whereby the drop is restored to its usual position. Upon the close of the conversation the subscriber rings off, as usual, thus dropping the shutter of the clearing-out annunciator, whereupon the operator clears out the plug-connectors, and the circuit-changer V is automatically returned to its normal position by a suitable spring, (not shown,) thus inserting the central-station telephone in the circuit of the plug-conductors and cutting out the clearing-out annunciator.

The conductor 12 and the tip S of the plug S² serve for making busy tests, as follows: Before inserting the connecting-plug into the jack of the desired substation the operator touches the ring of said jack with the tip S of the connecting-plug. If the line with which this jack is associated is in use, a circuit will be closed as follows: from the battery *p* over the conductor 11^b and the plug-terminal 10^a to the ring *h*², in which it is inserted, thence by the wire 5^b to the other ring *h*², which is supposed to have been tested by the other operator, thence from said other ring *h*² by way of tip-terminal s of the connector-plug which is being used to make the test, back over the corresponding conductor 12 of said plug and the telephone-receiver *t*, associated therewith, to the other pole of the battery *p*, it being understood that said battery *p* is common to all the operators' sets in the exchange.

The closing of the test-circuit as above described will give a click in the testing-operator's receiver and indicate in this way that the desired line is already in use.

As the battery *r*, which serves as a source of calling-current, is included in the talking-circuit during the continuance of a connection between substations, and hence would tend to energize the main coil of the clearing-out annunciator, it is necessary to use a polarized armature for the said clearing-out annunciator, as is obvious to those skilled in the art.

Fig. 2 shows the position of the switch V when the plugs are not in use. In this view the armature of the clearing-out annunciator is shown at *d*' and the drop at *c*.

In Fig. 3, *l*' *l*² *l*³ *l*⁴ represent subscriber-lines with return through the earth. *k*' *k*² are spring-jacks with corresponding rings *h*' *h*², and two pairs of plugs *s*' *s*² *s*³ *s*⁴ are shown. A battery *p* is arranged near the switchboard,

and one of the poles is connected to each of the rings h' h^2 , while the other pole is connected through line $x x$ and the coils of the electromagnets m with the cheeks z of the calling or connecting plugs s^2 s^4 , and, as shown in the drawings, the latter pole of battery p is also connected with the cheeks of the answering-plugs s' and s^3 . This latter connection serves in the so-called "multiple" switchboards as a part of the test-circuit, so that by touching a ring with the tip of a connecting-plug it is possible to ascertain if the lines are busy or not. Moreover, an auxiliary coil w^2 for the annunciator-drop f , adapted to raise the same automatically, is arranged between the rings h' h^2 and the battery p . The test connections are only shown for the sake of completeness in Fig. 3 and do not make part of my improvement. Switches v' and v^2 are connected with the pairs of plugs IV and V, serving to interchange the operator's telephones t and the annunciator-coils e in the circuit of the plugs. The armatures a' a^2 of the magnets m are so connected with the switch-levers that when in the position of rest the operator's telephones t are in the speaking-circuit.

Connections between two subscribers are made as follows: When the line-annunciator has dropped, the calling subscriber is communicated with by inserting the plug s' or s^3 in the ring h' of his circuit, which can be immediately accomplished, as the operator's telephone is in the circuit. So soon as the number of the subscriber to be called is obtained the calling or connecting plug s^2 or s^4 , corresponding to the answering-plug s' or s^3 just used, is placed in the ring h^2 of the circuit to be called, whereby the auxiliary circuit of battery p is closed by metallic contact of the cheek z of the plug with the ring h^2 , thus energizing the respective electromagnet m situated in this auxiliary circuit and causing the armature a' or a^2 to be attracted, whereby instead of the operator's telephone t the coil e' of the annunciator is cut in. When being moved from one situation into the other, the arm 3 of the switch v' slides over a contact connected with the restoring-coil e^2 of the annunciator, whereby the circuit of battery p through arm 3 and lines $y y$ and through said restoring-coil is temporarily closed and the annunciator c is automatically raised.

The pairs of plugs IV and V show two different forms of circuits for the operator's telephones t and the annunciator-coils e' . In the first case these devices are cut into the speaking-circuit, while in the second case they are in the auxiliary circuit between the speaking-circuit and the ground. The latter arrangement is now preferred to the former; but it requires a high resistance and great self-induction for coil e' of the annunciator. A battery r is provided as a source of calling-current, located in the form of circuits, shown in pair IV in the speaking-circuit and in pair

V in the auxiliary circuit, as shown. The latter arrangement presents the advantage that for the whole office a single battery r in the ground-line will suffice, while for the former a special battery r is required for each pair of plugs. The bells or other signals of the subscribers are so constructed that they are actuated by the current coming from battery r , so that the same are automatically set in action when the respective calling-plug s^2 or s^4 is employed.

As the current of battery r passes into the speaking-circuit during the connection of two subscribers, only continuous current can be then used; but if an alternating current is to be used an arrangement as shown in Fig. 4 will be necessary. In this figure the subscriber's lines $l l$ are shown as provided with a double or loop line—that is to say, metallic circuits are shown—but it is to be understood that a grounded circuit may also be used. In the auxiliary circuit of the battery p a second magnet m^2 is provided, which is alternately cut in the circuit by a switch u .

The armature a' is common to both magnets—i. e., it is so located that it can be alternately attracted by each of the magnets. Upon the pole of the magnet m' , turned toward the armature a' , is arranged a metal cap d , provided with a flexible diaphragm similar to those used in aneroid barometers. This diaphragm is drawn in by the magnet m' when the armature a' of said magnet is attracted. A valve, as Z' , Fig. 5, arranged in this cap, allows the air to escape when the cap is so drawn in and will tend to prevent the readmission of the air when the cap is released, so that the same will only slowly re-assume its original form. The three coupled levers of the switch w are connected with the diaphragm, whereby they perform the same movements as the said diaphragm. As in the construction shown in Fig. 1, the auxiliary circuit is closed when the call-plug is inserted in a jack, whereby the current of battery p passes over $x x$, m' , u , z , h , and $q q$, thus causing the attraction of armature a' by electromagnet m' , whereby the three arms of switch w touch the three contacts at the lower end of these with the following result:

Arm 1 closes the circuit from battery p over the restoring-coil e^2 of the annunciator and over lines $y y$ and $q q$, so that the annunciator-drop c is raised, the arms 2 and 3 break the two branches of the speaking-circuit in regard to the answering-plug s' , and connect the source r of calling-current to the calling-plug s^2 until the circuit is broken at arms 1 and 2 in virtue of the filling of cap d with air.

Before armature a' has traveled through its path toward the magnet m' the link b , connected to said armature, strikes the armature a^2 of the magnet m^2 and moves it, with its connected switch u , from the upper to the lower circuit-contact, whereby the current of battery p is cut off from magnet m' and passed into magnet m^2 with the following result: Ar-

mature a^2 and switch u are held in their new position, while armature a' , which only bears against the cap d , is attracted by magnet m^2 , whereby the link b moves switch v from its

5 lower contacts to the two upper contacts, thus causing the cutting out of the attendant's telephone t from its connection to the talking-circuit and the connection of coil e' of the annunciator to the talking-circuit, thus inter-
10 changing said central-station telephone and the clearing-out annunciator in their connection with the talking-circuit. The valve of the diaphragm and also the spring of armature a' , as well as the general construction of
15 this portion of the device, are shown in detail in longitudinal section in Figs. 5 and 6.

In the construction shown in Fig. 5 a disk-shape metal piece d^3 is screwed onto the iron core g' of the magnet m' , and the corrugated
20 flexible diaphragm z^2 is fixed to d^3 by means of the ring r' and the screws s^5 . The said flexible diaphragm z^2 is equipped with the ball-valve z' , upon which normally rests the armature a' , connected to the link b . This
25 armature is provided with a central hole for the escape of the air in the valve. If the current is passed through the coil v^5 of the magnet m' , the armature a' , attracted by the magnet, will push the diaphragm z^2 downward,
30 whereby the air can readily escape through valve z' , while, on the other hand, when the diaphragm by its resiliency is moved back to its normal position the air can only slowly enter beneath the diaphragm z^2 , thus retard-
35 ing the upward movement of the said diaphragm.

The arm 3 of the switch w , Fig. 4, rests upon the diaphragm z^2 . Each of the three arms of this switch is so constructed as to
40 exert a downward spring action.

Instead of the flexible-diaphragm form of device shown in Fig. 5 a bellows form of device, as shown in Fig. 6, may be used, the same being provided with several ball-valves
45 $x' x^2$. In this form the cover d^4 is pushed upward by the spiral spring y^3 , located in the bellows, the remaining portions of the device being substantially the same as shown in Fig. 5. In either construction, Figs. 5 and 6, the
50 distance between the armature a' and the coil m' can be changed by screwing the device up or down on the core g' .

As will be understood from the description hereinbefore, the telephone t when not in use is connected with the plug-circuits, so that
55 when a plug is inserted into a ring of a calling-line speaking connection is complete without the use of a switch. Hence with the construction shown in Fig. 4 so soon as the
60 connection between the two substations is completed the link b pushes the two arms of switch v upward owing to the fact that the armature a' is attracted by its magnet m^2 , so that the annunciator-coil e' is cut into and
65 the telephone t cut out of the talking-circuit. The arms of switch v have a downward spring action, so that when the pressure of

link b ceases—i. e., after the attraction of armature a' by magnet m^2 discontinues—these arms automatically move downward 70 and again cut in the telephone.

If the resistance of the magnets m is to be eliminated from the testing-circuit $x x q q$, the auxiliary circuit may be closed by a contact located at the calling or connecting seat 75 of the plug s^2 , which is closed when the plug is raised in the same way as shown at U, Figs. 1 and 2. In this case also the battery r may be a common source of calling-current for the entire exchange, in which case the coils $e' e^2$ 80 must have a great resistance and a high self-induction.

Having thus fully described my invention, what I claim is—

1. In a telephone system, the combination, 85 with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone and a clearing-out signaling device, of a source of calling-current, electromagnetic means arranged to close said 90 source of calling-current onto one of the plugs and interchangeably connect the clearing-out signaling device and central-station telephone to the talking-circuit, a local circuit in which said electromagnetic means is in- 95 cluded, and mechanism for closing said local circuit, whereby said electromagnetic means is set in operation.

2. In a telephone system, the combination, 100 with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between said central-station telephone and the terminals of the answering-plug, and a clearing-out signaling device, of a main-circuit 105 changer arranged to interchangeably connect the central-station telephone and the clearing-out signaling device to the talking-circuit, a source of calling-current, and means, actuated in producing the connection between 110 the substations, and arranged to operate the main-circuit changer and switch the source of calling-current onto the terminals of the connecting-plug.

3. In a telephone system, the combination, 115 with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between said central-station telephone and the terminals of the answering-plug, and a clearing-out signaling device, of a main-circuit 120 changer arranged to interchangeably connect the central-station telephone and the clearing-out signaling device to the talking-circuit, a source of calling-current, and means 125 actuated by the insertion of the connecting-plug in a jack for operating the main-circuit changer and switching the source of calling-current onto the terminals of the connecting-plug. 130

4. In a telephone system, the combination, with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between

said central-station telephone and the terminals of the answering-plug, and a clearing-out signaling device, of a main-circuit changer arranged to interchangeably connect the central-station telephone and the clearing-out signaling device to the talking-circuit, a source of calling-current, means operated by the insertion of the connecting-plug in a jack for operating the main-circuit changer and switching the source of calling-current onto the terminals of the connecting-plug, and mechanism for cutting off said source of calling-current from said plug-terminals.

5. In a telephone system, the combination, with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between said central-station telephone and the terminals of the answering-plug, and a clearing-out signaling device, of a main-circuit changer arranged to interchangeably connect the central-station telephone and the clearing-out signaling device to the talking-circuit, a source of calling-current, means operated by the insertion of the connecting-plug in a jack for operating the main-circuit changer and switching the source of calling-current onto the terminals of the connecting-plug, and automatic mechanism for cutting off said source of calling-current from said plug-terminals.

6. In a telephone system, the combination, with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between said central-station telephone and the terminals of the answering-plug, and a self-restor-

ing clearing-out annunciator, of a main-circuit changer arranged to interchangeably connect the central-station telephone and the clearing-out annunciator to the talking-circuit, a source of calling-current, means operated by the insertion of the connecting-plug in a jack for operating the main-circuit changer and switching the source of calling-current onto the terminals of the connecting-plug, mechanism for cutting off said source of calling-current from said plug-terminals, and automatic means for restoring the clearing-out annunciator to its normal condition.

7. In a telephone system, the combination, with the substation-lines, their jacks, a pair of plugs, their connecting-conductors, a central-station telephone, connections between said central-station telephone and the terminals of the answering-plug, and a clearing-out annunciator, of a main-circuit changer arranged to interchangeably connect the central-station telephone and the clearing-out annunciator to the talking-circuit, an electromagnet for operating said main-circuit changer, an auxiliary circuit including said electromagnet, means for energizing said auxiliary circuit, and mechanism for opening and closing the auxiliary circuit.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

GEORG RITTER.

Witnesses:

WILHELM LEVY,
CHRISTIAN BAUER.