

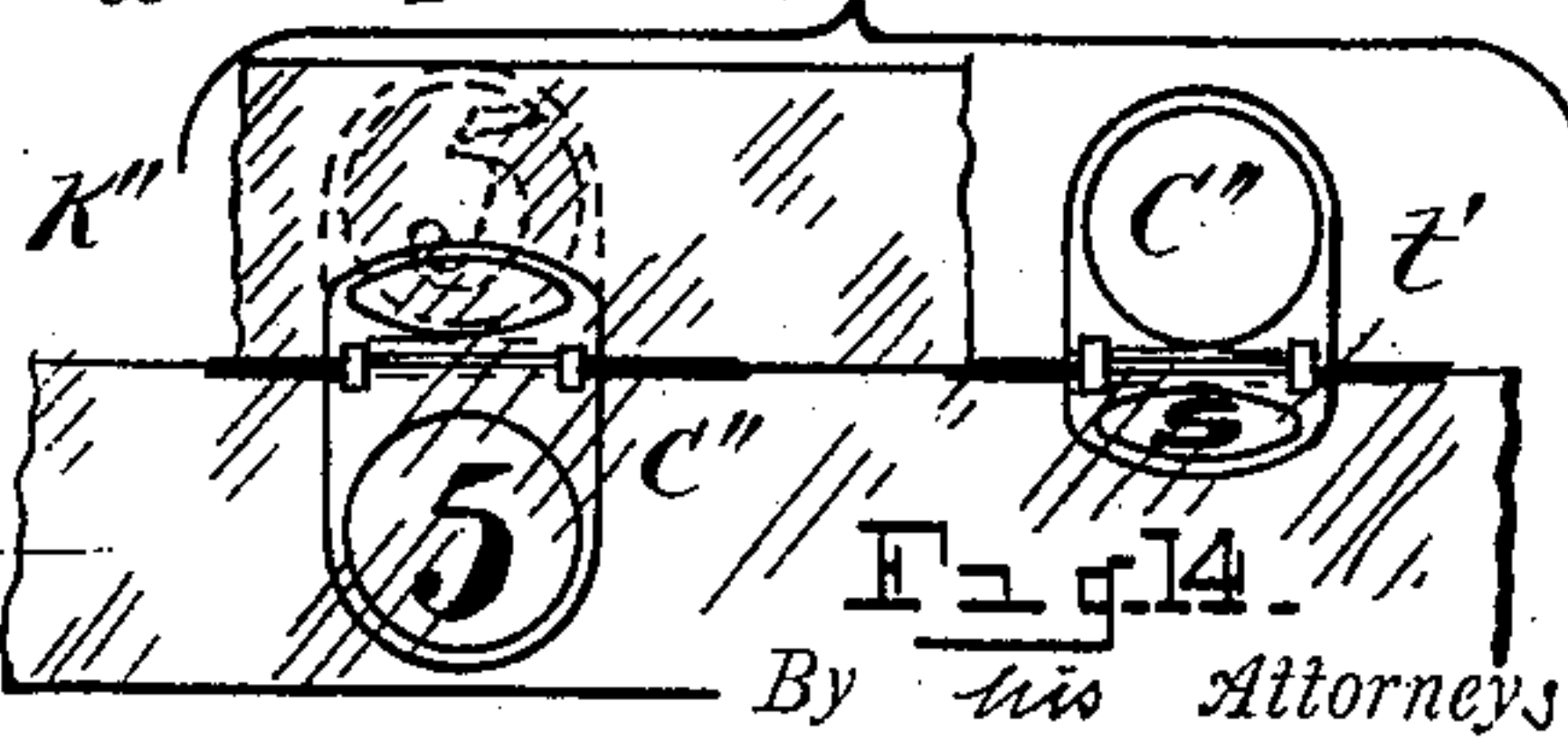
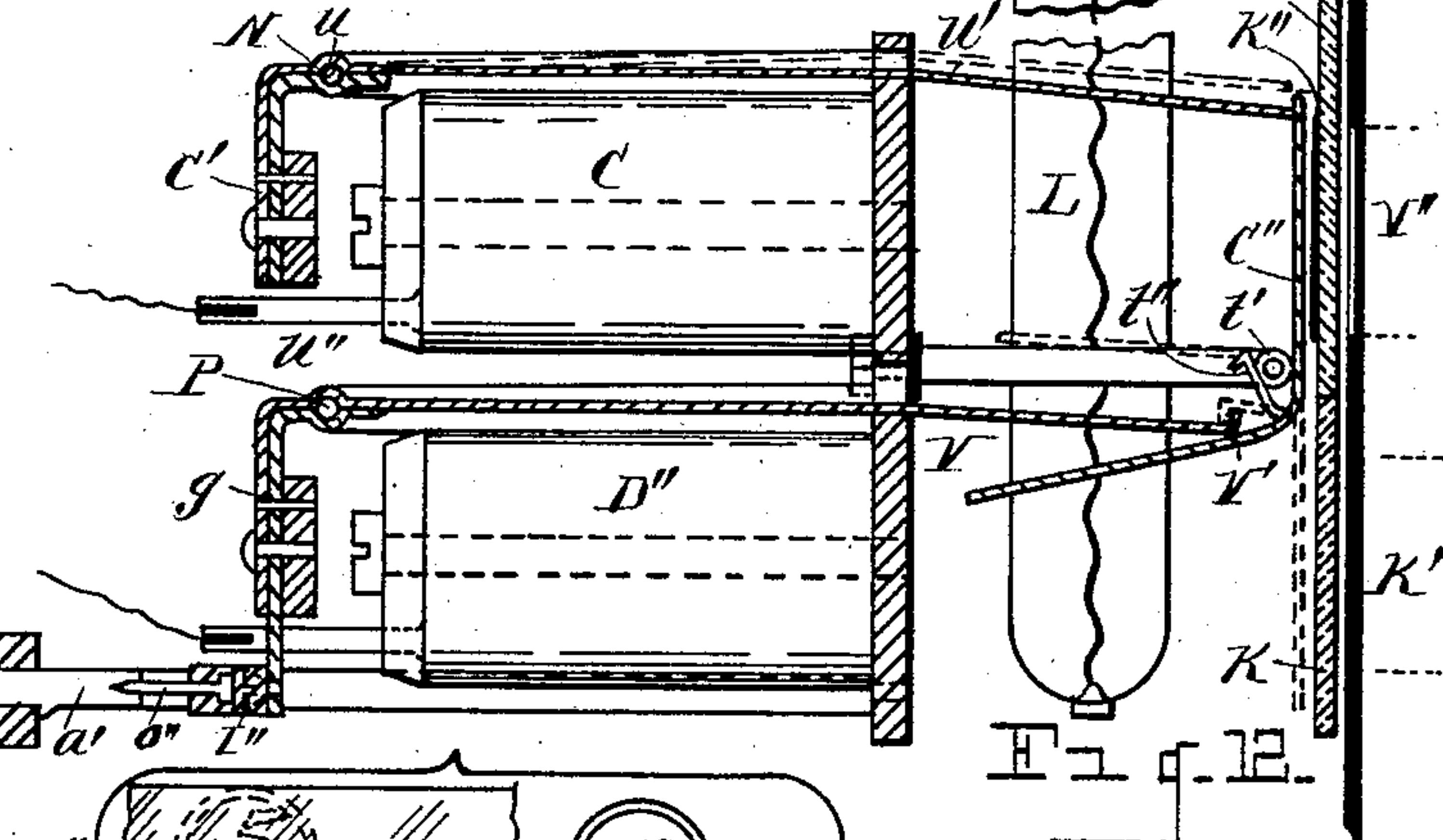
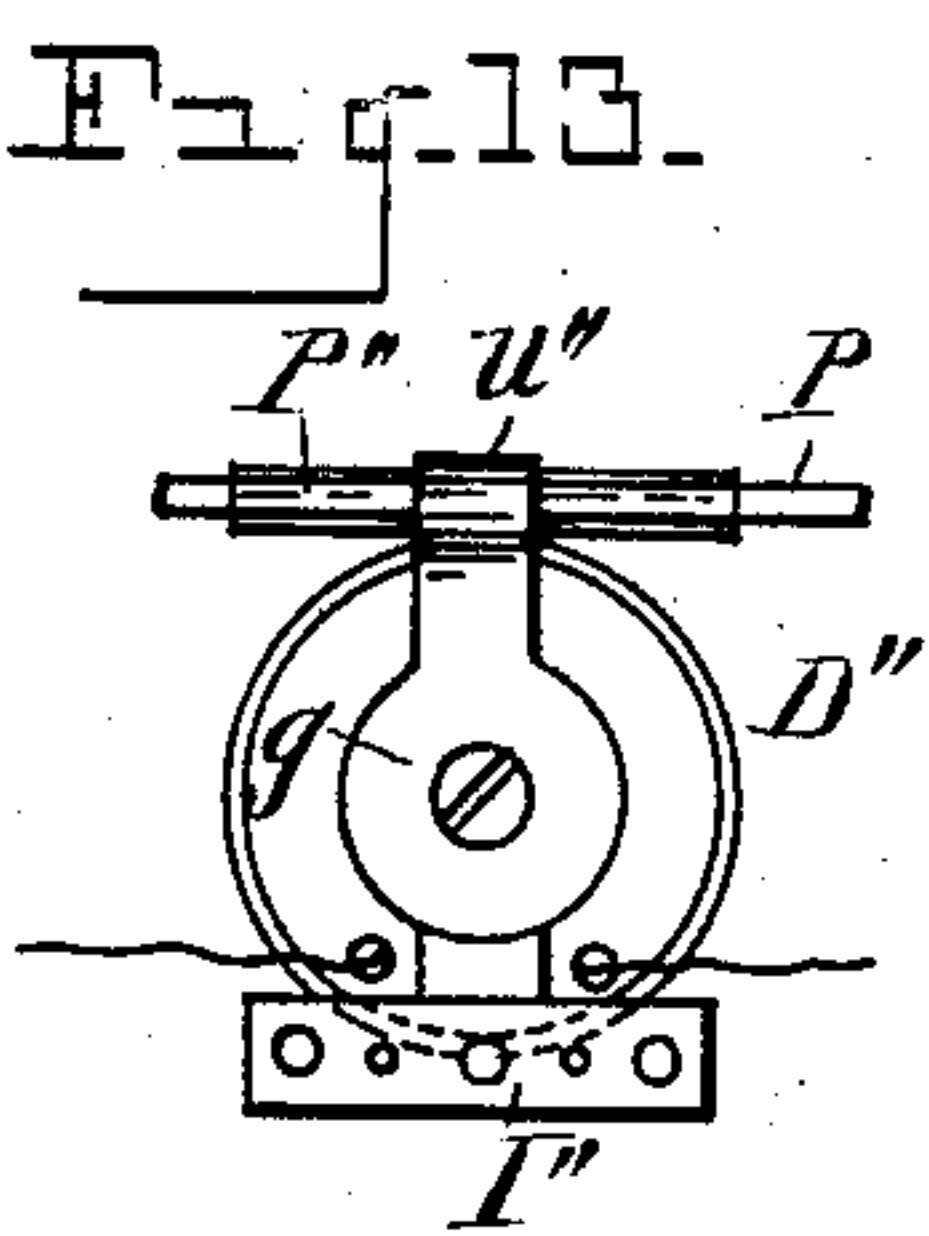
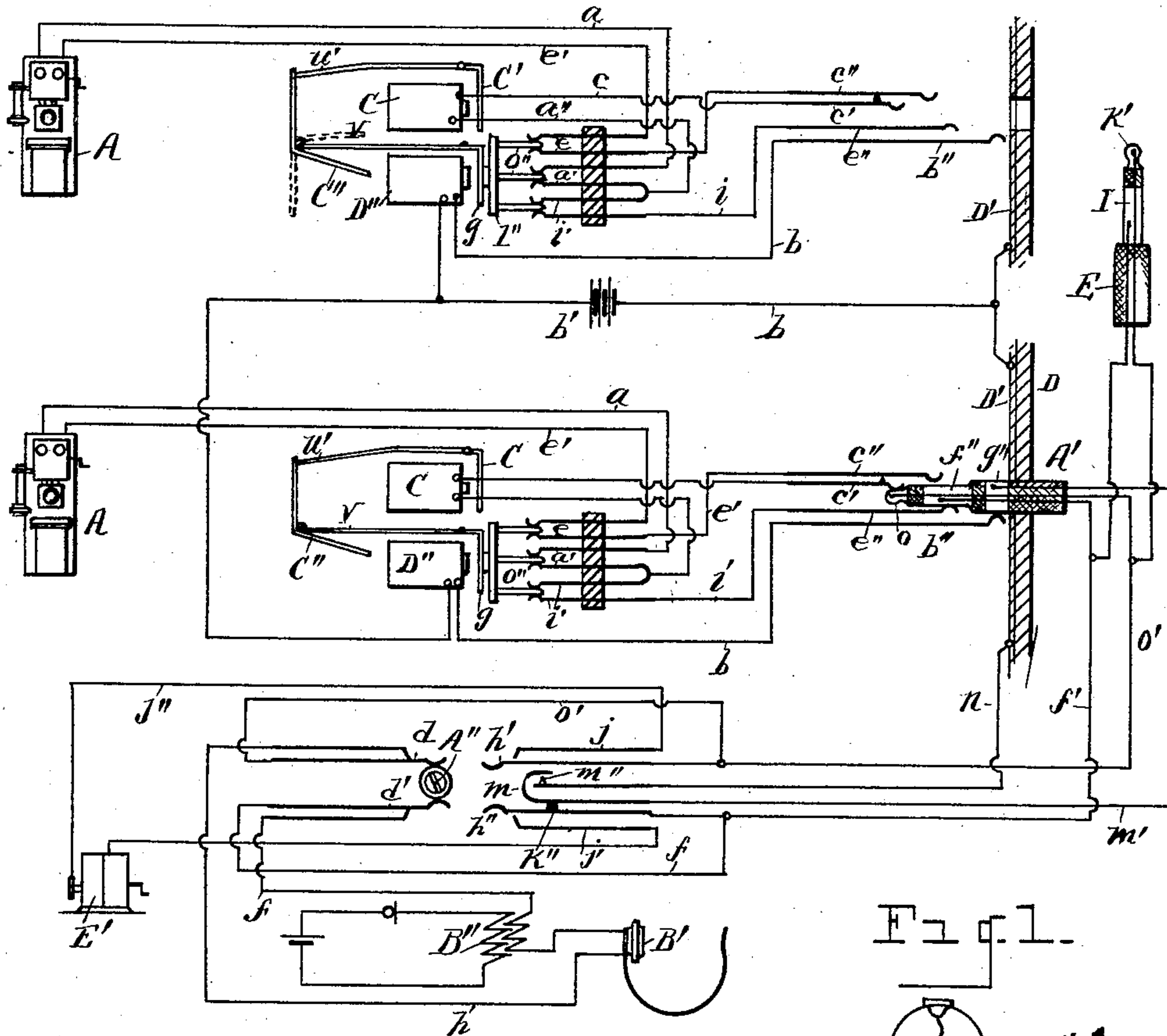
(No Model.)

4 Sheets—Sheet 1.

F. C. HUGHES.  
TELEPHONE SWITCHBOARD SYSTEM.

No. 605,670.

Patented June 14, 1898.



WITNESSES  
*O. H. Lenziger*  
*M. A. Martin*

INVENTOR  
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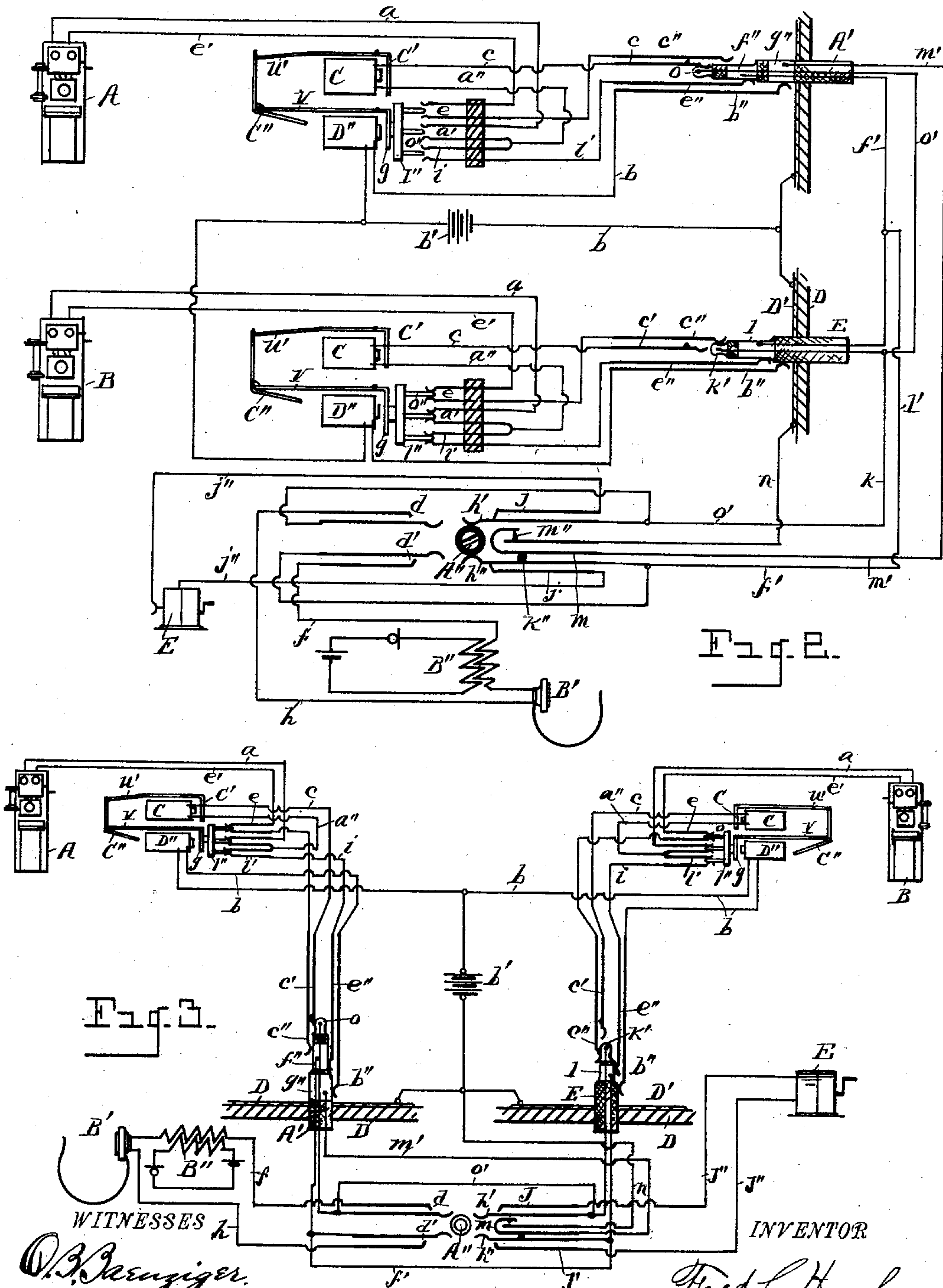
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4 Sheets—Sheet 2.

F. C. HUGHES.  
TELEPHONE SWITCHBOARD SYSTEM.

No. 605,670.

Patented June 14, 1898.



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M. A. Martin.

By his Attorneys

Fred C. Hughes.  
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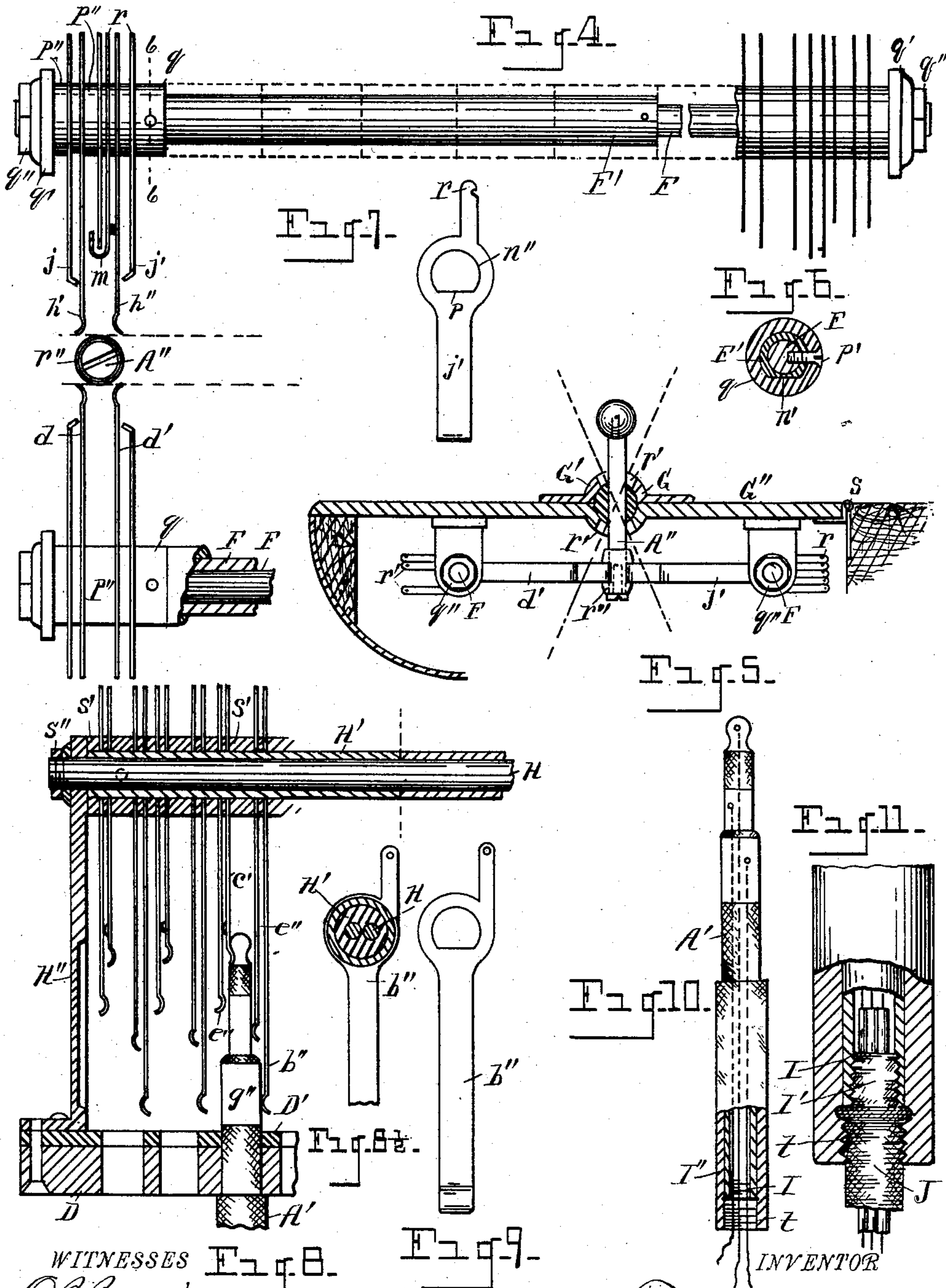
(No Model.)

4 Sheets—Sheet 3.

F. C. HUGHES.  
TELEPHONE SWITCHBOARD SYSTEM.

No. 605,670.

Patented June 14, 1898.



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(No Model.)

4 Sheets—Sheet 4.

F. C. HUGHES.  
TELEPHONE SWITCHBOARD SYSTEM.

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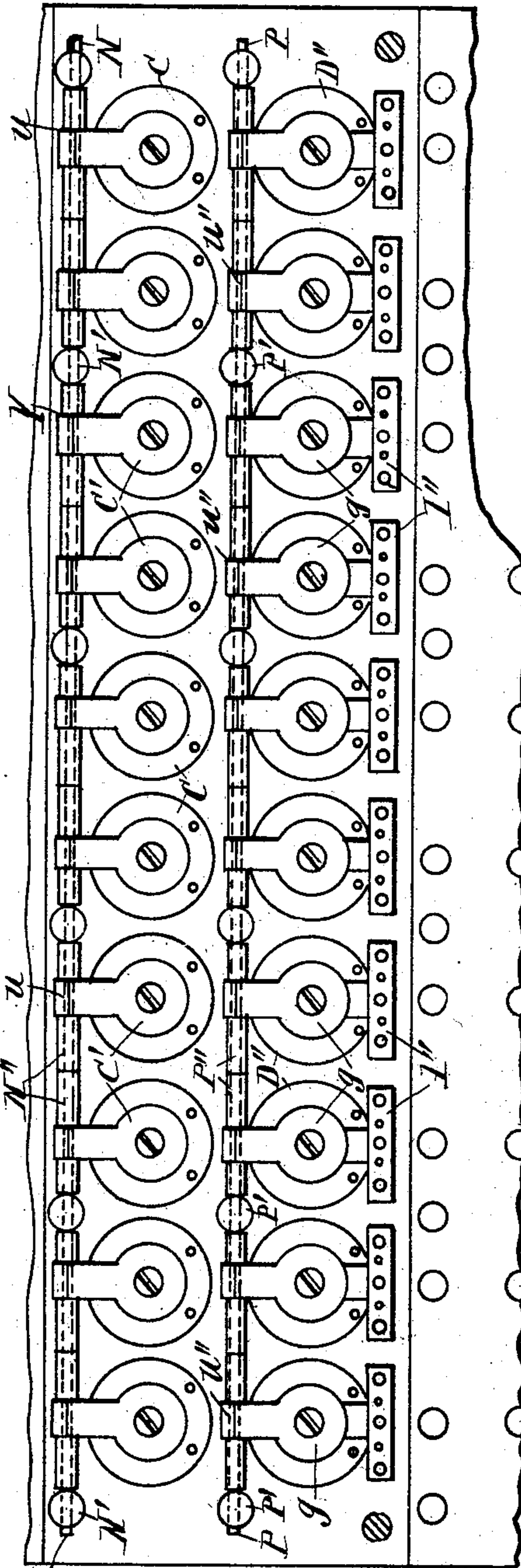


Fig. 15.

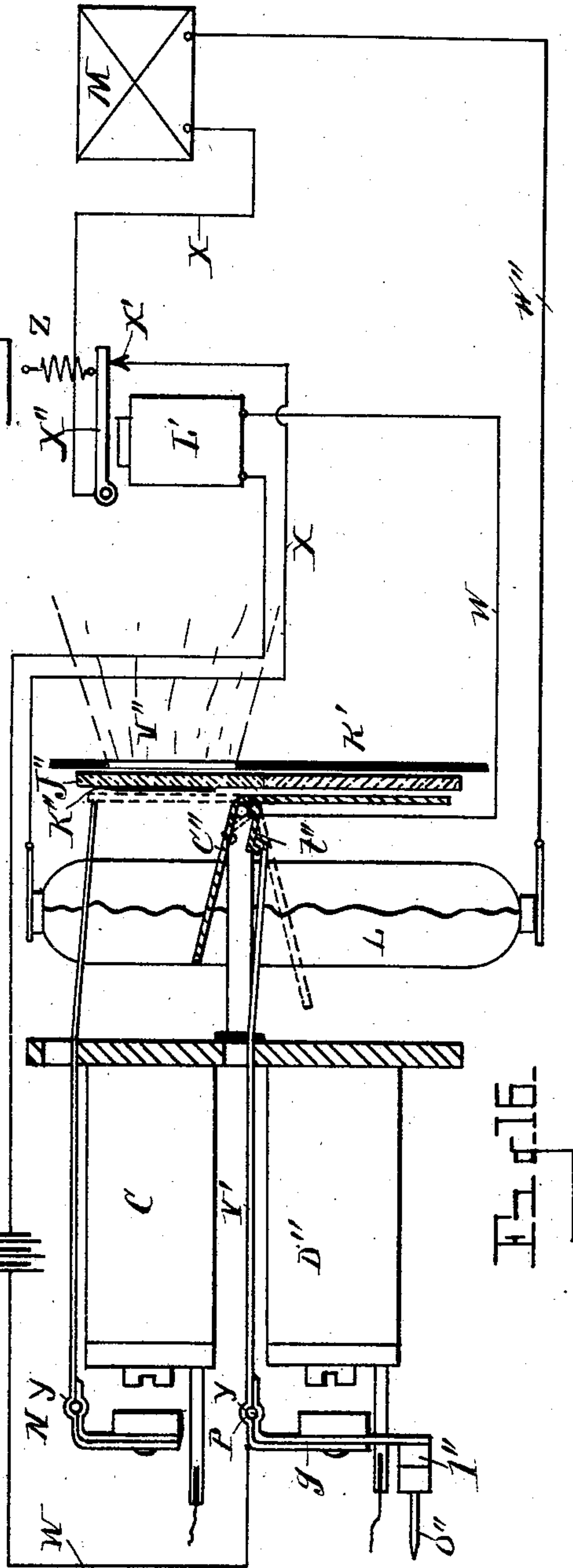


Fig. 16.

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# UNITED STATES PATENT OFFICE.

FRED C. HUGHES, OF DETROIT, MICHIGAN.

## TELEPHONE-SWITCHBOARD SYSTEM.

SPECIFICATION forming part of Letters Patent No. 605,670, dated June 14, 1898.

Application filed July 3, 1897. Serial No. 643,328. (No model.)

*To all whom it may concern:*

Be it known that I, FRED C. HUGHES, a citizen of the United States, residing at Detroit, in the county of Wayne, State of Michigan, have invented certain new and useful Improvements in Telephone-Switchboard Systems; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to new and useful improvements in telephone-switchboard systems; and it consists in the construction and arrangement of parts hereinafter fully set forth, and pointed out particularly in the claims.

The objects of the invention are to provide a simple, economical, and efficient metallic talking-circuit; to provide an inexpensive, compact, strong, and interchangeable spring-jack; to provide a combined listening and ringing key of simple construction and of reliable efficiency; to provide an automatic circuit-opener which operates to open the circuit of the subscriber calling when the operator rings on the line of the subscriber called; to provide means for readily restoring the annunciator to its normal position; to provide the annunciator with an illuminated signal in addition to that of the ordinary construction and means whereby either of said signals may be used at will, and to provide means for firmly securing the cord within the plug, so as to obviate the twisting thereof and the breaking of the connections of the conductors in the plug. These objects are attained by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a diagram view, some of the parts of which are in section, showing two subscribers' circuits and an operator's set, the upper circuit being in the normal position, while the lower circuit shows the position of the parts when the operator is answering a call. Fig. 2 is a like view showing the position of parts when the operator is ringing the subscriber called. Fig. 3 is a like view

showing two subscribers talking and the operator's instrument and generator cut out of the talking-circuit. Fig. 4 is an enlarged detail, partly broken away, showing construction and manner of mounting the springs of the listening and ringing key. Fig. 5 is a sectional view through the shelf on which said key is mounted, showing the manner of supporting said key in a rotary bearing. Fig. 6 is a sectional view, as on line 6 6 of Fig. 4. Fig. 7 is an elevation of one of the springs of the ringing and listening key. Fig. 8 is an enlarged detail, partly in section, of the spring-jacks, showing the manner of mounting said jacks upon a continuous rod and showing the plug in contact with the springs of the jack. Fig. 8½ is a sectional view showing a modification of the manner of mounting the spring-jacks upon two continuous rods instead of one. Fig. 9 is an elevation of one of the springs of said jack. Fig. 10 is an elevation of one of the plugs, partly broken away. Fig. 11 is an enlarged detail of the plug, partly in section, showing the manner of fastening the cord therein. Fig. 12 is a sectional view of the annunciator, showing the glass before the drop, the opaque screen adjacent to the glass, and a source of light for providing an illuminated signal, said view also showing on the armature of the restoring-magnet the circuit-opening device. Fig. 13 is an end elevation of the armature of the restoring-magnet, showing the manner of hinging said armature. Fig. 14 is a detail view of the drop, showing it in two positions and also showing by dotted lines the number on the rear face of the frosted glass in front of said drop, which serves as the illuminated signal. Fig. 15 is an end elevation of a series of annunciators, showing the manner of pivoting the armatures of the electromagnets. Fig. 16 is a view, partly in section, illustrating the illuminated signal, showing also a diagram of the electric-light circuit and of the means for opening and closing said circuit.

Referring to the letters of reference, A and B designate the subscribers' telephones. The normal condition of the subscriber's circuit is shown at the top of Fig. 1, which circuit, leading from the instrument on the line *a*, passes through the spring-terminals *a'* and to



the electromagnet or annunciator-coil C on line  $a''$  from said coil on line  $c$ , through the springs  $c' c''$  of the jack, through the spring-terminals  $e$ , and back to the instrument on line  $e'$ , whereby upon the ringing of the subscriber the annunciator-coil C is energized and its armature C' actuated to release the annunciator-shutter C'' to display the number of the subscriber calling, as will be hereinafter set forth.

Upon the dropping of the subscriber's shutter or the display of the signal of the subscriber calling the operator inserts the answering-plug A', as shown in the middle view of Fig. 1, whose contact-surfaces engage the spring-jacks  $c' e''$  of the subscriber's line, when by throwing the key A'' into the listening position, so as to engage the springs  $d$  and  $d'$ , the operator's telephone B' is connected with the subscriber's instrument A through the line  $f$ , which is closed at spring  $d'$ , through the line  $f''$ , which connects with the contact-surface  $f'''$  of said plug, which surface is in contact with the spring  $e''$  of the jack, thereby continuing the circuit from said spring on line  $i$  through the spring-terminals  $i'$  and  $a'$  and to the instrument on line  $a$ . From said instrument the circuit returns on line  $e'$  through the spring-terminals  $e$  and to the end  $o$  of the plug, through the springs  $c''$  and  $c'$  of the jack, from the end of said plug on line  $o'$  through the spring  $d$ , and to the operator's phone on line  $h$ , thereby placing the operator in communication with subscriber A, as will be well understood. B'' designates an induction-coil which is connected with the operator's telephone set.

To provide for restoring the annunciator-shutter to its normal position upon the insertion or withdrawal of the answering-plug A', there is provided upon the inner face of the apertured strip D, adapted to receive the plugs, a copper plate or electrical conductor D', which forms a portion of a general circuit (indicated by the lines  $b$ ) of which the battery  $b'$  is a source of electricity and of which the long spring  $b''$  of the jack forms one terminal. Included in said circuit  $b$  is an electromagnet or restoring-coil D'', whose armature  $g$  is provided with a lever  $v$ , which engages the drop C'', whereby upon the insertion or withdrawal of the plug A' the contact-surface  $g''$  thereon, while momentarily in engagement with the copper plate D' of the switchboard, will close the circuit  $b$  through said plate and the spring  $b''$  of the jack, which also engages said contact-surface of the plug, thereby energizing the restoring-coil D'' and actuating the armature thereof to restore the drop or shutter in a manner hereinafter set forth.

Upon learning from subscriber A the number of the subscriber with whom A desires to talk—which number, for example, we will say, is that of subscriber B—the operator inserts in the spring-jack of subscriber B the calling-plug E, as shown in Fig. 2. The key A'' is

then moved to the ringing position, pressing outward the springs  $h' h''$  of the ringing-key into contact with the terminals  $j j'$  of the generator-circuit  $j''$ , in which E' indicates the source of electricity, thereby causing the generator-current to pass into said plug E on line  $k$  to the contact-tip  $k'$ , through the spring  $c''$ , and on line  $e'$  to the subscriber's instrument B, returning on line  $a$  through the spring-contacts  $a' k''$  and back to the plug on spring  $e''$ , which engages with the contact-surface  $l$  thereof, from which surface leads a conductor  $l'$  back to the spring  $h''$  of the ringing-key, thereby ringing subscriber B. It will be seen that the conductors  $f' o'$  of the answering-plug A' are also connected with the generator-circuit, and to obviate the ringing of subscriber A when subscriber B is called provision must be made for opening the circuit of A. This is accomplished by closing the battery-circuit  $b$ , so as to energize the electromagnet D'', to the armature  $g$  of which is attached a cross-piece  $l''$ , carrying the conducting-pins  $o''$ , which by the operation of the armature of said magnet are withdrawn from the spring-contacts  $e a' i'$ , thereby opening the circuit of subscriber A, as shown at the top of Fig. 2. This closing of the circuit  $b$  is accomplished when the key A'' is moved to the ringing position, as said key in this position moves the spring  $h''$  outward, drawing the insulating-block  $k''$  carried thereby from contact with the curved-spring terminal  $m$  of the conductor  $m'$ , carried by the plug A', causing said curved spring  $m$  to engage the contact-point  $m''$  of the conductor  $n$ , which is electrically connected to the plate D' of the switchboard, thereby closing said circuit  $b$  through said coil D'', spring  $b''$ , the plug A', and the conductors  $m'$  and  $n$  and actuating the armature of said coil D'' to withdraw the contact-pins  $o''$  from the spring-contacts, as before stated, so that the generator-current used in ringing subscriber B cannot reach subscriber A owing to said opening in the circuit. This energizing of the electromagnet D'' through the closing of its circuit by the operation of moving the key A'' to the ringing position also serves to restore the annunciator as well as to open the line-circuit, for the pivoted armature  $g$  thereof, carrying the contact-pins  $o''$ , which serve to open said circuit, also carries an arm  $v$ , which engages and restores said annunciator, as hereinafter set forth. Subscriber B being called, the key A'' is placed in the open position shown in Fig. 2, placing the subscribers A and B in communication over their respective lines and the respective plugs A' and E, whereby they are connected by a free metallic circuit, from which circuit the operator's instrument and the generator E' are cut out. When the subscribers have ceased talking, upon the ringing off of either one of them the current is passed through a circuit formed by their respective lines, the plugs A' E, and the connecting-conductors  $f' c'$ , thereby energizing



the annunciator-magnet C and causing the drop or shutter C' to fall, thereby serving as a clearing-out signal.

A detail construction of the combined listening and ringing key is shown more clearly in Figs. 4, 5, 6, and 7. The spring-contacts of these keys are arranged in sets or a series of ten, more or less, and each series is mounted upon a single tie-rod F, common to all of said springs, as shown in Fig. 4, or said springs may be mounted upon two of said rods, as shown in Fig. 8½. This rod F passes through a sleeve F' of insulating material, which is provided upon one side with a flattened face n'. (See Fig. 6.) Upon this sleeve all of said springs are slipped, the apertures n'' in said springs through which said sleeve passes being provided with a straight side which engages the flat face n' on said sleeve to prevent the turning or displacement of said springs, said sleeve being held in place by a suitable set-screw p' passing therethrough. The springs of each set are insulated from one another by suitable collars p'' of insulating material, and each set of said springs is insulated from each adjacent set by like collars q of greater width. The ends of said tie-rod project beyond said sleeve and collars and receive the washers q' and nuts q'', whereby said springs are firmly locked in position and perfectly insulated from one another and from said rod, making a compact and economical construction. Each of the springs of said key is provided with a projecting end r for the attachment of the conductors thereto.

The listening and ringing key A' consists of a pin which is fixed in a short rock-shaft G, journaled in a suitable bearing G', mounted on a shelf G''. Said pin passes through slotted openings r' in said bearing and carries an operating-knob at its upper end, while the lower end thereof is provided with a sleeve r'', of insulating material, which is adapted to engage the respective springs of said key as said key is swung from side to side, as shown by dotted lines in Fig. 5, and force said springs into contact to close the listening and ringing circuits, respectively. The shelf G'', upon which said key is mounted, is hinged at s to enable said shelf to be raised when desired.

The spring-jacks shown in Fig. 8, like the springs of the listening and ringing key, are mounted upon a continuous rod H, carrying an insulating-sleeve H', which receives the springs of said jack (shown in Fig. 9) and upon which said springs are separated by the insulating-collars s', all of said parts being bound together by nuts s'' and the rod H. These springs, like the springs of the jacks, may be mounted on two rods, as shown in Fig. 8½. Fig. 8 illustrates in addition to the manner of mounting and insulating the spring-jacks the manner of supporting said jacks adjacent to the switchboard D through the medium of the brackets H'', which are mounted on said board and receive the ends

of said rod H. Said view also shows the conducting-plate D' on the rear face of the apertured strip D, which forms a portion of the general circuit, and, together with the contact-surface g'' on the listening-plug A' and the long spring b'' of the jack, effects a momentary closing of the circuit of the restoring-coil when the operator inserts said plug on the line of the subscriber calling.

To secure the conductors within the plug, so as to obviate the breaking of the contacts therein, the plug is provided at its rear end with a tube I, which is internally threaded, as shown in Figs. 10 and 11. The cord formed by the insulated conductors is wrapped with a serving of twine or other suitable material I', which is screwed into the threaded end of the tube I. The projecting end of the cord is then wrapped until it assumes an increased diameter, when the exterior sleeve I'' is slipped forward onto said tube until the threaded portion t thereof engages the enlarged wrapping J on said cord, when said sleeve is screwed tightly down over said wrapping, which is forced against the shoulder formed by the end of said tube, thereby firmly securing the cord within the end of the plug, as shown in Fig. 11.

The operation of the annunciator will be described with reference particularly to Figs. 12 and 16. The shutter consists of an angular plate C'', which is pivoted at t and provided with an inwardly-projecting hook t''. The armature C' of the electromagnet or annunciator-coil C is pivoted at u and is provided with an extending arm u', which normally engages the upper portion of the shutter C'' and holds it in a vertical position, as shown by solid lines in Fig. 12, the lower portion of said shutter carrying the number, as shown in Fig. 14, standing inward at an angle. Upon the energizing of the coil C through a call by a subscriber the armature C' is attracted, thereby causing it to swing upon its pivot u and raising the free end of the arm u', thereby releasing the shutter C'' and causing the lower side thereof to swing downward by gravity to the dotted position shown in Fig. 12 and the position shown by solid lines in Fig. 16, thereby displaying the number on said shutter to indicate the subscriber from which the call was received. To restore said shutter to its normal position, there is employed the restoring-coil or electromagnet D'', whose armature g is pivoted at u'' and is provided with an extending arm v, provided on its rear end with a hook v', with which the hook t'' on the shutter engages when said shutter falls, whereby upon the closing of the circuit of the restoring-coil its armature is actuated to swing upward the arm v, which, being in engagement with the hook t'' of the shutter, swings said shutter upward, so that the upper portion thereof is again held in vertical position by the arm u' of the armature of the annunciator-coil which drops behind it, in which position said shutter is re-



tained until the annunciator-coil is again energized.

To provide an illuminated signal which will show clearly the number of the subscriber calling, there is placed before the shutter of the annunciator two strips of glass, the upper one of which,  $J''$ , is frosted, while the lower strip  $K$  is clear or perfectly transparent. Before said strips of glass is mounted a movable opaque screen  $K'$ , having an aperture  $v''$  therethrough, which registers with the frosted strip of glass  $J''$ . Upon the back face of the frosted glass is placed the number of the annunciator, as shown by dotted lines  $K''$  in Fig. 14, and which number stands directly in line with the opening in said screen, as shown in Figs. 1<sup>a</sup> and 16. By this arrangement, through the energizing of the annunciator-coil, the upper portion of the drop is caused to swing inward, as described, away from the opening  $v''$  in said screen, permitting the rays from any suitable source of light  $L$ , which is located in the rear of said glass and screen, to shine through said opening and reveal the number upon the frosted glass which stands in line therewith, making a distinct signal. Should accident happen to the source of light, the annunciator would still be operative, for the reason that by simply lowering the screen  $K'$  until its apertures  $v''$  register with the transparent-glass strip  $K$  the number on the lower side of the shutter, when said shutter fell, could then be readily seen through the transparent glass  $K$ .

It is desirable that the source of light used in effecting the illuminated signal shall be produced by an electric incandescent lamp, and to avoid the expense of the continuous burning of said lamp it is essential to close the lamp-circuit only at such times as a call is made or upon the dropping of the annunciator. Provision is made to accomplish this result in the arrangement of the parts shown particularly in Fig. 16, in which there is employed an electric circuit containing an electromagnet  $L'$  and a source of electricity  $L''$ , one line  $w$  of this circuit being connected with the hook  $t''$  of the annunciator-shutter and the other line  $w'$  being connected with the arm  $v$  of the armature  $g$  of the coil  $D''$ .  $M$  designates the source of electricity which supplies the current to the lamp  $L$ , whose circuit consists of lines  $w''$  and  $x$ . Line  $x$  is closed at the contact-point  $x'$ , and the continuity of said line is effected through the armature  $x''$  of the electromagnet  $L'$ . By means of this arrangement it will be seen that upon the dropping of the annunciator-shutter the hook  $t''$  on said shutter will make an electric contact with the end of the arm  $v$  of the armature  $g$ , thereby closing the circuit of the magnet  $L'$  and attracting its armature  $x''$ , which by its movement closes the lamp-circuit at  $x'$ , thereby causing a current to pass through said lamp, whose rays passing through the opening in the screen  $K'$  clearly reveal the number  $K''$  upon the inner face of

the glass  $J''$ . Upon the restoration of the annunciator through the energizing of the restoring-coil  $D''$  the arm  $v$  and hook  $t''$  are separated, thereby breaking the circuit of the magnet  $L'$ , when its armature will be raised from the contact-point  $x'$  by the spring  $z$ , thereby cutting off the current through the lamp, as will be well understood.

The armature  $g$  of the electromagnet or restoring-coil  $D''$ , as before stated, is provided with a cross-piece  $l''$ , carrying the contact-pins  $o''$ , which normally engage the spring-terminals  $e$   $a'$   $i$  and close the line-circuit, as more clearly shown in Fig. 12. By this arrangement, as the circuit of said magnet or restoring-coil  $D''$  is closed by moving the key  $A''$  to the ringing position, said armature  $g$  is actuated to withdraw said pin  $o''$  and open the circuit at the same time the arm  $v$  of said armature is raised, causing the free end thereof to engage the hook  $t''$  of the shutter and restore said shutter to its normal position, thereby providing for the restoration of the annunciator-shutter through the ringing-key as well as by the insertion of the answering-plug.

In Fig. 15 is shown a rear end elevation of a series of annunciator and restoring coils, the armatures of each row of said coils being pivoted at  $u$   $u''$  upon their respective rods  $N$   $P$ , which are common to all of the armatures of each series. Said rods are supported by suitable posts  $N'$   $P'$ , and said armatures are separated and held in their proper position by dividing-sleeves  $N''$   $P''$  on said respective rods, making a strong, compact, and simple arrangement.

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

1. In a telephone-switchboard system, the combination of a line-circuit including an annunciator-actuating coil, a circuit-breaker, and a spring-jack, a second circuit including opposed contact-terminals and a restoring-coil having an armature adapted to actuate the circuit-breaker of the line-circuit, means actuated by said restoring-coil for restoring the annunciator-shutter to its normal position, and a plug having a contact-surface which normally passes into and out of contact with the terminals of said second circuit and alternately closes and opens the circuit of the restoring-coil when inserted in the spring-jack of the line-circuit and actuates the circuit-breaker therein to open said line-circuit.

2. In a telephone-switchboard system, the combination of a telephone-circuit including a spring-jack and an annunciator-actuating coil, a second circuit including a spring-contact terminal and an annunciator-restoring coil adapted to actuate the annunciator-restoring mechanism, a switchboard apertured to receive a plug and having upon the face thereof around said aperture a conductor forming part of the circuit of the restoring-coil and standing opposed to the spring-con-



tact terminal of said second circuit, a plug adapted to enter said aperture to engage said spring-jack having a contact-surface thereon which passes but momentarily into contact with the spring-terminal of the circuit of the restoring-coil and with said opposed conductor around said aperture, thereby alternately closing and opening the circuit of the restoring-coil when said plug is inserted in or withdrawn from said spring-jack.

3. The combination of a telephone-line including a spring-jack and an annunciator-coil adapted to actuate the annunciator-shutter, a restoring-coil included with a source of electricity and a contact-terminal in a normally open circuit, a ringing-key, a plug having a contact-surface adapted to engage said terminal and carrying a line connected with said contact-surface which is adapted to form a portion of the circuit of said restoring-coil and which is connected with the ringing-key, to enable the circuit of said restoring-coil to be closed by said ringing-key to restore the annunciator-shutter through the cord of said plug.

4. In a telephone system, the combination of a telephone-line including an annunciator-actuating coil and a circuit-breaker, an electromagnet included with a source of electricity in a normally open circuit, means operated by said electromagnet for actuating said circuit-breaker when said magnet is energized, a ringing-key adapted to close the circuit of said electromagnet when said key is in a ringing position, whereby the line-circuit of the calling subscriber is opened when the operator rings the subscriber called.

5. The combination of an annunciator consisting of a centrally-pivoted angle-plate or shutter whose opposed faces stand in separate planes and one of which faces carries an indicating character, means for moving said shutter on its pivot, a movable opaque screen having an opening which registers with said shutter, an indicating character on a transparent panel in line with said opening, a source of light behind said screen, and means for moving said drop or shutter to permit the light to shine through said opening and reveal said character on said panel and means for moving said screen to reveal the character on said shutter.

6. In an annunciator, the combination of a transparent plate having an indicating character on a portion of the surface thereof, a source of light, a movable drop or shutter consisting of an angle-plate one face of which is interposed between said light and character, the other face of said shutter carrying an indicating character corresponding with the character on said plate, means for actuating said shutter to move one face thereof from between said light and the character on said transparent plate and expose the character on the other face of said shutter through said transparent plate, and means for restoring said shutter to its normal position.

7. In an annunciator, the combination of an indicating character upon a transparent plate, a source of light behind said character, a movable drop or shutter consisting of a pivoted angle-plate one face of which is normally held in a vertical position interposed between said light and character, and the other face of which is of greater specific gravity and stands in a substantially horizontal position, means for releasing said shutter to cause the horizontal face thereof to swing downward and carry the vertical face to a horizontal position to permit the rays of light to shine upon and reveal said character, and means for restoring said shutter to exclude the light from said character, substantially as set forth.

8. In an annunciator, the combination of the annunciator magnet or coil, the pivoted shutter or drop consisting of an angle-plate having an indicating character upon its lower face, the armature of the annunciator-coil adapted to engage and retain said shutter in a normal position, in which the upper face of said shutter stands vertically, a strip of glass in front of said shutter the upper portion of which is frosted, an indicating character upon the frosted glass, a movable opaque screen in front of said glass having an opening therethrough which registers with said character on the glass and with the upper face of said shutter when in its normal position and with the lower face of said shutter when said screen is moved downward, a source of light behind said shutter, means for energizing the annunciator-coil to drop said shutter rendering visible the character on the lower face of said shutter through the strip of clear glass when the opening in said screen is placed in front of the lower face of said shutter, substantially as set forth.

9. In an annunciator, the combination of an indicating character visible by illumination, a normally open electric circuit containing a source of light, which source of light stands adjacent to said character, a movable shutter interposed between said light and character, means for moving said shutter to reveal said character, means connected with said shutter for closing the light-circuit upon the moving of said shutter from before said character, and means for restoring said shutter and simultaneously opening said circuit.

10. In an annunciator, the combination of the movable shutter consisting of an angle-plate whose opposed faces stand substantially at right angles to each other, said plate being pivoted near the point of angle and supported so that one of its faces normally stands in a vertical position and the other of its faces in a horizontal position, means for causing said shutter to swing on its pivot so as to present its normally vertical face in a horizontal position and its normally horizontal face in a vertical position, a hook projecting from the inner angle of said plate, a restoring coil or magnet having an armature provided with an arm which engages the hook of said plate or



shutter when its normally vertical face is in a horizontal position, and means for energizing said magnet to actuate said arm and restore said shutter, substantially as set forth.

5 11. The combination in a series of spring-jacks, of a continuous supporting-rod common to all of the springs of said jacks, said rod being supported at its opposite ends and covered throughout its length with a continuous casing of insulating material, a series of  
10 springs mounted upon said insulating-covering, intermediate the supports at the ends of said rod, means for preventing the springs from turning upon said rod, a series of insulating-collars upon said covering dividing  
15 said springs, and means for binding said parts together.

12. The combination in a spring-jack, of a

supporting-rod common to all of the springs of said jack, an insulating-covering upon said rod flattened upon one face, a series of springs  
20 mounted upon said insulating-covering having an aperture therein provided with a straight face which coincides with the flat portion of said insulating-covering, a series of  
25 insulating-collars mounted upon the insulating-covering of said rod and interposed between said springs, and the nuts on the ends of said rod for binding said parts together.

In testimony whereof I affix my signature 30  
in presence of two witnesses.

FRED C. HUGHES.

Witnesses:

E. S. WHEELER,  
M. A. MARTIN.