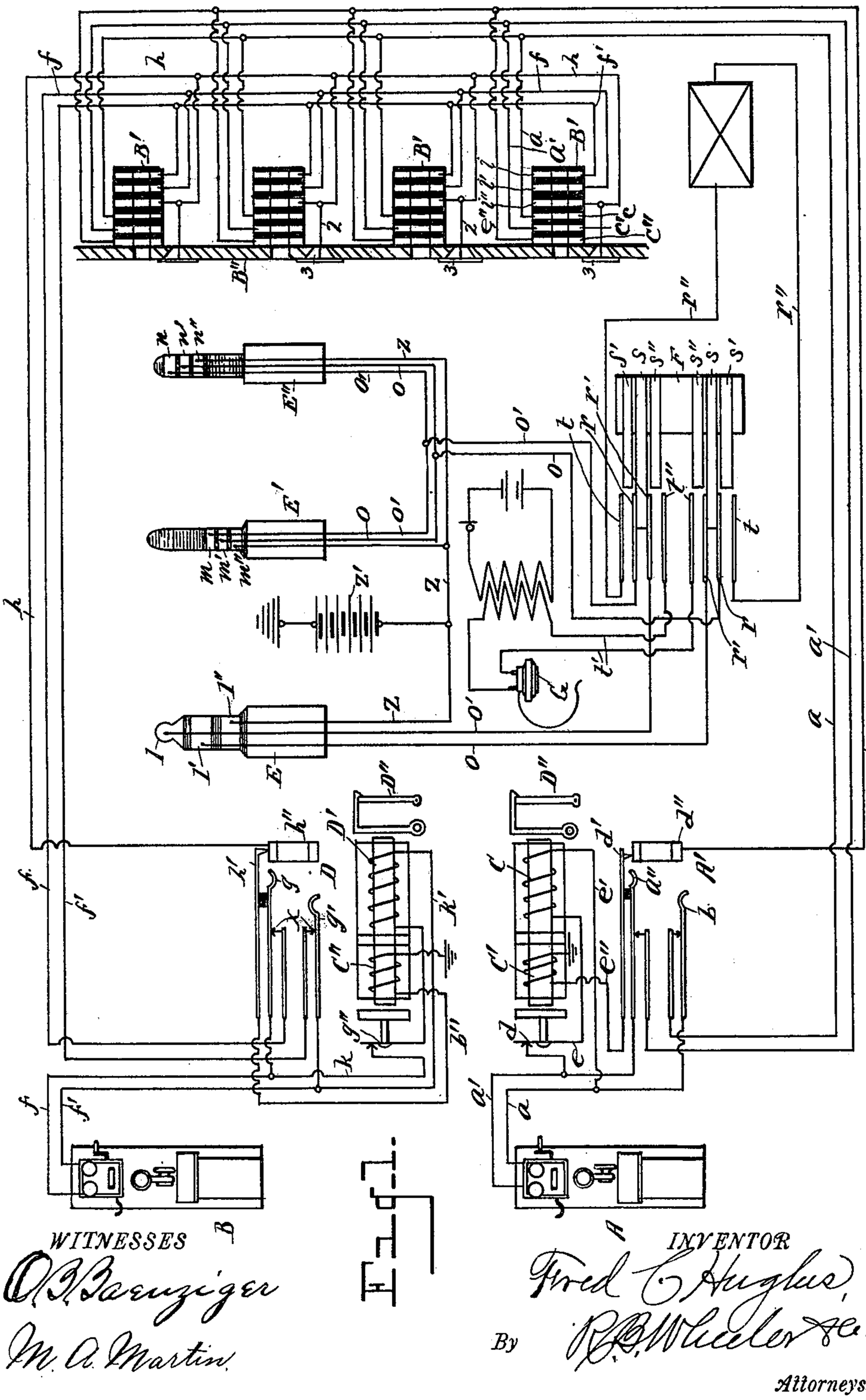
No. 646,121 Patented Mar. 27, 1900.

F. C. HUGHES.

DUPLEX MULTIPLE METALLIC TELEPHONE SYSTEM.

(Application filed Jan. 29, 1898.)

(No Model.) 4 Sheets—Sheet 1.



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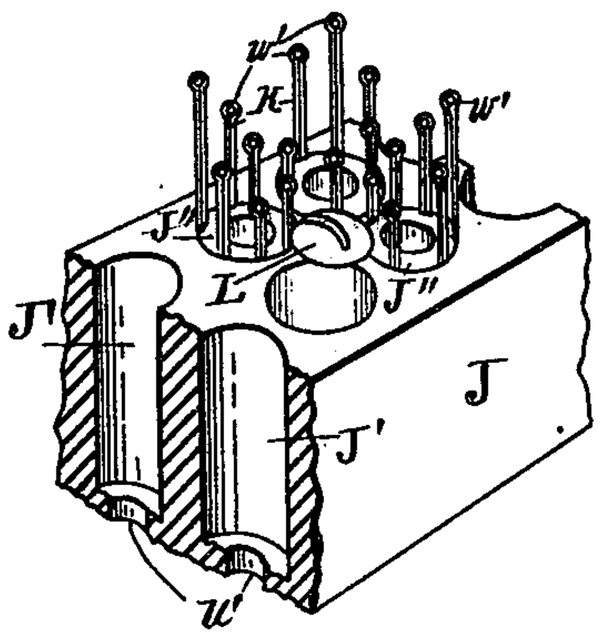
(No Model.) 4 Sheets—Sheet 2

Fig. 2.



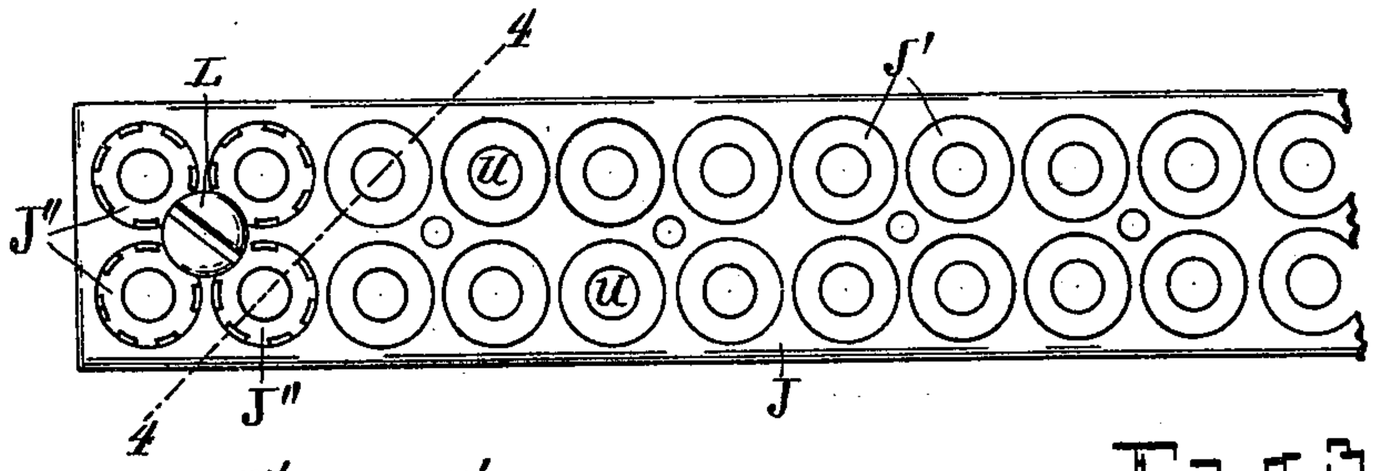
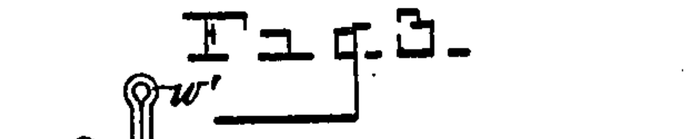


Fig. 3.



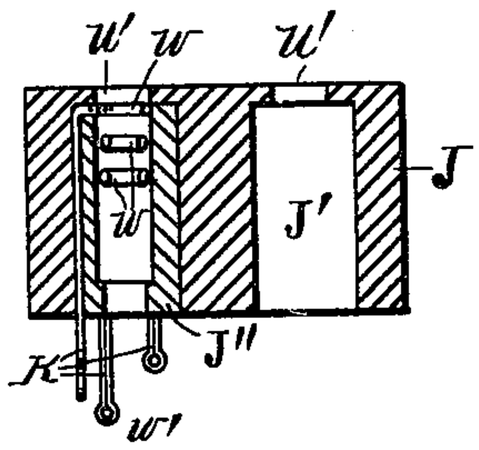


Fig. 4.

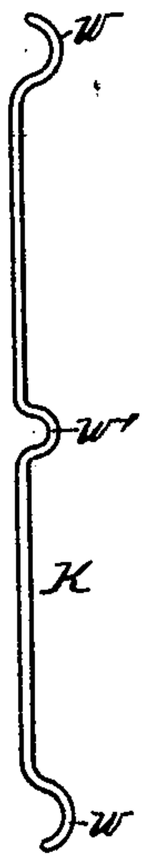


Fig. 9.

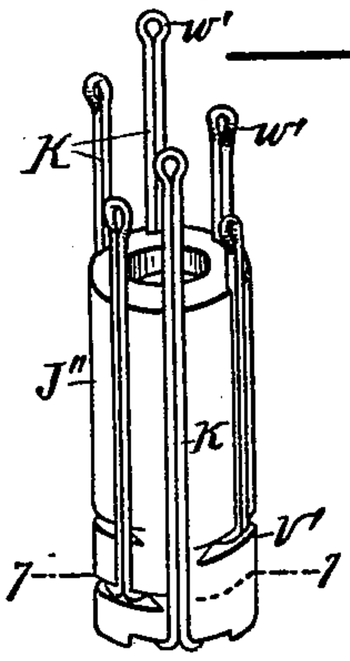


Fig. 5.

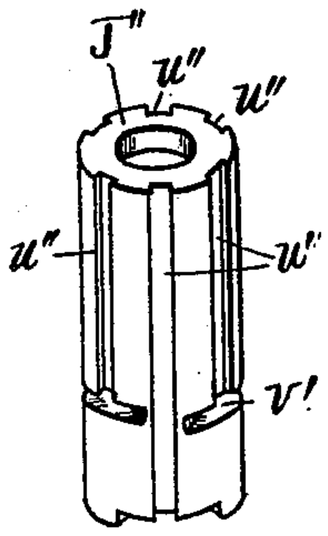


Fig. 6.

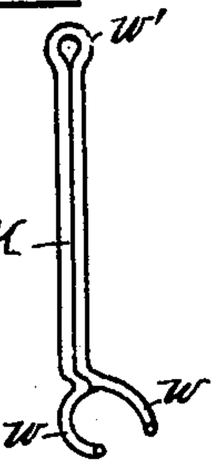


Fig. 8.

Fig. 7.

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DUPLEX MULTIPLE METALLIC TELEPHONE SYSTEM

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(No Model.) 4 Sheets—Sheet 3

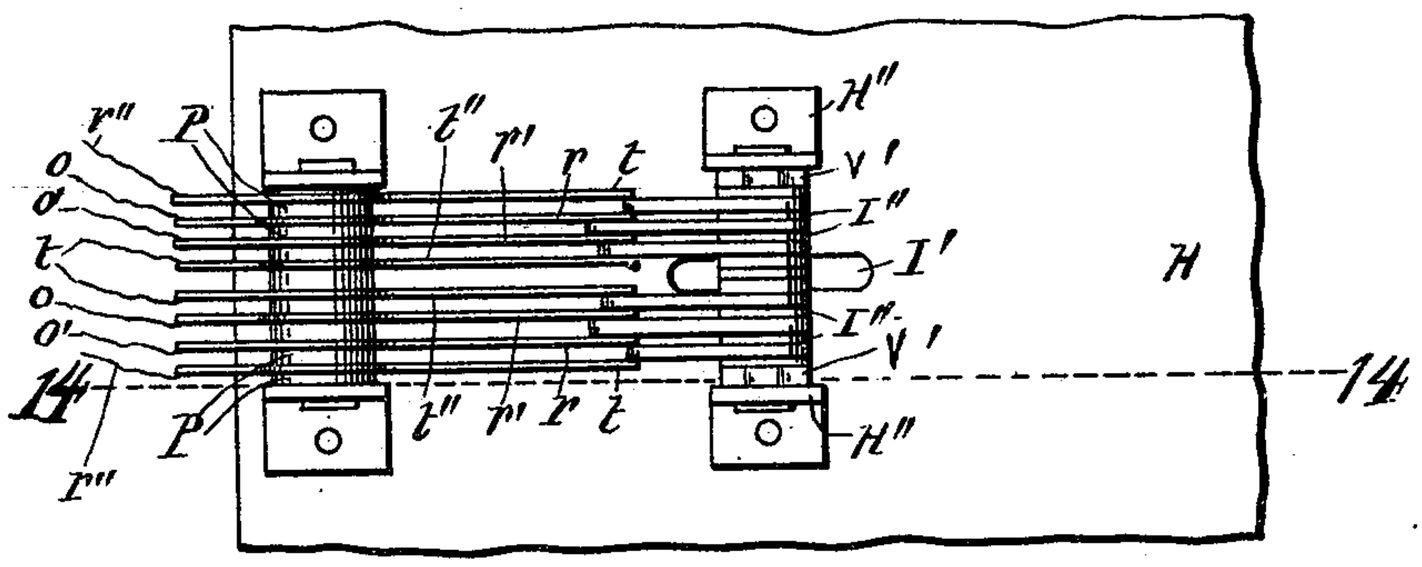

Fig. 15.

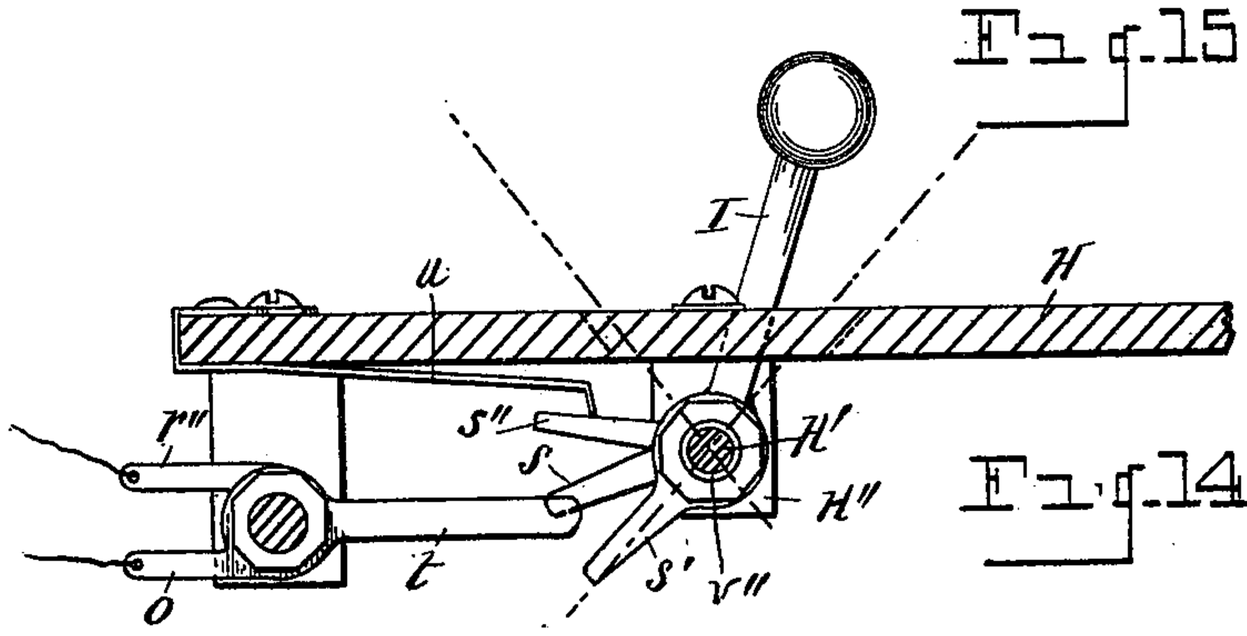

Fig. 14.

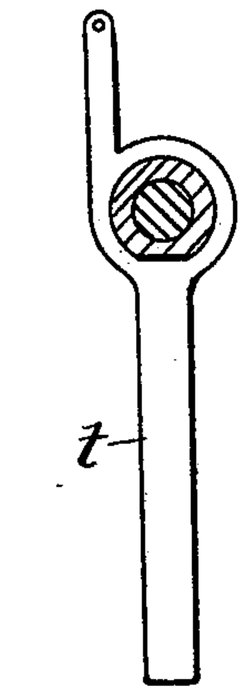

Fig. 10.

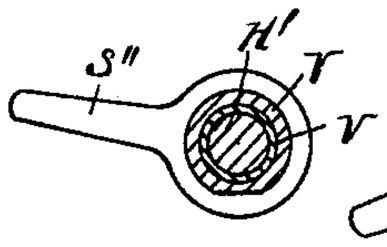

Fig. 11.

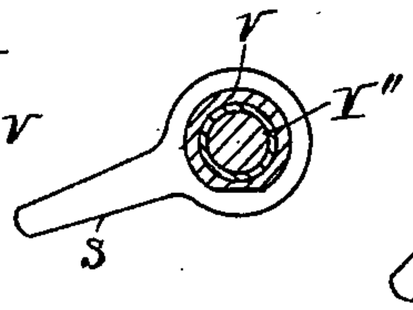

Fig. 12.

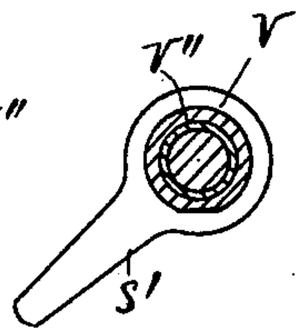

Fig. 13.

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DUPLEX MULTIPLE METALLIC TELEPHONE SYSTEM.

(Application filed Jan. 29, 1898.)

(No Model.) 4 Sheets—Sheet 4.

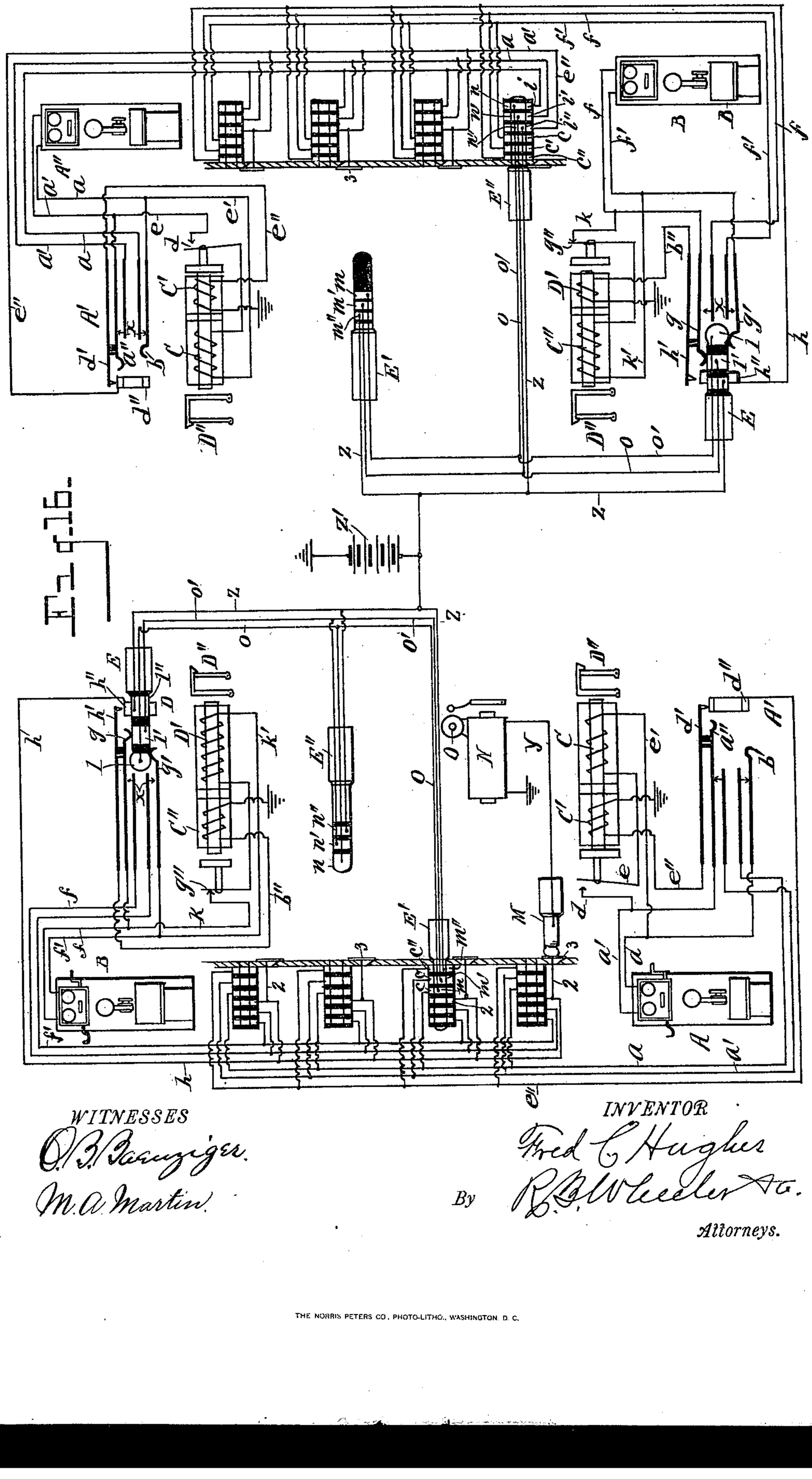

FIG. 5.

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UNITED STATES PATENT OFFICE.

FRED C. HUGHES, OF DETROIT, MICHIGAN.

DUPLEX MULTIPLE METALLIC TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 646,121, dated March 27, 1900.

Application filed January 29, 1898. Serial No. 668,465. (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 Duplex Multiple Metallic Telephone 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 and figures of reference marked thereon, which form a part of this specification.

This invention relates to a duplex multiple metallic telephone system; and it consists in the construction and arrangement of parts hereinafter fully set forth, and pointed out in the claims.

The objects of the invention are to provide a multiple metallic telephone system wherein the arrangement is such as to enable a very large number of substations to be connected to one switchboard; to provide means for automatically disconnecting the jacks on the multiple portion of the board from the answering-jacks, thereby reducing the "cross-talk" and increasing the electro capacity of the line; to provide means for breaking the auxiliary line at the answering-jack, thereby leaving the annunciator on the line to serve as a disconnecting-signal; to provide a cord and plug carrying an electric current to serve as a test and to provide a current to break the annunciator-circuit; to provide a listening and ringing key of simple and cheap construction, which serves as a switch or circuit-changer; to provide a spring-jack capable of carrying the lines of the two subscribers' telephones, and to provide means for connecting to each of said telephones. These objects are attained by the construction and association of parts illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatical view illustrating this improved telephone system in its normal position. Fig. 2 is a perspective view of a strip containing a series of spring-jacks, like parts being broken away. Fig. 3 is a plan view of a strip of jacks looking at the rear thereof. Fig. 4 is a diagonal section on line 4 4 of Fig. 3. Fig. 5 is a perspective view of a spring-jack carrying a series of contact-springs. Fig. 6 is a like view of the hollow insulating core or tube, showing the slots and grooves therein in which said contact-springs are located. Fig. 7 is a transverse section on line 7 7 of Fig. 5. Fig. 8 is an isometrical view of one of the contact-springs. Fig. 9 is a plan view of one of said springs in process of formation. Figs. 10, 11, 12, and 13 are sectional views showing the manner of mounting the spring-terminals of the lines and the contact plates or arms of the circuit-changer or switch. Fig. 14 is a view, partly in section, as on line 14 14 of Fig. 16, showing the relative position of the contacts of the circuit-changer or switch with respect to the spring-terminals of the line. Fig. 15 is an inverted plan view of Fig. 14. Fig. 16 is a diagrammatical view of this improved multiple telephone system, showing connection made between subscribers.

This telephone system is termed a "duplex multiple metallic system" owing to the fact that by its use double the number of substations may be connected to one switchboard over the ordinary construction.

The spring-jacks of this system are duplex or are provided with a double series of contacts, enabling twice the number of substations to be connected to a single switchboard. In illustration of this it may be stated that all substations from one to five thousand, inclusive, are connected to the first series of said contacts, while all substations over five thousand and inclusive of ten thousand are connected to the second series of said contacts, thereby obviating the necessity of two switchboards to accommodate ten thousand lines or substations. The connecting-plugs used in this system are three in number, comprising an answering-plug and two calling-plugs, one of which calling-plugs carries contact-surfaces for the first series of contacts of the jacks, while the second plug carries contact-surfaces for the second series of contacts of said jacks.

An illustration of the normal condition of this system is shown in the diagram Fig. 1, in which A and B designate two subscribers' telephones, respectively, both of whose lines are connected to each of the spring-jacks

B′ of the switchboard B″, as shown, which spring-jacks are provided with six contacts insulated from one another. The circuit of subscriber A comprises the lines *a a′*, which include the spring-contacts *a″ b* of the annunciator-jack A′ and which continue to the multiple portion of the board, being connected to the contacts *c c′* of the first series of contacts of each spring-jack. The annunciator-circuit of subscriber A consists of the lines *e e′*, which include the actuating-coil C of the annunciator D″ and a circuit-breaker *d* and which are connected with the lines *a a′* of said subscriber. The circuit-breaker *d* of said annunciator-circuit is actuated by a coil or electromagnet C′, which is included in a grounded auxiliary line *e″*, said line including the spring-contact *d′* and the contact-collar *d″* of the spring-jack A′ and terminating at the contact *c″* of the first series of contacts of the spring-jacks of the board.

The above description of the circuit of subscriber A also applies to the circuit of subscriber B, with the exception that the lines *f f′* of subscriber B are connected with the contacts *i i′* of the second series of contacts of the multiple jacks B′ of the board, said lines including the spring-contacts *g g′* of the annunciator-jack D and having connected thereto the lines *k k′* of the annunciator-circuit, in which is located the annunciator-actuating coil or electromagnet D′, which actuates the annunciator or shutter D″, and which annunciator-circuit also includes the circuit-breaker *g″*, actuated by the coil C″ of the grounded auxiliary line *h*, said auxiliary line including the spring-contact *h′* and the collar *h″* of the annunciator-jack D and terminating at the contacts *i″* of the second series of contacts of the jacks B′.

The set of plugs used in this improved system comprises three of three lines or conductors each, of which plug E is the answering-plug and the plugs E′ and E″ are the calling-plugs. It will be observed that the contact-surfaces *m m′ m″* of plug E′, to which its three conductors are attached, are near the base of said plug, while the contact-surfaces *n n′ n″* of plug E″, to which its conductors are attached, are located at the outer end of said plug.

The purpose of using the two plugs E′ E″, with their different sets of contact-surfaces, is to enable connection to be made through the answering-plug with either the first or second series of contacts of the jacks B′. For instance, where connection with the first series of contacts of the jacks is desired plug E′ is used, and where connection with the second series of contacts of said jacks is desired plug E″ is used, so that the operator is enabled to determine by the number called which of said plugs to employ. The cords of said plugs carry the conductors *o o′*, forming a line which unites all of said plugs through their contact-surfaces, in which line is located a switch or circuit-changer F, carrying contact-arms adapted to pass between the spring-terminals *r r′* of said lines and cross between them to effect a continuity of said lines between said plugs, as shown in Fig. 1, in which the contact-arms *s* of said circuit-changer or switch are shown lying between said spring-terminals. A further purpose of said circuit-changer is to throw the generator-current carried by the lines *r″*, having the spring-terminals *t*, onto the conductors *o o′* of said plugs by actuating said circuit-changer so as to carry its contact-arms *s′* between the spring-terminals *t* of the generator-circuit and the spring-terminals *r* of the lines of said plugs. It is also the purpose of said circuit-changer to place the operator's instrument G, whose lines *t′* are provided with the spring-terminals *t″*, in communication with the calling subscriber through the answering-plug E by actuating said circuit-changer so as to carry its contact-arm *s″* between the spring-terminals *t″* of the operator's line and the spring-terminals *r′* of the conductors of the plug E.

To more fully illustrate the construction and operation of the switch or circuit-changer, attention is called to Figs. 10 to 15, inclusive, in which Fig. 14 shows the circuit-changer mounted upon a suitable table H, from the under side of which a shaft or rod H′ is supported by the depending brackets H″. Upon this shaft or rod H′ is mounted a metallic tube *v″*, adapted to turn upon said shaft and having thereon an insulating-sleeve *v*, upon which are mounted a series of contact-arms in pairs, the two arms of each pair standing in the same plane, but each pair of arms occupying separate planes with respect to the other pairs. These contact-arms are insulated from each other by interposed insulating-washers I″ and the whole securely clamped together by the nuts *v′*. The relative positions of these pairs of contact-arms are shown in Figs. 11 to 13, inclusive, in which Fig. 13 shows the lower and outer arms *s′*, Fig. 12 the middle pair of contact-arms *s*, and Fig. 13 the upper and inner pair *s″*. The spring-terminals of the lines of the plugs, the generator, and the operator's telephone are indicated in Figs. 10, 14, and 15, illustrating their manner of mounting, which is similar to that of the contact-arms of the circuit-changer and between which said contact-arms are adapted to cross to close the circuit, as before described, said spring-terminals being separated by a series of insulating-washers P. It will be observed that but one set of said contact-arms can be in contact with said spring-terminals at one time and that the circuit-changer has three positions in which each set of its contact-arms is brought into contact with its respective spring-terminals of said lines. The operation of the circuit-changer is effected through the vibrating lever I, which is mounted upon the sleeve *v″* and projects through a slot I′ in said table, the length of said slot being sufficient to permit of the swinging of said lever, as indicated by dotted lines in Fig. 14, to bring the con-

tact-arms carried by said sleeve successively into contact with their corresponding spring-terminals. Engaging the upper set of said contact-arms s'' is a spring u, which yields as the lever is swung to bring the lower contact-arms s into engagement with their spring-terminals and which upon the release of said lever returns the circuit-changer to its normal position, as shown, in which the middle set of contact-arms is in engagement with the contact-terminals of the lines of the plugs. The spring-jacks employed in this improved system are illustrated in detail in Figs. 2 to 9, inclusive, and consist, as will be seen on referring to said figures, of a block or strip of insulating material in which are a number of adjacent sockets, a hollow core adapted to enter said sockets and provided with a number of longitudinal channels and transverse slots at the ends of said channels opening through said core to the interior thereof, said longitudinal channels being adapted to receive the contacts of the jack, whose contact end portions pass through said slots and lie within the hollow of said core in position to receive and engage the contact-surfaces of the plugs. The block or strip J may be of any suitable material. The sockets J′, formed in said block, are of such size as to snugly receive the hollow cores J″, which fit therein, their outer ends standing flush with the face of said block. The base of said sockets is provided with a reduced aperture u' for the reception of the plug, which is inserted in said aperture to reach the contacts within the core J″. It will be observed that the periphery of each core is provided with six longitudinal channels u'' of different lengths. At the termination of each of said channels, at the forward ends thereof, is a transverse slot v', which opens through to the interior of the core, as shown in Fig. 7. These transverse slots v' permit the curved right-angled ends w of the contacts K to enter and lie within the hollow of said core, while the body portion of said contacts is confined within the channels u''. These contacts are formed, preferably, by bending a wire of suitable gage upon itself, so as to form an eye w' for attaching the line-wires, while the meeting end portions of said wire are bent at right angles to the body portion and curved outwardly, as at w, so as to form a yielding loop, which will closely embrace the contact-surfaces of the plugs. The initial step in forming these contacts is shown in Fig. 9, while the completed contact is shown in Fig. 8. The contact ends w of said contacts lie within the hollow core and conform thereto, standing distant from the inner wall thereof, so as to permit the curved portions w to yield as the plug is inserted in and withdrawn from the jack, as clearly shown in Fig. 7.

By the arrangement just described a spring-jack is formed carrying six contacts, three of which are adapted to be engaged by the contact-surfaces of the plug E′ and three by the contact-surfaces of the plug E″. The channels u'' in the longitudinal periphery of the cores J″, in which the bodies of the contacts K lie, prevent said contacts from projecting beyond the periphery of said cores, enabling said cores to be inserted in the sockets J′ of the block or strip J, whereby each of said contacts is securely retained in place, as clearly shown in Fig. 2, while the projecting ends of said contacts are rendered readily accessible for attachment of the line-wires. By arranging the sockets J′ in double rows, as shown in Figs. 2 and 3, four of the contact-carrying cores J″ may be securely retained in said sockets by means of a single screw L, whose head is sufficiently large to engage four of said cores when screwed into the block between four of said sockets. This arrangement also facilitates the repairing of the switchboard, as it renders any one of the spring-jacks readily removable without in any way interfering with the other jacks of the board and enables the removal, repair, and replacing of a spring-jack to be simply and readily accomplished. The block J, as well as the contact-carrying cores J″, is made of suitable insulating material, preferably of vulcanized rubber, whereby the contacts of the jack, although closely assembled, are perfectly insulated from one another, producing a simple, cheap, and efficient jack.

The operation of this improved system will be explained with reference to Figs. 1 and 16. A call from subscriber B will cause a current to flow over the lines of said subscriber, thereby energizing the electromagnet D′ and drop the annunciator or shutter D″. The answering-plug E is then inserted in the answering-jack D, bringing its contact-surfaces $l\ l'$ into engagement with the spring-terminals $g\ g'$ of the lines of said subscriber, at the same time spreading said spring-terminals, so as to open the lines of the subscriber B at the contact-points x of said jack D, thereby cutting off the multiple portion of the board and increasing the electro efficiency of the lines of subscriber B. As the spring-terminal g in said jack D is crowded outward by the insertion of the answering-plug, it also moves the contact-point of the contact h' from the collar h'' of the grounded line, including the electromagnet C″, preventing the actuation of the circuit-breaker g'' and the opening of the annunciator-circuit of subscriber B by a flow of current from the contact-surface l'' of said answering-plug, thereby leaving said annunciator on the line of said subscriber to serve as a disconnecting-signal. Upon the insertion of the answering-plug in the jack D the operator moves the circuit-changer F so as to bring the contact-arms s'' thereon between the spring-contacts $t''\ r'$, thereby connecting the operator's instrument with subscriber B through the lines $o\ o'$ of the answering-plug. Upon ascertaining the number desired by subscriber B one of the calling-plugs is inserted in the jack of the number called. In this instance we will

say that the number called is below five thousand and that the plug used is plug E′, whose contact-surfaces are adapted to engage the first series of contacts of the jacks. The switch or circuit-changer F is then moved to carry its contact-arms *s′* between the spring-terminals *t r*, thereby throwing the generator-current onto the lines of the plugs E′ and ringing the subscriber called. It will be observed that as the circuit-changer is moved to throw the generator-current onto the lines of the plug E′ the contact-arms *s″* of said switch or circuit-changer are carried from contact with the spring-terminals *r′*, thereby opening the line to subscriber B through the answering-plug and preventing the ringing of said subscriber. After the ringing of the subscriber called the circuit-changer F is moved so as to bring its contact-arms *s* between the terminals *r r′*, thereby connecting the calling subscriber and the subscriber called through the lines of the plugs E E′ and establishing the talking-circuit, which position of parts is clearly shown at the left of Fig. 16. It will be observed that all of the plugs carry a third core or line *z*. This line *z* includes a battery *z′* and leads to the contact-surfaces *l″ m″ n″* of the respective plugs. Therefore when a connection is made between two subscribers, as shown at the left of Fig. 16, the current carried by the line *z* flows through the contact-surface *m″* of the plug E′, through the contact *c″* of the jack engaging said contact-surface of the plug, and on line *e″* through the coil C′ of the circuit-breaker and opening the annunciator-circuit of A, the subscriber called. This current flowing through the line *z* of the plugs passes through the contact-surface *l″* of plug E and the collar *h″*, embracing said contact-surface, onto line *h* to the multiple portion of the board and through the series of short conductors 2 to a series of plates 3 on the face of the board, thereby serving as a test, as the operator is enabled through the test-plug M, Fig. 16, the end of which may be placed against said contact-plate 3, to determine whether or not the line is in use, for should there be a current flowing through the line *h* said current will pass through the plug M and grounded line *y*, carried thereby, within which is an electromagnet N, which will be energized by the passage of said current and cause a stroke upon the bell O, indicating that the line is in service. In like manner a test for the first series of contacts of multiple jacks is provided through the lines *e″*, which are connected with the first series of contacts *c″* of the jacks, which contacts may be touched by the end of the plug M to determine whether or not the line connected therewith is in service.

Should subscriber B desire connection with a substation numbered above five thousand, which for illustration is subscriber A″, (shown on the right of Fig. 16,) plug E″ is employed, whose contact-surfaces engage the second series of contacts of the jacks, as shown, thereby placing subscriber A″ in communication with subscriber B in the manner before described, while the plug E′ remains unemployed.

It will now be understood that by means of the construction and arrangement herein shown and described a much greater number of substations may be connected to one switchboard because of the fact that each of the multiple spring-jacks is connected with a duplex or double system, each system of which may be readily connected with any subscriber through the employment of the series of three plugs and their connecting-cords, effecting great economy in space and in the cost of switchboard construction.

Having thus fully set forth this invention, what is claimed is—

1. A double multiple metallic telephone system, each line of which is provided with an answering spring-jack, a circuit-breaker at said answering-jack, and an annunciator-circuit, a series of connecting spring-jacks for each line placed one on each board, each of said connecting spring-jacks having a double set of contacts and a double system connected therewith, a set of three plugs united by conductors and having a series of contact-surfaces thereon, one of said plugs being adapted to be inserted in the answering-jack, and each of the other of said plugs being adapted to be inserted in each of the multiple jacks of the board to connect with each of the two systems, respectively, which are connected with said jacks.

2. A multiple metallic telephone system each line of which is provided with a distinct answering spring-jack, an annunciator-circuit and an annunciator-circuit breaker in circuit with the answering spring-jack, a multiple of connecting spring-jacks for each line, said answering spring-jack, multiple connecting spring-jacks and annunciator, normally in circuit with the subscriber's instrument, the line from which first passes to the answering spring-jack and thence to the connecting spring-jacks to the contacts of which latter jacks said line is permanently connected, a set of plugs carrying connecting-lines, and means for automatically breaking the lines at the answering spring-jacks only upon the insertion of the answering-plug therein to cut out the entire multiple portion of the board.

3. In a circuit-changer or switch, the combination of a series of insulated springs forming contact-terminals, said springs standing approximately parallel in the same plane, the rotary insulated sleeve carrying a series of insulated contact-arms, said arms comprising pairs which stand in separate planes, the arms of each pair being independent and insulated from each other, and means for moving said arms so as to bring each pair successively between the corresponding spring-terminals so as to cross between said terminals and change the circuit therethrough.

4. In a telephone system, a spring-jack com-

prising an insulating-body having a socket therein, a removable hollow core of insulating material adapted to be seated in said socket, an aperture through the wall of said core, a contact having its end portion projecting through said aperture and lying within the hollow of said core, and its body portion confined between said core and the wall of said socket.

5. In a spring-jack, the combination of an insulating-body, of a hollow core of insulating material adapted to be seated in said body, said core having a series of apertures opening through the wall thereof and peripheral channels leading from said apertures, a series of contacts whose contact end portions project through said apertures into the interior of said core and whose body portions lie in said channels and are confined therein by the embracing wall of said insulating-body.

6. A spring-jack comprising an insulating-body having a socket therein, a removable hollow core of insulating material adapted to be seated in said socket, an aperture through the wall of said core, and a channel in the periphery of the core leading from said aperture, a contact having its end portion projecting through said aperture and lying within the hollow of the core and its body portion lying in said channel.

7. In a spring-jack, the combination of an insulating-body provided with a socket therein and having an opening through the base of said socket, a removable hollow core of insulating material adapted to be seated in said socket and whose interior opening registers with the aperture in the base of said socket, a contact having its end portion extending within the hollow of said core and its body portion confined between said core and the wall of said socket.

8. In a spring-jack, the combination of a hollow tube of insulating material having a longitudinal groove in the face thereof, a contact-spring formed with an eye at one end for attachment of a wire and provided at the opposite end with bent end portions describing the arc of a circle and standing at an angle to the body thereof, said bent portion being adapted to lie within the hollow of said tube and receive the plug when inserted in the jack, substantially as set forth.

9. In a spring-jack, a spring formed by bending a wire upon itself to produce an eye at one end for attachment to a line-wire, the meeting opposite ends of said wire being bent at right angles and formed into a half-circle to embrace the contact-surface of the plug when inserted in the jack.

In testimony whereof I sign this specification in the presence of two witnesses.

FRED C. HUGHES.

Witnesses:
CHAS. MARTIN,
E. S. WHEELER.