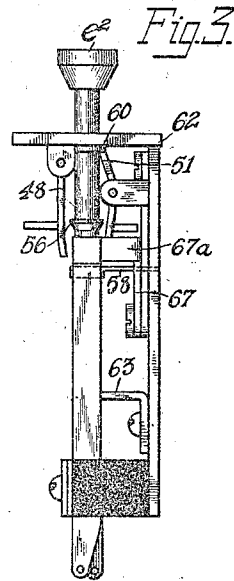
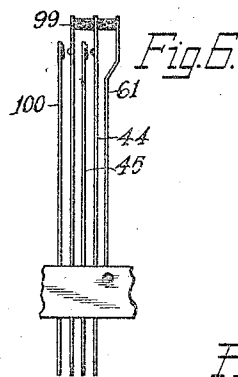
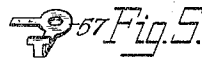
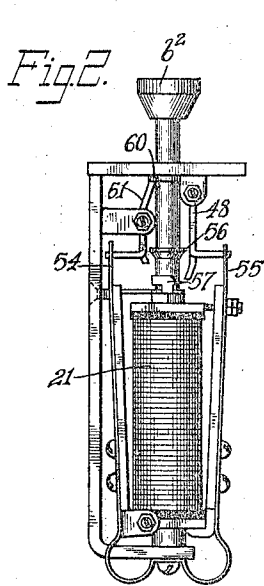
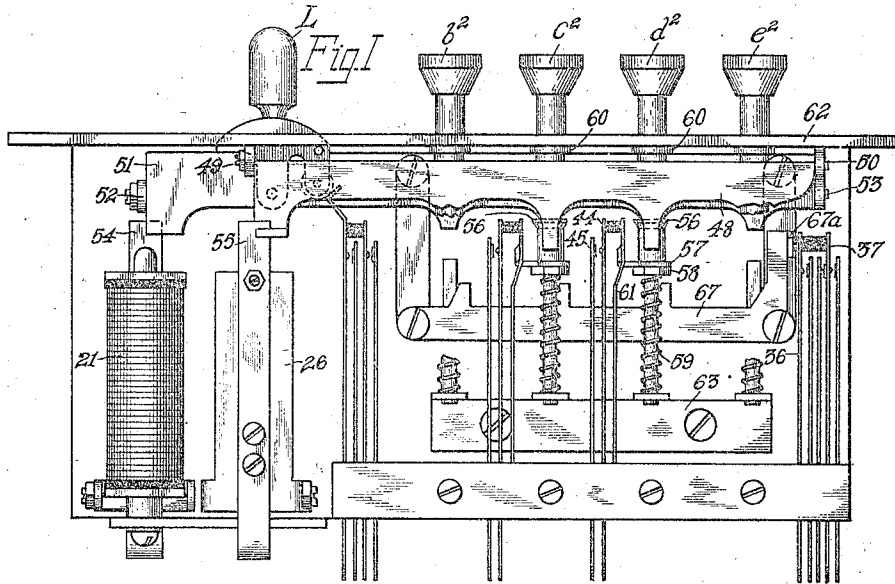


A. H. DYSON.
TELEPHONE SYSTEM.
APPLICATION FILED OCT. 11, 1911.

1,277,883.

Patented Sept. 3, 1918.
4 SHEETS—SHEET 1.



Witnesses:

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4 SHEETS—SHEET 2.

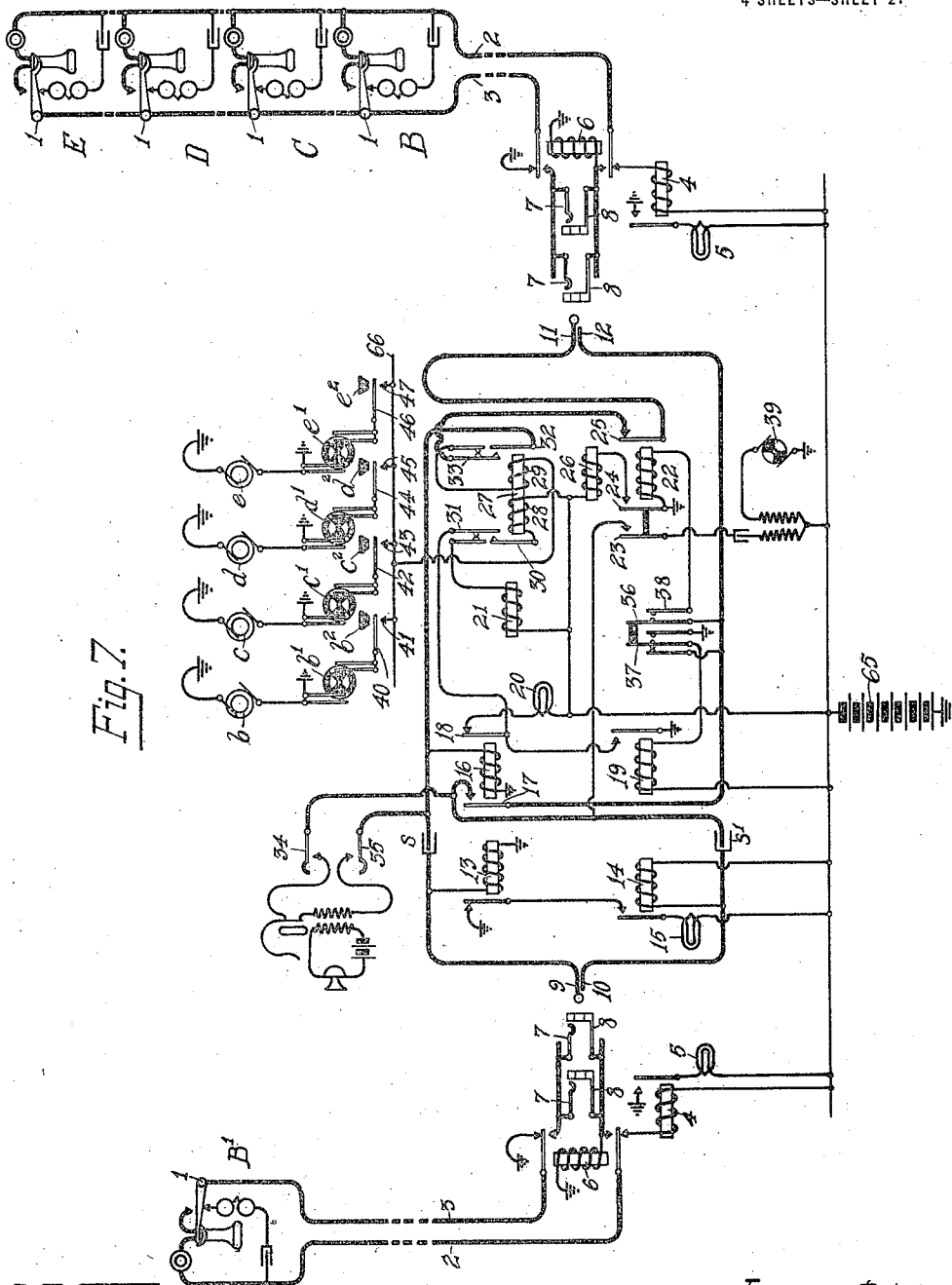


Fig. 7.

Witnesses:

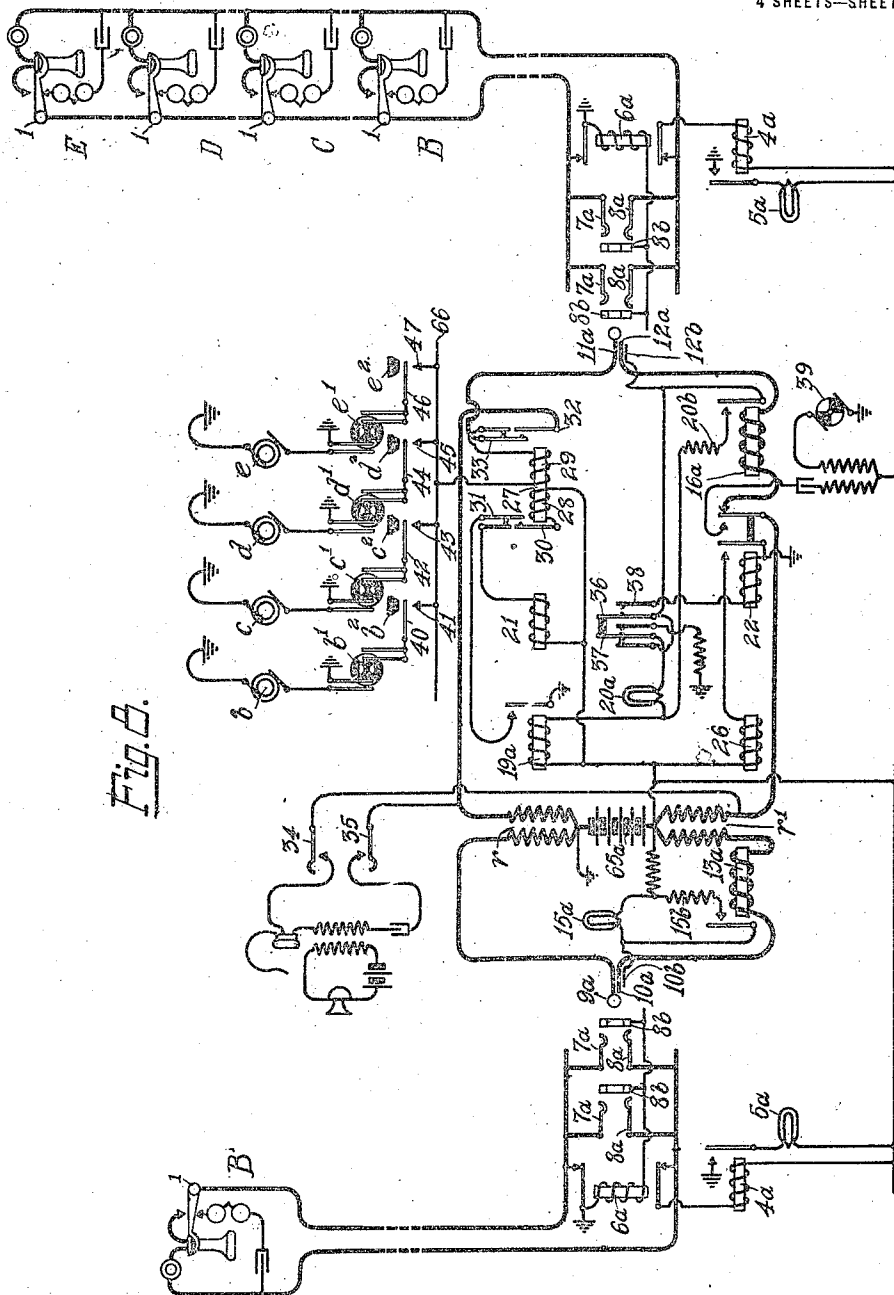
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4 SHEETS—SHEET 3.



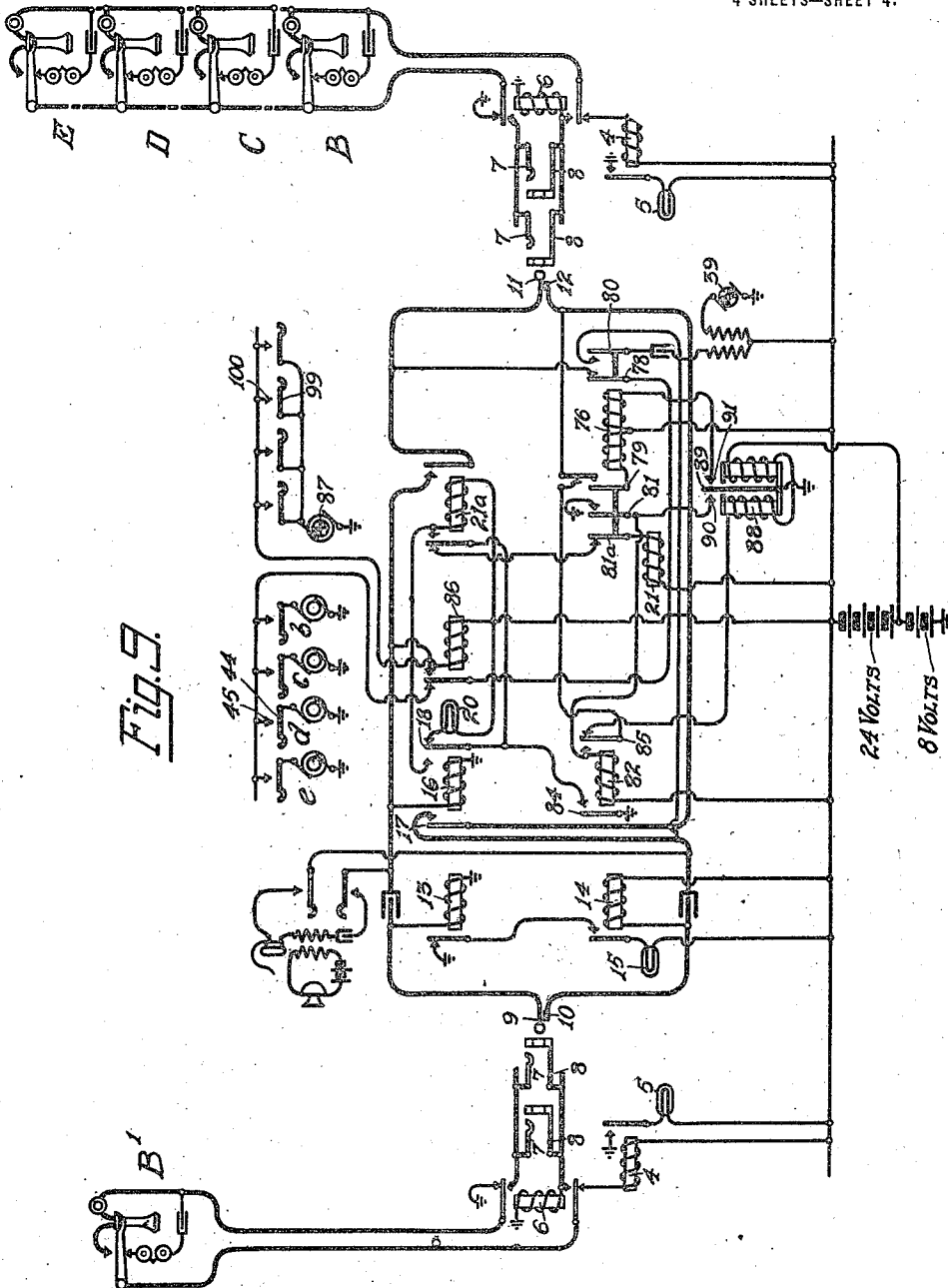
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,277,883.

Specification of Letters Patent.

Patented Sept. 3, 1918.

Original application filed March 19, 1906, Serial No. 306,817. Renewed April 17, 1912, Serial No. 691,505. Patent No. 1,208,718. Divided and this application filed October 11, 1911. Serial No. 653,990.

To all whom it may concern:

Be it known that I, ALFRED H. DYSON, residing in Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to multiple switchboard systems and more particularly to the means employed for signaling a called subscriber that his attention is wanted and for signaling the calling subscriber that the line wanted is busy, should such be the case.

The object of my invention is to provide a structure, capable of employment for party line service, in whose use the operator may, on learning the called subscriber's number, insert the calling plug immediately into the jack of the wanted line, without waiting to preliminarily test the line, and perform the switching operation for ringing the subscriber wanted, automatically controlled means being provided to render this act ineffective, should the line be busy, and to extend to the calling subscriber a busy signal.

I am aware that it is not new to provide means for automatically extending a calling signal or a busy signal, the signal extended being determined by the engaged or disengaged condition of the called line, but as far as I am aware, it is new to provide for the automatic extension of busy signals in combination with structures employing manually operated party line ringing keys.

My invention involves primarily special apparatus connected with the operators' cord circuits, and may be employed in connection with a plurality of known forms of line circuit arrangements without change therein, being thus adapted for ready installation in connection with existing telephone exchange systems.

The present application is a division of an application filed by me, for improvements in telephone systems, now issued as Patent No. 1,208,718, December 12, 1916.

Referring to the drawings,

Figure 1 illustrates a side view of a key structure employed in connection with my invention;

Fig. 2 is a left-end view thereof, omitting the listening cam L and its springs and the ringing springs of plungers b^2 ;

Fig. 3 is a right end-view of the key structure of Fig. 1.

Fig. 4 shows in perspective the upper portion of spring-lever 61.

Fig. 5 is a front view of arm 57 employed to actuate the spring-lever 61.

Fig. 6 shows the association of the circuit changing springs with spring lever 61 adapted for use in connection with the circuit of Fig. 9.

Fig. 7 illustrates two telephone lines and operator's cord connecting apparatus arranged in accordance with my invention.

Fig. 8 shows the application of my invention to a varying form of telephone exchange system.

Fig. 9 illustrates a modified form of operator's link circuit adapted for use with a modified form of key.

The key structure shown in Fig. 1, comprises the usual listening cam L adapted, when thrown over, to connect the operator's talking set with the cord strands. In addition, plungers b^2 , c^2 , d^2 and e^2 are provided, as is usual in selective party line ringing systems, each being adapted, when operated, to cause the bell of one subscriber's substation on the called line to ring, and of one only. Two magnets 21 and 26 are provided for controlling the operation of the plungers, magnet 21 being arranged to be operated when connection is made with a called line and to hold a depressed plunger in its ringing position until the called subscriber responds or the operator withdraws the plug from connection with his line, a response failing. The other magnet 26 is operated only in case the called line is busy, and when so operated prevents a depressed plunger from assuming its ringing position, so that interference with existing conversations by ringing current is prevented. In Fig. 1, parts of plungers b^2 and c^2 and their associated mechanisms are omitted, so as to disclose parts of the key structure that would otherwise be concealed. All of the plungers b^2 , c^2 , d^2 , and e^2 are identical, have similar working parts, and are controlled in the same manner by magnets 21 and 26. The former, 21, is provided with an armature and a spring 54 fastened thereto, interlocking with rocker arm 51 as shown in Figs. 1 and 2. The said arm is pivoted at

52 and 53, has four pawls, two of which are visible in Fig. 1 beneath plungers b^2 and e^2 , the other two being concealed by c^2 and d^2 . When the armature of 21 is at normal, as shown in Fig. 2, the pawls of 51 are out of engagement with the plungers, while the upper edge of 51 engages the shoulders 60 of the plungers preventing their depression, until such time as magnet 21 becomes energized, which occurs as soon as connection is made with a called line, when spring 54 rocks arm 51, so that it disengages shoulders 60 while its pawls press against the plungers. This is to prevent the operator from depressing a plunger until connection has been made with the called line, so that, should the line be busy, magnet 26 will be actuated in time to prevent a depressed plunger from assuming its ringing position.

Magnet 26, by its spring 55 (Figs. 1 and 2) fastened to its armature, interlocks with rocker arm 48, whose four pawls—two being shown complete in Fig. 1 and two as broken off—are normally held disengaged from their respective plungers. When 26 is actuated, spring 55 moves arm 48 about its pivots 49 and 50, so that the said pawls press against their plungers. As shown in Figs. 2 and 3, arms 48 and 51 are disposed on opposite sides of the plungers.

The plungers and the parts individual to them being identical, but one, d^2 , will be specifically described. It is journaled to mounting plate 62 and support 63, and when depressed and released, its spring 59 tends to raise it to its normal position shown. In addition to shoulder 60 before referred to, shoulder 56 is provided, which descends below the pawls of arms 51 and 48 on depression of the plunger, whereby its ascent is rendered controllable first by magnet 26, and thereafter by magnet 21. Fastened to the plunger is arm 57 whose T shaped extremity fitting into the I shaped orifice of spring lever 61 (Figs. 1, 4 and 5), on downward stroke of plunger d^2 , passes on the left side of 61, while on the upward stroke it passes on the right side of 61 to a position where it causes the closure of contact 44—45. This is the ringing position of the plunger, and in this position the plunger is held (provided the line wanted is idle) due to the energized condition of magnet 21 and the consequent engagement of arm 51 with shoulder 56, until, on the response of the subscriber, 21 is deenergized.

The plunger also carries arm 58 which extends through the frame, as shown in Fig. 3. When the plunger is fully depressed, 58 engaging its particular angular surface of rocker arm 67, pivotally connected to the vertical and pivoted supporting arms shown, it moves the said arm 67 to the right, which, by its extension 67^a, moves mechanically connected springs 36 and 37 to their alter-

nate positions. Should the called line be busy and magnet 26 therefore energized when the plunger is depressed, arm 48 by its pawl engages shoulder 56 and holds the plunger practically completely depressed, so that springs 36 and 37 continue in their alternate positions, while arm 57 is prevented from assuming its ringing position.

Having described in detail the special mechanism employed in connection with my invention, I shall describe the circuit drawings, in which, for the sake of clearness, but few mechanical elements, and those in diagrammatic form, are shown, without cross references to Figs. 1 to 5, assuming that the mechanical combinations are borne in mind. Similar parts, appearing in Fig. 7 and Figs. 1-5, have corresponding reference characters.

In Fig. 7, I have illustrated a telephone line extending from substation B' to the exchange and there provided with a well known line circuit arrangement. The mechanism at B' includes hook lever 1 normally maintaining the condenser and bell in bridge of limbs 2 and 3, and adapted on removal of the receiver to open the bell circuit and connect the transmitter and receiver with the line limbs.

The various ground connections illustrated at the exchange indicate connections to the grounded side of battery by the office return.

The line limbs 2-3 of substation B' are connected to the opposite sides of battery 65, the line relay 4, controlling line signal lamp 5, being connected between 2 and the active side of battery. The cut-off relay 6, connected from ground to the sleeve contacts 8 of the spring jacks, when actuated, by its armatures opens the normal connections of limbs 2 and 3 and connects them to jack contacts 8 and 7.

A second telephone line is shown, to which are connected substations B, C, D and E, to each of which the description of substation B' also applies. The central office circuit of this line is similar to that of the line of B'.

An operator's cord circuit is shown including an answering plug having tip and sleeve contacts 9 and 10, and a calling plug having tip and sleeve contacts 11 and 12. Associated with the answering plug contacts are relays 13 and 14, jointly controlling the answering supervisory signal 15, while, in association with the calling plug contacts, are relays 16 and 19 controlling the calling supervisory signal 20. Relay 16, by armature 17, further controls a contact in the sleeve cord strand, normally open, whereby interruption with an existing conversation by busy machine 39 is prevented, should the operator plug into a jack of a busy line.

Relay 19, having preferably a high resist-

ance winding, by its armature controls the circuit of key magnet 21 to effect its energization as soon as the calling plug is inserted in a line jack, whereby plungers b^2 , c^2 , d^2 , and e^2 are unlocked. A depressed plunger causes springs 37 and 36 to assume their alternate positions, the actuation of 36 uniting test relay 22 with the sleeve contact 12 whereby it becomes sensitive to the busy condition of a called line. By its armature 24, relay 22 controls the key magnet 26. Armature 23 controls the connection of busy machine 39 with the line of the calling subscriber.

The circuit of magnet 21 extends through spring 31 of relay 27 and its normal contact, which latter relay has an actuating winding 29, normally connected to tip contact 11 of the plug and conductor 66, and a locking winding 28 controlled by armature 30. Conductor 66 is adapted for connection with any of the ringing springs 40, 42, 44 and 46.

The generators b , c , d , and e , deliver current of different frequencies and the bells at substations B, C, D, and E are tuned so that each is responsive only to current of the frequency delivered by the generator designated by the corresponding small letter. Such an harmonic selective ringing system is described in U. S. Letters Patent to Wm. W. Dean, title, Party line telephone system, No. 779,533, issued Jan. 10, 1905.

By means of the plungers b^2 , c^2 , d^2 , and e^2 , the operator can connect the proper generator with an idle called line to ring the subscriber wanted. Interrupters b' , c' , d' , and e' are provided to alternately interrupt and close connection between springs 40, 42, 44 and 46 and their associated generators, whereby the substation bells are intermittently caused to ring. In addition to the two brushes effecting this are provided two additional brushes, so arranged that conductor 66 is always grounded when one of springs 40, 42, 44 and 46 is connected to it, in order to insure that when the called subscriber removes his receiver, circuit will instantaneously be completed through relay 27, whereby magnet 21 is deenergized to disconnect the generator. The remaining connections will be understood best from the description of the operation.

Operation Fig. 7.

Assuming that subscriber B' desires to converse with subscriber D, the removal of the receiver at substation B' completes circuit through line relay 4, the current traveling through hook lever 1 and its alternate contact. The attracted armature of relay 4 effects the display of lamp 5 to attract the operator's attention. She inserts the answering plug into the jack of the calling line, closing contacts 7-9 and 8-10, which latter completes a circuit of battery 65

through supervisory relay 14 and cut-off relay 6 in series. The attracted armatures of relay 6 open the circuit of relay 4 (whose retracted armature renders signal 5 inert) and by engaging their alternate contacts, connect limbs 2 and 3 to contacts 8 and 7. Relay 14 attracts its armature, which would cause the display of supervisory signal 15 were this not prevented by the attraction of the armature of relay 13, now energized by current through its winding, contact 9-7, armature of relay 6, hook-lever 1, returning through the other armature of relay 6, contact 8-10 and through relay 14 to battery.

The operator, ascertaining in the usual manner what subscriber is wanted, inserts the calling plug into a multiple jack of the line connected to the said subscriber's station closing contacts 11-7 and 12-8. Current flows from ground, through cut-off relay 6 of the called line, contact 8-12, its normal contact and spring 37, relay 19 to battery 65. The attracted armature of relay 19 closes circuit from ground, through spring 31 and its normal contact, key magnet 21 and to battery, whose actuation causes plungers b^2 , c^2 , d^2 and e^2 to be unlocked. The attracted armature of relay 19 also effects the display of supervisory signal lamp 20.

The operator now depresses plunger d^2 to its full extent, which throws over springs 37 and 36 to engage their alternate contacts. To this point, the operation of the system is the same whether the called line is busy or idle.

The described movement of spring 36 connects the winding of test relay 22 with the sleeve strand of the cord and through contact 12 with the sleeve contacts 8 of the spring jacks of the called line. The actuation described of spring 37 disconnects temporarily the sleeve strand of the cord from the active side of battery 65 and completes a new path for current through relay 19 to ground.

Assuming first that the called line is idle, it will be observed that the grounded winding of relay 22 is connected through contacts 38-36, 12-8, to the grounded winding of cut-off relay 6 of the called line. No flow of current results through relay 22, and the depressed plunger d^2 ascends to the ringed position because, owing to the deenergized condition of relay 22, key magnet 26 remains inert. The contact of springs 37 and 36 with their alternate contacts being in this case momentary only, they resume their normal positions, circuit being again completed from ground at the called line, through cut-off relay 6, contacts 8-12, spring 37, relay 19 to battery. The attracted armatures of cut-off relay 6 complete circuit for current from generator d , through interrupter d' , contact 44-45, plunger d^2 being now in ringing position,

through winding 29 of relay 27, its normal contact and spring 33, armature 25 of relay 22, contact 11—7, the attracted armature of relay 6, limb 3, through the call bells and condensers of substations B, C, D and E in parallel, returning over limb 2, the attracted armature of relay 6, contact 8—12, spring 37, relay 19, to battery. Due to the substation condenser the relay 27 is not energized; and the frequency of current being out of tune with the call bells of all the substations other than D, the subscriber at that substation is alone signaled. By the removal of the receiver at substation D, circuit is instantly completed from ground at the exchange, through one or the other of the brush pairs of interrupter d' , contact 44—45, winding 29 and, following the before traced path of ringing current, to battery 65. This being direct current, relay 27 is energized, whose attracted armature 30, engaging spring 31, completes a locking circuit through winding 28 for relay 27 and immediately thereafter opens the circuit of key magnet 21, whose deenergization allows the return of plunger d^2 to its normal position. The attracted armature 32 of relay 27, engaging spring 33, completes the talking circuit of the tip strand of the cord circuit and thereafter opens the circuit of winding 29 of relay 27. On the closure of contact 32—33, a path for the flow of current was established through the grounded winding of relay 16, over the talking circuit as indicated by the heavy lines, to limb 3 of the line of subscriber D, returning over limb 2 and through relay 19 to battery. The attracted armature 18 of relay 16 opens the circuit of supervisory lamp 20 which is thereby put out, notifying the operator that the response has been made. The attracted armature 17 of relay 16 completes the talking circuit of the sleeve strand of the cord circuit, and the two subscribers are now in conversation through condensers s and s' , the talking circuit being indicated from substation B' to substation D, through the exchange, by the heavily marked conductors, current for energizing their respective transmitters being supplied from battery 65 through the sleeve supervisory relays 14 and 19 respectively, the return path being traced through the relays 13 and 16 respectively.

When subscriber B' replaces his receiver, circuit is opened through relay 13, whose retracted armature effects the display of lamp 15; and when D replaces his receiver, circuit is opened through relay 16, whose retracted armature 18 closes circuit through lamp 20. The operator, observing the simultaneous display of the two supervisory signals, withdraws the answering plug from the calling line, effecting the deenergization of relays 6 and 14, while the withdrawal of the call-

ing plug interrupts circuit through relays 6 and 19. The retracted armature of relay 19 opens circuit through lamp 20 and also through the locking winding 28 of relay 27, whose retracted armature 30 allows spring 31 to engage its normal contact, again placing key magnet 21 under the control of relay 19; while the retracted armature 32 of relay 27 allows spring 33 to engage its normal contact, again placing conductor 66 in operative relation with tip contact 11 of the calling plug.

Connection with busy line.

The insertion of either an answering plug or a calling plug into the spring jack of a line causes a flow of current from battery 65, through the respective sleeve supervisory relay 14 or 19, to ground through the cut-off relay 6 of the line. Owing to the resistance of the cut-off relay winding, sleeve contacts 8 of the line spring jacks are, under this condition, of a potential other than that of ground. Assuming that, when the operator inserted the calling plug into a spring jack of the line of subscriber D, the just described condition existed, upon the complete depression of plunger d^2 throwing over springs 37 and 36 to engage their alternate contacts, the raised potential of the sleeve contact 8 of the jack, into which the calling plug was inserted, would cause a flow of current through sleeve contact 12 of the calling plug now inserted in the busy line, through contact 36—38, the winding of test relay 22 to ground. The attracted armature 24 of this relay then completes circuit through busy magnet 26, whose actuation prevents the return of plunger d^2 to the ringing position by holding it practically fully depressed so that springs 37 and 36 are continued in their alternate positions. The attracted armature 23 of relay 22 completes circuit from interrupter 39, through the induction coil and condenser, through the sleeve strand condenser s' and contact 10—8 to the calling line, whereby the calling subscriber is notified that the line wanted is busy. He thereupon replaces his receiver, thereby displaying supervisory signal 15 and advising the operator that the line should be disconnected. The withdrawal of the calling plug opens the circuit of test relay 22, whose retracted armatures 23 and 24 disconnect the busy machine 39 and deenergize key magnet 26, whereupon plunger d^2 ascends to a position where springs 36 and 37 assume their normal positions. As soon as 37 disengages its alternate contact, relay 19 becomes inert, and the retracted armature opens the circuit of key magnet 21, whose deenergization allows the return of plunger d^2 to normal.

Fig. 8.

In Fig. 8, I have illustrated a telephone

exchange system of well known character, employing three conductor spring jacks and cord circuits in association with the structure of my invention.

Salient features differentiating this system from that shown in Fig. 7 include the placing of cut-off relays 6^a in circuits independent of the talking circuits, the supervisory signals 15^a and 20^a being placed in series with the cut-off relays on connection of the plug terminals with the line jacks. The supervisory relays 13^a and 16^a, having the functions of rendering the supervisory signals inert when the substation circuits are completed by the removals of the receivers, render them inert by shunting them by resistances 15^b and 20^b respectively.

The two connected subscribers' lines in Fig. 8 are inductively united for conversation by windings r , r' , of a repeating coil, instead of by condensers s , s' , as shown in Fig. 7.

Briefly, the operation of Fig. 8 is as follows:

When subscriber B' initiates a call, relay 4^a and lamp 5^a are energized. On the insertion of the answering plug into the jack of the calling line, the placing in series of the signal lamp 15^a with cut-off relay 6^a would cause its display, were it not immediately shunted by resistance 15^b on the attraction of the armature of relay 13^a, which relay is energized at once by current over the calling line. The operator, learning in the usual manner what subscriber is wanted, assumed to be D, inserts immediately the calling plug in a spring jack of the called line, closing contacts 11^a—7^a, 12^a—8^a, and 12^b—8^b. Thereupon current flows from ground, through cut-off relay 6^a (attracting its armatures), contact 8^b—12^b, spring 37, signal 20^a (displaying it), relay 19^a to battery 65^a. The attracted armature of relay 19^a effects energization of key magnet 21, releasing the key plungers and setting the ringing position pawls against the plungers. The operator, now depressing plunger d^2 , causes springs 37 and 36 to engage their alternate contacts, the closing of contact 38—36, placing test relay 22 in operative relation with sleeve 12^b of the calling plug. If the plug of another cord is already connected to the called-for line, contacts 8^b and 12^b will be at a potential other than ground, due to a flow of current from the other cord, through the resistance of cut-off relay 6^a of the called line, to ground. Relay 22 will therefore be energized, and its attracted armatures will connect interrupter 39 with the calling line and cause the actuation of key magnet 26 respectively, to transmit the busy signal to subscriber B' and prevent plunger d^2 from assuming its ringing position. Subscriber B', replacing his receiver, thereupon deenergizes relay 13^a, whose retracted armature removes the shunt

of 15^b from signal 15^a. Both signals being displayed, the operator removes the two plugs and the apparatus resumes its normal condition.

Should, however, the called line be idle, 8^b and 12^b will be at the potential of ground, relay 22 and magnet 26 remain deenergized, and plunger d^2 assumes its ringing position, whereby contact 44—45 is closed and ringing current projected from generator d , through winding 29 of relay 27, over the called line to ring the bell of subscriber D, as before described. On the removal of the receiver at D, direct current flows from ground, through contact 44—45, winding 29, contact 11^a—7^a, through lever 1 at D, returning through 8^a, 12^a, supervisory relay 16^a to battery 65^a. Armatures 30 and 32 of relay 27 operate to deenergize magnet 21, to allow the return of plunger d^2 , and to complete the talking circuit of the tip cord strand. The attracted armature of relay 16^a shunts signal 20^a to render it inert by means of resistance 20^b.

When subscribers B' and D replace their receivers, relays 13^a and 16^a are deenergized, and their retracted armatures remove the shunts of resistances 15^b and 20^b from about signals 15^a and 20^a, whose simultaneous display notifies the operator to remove the answering and calling plugs, which causes the line circuits and the cord circuit to resume their normal positions.

In Fig. 9 I show my invention carried out in a form employing the polarized relay 88 and adapted to be used in connection with the key structure of Figs. 1 to 5; with the exception that key magnet 26 and its lever 48 are not employed, while fastened to lever 61 of each plunger is to be provided an additional switch spring 99 with its associated contact 100, as shown in Fig. 6, adapted when a plunger is in its ringing position to connect interrupter 87, (Fig. 9) with relay 86. On connection made with an idle line by the calling plug of Fig. 9, armature contact 89, 90 of relay 88 is closed to energize relay 82 whose armature 85 establishes a locking path for current for 82 from the 24 volt battery tap, through the switch springs of relay 76 and the cut-off relay 6 of the called line which flow puts the busy potential on the sleeve contacts of the spring jacks. The attracted armature 84 of relay 82 closes circuit through lamp 20 displaying it, a branch circuit through key magnet 21 being also established to actuate 21 which unlocks the plungers (see Figs. 1 and 2) and places the pawls of lever 51 in position to hold a depressed plunger in ringing position. Assuming the plunger of generator d (Fig. 9) to be depressed, contacts 44, 45 and 99, 100, will be closed and current will intermittently flow from generator d through armature of relay 86, when re-

tracted, armature 78 of relay 76 to the called line. On the response of the subscriber, relay 16 is actuated by current passing through the armature of relay 86 when attracted, armature 78 and over the called line. The attracted armature 18 of relay 16 puts out lamp 20 and establishes a flow of current to energize relay 21^a whose attracted armatures open circuit through key magnet 21 (allowing the return of a depressed plunger to normal, whereby contacts 44, 45 and 99, 100 are opened) and complete the talking circuit of the tip cord strand. Should the called line, however, be busy when the calling plug of Fig. 9 is connected to a spring jack thereof, armature 89 of relay 88 engages contact 91, and relay 76 is energized, its contact 81^a opening and preventing the energization of magnet 21 so that the key plunger cannot be depressed. The closing of alternate contact 79 establishes a locking circuit for relay 76 through the cut-off relay of the called line and the closing of alternate contact 81 energizes relay 82 to light signal 20. Busy back 39 is connected through alternate contact 80 to the sleeve strand of the cord and thus over the calling line whereupon the calling subscriber replaces his receiver. The operator finding the plungers locked against depression need not wait for the display of signal lamp 15, and she may therefore without delay remove the plugs of the cord circuit from the jacks of the two lines, whereby the cord apparatus is restored to normal, the calling subscriber having meanwhile for a short period heard the busy signal in his receiver.

It is not my intention to limit myself to the particular devices and arrangements herein shown and described, as the principle of my invention is capable of varying employments, and I aim to cover all such arrangements as come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A telephone system comprising a telephone line, a link-circuit for establishing connection with said line, a ringing current source, contacts for connecting said source to said line to transmit ringing current thereover, means normally operative to hold said contacts against operation, and means for freeing said contacts in response to the connection of said link-circuit to said line.

2. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts for connecting said source to said line to transmit ringing current thereover, a stop for preventing the operation of said contacts, an electromagnet for removing said stop from its preventing po-

sition, and circuit connections and a source of current for operating said magnet to remove said stop in response to the connection of said link-circuit to said line.

3. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, a ringing key for connecting said source to said line to transmit ringing current thereover, a stop normally lying in the path of movement of said key to prevent its operation, an electromagnet for removing said stop from its normal position to permit the operation of said key, and circuit connections and a source of current for operating said magnet upon the connection of said link-circuit and line.

4. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current thereover, means normally operative to hold said contacts against operation, and means for freeing said contacts by closing a circuit over a portion of the connected link-circuit and line.

5. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current thereover, a stop normally operating to prevent the operation of said contacts, electro-magnetic means for removing said stop from its normal position in response to the connection of said link-circuit and line, and means responsive to the subsequent operation of said contacts to cause said stop to lock said contacts in their actuated position.

6. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current thereover, a stop normally operating to prevent the operation of said contacts, electro-magnetic means for removing said stop from its normal position in response to the connection of said link-circuit and line, and means also controlled by said electro-magnetic means for locking said contacts in their actuated position.

7. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a source of ringing current, a key for applying current from said source to said line, and means for preventing the operation of said key until said link-circuit is connected to said line.

8. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a source of ringing current, normally locked ringing contacts

for applying current from said source to said line, means operated upon the connection of said link-circuit to said line to unlock said contacts, means responsive to the subsequent operation of said contacts to lock said contacts in their actuated position.

9. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a source of ringing current, normally locked ringing contacts for applying current from said source to said line, means operated upon the connection of said link-circuit to said line to unlock said contacts, means responsive to such connection to lock said contacts when moved to their actuated position.

10. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a source of ringing current, normally locked ringing contacts for applying current from said source to said line, means for unlocking said contacts by completing a circuit over a portion of the connected link-circuit and line, and means responsive to the subsequent operation of said contacts to lock said contacts in their actuated position.

11. A telephone system comprising a telephone line, a link-circuit for establishing connection to said line, a ringing current source, contacts to connect said source to said line to transmit ringing current thereover, a stop normally operating to prevent the operation of said contacts, electromagnetic means for removing said stop from its normal position, means for actuating said electromagnetic means by closing a circuit over a portion of the connected link-circuit and line, and means responsive to the subsequent operation of said contacts to cause said stop to lock said contacts in their actuated position.

12. A telephone system comprising a called telephone line, a link-circuit for connecting to said line, a source of ringing current, normally locked ringing contacts for applying said source to the connected line, means dependent upon the connection of said link-circuit to said line to free said ringing contacts, means operated upon the subsequent operation of said contacts to lock said contacts in their actuated position, and means dependent upon the response of the called party to again free said contacts.

13. In a telephone system including telephone lines, signals therefor at the exchange, and operators' link-circuits for connecting said lines, the combination, with a line, of a station connected thereto, an operator's link-circuit connected with said line rendering it busy, a second link-circuit connected with said line, a manually operated ringing key associated with said link-circuit adapted to be placed in its ringing position

by the operator, and apparatus sensitive to the connection of said first link-circuit with said line to prevent the placing of said key in ringing position and to extend a signal.

14. A telephone system comprising a telephone line, a link-circuit, a manually operated key for applying ringing current to the line when connected to said link-circuit, a control relay normally interrupting the talking circuit of said link circuit, a second relay, a control circuit therefor connected as a branch of a talking strand of said link-circuit, a switch for conductively uniting the telephone line limbs to operate said second relay, and means actuated by said second relay to operate said control relay to effect the continuity of the talking circuit of said link-circuit.

15. A telephone system comprising a telephone line, a link-circuit, means for applying ringing current to the line when connected to said link circuit, a control relay normally interrupting the talking circuit of said link circuit, a second relay therefor, a branch circuit extending from a talking strand of the link circuit and including said second relay, a switch for conductively uniting the telephone line limbs to operate said second relay, and means actuated by said second relay to operate said control relay to effect the continuity of the talking circuit of said link circuit.

16. A telephone system comprising a called party telephone line, a link circuit connected thereto, ringing keys adapted to be operated for associating ringing currents of different character with said link circuit and line, a magnet common to said keys, means for energizing said magnet, a relay and source of direct current in bridge of said line and link circuit, a switch at the called substation of said line adapted to be closed to cause operation of said relay by said source, and circuit connections effective upon such operation whereby said magnet is de-energized to release any actuated key from its ringing apparatus.

17. A telephone system comprising telephone lines terminating at an exchange, link circuits for interconnecting said lines, a source of signaling current, a key for each link circuit for applying current from said source to the associated link circuit and thus to the connected called lines, and means to prevent the operation of said key and thereby prevent the application of current to a link circuit until connection is made with an idle called line.

18. A telephone system comprising lines terminating at an exchange, link circuits for interconnecting said lines, a source of signaling current, a key for each link circuit for applying current from said source to called lines, and means to prevent the oper-

ation of a key until the associated link circuit is connected to a called line.

19. A telephone system comprising telephone lines terminating at an exchange, a plug ended link circuit for connecting to any of said lines as a called line, a source of signaling current, a key for said link circuit for applying current from said source to said link circuit, and means to prevent the operation of a key until the plug is connected to a jack of the called line.

20. A telephone system comprising telephone lines, an operator's link circuit for connecting to any of said lines as a called line, a normally disconnected source of signaling current, a key for said link circuit for connecting said signaling current to the link circuit, and means to prevent the operation of said key until a called line is connected with.

21. A telephone system comprising telephone lines, link circuits for interconnecting said lines, a key for each link circuit for connecting ringing current to the associated link circuit, and means to prevent the operation of the key unless a telephone line is connected with.

22. In a telephone exchange system including telephone lines, substations connected thereto, signals at the exchange adapted for display responsive to currents over said lines, multiple terminals associated with said lines and link-circuits for interconnecting said lines, adapted for connection with said terminals to render them busy, the combination with a link-circuit of a ringing key associated with said link circuit for actuation by the operator, means normally locking said key against actuation, an electromagnet adapted for energization on connection made with an idle line, and mechanism controlled thereby for unlocking said key and for causing it when actuated to assume its ringing position.

23. In a telephone exchange system including telephone lines, substations connected thereto, signals at the exchange adapted for display responsive to currents over said lines, multiple terminals associated with said lines and link-circuits for interconnecting said lines adapted for connection with said terminals to render them busy, the combination with a link-circuit of a ringing key associated with said link circuit for actuation by the operator, means normally locking said key against actuation, an electro-magnet adapted for energization on connection made with an idle line, mechanism controlled thereby for unlocking said key and for causing it when actuated to assume its ringing position, and means operative on a response at the called substation to cause the key to leave its ringing position.

24. In a telephone exchange system in-

cluding telephone lines, substations connected thereto, signals at the exchange adapted for display responsive to currents over said lines, multiple terminals associated with said lines and link-circuits for interconnecting said lines, adapted for connection with said terminals to render them busy, the combination with a link-circuit of a ringing key associated with said link circuit for actuation by the operator capable of being caused to assume three positions, means normally locking said key against actuation by the operator, an electro-magnet adapted for actuation on connection made with a line, mechanism controlled thereby for unlocking said key and for causing the actuated key to assume its ringing position, means operative on a response at a called substation to cause the key to leave its ringing position, a second electromagnet adapted for actuation when connection is made with a busy line only, and apparatus controlled thereby for holding the key, when initially actuated, in a busy position whereby said key is prevented from assuming its ringing position.

25. In a telephone exchange system including telephone lines, substations connected thereto, signals at the exchange adapted for display responsive to currents over said lines, multiple terminals associated with said lines and link-circuits for interconnecting said lines, adapted for connection with said terminals to render them busy, the combination with a link circuit of a ringing key associated with said link circuit for actuation by the operator capable of being caused to assume three positions, means normally locking said key against actuation by the operator, an electromagnet adapted for actuation on connection made with a line, mechanism controlled thereby for unlocking said key and for causing the actuated key to assume its ringing position, and means operative on a response at a called substation to cause the key to leave its ringing position.

26. In a telephone exchange system including telephone lines, substations connected thereto, signals at the exchange adapted for display responsive to currents over said lines, multiple terminals associated with said lines and link-circuits for interconnecting said lines, adapted for connection with said terminals to render them busy, the combination with a link-circuit of a ringing key associated with said link circuit for actuation by the operator capable of being caused to assume three positions, means normally locking said key against actuation by the operator, an electromagnet adapted for actuation on connection made with a line, and mechanism controlled thereby for unlocking said key and for causing

the actuated key to assume its ringing position.

27. A telephone system comprising telephone lines terminating at an exchange, a plurality of substations associated with each of said lines, link circuits for interconnecting said lines, sources of signaling current, a key for each link circuit for applying current from said sources to the associated link circuit and thus to the connected called lines, and means to prevent the operations of said key until connection is made with an idle called line.

28. In a telephone system, a plurality of telephone lines extending by their limbs from substations to an exchange, a cord circuit at the central for connecting said lines, a source of signaling current for sig-

naling said substations, circuit connections therefor, normally connected to the calling end of the cord circuit, manually operated switching means for connecting said source to said circuit connections and supervisory means operating on connection of the switching mechanism to a busy line to automatically disconnect the source of signaling current and prevent ringing in the ear of a subscriber using the line.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

ALFRED H. DYSON.

Witnesses:

GEORGE E. MUELLER,
M. R. ROCHFORD.