B. D. WILLIS.

SEMI-AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED OCT. 7, 1913.

1,230,639.

Patented June 19, 1917.

2 SHEETS—SHEET 1.

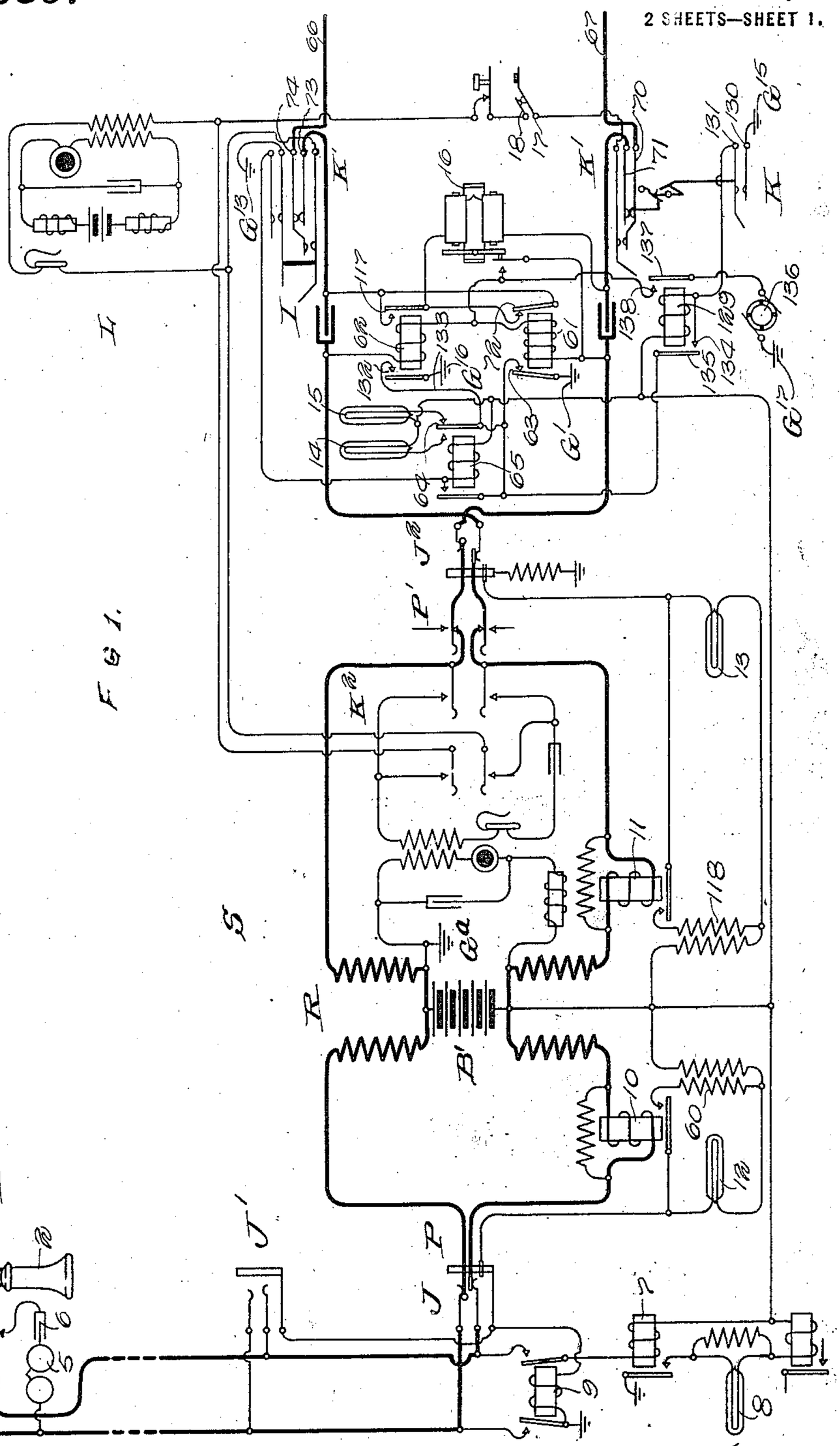

FIG. 1.

WITNESSES

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INVENTOR:

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By Bulkley & Sweatt

ATTORNEYS

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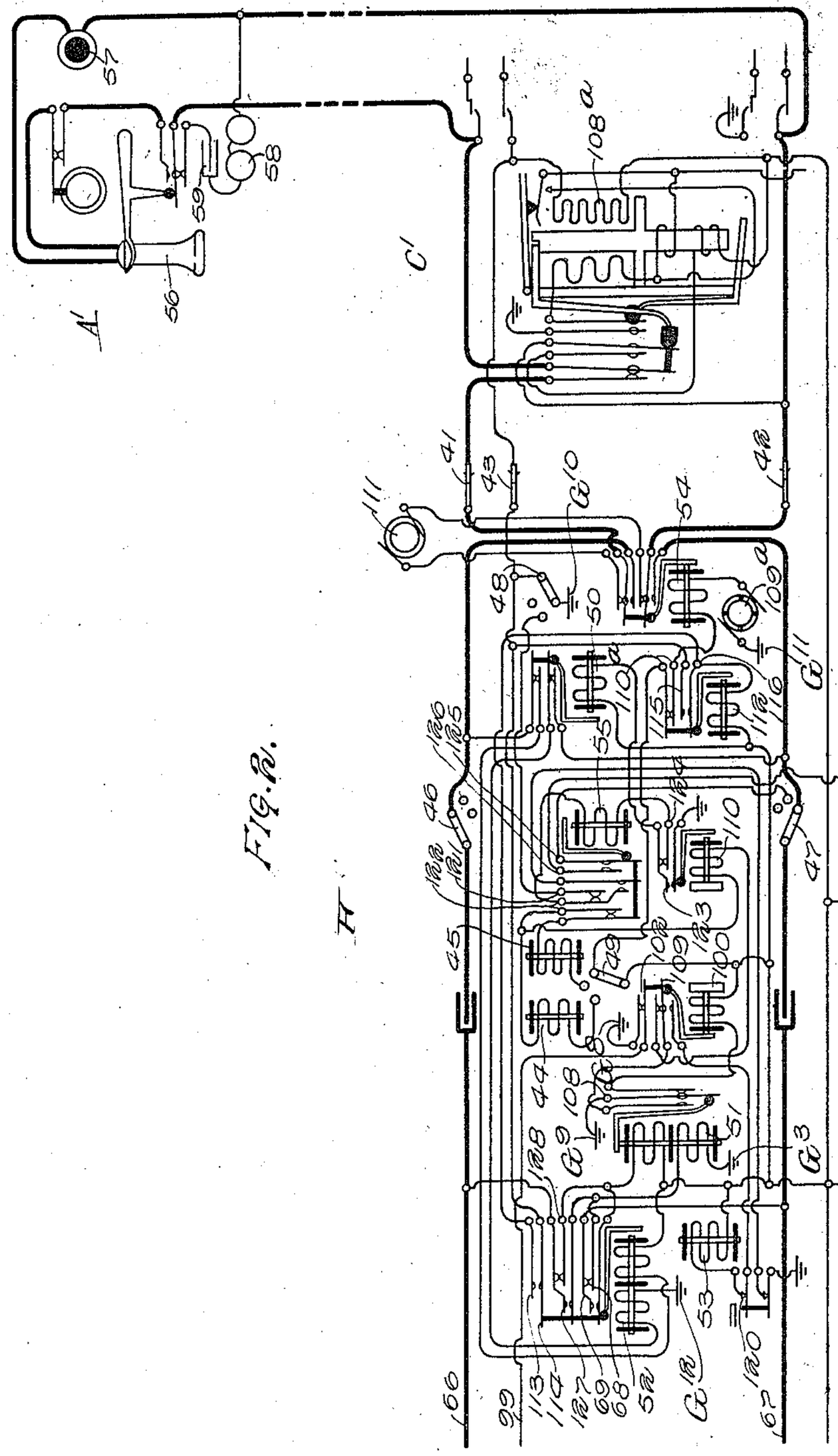

FIG. 2.

WITNESSES

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UNITED STATES PATENT OFFICE.

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SEMI-AUTOMATIC TELEPHONE SYSTEM.

1,230,639. Specification of Letters Patent. Patented June 19, 1917.

Application filed October 7, 1913. Serial No. 793,947.

To all whom it may concern:

Be it known that I, BERNARD D. WILLIS, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Semi-Automatic Telephone Systems, of which the following is a specification.

My invention relates to semi-automatic telephone systems, and more particularly to improved means for supervising in such a system to indicate to the operators when a called line is busy. My invention relates to a system comprising A and B operators in which the B-operator, upon receiving the busy signal, transmits a second busy signal to the A-operator to thus inform the latter operator that the line is busy.

More specifically, my invention relates to the means by which the B-operator, upon receiving the busy signal from the automatic apparatus through which the connection to the called line was completed, operates a push-button or key switch, the operation of which causes a visual signal at the A-operator's position to be intermittently operated, thus giving to the A-operator the busy signal.

My invention will be more readily understood by reference to the accompanying drawings, in which I have illustrated my invention in connection with a semi-automatic system of a particular type. In this system I have indicated a well-known A-operator's cord circuit which makes connection with a trunk line in which is located the B-operator's apparatus, the connection from this trunk being extended to the called line through an automatic connector switch of a well-known type.

It will, of course, be understood that other forms of cord circuits could be used, and likewise that in larger exchanges, instead of having the trunk line extending directly to the connector switch, a suitable number of selectors might be interposed in the well-known manner. In order to simplify the disclosure in this case, however, it is not thought necessary to illustrate such selectors, as their use and the manner in which they aer connected are well known.

Figs. 1 and 2 taken together show a complete circuit connection established between a calling manual substation T and a called automatic substation A′. Fig. 1 shows the manual substation T and an A-operator's cord circuit S and a B-operator's equipment I. Fig. 2 shows an automatic connector switch H, an individual or line switch C′ and an automatic substation A′.

The manual substation T (Fig. 1) is an ordinary common battery manual telephone comprising the usual receiver 2, transmitter 3, ringer 5 and condenser 6. At the central office the line of the substation T is provided with the usual answering jack J, a plurality of multiple jacks J′, line relay 7, line lamp 8 and cut-off relay 9. The cord circuit S is a well-known type of cord circuit comprising the usual answering and calling plugs P and P′, respectively, inductively connected together through the medium of a repeating coil R. The usual supervisory relays 10 and 11 are included in the sides of the cord circuit for controlling the supervisory lamps 12 and 13. The trunk circuit leading from the manual exchange to the automatic exchange leads from the multiple jacks J^2 on the A-operator's board to a connector switch H in the automatic exchange, and is provided at the B-operator's board with the equipment I. This trunking equipment comprises a lamp 14, a supervisory lamp 15, relays for controlling the circuits of the lamps, keys K and K′ and the polarized relay 16. These two keys K and K′ are so arranged that the operation of the key K automatically restores the key K′ to normal position if the latter is in operated position at the time. The key K′ is a calling device key, the purpose of which is to connect a calling device with the trunk line, through the medium of which calling device the operator may control the automatic switches to set up the proper connection. This calling device may be of any desired type, such, for instance, as that shown in British patent to S. G. S. Dicker No. 29,654 of 1910. Through the medium of this calling device the operator may interrupt the bridge across the trunk line a desired number of times for each of the digits of the number of the called subscriber.

The connector switch H (Fig. 2) is of the general type of connector switch disclosed in United States Letters Patent No. 815,176, issued March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central

office apparatus is controlled by impulses transmitted over the two sides of the line in series. The connector is provided with a shaft (not shown) carrying the wipers 41, 42 and 43 and is controlled by the vertical magnet 44 and the rotary magnet 45. The usual side switch carrying the wipers 46, 47, 48 and 49 is controlled by the private magnet 50 in the usual and well-known manner. The magnet 53 is the usual release magnet. The line relay 51 is connected with the line through the reversing springs of a so-called back-bridge relay 52, through the windings of which latter relay the called line is provided with talking current. The ringer relay 54 is the means through which the application of ringing current to the called line is controlled. At Q there is shown a busy signaling machine which is connected to the springs of the relay 55, the function of which machine is to send a busy tone, under certain conditions, back over the line. The complete operation of this relay will be described later. The busy signaling machine as represented herein comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and an interrupter. Through the medium of this interrupter an interrupted current is supplied to the primary winding which induces an alternating current in the secondary winding, whereby when said winding is connected to the subscriber's line a buzzing sound is heard in his receiver.

The automatic substation A′ (Fig. 2) comprises the usual receiver 56, transmitter 57, ringer 58 and condenser 59. Being an automatic substation it is also provided with a suitable call-sending mechanism for controlling automatic switches. Since the type of automatic substation shown at A′ and the line switch C′ are well known in the art of telephony, and as they form no part of my present invention, it is thought unnecessary to give a detailed description of them.

For the purpose of supplying current for operating the central office apparatus and for talking batteries B and B′ are shown having their positive terminals grounded at G and G^a. In practice, however, only one battery need be used.

Having given a general description of the apparatus, I will now describe the operations performed in the process of establishing a connection from the manual substation T (Fig. 1) to the automatic substation A′ (Fig. 2). Since the automatic apparatus represented herein is in general well known in the art, and is fully described in the publications herein referred to, its operation will be described in a more or less general manner. Upon the removal of the receiver at the calling telephone T, the circuit of the line relay 7 is closed in the usual manner, which relay, upon energizing, closes the circuit of the line lamp 8 to signal the operator. The operator answers the call by inserting the plug P into the jack J, whereby the connection is completed between the line and the cord S. By the engagement of the third conductor of the plug P with the jack J, the circuit of the cut-off relay 9 is closed in series with the lamp 12 of the cord. The relay 9, upon energizing, disconnects the line relay 7 from the line. When the connection is extended to the cord, the calling substation is provided with talking current from the battery B′ through two windings of the induction coil R and through the relay 10. The relay 10, upon energizing, closes a shunt around the lamp 12 through the resistance 60, thereby shunting sufficient current away from said lamp to prevent it from glowing. The operator then connects her talking set with the line through the medium of the key K^2, and, upon learning from the calling subscriber that a subscriber of the automatic exchange is wanted, she transmits the number to the B-operator over the usual order wire. The B-operator, upon receiving the number, assigns to the A-operator an idle trunk line, which we will assume to be the one terminating in the jack J^2. Upon the insertion of the plug P′ into the jack J^2, a circuit is closed from ground G^a over the tip strand through the plug P′, jack J^2, relay 61, relay 62, thence through the ring conductor of the jack J^2 and plug P′ and the relay 11 to the non-grounded terminal of battery B′. The relay 61 is of sufficiently high resistance to prevent sufficient current from flowing over this circuit to energize the relay 62 or the relay 11, but is itself energized to close a circuit from ground G′ through contact of the springs 63, back contact of the spring 64 and lamp 15 to battery B′. The relay 61, upon energizing, also operates to close a bridge across the trunk conductors 66 and 67, whereby a circuit is closed extending from ground G^3 through the lower winding of the line relay 51 of the connector H. thence through the springs 68 and 69, trunk conductor 67, springs 70 and 71 of the key K′, polarized relay 16, contact 72 of the high resistance relay 61, springs 73 and 74, conductor 66, springs 127 and 128 and the upper winding of the relay 51 to battery. The direction of the flow of current over this circuit is such that the polarized relay does not operatively energize. The line relay 51, however, attracts its armature and closes a circuit extending from ground G^9 through the winding of slow acting release relay 100 to battery. The release relay, upon energizing, prepares the usual circuit for the vertical and rotary magnets 44 and 45, and also connects ground G^8 to conductor 99. This

latter operation is unnecessary in the system shown; in fact, where connectors only are used the connector 99 and springs 102 might well be omitted. But in a larger system where selectors are used these parts are necessary for completing the usual holding circuit to prevent the release of the selectors included in the connection.

The B-operator, upon learning the number of the desired station, operates the key K′, whereby the polarized relay 16 is disconnected from the trunk and the calling device and operator's set are bridged across same instead. The springs of the key K′ are make before break contacts, as shown in the drawings. An additional result of the operation of the key K′ is the closure of a circuit extending from ground G^{13} through the relay 65 to battery B′. Upon energizing relay 65 locks itself at its left armature and at its right armatutre shifts ground G′ from lamp 15 to lamp 14, whereby the former is extinguished and the latter illuminated

The operator now operates her calling device for the first digit 2 of the called number, whereby the impulse springs 17 and 18 are operated twice momentarily, each time breaking the circuit of the connector line relay 51.

Since the relay 100 is slow acting it does not deënergize during the momentary interruptions of its circuit by the relay 51, so that each time the latter relay is deënergized a circuit is closed extending from ground G^{9} through the spring 108 and its back contact, spring 109 and its front contact, relay 110, vertical magnet 44 and the side switch wiper 49 to battery B. The vertical magnet 44 receives two impulses over this circuit and operates to raise the switch wipers 41, 42 and 43 to a position opposite the second level of bank contacts. The relay 110, which is included in series with the vertical magnet, remains in its energized position during the entire time impulses are being transmitted through it and operates to close the circuit of the private magnet 50. After the last impulse is delivered, the relay 110 opens the circuit of the private magnet 50, which, upon deënergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 49 from first to second position transfers the battery connection from the vertical magnet to the rotary magnet 45. The operator now operates her calling device for the last digit 0, in response to which the connector line relay 51 operates to transmit ten impulses through the rotary magnet 45, in series with the relay 110, whereby the shaft wipers are rotated onto the contacts of the desired line. The relay 110 operates in response to the impulses for this digit in the same manner as for the previous digits, to cause the private magnet 50 to advance the side switch one more position—that is, from second to third position. By the engagement of the side switch wipers 46 and 47 with their third-position contact points, the line connection is finally completed with the called substation, as shown by the heavy conductors. The circuit of the cut-off winding of the called subscriber's line switch is closed by the side switch wiper 48 passing to third position, said circuit extending from ground G^{10} through the side switch wiper 48, private wiper 43 and through the winding 108^{a} to battery. The connection of ground G^{10} with the connector private bank contact of the called line over a portion of the circuit just traced provides said contact and its multiples with a guarding potential to prevent the busy line from being seized by any other connector switch. By the engagement of the side switch wiper 49 with its third-position contact point, the circuit of the ringing relay 54 is closed, which circuit extends from ground G^{11} through the interrupter 109^{a}, relay 54, springs 110^{a} and the side switch wiper 49 to battery B. The ringing relay 54, upon energizing, disconnects the calling line from the called line and bridges the ringing current generator 111 across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 109^{a}. The B-operator, upon completing the call, restores the key K′ to normal position, thereby disconnecting the calling device and again placing the polarized relay 16 across the trunk lines 66 and 67 and disconnecting ground G^{13} from the relay 65. Upon the response of the called subscriber his line is provided with talking current through the windings of the back-bridge relay 52 of the connector switch, which relay, upon energizing, closes the circuit of the ringing cut-off relay 112, said circuit extending from battery B through the relay 112, springs 113 and 114 and the wiper 48 to ground G^{10}. The relay 112, upon energizing, interrupts the circuit of the ringing relay 54 at the springs 110^{a} and closes a locking circuit for itself through its own springs 115 and 116, independent of the springs of the back-bridge relay 52. A further result of the energization of the relay 52 upon the response of the called subscriber is the transportation of the connection between the windings of the line relay 51 and the trunk conductors 66 and 67, whereby the direction of current in the trunks 66 and 67 is reversed. This reversal of current in the trunks 66 and 67 causes the polarized relay 16 to operatively energize. The relay 16, upon energizing, puts a short-circuit around the high resistance relay 61. This short-circuiting of the relay 61 allows the relays 62 and 11 to operatively energize and the relay 61 deënergizes. The energization of

the relay 62 supplies a new holding ground for the relay 65 and also, by closing the springs 117, prevents the relay 16 from being disconnected from the trunks when the relay 61 falls back. The energization of the relay 11 of the A-operator's cord circuit short-circuits the lamp 13 by means of the resistance 118, whereby the lamp 13 is extinguished. This operation informs the A-operator that the called subscriber has answered.

After the conversation is completed the operator is given the release signal in the following manner: The hanging up of the receiver at the calling substation allows the relay 10 to deënergize, which operation removes the short-circuit from the disconnect lamp 12. The hanging up of the receiver at the called substation breaks the energizing circuit for the relay 52 of the connector. The relay 52, upon deënergizing, again reverses the current in the trunks 66 and 67, which again allows the relay 16 to fall back and disconnect the shunt from the relay 61. The relay 61, upon again being placed in the circuit, causes the relays 62 and 11 to fall back. The relay 11, upon falling back, disconnects the short-circuit from around the lamp 13, whereupon the lamp will glow. Thus the simultaneous glowing of the lamps 12 and 13 informs the A-operator that the conversation is completed. She then removes the plugs P and P′ from their respective jacks. The removal of the plug P from its jack clears the cut-off relay 9 and lamp 12 in the usual and well-known manner. The removal of the plug P′ from its jack breaks the circuit of the relays 61 and 62, which, upon deënergizing, break the locking circuit of relay 65 and also open the bridge across the conductors 66 and 67, whereby the circuit of the line relay 51 of the connector is broken. The line relay 51, upon deënergizing, opens the circuit of the relay 100, which in turn falls back, thereby closing a circuit through the release magnet 53. The circuit through the connector release magnet extends from ground G^9 through the back contact of the spring 108, back contact of the spring 109, off normal springs 120 and release magnet 53 to battery B. The magnet 53, upon energizing, operates to restore the shaft and side switch to normal position. Its own circuit is broken at the off-normal springs 120 when the shaft reaches its lowest position. Thus it will be seen that all of the apparatus is returned to normal position and is in readiness for another call.

It having been explained how connection may be completed with an automatic line through the medium of an A-operator and a B-operator when said line is idle, it will now be explained how said connection can be prevented from being made if the called line is busy, and it will also be explained how the A-operator receives the so-called flash busy signal, whereby she is also informed that the called line is busy. Referring now to the connector H (Fig. 2), if the called line is busy the private bank contact upon which the private wiper 43 comes to rest will be supplied with a guarding ground potential, either by reason of having called or having been called, in the usual and well-known manner. The wiper 43, upon coming in contact with this guarding ground and before the side switch has passed to third position, will close a circuit through the busy locking relay 55. This circuit extends from said ground at the private wiper 43 through the wiper 48 (in second position), springs 121 and 122, relay 55, springs 123 and 124 and the private magnet 50 to battery B. The relay 55, upon energizing, opens the circuit of the rotary magnet, closes a locking circuit for itself in series with the private magnet and also puts a busy signal on the calling line, said circuit extending from the busy machine Q through the springs 125 and 126, wiper 47, thence over the heavy conductor 67 to and through the B-operator's set L back over the heavy conductor 66 to and through the connector back-bridge relay springs 127 and 128 and the upper winding of the relay 51 to battery. Upon the B-operator receiving the busy signal she presses the key K, which operation automatically restores the key K′ to normal position, thus closing the talking conductors and permitting the busy signal to be transmitted to and through the calling subscriber's receiver, thereby informing him that the called line is in use. He then replaces the receiver on the hook, giving the A-operator the usual disconnect signal. The depressing of the key K closes the circuit of the relay 129. This circuit extends from ground G^{15} through the springs 130 and 131 and the relay 129 to battery B′. The relay 129, upon energizing, closes a locking circuit for itself extending from ground G^{16} (when the relay 62 energizes) through the springs 132, conductor 133, springs 134 and 135 and the relay 129 to battery B′. The intermittent ground from the interrupter 136 short-circuits the high resistance relay 61, which operation allows the relays 62 and 11 to energize in the manner described above. The short-circuit for the relay 61 extends from ground G^{17} through the interrupter 136, springs 137 and 138, thence through the relay 61, plug P′ and the jack J^2 to ground G^a. The relay 11, upon being intermittently energized and deënergized in this manner, operates to flash the lamp 13, thereby informing the operator that the called line is busy. If the calling subscriber does not hang up his receiver immediately after hearing the busy signal, the A-operator, upon receiving the busy signal,

may inform the calling subscriber that the called line is busy and remove the plugs P and P′ from their respective jacks, releasing the connection as described above.

It will thus be seen that I have devised a very simple and efficient means for giving the A-operator and the B-operator the busy signal.

While I have illustrated and described one particular embodiment of my invention, it will, of course, be understood that various forms of cord circuits and automatic apparatus may be employed without departing from the spirit of my invention.

What I claim as my invention is:—

1. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches for extending connection from said B-operator's board to the called line, a signal on said A-operator's board, and automatic means controlled by said B-operator to operate said signal when said automatic switches attempt to make connection with a busy line.

2. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches for extending connection from said B-operator's board to the called line, a visual signal on said A-operator's board, and automatic means controlled by said B-operator for intermittently operating said signal when said automatic switches attempt to make connection with a busy line.

3. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operator's board, a relay bridged across the conductors of the talking circuit at said B-operator's board, means controlled by said B-operator for intermittently varying the resistance of said bridge when said automatic switches attempt to make connection with busy line, and means controlled by the variation of said current for intermittently operating said signal.

4. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said A-operator's board to said B-operator's board and from said B-operator's board to said automatic switches, means controlled by said automatic switches for extending connection to the called line, a signal on said A-operator's board, a bridge across the conductors of the talking circuit, means controlled by said B-operator for increasing the flow of current through said bridge when said automatic switches attempt to make connection with a busy line, and means controlled by said increased flow of current for operating said signal.

5. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said A-operator's board to said B-operator's board and from said B-operator's board to said automatic switches, means controlled by said automatic switches for extending connection to the called line, a signal on said A-operator's board, a bridge across the conductors of the talking circuit, means controlled by said B-operator for intermittently increasing the flow of current through said bridge when said automatic switches attempt to make connection with a busy line, and means controlled by said increased flow of current for intermittently operating said signal.

6. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches controlled from said B-operator's board for extending connection to the called line, a signal on said A-operator's board, a relay controlling said signal, a circuit for said relay, and means controlled by said B-operator for intermittently varying the resistance of said circuit to thereby intermittently operate said signal.

7. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches controlled from said B-operator's board for extending connection to the called line, a signal on said A-operator's board, a relay controlling said signal, a high resistance bridge across the conductors of the talking circuit at said B-operator's board, a circuit for said relay including said bridge, means for transmitting a busy signal to the B-operator when said automatic switches attempt to make connection with the busy line, and means controlled by said B-operator for decreasing the resistance of said relay circuit to thereby cause the operation of said signal at said A-operator's board.

8. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches controlled from said B-operator's board for extending connection to the called line, a signal on said A-operator's board, a relay controlling said signal, a high resistance bridge across the conductors of the talking circuit at said B-operator's board, a circuit for said relay including said bridge, means for transmitting a busy signal to the B-operator when said automatic switches attempt to make connection with the busy line, and means controlled by said B-operator for intermittently decreasing the resistance of said relay circuit to thereby cause the intermittent operation of said signal at said A-operator's board.

9. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches controlled from said B-

operator's board for extending connection to the called line, a signal on said A-operator's board, a relay controlling said signal, a high resistance bridge across the conductors of the talking circuit at said B-operator's board, a circuit for said relay including said bridge, means for transmitting a busy signal to the B-operator when said automatic switches attempt to make connection with the busy line, a relay associated with said B-operator's board, means controlled by said B-operator for energizing said relay, and means controlled by the energization of said relay for reducing the resistance of said relay circuit to thereby cause the operation of said signal at said A-operator's board.

10. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches controlled from said B-operator's board for extending connection to the called line, a signal on said A-operator's board, a relay controlling said signal, a high resistance bridge across the conductors of the talking circuit at said B-operator's board, a circuit for said relay including said bridge, means for transmitting a busy signal to the B-operator when said automatic switches attempt to make connection with the busy line, a relay associated with said B-operator's board, means controlled by said B-operator for energizing said relay, a locking circuit for said relay for maintaining said relay energized, and means controlled by the energization of said relay for reducing the resistance of said relay circuit to thereby cause the operation of said signal at said A-operator's board.

11. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operator's board, a pair of relays bridged across the conductors of the talking circuit at said B-operator's board, means controlled by said B-operator for connecting ground to said bridge at a point between said relays, and means controlled by said ground connection for operating said signal at said A-operator's board.

12. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operators' board, a pair of relays bridged across the conductors of the talking circuit at said B-operator's board, means controlled by said B-operator for intermittently connecting ground to said bridge at a point between said relay, and means controlled by said intermittent ground connection for intermittently operating said signal at said A-operator's board.

13. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operator's board, a pair of relays bridged across the conductors of the talking circuit at said B-operator's board, a third relay associated with said B-operator's board, means controlled by said B-operator for energizing said third relay, means controlled by the energization of said third relay for establishing a ground connection to said bridge at a point between said first-mentioned relays, and means controlled by said ground connection for operating said signal at said A-operator's board.

14. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operator's board, a pair of relays bridged across the conductors of the talking circuit at said B-operator's board, a third relay associated with said B-operator's board, means controlled by said B-operator for energizing said third relay, means controlled by the energization of said third relay for establishing an intermittent ground connection to said bridge at a point between said first-mentioned relays, and means controlled by said intermittent ground connection for intermittently operating said signal at said A-operator's board.

15. In a telephone system, a called line, an A-operator's board, a B-operator's board, automatic switches, means for extending connection from said B-operator's board to said switches, means for controlling said switches for extending connection to said called line, a signal at said A-operator's board, a pair of relays bridged across the conductors of the talking circuit at said B-operator's board, a third relay associated with said B-operator's board, means controlled by said B-operator for energizing said third relay, means controlled by the energization of said third relay for establishing an intermittent ground connection to said bridge at a point between said first-mentioned relays, means controlled by said intermittent ground connection for intermittently operating said signal at said A-operator's board, and a locking circuit for said third relay for maintaining the same energized.

16. In a telephone system, a calling and a called subscriber's line, an A-operator's cord circuit adapted to be connected with the call-

ing line, a trunk line extending from said A-operator's cord, a listening key in said trunk, a B-operator's set adapted to be bridged across said trunk by the operation of said listening key, automatic switches for extending connection from said trunk to the called line, means for transmitting a busy signal back to said B-operator's board when an attempt is made to establish connection with a busy line, a busy button associated with said B-operator's board, and means controlled by the operation of said button for transmitting a busy signal back to the A-operator and for releasing said listening key to thereby permit the busy signal to be transmitted over the talking conductors back to the calling line.

17. In a telephone system, a plurality of subscribers' lines, means including an A-operator's cord circuit and a B-operator's cord circuit for establishing connection between two of said lines, means for automatically testing the called line, means whereby the B-operator receives a busy signal immediately upon establishing connection with a busy line, and means controlled by said B-operator for then transmitting a busy signal to the A-operator.

18. In a telephone system, a plurality of subscribers' lines, means including an A-operator's cord circuit, a B-operator's cord circuit and automatic progressively movable switching apparatus for establishing connection between two of said lines, means whereby the B-operator receives a busy signal immediately upon establishing connection with a busy line, and means controlled by said B-operator for then transmitting a busy signal to the A-operator.

Signed by me at Chicago, Cook county, Illinois, this 29th day of September, 1913.

BERNARD D. WILLIS.

Witnesses:
G. YANOCHOWSKI,
H. E. HERSHEY.