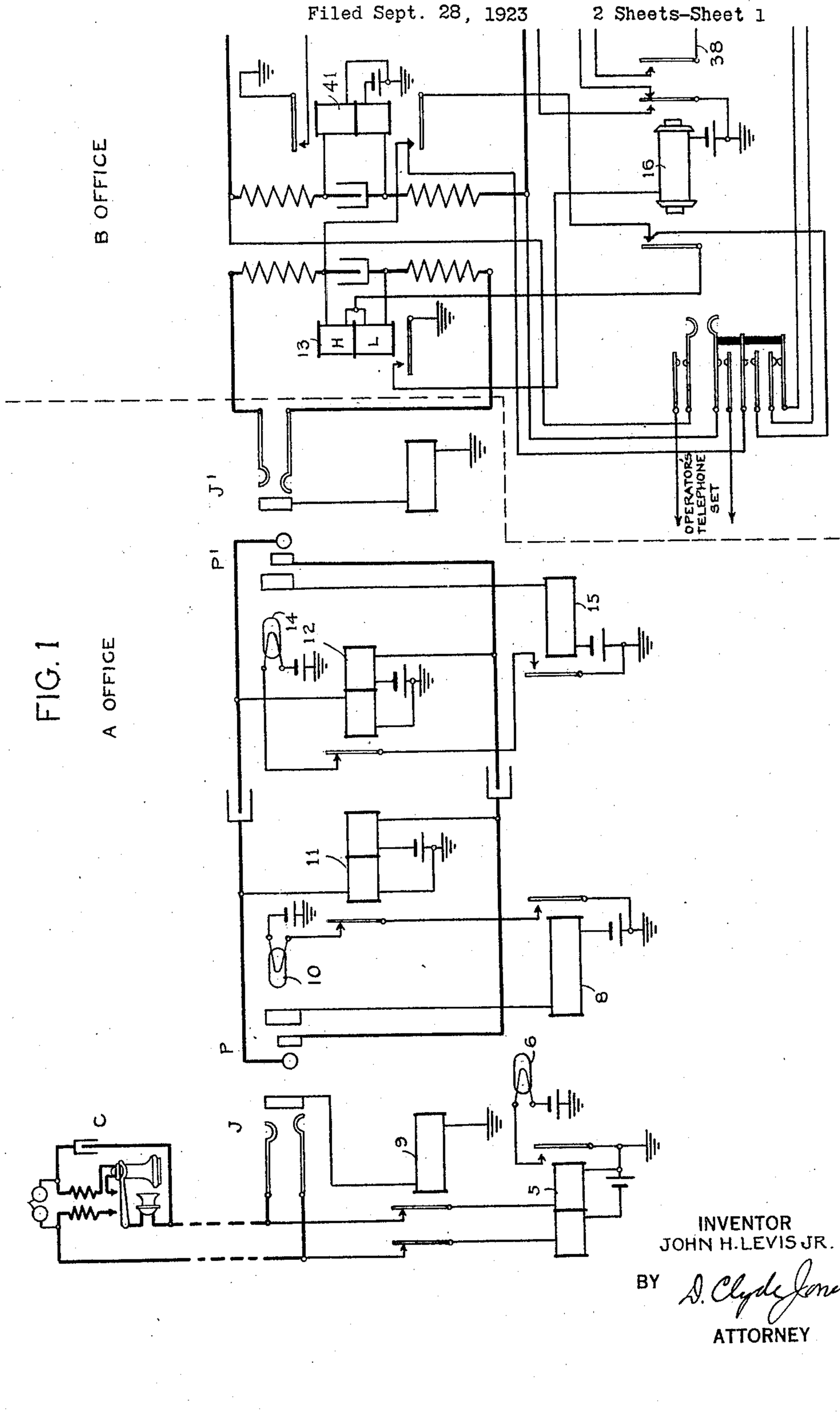
Jan. 11, 1927. 1,614,440

J. H. LEVIS, JR

MANUAL TELEPHONE SYSTEM

Filed Sept. 28, 1923 2 Sheets-Sheet 1

FIG. 1



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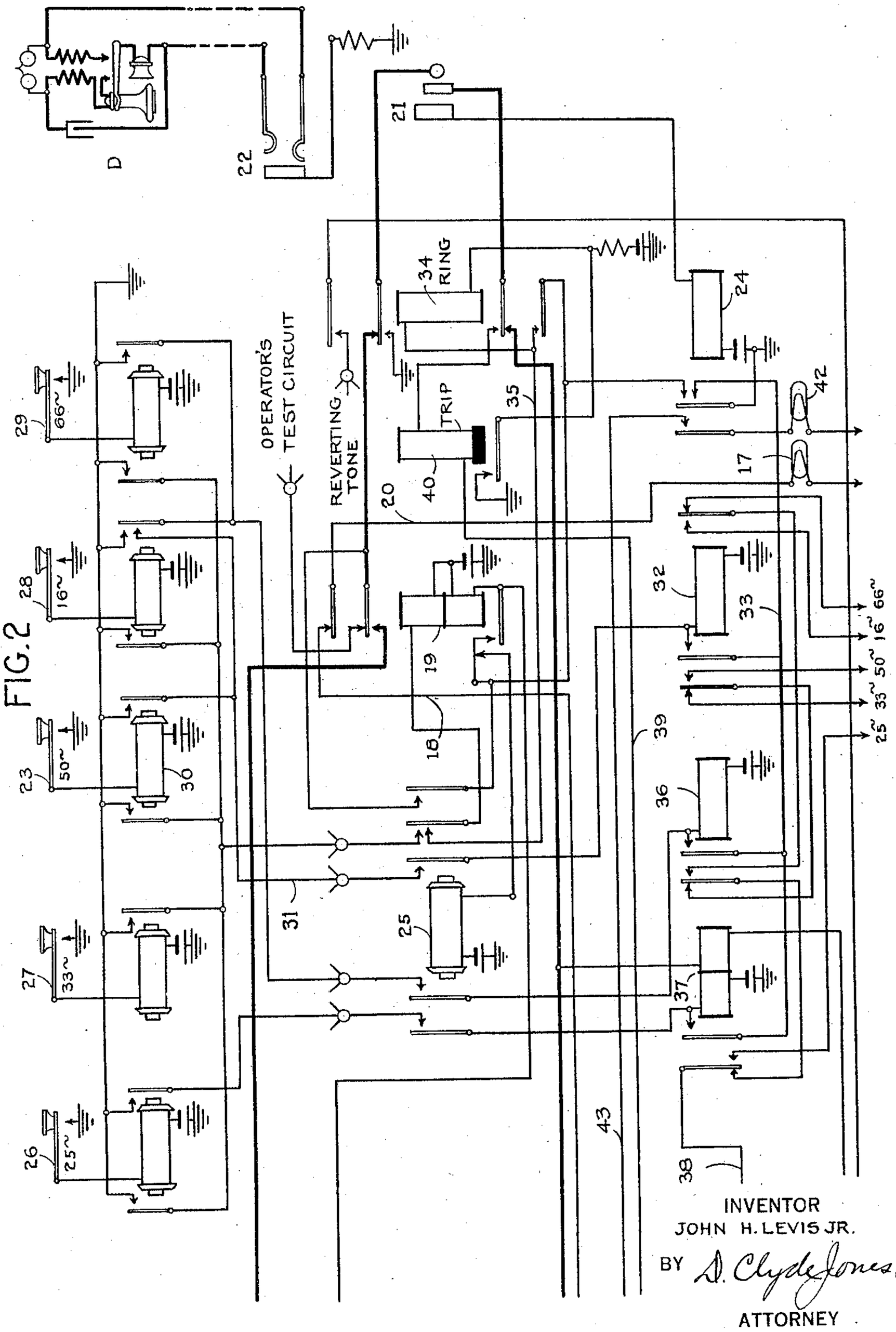

FIG.2

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UNITED STATES PATENT OFFICE.

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MANUAL TELEPHONE SYSTEM.

Application filed September 28, 1923. Serial No. 665,479.

This invention relates to telephone systems and is especially adapted for manual telephone systems.

In former telephone systems, much difficulty was encountered in maintaining the proper operation of the supervisory means at one office for controlling the supervisory signals at a second office of a multi-office system. In accordance with one arrangement for providing supervision in a multi-office telephone system, a supervisory relay at the called office provided with a high and a low resistance winding was included in series with a supervisory circuit including the two sides of a trunk circuit extending to the originating office, where a marginal supervisory relay was serially included in the connection. The marginal relay was so designed that it did not operate in series with the high resistance winding of the supervisory relay at the distant office. When the called party answered the high resistance windings of the supervisory relay was removed from the mentioned series and the marginal relay at the originating office was operated to control the supervisory signals. If, however, the series circuit was temporarily interrupted due to the A operator breaking the connection and then reestablishing the connection while the called party was maintaining his portion of the connection the high resistance winding of the supervisory relay was shunted so that it then became necessary for the mentioned supervisory relay to operate through its low resistance winding. This necessitated that the supervisory relay be designed with great care and further necessitated very careful maintenance of the same.

One of the main features of this invention is as arrangement whereby the supervisory means including the supervisory relay at the called office will operate with greater accuracy and with much less maintenance than in former systems.

Another feature of the present system resides in the provision of means whereby in a manual telephone system having a single set of common ringing keys for each operator's position ringing current is withheld from the called line whenever connection is made to this line at a time when the receiver at its substation is off the switch hook.

The drawings with Figs. 1 and 2, arranged in the order named, diagrammatically represent a telephone system, incorporating the present invention. At the left of Fig. 1 there is represented a subscriber's sub-station and line equipment which terminates at an "A" operator's position located at one manual exchange. Near the center of this figure there is represented a single manual cord circuit located at one of said "A" operator's positions. At the right of the dotted line in Fig. 1 and in Fig. 2 there is shown a trunk circuit leading from the "A" office to a "B" operator's position at a second office. At the extreme right of Fig. 2 there is shown a subscriber's sub-station and telephone line terminating at the "B" office.

It is believed that the invention will best be understood by describing the method of establishing a telephone connection from a subscriber's line, such as that indicated at "C," which terminates in one manual office, to a subscriber's line designated "D," which terminates at a second office. When the subscriber at "C" initiates a call by removing his receiver from its switchhook, the line relay 5 is operated in the well known manner over the two sides of the subscriber's line in series, and when operated, it lights the line lamp 6 associated with an answering jack of the telephone line located at an "A" operator's position at the "A" office. The "A" operator on noting that the line lamp 6 is lighted, inserts the plug P of one of her cord circuits into the jack J of the calling line. This is effective to extend the calling line through the tip and ring conductors of the cord circuit through both windings in series of the supervisory relay 11 to ground and grounded battery respectively.

At this time the sleeve relay 8 is also actuated in series with the cut-off relay 9 and as is well known, the cut-off relay disconnects the line relay from the calling line and extinguishes the line lamp 6.

The sleeve relay 8 closes a break point in the circuit of the answering supervisory lamp 10, but at this time the circuit of this lamp is open at the armature and back contact of the answering supervisory relay 11. The "A" operator's telephone set is then connected to the calling telephone line either by a listening key (not shown) or by means of relay means (not shown). The "A" operator thereupon inquires the number of the

wanted telephone line and as soon as she discovers that the wanted line terminates at a distant office, she communicates with a "B" operator at the office over an order wire (not shown) and the "B" operator assigns a trunk circuit for use.

Let it be assumed that the trunk circuit assigned is that shown in Fig. 2 and at the right of Fig. 1. The "A" operator then inserts the calling plug P′ into the jack J′ and thereby extends the calling line to the "B" office. The supervisory relay 13 is thereupon actuated in a circuit closed from ground, left hand winding of relay 12, tip contacts of plug P′ and jack J′, through the upper left hand winding of the repeating coil, through the high and low resistance windings of the relay 13, lower left hand winding of the repeating coil and the ring conductor of the trunk circuit, ring contacts of the plug P′ and jack J′, through the right hand winding of relay 12 to grounded battery. Also, when the calling end of the cord circuit is connected with the trunk circuit, the sleeve relay 15 is actuated in a circuit closed through the sleeve contacts of the plug P′ and jack J′. The relay 15 when actuated closes a break point in the circuit of the calling supervisory lamp 14.

The relay 13 is actuated in the above described circuit and at its lower armature and front contact closes an operating circuit for the slow releasing relay 16, which relay at its inner right hand armature and front contact closes a circuit for lighting the incoming signal lamp 17. The circuit from this lamp extends from ground, inner armature and front contact of relay 16. conductor 18. upper-most back contact and armature of relay 19, conductor 20, lamp 17 to grounded battery, not shown. The lighting of the lamp 17 indicates that the calling line has been extended to the assigned trunk circuit. The "B" operator has already received the designation of the wanted telephone line which it is assumed is shown at the right of Fig. 2 and then inserts the plug generally designated 21 into the multiple jack generally designated 22.

Since it is assumed that the wanted line is a party line, although only one of the substations is diagrammatically shown, the operator depresses the proper frequency key for signalling the station "D". It is assumed that the ringing button 23 is the proper one for selecting the desired signalling current for selecting that wanted station. As soon as the plug 21 is inserted into the multiple jack 22, the sleeve relay 24 is operated in a circuit closed from grounded battery, sleeve contacts of the plug 21 and jack 22, and through the resistance which may be the cut-off relay of the called line to ground.

With relay 24 operated, an actuating circuit for the slow releasing relay 25 is closed from grounded battery, winding of this relay, back contact and continuity spring of relay 19, inner front contact and armature of relay 24 to ground. The relay 25 connects the circuits of the five common ringing keys or buttons 23, 26, 27, 28 and 29 to the trunk circuit taken for use. When the operator depresses the ringing button 23, the slow releasing relay 30 attracts its armatures and at its right hand armature and front contact closed a circuit from ground over the common conductor 31, innermost front contact and right hand armature of relay 25, winding of relay 32 to grounded battery. The relay 32 is operated in this circuit and at its inner left hand front contact and armature completes a locking circuit for itself, over conductor 33, inner front contact and armature of relay 24 to ground. Simultaneously with the actuation of 32, the ringing relay 34 is operated in a circuit traceable from grounded battery, resistance, winding of this relay, conductor 35, front contacts and middle armature of relay 25, left hand armature and front contact of relay 30 to ground. The ringing relay 34 also closes a locking circuit for itself through its lowermost front contact and armature, inner front contact and armature of sleeve relay 24 to ground. At the same time that the relays 32 and 34 are operated, the relay 19 is actuated through its upper winding, middle armature and front contact of relay 25 and over the remainder of the circuit in multiple with the operating circuit of the relay 34.

With the ringing relay 34 operated and with the frequency selecting relay 32 actuated, ringing current from the 50 cycle source is connected to the wanted telephone line over a circuit now completed, through the outer left hand front contact and armature of the relay 32, back contact and armature of the relay 36, back contact and armature of the relay 37, conductor 38, outer armature and front contact of relay 16, conductor 39, winding of the trip relay 40, inner, lower front contact and armature of relay 34, ring contacts of the plug 21 and jack 22, through the ringer of the sub-station D, over the upper side of the called line, tip contacts of the jack 22 and plug 21, inner upper armature and front contact of relay 34 to ground. Ringing current from the 50 cycle source is thus applied to the called telephone line, until the subscriber removes his receiver from its hook-switch, at which time the trip relay 40 is actuated and at its front contact and armature short circuits the ringing relay 34 which deenergizes, to close break points in the trunk conductors. The supervisory relay 41 is thereupon actuated over the two sides of the trunk circuit and the two sides of the wanted telephone line in series.

Talking battery is supplied to the calling party through the windings of the supervisory relay 11, while talking battery is supplied to the called subscriber's telephone through the windings of relay 41. In accordance with one of the features of the present invention, it is proposed to provide a novel arrangement for the supervision of the connection extending between the "A" and "B" offices. The connection of the "A" cord circuit through the plug P′ and jack J′ to the trunk leading to the "B" office, serves to complete an energizing circuit for the relay 13 as previously described, from ground the left hand winding of relay 12, tip contacts of the plug P′ and jack J′, upper winding of the repeating coil, through both windings in series of the relay 13, winding of the repeating coil, ring contacts of the jack J′ and the plug P′, right hand winding of relay 12 to grounded battery.

The operation of the relay 13 as previously pointed out effects the energization of the slow releasing relay 16. When, however, the called party responds to the ringing signal and removes his receiver from its switchhook, the supervisory relay at the "B" office attracts its armatures. This is effective to short circuit the high resistance winding of the relay 13 by a circuit traceable through the lower front contact and armature of relay 41, the left hand front contact and armature of relay 16 to the upper winding of relay 13. At this time, however, the relay 13 is maintained energized through its low resistance winding in a circuit similar to that previously described, except that it now extends from the ring contacts of jack J′, lower winding of the repeating coil, low resistance winding of relay 13, left hand front contact and armature of relay 16, lower armature and front contact of relay 41, upper winding of the repeating coil to the tip of the jack J′.

When the called subscriber terminates the connection by replacing his receiver on its switch hook, the supervisory relay 41 retracts its armature and thereby removes the short circuit from the high resistance winding of the relay 13. This last named relay then includes both its high resistance and its low resistance windings in series with the supervisory relay 12 located at the "A" office. The relay 12 is so designed that it does not hold its armature attracted when its energizing circuit includes both windings of relay 13.

When relay 12 deenergizes, the supervisory lamp 14 lights in a circuit now completed through the back contact and armature of relay 12 and the front contact and armature of relay 15. The "A" operator then removes the plug P′ from the jack J′ to disestablish the connection. If, however, the calling party at sub-station "C" has terminated the connection, the supervisory lamp 10 informs the "A" operator that the calling party has disconnected and the "A" operator then removes the plug P and the calling plug P′ of the "A" cord circuit from the jacks to which they were connected. As soon as plug P′ is disconnected from the jack J′, relay 13 deenergizes and effects the release of the slow releasing relay 16. This completes the circuit for the disconnect lamp 42 of Fig. 2, the circuit of which is completed from grounded battery, not shown, through the lamp 42 armature and front contact of relay 24, conductor 43, inner back contact and armature of relay 16 to ground.

In practice it frequently happens that the plug P′ is inserted into the jack J′, when a subscriber such as "D" is already connected to the link circuit terminating in jack J′. This may arise when an "A" operator through mistake removes the plug P′ from the jack J′, but immediately discovers her error and reestablishes the connection. In the former arrangements the high resistance of the relay corresponding to 13 was short circuited as long as the supervisory relay corresponding to 41 was operated, with the result that under the condition just named, it was necessary to design the relay 13, so that it would attract its armature when energized only through its low resistance winding. Such a condition required very careful design of the relay 13 and even when the relay was installed in a commercial exchange, it required a great deal of attention to maintain it in operation.

In accordance with the present invention, it is proposed to incorporate in the system the slow releasing relay 16, which is controlled at a front contact and armature of the relay 13. When, therefore, the plug P′ is removed temporarily from the jack J′, the relay 16 deenergizes so that even if the supervisory relay 41 is maintained operated, the short circuit of the high resistance winding of relay 13 is opened at the left hand armature and front contact of relay 16. This insures that the relay 13 is operated through both windings in series, thereby securing a safer margin of operation.

In cord circuits employing a set of common ringing keys for a plurality of cord circuits, means must be provided to prevent the ringing of the called subscriber in the ear whenever the cord circuit is temporarily disconnected from the called line and then the connection is reestablished thereto. To take care of this condition, means are provided to prevent ringing current from reaching the called subscriber's sub-station on the reestablishing of a connection on such telephone line.

When the plug 21 is removed from the multiple jack 22 of the called line, sleeve relay 24 deenergizes, but when the connection

is reestablished by the reengagement of this plug and jack, the sleeve relay 24 is again operated and closes a circuit from ground, its inner armature and front contact, lower continuity spring and back contact of relay 19, winding of the slow releasing relay 25 to grounded battery. The relay 25 attracts its armatures and thereby completes another circuit from ground, armature and front contact of relay 24, outermost armature and front contact of relay 25, inner back contact and armature of relay 34, through the tip contacts of the plug 21 and jack 22 through the subscriber's line and sub-station at "D," ring contacts of the jack 22 and the plug 21, lower inner armature and back contact of relay 34, lower right hand winding of the repeating coil, lower winding of relay 41 to grounded battery.

With the relay 41 operated, the disabling relay 19 is actuated from grounded battery, its lower winding, upper front contact and armature of relay 41 to ground. Relay 19 at its upper, inner armature closes a break point in the talking circuit and its lower armature and continuity spring closes a locking circuit for itself, which circuit is completed at the front contact and armature of the relay 24. As soon as the disabling relay 19 is operated, it opens the circuit of the slow releasing relay 25, at its back contact and continuity spring. It will be noted that the relay 25 controls a break in the energizing circuit of the ringing relay 34 and also controls break points in the circuits by which the ringing keys selectively operate the selective ringing relays 32, 36 and 37. It will thus be seen that whenever a trunk circuit is connected to a called line, at a time when the called subscriber's receiver is off the switchhook, the relays 19, 25 and 41 operate in the manner just described to prevent ringing current from reaching the called subscriber's line.

It will be understood that the present disclosure merely illustrates one modification of applicant's invention and should in no way be construed as limiting the scope of the appended claims.

What is claimed is:

1. In a telephone system, a primary office, a second office, a plurality of telephone lines at said offices, a supervisory signal at said primary office, a supervisory relay for controlling the same, a second relay at said second office, a supervisory circuit including said relays in series, said second relay having a high resistance winding and a low resistance winding, said supervisory relay being of such value as not to operate in series with said high resistance winding, a third relay actuated by the response of the called party, a slow releasing relay, a circuit controlled by said third relay and by said slow releasing relay for completing a circuit for said second relay through its low resistance winding independently of said hight resistance winding, said slow releasing relay being responsive to all releases of said second relay for including said high resistance winding in said supervisory circuit.

2. In a telephone system, a primary office, a second office, a plurality of telephone lines at said offices, a supervisory signal at said primary office, a supervisory relay for controlling the same, a second relay at said second office, a circuit extending between said offices serially including said supervisory relay and said second relay, said second relay having a high resistance winding and a low resistance winding, said supervisory relay being of such value as not to operate in series with said high resistance winding, a third relay actuated by the response of the called party, a slow releasing relay controlled by the operation of said second relay, means including said slow releasing relay and said third relay for placing a shunt circuit about said high resistance winding, and means including said slow releasing relay responsive to all deenergizations of said second relay for opening said shunt circuit.

3. In a telephone system, telephone lines, cord circuits and link circuits for interconnecting said telephone lines, each link circuit having sections inductively connected together, a first supervisory relay bridged across one section, and a second supervisory relay bridged across another section of each link circuit, a third supervisory relay bridged across each cord circuit, said third relay and said first supervisory relay being included in a circuit extending through a cord circuit and a link circuit when a connection is established, said first supervisory relay having a high and a low resistance winding whereby said third relay is not operated in series therewith, means including said second supervisory relay for removing said high resistance winding from said circuit whereby said first relay is operated, and means for including said high resistance winding in said circuit whenever said first relay deenergizes even when said second relay is operated.

4. In a telephone system, a plurality of telephone lines, a plurality of link circuits, a supervisory relay for each link circuit, a ringing key common to said circuits, a source of ringing current, a second relay in each link circuit for connecting said key to its link circuit, a circuit for initially energizing said second relay, a circuit including contacts of said second relay and a winding of the supervisory relay, a third relay, a circuit for said third relay, completed at said supervisory relay, and means controlled by said third relay for disabling said second relay.

5. In a telephone system, telephone lines,

a plurality of link circuits for interconnecting said telephone lines, a source of ringing current, a ringing key common to said link circuits, a ringing circuit controlled by said ringing key extending over a link circuit to a wanted telephone line, a cut-in relay in each link circuit operated responsive to the connection of said link circuit to a wanted telephone line for placing said ringing circuit under the control of said ringing key, a supervisory relay operated by the response of the subscriber on the wanted telephone line, a sleeve relay energized while said link circuit is connected to the wanted line, a circuit for said cut-in relay completed at said sleeve relay, an operating circuit for said supervisory relay including its winding and contacts of said cut-in relay, means including a disabling relay for disabling said cut-in relay, and a circuit for said disabling relay completed at said supervisory relay.

6. In a telephone system, a plurality of telephone lines, a plurality of link circuits, a supervisory relay for each link circuit initially energized over its link circuit, signaling means common to said circuits, a source of ringing current and a second relay in each link circuit for connecting said signaling means to said link circuit, a circuit for initially energizing said supervisory relay, a second circuit for said second relay including its own winding and contacts of said second relay, a third relay, a circuit for said third relay, normally completed in part by said signaling means, another circuit for said third relay completed at said supervisory relay, and means controlled by said third relay for disabling said second relay.

7. In a telephone system, telephone lines, a plurality of link circuits for interconnecting said telephone lines, a source of ringing current, signalling means, including a ringing key common to said link circuits, signalling devices controlled by said signalling means for supplying signalling current over a link circuit to a wanted telephone line, a sleeve relay energized when said link circuit is connected to the wanted telephone line, a second relay in each link circuit normally operated by the energization of said sleeve relay for placing said signalling devices under the control of said signalling means, a supervisory relay operated by the response of the subscriber on the wanted telephone line, a circuit for said supervisory relay, including its own winding and contacts of said second relay, means including a relay for opening said last mentioned circuit, and a circuit for said last mentioned relay completed at said supervisory relay.

In witness whereof, I hereunto subscribe my name this 27 day of September, A. D. 1923.

JOHN H. LEVIS, Jr.