Dec. 13, 1932. B. A. WALLACE 1,890,479

TELEPHONE SYSTEM

Filed Feb. 21, 1930 2 Sheets-Sheet 1

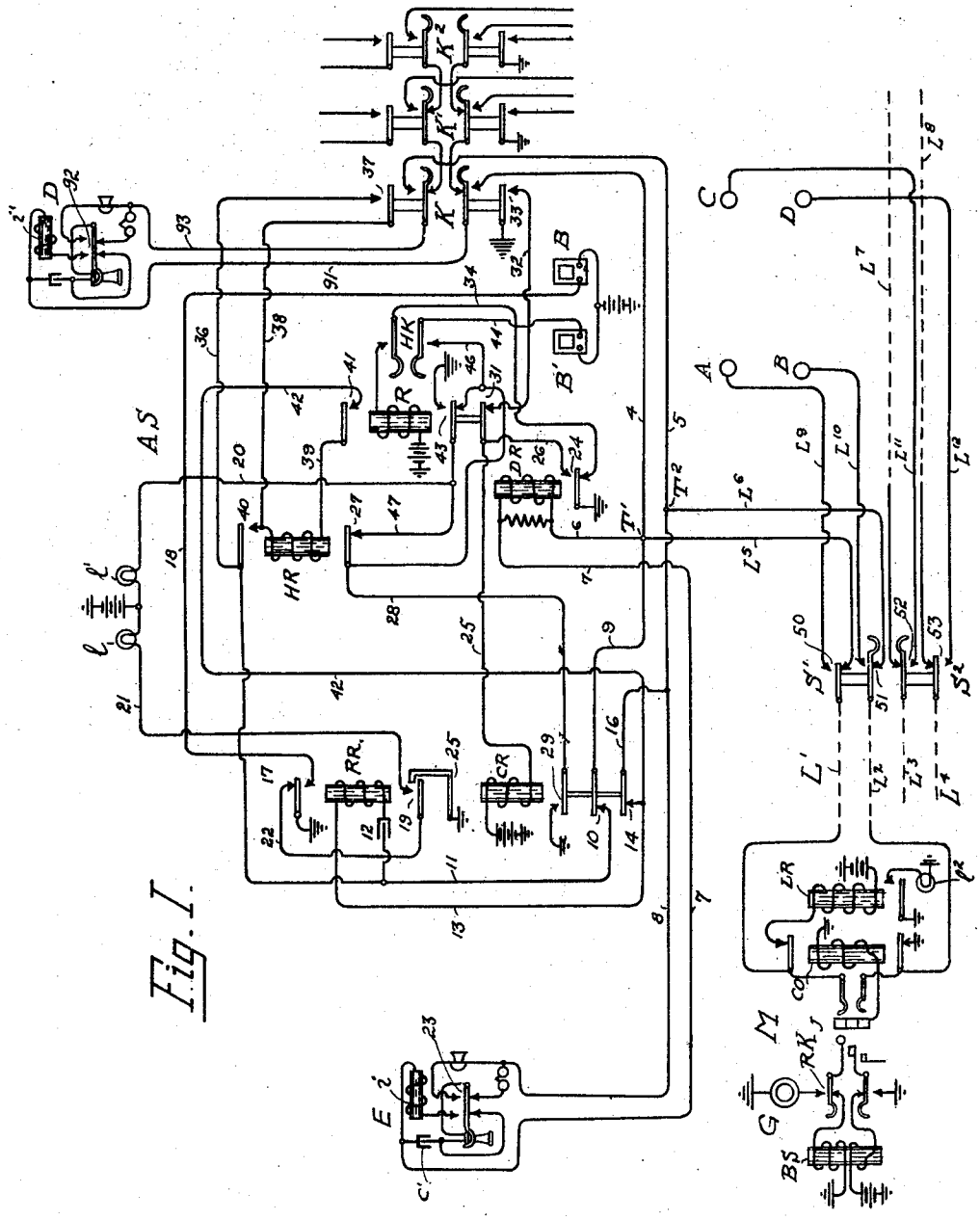


Fig. 1.

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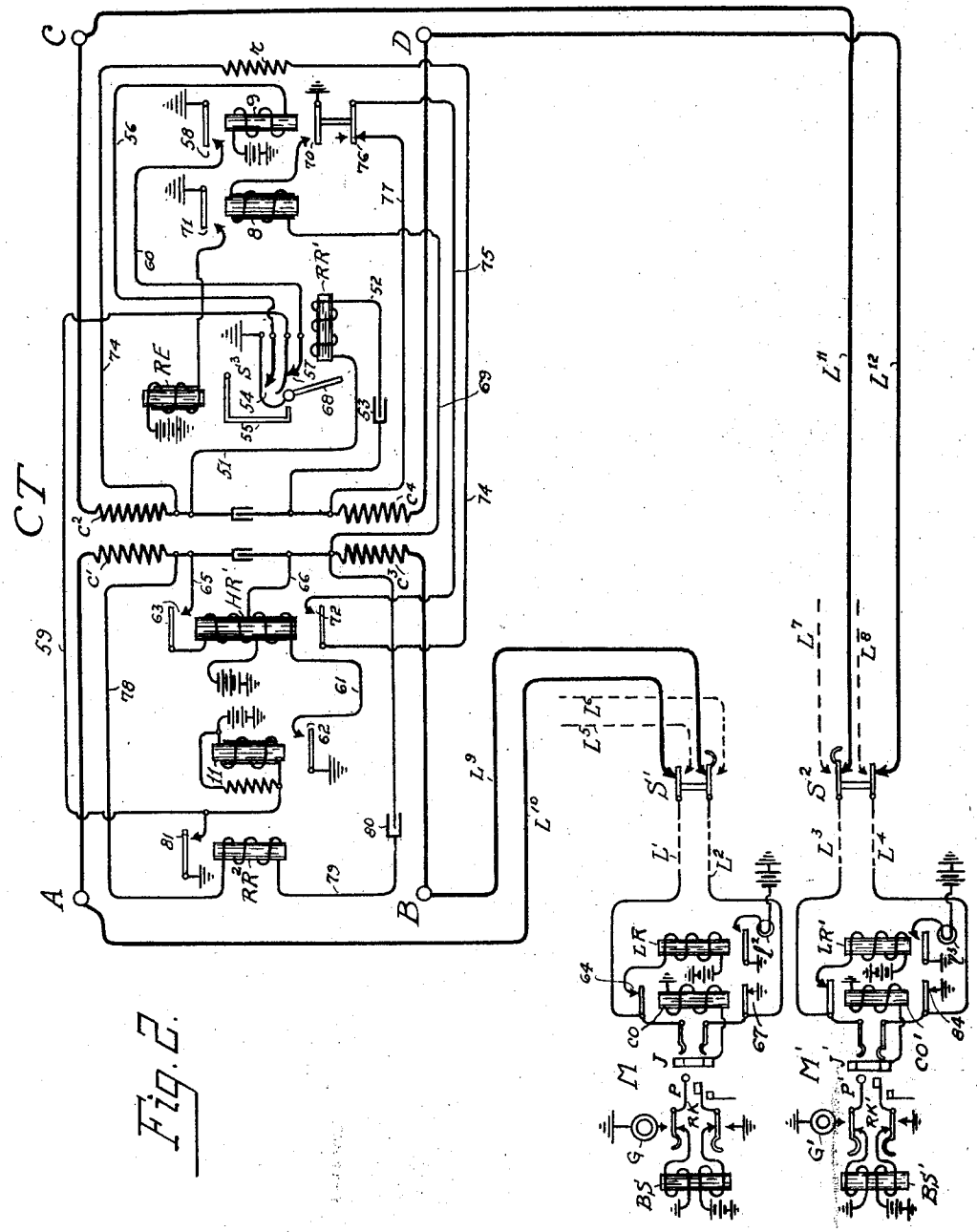


Fig. 2.

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Patented Dec. 13, 1932 1,890,479

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed February 21, 1930. Serial No. 430,348.

My invention relates to telephone systems and more particularly to an improved attendant station circuit of the type used in office buildings, hotels, etc. and to intercommunication between such an attendant station and corresponding main exchanges.

A feature of my invention is the provision of means whereby an incoming call from a main exchange may either be answered directly by the called partly without the interception of the attendant, or may be handled by the latter in the absence of the former.

Another feature of my invention is the provision of means whereby one or more incoming calls from one or more main exchanges may be held over for a length of time until answered either by the called party or by the attendant.

A further feature of my circuit is the provision of improved signalling means whereby the attendant is kept informed as to the proceeding of the call and the normal condition of the circuit.

A still further feature of my invention is the provision of a special converting trunk circuit by means of which at times when the attendant station and the extension stations associated therewith are idle, as for instance at nights and at holidays, an incoming call may be automatically redirected into another main exchange communicating with an active attendant station affiliated with said first idle attendant station.

The above features as well as others will be more specifically hereinafter described in the ensuing specification and the accompanying drawings of which:

Fig. 1 illustrates the attendant station of my invention and

Fig. 2 the converting trunk circuit.

Referring more in detail to Fig. 1, I have illustrated an attendant's station circuit AS, a pair of switching keys S′ and S^2, said keys communicating through respective lines L′, L^2, L^3 and L^4 with two corresponding main exchanges of which only one, namely M, is shown in the drawing. The apparatus shown at M comprises a line circuit composed of a line relay LR, a cut-off relay CO, and a line lamp l^2. A portion of a cord circuit is also shown namely a ringing key RK, operable to connect the ringing generator G to the line and a battery supply relay BS. An extension phone E and an attendant's phone D are shown associated with the attendant's circuit AS. The latter consists of a ringing relay RR, a control relay CR, a ringing disconnect relay DR and two holding relays R and HR. A number of interconnected answering keys K, K′, K^2, etc. are also shown, each of which is intended to be associated with a respective main exchange such as M. The various functions of this apparatus will be more readily understood from a description of the procedure followed and the operations effected in connection with one or more incoming calls.

Upon the operation of ringing key RK ringing current from the generator G associated with the exchange M will be transmitted in the usual manner through the jack J, the lines L′ and L^2, the key S′ and the lines L^5 and L^6 to the taps T′ and T^2 of the attendant's circuit AS. The taps T′ and T^2 communicate on one side with the answering key K through the leads 4 and 5 and on the other side with the extension phone E through a circuit traced from tap T′, over lead 6, ringing disconnect relay DR, lead 7, condenser C′ of the extension phone, lead 8, to tap T^2. They also communicate with the ringing relay RR in such a manner that the latter is energized by the ringing current over a circuit comprising tap T′, lead 9, normal contact 10 of the control relay CR, lead 11, condenser 12, relay RR, lead 13, normal contact 14 of relay CR, leads 16 and 8, to tap T^2. A ringing current, therefore, would ring the bell of the extension phone and operate relay RR, but not relay DR which requires direct current for its operation. By closing its alternate contact 17 relay RR actuates the buzzer B over a circuit traced from the battery through buzzer B, alternate contact 17 to ground. Said contact 17 is a spring contact closing only during the ringing intervals.

By closing its lower contact 19 the relay RR lights the line lamp l over a circuit leading from the battery through lamp l, lead 21, closed contact 19, lead 22, normal contact 17

to ground. The construction of contact 19 is such that it stays closed after the deenergization of relay RR, thus cooperating with the spring contact 17, and keeping the lamp *l* lighted after the ringing period. If now the called party at E answers the call, he will thereby, by lifting the receiver and closing switchhook contacts 23, energize the ringing disconnect relay DR over the circuit previously indicated for the ringing current, the closed contacts of the ringing key RK and winding of the battery supply relay BS. By closing its alternate contact 24 relay DR will energize relay CR, the corresponding circuit leading from the battery through relay CR, leads 25 and 26, alternate contact 24 of relay DR to ground. By attracting its armature 25 relay CR will restore contact 19 of relay RR to normal thus extinguishing the line lamp. The energization of CR will also light the busy signal lamp *l'* over a circuit traced from the battery through lamp *l'*, leads 20 and 47, normal contact 27 of relay HR, lead 28, alternate contact 29 of relay CR to ground. Finally by opening its contacts 10 and 14 relay CR interrupts the energizing circuit of relay RR as previously traced and prevents the operation of relay RR should ringing current again be applied to the lines L' and L².

After the conversation has been finished, the called party at E replaces the receiver and thereby interrupts the circuit for relay DR and the latter restoring causes a similar interruption of the energizing circuit of relay CR as previously traced thus restoring the entire system to normal.

Instead of the called party at E answering, the attendant having heard the buzzer and noticed the white light, may answer the call by throwing in the answering key K thereby connecting her own phone to the line and energizing relay CR over a circuit traced from the battery, relay CR, lead 25, normal contact 31 of relay R, lead 32, contact 33 of key K to ground. In the same manner as indicated before relay CR will restore contact 19 of relay RR to normal, extinguish the line lamp *l* and light the lamp *l'* as a busy signal. When the attendant, having given the necessary information, replaces her receiver, she will thereby effect the usual disconnect signal to the main exchange by interrupting the energizing circuit of relay BS, but relay CR and the busy signal lamp L' will remain energized until the answering key K is restored to normal. The latter action will in turn revert the entire system to normal by deenergizing relay CR. If, before the key K is restored to normal, a second call comes in over the same line, said second call will actuate the bell of the attendant's phone as well as that of the extension phone, but will not otherwise affect the system.

Should the attendant desire to hold a connection after answering the same she will first actuate the holding key HK and then restore the answering key K to disconnect the attendant's phone D to permit her to answer other calls during the holding period. The first of these will energize relay R over a circuit leading from the battery, through relay R, key HK, lead 34, normal contact 24 of relay DR to ground. Relay R will in turn cause the energization of the holding relay HR from the line voltage over an original circuit which may be traced from tap T' over lead 9, normal contact 10 of relay CR, leads 11 and 36, alternate contact 37 of key K, lead 38, relay HR, lead 39, closed contact 41 of relay R, lead 42, normal contact 14 of relay CR, leads 16 and 8, to tap T². By closing its contact 40 relay HR locks itself over a portion of its previous energizing circuit to compensate for the opening of key K, and at the same time, by being energized from the line it prevents a disconnect signal to the main exchange. The previously referred to energization of relay R besides effecting the energization of relay HR will light the busy signal lamp *l'* whose original energizing circuit has been interrupted through the release of key K. The new circuit can be traced from the battery through lamp *l'*, lead 20, alternate contact 43 of relay R to ground.

If now the party at the extension phone E answers the call, by lifting his receiver he will energize relay DR as previously set forth. The latter will break the previously traced energizing circuit of relay R at contact 24, thus deenergizing also relay HR. On the other hand it will energize relay CR and restore the original energizing circuit of the busy signal lamp *l'* whose subsequent energizing circuit had been broken with the release of relay R. It will also actuate the holding buzzer B' to announce that the extension party has answered the call and to elicit from the attendant the release of the holding key HK, the corresponding circuit leading from the battery through buzzer B', lead 44, closed holding key HK, lead 46, normal contact 43 of relay R, lead 47, normal contact 27 of relay HR, lead 28, alternate contact 29 of relay CR to ground. With the release of the holding key HK by the attendant the system once more reverts to normal.

The party at the extension phone E can originate a call in the usual manner by lifting his receiver thus automatically energizing the line relay LR at exchange M and lighting the line lamp *l²* as a signal to the operator. The corresponding circuit can be traced from the battery through relay LR, lines L' and L⁵, relay DR which is energized, lead 7, induction coil *i*, alternate switchhook contact 23, line 8, tap T², lines L⁶ and L² to ground at lower contact of relay CO. The above referred to energization of relay DR causes the

energization of relay CR over a circuit traced from the latter's ground, battery and winding over leads 25 and 26, closed contact 24 to ground. The energization of relay CR brings the lamp l' to glow as a busy signal, the corresponding circuit being traced from the ground and battery, through lamp l', leads 20 and 47, normal contact 27, lead 28, closed contact 29 to ground. The attendant at D can also place a call at exchange M by closing the key K and lifting her receiver, thus closing a circuit across the taps T′ and T² for the energization of line relay LR and lighting the signal lamp l^2, said circuit comprising tap T′, leads 4 and 91 across key K, induction coil i', switchhook contact 92, lead 93, key K, and lead 5 to tap T².

While I have shown only one attendant circuit associated with the lines L′ and L² coming in from the main exchange M, a number of such attendant circuits provided with the respective extension phones E′, E², etc. not shown in the figure and connected in parallel with respect to the lines L⁵ and L⁶ may be installed. All of which may be controlled by the same attendant and have a common buzzer B and an individual holding buzzer B′ to indicate that the particular extension party for whom the call has been held has answered and that the holding key should be restored.

A similar system may be carried out in connection with calls coming in from other main exchanges through the keys K′, K², etc.

In the drawings I have shown four terminals, A, B, C, D associated with the keys S′ and S², these being the terminals of the converting trunk circuit shown in Fig. 2.

At times when the aggregate of attendant and extension stations such as AS, E, and others, not shown in the figure, located in the same building or office are not being operated, for instance at nights and on holidays, it may be desirable to have the calls coming in from a main exchange such as M redirected to another active attendant station associated with another main exchange such as M′ shown in Fig. 2, said second attendant station being affiliated with the first, for instance by virtue of belonging to the same concern.

For the purpose of automatically transferring an incoming call either from main exchange M to main exchange M′ or from the latter to the former the converting trunk circuit CT shown in Fig. 2 is provided. It is thrown into operation by shifting the switching keys S′ and S² which may be combined into a single 4-pole switch, so that the lines L⁵, L⁶, L⁷ and L⁸ connecting the attendant station with the main exchanges M and M′ are disconnected, and the lines L⁹, L¹⁰, L¹¹ and L¹² leading to the terminals A, B, C and D of the converting trunk circuit CT are connected instead.

When the operator at exchange M′ plugs the cord P′ into the jack J′ and operates the ringing key RK′ ringing current is transmitted from G′ which energizes ringing relay RR′ of the converting trunk circuit CT over a circuit traced from the generator G′ and its ground, alternate contact of RK′, and L¹¹, repeating coil C², lead 51, relay RR′, lead 52, condenser 53, repeating coil C⁴, line L¹² to the ring side of the line through jack J′ and plug P′, alternate contact of RK′ to the ground associated therewith. The construction of switch S³ is such that when relay RR′ is energized and attracts its armature 68, contact 54 closes and remains closed until restored mechanically through the operation of release relay RE and its armature 55.

Another result of the actuation of armature 68 is the opening of contact 57, but only during the ringing intervals. The closure of contact 54 completes an energizing circuit for relay 9, said circuit leading from the battery, through relay 9, lead 56, contact 54 to ground. By closing its contact 58, relay 9 completes an energizing circuit for relay 11 traced from the battery and winding of relay 11, lead 59, contact 57, lead 60, contact 58 to ground. Relay 11 in turn provides for the energization of the holding relay HR′ over a circuit leading from the battery through relay HR′, lead 61, contact 62 of relay 11 to ground. By closing its contact 63, relay HR′ completes a locking circuit for itself and energizes the line relay LR of the exchange M which in turn lights the line lamp l^2 as a signal to the operator at the main exchange M, the corresponding circuit leading from the battery and relay LR through contact 64 of relay CO′, lines L′ and L¹⁰, repeating coil C′, lead 65, alternate contact 63 and upper winding of relay HR′, lead 66, repeating coil C³, lines L⁹ and L² to ground at contact 67 of relay CO. The operator at exchange M noticing the glow of lamp l^2 will insert the plug P into the jack J as a result of which the cut-off relay CO′ is energized opening its contacts 64 and 67. Concomitantly an energizing circuit for relay 8 of the converting trunk circuit is established which may be traced from the battery and winding of relay BS of exchange M over ringing key RK, the ring contact of plug P, line L², repeating coil C³, lead 69, relay 8, closed contact 70 of relay 9 to ground. Relay 8 by closing its contact 71 throws release relay RE into operation which, through its armature 55 mechanically restores contact 54 of switch S³ to normal. Since said contact 54 forms a link in the energizing circuit of relay 9, the latter is now deenergized, opening its contacts 58 and 70 and consequently releasing also relays 11 and 8 in the consecutive order of their previous energization. Solely the holding relay HR′ remains energized over its locking circuit previously traced from the energization of the line relay LR except that for the battery of

said relay LR and the ground of relay CO, now disconnected, the battery and ground of relay BS are substituted through the corresponding part of the cord circuit. By keeping its contact 72 closed relay HR′ causes the operation of relay BS′ at M′ to give supervision of the call to the operator at exchange M′, over a circuit which can be traced from the tip side of the cord, line L^{11}, repeating coil C^2, lead 74, resistance r, contact 72 of relay HR′, lead 75, normal contact 76 of relay 9, lead 77, repeating coil C^4, line L^{12} to the ring side of the cord plug P′. In the meantime conversational facilities have been established for the stations associated with the exchanges M and M′ over their respective cord circuits, answering and calling plugs P and P′ and the heavily outlined conductors of the converting trunk circuit, including the repeating coils.

When after the end of the conversation the operator at exchange M withdraws her plug P the energizing circuit of the holding relay HR′ is broken and by opening contact 72 of the previously traced supervisory circuit a disconnect signal is given to the operator of exchange M′ who also withdraws her plug and the entire system reverts to normal.

Having described the procedure and operation in connection with a call coming in by the way of exchange M′ I shall now do the same with reference to a call coming in from exchange M. Similarly to the preceding case the operator at exchange M inserts her calling plug P and sends ringing current through the system which actuates relay RR^2 over a circuit traced from the ringing generator G and its ground, ringing key RK, plug P, lines L′ and L^{10}, repeating coil C′, lead 78, relay RR^2, lead 79, condenser 80, repeating coil C^3, line L^9 to ground at alternate contact of the ringing key RK. By closing contact 81 relay RR^2 provides a path for the energizing current of relay 11 traced from the latter's battery and winding to ground at contact 81. Relay 11 in turn by closing its contact 62 provides for the energization of relay HR′ from the latter's battery. By closing its contact 63, relay HR′ locks up over a circuit comprising the upper half of its winding and originating and ending in the battery and ground of relay BS of exchange M as previously traced. By closing its contact 72, relay HR′ provides for the lighting of the signal lamp l^3 through the energization of the line relay LR′ over a circuit traced from the latter's battery and winding over lines L^3 and L^{11}, repeating coil C^2, lead 74, resistance r, contact 72 of relay HR′, lead 75, normal contact 76 of relay 9, lead 77, repeating coil C^4, line L^{12} to ground at contact 84 of relay CO^2. The operator at exchange M′ inserts her plug P′ into the jack J′ as a result of which a conversational circuit is established between the two exchanges including their respective cord circuits, the heavily outlined conductors of the converting trunk circuit and the repeating coils. When the conversation is finished the operator at exchange M withdraws the plug P and the relays 11 and HR′ are deenergized in the consecutive order of their energization restoring the system to normal and giving a disconnect signal to exchange M′ in the above described manner.

If at the point when the operator at exchange M having inserted her plug P, actuating consecutively relays RR^2, 11, HR′ lighting the line lamp l^3 at exchange M′ receives no answer from the latter, she withdraws her plug thereby deenergizing the above mentioned relays extinguishing the line lamp l^3 and restoring the entire system to normal.

It has been pointed out that at the time when the plug P is inserted relay HR′ locks from the battery of relay BS, the battery of relay LR′ being at this time disconnected through the simultaneous energization of relay CO; but when the operator at M withdraws the plug relay CO is deenergized and the battery of relay LR′ is switched upon the said locking circuit of relay HR′, without however preventing deenergization of the same because its polarity is opposite to that of the battery of relay BS.

Relays RE, 8 and 11 are copper sleeve relays for the usual purpose of retarding their deenergization. The same purpose is served by the resistances in shunt with relay DR in Fig. 1 and relay 11 in Fig. 2. Resistance r in Fig. 2 being connected in series with the repeating coils C^2 and C^4 through contacts 72 of relay HR′ and 76 of relay 9, serves to prevent too high a magnetization of the repeating coils by current from the exchange M′ when the operator at the latter connects her plug to the line.

Having described my invention operating with a certain circuit arrangement, I do not wish to be limited to the same, as changes and modifications may readily suggest themselves to those skilled in the art, and I, therefore, aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

Having described my invention, what I claim is new and desire to secure by United States Letters Patent is:

1. A telephone system including an attendant station circuit, an extension phone and an attendant phone, means whereby an incoming call may be answered directly at the extension phone and supervisory signalling means including means for indicating the answering of the call at the extension phone and the termination of the call automatically controlled by said extension phone.

2. An attendant station circuit communicating with a main exchange and including an extension phone, means for answering an incoming call from said main exchange di-

rectly at the extension phone, supervisory signalling means indicating the arrival of the call, and supervisory signalling means indicating the completion and the termination of the call, said supervisory signalling means controlled automatically by the called party at the extension phone.

3. An attendant station circuit including an extension phone and an attendant's phone, means for answering an incoming call directly at the extension phone, means for answering an incoming call at the attendant's phone, supervisory signalling means announcing the arrival of the call automatically controlled by the act of answering the call at any of said phones and supervisory signalling means announcing the process of completion and termination of the call automatically controlled by the act of terminating the call from any of said phones.

4. An attendant station circuit including an attendant's phone and an extension phone, means for answering an incoming call directly at the extension phone, means for answering said incoming call at the attendant's phone, and manually controlled means comprising relays controlled by the extension phone for holding said incoming call until answered by party at extension phone.

5. An attendant station circuit associated with a plurality of telephone exchanges and including an extension phone and an attendant phone, means for answering an incoming call from any of said exchanges directly at the extension phone, means for answering the same at the attendant's phone, manually controlled relay means for holding an incoming call until answered by the party at the extension phone, supervisory signalling means indicating the duration of the holding interval of said call and supervisory signalling means indicating the completion of said held call by the party at the extension phone.

6. A telephone circuit having two pairs of terminals and including a plurality of relays and sources of electric power some of said relays energized by an alternating ringing current coming in from one pair of terminals to operate other relays, said last relays operating to permit the flow of direct current through the other pair of terminals, and vice versa.

7. A telephone circuit of the character described including a plurality of relays in combination, interposed between a main exchange A and a main exchange B, one of said relays energized by a ringing current from exchange A to cause the energization of a holding relay, said last relay having a holding winding energized by direct current from exchange A and a holding contact forming a link in a direct current circuit associated with exchange B.

8. A telephone circuit of the character described interposed between a main exchange A and a main exchange B and comprising a plurality of relays in combination, one of said relays energized by ringing current from main exchange B to cause the energization of a holding relay through the instrumentality of other relays, said holding relay having a secondary holding winding forming a link in a direct current control circuit associated with exchange A.

9. A telephone circuit of the character described interposed between a main exchange A and a main exchange B including a holding relay and auxiliary relays, said holding relay having a winding for the purpose of an initial energization from either exchange A or exchange B through the instrumentality of respective auxiliary relays, and a locking winding for the purpose of maintaining intact control and supervisory direct current circuits associated with exchanges A and B respectively.

10. A transferring circuit of the character described interposed between a main exchange A and a main exchange B including a holding relay initially energized either from exchange A through the instrumentality of respective auxiliary relays or from exchange B through the instrumentality of respective auxiliary relays, subsequently energized by a holding circuit associated with exchange A, means for deenergizing the auxiliary relays instrumental in the energization of the holding relay from exchange B concomitantly with the establishment of a conversational circuit between exchanges A and B.

11. A transferring circuit of the character described interposed between two telephone exchanges A and B respectively and having a holding relay initially energized either from exchange A through the instrumentality of respective auxiliary relays operating solely during the ringing intervals or from exchange B through the instrumentality of respective auxiliary relays energized solely during the interval between the initiation of the call from exchange B and the establishment of a conversational circuit between exchanges A and B, said holding relay having a secondary holding winding subsequently energized by a controlling circuit from exchange A, and a holding contact forming a link in a direct current supervisory and signal circuit associated with exchange B, disconnect means for reverting said transferring circuit and said supervisory circuit to normal through automatic interruption of said control circuit from exchange A.

12. A telephone system including an attendant station circuit, an extension phone and an attendant phone, means whereby an incoming call may be answered directly at the extension phone or at the attendant phone, means whereby an outgoing call may be initiated directly at the extension phone or at the attendant phone, and supervisory

means indicating the answering of the incoming call at the extension phone and the termination of the call, said supervisory means automatically controlled by said extension phone.

13. A telephone system including an attendant station circuit, an extension phone and an attendant phone, means whereby an incoming call may be answered directly at the extension phone or at the attendant phone, and supervisory means indicating the busy condition of said extension phone.

14. A telephone system including an attendant station circuit, an extension phone and an attendant phone, means whereby an incoming call may be answered directly at the extension phone or at the attendant phone, and supervisory means indicating the busy condition of said extension phone automatically controlled by said extension phone.

Signed by me, at Chicago, in the county of Cook and State of Illinois, this 19th day of February, 1930.

BERT A. WALLACE.