

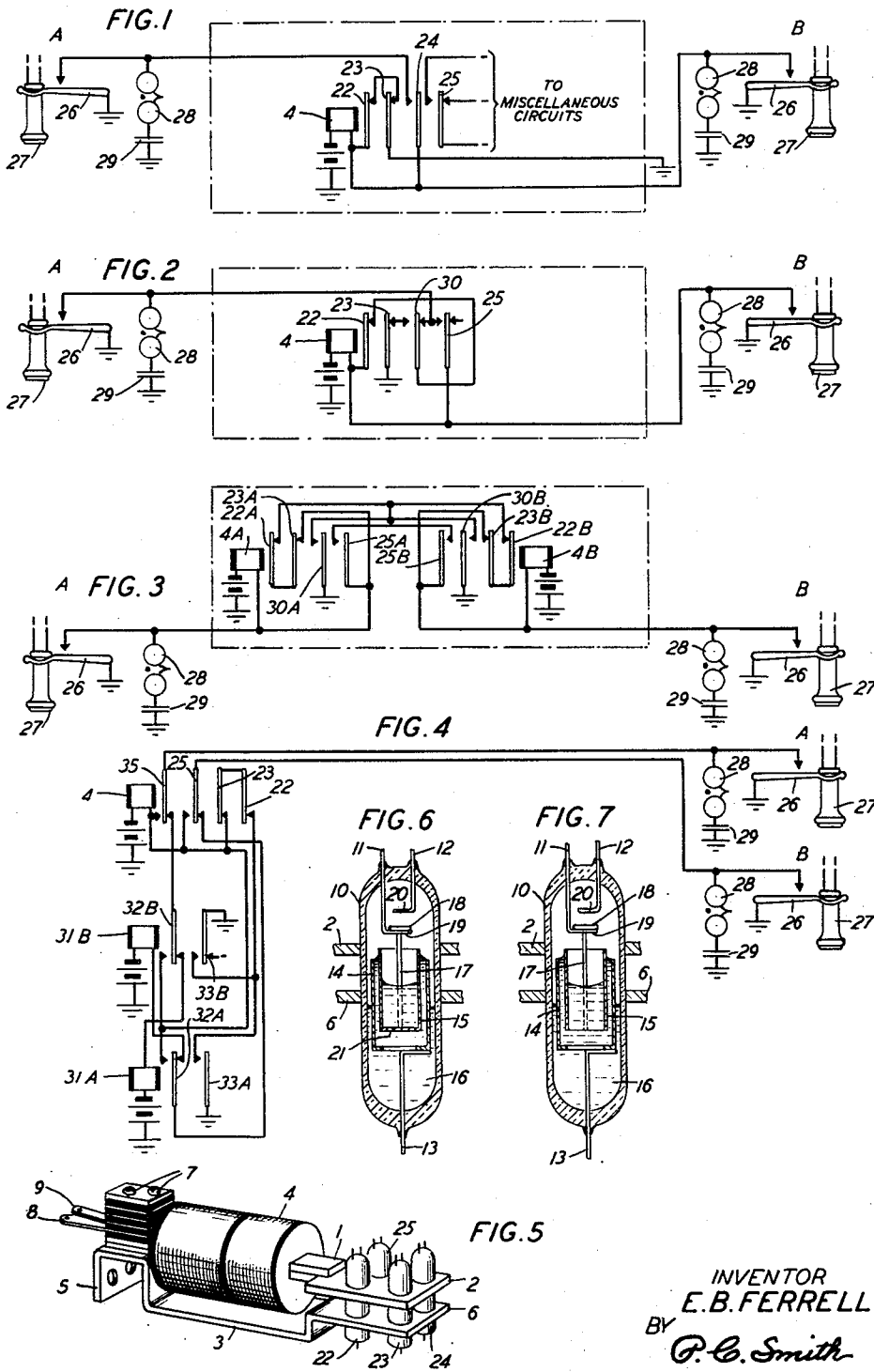
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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8 Claims. (Cl. 179-84)

This invention relates to telephone systems and more particularly to interconnecting or link circuits therefor, such as cord circuits of manual systems or the analogous connector switch circuits of dial switching systems.

For such interconnecting circuits a source of ringing current interrupted at suitable intervals must be provided common to a plurality of the circuits and each circuit must be provided with means for disconnecting the source of ringing current when the called subscriber answers, with means for cutting a talking circuit through from the called line to the calling line, with means for furnishing supervision for the called line and with means for performing various other miscellaneous functions. Thus for performing all of these functions, each interconnecting circuit thereto and with an expensive ringing machine common to a plurality of such circuits.

It is the object of the present invention to simplify such interconnecting circuits by combining the functions of the usual ringing machine and the several relays heretofore required into a single structure.

This object is attained by the use of a relay of the type disclosed in the application of H. C. Harrison and C. E. Pollard, Serial No. 302,526, filed November 2, 1939. The relay structure employed in accordance with the present invention has a single magnetic circuit including two parallelly disposed pole-pieces having sets of aligned openings therein in which switch elements of the magnetically operated mercury type are positioned. Each of these switch elements is provided with a pair of contact terminals which may be bridged by a globule of mercury.

When the interconnecting circuit in which the relay is used has located the called line, tested it and found it to be idle, a circuit is established from ground over the normally connected contacts of a first and a second switch element of the relay and through the relay winding to battery and also from ground through the condenser and ringer at the called substation over the called line to battery through the winding of the relay, but with the relay unoperated, the substation ringer and condenser are short-circuited and therefore unaffected. The relay, however, operates and opens the connection between the contacts of the first switch element thereby removing the short circuit from the substation ringer and condenser to permit a pulse of charging current to flow from battery through the winding of the relay and through the ringer into

the condenser, thus maintaining the relay operated until the condenser becomes fully charged at which time current ceases to flow through the relay winding. The first switch element thereupon releases to reestablish the direct ground connection, thereby permitting the condenser to discharge through the ringer to such ground. In this manner the relay is operated and released at intervals thereby causing the generation and application of ringing current of the desired periodicity to the ringer. The second switch element, connected between ground and the winding of the relay, is of the type which is slow to break and slow to make the circuit over its contacts whereby the ringing impulses are transmitted for a desired period, for example, for one second until this switch element in response to the pulses interrupts the circuit over its contacts through the relay winding and with the relay winding then deenergized, recloses its contacts after a further interval, for example, three seconds to produce a ringing cycle, for example, of four seconds.

When the called subscriber answers and removes his receiver from the switchhook, direct ground is connected to the winding of the relay to hold it steadily operated, thereby terminating the generation of ringing impulses and to permit others of its associated switch elements to establish circuits therethrough for controlling the cut-through of the connection between the calling and called subscriber's line and for controlling other desired circuit operations. These latter switch elements may be of the type which are sufficiently slow to prevent their operation on the ringing current pulses through the relay winding, but to operate on a steady current of a fraction of a second.

At the end of the call when the subscribers hang up their receivers, the relay releases and all switch elements restore to their normal condition.

The invention has been illustrated by the application thereof to several types of circuits and reference is now made to the following detailed description taken in connection with the accompanying drawing in which:

Fig. 1 shows the invention applied to a simplified circuit for interconnecting two subscribers' lines;

Fig. 2 shows a modification of the circuit of Fig. 1;

Fig. 3 shows a further modification employing two control relays whereby either of two subscribers may call the other subscriber;

Fig. 4 shows a further modification employing a single control relay and two selecting relays whereby either of two subscribers in an inter-phone system may call the other subscriber;

Fig. 5 shows a mercury contact relay of the type employed as the combined relay structure of the several other figures;

Fig. 6 shows one of the switch elements of the relay of Fig. 5 which is slow to open and slow to close its normally closed contacts; and,

Fig. 7 shows another of the switch elements of the relay of Fig. 5 which is quick to close and slow to open its normally open contacts.

As fully disclosed in the application of C. E. Pollard, Jr., Serial No. 402,727, filed July 17, 1941, and as disclosed in Figs. 6 and 7 of the present application, each of the switch elements comprises an envelope 10 of glass or other suitable material through the upper end of which a back contact member 11 and a front contact member 12 are sealed and through the lower end of which an upwardly extending terminal 13 is sealed. Supported within the envelope upon the upper end of the terminal 13 is a cylindrical guide sleeve 14 of a material easily wettable by mercury and positioned within the guide sleeve 14 is a tubular armature 15 of a magnetic material and also wettable by mercury. The armature 15 has its lower end partly immersed in a pool 16 of mercury located in the bottom of the envelope. Secured to the armature 15 is an upwardly extending contact member 17, comprising a pair of parallelly disposed wires which serve to conduct mercury by capillary action from the pool 16 upwardly to its horizontally disposed contact portion 18 whereby such portion is normally wetted by a film of mercury. In the normal or unattracted position of the armature 15 with respect to the pole-piece plates 2 and 6, the contact portion 18 rests upon the horizontally disposed contact portion 19 of the back contact member 11 and transfers mercury thereto whereby the surface of the contact portion 19 also becomes wetted and a back contact closure is thereby effected. Upon the attracted or lifting movement of the armature 15, the contact portion 18 is moved away from the contact portion 19 of the contact member 11 into engagement with the horizontally disposed contact portion 20 of the front contact member 12 which is also wetted by the mercury.

To render the switch element disclosed in Fig. 6 slow to respond to short impulses in the order of 20-cycles per second, the lower end of the armature 15 is closed except for the small hole 21 so that only a small amount of the mercury contained within the armature can run out upon each short upward attracted movement of the armature and therefore the armature will be moved upwardly with a step-by-step movement. Also since both of the contact portions 18 and 19 have considerable area, the mercury enclosed between their adjacent surfaces will have considerable adherence thereto and will be drawn out into a film as the contact portion 18 is moved away from the contact portion 19 until such film breaks after an interval of about one second. The contact portion 20 has considerable area and therefore when the contact portion 18 engages therewith, the film of mercury enclosed between them holds them together after the relay coil de-energizes for a period of about three seconds or until sufficient mercury has reentered the armature 15 through the hole 21 to lower the armature to a point where the film between the con-

tact portions 18 and 20 breaks and the contact portion 18 reengages with the contact portion 19. This switch element is therefore slow to break its back contact and slow to reclose its back contact. A switch element of this type is indicated at 23 in Figs. 1, 2, 4 and 5 and at 23A and 23B in Fig. 3.

The switch element disclosed in Fig. 7 has the bottom of its armature 15 open and has the contact portion 19 of its back contact member 11 provided with a small area. The contact portions 18 and 20 of the contact members 11 and 12 are, however, of greater area. There is therefore slight adhesion of the mercury film between the contact portion 18 and the contact portion 19 and since the bottom of the armature 15 is open, there is no restraint to its upward movement upon the energization of the relay winding and a quick make is effected between the contact portion 18 and the contact portion 20 of the front contact member. Since the contact portions 18 and 20 both have considerable area, a film of mercury will be drawn out upon each retraction of the armature which will delay the breaking of the circuit of these contacts sufficiently to prevent these contacts from opening upon the 20-cycle deenergization of the relay winding. This switch element is therefore quick to make a front contact closure and slow to break such closure. A switch element of this type is disclosed at 30 in Fig. 2.

The switch elements 24, 25, 25A, 25B and 35 disclosed in the several figures are similar to that disclosed in Fig. 7 except that the contact portion 19 of the back contact member 11 has a large area and the contact portion 20 of the front contact member 12 has a small area so that the switch element is slow to break the armature contact portion 18 away from the back contact portion 19 and thus is ineffective to break such contacts apart in response to 20-cycle impulses. However, on a longer energization of the relay winding, such contacts have sufficient time to break apart and the armature contact portion 18 then engages with the front contact portion 20. Since this contact portion 20 has slight area, the film of mercury enclosed between it and the armature contact portion 18 is quickly disrupted upon the deenergization of the relay winding. This switch element is therefore slow to make a front contact closure and quick to break such closure.

Switch element 22 of Figs. 1 to 5, inclusive, is similar to that disclosed in Fig. 7 except that all of its contact portions 18, 19 and 20 have small areas and consequently the films between the portions 18 and 19 and between the portions 18 and 20 are quickly broken in response to the attractive and retractive movements respectively of the armature 15. This switch element is therefore fast to make a front contact closure and fast to break such closure.

Considering now the circuit of Fig. 1, it will be assumed that the calling substation A has been connected by any suitable means not shown to apparatus enclosed in the dot-dash rectangle and that the apparatus has been connected by means not shown with the called substation B. Such connecting means might include the usual plug and jack connectors of a manual cord circuit or might include the automatic line-finder and connector switch equipment of a dial switching system. The substations have been schematically represented by a switchhook 26, a receiver 27, a ringer 28 and a ringer condenser 29.

It will be assumed that the called line terminating in station B was found to be idle and upon the seizure thereof, ground potential was applied for example, over the sleeve or test conductor of the means by which the connection was made to the called line, over the normally closed or back contact closures of the switch elements 22 and 23 associated with the relay 4 and thence through the winding of such relay to battery and ground. This ground potential is in shunt of the circuit extending from the winding of the relay over the called line through the ringer 28 and condenser 29 to ground at the called substation and therefore the ringer and condenser are unaffected.

The winding of relay 4 is, however, energized and since the switch element 22 is of the type which is fast to disrupt the back contact closure therethrough, the initial operating circuit through the relay winding is opened thereby but current continues to flow through the relay winding, ringer 28 and condenser 29, until the condenser becomes fully charged, whereupon the charging current ceases to flow through the winding of the relay and the switch element 22 quickly reestablishes its back contact closure to thereby reestablish the initial operating circuit through the relay winding. A discharge circuit is now established from ground through condenser 29, ringer 28 and the back contact closures of switch elements 22 and 23 to ground. An impulse of current has thus been directed in each direction through the winding of the ringer 28 to constitute a single cycle of ringing current. Upon the reestablishment of the initial circuit for the relay over the normal contact closures of switch elements 22 and 23 and the subsequent opening of such circuit, a second cycle of ringing current is generated. These cycles of ringing current are thus generated at the rate of .05 second per cycle to thereby produce ringing current of 20-cycle frequency to which the ringer 28 is adapted to respond. It is to be understood, however, that ringing current of any desired frequency could be generated in a similar manner.

Upon the first energization of the relay winding, the switch element 23, of the type disclosed in Fig. 6 as previously stated, starts to disrupt its back contact closure, but due to the short period during which the relay winding is energized and due to the weight of the mercury normally contained within its armature 15, the armature will be lifted only slightly to permit a very small amount of such mercury to run out through the hole 21 in the bottom wall, but not sufficiently to disrupt the film of mercury between the contact portions 18 and 19 of the armature contact member 17 and the back contact member 11. In response to the following deenergization of the relay winding, the armature 15 will fall back into the mercury slightly due to the fact that a small amount of mercury will reenter the armature. In response to following energizations and deenergizations of the relay winding, the armature 15 will in this manner be lifted step-by-step until the contact portion 18 of the armature contact member 17 has been raised sufficiently above the contact portion 19 of the back contact 11 to disrupt the film of mercury between them to open the circuit through the relay winding. This opening of the circuit of the relay will occur about one second following the initial closure of such circuit. With the relay winding deenergized, the armature 15 will return to its normal position at a rate determined by the inflow of mercury through the hole 21 and will slowly

move the contact portion 18 of the armature contact member away from the contact portion 20 of the front contact member 12, thus elongating the film of mercury adhering to their surfaces until the armature contact portion 18 reengages the contact portion 19 of the front contact member 11 and the film between the contact portions 18 and 20 become disrupted. This interval is determined by the characteristics of the switch unit as approximately three seconds. In this manner a ringing cycle of four seconds duration is measured comprising a ringing interval of one second and a silent interval of three seconds. The switch element 23 could, if desired, be timed to measure ringing cycles of other durations.

These ringing cycles are repeated until the called subscriber responds by lifting his receiver 27 from the switchhook 26 thereby establishing a direct current circuit over the called line and through the winding of relay 4 to hold such relay operated thus terminating the generation of ringing current. Switch elements 24 and 25 being of the type disclosed in Fig. 7 but having widened contact portions on their back contact members 11 are slow to disrupt the films of mercury formed between such contact portions and the contact portions of the armature contact members and as a consequence these elements will not respond to the short impulses during ringing current generation to establish front contact closures between their armature contact portions and their front contact portions. When, however, the relay is steadily energized following the response of the called subscriber, these switch elements have sufficient time to respond, the switch element 24 completing a talking connection between the calling substation A and the called substation B and switch element 25 completing any other desired supervisory circuit. The relay is now held operated by circuits extending over both lines until both subscribers restore their receivers to the switchhooks. When this occurs all of the switch elements 22, 23, 24 and 25 return to their normal conditions.

The circuit of Fig. 2 is similar to that of Fig. 1 except that the initial starting circuit of relay 4 extends from ground at the calling substation A over the connection established over the calling line, over the normal or back contact closure of the switch element 30 and the normal or back contact closure of the switch element 22. In this case the switch element 30 is of the type disclosed in Fig. 7 and is responsive to the initial energization of the relay winding to effect a fast front contact closure but is slow to disrupt its front contact closure in response to the 20-cycle interruption of the relay circuit by the switch element 22. Following the contact closure by the switch element 30 the circuit of the relay winding extends from battery through such winding over the back contact closure of switch element 22, the front contact closure of switch element 30 and the back contact closure of switch element 23 whereby in the manner previously described impulses of ringing current are generated by the intermittent energization and deenergization of the relay winding under the control of switch element 22 and are transmitted through the ringer at substation B at a periodicity of 20 cycles per second and such ringing current is divided into four-second ringing cycles under the control of the switch element 23. The switch element 25 being of the type which is slow to effect its front contact closure since it is provided with a contact portion 19 on its back contact

member having a widened area, does not effect a front contact closure during the 20-cycle operation of the relay, but does effect such closure upon the continued energization of the relay winding following the response of the subscriber at the called substation B to establish a talking circuit between the calling and called subscribers' substations. The relay is now held operated by circuits extending over both lines until both subscribers hang up. When this occurs all of the switch elements return to their normal condition.

Fig. 3 shows a modification of the circuit whereby the subscriber at either substation may initiate the application of ringing current to the other substation. For this purpose the interconnecting apparatus includes a relay 4A for one line and a similar relay 4B for the other line. If the subscriber at substation A initiates a call, relay 4A is operated over the circuit extending over such substation line to ground at such substation, thereby opening the back contact closures of the switch elements 22A and 23A and effecting the front contact closures of the switch elements 30A and 25A. With the front contact closure of the switch element 30A quickly established, a start circuit is closed from ground thereover, over the normal or back contact closures of switch elements 22B and 23B of relay 4B through the winding of relay 4B and battery to ground, thereby initiating the 20-cycle operation of relay 4B to operate the ringer at substation B and to produce the four-second ringing cycle as previously described. Switch element 30B being of the type which quickly establishes a front contact closure upon the initial energization of the winding of relay 4B establishes a circuit from ground thereover, thence over the back contact closures of switch elements 22B and 23B, through the winding of relay 4B independent of the continued operation of relay 4A until the subscriber at substation B responds. Thereupon relay 4B is held steadily energized over the called line to stop ringing by holding the switch elements 22B and 23B with their back contact closures disrupted, to maintain switch element 30B in its front contact closure position and to enable switch element 25B, which is slow to effect a front contact closure during the 20-cycle impulsing of relay 4B, to effect a front contact closure. A talking circuit is now established from substation A over the substation line, over the front contact closures of switch elements 25A and 25B and the line extending to the substation B. This talking circuit is maintained until both subscribers hang up.

If the subscriber at substation B initiates a call, the connecting apparatus functions in a similar manner except that relay 4B first operates and initiates the operation of relay 4A to generate and transmit ringing current through the ringer at the substation A.

Fig. 4 discloses the invention applied to a two station interphone system having two substations A and B and a connecting apparatus comprising relay 4 similar in construction and operation to the similar relay disclosed in Figs. 2 and 3 except that switch elements 25 and 35 thereof are both of the type which are slow to break back contact closures and to establish front contact closures, and two selector relays 31A and 31B. The selector relays may also be of the mercury contact type each having two switch elements which are fast to effect front contact closures and

fast to effect the disruption of such closures, or such relays may be of any well-known type.

It will first be assumed that the subscriber at substation A initiates a call, thereby establishing a circuit from ground over the switchhook contacts thereof, over the substation line, the normal or back contact closure of the switch element 35 of relay 4, the normal or back contact closure of switch element 32B of relay 31B to battery and ground through the winding of relay 31A. Relay 31A is thereupon energized to quickly effect the front contact closures of its switch elements 32A and 33A. The front contact closure of switch element 33A establishes a circuit from ground thereover, thence over the normal or back contact closures of the switch elements 22 and 23 and winding of relay 4 to battery and ground thereby initiating the 20-cycle operation of relay 4. Upon each energization of relay 4, the charging circuit for the condenser 29 at substation B is effective from battery through the winding of relay 4, the front contact closure of switch element 32A of relay 31A, the back contact closure of switch element 25 of relay 4, which is slow to disrupt its back contact closure in response to the 20-cycle energization of relay 4, thence through the ringer 28 and condenser 29 to ground at substation B. Upon each deenergization of relay 4, the discharge circuit of condenser 29 extends through the ringer 28, the back contact closure of switch element 25 of relay 4, the front contact closure of switch element 32A of relay 31A, the back contact closures of switch elements 23 and 22 of relay 4 to ground over the front contact closure of switch element 33A of relay 31A. As previously described the switch element 22 causes the intermittent operation of relay 4 to produce 20-cycle ringing current impulses and the switch element 23 causes the application of the ringing current to the substation B in four-second cycles.

When the subscriber at substation B responds, relay 4 is held energized over the circuit previously traced through the winding of relay 4 to the substation and thence to ground over the switchhook contacts, whereby the generation of ringing current impulses is arrested. With the winding of relay 4 steadily energized, switch elements 25 and 35 now effect front contact closures thereby establishing a talking circuit from the substation A over the front contact closures of switch elements 25 and 35 of relay 4 to substation B, the relay 4 being held energized until both subscribers restore their receivers to the switchhooks. When the switch element 35 disrupts its back contact closure, relay 31A releases thereby restoring its switch elements to their normal condition.

Had the subscriber at substation B initiated the call, a circuit would have been established from ground over the switchhook contacts thereof, over the substation line, the normal or back contact closure of the switch element 25 of relay 4, the normal or back contact closure of switch element 32A of selector relay 31A, to battery and ground through the winding of selector relay 31B. Relay 31B is thereupon energized to quickly effect the contact closures of its switch elements 32B and 33B. The front contact closure of switch element 33B establishes a circuit from ground thereover, over the normal or back contact closures of switch elements 22 and 23 and winding of relay 4 to battery and ground, thereby initiating the 20-cycle operation of relay 4. Upon each energization of relay 4, the charging circuit for the condenser 29 at the substation A is

effective from battery through the winding of relay 4, the front contact closure of switch element 32B of relay 31B, the back contact closure of switch element 35 of relay 4, which element is slow to disrupt its back contact closure in response to the 20-cycle energization of relay 4, through the ringer 28 and condenser 29 to ground at substation A. Upon each deenergization of relay 4 the discharge circuit of condenser 29 extends through the ringer 28, the back contact closure of switch element 35 of relay 4, the front contact closure of switch element 32B of relay 31B, the back contact closures of switch elements 23 and 22 of relay 4 to ground over the front contact closure of switch element 33B of relay 31B. As previously described, the switch element 22 causes the intermittent operation of relay 4 to produce 20-cycle ringing current impulses and the switch element 23 causes the application of such ringing current impulses to the substation A in four-second cycles.

When the subscriber at substation A responds, relay 4 is held energized over the circuit previously traced through the winding thereof to the substation and thence to ground whereby the generation of ringing current impulses is arrested. With relay 4 steadily energized, switch elements 25 and 35 now effect front contact closures thereby establishing a talking circuit from substation B to substation A and the circuit for selector relay 31B is opened by the disruption of the back contact closure of switch element 25.

What is claimed is:

1. In a telephone system, a subscriber's line having a ringer and a serially connected condenser at the substation thereof, a link circuit for connection with said line, a source of direct current, a control relay for said link circuit having a magnetic circuit and a plurality of switch elements associated therewith, an initial operating circuit for said relay extending serially through two of said switch elements, one of which opens and closes said circuit at a predetermined frequency and the second of which is slow to open and slow to close said circuit, a second circuit including said source and the winding of said relay extending over said line and through said ringer and condenser whereby the operation of said first and second switch elements causes the alternate charging and discharging of said condenser to operate said ringer at interrupted intervals and means for causing the steady energization of said relay over said latter circuit to arrest the operation of said ringer.

2. In a telephone system, a subscriber's line having a ringer and a serially connected condenser at the substation thereof, a link circuit for connection with said line, a source of direct current, a control relay for said link circuit having a magnetic circuit and a plurality of switch elements associated therewith, an initial operating circuit for said relay extending serially through two of said switch elements, one of which opens and closes said circuit at a predetermined frequency and the second of which is slow to open and slow to close said circuit, a second circuit including said source and the winding of said relay extending over said line and through said ringer and condenser whereby the operation of said first and second switch elements causes the alternate charging and discharging of said condenser to operate said ringer at interrupted intervals, and means for causing the steady energization of said relay over said latter circuit to arrest the operation of said ringer, the others of said switch ele-

ments being operable only upon the steady energization of said relay to connect said link circuit with said line and to establish supervisory circuits.

3. In a telephone system, a subscriber's line having a ringer and a serially connected condenser at the substation thereof, a link circuit for connection with said line and means for generating and applying ringing current to said line comprising a source of direct current, a relay having a magnetic circuit and a plurality of switch elements associated therewith, one of which is fast to break and fast to remake its normal contact closure and a second of which is arranged to break its normal contact closure after approximately one second and to remake such closure after approximately three seconds, an initial operating circuit extending through said switch elements, and a second circuit including said source and the winding of said relay extending over said line and through said ringer and condenser, whereby the operation of said first switch element causes the alternate charging and discharging of said condenser to operate said ringer and the operation of said second switch element causes the interruption of the operation of said ringer into ringing and silent intervals.

4. In a telephone system, a calling subscriber's line, a called subscriber's line, each having a ringer and a serially connected condenser at the substation thereof, a link circuit for interconnecting said lines, a source of direct current, a control relay having a magnetic circuit and a plurality of switch elements associated therewith, an initial operating circuit for said relay extending over said calling line and serially over the normally closed contacts of a first and second of said switch elements, a secondary operating circuit for said relay established by the operation of said relay extending from ground over the normally closed contacts of a third of said switch elements, over a front contact closure of said first switch element, which is fast to make and slow to break said closure, and over the normally closed contacts of said second switch element, said second switch element being fast to open and fast to close said latter circuit at a predetermined frequency and the third of said switch elements being slow to break its back contact closure and slow to remake said closure, a third circuit including said source and the winding of said relay extending over said called line and through the ringer and condenser thereof whereby the operation of said second and third switch elements causes the alternate charging and discharging of said condenser to operate said ringer at interrupted intervals, and means controlled over said called line for causing the steady energization of said relay to arrest the operation of said ringer, the other of said switch elements being operable only upon the steady energization of said relay to interconnect said line through said link circuit.

5. In a telephone system, two subscribers' lines each having a ringer and a serially connected condenser at the substation thereof, a link circuit for interconnecting said lines, a source of direct current, a first control relay directly operable over one of said lines when calling, a second control relay directly operable over the other of said lines when calling, each of said relays having a magnetic circuit and a plurality of switch elements associated therewith, the first of which is fast to break and fast to remake its normal contact closure, a second of which is slow to break and slow to remake its normal

contact closure, a third of which is fast to make and slow to break its front contact closure and a fourth of which is slow to make its front contact closure, a circuit established by the initial operation of either one of said relays over the third switch element thereof and the first and second switch elements of the other relay for causing the operation of said other relay whereby the operation of the first and second switch elements of said other relay causes the alternate charging and discharging of the condenser at the substation of the associated line to operate the ringer of such substation at interrupted intervals, and means for causing the steady energization of said second relay to arrest the operation of said ringer, the fourth switch element of both of said relays being effective upon the steady energization of said relays to interconnect said lines through said link circuit.

6. In a telephone system, two subscribers' lines each having a ringer and a serially connected condenser at the substation thereof, a link circuit for interconnecting said lines, a source of direct current, a first control relay directly operable over one of said lines when calling, a second control relay directly operable over the other of said lines when calling, each of said relays having a magnetic circuit and a plurality of switch elements associated therewith, a first of which is fast to break and fast to remake its normal contact closure, a second of which is arranged to break its normal contact closure after approximately one second and to remake such closure after approximately three seconds, a third of which is fast to make and slow to break its front contact closure and a fourth of which is slow to make its front contact closure, a circuit established by the initial operation of either one of said relays over the third switch element thereof and the first and second switch elements of the other relay for causing the operation of said other relay, whereby the operation of the first switch element thereof causes the alternate charging and discharging of the condenser at the substation of the associated line to operate the ringer of such substation and the operation of the second switch element thereof interrupts the operation of said ringer into ringing and silent intervals, and means for causing the steady energization of said second relay to arrest the operation of said ringer, the fourth switch element of both of said relays being effective upon the steady energization of said relays to interconnect said lines through said link circuit.

7. In a telephone system, two subscribers' lines each having a ringer and a serially connected condenser at the substation thereof, a link circuit for interconnecting said lines, a source of direct current, a control relay, a selector relay for one of said lines, a selector relay for the other of said lines, said control relay having a magnetic circuit and a plurality of switch elements associated therewith, a first of which is

fast to break and fast to remake its normal contact closure, a second of which is slow to break and slow to remake its normal contact closure and the third and fourth of which are slow to make their front contact closures, a circuit established by the initiation of a call on either of said lines over either the third or fourth of said switch elements for causing the operation of the selector relay allocated to such line, means operable by said operated selector relay for preventing the operation of the other of said selector relays, a circuit established by said operated selector relay over the first and second switch elements of said control relay for causing the operation of said control relay, whereby the operation of the first and second switch elements thereof causes the alternate charging and discharging of the condenser at the substation of the other line to operate the ringer at said substation at interrupted intervals, and means controlled from the called substation over either the third or fourth switch element of said control relay to steadily energize said control relay to arrest the operation of said ringer and whereby said third and fourth switch elements are operated to interconnect said lines through said link circuit.

8. In a telephone system, two subscribers' lines each having a ringer and a serially connected condenser at the substation thereof, a link circuit for interconnecting said lines, a source of direct current, a control relay, a selector relay for one of said lines, a selector relay for the other of said lines, said control relay having a magnetic circuit, and a plurality of switch elements, a first of which is fast to break and fast to remake its normal contact closure, a second of which is slow to break and slow to remake its normal contact closure, and the third and fourth of which are slow to make their front contact closures, a circuit established by the initiation of a call on either of said lines over either the third or fourth of said switch elements and over a back contact of one of said selector relays for causing the operation of the selector relay allocated to the calling line, whereby the operation of the other selector relay is prevented, a circuit established by the operated selector relay over the first and second switch elements of the control relay for causing the operation of said control relay, whereby the operation of the first and second switch elements thereof, causes the alternate charging and discharging of the condenser at the substation of the other line to operate the ringer at said substation at interrupted intervals, and means controlled from the called substation over either the third or fourth switch element of said control relay to steadily energize said control relay to arrest the operation of said ringer and whereby said third and fourth switch elements are operated to release the operated selector relay and to interconnect said lines through said link circuit.

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