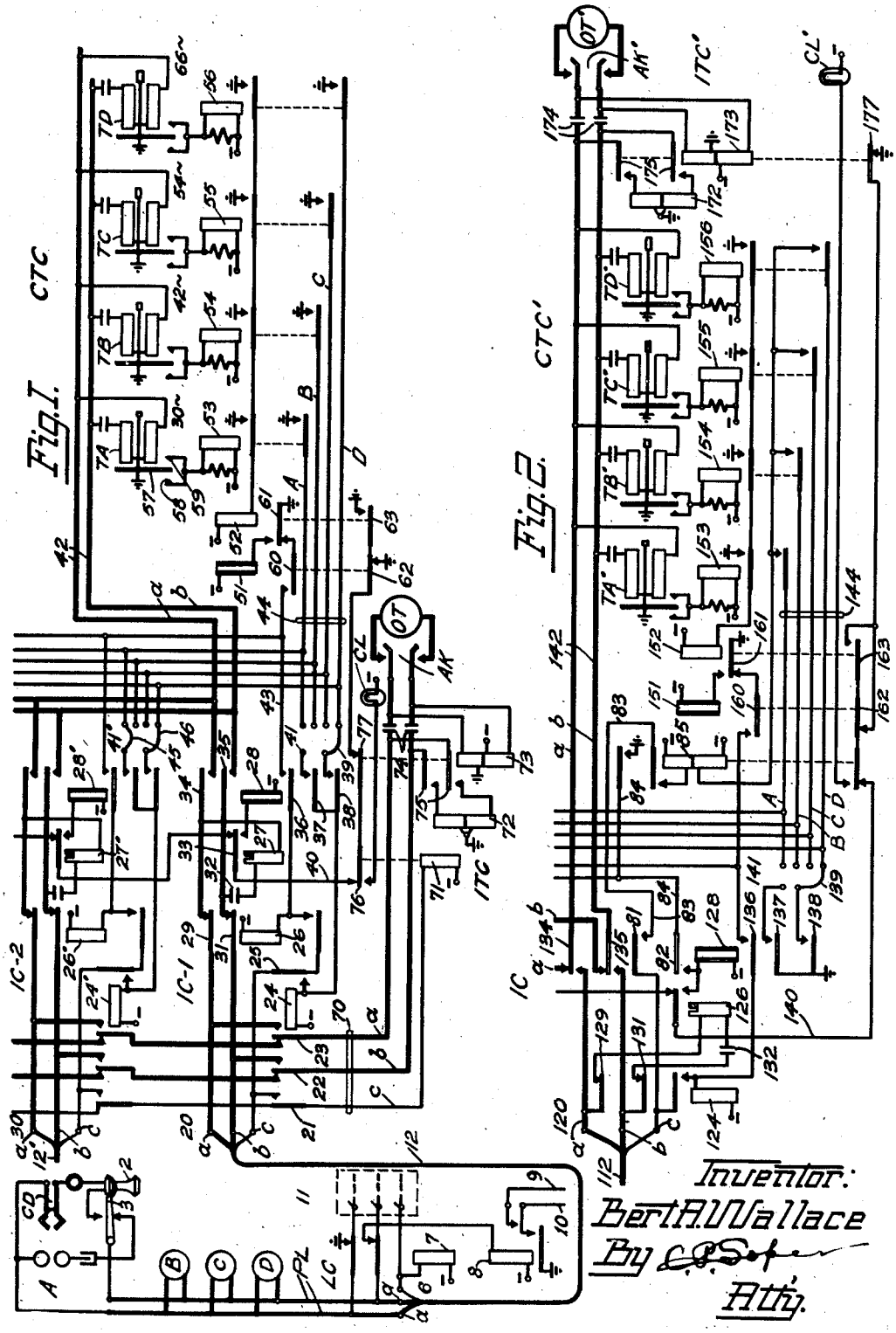
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems, being concerned more particularly with telephone systems employing party lines, and it has for its chief object the production of new and improved circuit arrangements for use in a party-line telephone system for enabling intercepting service to be given to a party line when one or more of the substations thereon has been disconnected.

A further object of the invention is the production of circuit arrangements enabling the total amount of equipment used for intercepting service to be reduced.

A more specific object of the invention is to provide common test equipment for determining which substation on a party line is being called, together with means for automatically associating the common equipment with the respective party lines as they are called.

General Description

Although the invention is applicable to other types of party-line telephone systems, it has been illustrated as applied to a party line system employing the so-called harmonic system of ringing, wherein the ringers at the party-line substations are tuned respectively to separate frequencies of ringing current.

It is a feature of the invention that equipment is provided in common to a number of party lines requiring intercepting service, which common equipment includes test devices tuned respectively to the frequencies employed for selective substation signaling over the party lines, and that such equipment is rendered temporarily individual to a called party line to determine the frequency of the ringing current applied thereto, and to control the signaling of the intercepting operator when the test indicates that the call is for a disconnected substation.

A further feature of the invention is that the common test equipment, if idle, is rendered temporarily individual to the next called party line to receive ringing current, but the common equipment is automatically disassociated from the called line and returned to its idle condition as soon as the first application of ringing current is terminated, unless the call is to be intercepted.

Although the invention is applicable to manual and to semi-automatic telephone systems, the invention is disclosed as applied specifically to an automatic telephone system.

The foregoing other objects and features of the invention will become more apparent as the description progresses.

The drawing

Referring now to the accompanying drawing, comprising Figures 1 and 2, there is shown thereon a sufficient amount of the equipment employed in a selective ringing party-line system provided with intercepting service to enable the invention to be understood.

Figure 1 shows an embodiment of the invention in which a cut-through relay, individual to a line provided with intercepting service, switches the call to an intercepting operator, while

Figure 2 shows a desirable modification in which the individual cut-through relay is eliminated.

Referring now particularly to Figure 1, PL indicates a four-party line having substations A, B, C, and D thereon, each substation having a bridged ringer. The ringers at substations A to D are indicated as being responsive, respectively, to ringing frequencies of 30, 42, 54, and 66 cycles, respectively.

The party line PL terminates at the telephone exchange in terminals *a* and *b* of terminal group **6**, to which terminal group is connected the line circuit LC and the finder-connector multiple **11**, the automatic switching equipment being assumed to be of the type which employs a finder to connect an idle link to the calling lines, and which employs a connector to make connection with the lines when called.

The party line PL is only one of a number of similar party lines.

When all of the substations on a party line are equipped and connected, there is no need for intercepting service, but when one of the substations is disconnected, either because the subscriber thereat has discontinued telephone service, temporarily or permanently, or has moved to a new location and has had a new number assigned, it is desirable that the line be provided with intercepting service for a sufficient period of time to acquaint the subscribers generally with the fact that such subscriber is not to be reached by calling his previously listed telephone number. A line so connected for this service is said to be on intercepting service.

The equipment for providing intercepting service for the party lines, such as PL, includes a sufficient number of individual circuits, such as IC—1 and IC—2, that a separate one may be connected individually to each party line in need of intercepting service. This number will ordinarily be much less than the total number of party lines, such as PL, and will vary according to

the number of party lines in use and according to the type of locality in which the system is installed.

The conductors, some of which are multipled and some of which are chained, extending upwardly from the individual circuit IC—2 extend to and through as many additional similar individual circuits as may be desired.

The intercepting trunk circuit ITC is associated with all of the individual circuits, such as IC—1 and IC—2, and can be connected with any one of them to intercept a call.

The intercepting trunk circuit ITC has the call lamp CL to apprise the operator of intercepted calls, and the answering key AK to enable the operator's telephone OT to be connected and disconnected.

The individual intercepting circuit IC—1 is provided with *a*, *b*, and *c* terminals **20**, while the circuit IC—2 is provided with *a*, *b*, and *c* terminals **30**. The terminals **20** and **30** of any one of the individual intercepting circuits may be connected with terminals such as **6** by means of the usual three-wire jumper. The terminals **6** and **20** are shown inter-connected by means of the jumper **12**, to illustrate how the party line PL may be placed on intercepting service through the individual intercepting circuit IC—1.

In order that the intercepting equipment extend calls to the intercepting operator only when a disconnected substation is called, test equipment must be available to determine which substation on a line is being called. This test equipment is contained in the common test circuit CTC. This common test circuit includes tuned relays TA, TB, TC, and TD, tuned respectively to the 30, 42, 54, and 66 cycle frequencies used to signal the party-line substations. Each of these test relays may conveniently include a tuned vibrating mechanism similar to that employed in substation ringers. Relays **53** to **56** are arranged to respond respectively to tuned relays TA to TD. A pair of control relays **51** and **52** is provided in common to relays **53** to **56**.

Referring more particularly to the individual intercepting circuits, the circuit IC—1 includes a bridged ring-up relay **27** which controls the operation of connecting relay **28** to connect the individual circuit to the common test equipment CTC. Circuit IC—1 includes also a cut-off relay **26** which is operable from the common test equipment and after a test has been made to disconnect the ring-up relay **27**, cut-through relay **24**, operable from circuit CTC, extends the connected party line through to the intercepting trunk circuit ITC when the call is to be intercepted.

Detailed Description

The disclosure having been described generally, a detailed description of the system of Figure 1 will now be given.

Outgoing calls

Assuming now that the subscriber substation A, Figure 1, desires to make an outgoing call at the time party line PL is idle, the removal of the receiver **2** from hook-switch **3** closes a direct-current bridge across the conductors of the party line through receiver **2**, and transmitter **4**, and calling device CD, in series, thereby operating bridged line relay **8** of line circuit LC through contacts of cutoff relay **7**. Line relay **8** places an energizing ground potential on the group marking conductor **9** and also on the individual marking conductor **10**, thereby starting the well-known sequence of operations which results in a finder making connection with the line circuit LC, through the finder connector multiple **11**. When this connection has been made, the placing of ground potential upon the *c* conductor of the line multiple in the usual manner results in the operation of cutoff relay **7** to clear the line and restore line relay **8**.

In order to effect the completion of the desired connection, the subscriber at substation A now operates his calling device CD in accordance with the respective digits in the desired number, each operation resulting in the production of corresponding series of interruptions in the calling line to operate the automatic switching equipment in the well-known manner to complete the connection.

When the connection has been completed and the subscriber at substation A thereafter replaces his receiver, the automatic switching equipment clears out in the usual manner, and removes ground potential from the *a* lead of line circuit LC, permitting cutoff relay **7** to restore to reconnect the line relay **8**, in series with the common current source, across the conductors of the line.

Incoming calls

When a substation on the party line PL is to be called, connection is made with this line through the finder connector multiple **11**. When this connection is made, ground potential is placed on the *c* conductor of the multiple, bringing about the operation of cutoff relay **7** to clear the called line PL of its calling bridge. Thereafter, ringing current of the frequency corresponding to the desired one of the substations A to D is transmitted intermittently over the line PL, actuating only the ringer at the desired substation, the other ringers not responding because they are tuned to respective other ringing frequencies.

Intercepting service on the party line PL

Let it be assumed now that one of the substations, substation D for example, is disconnected from the party line PL, either because the subscriber thereat is desirous of temporary or permanent suspension of telephone service or has moved to a different locality, served by another telephone line. Under this condition, all calls reaching the party line PL and intended for substation D should be intercepted and the calling subscriber should be apprised of the changed condition.

The attendant or maintenance man at the telephone exchange may now run the jumper **12** to connect terminals *a*, *b*, and *c* of group **6** with terminals *a*, *b*, and *c* of group **20**, respectively, to thereby render the intercepting circuit IC—1 temporarily individual to the party line PL. It will be understood that, had the intercepting circuit IC—1 been already connected to another party line on intercepting service, the attendant would have chosen a free intercepting circuit, in place of IC—1.

Since the D substation on the party line PL is the one whose calls are to be intercepted, the attendant also places the strap or jumper **39** between one of the left-hand terminals **41** and the right-hand terminal connected to the D conductor of group **44**, to thereby condition the circuit IC—1 to cause calls to the disconnected substation D to be intercepted.

With the jumper **12** in position, the ring-up relay **27**, in series with condenser **32** is bridged across talking conductors, *a* and *b*, at the line PL, through armatures **29** and **31** of cutoff relay

26. This relay is so related to the capacity of condenser 32, and so adjusted, that it does not respond to the potential changes (including dial-pulse kicks) which occur across the talking conductors of the party line PL pursuant to the making of outgoing calls from this line. Relay 27 is preferably of the shaded-pole A. C. type, indicated by the cross-hatching of a portion of the upper part thereof, and is therefore able to maintain its actuated armature attracted continuously throughout an application of ringing current.

When the party line PL is seized, through multiple 11, pursuant to a call to one of the substations thereof and ground potential is applied to the *c* conductor of the multiple, this same ground potential is extended to the *c* conductors of jumper 12 to the *c* terminal 20, preparatory to an operation of the intercepting circuit IC—1.

Following the seizure of the party line PL, ringing current is impressed intermittently across the conductors thereof to intermittently signal the desired substation.

A portion of this ringing current is transmitted through the *a* and *b* conductors of jumper 12, and through armatures 29 and 31 of cutoff relay 26, to ring-up relay 27, bridged across the extended talking conductors through condenser 32. Assuming that the common test equipment CTC and the intercepting trunk circuit ITC are idle, ground potential is on armature 33 of ring-up relay 27, through armatures 62, 77 and 76. Under this condition, the operation of relay 27 responsive to the first application of ringing current to the called party line PL, closes a circuit for connecting relay 28. Connecting relay 28 is the usual type of slow-releasing sleeved relay. When connecting relay 28 operates, it extends the talking conductors of the party line PL, at armatures 34 and 35, to the *a* and *b* conductors 42 of the common test circuit CTC. The tuned test relays TA to TD are thereby bridged across the conductors of the party line PL at the beginning of the application of ringing current. Relay 28 also connects the winding of cut-off relay 26, through armature 36, to the common cutoff conductor 43, and it connects the winding of cut-through relay 24, through armatures 37 and 38, to the left hand ones of terminals 41 to prepare for an operation of the cut-through relay in the event that the call is to be intercepted.

Only one of the relays TA to TD is able to vibrate its armature, such as 57 to relay TA, to apply ground potential alternately to the associated contacts, such as 58 and 59. Accordingly, one of the relays 53 to 56 intermittently receives operating current. The one receiving this current operates on the first impulse thereof and remains operated throughout the remaining portion of the application of ringing current, for such relay 53 to 56 is shunted by a resistor which renders it slow-releasing.

At the end of the application of ringing current, the armature of the responding one of the tuned relays TA to TD, ceases to vibrate, and the associated one of relays 53 to 56 restores.

According to which of the relays 53 to 56 was operated, ground potential was impressed on one of the conductors A to D of the conductor group 44, extending to the right hand row of terminals 41. Cut-through relay 24 is operated or not, depending upon whether or not the energized one of conductors in group 44 is cross-connected at terminals 41 to relay 24.

The operation of any one of the relays 53 to 56 closes a circuit for relay 52, and this relay operates the slow-releasing relay 51 at armature 61. Relay 51 prepares a cutoff circuit at armature 60.

When the operated one of the relays 53 to 56 restores at the end of application of ringing current, it opens the circuit of control relay 52. Relay 52 restores, opening the circuit of the slow-releasing, sleeved relay 51 at armature 61, at the same time closing a circuit through actuated armature 60, over the common cutoff lead 43, and through actuated armature 36 of the slow-releasing connecting relay 28, for cutoff relay 26. Cutoff relay 26 is thus operated at the end of the first application of ringing current to the called party line, entirely independent of whether or not the call is for a disconnected substation or a connected one. Upon operating, cutoff relay 26 locks itself to the grounded *c* conductor at its lower armature, while at armatures 29 and 31 it disconnects the talking conductors from relay 27 to prevent any further actuation of relay 27 responsive to any further applications of ringing current to the called party line PL.

A moment later, slow-acting connecting relay 28 in the individual circuit IC—1 restores responsive to the restoration of relay 27 at the end of the application of ringing current, and slow-acting relay 51 in the common test circuit CTC restores responsive to the previously mentioned opening of its circuit by relay 52.

With cutoff relay 26 now operated and locked to the grounded *c* conductor of the line circuit LC, the intercepting circuit IC—1 remains effectively disassociated from the common test equipment for the duration of the connection established to the party line PL. Relay 27 subsequently restores, along with the cutoff relay 7 of the line circuit LC, when the connection to line PL is released.

Calling the intercepting operator

Let it be assumed now that the call as previously described to the party line PL is for the now-disconnected 66-cycle substation D. The tuned test relay TD in the common test circuit CTC, as previously pointed out, is the 66-cycle one. Under this condition, the associated relay 56 is the one which responds to the operation of the tuned test relay. Relay 56, in addition to operating relay 52 with the results described, closes a circuit at its lower armature over the D conductor of group 44, through the jumper 39 at terminals 41, and through armature 38 of the actuated connecting relay 28 for cut-through relay 24. Relay 24 thereupon operates and locks itself at armature 25 to the grounded *c* conductor. At armatures 23 and 22, relay 24 disconnects the *a* and *b* conductors 70 of the intercepting trunk circuit ITC from the corresponding conductors leading to the succeeding intercepting circuits, such as IC—2, and connects them to the talking conductors of the intercepting circuit IC—1, and, consequently, by way of jumper 12, to the talking conductors of the line circuit LC and party line PL. At armature 21, relay 24 extends ground potential, from the conductor grounded *c* lead to the call relay 71. Call relay 71 thereupon operates, and at armatures 76 closes a circuit for the call lamp CL, which includes armature 77 and armature 62 or 63. Call lamp CL lights to attract the attention of the intercepting operator.

The intercepting operator may now answer the

call by actuating her answer key AK. Key AK connects the operator's telephone OT across the talking conductors extended through talking condensers 74. Back-bridge relay 73 now operates through the operator's telephone set OT to extinguish the call lamp CL at armature 77 and at armatures 75 it connects ground through the windings of the retard coil 72 to the respective talking conductors of the called line to cause the usual automatic discontinuance of ringing current to the called line and the completion of the talking circuit.

The operator may now make inquiry as to the destination of the call and give the proper information to the calling subscriber, informing him that the substation D has been disconnected from the party line PL, whereupon she may restore her answering key AK.

When the answer key AK is restored, relay 73 restores to disconnect the windings of retard coil 72 at armatures 75 to give disconnect supervision in the event that the call is through an operator's switchboard. At armature 77, relay 73 relights the call lamp CL as a supervisory lamp.

When the calling subscriber replaces his receiver and thereby causes the automatic switches to release the connection, the removal of ground potential from the *c* lead from the line circuit LC permits the restoration of the locked up relays 24 and 26 in the intercepting circuit IC—1 and permits the restoration of relay 71 in the intercepting trunk circuit ITC. When relay 71 restores, call lamp CL becomes extinguished to indicate to the operator that the calling connection has cleared out.

Overlapping calls

Arrangements are provided to prevent interference between overlapping or simultaneous calls to two or more party lines connected for intercepting service. Such arrangements will now be described.

It is to be observed that the ground potential supplied to armatures of ring-up relays (27 of IC—1 and 27' of IC—2) is chained; that is, when armature 33 of relay 27 operates, it removes ground potential from the corresponding armatures of all the succeeding individual circuits. The same is true when the relay 27' operates, with respect to the succeeding individual circuits. By this arrangement, if two lines jumpered to respective intercepting circuits are called at about the same time, and ringing current begins to be applied simultaneously to these two lines, two relays such as 27 and 27' operate at the same time. Of these relays, the one having the lowest position in the chain circuit actuates its associated connecting relay such as 28 or 28', but the operation of any succeeding ring-up relay in the chain circuit is of no avail at this time, because ground potential is removed, as at armature 33, from the armatures of the succeeding ring-up relays.

Keeping in mind that the cutoff relay of an individual circuit connected to the common circuit CTC, such as relay 26 of circuit IC—1, operates at the end of the first received application of ringing current to prevent a further operation of the associated ring-up relay, such as 27, it will be appreciated that the chain circuit is reestablished at the end of the first ringing application, thus permitting association of the common test equipment with a further individual circuit as soon as the one most preferentially located has received one application of ringing current.

In order to prevent unintended operation of the individual circuits when such circuits are connected to line groups rung alternately or successively by the common ringing equipment, relays 52 and 51 of circuit CTC control the application of ground potential to chain lead 40 at armatures 62 and 63.

When relay 52 operates, it makes a further application of ground potential to the chain lead 40, independent of armature 62. When relay 51 operates, as it does immediately, the common chain circuit is left grounded only at armature 63. Then, when relay 52 restores at the end of the application of ringing current (responsive to the restoration of one of the relays 53 to 56) and opens a circuit of the slow-releasing relay 51 at armature 61, it temporarily removes ground potential at armatures 63 from the control chain; so as to hold the armatures of all the ring-up relays 27, 27', etc., groundless to prevent the actuation of a further connecting relay, such as 28 or 28', until sufficient time has been allowed for the one last actuated to clear out.

In order to prevent any possibility of a second line from being cut through to the intercepting trunk circuit ITC as long as one is connected thereto (responsive to the operation of a cut-through relay such as 24 or 24'), the talking conductors *a* and *b* of group 70 are chained through armatures of the cut-through relays, such as 23 and 22 of relay 24. Additionally, each of the armatures 76 and 77 of the call and answer relays 71 and 73, respectively, of the intercepting trunk circuit ITC, breaks the operating chain while actuated. In this way, the operating chain is held open to prevent any needless connection of the common test equipment CTC to an individual circuit while the intercepting trunk is busy.

From the foregoing description, it will be observed that the common test equipment CTC is connected automatically to any working individual circuit such as IC—1 and IC—2 when a call comes to a party line to which circuit is rendered temporarily individual; that the common test circuit CTC secures the operation of the cut-through relay, such as 24 or 24', to connect the individual circuit to the intercepting trunk circuit in the event that the call is for a disconnected substation on the called party line; and that, in any event, the cutoff relay, such as 26, operates at the end of the instant application of ringing current to free the common test equipment for further use.

With further reference to the terminal groups 41 and 41', it should be noted that the number of terminals at the left, associated with armatures 37 and 38 of relay 28 for example, need be only sufficient at any individual circuit to equal the maximum number of substations on the line which are likely to require intercepting service at the same time, while the number of terminals at the right, of group 41, for example, equals the maximum number of substations on any party line, one such terminal for each of the four frequencies of ringing current employed.

It is assumed that individual circuit IC—2 is connected, by means of a jumper 12', attached to terminals 30, to a party line from which two substations have been recently disconnected.

It is assumed that the disconnected substations are the A and D substations (30 and 60 cycles, respectively). Jumper 45 prepares a cir-

cuit for relay 24' over the A conductor of test-indicating group 44, while the jumper 46 prepares a circuit for relay 24' over the D conductor of group 44. Therefore, when the line to which jumper 12' extends receives a call for either the A station or the D station previously connected thereto, the operation of one or the other of the common test relays TA and TD, and the resulting operation of one or the other of relays 53 and 56, results in the closure of a circuit over conductor A or conductor D by way of jumper 45 or jumper 46, and through contacts of the then-actuated connecting relay 28' for cut-through relay 24', to switch the call to the intercepting trunk as described.

It will be understood, of course, that when it is considered likely that more than two substations may be currently disconnected from a party line, additional terminals may be provided on the left hand side of the terminal groups 41 and 41', connected to the concerned relay 24 or 24', by the way of additional contacts of relays 28 and 28'.

In the event that the telephone system is arranged for there to be greater or lesser numbers of substations on a party line than four, the common control circuit CTC may be modified accordingly. For any lesser number of substations than four, one or more of the ringing-current responsive groups, such as relays TD and 56, may be removed. Alternatively, if the system employs more than four substations on a line, additional sets of frequency responsive equipment may be employed and connected in a manner similar to that shown.

By suitable modifications of the circuit CTC, it is apparent that intercepting service may be given by the disclosed system to party lines employing specifically different systems or arrangements of substation signalling.

Figure 2

Figure 2, which shows a desirable modification in which the cut-through relays (such as relays 24 and 24' of Figure 1) of the individual circuits are eliminated. The apparatus shown in Figure 2 includes the individual circuit IC, comparable to circuits IC—1 and IC—2, Figure 1. The conductors, shown as extending upwardly from circuit IC are understood to extend to and through succeeding similar individual circuits.

Figure 2 shows also the common test circuit CTC', somewhat similar to the circuit CTC, Figure 1, and the intercepting trunk circuit ITC', somewhat similar to the intercepting trunk circuit ITC, Figure 1. In order to enable a more ready comparison to be made between the disclosure in Figure 1 and that in Figure 2, the parts in Figure 2 which are similar to parts in Figure 1 have the same respective reference numerals applied, but with the digit 1 prefixed. For example, relays 26, 27, and 28 of Figure 1 become, respectively, 126, 127, and 128, in Figure 2.

As pointed out, individual circuit IC, Figure 2, has no relay comparable to cut-through relay 24 of Figure 1. In Figure 2, the intercepting trunk circuit ITC' is connected to the *a* and *b* talking conductors 142 of the common equipment. This arrangement enables test relay 85, added to the common equipment, to perform the function of signaling the operator when a call is to be intercepted, and of holding the connecting relay 128 of individual circuit IC operated until the intercepted call has been disposed of.

Let it be assumed that the jumper 112 connects the *a*, *b*, and *c* terminals 120 of the individual circuit IC to a party line on intercepting service, and that calls to the D substation thereon are the ones to be intercepted. Under this condition, jumper 139 at terminals 141 is connected with the D conductor in group 144, as illustrated.

When the party line to which jumper 112 extends is called, the first application of ringing current thereto results in the operation of ring-up relay 126, through armatures 129 and 131 of cutoff relay 124, and through condenser 132. Upon operating, relay 126 closes a circuit, from ground on the chain ground conductor 140, for relay 128, assuming the common equipment to be idle at the time. Connecting relay 128 thereupon operates and prepares a locking circuit for itself at armature 82 over the common locking conductor 84; prepares circuit for cutoff relay 124 at armature 136; grounds the left hand terminals of group 141 at armatures 137 and 138; at armature 81, it extends the now-grounded *c* lead of group 120 to the common *c* conductor 83, to prepare a locking circuit for test relay 85; and at armatures 134 and 135, it disconnects the common *a* and *b* conductors 142 from the chained *a* and *b* conductors extending to the other individual circuits and connects them to the *a* and *b* leads 120 to associate the common tuned relays TA' to TD' with the party line to which circuit IC is connected by means of jumper 112.

The one of relays TA' to TD' which corresponds to the frequency of ringing current being transmitted now responds, as pointed out in connection with Figure 1, resulting in the operation of the associated one of relays of 153 to 156. The operation of relays 151 and 152 takes place sequentially, as described in connection with relays 52 and 51 of Figure 1, resulting in a circuit being prepared at armature 160 for the operation of cutoff relay 124.

At the end of the instant application of ringing current, the restoration of the actuated one of relays 153 to 156 results in the restoration of relay 152, followed by the restoration of the slow-releasing relay 151. During the interval elapsing between the restoration of relays 152 and 151, a circuit is closed through the restored armature 161 and the actuated armatures 160 and 136 for the cutoff relay 124 of the circuit IC. Relay 124 thereupon operates to lock itself at its inner armature to the associated grounded *c* lead, while at armatures 129 and 131 it disconnects ring-up relay 126 to prevent further operation of this relay during the current call to the associated party line.

It will be understood, of course, that ring-up relay 126 has, in the meantime, restored responsive to the cessation of the application of the ringing current, and has opened the circuit of slow-releasing relay 128. Relay 128 is, therefore, free to restore to free the common equipment unless its locking circuit over conductor 84 has been completed, the completion of which locking circuit is dependent upon the operation of the test equipment resulting in the determination that the instant call is one which should be intercepted, as will now be pointed out.

Assuming that the tuned relay operated during the instant call is one of the relays TA' to TC', one of the associated relays 153 to 155 is the one operated, and the preparation of the circuit of test relay 85 at the lower armature of one of these relays, over A, B, or C lead 144 if of no avail, because these leads are not connected up

at terminals 141. Consequently, test relay 85 is not operated under this condition and the cessation of ringing current is followed by the restoration of connecting relay 128 to disassociate the individual circuit IC from the common equipment.

On the other hand, if it be assumed that the call under consideration is one for the now disconnected D substation of the party line to which jumper 112 extends, the 66-cycle relay TD' is the one operated, and its operation results in the operation of the associated relay 156 until the end of the application of ringing current.

When relay 156 operates, it closes a circuit at its inner armature, causing relays 152 and 151 to operate as previously noted, while at its lower armature it connects the D conductor of group 144 to the lower winding of test relay 85. This operation closes a circuit for relay 85, from ground by way of the actuated armature 138 of connecting relay 128, jumper 139 at the terminals 141, the D conductor of group 144, and the actuated lower armature of relay 156, to relay 85. Relay 85 thereupon operates, and at its inner upper armature locks itself to the extended c lead 83, through actuated armature 81 of relay 128 to enable it to remain operated as long as the connection to the called party line is maintained. Test relay 85 also places ground potential at its upper armature on the common locking conductor 84, thereby completing a locking circuit through the actuated armature 82 of relay 128. Relay 128 is thereby held operated as long as test relay 85 is held locked over the c lead of the established connection.

Relay 85 also removes ground potential at its lower armature from the chain-ground conductor 140 and connects it to the call lamp CL'. Call lamp CL' now becomes lighted to signal the intercepting operator.

The intercepting operator may now answer the call by manipulating her answer key AK' to connect her operator's telephone OT' with the extended talking circuit, by way of talking condensers 174. Answer relay 173 now operates in series with the operator's telephone OT' to connect up the retard coil 172 for purposes explained in connection with Figure 1, and at armature 177 it opens a further point in the previously established connection to chain-ground conductor 140 serving at this time to extinguish the call lamp CL'.

When the operator restores her answering key AK', the restoration of relay 173 relights the lamp CL', at armature 177, as a supervisory signal.

When the automatic switching equipment releases the connection established to the called party line, and ground potential is removed from the c terminal 120, the locking circuits of relays 124 and 85 are thereby opened, permitting these relays to restore. At its lower armature, relay 85 extinguishes the lamp CL' and reestablishes the chain-ground circuit, while, at its upper armature, it removes ground potential from conductor 84 to unlock relay 128. Relay 128 thereupon restores.

The intercepting circuit IC is now in normal condition and the common equipment CTC is made available for use in connection either with the intercepting circuit IC or with any other similar associated individual circuit.

What is claimed is:

1. In a telephone system including party lines, circuit means enabling an intercepting operator to intercept calls to substations which have been disconnected from said party lines, test equipment common to said party lines, and means responsive to any one of said party lines being called for connecting said test equipment temporarily to such line, said test equipment including test means for determining whether the call is for a disconnected, or for a connected, substation thereof, and means controlled by said test means for extending calls for disconnected substations to the said intercepting operator.

2. In a telephone system including party lines, individual circuits associated respectively with party lines having one or more substations disconnected therefrom, common call-test means and means for temporarily connecting it individually to any called one of said individual circuits, and selective means in said common equipment effective to condition the individual circuit to which it is temporarily connected according to whether the substation being signaled on the associated party line is one which is now connected to, or is one which has been disconnected from, the said party line.

3. In a telephone system including party lines, intercepting circuits individual respectively to certain ones of said party lines, an intercepting circuit common to all said individual intercepting circuits, means in any individual intercepting circuit responsive to an application of ringing current to the party line to which it is individual for connecting the said common circuit to such individual circuit and for disconnecting the last-named circuits from each other at the end of the said application of ringing current, and means in such individual circuit for preventing reconnection of the common circuit thereto, during subsequent applications of ringing current to the associated party line, until the called line is subsequently freed.

4. In a telephone system including party lines, circuits individual respectively to the ones of said party lines from which substations have been disconnected, circuit equipment common to all said individual circuits, means responsive to the application of ringing current to a called party line for interconnecting the one of said circuits individual thereto with said common equipment, test means at said common equipment effective during the said application of ringing current, following the said connection, for extending a connection from the called party line to an intercepting operator dependent upon the call being for a disconnected substation, and means effective at the end of said application of ringing current for disconnecting said common equipment from the individual circuit and for maintaining it disconnected whether the call was extended to said operator or not.

5. In a telephone system including party lines, circuits individual respectively to ones of said party lines having substations disconnected therefrom, means associated with said circuits for extending calls received on said lines to an intercepting operator when a call for one of said lines is for a substation which has been disconnected, equipment common to said individual circuits and means for associating it individually with any one of them responsive to the associated party line receiving a call, and means including a chain circuit extending through said individual circuits for preventing association of said common equipment with two of said individual circuits at the same time.

6. In a telephone system including party lines,

intercepting circuits individual respectively to certain of said party lines having substations disconnected therefrom, means including an operator's trunk circuit for extending calls incoming to said party lines to an intercepting operator when the call received at any one of them is for a substation which has been disconnected therefrom, equipment common to all said individual circuits and means for associating said common equipment with any individual circuit to supplement it and render it effective for the purpose set forth, and means included in said operator's trunk circuit effective when a call for a substation disconnected from a called party line has been extended thereto for preventing the said common equipment from being associated with any further individual circuit and for preventing any further extension of calls to said trunk circuit until the call extended thereover has been disposed of.

7. In a telephone system including party lines, intercepting circuits individual respectively to ones of said party lines having substations disconnected therefrom, an intercepting operator's trunk, test means common to all said individual intercepting circuits and including means for determining whether or not a call to a party line is for a disconnected, or for a connected, substation, each of said individual circuits including relay means responsive to ringing current to connect the individual circuit to said common circuit, a cutoff relay in each individual circuit and means for operating it from the common circuit to disable the first-named relay means therein, a cut-through relay in each individual circuit, and means included in said common circuit for operating said cut-through relay whenever the test means determines that the instant call to the associated party line is for a disconnected substation, said cut-through relay serving, when operated, to extend a connection from the called party line to said intercepting operator's trunk circuit.

8. In a telephone system including party lines, circuits individual respectively to ones of said lines having substations disconnected therefrom, circuit equipment common to all said individual circuits, each individual circuit including a relay responsve to ringing current received over the associated party line, when called, for connecting the individual circuit to the said common equipment, test means in said common equipment capable of determining which substation of the called party line is being called, means controlled by said test means for maintaining the connection between common equipment and the connected individual circuit in the event the substation being called has been disconnected from the called party line, and means also included in said common equipment for extending the call to an operator's switchboard.

9. In a telephone system including party lines the substations on said party lines being arranged to be signaled by frequencies of ringing current assigned respectively thereto, intercepting circuits individual respectively to ones of said party lines having substations disconnected therefrom, a group of test devices selectively responsive to ringing current applications according to the frequency thereof, said group of test devices being accessible in common to all said individual circuits, means responsive to the application of ringing current to any called line having one of said circuits individual thereto for operating the individual circuit to make connection with the said common test means, and means in the individual circuit controlled from said common test means for extending the call received on the party line to an operator's switchboard or not, depending on whether the call is for a connected, or a disconnected, one of the substations of the party line.

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