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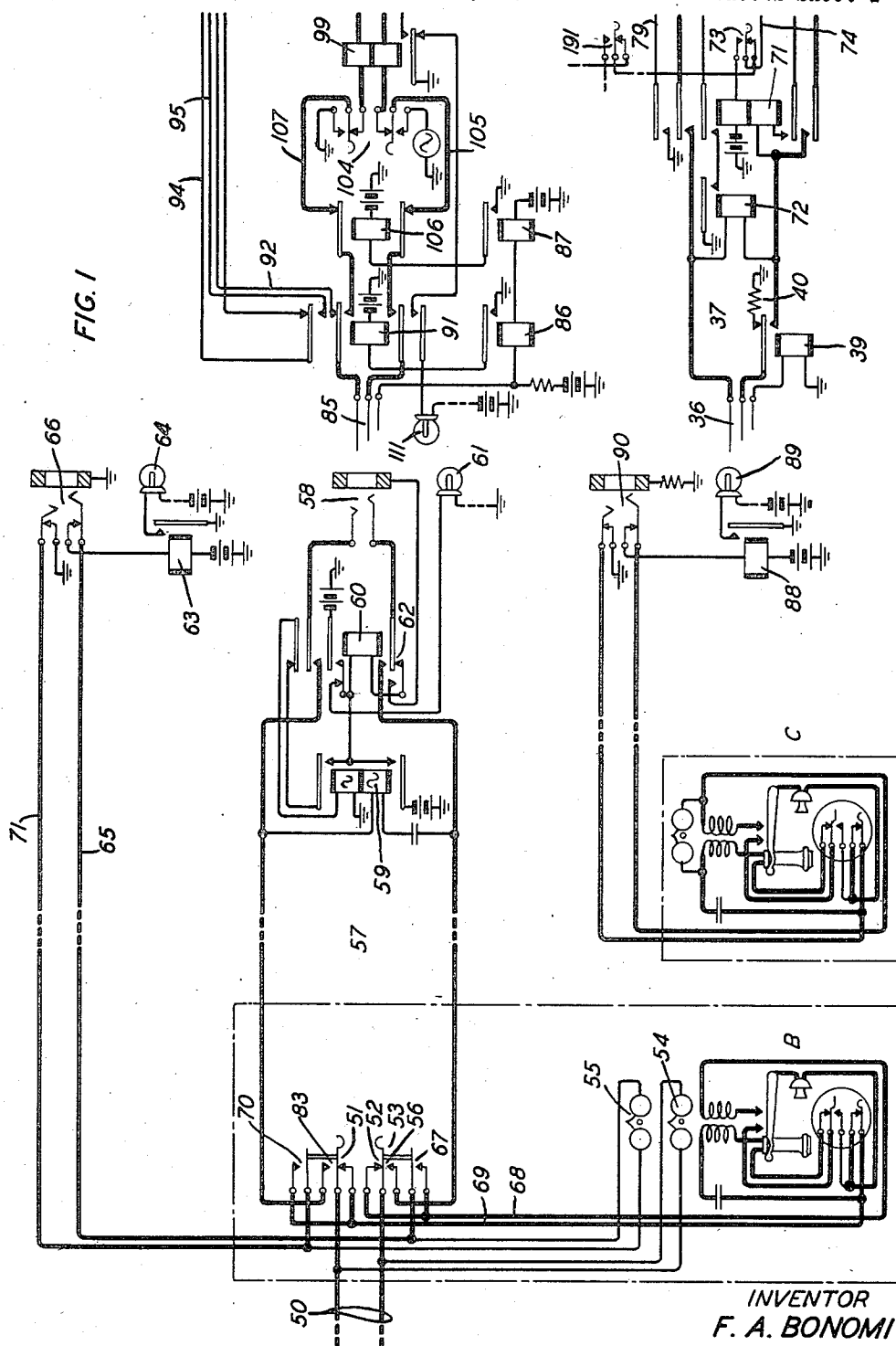
F. A. BONOMI

2,031,922

TELEPHONE SYSTEM

Filed July 29, 1932

3 Sheets-Sheet 1



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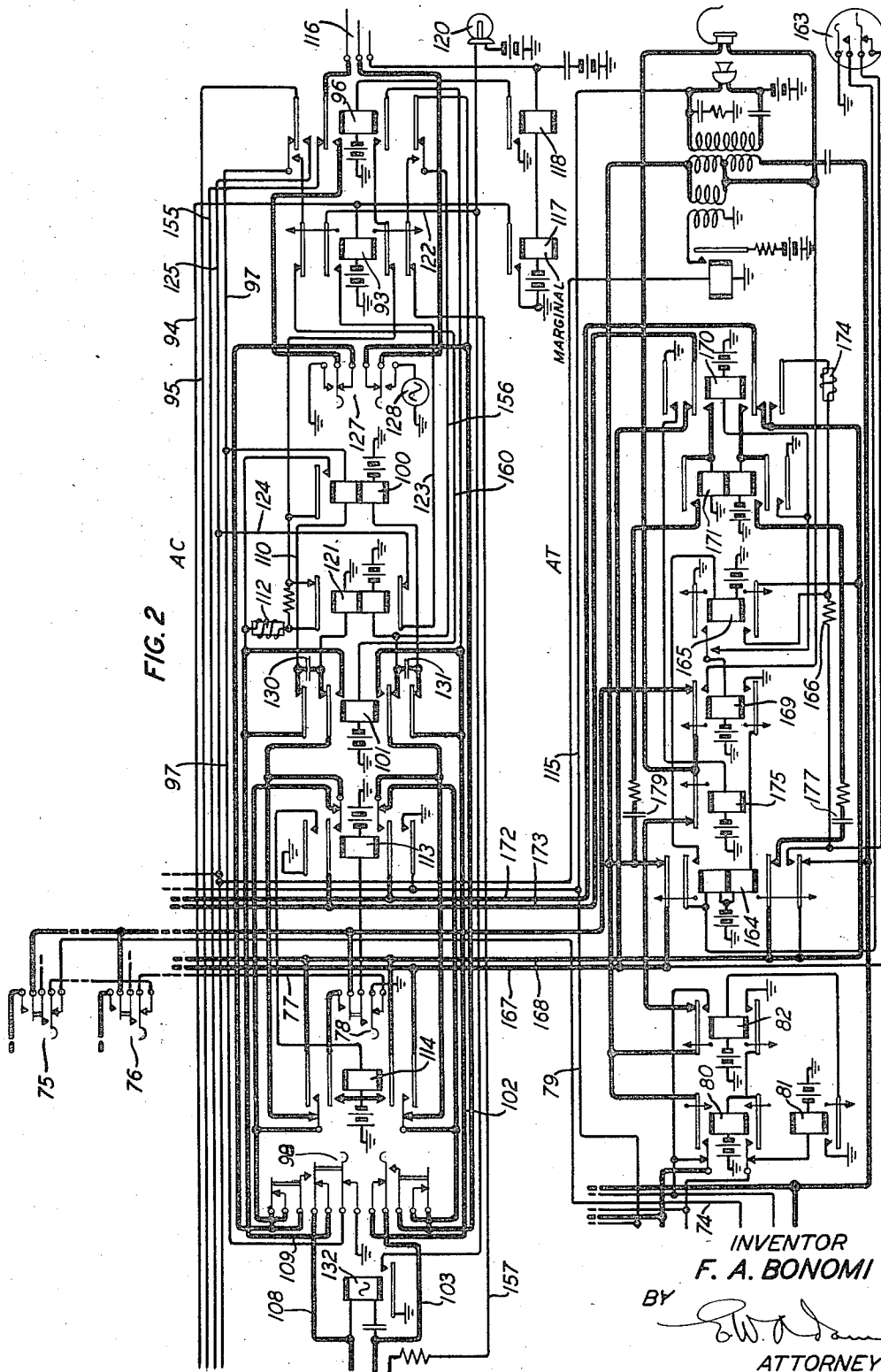
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3 Sheets-Sheet 2

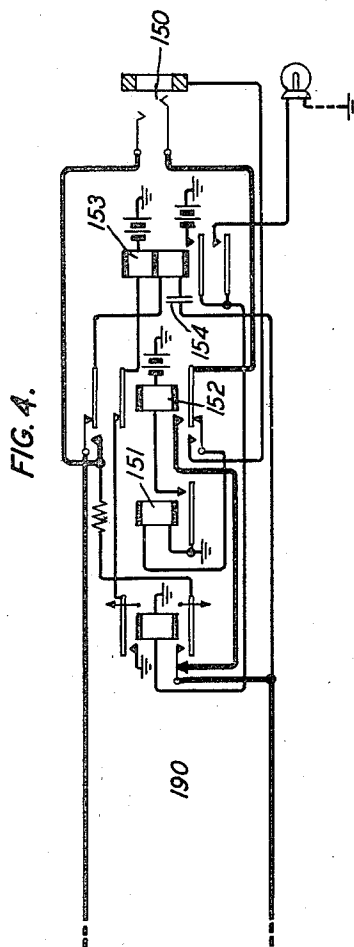
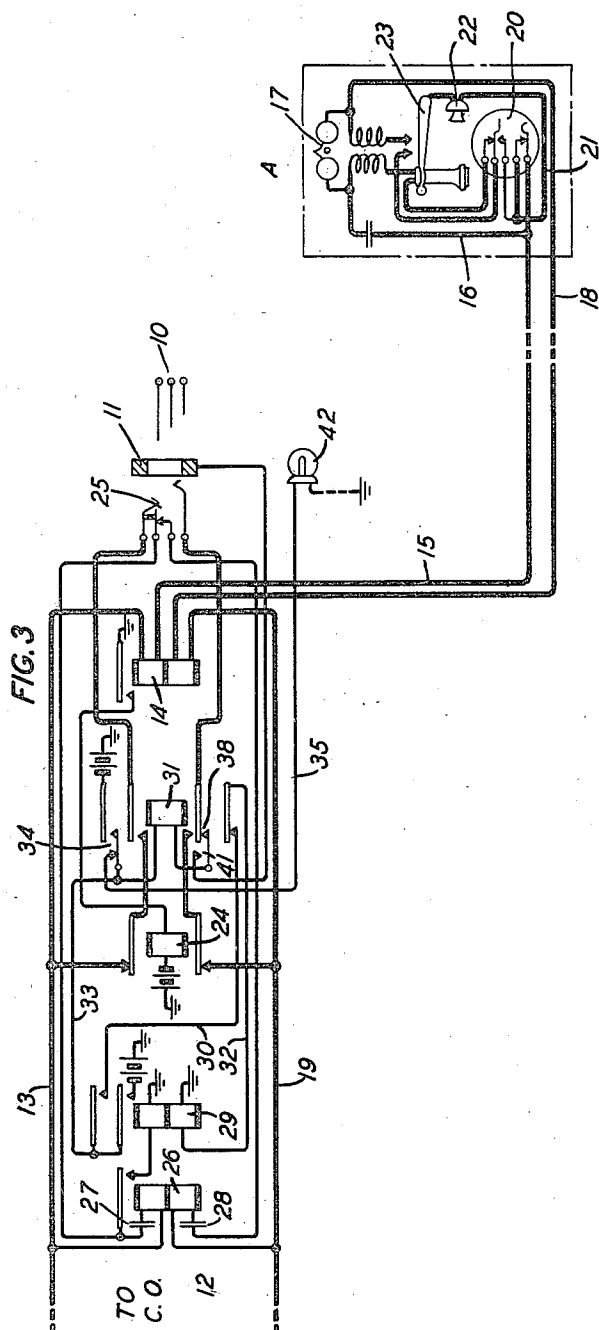


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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,031,922

TELEPHONE SYSTEM

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11 Claims. (Cl. 179—27)

This invention relates to telephone systems and more particularly to improvements in private branch exchange systems.

In private branch exchange systems that are in common use today, a plurality of subscribers' lines, usually located in one building such as an apartment house, a large business establishment or the like, terminate at a local switchboard located in the building and operated by an attendant. Trunk lines incoming from central offices also terminate at the P. B. X. switchboard so that, through the intermediation of the attendant, calls to and from the P. B. X. subscribers' lines may be completed at the P. B. X. board. That is, all calls originating at the subscriber's station as well as those incoming to or intended for the subscriber are completed by the P. B. X. attendant at the P. B. X. board.

Such systems have given satisfactory service in the past but with the ever increasing size of our modern apartment houses and the class of people occupying them it has been found necessary not only to furnish the subscribers' lines with P. B. X. service in such cases but to also provide direct central office service so as to modify the duties of the attendant from those of an ordinary telephone operator to those of a secretary.

It is accordingly the object of this invention to improve upon existing private branch exchange systems so as to combine direct central office telephone service with that ordinarily furnished by the private branch exchange switchboard.

This object is attained in accordance with a feature of the invention by the provision of means whereby central office calls may be received and originated at a station, having access to P. B. X. service, independently of the P. B. X. attendant.

Another feature of the invention resides in the provision of means, under the control of the P. B. X. subscriber, for the interception by the P. B. X. attendant of all incoming central office calls to the subscribers' lines.

A further feature of the invention provides for the exclusive use of the central office line, normally associated with the subscriber's line, by the subscriber. By this feature, the P. B. X. operator is prevented from originating central office calls over the line allotted to the subscriber's line when the latter is conditioned for intercepting service.

A still further feature of the invention resides in the provision, at the subscriber's station, of separate distinctive toned ringers whereby the

subscriber is enabled to distinguish between incoming central office calls and calls completed to his station at the P. B. X. board.

Another feature of the invention is embodied in a particular chain arrangement of the talk keys associated with the P. B. X. operator's cord circuits whereby the operator is prevented from listening in on more than one connection at a time.

These and other features not specifically identified, will appear from the following detailed description made with reference to the accompanying drawings in which:

Fig. 1 shows two P. B. X. lines terminating at a private branch exchange and the rear ends of a regular cord circuit and an intercepting cord circuit employed in setting up connections from and completing connections to stations on the lines;

Fig. 2 shows the major portions of the attendant's cord circuits and dialing equipment and in reading the drawings Fig. 2 is placed to the right of Fig. 1;

Fig. 3 shows an intercepting trunk with which is associated a subscriber's line, the trunk circuit interconnecting a private branch exchange and a central office;

Fig. 4 shows a two-way trunk terminating at the P. B. X.

Special reference is now made to Fig. 3 in describing a condition in which the interception of calls intended for a P. B. X. subscriber by a P. B. X. attendant is under the control of the attendant at the P. B. X. board.

Assuming the subscriber at station A is at home and desires calls intended for him to come direct to his station and not be intercepted by the attendant, a dummy plug generally indicated at 10 would be inserted in jack 11 of the intercepting trunk circuit 12. Under this condition, ringing current emanating from the central office traverses trunk conductor 13, upper winding of relay 14, conductor 15, conductor 16, ringer 17, conductor 18, lower winding of relay 14, trunk conductor 19 to the ringing current source at the central office. The ringer 17 operates in this circuit to signal the subscriber at station A. In response to this signal the subscriber removes the receiver at station A, whereupon relay 14 operates from central office battery over a circuit including trunk conductor 13, upper winding of relay 14, conductor 15, lower normal contact of dial 20, conductor 21, transmitter 22, receiver switch arm 23, conductor 18, lower winding of relay 14, trunk conductor 19 to the central office battery. Relay 14 in operating causes relay 24

to operate in an obvious circuit. Relay 24 performs no useful function at this time because the line is not conditioned for intercepting service.

5 When a subscriber desires his incoming calls to be intercepted by the P. B. X. attendant for any reason, the dummy plug 10 is removed from jack 11. This operation closes jack contact 25, which connects the upper and lower windings of
10 relay 26 in series with the tip and ring condensers 27 and 28 across the tip and ring of the trunk 12.

When ringing current is applied to the trunk circuit 12 at the central office, the subscriber's bell 17 at station A operates as before and relay 26 operates as long as ringing continues. Relay 26 operated, connects the upper winding of relay 29 to the mid-point of the ringing bridge. Relay 29 operates to ground in multiple with the upper winding of relay 26 and condenser 27. Relay 29
20 in operating locks in a circuit extending from grounded battery, front contact and lower armature of relay 29, upper armature and front contact of relay 29, conductor 30, back contact and outer lower armature of relay 31, conductor 32
25 to ground through its own lower winding. Relay 29 also causes lamp 32 to be lighted in a circuit extending from grounded battery, front contact and lower armature of relay 29, conductor 33, normal make-before-break contact 34 of relay 31,
30 conductor 35 to ground through the filament of lamp 32. Relay 29 also connects battery to one winding terminal of relay 31 by way of conductor 33.

The combination of relays 26 and 29 and the method of connecting relay 29 from the mid-point of the ringing bridge, prevents the lamp 32 from lighting falsely when the plug of an intercepting cord is removed from jack 11 and also prevents the lamp 32 from lighting falsely in case the
40 subscriber at station A dials when his line is conditioned for intercepting service.

Upon noting the lighted lamp 32, the P. B. X. attendant inserts plug 36 of intercepting cord 37 into jack 11 associated with the lighted lamp 32, which operation opens up the ringing bridge at jack contact 25 and causes relay 31 to operate in a circuit extending from grounded battery, front contact and lower armature of relay 29, conductor 33, winding of relay 31, lower normal make-before-break contact 38 of relay 31, and its armature, ring contacts of jack 11 and plug 36, armature and back contact of relay 39, resistance element 40 to ground.
50

Relay 31 operated, locks in a circuit extending from grounded battery, front contact and lower armature of relay 29, conductor 33, winding and contact 41 of relay 31, sleeve contacts of jack 11 and plug 36 to ground through the winding of relay 39. Relay 31, at its innermost front contacts and armatures connects the tip and ring conductors 13 and 19 of the intercepting trunk 12 through to the P. B. X. attendant's cord circuit 37. At its contact 34, it opens the circuit to the lamp 32 and at its lower outer armature and front contact it opens the locking circuit for relay 29, which releases.
60

Relay 31 locks in series with relay 39 in the attendant's intercepting cord circuit 37, relay 39 operating in this circuit. Relay 39 operated, disconnects ground from the ring contact of plug 36, connects the ring conductor through to a contact of relay 71 and connects relay 72 across the tip and ring of the cord 37.
70

The attendant now actuates the talk key 73, whereupon relay 71 operates in a circuit extend-

ing from grounded battery, winding of relay 71, alternate contacts of key 73, conductor 74, normally closed contacts of key 75 which is the last key in the chain of keys associated with the attendant's regular cords, normally closed
5 contacts of key 76, conductor 77 to ground on the normally closed contact of key 78 which is the first key in the chain. Relay 71 operated, connects ground to the attendant's transmitter by way of the front contact and outermost upper
10 armature of relay 71 and conductor 79. At its outermost lower armature and middle upper armature relay 71 connects the tip and ring of the cord 37 to corresponding conductors of the attendant's telephone circuit AT, and at its inner
15 lower armature, it connects the secondary winding of relay 72 across the tip and ring of the cord by way of the normally closed upper make-before-break contacts of relay 80.

Relay 72 may or may not operate on ringing current but it will operate on direct current supplied during the silent interval. Relay 72 operated, causes relays 81, 82 and 83 in the attendant's telephone circuit to maintain the secondary winding of relay 72 across the cord long enough
25 to trip machine ringing first and then to connect the attendant's telephone set across the tip and ring of the cord.

The attendant, after receiving the necessary instructions about the call and imparting the
30 called station instructions, releases key 73 and removes plug 36 from jack 11 releasing all the relays operated and returning the circuit to normal.

When a subscriber whose line, such as the line
35 associated with station A, has been conditioned for intercepting service by the insertion of a dummy plug 10 into the jack 11, removes his receiver from the switchhook in response to an incoming call, relay 14 operates as hereinbefore
40 described over the central office loop, which causes relay 24 to operate in an obvious circuit. Relay 24 in operating disconnects the tip and ring conductors 13 and 19 from the contacts of relay 31. The P. B. X. attendant is thereby pre-
45 vented from associating her telephone circuit with a line after the subscriber has answered, and in case the subscriber removes his receiver after a call has been intercepted by the P. B. X. attendant, the attendant is immediately cut off
50 by the operation of relay 24.

It will be noted that the trunk circuit 12 which is individual to the subscriber's station A is not accessible to the P. B. X. attendant for the purpose of originating outgoing central office calls.
55 This is rendered possible by the fact that relay 31, which completes the connection of the tip and ring conductors of the trunk 12 with the attendant's cord, can not be operated unless relay 29 is operated which operates when relay 26
60 operates, the latter being operable from the central office end only.

The next description is directed to intercepting service in which the subscriber is provided with the necessary equipment at his station to elect
65 whether or not incoming calls are to be routed to the P. B. X. attendant.

In Fig. 1 the line 50 incoming from a central office is shown normally associated with contacts 51 and 52 of key 53 which is located at the sub-
70 scriber's station B and is furnished as part of the substitution equipment.

Ringing current incoming over the line 50 operates the ringer 54. The station B is furnished with two ringers 54 and 55 each being
75

differently pitched or furnishing a distinctive signal so that the subscriber at station B may determine whether or not the incoming call originated at a central office or at the local P. B. X. as will appear presently.

In response to the signal 54, the subscriber at station B removes his receiver to answer the call in the usual manner.

When a subscriber desires his incoming calls to be intercepted by the P. B. X. attendant for any reason, the key 53, which is a locking key, is operated. The operation of the key 53 disconnects the substation B from the central office line 50 at contacts 51 and 52 and substitutes therefor by way of contacts 55 and 56, the intercepting trunk 57, which terminates at the P. B. X. attendant's position in jack 58.

When ringing current is applied to the line 50 at the central office, the ringer 54 is rung at station B and relay 59 operates by way of its lower winding. Relay 59 operated, establishes a locking circuit for itself extending from grounded battery, lower armature and front contact of relay 59, front contact and upper armature of relay 59, back contact and outermost upper armature of relay 60, to ground by way of the upper winding of relay 59. It also prepares an operating circuit for relay 60 and establishes a circuit for lamp 61 by way of the upper make-before-break contacts of relay 60.

The P. B. X. attendant answers the incoming call in response to the lighted lamp 61 by inserting the plug 36 of an intercepting cord 37 into jack 58. Relay 60 thereupon operates over the ring circuit including resistance element 40 and contacts 62 of relay 60 and immediately locks over the sleeve circuit in series with relay 39. Relay 60 operated, closes the tip and ring conductors of the intercepting trunk 57 through to the P. B. X. attendant, opens the energizing circuit for lamp 61 and opens the locking path for relay 59 which releases.

After the completion of the call, the P. B. X. attendant removes plug 36 from jack 58 causing relay 60 to release and restore the circuit to normal.

Should the key 53 at station B be actuated for intercepting service and the subscriber desire to answer a call incoming over the line 50 in response to the operation of ringer 54, it is necessary that he restore the key to normal before removing his receiver from its switchhook. Failure to do this would result in the operation of line relay 63 and the consequent lighting of lamp 64 at the P. B. X. attendant's position. Under this condition, that is, with key 53 operated and the receiver at station B off the hook, the relay 63 would operate in a circuit extending from grounded battery, normal ring contacts of jack 66, conductor 65, contacts 67 of key 53, conductor 68, through the closed subscriber's station loop, conductor 69, contacts 70 of key 53, conductor 71 to ground at the normal tip contacts of jack 66.

With the key 53 operated, it is impossible for the P. B. X. attendant to originate central office calls over the line 50 since it is impossible to operate relay 60 to close the trunk circuit 57 through to the attendant, except when relay 59 is operated which can only be operated from the central office end.

As hereinbefore stated, the ringers 54 and 55 located at station B are separate, distinctively toned ringers in order to indicate to the subscriber whether a local or central office call is

incoming, the former by way of a line circuit made up of conductors 65 and 71 and the latter by way of a central office line circuit such as 50.

It will be noted that the intercepting trunks 57 and 12 require ground potential on the ring lead in order to operate relays 60 and 31, respectively, to connect the attendant through to the line. It is, therefore, impossible for the attendant to employ a regular cord circuit to handle calls on these trunks, because the attendant's regular cords furnish battery on the ring lead as will appear in a subsequent description. The reason it is undesirable to allow the attendant to employ a regular cord in handling intercepted calls is that the subscriber is charged for the exclusive use of the intercepting trunk associated with his line and should therefore be guaranteed that no other party can originate central office calls over the trunk. By furnishing battery potential on the ring lead of the attendant's regular cords and requiring ground potential on the ring lead of the trunks to operate relays 60 and 31, the attendant must of necessity employ an intercepting cord 37 when handling a call on an intercepting trunk, the cord 37 being capable of providing the necessary ring lead potential.

In order to furnish a complete understanding of the service possible with the system herein disclosed, it will now be shown how a connection between an unrestricted service station C and a restricted service station B is effected.

A subscriber at the unrestricted service station C removes his receiver from its switchhook establishing an obvious circuit for the line relay 88 which operates causing the line lamp 89 to be lighted as a signal to the attendant. The attendant thereupon inserts plug 85 of her regular cord circuit AC into jack 90 associated with the lighted line lamp 89 thereby opening the energizing circuit for relay 88 and extinguishing the line lamp 89. With plug 85 in jack 90, relay 86 operates in series with the winding of relay 87 in an obvious sleeve circuit. Relay 87 is a marginal relay and does not operate owing to the high resistance in the sleeve of jack 90.

Relay 86 operated, operates relay 91 in an obvious circuit. Relay 91 at its upper inner armature disconnects the busy test conductor 92 from the tip of the rear cord. At the outer upper armature relay 91 establishes a circuit for relay 93 which may be traced from grounded battery, winding of relay 93, conductor 94, outer upper armature and front contact of relay 91, conductor 95, outer upper armature and back contact of relay 96, conductor 97 to ground on a normal contact of key 98. At its two inner armatures relay 91 connects relays 99 and 100 to the tip and ring leads of the rear cord whereupon these relays operate. The circuit for relays 99 and 100 may be traced from grounded battery, lower winding of relay 100, outer lower armature and back contact of relay 101, conductor 102, a normally closed contact of key 98, conductor 103, lower winding of relay 99, a normally closed contact of key 104, conductor 105, back contact and lower armature of relay 106, front contact and inner lower armature of relay 91, ring contacts of plug 85 and jack 90, through the closed subscriber's loop at station C, tip contacts of jack 90 and plug 85, inner upper armature and front contact of relay 91, upper armature and back contact of relay 106, conductor 107, a normally closed contact of key 104, upper winding of relay 99, conductor 108, a normally closed contact of key 98, conductor 109, outer upper armature and

back contact of relay 101, conductor 110, upper winding of relay 100, conductor 97, to ground at a normally closed contact of key 98. Relays 99 and 100 operate in this circuit. Relay 93 operated, performs no useful function at this time. Relay 99 operated prevents the rear cord supervisory lamp 111 from lighting while relay 100 short circuits the retardation coil 112.

The attendant now actuates the "Talk and Dial" key 78 whereupon relay 113 operates in an obvious circuit and causes relay 114 to operate in an obvious circuit. Relay 113, at its lower outer armature and front contact connects ground to the attendant's transmitter circuit by way of conductor 115. Relay 113 at its inner armatures and front contacts and relay 114 at its outer armatures and front contacts connect the attendant's telephone set across the tip and ring of the rear cord.

The attendant now receives the required information from the unrestricted service station C, releases the "Talk and Dial" key 78, releasing relays 113 and 114 and inserts the front cord plug 116 into the restricted service line jack 66, causing relays 117 and 118 to operate in series in an obvious sleeve circuit. Relay 118 causes relay 96 to operate in an obvious circuit while relay 117 maintains an obvious operating circuit for relay 93. Relay 93 being kept operated, prevents relay 101 from operating, prevents a short circuit from being placed across the tip and ring leads of the rear cord when relay 96 operates and causes the front supervisory lamp 120 to light under control of relays 121 and 96. The circuit for lamp 120 may be traced from grounded battery, filament of lamp 120, conductor 122, inner upper armature and front contact of relay 93, conductor 123, lower armature and back contact of relay 121, conductor 124, conductor 125, front contact and outer upper armature of relay 96, conductor 95, front contact and upper outer armature of relay 91, conductor 94, to ground at the armature and front contact of marginal relay 117.

Relay 96 operated, disconnects the busy test lead from the tip of the front cord and connects the tip through to the front ringing key 127.

The attendant now rings the restricted service station B by operating key 127. The path for the ringing current extends from grounded ringing current source 128, lower alternate contact of key 127, ring contacts of plug 116 and jack 66, through the signaling circuit at station B, tip contacts of jack 66 and plug 116, inner upper armature and front contact of relay 96, to ground at the upper alternate contact of key 127. It will be noted that on a call completed at the P. B. X. the ringer 55 at station B is actuated whereas, as hereinbefore described, on a call incoming from a central office to station B, the ringer 54 is actuated. The subscriber at station B can readily determine the character of the incoming call since the ringers 54 and 55 are distinctively toned.

When the receiver at the station B is removed from the switchhook, relay 121 in the attendant's cord operates causing the supervisory lamp 120 to be extinguished.

Under the conditions of the established connection between stations C and B by way of the cord circuit AC, battery and ground for the unrestricted service station C are furnished by the cord circuit AC through windings of relays 100 and 99; battery and ground for the restricted service station B are furnished by the cord circuit AC through windings of relay 121; the front

and rear cords of cord circuit AC are coupled through condensers 130 and 131 and no bridge is connected across the tip and ring of the cord except ringing relay 132 which performs no useful function at this time.

Both stations B and C have flashing and disconnect switchhook supervision.

In the case of a restricted service station such as station B calling another restricted service station, the call is usually answered by the attendant with the front cord and completed with the rear cord. The relays in the cord operate in the same manner as just described in connection with a call originating at an unrestricted service station and intended for a restricted service station.

A call from an unrestricted service station for another restricted service station may be answered with either the front or rear cord and completed with either cord.

As it was necessary in the descriptions so far completed to refer to certain relays such as 80, 81 and 82 in the attendant's telephone and dialing circuit, it was deemed advisable to show this circuit in its entirety in order to render the disclosure fully understandable. To set forth the operations of this circuit, the following description is directed to a connection between an unrestricted subscriber's station C and a central office with the attendant dialing.

As hereinbefore set forth, a call originating at an unrestricted subscriber's station C is answered by the attendant with the rear cord of the cord AC. As all the operations incident to the insertion of plug 85 of the rear cord in jack 90 of the unrestricted subscriber's line have already been described, it is deemed unnecessary to repeat them here.

The attendant upon learning that a central office call is desired by the subscriber at station C selects an idle trunk 190 (Fig. 3) and inserts plug 116 of the front end of cord AC into jack 150 of the idle trunk. Relay 151 thereupon operates from battery on the ring contacts of jack 150 and plug 116 furnished from the cord AC by way of the lower winding of relay 121. Relay 151 causes relay 152 to operate in an obvious circuit. Relay 152 operated, disconnects the ringing bridge comprising the lower winding of relay 153 and condenser 154 from across the tip and ring of the trunk 190, closes the tip and ring of the trunk from the cord AC to the central office and transfers the holding path for relay 151 from the ring to the sleeve of the cord. A circuit may now be traced from grounded battery, windings of relays 117 and 118, sleeve contacts of plug 116 and jack 150, lower make-before-break contacts of relay 152 to ground through the winding of relay 151. Relay 118 operates in this circuit, but relay 117 being marginal does not operate owing to the high resistance of the sleeve circuit just traced. Relay 118 causes relay 96 to operate to perform all the functions hereinbefore set forth in the description directed to the establishment of a connection between unrestricted and restricted subscribers' lines. It will be noted now that relay 117 not having operated does not maintain a circuit for relay 93 which releases as a consequence of the operation of relay 96. Relay 93, released, causes relay 121 to operate in a circuit extending from grounded battery, lower winding of relay 121, conductor 156, lower make-before-break contacts of relay 96, outer lower armature and back contacts of relay 93, conduc-

tor 157 to ground at the front contact and armature of relay 99.

Relay 101 operates in a circuit extending from grounded battery, winding of relay 101, conductor 160, outer upper back contact and armature of relay 93, upper make-before-break contacts of relay 96, conductor 97, to ground at key 98. Relay 101 operated disconnects the condensers 130 and 131 from the talking circuit, disconnects battery and ground through the windings of relay 100 from the ring and tip of the rear cord causing relay 100 to release. Relay 101 also disconnects battery and ground through the windings of relay 121 from the ring and tip of the front cord and connects the tip and ring of the front cord directly to the tip and ring of the rear cord respectively.

With the talk and dial key actuated and relays 113 and 114 operated as a consequence thereof, the attendant may now proceed to dial the desired central office number. When the attendant moves the dial 163 off-normal relay 164 operates by way of its upper winding to ground on the off-normal contacts of the dial. At its outer upper and lower contacts, relay 164 opens the attendant's telephone circuit; at its upper inner contacts it establishes an obvious circuit for relay 165; at its lower front contact relay 164 connects resistance 166 across the leads 167 and 168.

Relay 165 operated short circuits resistance 166 and establishes obvious circuits for relays 169 and 170. Relay 170 at its inner armatures and back contacts splits the cord circuit and connects battery and ground through the windings of relay 171 to the rear cord by way of conductors 172 and 173, leaving the dialing contacts of dial 163 connected to the front cord by way of conductors 167 and 168. Relay 170 operated, also connects retardation coil 174 across the leads 167 and 168 through the pulsing contacts of dial 163, the resistance 166 and retardation coil 174, however, being short-circuited by relay 165.

Relay 169 operated, provides an obvious locking circuit for relay 164. At its upper contact it disconnects the tip lead from the attendant's telephone set and short-circuits the attendant's head receiver to prevent an undesirable click when the dial returns to normal and to prevent the attendant from hearing the dial pulses.

Relay 175 operates in response to the operation of relay 170 and performs no useful function at this time. Its primary function is to maintain the attendant's receiver circuit normally closed. A circuit may now be traced from grounded battery, lower winding of relay 171, inner lower front contact and armature of relay 170, conductor 172, inner lower armature and front contact of relay 113, inner lower armature and front contact of relay 101, normal contacts of key 98, conductor 103, lower winding of relay 99, normal contacts of key 104, conductor 105, normal contacts of relay 106, inner lower front contact and armature of relay 91, ring contacts of plug 85 and jack 90, over the closed subscriber's line hook at station C, tip contacts of jack 90 and plug 85, upper inner armature and front contact of relay 91, upper armature and back contact of relay 106, conductor 107, normal contacts of key 104, upper winding of relay 99, conductor 103, normal contacts of key 98, conductor 109, inner upper front contact and armature of relay 101, inner upper front contact and armature of relay 113, conductor 173, inner upper armature and front con-

tact of relay 170, to ground through the upper winding of relay 171. Relay 171 operated, closes an obvious locking circuit for relay 170.

As hereinbefore described, the dialing contacts are connected to the front end of cord AC by way of conductors 167 and 168 so that the dial pulses are sent over the front cord and thence over the trunk COT in the well known manner.

When the dial has completely restored, relay 165 releases removing the short circuit from resistance 166 and retardation coil 174 and also causes relay 169 to release. Relay 169 released, removes the short circuit from the attendant's receiver and causes relay 164 to release. The release of relay 164 removes the resistance 166 shunt from the retardation coil 174 and closes the attendant's talking circuit. The retardation coil 174 now holds the central office connection and the front and rear cords of cord AC are connected through the condensers 177 and 178 to enable the station to talk on the connection even though the attendant should fail to restore the talk and dial key 75 after dialing. When the key 75 is restored relays 113 and 114 restore causing relays 171 and 170 to release. Relay 170 released, causes relay 175 to release. Relay 175 is made slow to release in order to keep the attendant's receiver circuit open long enough to prevent clicks in the receiver due to the release of key 78 in the cord circuit AC.

At the termination of the connection, the subscriber at station C replaces the receiver on its switchhook thereby causing relay 99 to release which in turn causes the release of relay 121. Relay 99 in releasing establishes an obvious circuit for supervisory lamp 111 which lights as a disconnect signal. Upon receipt of the disconnect signal the attendant may withdraw the front and rear cord plugs 116 and 85 from jacks 150 and 90 respectively whereupon all operated relays release and the circuit is restored to normal.

In previous descriptions, it has been shown that the operation of such keys as key 73 and 191, which are individual to intercepting cord circuits such as 37, result in the connection of the attendant's receiver to the intercepting cords by virtue of the operation of relay 71. It has also been shown that the operation of keys such as 78, 76 and 75, which are individual to the attendant's regular cord circuits such as AC, cause relays 113 and 114 to operate to effect the association of the attendant's receiver with the regular cords. Keys 73 and 191 of the intercepting cords and keys 78, 76 and 75 are all connected in a chain circuit, key 78 constituting the first key in the chain and furnishing ground potential for all the other keys. This arrangement precludes the possibility of an attendant listening in on more than one connection at a time. The operation of key 78 removes ground potential from all the other keys so that should an attendant actuate another key, such as 76 or 73, for the purpose of listening in on another connection, relays 113 and 114 of the regular cord with which key 76 is associated would not operate, nor would relay 71 of the intercepting cord with which key 73 is associated function. Should a key such as 75 be in its operated position and the attendant's receiver therefor associated with the cord circuit to which key 75 is individual and any other key, such as key 76 or 78, having a lower position in the chain be actuated, the attendant's receiver would be automatically disconnected from the cord corresponding to key 75 and connected to

the cord corresponding to key 76 or 78 depending on which was operated.

What is claimed is:

1. In a telephone system, a subscriber's station, a signaling device thereat, a link circuit individual to said subscriber's station and terminating at a central office, an intermediate office, a signaling device thereat, and means at said subscriber's station for disconnecting said station from said link circuit and causing the signaling device at said intermediate office to be actuated simultaneously with the signaling device at said station in response to a call incoming from said central office over said link circuit.

2. In a telephone system, a subscriber's line circuit, a central office, an intermediate office, a telephone line circuit normally connecting said subscriber's line circuit with said central office, in intercepting trunk circuit terminating at said intermediate office, means under the control of the subscriber on said subscriber's line circuit for transferring the connection of said telephone line circuit from said subscriber's line circuit to said trunk circuit for the reception, at said intermediate office, of calls incoming over said telephone line circuit, and means included in said intercepting trunk circuit for rendering said telephone line circuit inaccessible at said intermediate office for the initiation of calls to said central office by way of said telephone line circuit.

3. In a telephone system, a subscriber's station, a central office, an intermediate station, a link circuit terminating at said central office, switching means at said subscriber's station for interconnecting said central office and said intermediate office by way of said link circuit for the reception at said intermediate office, of calls originating at said central office and means for rendering said link circuit inaccessible at said intermediate office for the origination of calls to said central office.

4. In a telephone system, a subscriber's line, a private branch exchange, a central office line normally connected to said subscriber's line, a trunk circuit terminating at said private branch exchange, switching means associated with said subscriber's line for disconnecting said central office line from said subscriber's line and connecting it to said trunk circuit for directing calls incoming over said central office line and intended for said subscriber's line to said private branch exchange and means included in said trunk circuit for rendering said central office line inaccessible to the attendant at said private branch exchange for originating outgoing calls when said switching means is actuated.

5. In a telephone system, a subscriber's line, a central office line for connecting said subscriber's line with a central office, a private branch exchange, means for directing calls incoming over said central office line from said subscriber's line to said private branch exchange and means for rendering said central office line inaccessible from said private branch exchange for initiating calls outgoing over said central office line.

6. In a telephone system, a subscriber's line, a central office line connecting said subscriber's line with a central office, a private branch exchange, a trunk circuit terminating at said private branch exchange, a ringing relay associated with said trunk circuit, and switching means associated with said subscriber's line for disconnecting said subscriber's line from said central office line and connecting said ringing relay in circuit with said central office line to cause a signal to be displayed at said private branch exchange in response to the actuation of said ringing relay on a call incoming on said central office line, the disconnecting and connecting functions of said switching means being effected immediately upon the actuation of said switching means.

7. In a telephone system, a subscriber's line, a central office line connected to said subscriber's line, a private branch exchange, a link circuit terminating at said private branch exchange, a ringing relay in said link circuit, switching means associated with said subscriber's line for connecting said ringing relay in circuit with said line and to cause a signal to be displayed at said private branch exchange when said relay is operated on a call incoming on said central office line and means responsive to the seizure of said link circuit at said private branch exchange subsequent to the display of said signal for completing the talking conductors of said link circuit from said private branch exchange.

8. In a telephone system, a subscriber's line, a central office line connected to said subscriber's line, a private branch exchange, a link circuit adapted to connect said subscriber's line with said private branch exchange, and a pair of signaling devices for said subscriber's line, one of said devices permanently associated with said central office line and the other with said link circuit, said devices having different signaling characteristics whereby calls incoming to said subscriber's line over said central office line are distinguished from calls originating at said private branch exchange.

9. In a telephone system, an intercepting trunk circuit terminating at a private branch exchange and normally accessible to the attendant at said exchange for the reception of calls incoming over said trunk, a subscriber's line normally associated with said trunk and means responsive to the answer of an incoming call over said trunk by the subscriber on said line for rendering said trunk inaccessible to the attendant at said exchange.

10. In a telephone system, a plurality of link circuits, an operator's telephone, a key for each of said link circuits, means responsive to the operation of each of said keys for connecting said operator's telephone with the link circuit corresponding to the actuated key and means joining all of said keys in a chain circuit whereby the operation of any one of said keys renders ineffective the operation of another key located further from the start of said chain circuit.

11. In a telephone system, a plurality of link circuits, an operators' telephone, a key for each of said link circuits, means responsive to the actuation of one of said keys for connecting said operator's telephone with the link circuit corresponding to the actuated key and a chain circuit including all of said keys whereby the operation of a key nearer the start of said chain circuit automatically disconnects said operator's telephone from the link circuit corresponding to a previously actuated key and connects it to the link circuit corresponding to the key located nearer the start of said chain circuit.

FELIX A. BONOMI.