

March 31, 1942.

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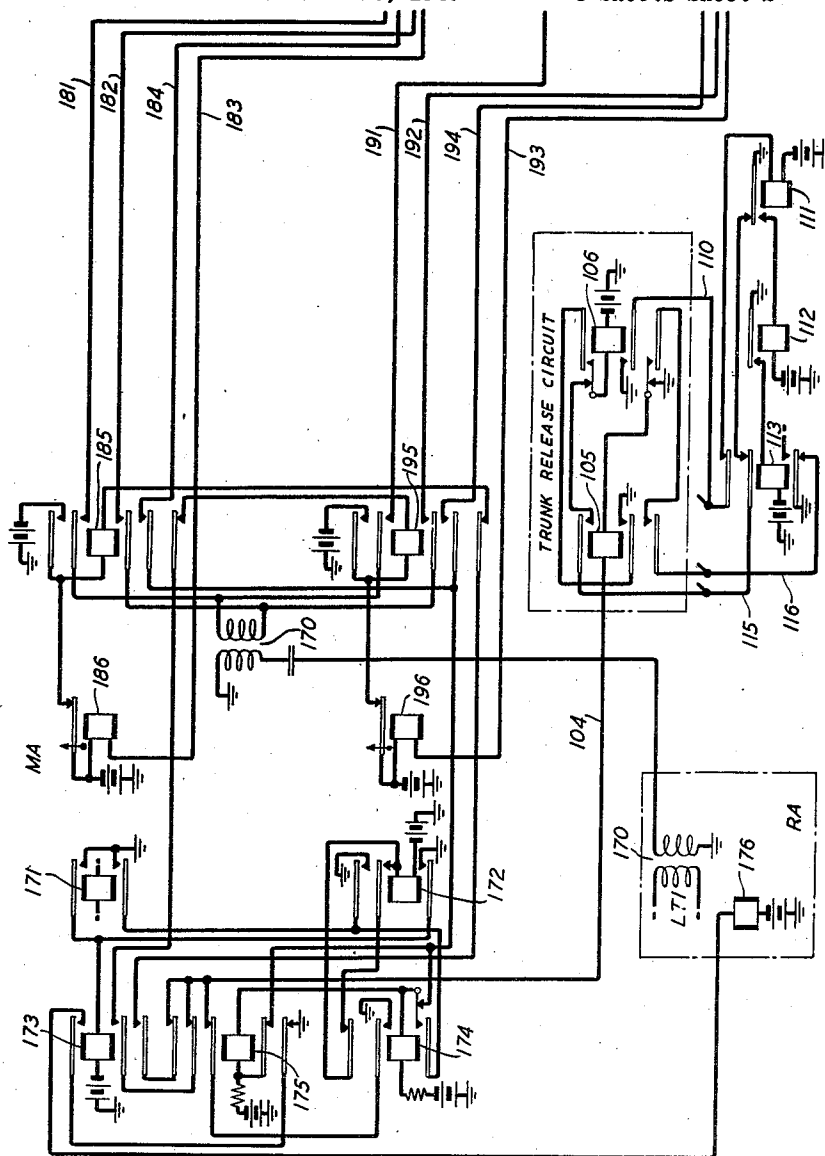
2,278,172

TELEPHONE SYSTEM

Filed Oct. 29, 1940

3 Sheets-Sheet 2

FIG. 3



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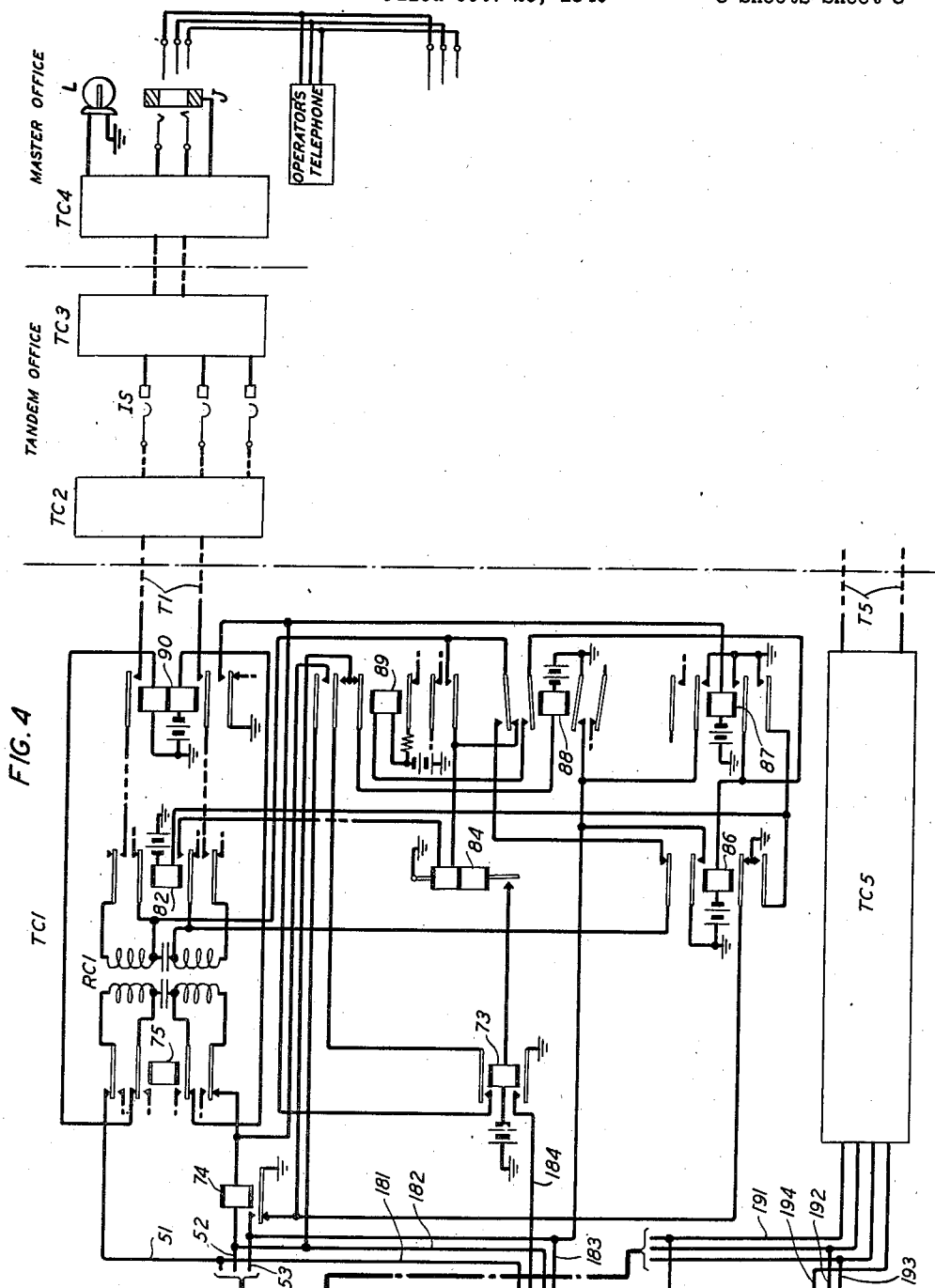
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TELEPHONE SYSTEM

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Application October 29, 1940, Serial No. 363,265

12 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to systems comprising unattended automatic offices.

It is the object of the invention to improve the facilities provided in telephone systems for transmitting alarms from an unattended dial office to the master office and to increase the efficiency of trunking systems.

It is usual to provide alarm apparatus in an unattended dial office which is effective when a trouble condition exists to seize a trunk through which calls to the master office may be completed and upon answer of the call in the master office to transmit a tone signal to indicate that the call is an alarm call from an unattended office. The patent to J. N. Walters No. 2,262,595 granted Nov. 11, 1941, discloses a system comprising an unattended office having direct trunks to a master office and alarm apparatus for seizing either one of two of these trunks for transmitting trouble signals thereover. When, however, calls from a first unattended dial office to a master office are completed through a second or tandem unattended office, seizure of a trunk in the first unattended office on a call to the master office may effect the automatic operation of an incoming selector in the tandem office to select an idle trunk from the tandem office to the master office. Such a system is disclosed in the patent to J. Baumfalk et al. No. 2,268,635 granted Jan. 6, 1942. If all of the trunks to the master office are busy, upon seizure of a trunk in the first unattended office on a call to the master office, a busy tone is transmitted to the first unattended office; and, if the call is from a subscriber, the connection will be released in usual manner. But if the call is a trouble alarm call, the tone signal is ineffective to cause release and the trunk will be held without completion of the alarm call.

This invention is an arrangement which provides for the automatic release of a trunk seized in an unattended office on a trouble alarm call to the master office in case the call is not answered within a predetermined interval of time after seizure of the trunk.

According to a feature of the invention automatic release means is provided in an unattended dial office for the trunks which are seizable on trouble alarm calls to the master office; the release means, comprising a relay for each of the trunks, being effective to release a trunk seized on an alarm call if the call is not answered within a predetermined interval of time.

According to another feature of the invention automatic trunk release means is provided in an

unattended dial office, said release means being common to the trunks which are seizable on trouble alarm calls to the master office.

A clear and complete description of the invention and its features will be facilitated by considering a telephone system in which the invention is embodied, such a system being shown schematically in the drawings which form a part of this specification. The invention is not limited in its application to the particular system shown in the drawings but is generally applicable to automatic switching and signaling systems.

Referring to the drawings:

Fig. 1 shows an unattended dial office LO comprising subscribers' stations A and B, lines L1 and L2, line circuits LC1 and LC2, line-finder switch LF1, first selector S1, and a connector C1;

Fig. 2 shows alarm apparatus MA in the unattended office LO;

Fig. 3 shows an alternative arrangement of the alarm apparatus MA in the unattended office LO; and

Fig. 4 shows trunk circuits TC1 and TC5 in the unattended office LO; shows a tandem unattended office comprising trunk circuit TC2, incoming selector IS and trunk circuit TC3; and shows a master office comprising a trunk circuit TC4 terminating at a jack J at an operator's position.

The subscribers' stations are of the type provided on lines terminating in common battery central offices and each includes a dial or other impulse sender for controlling the operation of automatic switches through which desired connections are established. The line-finder, selector and connector switches may be of the well-known two-motion step-by-step type. Reference may be had to "Automatic Telephony" by Smith and Campbell, 2nd edition, pages 53 to 65, inclusive, for a description of the structure of such switches and their operation when used as selectors and connectors. The line circuits LC1 and LC2 may be similar to the line circuit disclosed in the patent to T. L. Dimond No. 2,210,068, granted August 6, 1940; and reference may be had to this patent for a description of the operation of a two-motion step-by-step line finder. The line finder LF1 and the connector C1 are each represented by a set of brushes and a single set of terminals, all operating magnets and control relays being omitted. The selector S1 is represented by a set of brushes, by a set of terminals 35 representing a level through which the

selector has access to connectors C1, and by two sets of terminals 37 and 38, representing the tenth level of the bank through which the selector has access to trunks to the tandem office on calls to an operator in the master office; all operating magnets and control relays associated with selector S1 are omitted.

The alarm apparatus MA in Fig. 2 is similar to the alarm apparatus MA disclosed in the aforementioned patent to J. N. Walters except that relays 187, 197, 190, 101 and 103 and resistors 188, 198 and 102 have been added to effect the automatic release of either of the trunks used for alarm calls as hereinafter described in detail. The apparatus MA is represented by alarm relays 171 and 172 which are operated upon the occurrence of trouble conditions; relays 173, 174 and 176, for initiating an alarm call and for preventing a second alarm call after answer and release of a first alarm call when the trouble condition continues to exist; relays 185, 186 and 187 individual to one of two trunks connected for use on alarm calls; relays 195, 196 and 197 individual to the other of these trunks; and relays 190, 101 and 103 for effecting release of a seized one of the two trunks in case the call is not answered within an interval of from two to eight minutes after seizure.

The alarm apparatus MA shown in Fig. 3 is similar to that disclosed in the aforementioned patent to J. N. Walters, except that relays 105 and 106 are added to control the automatic release of either of the two trunks used for alarm calls.

The ringing and tone apparatus RA comprises a start relay and a tone transformer LT1 which supplies the trouble tone which is transmitted on an alarm call to the master office. Timing relays 111, 112 and 113 operate in a two to four-minute cycle to periodically connect ground to and disconnect ground from conductors 114 and 115 as long as ground is connected to start conductor 110.

The trunk circuit TC1 associated in office LO with one of the two trunks which are used for alarm calls, in addition to being used for regular calls, comprises a repeating coil RC1, line relay 90, release control relays 86 and 87, pulse generating relays 74, 88 and 89, an outgoing call control relay 82, and a polarized supervisory relay 84. The trunk circuit TC5 associated with the other of the trunks used for alarm calls is similar to trunk circuit TC1. The trunks T1 and T5 are two-way trunks but the relays used only on incoming calls are not shown in Fig. 4. Reference may be had to the aforementioned patent to J. Baumfalk et al. for a complete detailed disclosure of the trunk circuits TC1 and TC5.

The trunk circuits TC2 and TC3 in the tandem office and trunk circuit TC4 in the master office are similar to the trunk circuits of like designation disclosed in detail in the aforementioned patent to J. Baumfalk et al. and in the patent to R. B. Buchanan et al., No. 2,233,282, granted February 25, 1941.

Consider first the operation of the alarm apparatus MA in Fig. 2 on an alarm call over trunk T1. When either one of alarm relays 171 or 172 is operated, in the manner described in the aforementioned patent to J. N. Walters, a circuit is closed for operating relay 173. Relay 173 connects ground to conductor 159, to operate the start relay 160 of the ringing and tone apparatus RA; and connects ground through back contacts of relays 195 and 185 and the windings of

relay 185 and 195, to battery at the back contacts of relays 186 and 196, relay 186 being normal if trunk circuit TC1 is idle and relay 196 being normal if trunk circuit TC5 is idle. Whichever of relays 185 and 195 operates first, it locks and opens the circuit for operating the other. If relay 185 operates, it connects the secondary winding of transformer 170 in series with the upper winding of relay 187, across conductors 181 and 182 and connects supervisory relay 174 to conductor 184. If relay 195 operates, it connects the right winding of transformer 170 in series with the upper winding of relay 197, across conductors 191 and 192 and connects supervisory relay 174 to conductor 194.

Assuming that an operation of relay 173 causes the operation of relay 185, the connection of the right winding of transformer 170 across conductors 181 and 182 causes the operation of relay 187 of the alarm apparatus and the operation of relays 74 and 90 of trunk circuit TC1. Relay 90 closes a circuit for operating relay 87. Relay 87 closes circuits for operating relays 82 and 86, connects ground potential to conductor 183 to operate relay 186 and hold relay 187, and connects ground potential to conductor 53 to prevent seizure of trunk circuit TC1 by a selector S1. Relay 86 also connects ground potential to conductors 53 and 183 and closes a circuit for operating relay 82. With relays 90 and 82 operated, the upper winding of polarized relay 84 is bridged across the conductors of trunk T1 to operate the line relay (not shown) of the trunk circuit TC2, the current through the upper winding of relay 84 being in the non-operating direction. The aforementioned operation of relay 74 in series with relay 90 connects ground to conductor 53 and, relay 86 having been operated, opens the operating circuit of the normally operated relay 88. Relay 88 is slow in releasing so as to maintain the bridge across the conductors of trunk T1 for a long enough time to prepare the incoming selector IS in the tandem office for response to impulses. When relay 88 releases, it opens the bridge across the conductors of trunk T1, closes a circuit for operating relay 89, and connects ground to conductors 53 and 183. The operation of relay 89 short-circuits the winding of relay 74 to cause its release, recloses the bridge across trunk T1, and prevents the reoperation of relay 88 until the connection is released. The momentary opening of the bridge across trunk T1, due to the release of relay 88 and operation of relay 89, causes the brushes of the selector IS in the tandem office to be stepped up to the first level of its bank and to be advanced in this level to select an idle trunk to the master office, in the manner set forth in detail in the aforementioned patent to J. Baumfalk et al.

If the selector IS fails to find an idle trunk to the master office, the brushes are advanced to an eleventh rotary position in the manner described in the aforementioned 2nd edition of "Automatic Telephony" to transmit a busy tone over trunk T1 to office LO. Since the call is a trouble alarm call, this busy tone is without effect. To enable release of the trunk T1 and selector IS so that a second alarm call can be made, the aforementioned operation of relay 187 connects the winding of relay 101 to timing conductor 115; and, as soon thereafter as timing relays 111, 112 and 113 are normal, the connection of ground to conductor 115 causes the operation of relay 101. Relay 101 locks under control of relays 103, 187 and

100, connects ground to start conductor 110 to cause the operation of timing relay 111, and connects the winding of relay 103 to timing conductor 114. Relay 111 disconnects ground from conductor 115 and closes the circuit for energizing relay 112. Relay 112 is slow in operating and operates from two to four minutes after its energizing circuit is closed. Relay 112 closes the circuit for operating relay 113. The operation of relay 113 causes the release of relay 111; the release of relay 111 causes the release of relay 112; and the release of relay 112 causes the release of relay 113, thereby reconnecting the winding of relay 111 to start conductor 110. Relay 113 is slow in releasing and, while operated, it connects ground to conductor 114 to cause the operation of relay 103. Relay 103 locks under control of relays 187 and 100, releases relay 101, releases relay 185, and opens the bridge across conductors 181 and 182, thereby causing the release of relay 90 of trunk circuit TC1. Relay 101 is rendered somewhat slow in releasing due to the connection of resistor 102 in parallel with its winding so as to insure closure of the locking circuit of relay 103 before the operating circuit of relay 103 is opened. The release of relay 90 opens the bridge across the conductors of trunk T1, to cause the return of the trunk circuit TC2 and selector IS to normal, and causes the successive release of relays 87, 86, 82 and 89 and reoperation of relay 88. With relays 74, 86 and 87 released and relay 88 reoperated, ground is disconnected from conductors 53 and 183, thereby releasing relays 186 and 187. The release of relay 187 causes the release of relay 103, relay 103 being slow in releasing to insure return of the trunk and selector circuits in the tandem office to normal before trunk T1 can again be seized. With relay 173 held operated by one of alarm relays 171 and 172, relay 185 reoperates and the trunk T1 is again seized to initiate another alarm call.

If on the above-described alarm call the selector IS finds an idle trunk to the master office, the trunk circuits TC3 and TC4 are effective in the manner described in the aforementioned patent to J. Baumfalk et al. and J. N. Walters to operate a calling signal L associated with jack J at an operator's position. When the call is answered, the trunk circuit TC4 transmits an answering signal to the trunk circuit TC3, the trunk circuit TC3 thereupon transmits an answering signal to the trunk circuit TC2, and the trunk circuit TC2 reverses the current through the conductors of trunk T1 to effect the operation of the polarized supervisory relay 84 all in the manner described in the aforementioned patent to J. Baumfalk et al. and J. N. Walters. Relay 84 closes a circuit for operating relay 73. Relay 73 closes a circuit for holding relay 87 operated independent of the continued operation of relay 90 and connects ground to conductor 184 to operate relays 174 and 100. Relay 176 does not operate since its winding is short-circuited. Relay 174 locks under control of the operated one of alarm relays 171 and 172 and closes a circuit through the left winding of transformer 170 and the left winding of tone supply transformer LTI to transmit a trouble tone to the answering operator in the master office. When the operator releases the connection, the current through the conductors of trunk T1 is again reversed in the manner described in the aforementioned patent to J. Baumfalk et al. to cause the release of relay 84. The release of relay 84

causes the release of relay 73, thereby disconnecting ground from conductor 184 to open the short circuit around the winding of relay 176. Relay 176 operates and is held operated under the control of the operated one of alarm relays 171 and 172 to prevent the initiation of a second alarm call to the master office. The operation of relay 176 releases relay 185, thereby opening the bridge across conductors 181 and 182 to cause the release of relay 90 of trunk circuit TC1. The release of relay 90 causes the successive release of relays 87, 86 and 82, ground being thereby disconnected from conductor 53 to render the trunk circuit TC1 selectable, and from conductor 183 to cause the release of relays 186 and 187.

If relay 195 is operated, due to the operation of relay 173, the trunk circuit TC5 is seized to initiate an alarm call; and in this case relays 196 and 197 function as do relays 186 and 187 on an alarm call through trunk circuit TC1, as above described.

It is to be noted that whenever trunk circuit TC1 is busy, relay 186 is operated by ground potential connected to conductor 183 to prevent the operation of relay 185; and that whenever trunk circuit TC2 is busy, relay 196 is operated by ground potential connected to conductor 193 to prevent the operation of relay 195.

Referring now to the alarm apparatus MA shown in Fig. 3, relay 105 of the trunk release circuit is operated through conductor 104, in series with the one or the other of relays 185 or 195, upon operation of relay 173. An alarm call is thereby initiated over trunk T1 or trunk T5 as above described. Relay 105 connects the winding of relay 196 to timing conductor 115; and, as soon thereafter as timing relays 111, 112 and 113 are normal, relay 106 operates. Relay 106 locks under the sole control of relay 105, closes a circuit for holding relay 105 and the operated one of relays 185 and 195 under control of timing relay 113, and connects ground to start conductor 110 to cause the timing relays to repeat their cycle of operations. If the alarm call is not answered, or the incoming selector in the tandem office encounters an all-trunks-busy condition, so that the relay 174 is not operated, the operation of relay 113, from two to four minutes after the operation of relay 106, disconnects ground from conductor 116 to cause the release of relay 105 and the release of the operated one of relays 185 and 195. The release of the operated one of relays 185 and 195 causes the release of the associated one of trunk circuits TC1 and TC5 and the release of the associated incoming selector in the tandem office. As soon as the operated one of relays 185 and 196 releases and relay 113 also releases, relay 185 or relay 195 will be operated to originate a new alarm call.

What is claimed is:

1. In a telephone system, an unattended office, trunks for use on calls from the unattended office to a master office, means in said unattended office responsive to a trouble condition therein for seizing an idle one of said trunks to initiate an alarm call to an operator in the master office, means associated with the seized trunk responsive to the answer of the call and the subsequent release of the connection by the answering operator in the master office for releasing the trunk in the unattended office, and means in the unattended office effective if an alarm call is not answered within a predetermined interval of time for automatically causing release of the trunk over which the alarm call is being made.

2. In a switching system, outgoing trunks, means for seizing an idle one of said trunks, means associated with a seized trunk operatively responsive to an answering signal incoming over the trunk, and means effective only if no answering signal is received within a predetermined interval of time after a trunk is seized for automatically causing the release of said trunk.

3. In a telephone system, an unattended local office, a tandem unattended office, a master office, trunks between said unattended offices, a group of trunks between said tandem and master offices, selectors in said tandem office, each selector individual to one of the first-mentioned trunks and all of said selectors having access in common to said group of trunks to the master office, means in the local office for seizing an idle trunk to the tandem office and for automatically causing the operation of the associated selector in the tandem office to select the group of trunks to the master office and an idle trunk therein, means comprising a calling signal in the master office associated with the selected trunk and actuated responsive to seizure by said selector, means effective if all of the trunks in said group are busy for operating said selector to an overflow position, means for answering a call in the master office, means in the local office responsive to the answer of a call to the master office, and means in the local office automatically effective if a call to the master office is not answered within a predetermined interval after seizure of a trunk to the tandem office for releasing the trunk to the tandem office.

4. In a telephone system, an unattended office, trunks for use on calls from the unattended office to a master office, means in said unattended office responsive to a trouble condition therein for seizing an idle one of said trunks to initiate an alarm call to an operator in the master office, means associated with a seized trunk effective if the call is not answered within a predetermined interval after seizure for automatically effecting release of the trunk, and means associated with said trunk in the unattended office responsive to answer of the call in the master office for preventing said automatic release of the trunk.

5. In a telephone system, an unattended office, trunks for use on calls from the unattended office to a master office, means in said unattended office responsive to a trouble condition therein for seizing an idle one of said trunks to initiate an alarm call to an operator in the master office, means in said unattended office comprising a relay individual to a seized one of said trunks and timing means common to said trunks for automatically effecting release of the trunk if the call is not answered within a predetermined interval of time, and means associated with said trunks in the unattended office responsive to answer of an alarm call to the master office for preventing the automatic release of the trunk used on the call.

6. In a telephone system, an unattended office, trunks for use on calls from the unattended office to a master office, means in said unattended office responsive to a trouble condition therein for seizing an idle one of said trunks to initiate an alarm call to an operator in the master office, means in said unattended office and common to said trunks for automatically effecting release of a seized trunk if the call is not answered within a predetermined interval of time, and means

associated with said trunks in the unattended office responsive to answer of an alarm call to the master office for preventing the automatic release of the trunk used on the call.

7. In a telephone system and combination according to claim 4, means associated with said trunks in the unattended office responsive to release of an alarm call by the answering operator in the master office for effecting release of the trunk used on the call and for preventing seizure of a trunk to initiate another alarm call as long as the same trouble condition continues to exist in the unattended office.

8. In a telephone system and combination according to claim 5, means associated with said trunks in the unattended office responsive to release of an alarm call by the answering operator in the master office for effecting release of the trunk used on the call and for preventing seizure of a trunk to initiate another alarm call as long as the same trouble condition continues to exist in the unattended office.

9. In a telephone system and combination according to claim 6, means associated with said trunks in the unattended office responsive to release of an alarm call by the answering operator in the master office for effecting release of the trunk used on the call and for preventing seizure of a trunk to initiate another alarm call as long as the same trouble condition continues to exist in the unattended office.

10. In a telephone system and combination according to claim 4, means responsive to the automatic release of a trunk on an alarm call to the master office for immediately effecting reseizure of said trunk to initiate another alarm call.

11. In a telephone system and combination according to claim 4, means associated with said trunks in the unattended office responsive to release of an alarm call by the answering operator in the master office for effecting release of the trunk used on the call and for preventing seizure of a trunk to initiate another alarm call as long as the same trouble condition continues to exist in the unattended office, and means responsive to the automatic release of a trunk on an alarm call to the master office for immediately effecting reseizure of said trunk to initiate another alarm call.

12. In a telephone system, an unattended local office, a tandem unattended office, a master office, trunks between said unattended offices, a group of trunks between said tandem and master offices, selectors in said tandem office, each selector individual to one of the first-mentioned trunks and all of said selectors having access in common to said group of trunks to the master office, means in the local office for seizing an idle trunk to the tandem office and for automatically causing the operation of the associated selector in the tandem office to select the group of trunks to the master office and an idle trunk therein, means comprising a calling signal in the master office associated with the selected trunk and actuated responsive to seizure of said selector, means for answering a call in the master office, means in the local office responsive to the answer of a call to the master office, and means in the local office automatically effective if a call to the master office is not answered within a predetermined interval after seizure of a trunk to the tandem office for releasing the trunk to the tandem office.

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