May 8, 1945. H. N. NEWSTEDT 2,375,678

TELEPHONE SYSTEM

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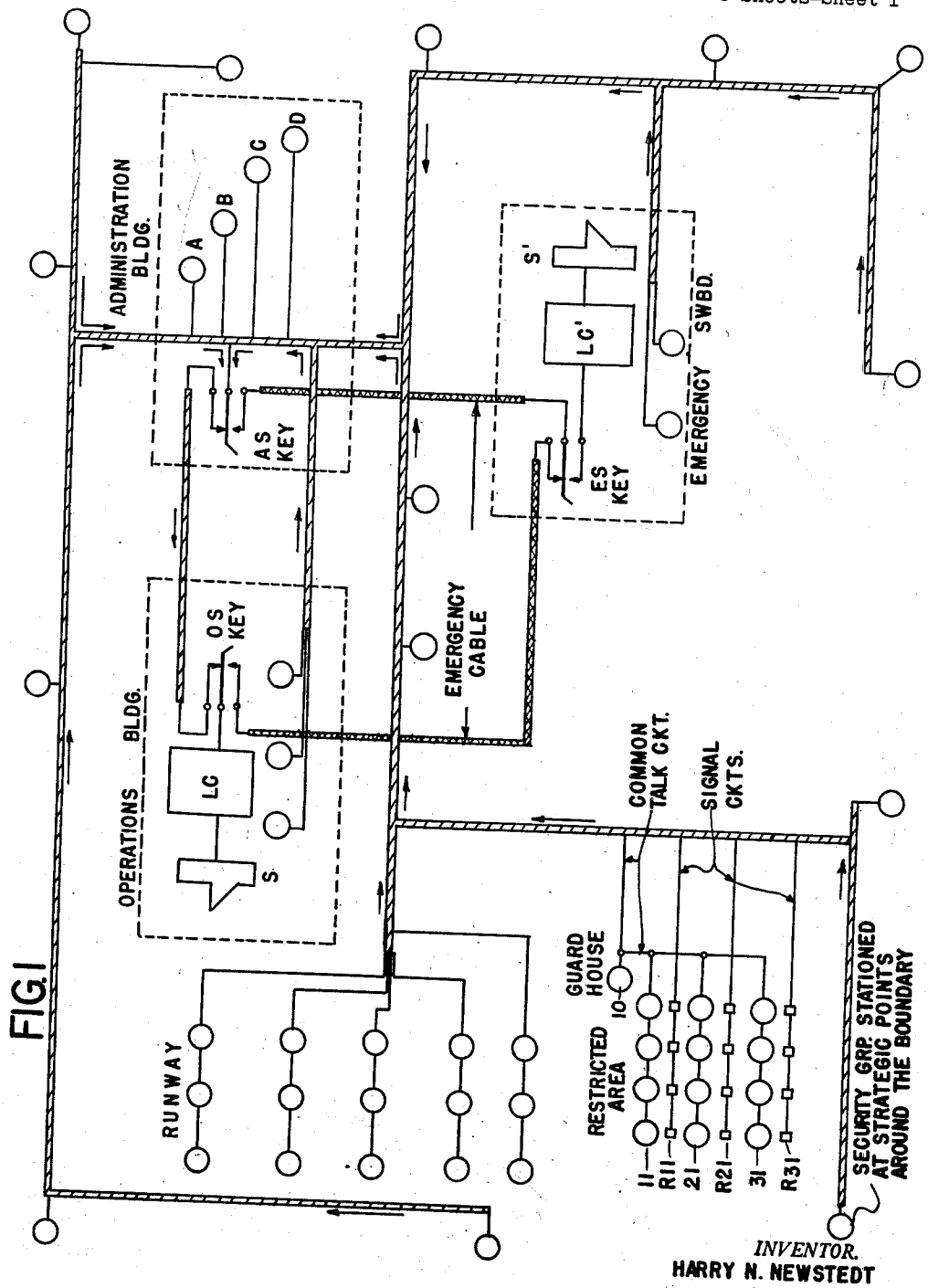


FIG. 1

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May 8, 1945. H. N. NEWSTEDT 2,375,678

TELEPHONE SYSTEM

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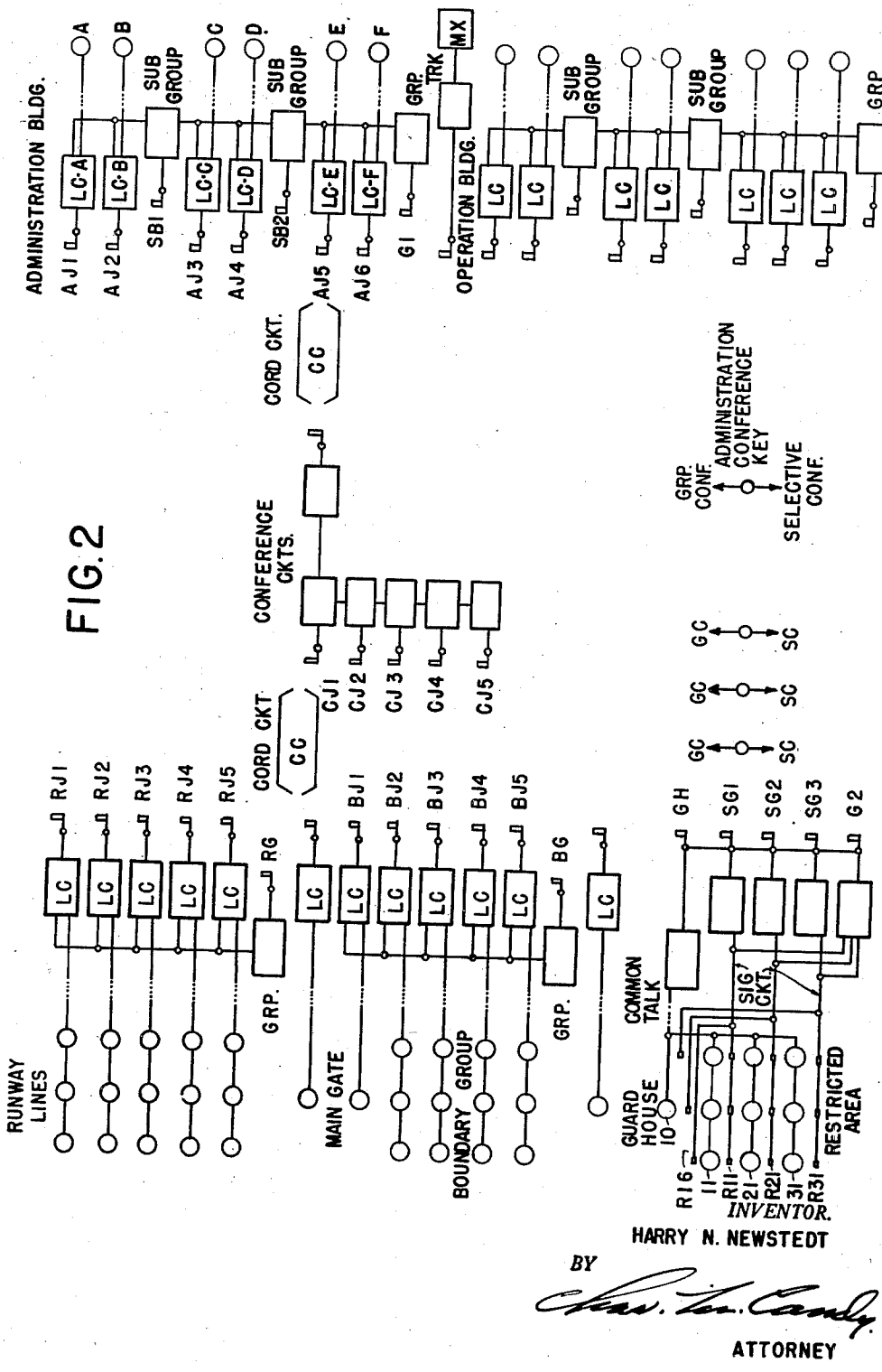


FIG. 2

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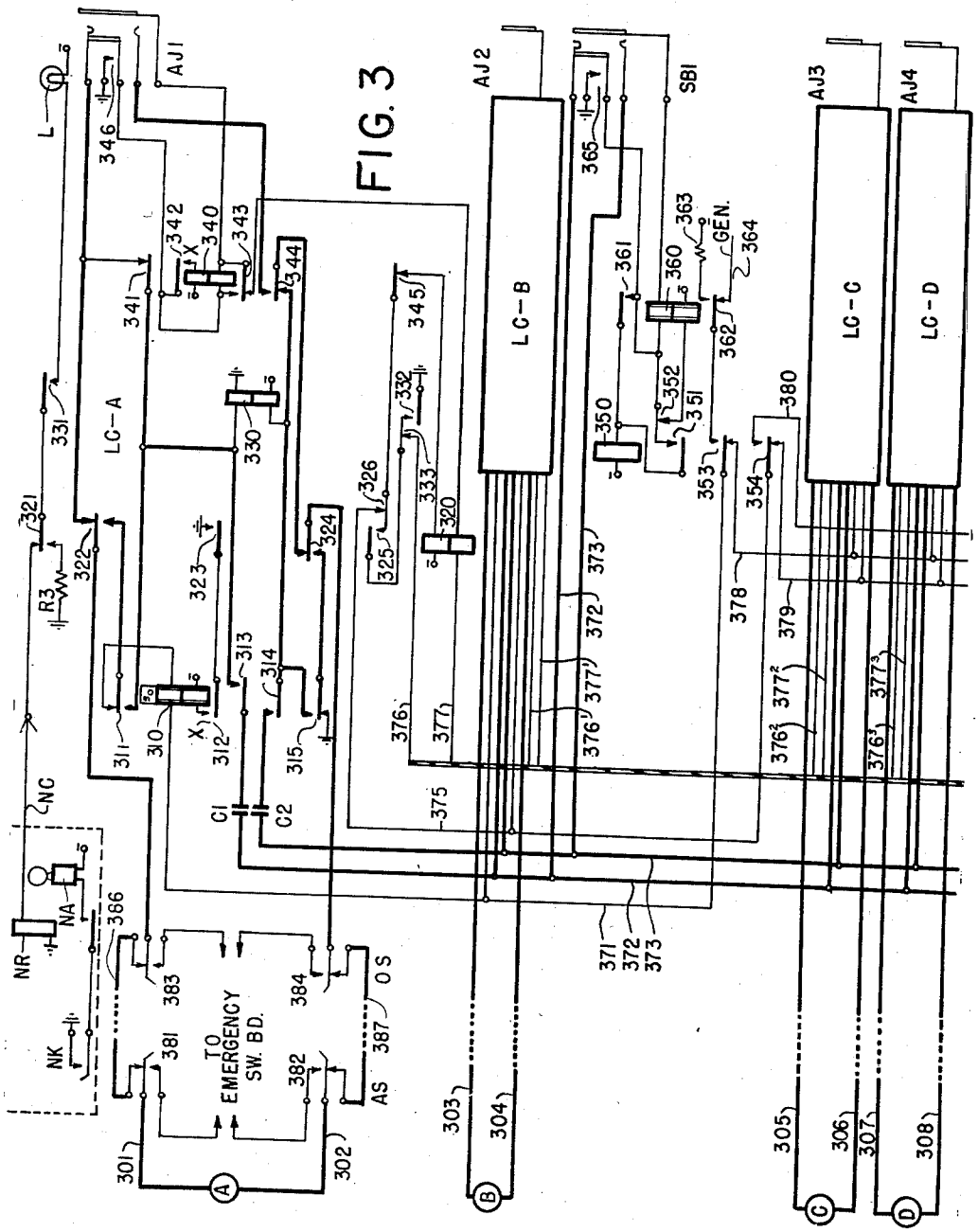
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May 8, 1945. H. N. NEWSTEDT 2,375,678

TELEPHONE SYSTEM

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FIG. 3



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TELEPHONE SYSTEM

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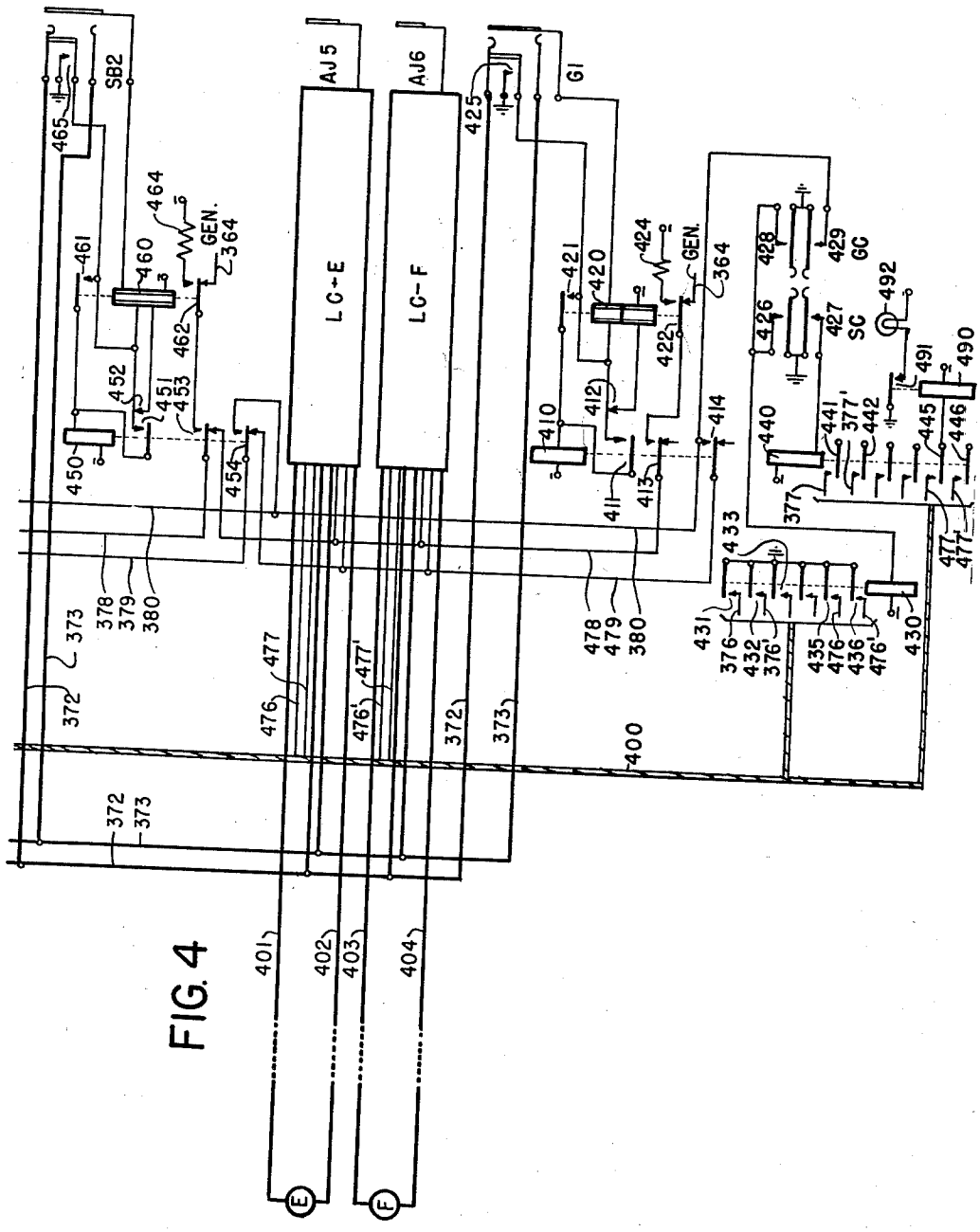


FIG. 4

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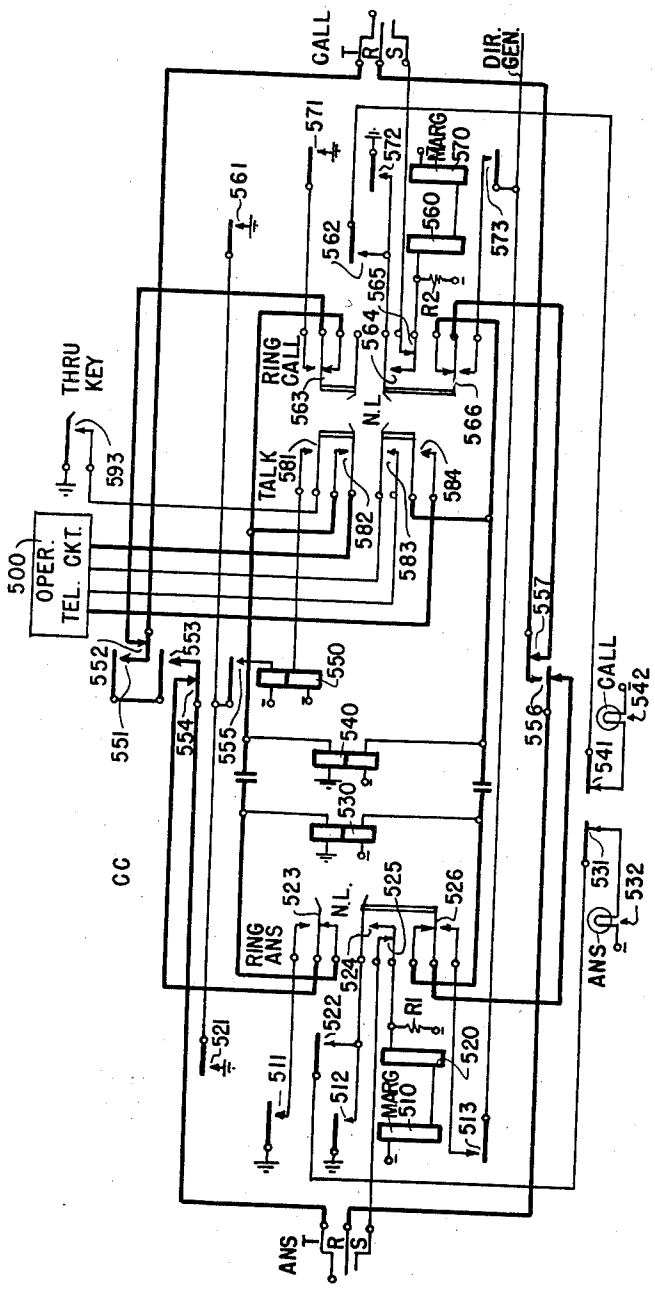
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TELEPHONE SYSTEM

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FIG. 5



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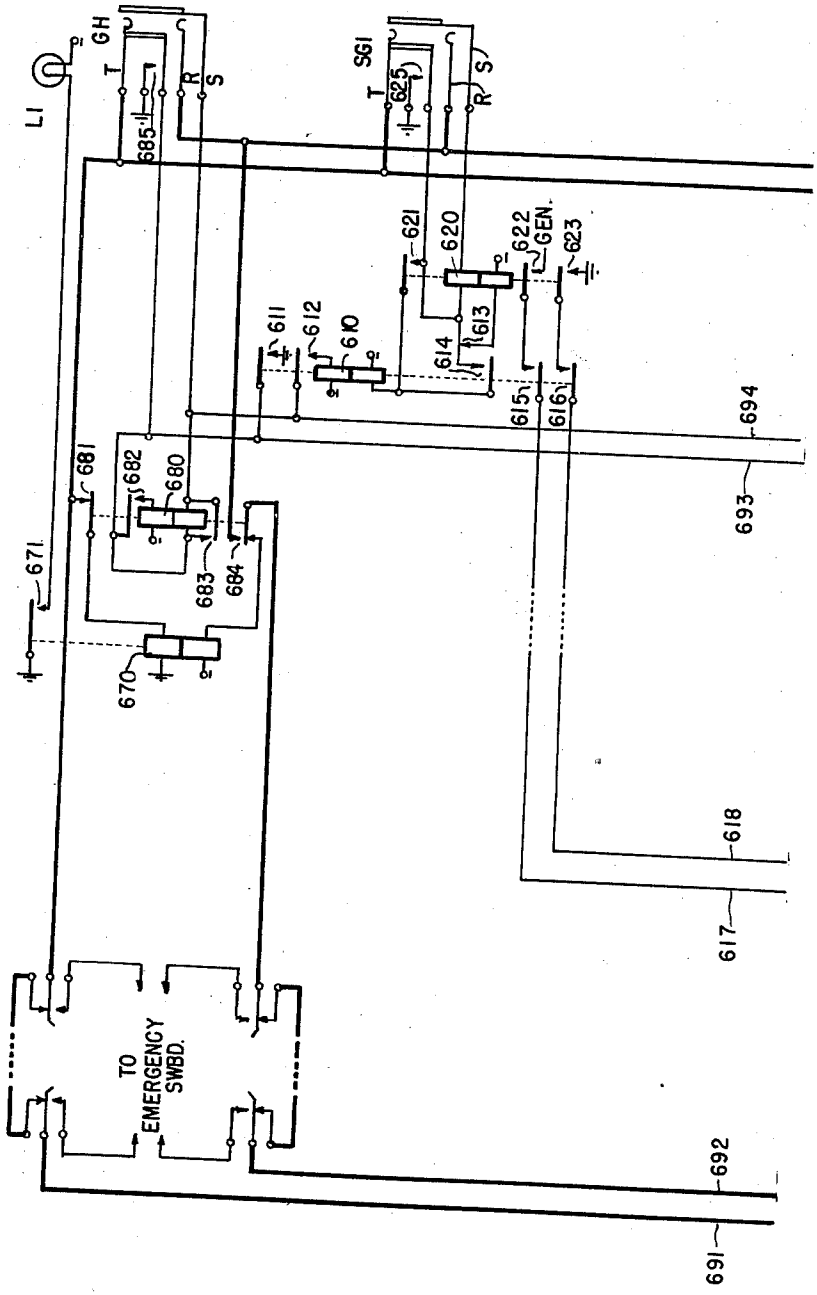
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TELEPHONE SYSTEM

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FIG. 6



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TELEPHONE SYSTEM

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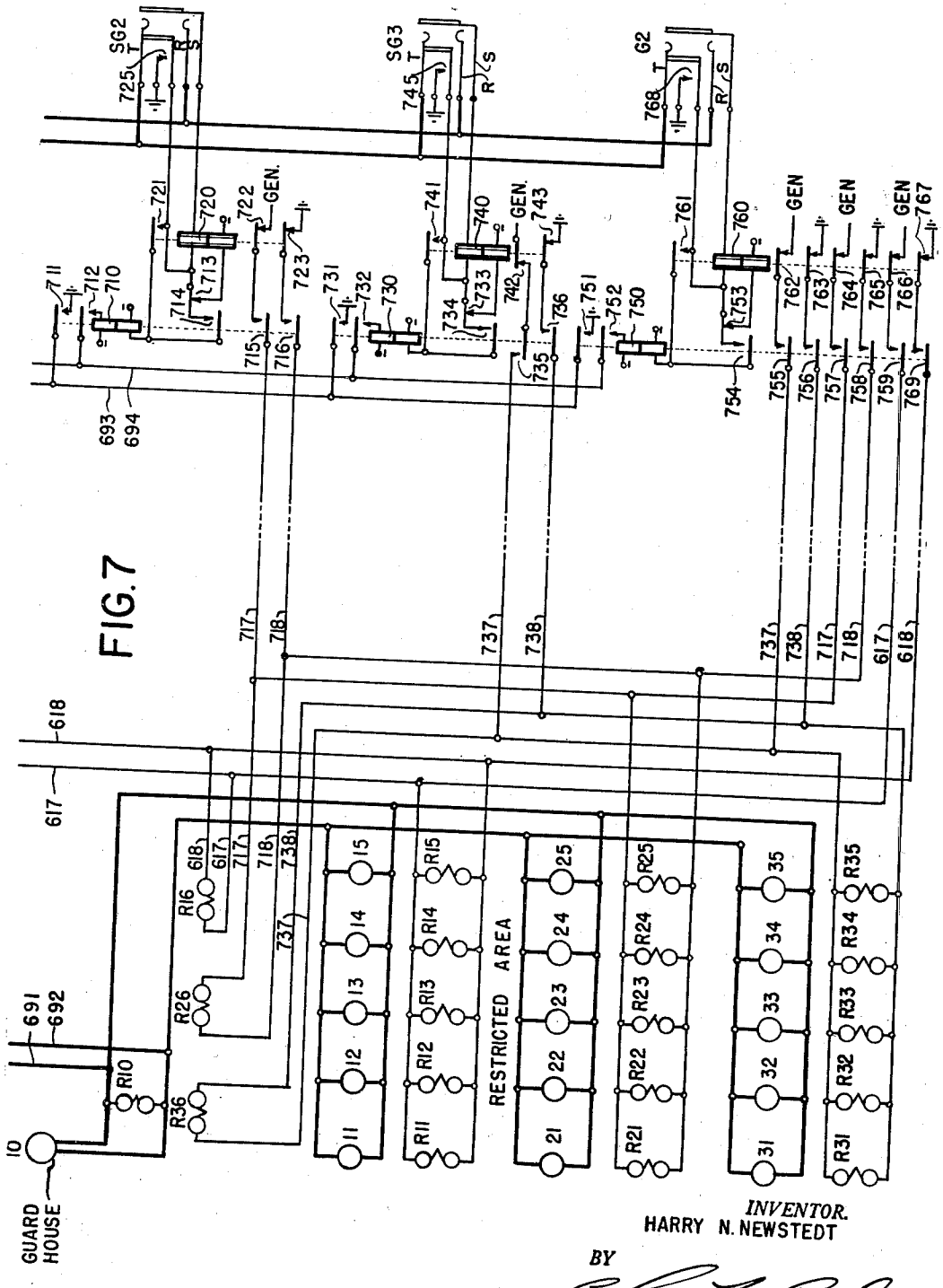


FIG. 7

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TELEPHONE SYSTEM

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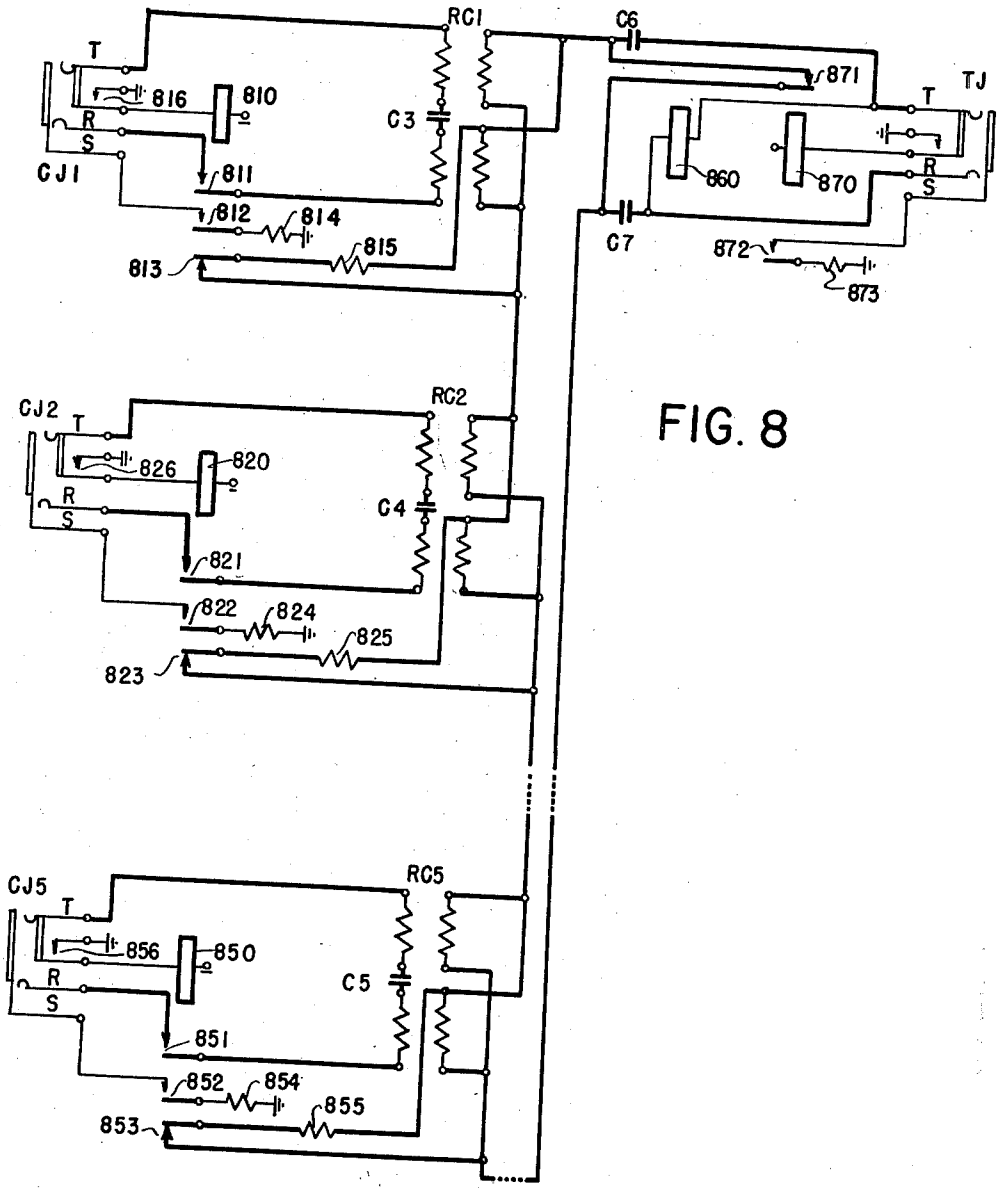


FIG. 8

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Patented May 8, 1945

2,375,678

UNITED STATES PATENT OFFICE

2,375,678

TELEPHONE SYSTEM

Harry N. Newstedt, Chicago, Ill., assignor to Automatic Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application February 7, 1944, Serial No. 521,347

39 Claims. (Cl. 179—42)

This invention relates in general to small private branch exchange telephone systems, but more particularly to private branch exchange telephone systems arranged for conference calls and having special signaling circuits for simultaneously signaling a plurality of lines.

The object of the present invention is to provide a conference call arrangement whereby group conference calls may be set up by inserting the plug of a cord circuit into a group or subgroup jack and then simultaneously signaling all the subscribers' lines associated with this group or subgroup jack.

Another object of the invention is to provide arrangements for including a predetermined number of lines in a main conference group and then provide progressively smaller subgroups of these lines for conference subgroups. That is, the main conference group includes, by way of example only, six subscribers' lines, the next subgroup contains only four of these six subscribers' lines and the last subgroup contains only two of the last four subscribers' lines.

A further object of the invention is to provide a selective conference arrangement whereby the operator by tip touching the sleeves of the jacks of the subscribers' lines desired in the conference may be selectively and simultaneously signaled and connected in a common conference circuit upon answering.

A feature of the invention relates to the provision of a special conference trunk whereby several groups of lines may be inter-connected for conference. Another feature relates to the circuit arrangements whereby any line in conference may retire from the conference at will and resume regular service.

Other objects and features of the invention will become apparent from the following description of the drawings in which Fig. 1 diagrammatically illustrates the telephone lines and inter-connections in a particular area, Fig. 2 diagrammatically illustrates an operators switchboard and the different lines of this area terminating therein, Figs. 3 and 4 illustrate one group of lines and their associated line equipment terminating at the operator's switchboard, Fig. 5 shows the operator's cord circuit, Figs. 6 and 7 show another group of lines and their associated line equipment terminating at the operator's switchboard, and Fig. 8 shows a common conference circuit.

This telephone system is intended for use in a fairly large area which includes an airfield with a number of long runways, an operations building, an administration building, other miscellaneous buildings including a guard house and a restricted area. Telephone sets are provided at strategic points around the boundary of this entire area and these telephone sets may be connected to individual telephone lines or to party lines as desired. A telephone line is provided for each runway of the airfield and telephone sets are provided for each line at predetermined points along each of the runways. A number of individual telephone lines are also provided in each of the different buildings for the different offices therein. A common telephone talking circuit is provided for the restricted area and the telephone sets in this area are divided into a plurality of groups, each such group having a separate signaling circuit. The guard house is provided with a telephone set connected to the common talking circuit of this area and may be individually signaled or signaled over the above mentioned separate group signaling circuits whenever a group in the restricted area is signaled.

All of these telephone lines and circuits extend by cable to the administration building where they terminate in switching keys which are connected by cable to the operations building where they terminate in similar switching keys which normally connect these lines through their line circuits to the manual switchboard in the operations building.

An emergency switchboard, which is a duplicate of the switchboard in the operations building, is provided at some other building somewhat remote from the operations building. Emergency cables connect the emergency switchboard to the switching keys in both the operations building and in the administration building. The telephone lines can be switched to this emergency board by means of the cables provided in case the main switchboard or certain cables are damaged.

Each telephone line terminates in a manual jack at the switchboard while the common talking circuit for the restricted area is multipled to a plurality of jacks, one for calling purposes and one for each separate group on this common talking circuit for signaling purposes. The runway telephone lines, in addition to their regular line jacks, are provided with a common jack for use when group signaling on all runway lines is desired. A similar common group signaling jack is provided for the telephone lines extending to the boundary posts, or substations. Some of the telephone lines in both the operations and administration buildings are divided into subgroups,

the first subgroup comprising certain telephone lines, the second subgroup comprising the same certain lines as in the first subgroup and, in addition, other lines. Successive subgroups include all the lines of the preceding subgroups and certain additional lines. Finally a main group is provided which includes all of the lines in the preceding subgroups and further additional lines. A jack is provided at the switchboard for each of these subgroups and for the main group for group signaling the subgroup or main group of lines desired for conference. A conference trunk terminating in a plurality of jacks at the switchboard is provided to enable the operator to interconnect any of the lines of this system for conference purposes by means of the cord circuits at her position. A conference group key is provided at the operator's position for each group of subscribers' lines to enable the operator to provide a conference between a predetermined subgroup or group of lines. A conference select key is also provided for each group of subscribers' lines to enable the operator to provide a conference between certain selected subscribers' lines in a group.

Referring now to Fig. 1, the circles at the outer edges of this figure designate the boundary posts or the boundary telephone lines of this particular area. The lefthand dotted rectangle designates the operations building in which is provided telephone subscribers' lines designated by circles, an operator's switchboard designated "S," and one of the line circuits designated "LC." The righthand dotted rectangle designated "Administration building" is also provided with a number of telephone lines designated by circles, such as A to D, inclusive. An air field is included in this area and a number of telephone lines extend parallel with these runways and the substations on these lines are shown as circles directly below the designation "Runway." Also included in this area is a restricted area which is provided with a common talking circuit. The subscribers' lines connected to this common talking circuit are divided into three groups, each of which have their individual signaling circuits. The circles, such as 11, 21 and 31, designate one of the substations in each of these three groups and the small rectangles, such as R11, R21 and R31 designate the ringers for these substations. A substation is also provided at the guard house, designated 10, and is also connected to this common talking circuit. The guard house may be individually signaled and is always signaled when any one of the lines in this group are signaled. An emergency switchboard is provided in one of the other buildings in this area and this switchboard is a duplicate of the switchboard in the operations building. All of the line conductors from the various telephone lines throughout this area extend to the administration building where they terminate in the switching key AS. Through back contacts on switching key AS all of these lines are further extended to the operations building where they terminate in the switching key OS and from thence terminate in their respective line circuits LC and jacks at the operator's switchboard. At make contacts of the switching keys AS and OS these lines can be extended by cable to the emergency switching key ES. In case the regular switchboard in the operations building is destroyed it would then be possible to continue the service from the emergency switchboard, in which case the switching keys AS and ES are operated to connect all of the lines of this area with the emergency switchboard. In case the cable extending from the back contacts of switching key AS to back contacts of switching key OS should be destroyed or damaged the telephone lines in this area could be connected to the switchboard in the operations building by way of front contacts of switching key AS, back contacts of switching key ES, and front contacts of switching key OS.

In Fig. 2 the subscribers' lines A to F, inclusive, in the administration building are shown terminating in line circuits LCA to LCF, inclusive, and jacks AJ1 to AJ6, inclusive, at the operator's switchboard in the operations building. A main group jack G1 and two subgroup jacks SB1 and SB2 are shown for enabling the operator to set-up conference calls for these respective lines in the administration building. The detailed circuits for this group of lines in the administration building is shown in Figs. 3 and 4.

In the center of Fig. 2 is shown the conference circuits which are shown in detail in Fig. 8. These conference circuits are used by the operator to interconnect two groups of lines for conference purposes and are interconnected by way of the operator's cord circuits CC. Fig. 2 also shows the conference keys which are thrown upwards when all of the subscribers in a group or subgroup are desired in a conference and which keys are thrown downwards when the operator selects only particular ones of the subscribers of a group for conference purposes. A similar set of line circuits and jacks are shown for terminating the telephone lines in the operations building. The telephone lines indicated as runway lines in the upper lefthand corner terminate in the operator's switchboard in line circuits LC and jacks RJ1 to RJ5, inclusive. These runway lines have a conference group circuit terminating in the jack RG for enabling the runway telephone lines to be included in a conference call arrangement. The telephone lines around the outer extremity of this area terminate in line circuits and jacks BJ1 to BJ5, inclusive, and are also provided with a common conference group jack BG. The telephones associated with the restricted area are shown in the lower lefthand corner of Fig. 2 and comprises the guard house telephone 10 and three groups of subscribers' lines, such as 11, 21 and 31 all of which are connected to a common talking circuit. Each of the three groups of telephones in this common talking area is provided with separate and individual signaling circuit. The jacks GH, SG1 to SG3, inclusive, and jack G2 are associated with this common talking circuit. The jack GH is for use in signaling only the guard house 10 and for use when any line in this group initiates a call. The jack SG1 is for signaling only the first subgroup of lines, the jack SG2 is for signaling only the second subgroup and the jack SG3 is for signaling only the third subgroup. The group G2 is used by the operator when all of the lines associated with this common talking circuit are to be signaled. The guard house is also signaled whenever another subgroup is signaled. The circuits for this restricted area is shown in detail in Figs. 6 and 7.

In Fig. 3 the administration subscriber's line A is connected by way of line conductors 301 and 302 to the administration switching key AS, conductors 386 and 387, the operations building switching key OS, to the line circuit LC—A, which is individual to this line. The line circuit LC—A comprises a ring cut-off relay 310, a conference relay 320, a line relay 330, a cut-off relay 340,

and a jack AJ1. Subscriber's line B extends by way of line conductors 303 and 304 to the dotted portion, which indicates the switching keys similar to the keys shown for subscriber A, and terminating in a line circuit LC—B and jack AJ2. Line circuit LC—B also has a ring cut-off relay, a conference relay, a line relay and a cut-off relay corresponding to the relays in the line circuit LC—A. The subscribers' lines C and D shown in Fig. 3 and the subscribers' lines E and F shown in Fig. 4 are similarly connected to their individual line circuits which are identical with the line circuit LC—A. The subgroup jack SB1 and associated relays 350 and 360 are used by the operator when it is desired to include substations A and B in a subgroup conference. The subgroup jack SB2 and its associated relays 450 and 460 are used by the operator when it is desired to include substations A, B, C and D in a subgroup conference. The main group jack G1 and its associated relays 410 and 420 are used by the operator when it is desired to include all of the subscribers' lines A to F, inclusive, in a group conference. The group conference key GC is operated by the operator to control relay 430 and to ground conductor 380 when the operator is establishing a group conference. The select conference key SC is closed to control relays 430, 440 and 490 when the operator desires to select only certain of the subscribers in this group for conference.

Fig. 5 shows an operator's cord circuit CC and diagrammatically illustrates the operator's telephone circuit 500. The cord circuit comprises a ring answer key, a ring call key, and a talk key. A through key is associated with the operators common equipment for operating the switch through relay 550 in the cord circuit when it is desired to switch the talking conductor of the cord circuit straight through to establish a clean metallic circuit. A pair of relays 510 and 520 are associated with the answer plug of the cord circuit and are utilized for controlling the application of generator to an individual subscriber's line and for controlling the answer lamp 532. The relay 510 is marginal and will not operate in series with the high resistance upper winding of relays, such as relays 360, 460 and 420. A similar pair of relays 560 and 570 are associated with the call plug of the cord circuit and perform similar functions. The relays 530 and 540 are connected in bridge of the cord circuit for feeding talking battery to the calling and called subscribers and for controlling the answer and call lamps 532 to 542, respectively.

In Figs. 6 and 7 are shown the detailed circuit arrangements for the common talking circuit and group signaling circuits for the lines in the restricted area. The common talking circuit indicated by the heavy lines terminate in the operator's switchboard in jacks GH, SG1 to SG3, inclusive, and G2. The jack GH is used by the operator when it is desired to signal only the substation 10 at the guard house or to answer a call initiated by any one of the lines connected to this common talking circuit. The jack SG1 and its associated relays 610 and 620 are for use when it is desired to signal the first group of substations comprising the substations 11 to 15, inclusive. The subgroup jack SG2 and its associated relays 710 and 720 are used by the operator when it is desired to select and signal only the second group subscribers, such as subscribers 21 to 25, inclusive. The subgroup jack SG3 and its associated relays 730 and 740 is used by the operator when it is desired to selectively signal and converse with the third group subscribers comprising the substations 31 to 35, inclusive. The group jack G2 and its associated relays 750 and 760 is used by the operator when it is desired to signal all of the subscribers in the entire group. The signaling conductors 617 and 618 for the first subgroup of lines extend to the individual ringers R11 to R15 of the first group subscribers and also to the ringer R16 in the guard house. The signaling conductors 717 and 718 for the second subgroup and the signaling conductors 737 and 738 for the third subgroup are similarly connected to the ringers of the second and third groups, respectively, and to ringers in the guard house. The line circuit for this common talking circuit comprises the line relay 670 and the cut-off relay 680.

Fig. 8 shows the detailed circuits of the conference circuit provided at the operator's switchboard. This conference circuit comprises the conference jacks CJ1 to CJ5, inclusive, and the trunk jack TJ and associated relays 810 to 870, inclusive. The repeating coils RC1 to RC5, inclusive, inductively connect the conference jacks with the common conference circuit to enable the operator to interconnect a plurality of groups of subscribers in a conference circuit.

In order to describe the operation it will be assumed that subscriber A in the administration building desires to converse with subscriber B also in the administration building. In response to subscriber A removing his receiver the following circuit is completed for line relay 330 in the individual line circuit LC—A for subscriber A: from ground through the upper winding of relay 330, contact 341, back contacts 322, back contact springs of switching key OS in the operations building, conductor 386 included in the cable extending to the administration building where conductor 386 terminates in back contacts 381 of switching key AS, line conductor 301 extending to the substation circuit A, through the switch hook contact at substation A and over line conductor 302 to back contacts 382 of switching key AS, conductor 387, back contacts 384 of the operations switching key OS, back contacts 324 and 344 and through the lower winding of line relay 330 to battery. Line relay 330 energizes and at contacts 331 completes the circuit for brightly illuminating the call lamp L. This circuit may be traced from ground through the lower resistance winding of common night relay NR, back contacts 321, contacts 331 and through filament of the lamp L to battery. Due to the low resistance of the common night relay NR the lamp L is brightly illuminated to distinguish from a dimly lighted lamp which indicates that a subscriber has answered a conference call. At contacts 332 relay 330 prepares a point in the locking circuit for the conference relay 320. The night relay NR is energized over the above traced circuit and at its contacts prepares the circuit for the night alarm NA which is only operative in case the night key NK is operated. The night relay NR is common to all of the line circuits LC—B, LC—C, LC—D, LC—E and LC—F.

Upon observing the brightly lighted lamp L the operator inserts the answer plug of her cord circuit CC into jack AJ1, thereby completing the circuit for energizing relays 340 and 520 in series as follows: from ground by way of contacts 346, closed in response to the insertion of the plug into jack AJ1, lower winding of cut-off relay 340, sleeve of jack AJ1, sleeve conductor of cord cir-

cuit CC, contacts 525, winding of relay 520 and through the winding of marginal relay 510 to battery. Marginal relay 510 does not energize in series with the high resistance winding of cut-off relay 340. Relay 520, upon energizing, at contacts 521 prepares a point in the locking circuit for the switch through relay 550, and at contacts 522 prepares a point in the circuit for the answer lamp 532. Cut-off relay 340, upon energizing over the above traced circuit, first closes its contacts 342 to complete a locking circuit through its upper winding to grounded contact 346. At contacts 341 relay 340 opens the circuit extending to the upper winding of line relay 330, at back contacts 344 opens the circuit extending to the lower winding of line relay 330 and at front contacts 344 completes a point in the talking circuit including the heavy talking conductors. At contacts 345 relay 340 opens a point in the circuit for the upper winding of conference relay 320 and at back contacts 343 opens a point in the circuit for the lower winding of conference relay 320 while at front contacts 343 the lower winding of cut-off relay 340 is short circuited thereby permitting the marginal relay 510 in the cord circuit to operate. Relay 510, upon energizing, at contacts 511 and 513, prepares points for connecting ringing current out over the tip and ring conductors of the answer plug of the cord circuit and at contacts 512 prepares a circuit for operating the answer lamp 532. The answer lamp 532, however, is not lighted at this time because the battery feed relay 530 in the cord circuit is operated over the following circuit: from ground through the upper winding of relay 530, back contacts 523 of the ring answer key, contacts 554, tip of cord circuit CC, tip of the jack AJ1, back contacts 322, back contacts 383, conductor 386, back contacts 381, line conductor 301 through the substation circuit at substation A, line conductor 302, back contacts 382, conductor 387, back contacts 384 and 324, front contacts 344, ring contact spring of jack AJ1, ring of the cord circuit CC, back contacts 556, back contacts 526 and through the lower winding of battery feed relay 530 to battery. At contacts 531 relay 530 opens the circuit to the answer lamp 532 to prevent its illumination at this time. The operator now operates her talking key to bridge her headset across the talking conductors of the cord circuit at contacts 582 and 584. Contacts 583 completes a circuit (not shown) for connecting battery to the operator's headset for talking purposes. The purpose of this arrangement is to provide the operator with a quiet headset when not in use. When the operator is informed by subscriber A that a connection is desired to subscriber B the operator will restore the talk key and insert the call plug of her cord circuit into the jack AJ2 individual to line B. In response to the insertion of the call plug in the jack AJ2 a circuit is completed for energizing the cut-off relay in line circuit LC–B, corresponding cut-off relay 340 in line circuit LC–A, and relays 560 and 570 in the cord circuit. Relay 570 is marginal and will not energize in series with the lower winding of the cut-off relay in line circuit LC—B. The circuit for energizing the cut-off relay in the line circuit LC—B and relay 560 in the cord circuit may be traced as follows: from ground through springs, corresponding to springs 346, closed by the insertion of the call plug into the jack AJ2, through the lower winding of the cut-off relay in line circuit LC—B, over the sleeve of jack AJ2, the sleeve of the call plug of the cord circuit CC, contacts 565, winding of relay 560 and through the winding of marginal relay 570 to battery. The cut-off relay in the line circuit LC—B operates to perform the same functions as described for the cut-off relay 340 of line circuit LC—A. When the cut-off relay in line circuit LC—B energizes it short circuits its lower winding to permit the energization of marginal relay 570. Relay 560, upon energizing, at contacts 561 prepares a locking circuit for the switch through relay 550 and at contacts 562 prepares a point in the circuit to the call lamp 542. Marginal relay 570 at contacts 571 and 573 prepares a circuit for connecting ringing current to the called subscriber's line. At contacts 572 relay 570 completes a circuit for lighting the call lamp 542 as follows: from ground by way of contacts 572, 562 and 541 and through the filament of the call lamp 542 to battery. In the line circuit LC—B the cut-off relay has disconnected the associated line relay and has connected the conductors preparatory to ringing the called subscriber.

The operator now operates the ring call key to signal the called subscriber. In response to the operation of the ring call key, a circuit is completed at contacts 564 and grounded contacts 572 for maintaining relays 560 and 570 in operated position. At make contacts 566 and 563 of the ring call key the operator connects ringing current to the called subscriber's line over the following circuit: from direct generator through contacts 573, make contacts 566, contacts 557, ring conductor of the call plug, ring spring of the jack AJ2, front contacts of the operated cut-off relay, back contacts of the conference relay over the lower talking conductor extending through the switching keys indicated by the dotted lines, line conductor 304, through the ringer at substation B over line conductor 303 through the switching keys indicated by the dotted lines over the heavy upper talking conductor to a back contact on the conference relay, tip spring of the jack AJ2, tip conductor of the call plug, contacts 552, make contacts 563 and contacts 571 to ground. The operation of the ring call key opens contacts 565 thereby opening the original energizing circuit of the cut-off relay in line circuit LC—B, but this relay is maintained energized through its upper winding by way of the ground closed at the jack springs in response to the insertion of the call plug into jack AJ2. After ringing the called subscriber B, the operator restores the ring call key and when subscriber B removes his receiver battery feed relay 540 is energized over the following circuit: from ground through upper winding of relay 540, back contacts 563, contacts 552, tip conductor of the call plug, tip conductor of the jack AJ2, back contacts on the conference relay and thence over the heavy talking conductors previously traced for the ringing circuit back to back contacts on the conference relay, front contacts on the cut-off relay, ring conductor of jack AJ2, ring conductor of the call plug, contacts 557, back contacts 566 and through the lower winding of battery feed relay 540 to battery. At contacts 541 battery feed relay 540 opens the circuit of the call lamp 542 thereby extinguishing the same to inform the operator that subscriber B' has answered the call. The calling and called subscribers now converse over the heavy talking conductors.

After conversation and in response to the replacement of the receiver at substation A battery feed relay 530 deenergizes and completes a cir-

cuit at contacts 531 for lighting the answer lamp 532. This circuit may be traced from ground at contacts 512 and 522, contacts 531 and through the filament of the answer lamp 532 to battery. When the called subscriber B replaces his receiver battery feed relay 540 deenergizes and at contacts 541 lights the call lamp 542 over the circuit previously traced. The operator upon observing the lighted condition of these lamps removes the answer and call plugs from the jacks AJ1 and AJ2, respectively, thereby causing the deenergization of relays 510, 520, 560 and 570 and the deenergization of the cut-off relays in both line circuits LC—A and LC—B. All the apparatus, including the relays, are now restored to normal position and may be used on subsequent calls. Connections between individual subscribers' lines in any of the groups terminating at this switchboard may be completed in the same manner as described for the connection between subscribers A and B.

It will now be assumed that subscriber F desires to hold a conference with subscribers A and B simultaneously. Subscriber F removes his receiver to initiate a call and the operator answers this call by means of her cord circuit CC in the same manner as described previously for subscriber A. The cut-off relay in line circuit LC—F, corresponding to cut-off relay 340, and relays 510 and 520 in the cord circuit CC are operated in the same manner as previously described. When the operator is advised by subscriber F that both subscribers A and B are desired in a conference the operator will thereupon insert the call plug of her cord circuit into the subgroup jack SB1 and will operate the group conference key GC. In response to the operation of the group conference key GC conductor 380 is grounded by contacts 429 and relay 430 is operated from grounded contacts 428. Relay 430, upon energizing, at contacts 431 to 436, inclusive, grounds the conductors, such as conductors 376, 376', 476 and 476' extending to each of the subscriber's line circuits to provide a locking circuit for the associated conference relays. In response to inserting the call plug into jack SB1, relay 560, in the cord circuit and relay 360 are energized. The energizing circuit for relay 560 may be traced from grounded contacts 365, which were closed in response to the insertion of the plug into jack SB1, upper high resistance winding of relay 360, sleeve of jack SB1, sleeve of plug, contacts 565, winding of relay 560 and through the winding of marginal relay 570 to battery. Due to the high resistance winding of relay 360, marginal relay 570 does not energize over this circuit. Another circuit for the lower winding of relay 360 may be traced from grounded contacts 365, normally closed contacts 352 and through the lower winding of relay 360 to battery. Relay 360, upon energizing, at contacts 361 completes an obvious energizing circuit for relay 350 from grounded contacts 365. Relay 350, upon energizing, at contacts 351 completes a locking circuit for itself from grounded contacts 365 and at contacts 352 opens the circuit extending through the lower winding of relay 360. At front contacts 353 relay 350 connects battery potential to the windings of the ring cut-off relays, such as relay 310, and at front contacts 354 connects grounded conductor 380 to conductor 375 for energizing the conference relays, such as relay 320 in each of the line circuits LC—A and LC—B. The circuit for conference relay 320 may be traced as follows: from grounded contacts 429, conductor 380, front contacts 354, conductor 375, contacts 326 and 345 and through the upper winding of conference relay 320 to battery. The conference relay in the line circuit LC—B is energized over grounded conductor 375 over a similar circuit. At contacts 321 relay 320 prepares a circuit for dimly lighting the lamp L, at front contacts 322 and 324 prepares a point in the ringing and talking circuits, at contacts 323 prepares a locking circuit for the ring cut-off relay, and at contacts 325 completes a locking circuit for relay 320. This locking circuit may be traced from grounded conductor 376 by way of contacts 333, front contacts 325, contacts 345 and through the upper winding of conference relay 320 to battery. The operation of the conference relay in the line circuit LC—B performs similar operations.

The operator now actuates her ring call key to simultaneously signal both subscribers A and B. The operation of ring springs 563 and 566 are ineffective at this time because the marginal relay was not operated and therefor ringing current is not transmitted from the cord circuit. However, in response to the opening of contacts 565, both relays 560 in the cord circuit and relay 360 associated with the subgroup jack SB—1 deenergize. In response to the deenergization of relay 360 generator is connected to conductor 371 through the upper windings of cut-off relay 310 and the corresponding relay in the line circuit LC—B through back contacts of these relays, over front contacts, such as contacts 322, over the conductors including the ringers at substations A and B, back over front contacts, such as contacts 324, and through back contacts, such as 315, to ground.

The restoration of the ring call key at contacts 565 again completes the circuit for reenergizing relays 560 and 360. At back contacts 362 relay 360 disconnects generator from the called lines and at front contacts 362 connects battery potential through resistance 363 to provide a circuit for energizing the ring cut-off relays, such as relay 310 in line circuits LC—A and LC—B when the subscribers A and B remove their receivers. When subscriber A removes his receiver ring cut-off relay 310 is energized over the previously traced ringing circuit, this time, however, including the battery potential through resistance 363 instead of ringing generator included in the ringing circuit. When subscriber B removes his receiver the corresponding ring cut-off relay in the line circuit LC—B is likewise operated. Ring cut-off relay 310 energizes and closes its contacts 312 to complete a circuit for fully energizing and locking this relay through its lower winding. At back contacts 311 relay 310 opens the circuit through the upper winding of ring cut-off relay and at front contacts thereof prepares a point in the talking circuit. At contacts 313 and 314 relay 310 connects the conference conductor 372 and 373 to the line conductors of subscriber A. At back contacts 315 relay 310 opens a further point in the circuit of ring cut-off relay and at front contacts thereof completes the talking circuit from the conference conductors 372 and 373 to the conductors of subscriber A. At front contacts 311 and 315 relay 310 completes the circuit for energizing line relay 330 as follows: from ground through the upper winding of line relay 330, front contacts 311 and 322 over the heavy talking conductors through the substation A, front contacts 324 and 315 and through the lower winding of line relay 330 to battery. The corresponding line relay in line circuit LC—B is also energized over a similar circuit. Line relay 330, upon energizing, at contacts

331 completes a circuit for dimly lighting the lamp L and at contacts 332 completes a new locking circuit for the upper winding of conference relay 320. The circuit for dimly lighting lamp L may be traced from ground through resistance R3, front contacts 321, contacts 331 and through the filament of lamp L to battery. The lamp L is dimly lighted at this time to inform the operator that subscriber A has answered a conference call. The locking circuit for relay 320 may be traced from grounded contacts 332, contacts 325 and 345 and through the upper winding of relay 320 to battery. Conference relay 320 is now locked in energized position under control of the line relay 330 and is therefor independent of the previously traced locking circuit including the grounded conductor 376. Similar operations take place in the line circuit LC—B to connect the talking conductors of subscriber B to the conference talking conductors 372 and 373. Subscribers A and B are fed talking battery through the windings of their line relays, while the calling subscriber F is fed talking battery through the windings of battery feed relay 530 in the cord circuit CC. The talking circuit in this conference connection includes the talking conductors of subscribers A and B and extend by way of the heavy talking conductor through front contacts on the operated conference relays and operated ring cut-off relays to condensers C1 and C2 and thence by way of conductors 372 and 373 to the tip and ring springs of jack SB1 over the tip and ring conductors of the call plug of cord circuit CC, contacts 552 and 557, contacts 563 and 566 of the ring call key through condensers in the cord circuit, back contacts 523 and 526 of the ring answer key, contacts 554 and 556 over the tip and ring conductors of the answer plug of the cord circuit CC over the tip and ring conductors of the jack AJ5, back contacts of the conference relay, corresponding to relay 320 and over the line conductors 403 and 404 to line F.

After both subscribers have answered thereby dimly lighting their associated lamps, such as L, the operator may restore the group conference key GC to disconnect ground from conductor 380 and to release relay 430. Relay 430, upon deenergizing, disconnects ground from conductors, such as conductor 376. After the conference is through and when subscriber F replaces his receiver the battery feed relay 530 in the cord circuit CC deenergizes to light the answer lamp 532 to inform the operator that subscriber F has hung up. When subscriber A replaces his receiver, line relay 330 deenergizes and at contacts 331 opens the circuit to lamp L which is extinguished. At contacts 332 relay 330 opens the locking circuit extending through the upper winding of conference relay to cause the deenergization of this relay. The conference relay deenergizes in this instance because the operator has restored the group conference key GC to remove ground from conductor 376. In case, however, the group conference key GC has been maintained energized the relay 430 grounds conductor 376 with the result that the locking circuit for the upper winding of conference relay 320 is transferred back to grounded conductor 376 when line relay 330 deenergizes. If subscriber A attempts to originate a new call, such subscriber will be connected back to the conference trunk conductors 372 and 373 because the ring cut-off relay is locked in energized position as long as the conference relay is maintained operated. Since, however, the operator has restored the group conference key GC the subscriber A may at any time retire from the conference connection by replacing his receiver thereby causing the deenergization of his line relay 330 and his conference relay 320. In response to the deenergization of conference relay 320 the locking circuit of ring cut-off relay 310 is open whereupon this relay deenergizes and restores the line circuit LC—A to its normal condition. Assuming that subscriber A has replaced his receiver while subscribers B and F are still in conference, the above described operations take place and subscriber A can initiate a new call. It is, therefore, possible for any subscriber to retire from a conference connection after the group conference key GC is restored and initiates a regular call over their individual jacks, such as jack AJ1.

When subscriber B replaces his receiver, the relays in line circuit LC—B restore to normal in the same manner as described for line circuit LC—A. The lamp individual to line circuit LC—B is extinguished and the operator is therefore informed that the conference is now terminated. The operator therefore removes the cord circuit CC from jack AJ6 and jack SB1 thereby restoring relays 350 and 360 and relays 510, 520 and 560. All of the apparatus is now restored to normal condition.

In case subscriber F desires to hold a conference with subscribers A, B, C, and D, the operator, after answering the call of subscriber F, and being informed that subscribers A to D, inclusive, are desired in the conference, the operator will operate the group conference key GC and insert the call plug of the cord circuit into subgroup jack SB2 and then rings these subscribers by operating the ring call key in her cord circuit. The operation of the group conference key GC again grounds conductor 380 and operates relay 430. Relay 430 grounds conductors, such as conductor 376 and 376' to prepare a locking circuit for the conference relays in the line circuits of the called subscribers. In response to inserting the call plug into jack SB2 relays 460 and 560 operate in the same manner as described for relays 360 and 560. Relay 450 is operated in response to the operation of relay 460 from ground at contacts 465 and 461. At contacts 451 relay 450 locks itself to grounded conductor 465. At front contacts 453 relay 450 prepares the ringing circuit for the called subscribers and at front contacts 454 connects grounded conductor 380 to conductor 379 for energizing all of the conference relays, such as relay 320, in all line circuits LC—A to LC—D, inclusive. The circuit for energizing the conference relay 320 in line circuit LC—A may be traced as follows: from grounded contacts 429, conductor 380, front contacts 454, conductor 379, back contacts 354, conductor 375 and through contacts 326 and 345 through the upper winding of conference relay 320 to battery. Similar circuits are completed for operating the conference relays in line circuits LC—B, LC—C and LC—D. The conference relays, such as relay 320, operate in the same manner as previously described and complete a locking circuit from grounded conductor, such as conductor 376, by way of contacts 325 and 345 and the upper winding of relay 320 to battery. Marginal relay 570 in the cord circuit does not energize in series with the high resistance upper winding of relay 460. In response to the operation of the ring call key, the circuit to relays 560 and 460 is opened at contacts 565 with the result that these relays deenergize and relay 460 at back contacts

462 connects generator to conductors 378 and 371 for simultaneously signaling subscribers A to D, inclusive. The ringing current extends from generator over conductor 364, back contacts 462, front contacts 453, conductor 378, by way of the multipled branches extending through the upper windings of the ring cut-off relays in line circuits LC—C and LC—D and thence through the ringers at subscribers C and D back to ground in these line circuits. Ringing current is further extended by way of back contacts 353, conductor 371 through the upper windings of the ring cut-off relays in line circuits LC—A and LC—B and out over the previously traced circuit including the ringers at subscribers stations A and B. When these subscribers answer their associated ring cut-off relays, such as relay 310, energize in the manner previously described to complete the circuits for energizing their associated line relays, such as relay 330. The energization of the line relays in the respective line circuits cause the lamps, such as L, to be dimly lighted to inform the operator that such subscribers have answered. After all of these subscribers have answered the operator restores the group conference key GC and the conference relays, such as relay 320, are locked energized under control of their associated line relays. All of the subscribers are connected in the conference talking circuit, including conductors 372 and 373 and all subscribers A to D, inclusive, receive their talking battery from their associated line relays in a manner apparent from the foregoing description. After the operator restores the group conference key GC any one of the subscribers A to D, inclusive, may retire from the conference and initiate a new call if desired. After the conference is terminated the subscribers replace their receivers to cause the deenergization of their associated line relays to cause the lamps L to be extinguished. In response to the deenergization of the line relays, the conference relays and the ring cut-off relays in each of the line circuits deenergize to restore these line circuits to their normal condition. The operator now withdraws the plugs of her cord circuit and the apparatus is now restored to its normal condition.

In case some other line in another similar group, for instance a line in the operations building, desires to have a conference with all subscribers A to F, inclusive, in the administration building, the operator after answering the call would then operate the group conference key GC, insert the call plug into the group jack GI and then ring these subscribers as previously described. The relay 430 is again actuated and grounds the conductors, such as conductor 376 in all the line circuits and conductor 380 is grounded in response to the operation of the group conference key GC. Relays 410 and 420 operate in the same manner and perform the same functions as described for relays 350 and 360. Relay 410, upon energizing, grounds conductors 479, 379 and 375 by way of grounded conductor 380 and contacts 414, 454 and 354 for energizing all of the conference relays, such as conference relay 320, in all of the line circuits LC—A to LC—F, inclusive. All of the conference relays energize and lock to conductors, such as conductor 376, grounded by the actuation of relay 430. In response to the operation of the ring call key relay 420 deenergizes to connect generator to conductors 478, 378 and 371, thereby transmitting ringing current through the upper windings of the ring cut-off relays, corresponding to relay 310, over the line conductors of lines A to F, inclusive. When these subscribers answer, the ring cut-off relays operate over circuits similar to that previously traced now including front contacts 413 and 422, the resistance 424 to negative battery. When the ring cut-off relays in the respective line circuits operate, their corresponding line relays will actuate to dimly light their associated lamp, such as L, and to close a new locking circuit for the upper windings of the conference relays, corresponding to relay 320, in all of the line circuits in a manner similar to that previously described. After all of the subscribers have answered the operator restores the group conference key and the conference relays are then locked under control of their associated line relays. Any one of the subscribers can withdraw from the conference by replacing his receiver and may thereafter remove his receiver to initiate a new call. For example, when A replaces his receiver line relay 330 restores and at contacts 332 opens the locking circuit of the conference relay 320. Relay 320 restores and at contacts 323 opens the locking circuit of the ring cut-off relay 310 which likewise restores. Line circuit LC—A is now restored to its normal condition and in case subscriber A removes his receiver the line relay 330 is operated to brightly light lamp L thereby informing the operator that subscriber A has retired from the conference and has initiated a new call. The operator is informed of the initiation of the new call by the brightly lighted lamp L since this lamp is only dimly lighted during the time subscriber A is included in the conference connection.

It will now be assumed that a particular subscriber desires to hold a conference with only certain of the subscribers shown in Figs. 3 and 4. It will be further assumed that only subscribers A, C and F are desired in this particular conference. The calling subscriber desiring such a conference will initiate the call in the usual manner and will be answered by the operator and will inform the operator that a conference is desired with subscribers A, C and F. Since subscribers A, C, and F are in the administration building group, the operator will insert the call plug of her cord circuit into the group jack GI associated with the group of lines containing these subscribers lines. The operator now operates the conference select key SC and in so doing operates relays 430 and 440 over obvious circuits. Relay 430, upon energizing, grounds all of the conductors corresponding to conductor 376 and relay 440, upon energizing, connects negative battery potential through the winding of relay 490 to all conductors corresponding to conductor 377 extending to the lower windings of the conference relays in each of the line circuits in this group. In response to the insertion of the call plug into the jack GI the relays 410 and 420 are operated as previously described. In this case, since conductor 380 is not grounded, the conference relays in the line circuits are not energized at this time. In order to condition the line circuit LC—A for connection with the conference circuit the operator will touch the tip of the call plug of the cord circuit with the sleeve of the jack AJI to complete an energizing circuit through the lower winding of conference relay 320. This circuit may be traced as follows: from ground through the upper winding of battery feed relay 540, back contacts 563 of the ring call key, contacts 552, tip conductor of the call plug, sleeve of the jack AJI, back contacts 343, lower

winding of conference relay 320, conductor 377, contacts 441, and through the winding of relay 490 to battery. Since the subscriber C is desired in this conference the operator will tip touch the sleeve of jack AJ3 to complete a similar circuit through the lower winding of the conference relay in the line circuit LC—3 to energize the corresponding conference relay. In a similar manner the operator tip touches the sleeve of the jack AJ6 to operate the conference relay in line circuit LC—F. Conference relay 320 energizes over the above traced circuit to prepare the circuit for the lamp L, to prepare the ringing and talking circuits, to prepare the locking circuit for the ring cut-off relay 310 and to complete a locking circuit for itself. This locking circuit may be traced from grounded conductor 376, contacts 333, 325, 345 and through the upper winding of conference relay 320 to battery. The operation of the conference relays in line circuits LC—C and LC—F perform the same functions. Since the operator has tip touched only the sleeves of the jacks of subscribers A, C and F only the subscribers' lines A, C and F are therefor prepared to be included in the conference circuit. After tip touching the sleeves of the jacks of subscribers A, C and F the operator inserts the call plug of the cord circuit CC into the group jack G1 to operate relays 410 and 420 as previously described. The relay 490 is energized in series with the conference relay and at contacts 491 lights the lamp 492 during the interval that the operator is tip touching the sleeves of the desired subscribers desired in a conference. Relay 490 therefor energizes each time the operator tip touches a jack of an idle subscriber's line in this group. The lighting of the lamp 492 informs the operator that the circuit has been completed for operating the desired conference relay. The relay 490 and the lamp 492 operate only during the time of tip touching the sleeves of the subscribers' jacks to inform the operator that the corresponding subscribers' lines are prepared for conference. In case the cut-off relays, corresponding to cut-off relay 340, were energized at the time the operator tip touched the jack AJ1, the back contacts 343 would be open with the result that no circuit is completed at this time for the lower winding of conference relay 320 or winding of relay 490 and therefor the lamp 492 would not be lighted. Since the lamp 492 does not light at this time the operator is aware of the fact that the line circuit LC—A cannot be prepared for connection with the conference circuit. The energization of the conference relays in line circuits LC—A, LC—C and LC—F prepare circuits for dimly lighting the lamps, corresponding to lamp L, prepares a locking circuit for ring cut-off relays, corresponding to relays 310, and prepares the ringing and talking circuits in a manner similar to that previously described.

After insertion of the call plug into jack G1 the operator operates the ring call key to open the circuit of relay 560 at contacts 565. Relay 420 deenergizes and at back contacts 422 connects the ringing current through the windings of the ring cut-off relays in only the line circuits LC—A, LC—C and LC—F. The ringing circuit from subscriber A extending from generator conductor 364, back contacts 422, contacts 413, conductor 478, back contacts 453, back contacts 353, conductor 371 through the upper winding of ring cut-off relay 310 and over the previously traced ringing circuit back to ground at back contacts 315. A similar ringing circuit is completed for line C from generator connected to conductor 378 over a branch circuit which extends to the upper winding of the ring cut-off relay in the line circuit LC—C. A similar ringing circuit is provided for subscriber F and extends from a branch conductor connected to conductor 478 through the upper winding of the ring cut-off relay in the line circuit LC—F. After ringing and in response to the restoration of the ring call key in the cord circuit the relays 560 and 420 re-energize and the latter relay at front contacts 422 connects battery potential through resistance 424 to provide a circuit for energizing the ring cut-off relays when the calling parties remove their receivers. When subscriber A answers the call the ring cut-off relay 310 is operated from ground over the subscribers loop and through the upper winding of ring cut-off relay 310 to battery through resistance 424 as previously traced. Ring cut-off relay 310 first operates its contacts 312 to complete a locking circuit through its lower winding and then operates its remaining contacts to connect subscriber A to the conference conductors 372 and 373 and to operate line relay 330 in a manner similar to that previously described. At contacts 331 relay 330 dimly lights the lamp L and at contacts 332 completes the locking circuit including contacts 325 and 345 for the upper winding of conference relay 320. In a similar manner the ring cut-off relays and the line relays in line circuits LC—C and LC—F operate when subscribers C and F remove their receivers in answering this this call. Subscribers A, C, and F are now each connected to the conference conductors 372 and 373 and may now converse with each other and with the calling party. The talking battery for the called subscribers extend through their individual line relays, corresponding to line relay 330. After all of the desired called subscribers are included in the conference circuit, the operator may restore the select conference key SC to cause the deenergization of relays 430 and 440. The operated conference relays are now maintained in energized position under control of their respective line relays as previously described. Any one of the subscribers A, C or F may retire from the conference and initiate a new call by simply replacing his receiver and removing the same. When the receiver at subscriber A is replaced line relay 330 deenergizes and at contacts 331 lamp L is extinguished. On the termination of the conference the calling and called subscribers replace their receivers to restore the line circuits to their normal condition as previously described thereby extinguishing the lamps, such as lamp L. The operator thereupon removes the plugs of her cord circuit from the jacks of the calling and from jack G1 to restore the relays in the cord circuit and to restore relays 410 and 420. All the apparatus is now restored to normal and may be used on subsequent calls.

Referring now to the common talking circuit shown in Figs. 6 and 7 it will be assumed that subscriber 10 at the guard house desires to call another subscriber, for example, subscriber A in the administration building. Responsive to the removal of the receiver at substation 10, line relay 670 is energized over the following circuit: from ground through the upper winding of line relay 670, back contacts 681, through the line switching keys in the operations and administration buildings, conductor 691, through substation 10, conductor 692 through the administration and operations building switching keys, back contacts 684, and through the lower winding of line relay 670 to

battery. At contacts 671 line relay 670 lights the lamp L1 to indicate to the operator that some one of the subscribers on this common talking circuit has initiated a call. Upon observing the lighted condition of the lamp L1 the operator inserts the answer plug of her cord circuit CC into jack GH. In response to the insertion to the answer plug into jack GH relays 680 and 520 are operated over the following circuit: from ground at spring 685, lower winding of relay 680, sleeve of jack GH, sleeve of the answer plug, contacts 525, through the windings of relay 520 and relay 510 in series to battery. Relay 510 is a marginal relay and will not energize in series with the lower winding of relay 680. Relay 680, upon operating, first completes a locking circuit through its upper winding over contacts 682 from grounded contacts 685 and then short circuits its lower winding at contacts 683 to permit the operation of marginal relay 510 in the cord circuit. Relay 680 at back contacts 681 and 684 disconnects the line relay 670 and at front contacts 684 completes the talking circuit and the circuit for operating the battery feed relay 530 over the heavy talking conductors including the tip and ring conductors of the jack GH and the cord circuit CC. The battery feed relay at contacts 531 extinguishes the answer lamp 532 in case it has been illuminated. Line relay 670, upon deenergizing at contacts 671 extinguishes the lamp L1.

When the operator is advised that a connection to subscriber A is desired, the operator inserts the call plug of the cord circuit CC into jack AJ1 and rings subscriber A as previously described by the operation of the ring call key and the application of generator to contacts 573 and 566 of the cord circuit. The connection to subscriber A is completed as previously described. Talking battery is fed through the windings of the battery feed relays 530 and 540 for the calling and called subscribers respectively. After termination of conversation and responsive to the subscribers replacing their receivers, battery feed relays 530 and 540 deenergize and light their associated call and answer lamps 532 and 542 to inform the operator that the connection is no longer desired. The operator now removes the cord circuit from the jacks GH and AJ1 to restore the relays in line circuit LC—A to normal and to restore relay 680 in the line circuit of the common talking circuit. The line relay 670 in the line circuit of the common talking circuit is again normally connected to line conductor 691 and 692 in response to the restoration of cut-off relay 680.

Any other subscriber on this common talking circuit can initiate a call in the same manner as described for subscriber 10 since all of the subscribers are connected to the common talking conductors 691 and 692.

It will now be assumed that subscriber 10 at the guard house is called by subscriber A. When the operator is informed by subscriber A that subscriber 10 at the guard house is desired she will insert the call plug of her cord circuit into jack GH. Relay 680 and relay 560 are now energized over the following circuit from ground by way of contacts 685, lower winding of cut-off relay 680, sleeve of jack GH and the call plug, contacts 565, winding of relay 560 and through the winding of marginal relay 570 to battery. Relay 570 will not energize in series with the lower winding of relay 680. Relay 680 energizes and first locks itself to contacts 682 and 685 and then short circuits its lower winding at contacts 683. At back contacts 681 and 684 relay 680 disconnects the line relay 670 and at front contacts 684 completes a point in the talking circuit. Marginal relay 570 energizes when cut-off relay short circuits its lower winding and a circuit is now completed for lighting the call lamp 542 by way of contacts 572, 562 and 541. The operator now operates the ring call key to connect generator from the cord circuit to the called line. The relays 560 and 570 in the cord circuit are maintained in operated position by way of contacts 570 and 564 when the ring call key is operated. Ringing current is connected to the call line through the ring call key as follows: from generator, contacts 573, front contacts 566, contacts 557 over the ring conductor of the cord circuit CC and jack GH, front contacts 684, through the switching keys to conductor 692 through the ringer R10 at the guard house, over conductor 691 through the switching keys over the tip conductor of the jack GH and the call plug of the cord circuit, contacts 552, front contacts 563, to ground at contacts 571. After ringing the operator restores the ring call key and when subscriber 10 responds the battery feed relay 540 is energized by way of back contacts 563 and 566 and the called subscriber's loop. At contacts 541 relay 540 extinguishes the call lamp 542 to notify the operator that subscriber 10 has answered the call. After conversation and responsive to the calling and called subscribers replacing their receivers, battery feed relays 530 and 540 restore to light their associated answer and call lamps 532 and 542, respectively. The operator now withdraws the plugs of her cord circuit from the jacks and returns the apparatus to normal position.

As previously described, the remaining lines in the restricted area are divided into three groups of lines each having separate signaling conductors. It will now be assumed that the subscribers 11 to 15, inclusive, in the first subgroup are desired in a connection. After answering a call and being informed that one or all of the subscribers in the first group, comprising lines 11 to 15, inclusive, are desired in a connection, the operator inserts the call plug of her cord circuit CC into jack SG1 and then actuates the ring call key. In response to the insertion of the call plug into jack SG1 relays 620 and 560 are operated over the following circuit: from ground by way of contacts 625 through the upper high resistance winding of relay 620, sleeve of jack SG1, sleeve of the call plug, contacts 565, winding of relay 560 and through the winding of marginal relay 570 to battery. Marginal relay 570 will not operate in series with the high resistance winding of relay 620. A branch circuit also extends by way of contacts 613 through the lower winding of relay 620 to assist this relay in operating. At contacts 621 relay 620 completes a circuit from grounded contacts 625 through the lower winding of relay 610 to operate the latter relay. At contacts 622 and 623 relay 620 disconnects ground and generator. Relay 610 at contacts 614 completes a locking circuit for itself from grounded contacts 625 and at contacts 615 and 616 prepares a point in the signaling circuit which is now open at contacts 622 and 623. At contacts 611 and 612 relay 610 completes a circuit for energizing cut-off relay 680 through the upper winding of relay 610 as follows: from ground by way of contacts 611, lower winding of relay 680, contacts 612 and through the upper winding of relay 610 to battery. Cut-off relay 680 operates and first

closes a locking circuit for itself by way of contacts 682 and 611 and then short circuits its lower winding at contacts 683. At contacts 681 and 684 cut-off relay 680 disconnects the line relay 670 and completes a point in the talking circuit.

In response to the operation of the ring call key, relays 560 and 620 deenergize when contacts 565 in the ring call key are opened. The deenergization of relay 560 in the cord circuit is without effect at this time because the marginal relay 570 is not operated. Relay 620 deenergizes and at contacts 622 and 623 connects generator and ground to signaling conductors 617 and 618, respectively, to operate all the ringers R11 to R16, inclusive. The ringer R16 located at the guard house is operated whenever ringing current is transmitted over the signaling conductors 617 and 618 for the first subgroup of subcribers in this restricted area. When any one of the subscribers answer and close a bridge across the conductors 691 and 692, the battery feed relay in the cord circuit is operated. The talking circuit for the called subscribers may be traced as follows: from ground and battery through the windings of battery feed relay 540, back contacts 563 and 566 of the ring call key, contacts 552 and 557, tip and ring conductors of the call plug and jack SG1, over the heavy conductors through contacts 684 and the switching keys, over the common talking conductors 691 and 692 to the called substations. After conversation and when the calling subscriber replaces his receiver the operator receives disconnect supervision in response to the deenergization of relay 530 by the lighting of the answer lamp 532. The operator now removes the cord circuit from the jacks of the calling line and jack SG1 to restore the relays in the cord circuit CC and relay 610, 620 and 680.

In case one or more of the subscribers in the second subgroup are desired in a connection the operator would plug into jack SG2 and operate the ring call key as before. In this case relays 720, 710 and 680 are operated in a manner similar to that described when calling the first subgroup. In response to the operation of the ring call key relay 720 deenergizes to connect generator and ground to the signaling conductors 717 and 718, respectively, to operate the ringers R21 to R26, inclusive. In order to signal the third subgroup of subscribers, the operator plugs into jack SG3 to operate relays 730, 740 and 680 over similar circuits. In response to the operation of the ring call key relay 740 deenergizes and connects ringing current to the signaling conductors 737 and 738 to operate the subscribers' ringers R31 to R36, inclusive. The guard house is provided with four ringers, an individual ringer R10, a ringer R16 which is operated whenever the first subgroup is signaled, a ringer R26 for the second subgroup and a ringer R36 with the third subgroup. In case it is desired to signal all of the subscribers in the restricted area, the operator would plug into jack G2 and operate the ring call key. Relays 750, 760 and 680 are operated in a manner obvious from the foregoing description and in response to the actuation of the ring call key relay 760 deenergizes and connects generator and ground to each of the three signaling circuits to thereby simultaneously ring all the ringers R11 to R36, inclusive.

Any subscriber on the common talking circuit can originate a call and request a connection to any other subscriber connected to this common talking circuit. For example, it will be first assumed that subscriber 11 desires a connection with the subscriber 10 at the guard house. In response to the removal of the receiver at substation 11, the line relay 670 is operated to light lamp L1 to signal the operator who then inserts the answer plug of her cord circuit into jack GH. In response to the insertion of the answer plug into jack GH cut-off relay 680 and relay 520 operates and after relay 680 short circuits its lower winding marginal relay 510 operates. Relay 530 is operated over the calling loop to open the circuits to the answer lamp 532. When the operator is informed that subscriber 10 is desired she will advise the calling subscriber 11 to momentarily replace his receiver while she is ringing subscriber 10. When subscriber 11 replaces his receiver relay 530 deenergizes to light lamp 532. The operator now operates her ring answer key to operate ringer R10. At contacts 524 relays 510 and 520 are maintained in operated condition when the sleeve circuit is opened at contacts 525 and relay 680 is maintained operated over its upper winding to ground at contacts 685. At front contacts 523 and 526 ringing current is transmitted by way of contacts 513 and the heavy talking conductors to operate ringer R10. After ringing the operator restores her ring key and when subscribers 10 and 11 remove their receivers battery feed relay 530 is operated to extinguish the lamp 532. The talking current for subscribers 10 and 11 is furnished through the windings of battery feed relay 530. After conversation and when both subscribers replace their receivers, relay 530 deenergizes and lights the answer lamp 532. The operator now removes the plug from jack GH and all apparatus is restored to normal.

In case subscriber 11 desires to converse with subscriber 21, subscriber 11 will initiate the call and operate the line relay 670 to light lamp L1 in order to signal the operator. The operator answers the call in the usual manner by inserting the answer plug of her cord circuit CC into jack GH. Relays 680, 520, 530 and 510 energize and line relay 670 deenergizes as previously described. When the operator is informed that subscriber 21 is desired in a connection she will insert the call plug of the cord circuit in use, or a plug of another cord circuit, into jack SG2 and operate the associated ring call key of such cord circuit. In response to the insertion of the call plug into jack SG2 relays 710, 720 and 560 operate as previously described. Marginal relay 570 does not operate because of the high resistance upper winding of relay 720. The operator now operates her ring call key to open the circuit of relay 720 which accordingly deenergizes and connects ringing current to the signaling conductors 717 and 718 to operate ringers R1 to R26, inclusive. It will be seen that all of the subscribers' ringers in the second subgroup as well as the ringer R26 associated with the guard house are operated. These subscribers may remove their receiver and may replace them when informed by the calling subscriber the message is intended for subscriber 21. After ringing over the signaling conductors the operator will withdraw the call plug from jack SG2 leaving only the answer plug of her cord circuit in jack GH. Talking battery is fed through the windings of the battery feed relay 530 over the heavy talking conductors of the cord circuit and the heavy talking conductors of the common talking circuit. After conversation and in response to the subscribers replacing their receivers battery feed relay 530 deenergizes to light the lamp 532 thereby advising the operator that this

conversation has been terminated. The operator then withdraws the plug from jack GH to restore the apparatus to normal.

In case subscriber 11 desires to talk to a subscriber in his own subgroup, for example, subscriber 12, the call will be initiated and answered in the same manner as previously described and in order to signal subscriber 12 the operator will insert the call plug of her cord circuit into jack SG1 and operate her ring call key. The relays 610, 620 and 560 operate in a manner obvious from the foregoing description and when the operator operates her ring call key relay 620 deenergizes to connect ringing current to the signaling conductors 617 and 618 to simultaneously operate ringers R11 to R16, inclusive. After ringing the operator withdraws the plug from jack SG1 leaving only her answer plug in jack GH. After conversation and in response to the subscribers replacing their receivers the established connection is released in the same manner as previously described.

The subscriber 10 at the guard house may also originate a call and have the operator selectively signal only a certain one of the subgroups or may have the operator simultaneously signal all of the subscribers in all three subgroups by insertion of the call plug into group jack G2. In case subscriber 10 desires to simultaneously signal all of the subscribers in all three subgroups, the operator, after answering the call, will insert the call plug into jack G2 and operate her ring call key to deenergize relay 760 in a manner obvious from the foregoing description. In response to the deenergization of relay 760 ringing current is simultaneously connected to all three of the signaling circuits comprising conductors 617, 618, 717, 718, 737 and 738 to simultaneously operate all of the ringers R11 to R36, inclusive. After ringing the operator will withdraw the call plug from jack G2 and talking battery for the subscribers' lines is furnished through the battery feed relay 530. The release of the established connection is the same as previously described.

The conference circuit shown in Fig. 8 is provided for use when it is desired to connect a plurality of lines in a plurality of different groups in a conference connection. For example, some executive, having an individual line, may desire a conference with only certain of the lines in the administration building, or all these lines, and at the same time have included in this conference all or only certain of the lines in the operations building, all or only a portion of the lines in the boundary group, as well as all or only a portion of the lines in the runway group.

It will first be assumed that the calling line desires a conference connection including all of the lines in the administration building and all of the lines in the boundary group. The call is answered by the operator in the usual manner by plugging into the jack of the calling line and upon being advised that the conference should include all the lines in the group of the administration building and the boundary group, the operator will insert the call plug of the cord circuit in use into conference jack CJ1. In response to the insertion of the call plug into jack CJ1 relay 810 is operated by the closure of the jack springs 816. At contacts 811 relay 810 completes the talking circuit to the lefthand windings of the repeating coil RC1 and at contacts 813 removes the resistance shunt around the righthand windings of repeating coil RC1. At contacts 812 relay 810 completes the circuit for operating relay 560 of the cord circuit as follows: from ground through resistance 814, contacts 812, sleeve of jack CJ1, sleeve of call plug of cord circuit CC, contacts 565, winding of relay 560 and through the winding of marginal relay 570 to battery. Relay 570 is marginal and will not energize in series with resistance 814.

The operator now takes another cord circuit, similar to cord circuit CC, and inserts the answer plug into group jack G1 and operates the group conference key GC associated with the group of lines in the administration building. In response to the insertion of the answer plug into jack G1 relays 410, 420 and 520 operate in a manner apparent from the foregoing description. Conductor 380 is grounded and relay 430 operates to ground conductors, such as conductor 376, in response to the operation of the group conference key GC. At contacts 414 relay 410 grounds conductor 479 thereby grounding conductors corresponding to conductor 375, to cause the energization of the conference relays, corresponding to relay 320, in all of the line circuits of the administration group. These operated conference relays prepare the circuits for the individual ring cut-off relays, such as relay 310. The operator then inserts the call plug of this other cord circuit into jack CJ2 to operate relay 820 which performs the same functions as stated for the corresponding relay 810. The operator now takes a third cord circuit and plugs it into the group jack BG of the boundary group and into conference jack CJ3 and operates the group conference key, such as GC, associated with the boundary group to perform operations similar to that described for the administration group. In case any further groups are desired in the conference, the operator would use another cord circuit and plug it into the corresponding group jack and one of the conference jacks and operate the corresponding group conference key. After the operator has plugged up the desired number of conference connections she will then operate the ring keys in all but the first cord circuit to simultaneously signal all of the subscribers in their respective groups. For example, when the ring answer key in the second cord circuit is actuated relay 420 deenergizes and simultaneously rings all the subscribers in the administration group in the same manner as previously described. All of the boundary lines are simultaneously signaled in a similar manner. When each of the subscribers respond, their associated individual ring cut-off and line relays, corresponding to relays 310 and 330, respectively, operate to complete the talking circuits over the heavy talking conductors, to dimly light their individual lamps, corresponding to lamp L, and to lock their associated conference relays, corresponding to relay 320 under control of their line relays. After all of the subscribers in a group have answered the operator may restore the group conference key for that group. The individual conference relays will now be maintained in operated position by their associated line relays. Talking battery for the called subscribers lines are fed through the windings of their individual line relays. The talking circuits include the heavy talking conductors extending from the subscribers' lines, the group conference conductors, such as conductor 372 and 373, in the administration and boundary groups, the heavy talking conductors of the cord circuits and the conference circuit in Fig. 8. Talking currents are induced through the windings of the repeating coils RC1, RC2 and RC3 in a well known manner. After the operator restores the

group conference keys any one of these subscribers may retire from the conference and initiate a regular call in a manner apparent from the foregoing description.

When the calling subscriber replaces his receiver after termination of the conference the battery feed relay **530** of the first cord circuit deenergizes to give the operator disconnect supervision by lighting lamp **532** and in response thereto the operator withdraws the various plugs from the group and conference jacks as well as from the calling line jack. The operated relays are all restored to normal.

In case only certain individual subscribers' lines are to be connected to the conference circuits then the operator would plug into their corresponding individual jacks and in such cases the operator would receive disconnect supervision from such lines when they replace their receivers.

From the foregoing it can be seen that the conference circuit may be connected to as many groups of lines as there are conference jacks provided.

It will now be assumed that a calling subscriber desires a conference with only certain of the lines in a plurality of different groups of lines. For example, it will be assumed that the calling subscriber desires subscribers A and F in the administration group and two lines in the boundary group, which terminates in jacks BJ1 and BJ2, in a conference. After answering the call the operator inserts the call plug of the first cord circuit into the conference jack CJ1, then inserts a second cord circuit into jack G1 and operates the select conference key SC associated with the administration group. The operator then tip touches the sleeves of jacks AJ1 and AJ6 with the tip of the call plug of the second cord circuit to operate and lock the conference relays, corresponding to relay **320** in both line circuits LC—A and LC—F. After this the operator inserts the call plug of the second cord circuit into jack CJ2. In a similar manner the operator takes a third cord circuit and inserts it into the boundary group jack BG, operates the associated conference select key, and then tip touches the sleeve of jacks BJ1 and BJ2 with the tip of a call plug of the second cord circuit and thereafter inserts this plug into the third conference jack CJ3. The conference relays, corresponding to relay **320**, in the line circuits individual to these subscribers are locked in energized position. The manner in which these conference relays are energized may be briefly described as follows: when the conference key is actuated battery potential through the winding of relay **490** is connected through the lower windings of the conference relays, such as relay **320**, and when the grounded tip of the cord circuit touches the sleeve of the jack the conference relay energizes and locks to ground conductor, such as conductor **376** through its upper winding.

After completing these operations the operator operates the ring answer keys in the second and third cord circuits to deenergize the group relays, corresponding to relay **420**. These relays deenergize and connect ringing current through the windings of the ring cut-off relays to the selected lines by way of the operated contacts, such as contacts **322** and **324**, on the energized conference relays. When each called subscriber answers his individual ring cut-off relay and line relay operate and the latter relays dimly light the call lamps and locks the conference relays independent of the operated condition of the select conference key. After all of the selected subscribers have answered the operator may restore the select conference keys to normal. The talking circuit over which these subscribers converse includes the heavy talking conductors and repeating coils RC1, RC2 and RC3 as previously described. Any one of the called subscribers may retire from this conference connection and initiate a regular call as previously described. After termination of the conference and when the calling party replaces his receiver the operator receives disconnect supervision in the usual manner and releases the connection.

It should possibly be stated that the trunk jack TJ is connected to the conference circuits of Fig. 8 to provide a means for including a trunk connection in the conference circuits or an additional subscriber's line. Relay **870**, as is obvious, operates when the plug is inserted into jack TJ and this relay at contacts **871** removes the shunt from around condensers C6 and C7. At contacts **872** relay **870** connects ground through resistance **873** to operate relays **520** or relay **560** dependent upon which plug is inserted into trunk jack TJ. The marginal relays in the cord circuit will not operate in series with resistance **873**.

It is apparent from the foregoing description that the conference circuits may be connected to any of the lines in the runway, boundary, administration, or operations group or to any individual lines not included in such groups. It is also apparent that when a conference between a calling line and two or more lines of a certain group is desired that the conference circuits of Fig. 8 are not needed since such a conference connection can be set up in the group conference circuits provided in such certain groups. Therefore, the conference circuits of Fig. 8 are only used when a number of subscribers in different groups, or individual subscribers not in any groups, are desired in a conference.

Having described the invention, what is considered to be new and is desired to have protected by Letters Patent will be set forth in the following claims.

I claim:

1. In a telephone system, an operator's position, a group of subscribers' lines each normally terminating in an individual jack at said position, a talking circuit common to all said subscribers' lines in said group, a group jack terminating said common talking circuit at said position, a group conference key associated with said group jack, and means jointly responsive to the insertion of an operator's cord circuit into said group jack and the actuation of said group conference key for disconnecting each of said subscribers' lines from its individual jack and for preparing the connection of each of said subscribers' lines to said common talking circuit.

2. In a telephone system, an operator's position, a group of subscribers' lines each normally terminating in an individual jack at said position, a talking circuit common to all said subscribers' lines, a group jack terminating said common talking circuit at said position, a group conference key associated with said group jack, a conference relay individual to each subscriber's line, means including a circuit jointly controlled by the insertion of an operator's cord circuit into said group jack and by the actuation of said key for operating all said conference relays, and means controlled by the actuated conference relays for operatively associating said common talking circuit with said subscribers' lines.

3. In a telephone system, an operator's position, a group of subscribers' lines, a talking circuit common to all said subscribers' lines, a signaling circuit common to all said subscribers' lines, a group jack terminating said common talking circuit at said position, a group conference key associated with said group jack, a conference relay individual to each subscriber's line, a circuit for operating all of said conference relays, means responsive to the insertion of an operator's cord circuit into said group jack for preparing said circuit for operating said conference relays and for preparing said signaling circuit, means responsive to the actuation of said group conference key for completing said circuit to actuate all said conference relays, contacts on said conference relays for operatively connecting said signaling circuit to all said subscribers' lines, operator controlled means for completing said signaling circuit to simultaneously signal all said subscribers, and means responsive to each called line answering for disconnecting said signaling circuit and for completing and connecting said common talking circuit to each subscriber's line as such subscribers answer.

4. In a telephone system, an operator's position, a group of subscribers' lines each normally terminating in an individual jack at said position, a talking circuit common to all said subscribers' lines, a group jack terminating said common talking circuit at said position, a group conference key associated with said group jack, a conference relay individual to each subscriber's line, a circuit for operating all said conference relays, means responsive to the insertion of an operator's cord circuit into said group jack for preparing said circuit for operating said conference relays, means responsive to the actuation of said key for completing said circuit to actuate all said conference relays, contacts on said actuated conference relays for disconnecting each subscriber's line from its individual jack and for preparing the connection of said common talking circuit to the corresponding subscriber's line, means for signaling all said subscribers, and means responsive to each subscriber answering for completing and connecting said common talking circuit to each subscriber's line as such subscribers answer.

5. In a telephone system, an operator's position, a group of subscribers' lines, a talking circuit common to all said subscribers' lines, a group jack terminating said common talking circuit at said position, a group conference key associated with said group jack, a signaling circuit common to all said subscribers' lines, a conference relay individual to each subscriber's line, means responsive to the insertion of an operator's cord circuit into said group jack and the actuation of said group conference key for operating all of said individual conference relays, means controlled by said operated conference relays for operatively connecting said common signaling circuit to said subscribers' lines, operator controlled means for connecting ringing current to said signaling circuit to simultaneously signal all said subscribers in said group, and a ring-cut-off relay individual to each subscriber's line for opening said signaling circuit at its subscriber's line and for connecting its subscriber's line to said common talking circuit in response to such subscriber answering.

6. In a telephone system, an operator's position, a group of subscribers' lines terminating at said position, said group divided into a plurality of subgroups each containing a plurality of subscribers' lines, a first subgroup jack at said position for the first of said subgroups, a second subgroup jack at said position for both the first and second of said subgroups, a group jack at said position for all the subscribers' lines in said group, and means for including all the subscribers' lines in only the first subgroup in a conference circuit, for including all the subscribers' lines in only the first and second subgroups in a conference circuit, or for including all the subscribers' lines in said group in a conference circuit dependent upon whether the operator plugs into the first subgroup jack, the second subgroup jack, or the group jack, respectively.

7. In a telephone system, an operator's position, a group of subscribers' lines each normally terminating in an individual jack at said position, said group of subscribers' lines divided into a plurality of subgroups each containing a plurality of subscribers' lines, a first subgroup jack at said position for the first of said subgroups, a second subgroup jack at said position for both the first and second of said subgroups, a group jack at said position for all said subscribers' lines in said group, a common talking circuit common to all said subscribers' lines in said group and terminating in said first and second subgroup jacks and in said group jack, and means for disconnecting said subscribers' lines of said first subgroup, of said first and second subgroups, or of said group from their individual jacks and for connecting such disconnected lines to said common talking circuit dependent upon whether the operator plugs into said first subgroup jack, said second subgroup jack, or said group jack, respectively.

8. In a telephone system, a first group of lines including a first plurality of subscribers' lines, a second group of lines including said first plurality of subscribers' lines and a second plurality of subscribers' lines, a third group of lines including both said first and second plurality of said subscribers' lines and a third plurality of subscribers' lines, a talking circuit common to all said subscribers' lines, connecting means individual to each of said groups terminating said common talking circuit, and means dependent upon the particular one of said individual connecting means taken into use for connecting said common talking circuit to the said subscribers' lines included in said first, second or third groups.

9. In a telephone system, an operator's position, a group of subscribers' lines terminating at said position, said group of subscribers' lines divided into a plurality of subgroups each containing a plurality of subscribers' lines, a first subgroup jack at said position for including the subscribers' lines in the first of said subgroups in a conference circuit, a second subgroup jack at said position for including the subscribers' line in both the first and second of said subgroups in a conference circuit, a group jack at said position for including all said subscribers' lines in said group in a conference circuit, and means for simultaneously signaling all the subscribers in only the first subgroup, for simultaneously signaling all of the subscribers in only the first and second subgroups, or for simultaneously signaling all the subscribers in said group dependent upon whether said operator plugs into the first subgroup jack, the second subgroup jack, or the group jack, respectively.

10. In a telephone system, an operator's position, subscribers' lines arranged in groups, a

common talking circuit terminating at said position in an answer jack, a plurality of subgroup jacks each corresponding to a group of said subscribers' lines, and a main group jack, a separate signaling circuit for each group of subscribers' lines terminating at said position at its corresponding subgroup jack and all said signaling circuits also terminating at said position at said main group jack, means for using said answer jack to answer a call initiated by any one of said subscribers' lines, means for using one of said sub-group jacks to extend a call to the corresponding group of subscribers' lines and to complete the corresponding signaling circuit to selectively signal only the subscribers' lines in the corresponding group, and means for using said main group jack to extend a call to all said subscribers' lines and to complete all said separate signaling circuits to signal all said subscribers' lines.

11. In a telephone system, an operator's position, subscribers' lines arranged in groups, a master station, a common talking circuit connecting said master station and all said subscribers' lines, said common talking circuit terminating at said position in a plurality of jacks comprising an answer jack, a plurality of subgroup jacks each corresponding to a group of said subscribers' lines, and a main group jack, means for using said answer jack to answer a call initiated by any one of said subscribers' lines or said master station, means for using said answer jack to extend a call to said master station and to selectively signal only said master station, means for using one of said subgroup jacks to extend a call to the corresponding group of lines and to selectively signal only said corresponding group of lines and said master station, and means for using said main group jack to extend a call to all said subscribers' lines and to signal all said subscribers' lines and said master station.

12. In a telephone system, an operator's position, subscribers' line arranged in groups, a talking circuit common to all said subscribers' lines terminating at said position in an answer jack, a plurality of subgroup jacks each corresponding to a group of said subscribers' lines, and a main group jack, means for using said answer jack to answer a call initiated on any one of said subscribers' lines, means for using one of said subgroup jacks to extend a call to the corresponding group of lines and to selectively signal only said corresponding group of lines, and means for using said main group jack to extend a call to all said subscribers' lines and to signal all said subscribers' lines.

13. In a telephone system, an operator's position, including cord circuits, a group of subscribers' lines terminating at said position, a conference circuit common to all said lines, a group jack terminating said common conference circuit at said position, a group conference key and a select conference key associated with said group jack at said position, conference connecting means individual to each subscriber's line for connecting its corresponding line in a conference connection including said common conference circuit, means responsive to the insertion of an operator's cord circuit into said group jack and the actuation of said group conference key for operating all of said individual conference connecting means to thereby establish a conference connection including said common conference circuit and all said subscribers' lines, means responsive to the insertion of an operator's cord circuit into said group jack and the actuation of said select conference key for preparing all of said individual conference connecting means for operation, and operator controlled means for selectively operating certain of said individually prepared conference connecting means to thereby establish a conference connection including said common conference circuit and certain corresponding subscribers' lines.

14. In a telephone system, an operator's position, a group of subscribers' lines, a conference circuit common to all said subscribers' lines, conference connecting means individual to each subscriber's line for connecting its corresponding line in a conference connection including said common conference circuit, operator controlled means for operating all said individual conference connecting means to thereby establish a conference connection including said common conference connection and all said subscribers' lines, operator controlled means for preparing all said individual conference connecting means for operation, and operator controlled means for selectively operating certain of said individually prepared conference connecting means to thereby establish a conference connection including said common conference circuit and certain corresponding subscribers' lines.

15. In a telephone system, an operator's position, a group of subscribers' lines, a conference circuit common to all said subscribers' lines, conference connecting means individual to each subscriber's line for connecting its corresponding line in a conference connection including said common conference circuit, a group conference key and a select conference key associated with said group at said operator's position, operator controlled means including the actuation of said group conference key for operating all of said individual conference connecting means to thereby establish a conference connection including said common conference circuit and all said subscribers' lines, operator controlled means including the actuation of said select conference key for preparing all of said individual conference connecting means for operation, and operator controlled means for selectively operating certain of said prepared individual conference connecting means to thereby establish a conference connection including said common conference circuit and certain corresponding subscribers' lines.

16. In a telephone system, a group of subscribers' lines, a conference circuit common to all said subscribers' lines, conference connecting means individual to each subscribers' line for connecting its corresponding line in a conference connection including said common conference circuit, a group means and a select means associated with said group of lines and said conference circuit, means including the actuation of said group means for operating all of said individual conference connecting means to thereby establish a conference connection including said common conference circuit and all said subscribers' lines, means including the actuation of said select means for preparing all of said individual conference connecting means for operation, and means for thereafter selectively operating certain of said prepared individual conference connecting means to thereby establish a conference connection including said common conference circuit and certain corresponding subscribers' lines.

17. In a telephone system, an operator's posi-

tion including cord circuits, a group of subscribers' lines each terminating in an individual jack at said position, a talking circuit common to all said subscribers' lines in said group, a group jack terminating said common talking circuit at said position, a conference key associated with said group jack, conference connecting means individual to each subscriber's line for connecting its corresponding line in a conference connection including said common talking circuit, means responsive to the insertion of an operator's cord circuit into said group jack and the actuation of said conference key for preparing each said individual conference connecting means for operation, and means responsive to the operator touching the tip of one of her cord circuits to the sleeves of the individual jacks corresponding to the subscribers' lines desired in a conference connection for operating the corresponding conference connecting means to connect such subscribers' lines in a conference circuit including said common talking circuit.

18. In a telephone system, an operator's position, a group of subscribers' lines each terminating in an individual jack at said position, a conference circuit common to all said subscribers' lines, a conference relay individual to each subscriber's line, a circuit for operating each of said relays including the sleeve of its corresponding individual jack, a source of current, operator controlled means for preparing all said conference relays for operation by connecting one pole of said source to each circuit of all said conference relays, means responsive to the operator selectively connecting the other pole of said source to the sleeves of certain of said jacks for selectively operating certain of said conference relays over their prepared circuits to thereby select certain of said subscribers' lines for a conference connection, and means controlled by the selectively operated conference relays for establishing a conference connection including said common conference circuit and said selected subscribers' lines.

19. In a telephone system, an operator's position including cord circuits, a group of subscribers' lines each terminating in an individual jack at said position, a conference circuit common to all said subscribers' lines, conference connecting means individual to each subscriber's line for connecting its line in a conference connection including said common conference circuit, means for preparing each of said individual conference connecting means for operation, and means for selectively operating said prepared individual conference connecting means to select the corresponding subscribers' lines desired in a conference connection in response to the operator selectively touching the tip of one of her cord circuits to the sleeves of said jacks of said selected subscribers' lines.

20. In a telephone system, an operator's position including cord circuits, a group of subscribers' lines each terminating in an individual jack at said position, a talking circuit common to all said subscribers' lines, conference connecting means individual to each subscriber's line for connecting its line in a conference connection including said common talking circuit, and means for selectively operating said individual conference connecting means in response to the operator touching the tip of one of her cord circuits to the sleeves of the individual jacks corresponding to the subscribers' lines desired in a conference connection.

21. In a telephone system, an operator's position, a group of subscribers' lines, a conference circuit common to all said subscribers' lines, a conference relay individual to each subscriber's line, a source of current, operator controlled means for preparing all said conference relays for operation by connecting one pole of said source to all said conference relays, operator controlled means for selectively operating certain of said conference relays by selectively connecting the other pole of said source to said certain relays to thereby select certain of said subscribers' lines for a conference, and means controlled by said selectively operated conference relays for establishing a conference connection including said common conference circuit and said selected subscribers' lines.

22. In a telephone system, a group of subscribers' lines, a conference circuit common to all said subscribers' lines, a conference relay individual to each subscriber's line, a source of current, means operated for preparing all of said conference relays for operation by connecting one pole of said source to all said conference relays, means for selectively operating selected ones of said conference relays by selectively connecting the other pole of said source to certain ones of said conference relays, and means controlled by said selectively operated conference relays for establishing a conference connection including said common conference circuit and the corresponding subscribers' lines.

23. In a telephone system, a group of subscribers' lines, a terminal individual to each subscriber's line, a talking circuit common to all said subscribers' lines for use in a conference connection, means for selectively and momentarily connecting a source of potential to selected ones of said terminals to select the subscribers' lines desired in a conference connection, and conference connecting means individual to each selected subscriber's line operated in response to said momentary connection of said source of potential to said selected terminals for establishing a conference connection including said common talking circuit and said selected subscribers' lines.

24. In a telephone system, an operator's position, subscribers' lines terminating at said position, a line relay individual to each subscriber's line, an individual signaling device for each subscriber's line at said position, means for operating said line relays in response to corresponding subscribers initiating calls, means for operating said individual signaling devices in one manner in response to the operation of said individual line relays, operator controlled means for answering said calls, means for releasing said relays in response to the operator answering said calls, operator controlled means for establishing a conference connection between a plurality of called subscribers' lines, means for operating the line relays of said last mentioned called subscribers' lines included in said conference connection in response to said subscribers answering, and means for operating said individual signaling devices in a different manner in response to said last mentioned operations of said line relays.

25. In a telephone system, an operator's position, subscribers' lines terminating at said position, a line relay individual to each subscriber's line, means for energizing said line relays in response to corresponding subscribers initiating calls, operator controlled means for answering said calls, means for releasing said relays in response to the operator answering said calls,

operator controlled means for establishing a conference connection between a plurality of called subscribers' lines, and means for feeding talking battery through said line relays and for energizing said line relays corresponding to said called subscribers' lines included in said conference connection in response to said called subscribers answering on said conference call.

26. In a telephone system, subscribers' lines, an individual line circuit including an individual signaling device for each subscriber's line, an individual line relay in each subscriber's line circuit, means for energizing said line relays in response to the corresponding subscribers initiating calls, means controlled by the energized line relays for operating their corresponding individual signaling devices in one manner, means for answering said calls, means for deenergizing said line relays in response to said calls being answered, means for establishing a conference connection to a plurality of called ones of said subscribers' lines, means for energizing said line relays of said called ones of said called subscribers' lines included in said conference connection in response to such called subscribers answering, and means for operating the individual signaling devices in a different manner in response to the said last mentioned energizations of said line relays.

27. In a telephone system, subscribers' lines, a line relay individual to each subscriber's line, means for energizing said line relays in response to corresponding subscribers initiating calls, means for answering said calls, means for releasing said line relays in response to said calls being answered, means for establishing a conference connection between a plurality of called ones of said subscribers' lines, and means for feeding talking battery through said line relays and for energizing said line relays corresponding to said called subscribers' lines included in said conference connection in response to said called subscribers answering on said conference call.

28. In a telephone system, subscribers' lines, an individual line circuit for each subscriber's line, an individual line relay in each subscriber's line circuit, circuits for energizing said line relays completed in response to the corresponding subscribers initiating calls, means for answering said calls, means for opening said circuits to disconnect said line relays in response to said calls being answered, means for establishing a conference connection to a plurality of called ones of said subscribers' lines, and circuits for energizing said line relays of said called ones of said called subscribers' lines included in said conference connection in response to such called subscribers answering.

29. In a telephone system, subscribers' lines, an individual line circuit for each subscriber's line, an individual line relay in each subscriber's line circuit, circuits for energizing said line relays completed in response to the corresponding subscribers initiating calls, means for answering said calls, means for opening said circuits to disconnect said line relays in response to said calls being answered, means for establishing a conference connection to a plurality of called ones of said subscribers' lines, circuits for energizing said line relays of said called ones of said called subscribers' lines included in said conference connection in response to such called subscribers answering, and transmission battery for each of said called subscribers' lines being fed through said corresponding line relays.

30. In a telephone system, a subscriber's line, a line relay individual to said line, means for operating said line relay in response to the initiation of a call on said line, means for answering said call, means for releasing said relay in response to said call being answered, means for establishing a conference connection between said line and other subscribers' lines, and means for feeding talking battery to said line and for operating said line relay in response to said line answering said conference call.

31. In a telephone system, a subscriber's line, a signaling lamp individual to said line, means for brightly lighting said lamp in response to said subscriber initiating a call over said line, means for establishing a conference connection between said line and other subscribers' lines, and means for dimly lighting said lamp during the time said line is connected in said conference connection.

32. In a telephone system, a subscriber's line, a signaling device individual to said line, means for operating said individual signaling device in one manner in response to said subscriber initiating a call over said line, means for establishing a conference connection between said line and a plurality of other subscribers' lines, and means for operating said individual signaling device in a different manner during the time said line is connected in said conference connection.

33. In a telephone system, an operator's position, a line jack and a group jack at said position, an operator's cord circuit, a source of ringing current in said cord circuit, and a pair of relays in said cord circuit, means responsive to the operator inserting the plug of said cord circuit into said line jack for operating said pair of relays, a line signaling circuit for connecting said source of current through said cord circuit and said line jacks to the line conductors of said line jack prepared in response to the operation of said relays, a ringing key in said cord circuit, means for maintaining said relays operated and for completing said prepared line signaling circuit in response to the actuation of said ringing key, a group signaling source of ringing current, means responsive to the operator inserting the plug of said cord circuit into said group jack for operating only one of said relays, a group signaling circuit associated with said group jack, and means responsive to the actuation of said ringing key when said cord circuit is plugged into said group jack for releasing the operated one of said relays and for directly connecting said group signaling source of ringing current to said group signaling circuit exclusive of said cord circuit and said group jack.

34. In a telephone system an operator's position, a line jack and a group jack at said position, an operator's cord circuit, a source of signaling current in said cord circuit, a pair of relays in said cord circuit, means responsive to the operator inserting the plug of said cord circuit into said line jack for operating said pair of relays, a line signaling circuit for connecting said source through said cord circuit and said line jack to the line conductors of said line jack prepared in response to the operation of one of said relays, a ringing key in said cord circuit, means for maintaining said relays operated and for completing said prepared line signaling circuit in response to the actuation of said key, a group signaling source of current, means responsive to the operator inserting the plug of said cord circuit into said group jack for operating only the other one of said relays, a group

signaling circuit associated with said group jack, means responsive to the actuation of said ringing key when said cord circuit is plugged into said group jack for releasing the said operated other one of said relays and for directly connecting said group signaling source to said group signaling circuit exclusive of said cord circuit and said group jack, a supervisory lamp in said cord circuit, and a circuit for controlling said supervisory lamp including contacts on said pair of relays.

35. In a telephone system, an operator's position, a line jack and a group jack at said position, an operator's cord circuit, a source of signaling current, a line signaling circuit, means in said cord circuit effective only when said cord circuit is plugged into said line jack for preparing the connection of said source to said line signaling circuit, a ringing key in said cord circuit for maintaining said means effective and for completing the prepared connection of said source through said cord circuit and line jack to said line signaling circuit in response to the operation of said ringing key, a group signaling source of current, a group signaling circuit, means responsive to the operator plugging said cord circuit into said group jack for preparing the connection of said group signaling source to said group signaling circuit, and means thereafter responsive to the actuation of said ringing key for completing the prepared connection of said group signaling source to said group signaling circuit by directly connecting said group source to said group signaling circuit exclusive of said cord circuit and said group jack.

36. In a telephone system, an operator's position, a group of subscribers' lines each terminating at said position in an individual jack, a talking circuit common to said subscribers' lines terminating at said position in a group jack, means including an operator's cord circuit and a subscriber's individual jack for extending a call to such subscriber's line, a ringing key in said cord circuit, a source of ringing current in said cord circuit, means responsive to the actuation of said ringing key in the extension of said call for transmitting ringing current from said source through said cord circuit and said subscriber's individual jack to said subscriber's line, means including said operator's cord circuit and said group jack for extending a call to all said subscribers' lines over said common talking circuit, a source of ringing current associated with said group jack, and means responsive to the actuation of said ringing key in the extension of said last mentioned call for transmitting ringing current from said last mentioned source to all said subscribers' lines over a circuit excluding said cord circuit and said group jack.

37. In a telephone system, a first set of switching keys at one location, telephone lines throughout the entire system terminating in said first set of switching keys at said first location, a switchboard and a second set of switching keys at a second location, a cable for extending all said lines through said first and second sets of switching keys to said switchboard, an emergency switchboard and a third set of switching keys at a third location, and cables extending from said first and second sets of switching keys to said third set of switching keys for connecting said lines to said emergency switchboard when desired.

38. In a telephone system, an operator's position including cord circuits, a plurality of groups of subscribers' lines, a common talking circuit individual to each group of subscribers' lines, a group jack terminating each common talking circuit at said position, means for selectively including only certain of said subscribers' lines of each respective group in a conference connection including its own corresponding common talking circuit, a conference circuit terminating in a plurality of jacks at said position, and means including said group jacks, operators' cord circuits, and said conference jacks for interconnecting a plurality of groups of said selected subscribers lines in a conference connection including said conference circuit and a plurality of said common talking circuits.

39. In a telephone system, an operator's position including cord circuits, a plurality of groups of subscribers lines, a common talking circuit individual to each group of subscribers' lines, a group jack terminaing each common talking circuit at said position, means for including all the subscribers' lines of each respective group in a conference connection including its own corresponding common talking circuit, a conference circuit terminating in a plurality of jacks at said position, and means including said group jacks, operators' cord circuits, and said conference jacks for interconnecting a plurality of groups of subscribers' lines in a conference connection including said conference circuit and a plurality of said common talking circuits.

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