Oct. 25, 1949. J. H. VOSS 2,486,231

PRIVATE AUTOMATIC TELEPHONE EXCHANGES EMPLOYING NONNUMERICAL SWITCHES FOR INTERCONNECTING LOCAL LINES, AND FOR INTERCONNECTING LOCAL LINES AND TRUNK LINES

Filed June 29, 1945 8 Sheets-Sheet 1

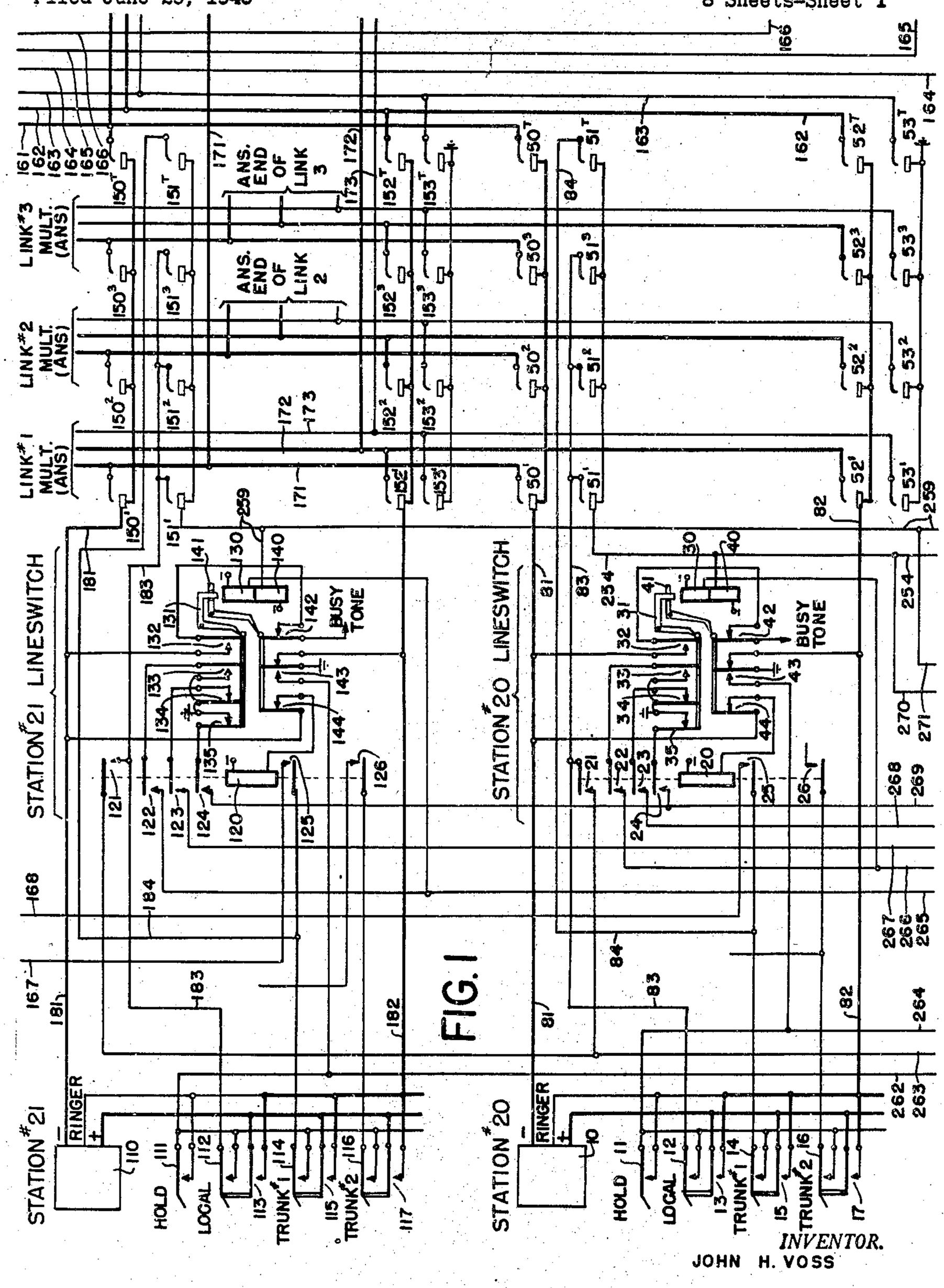

FIG. 1

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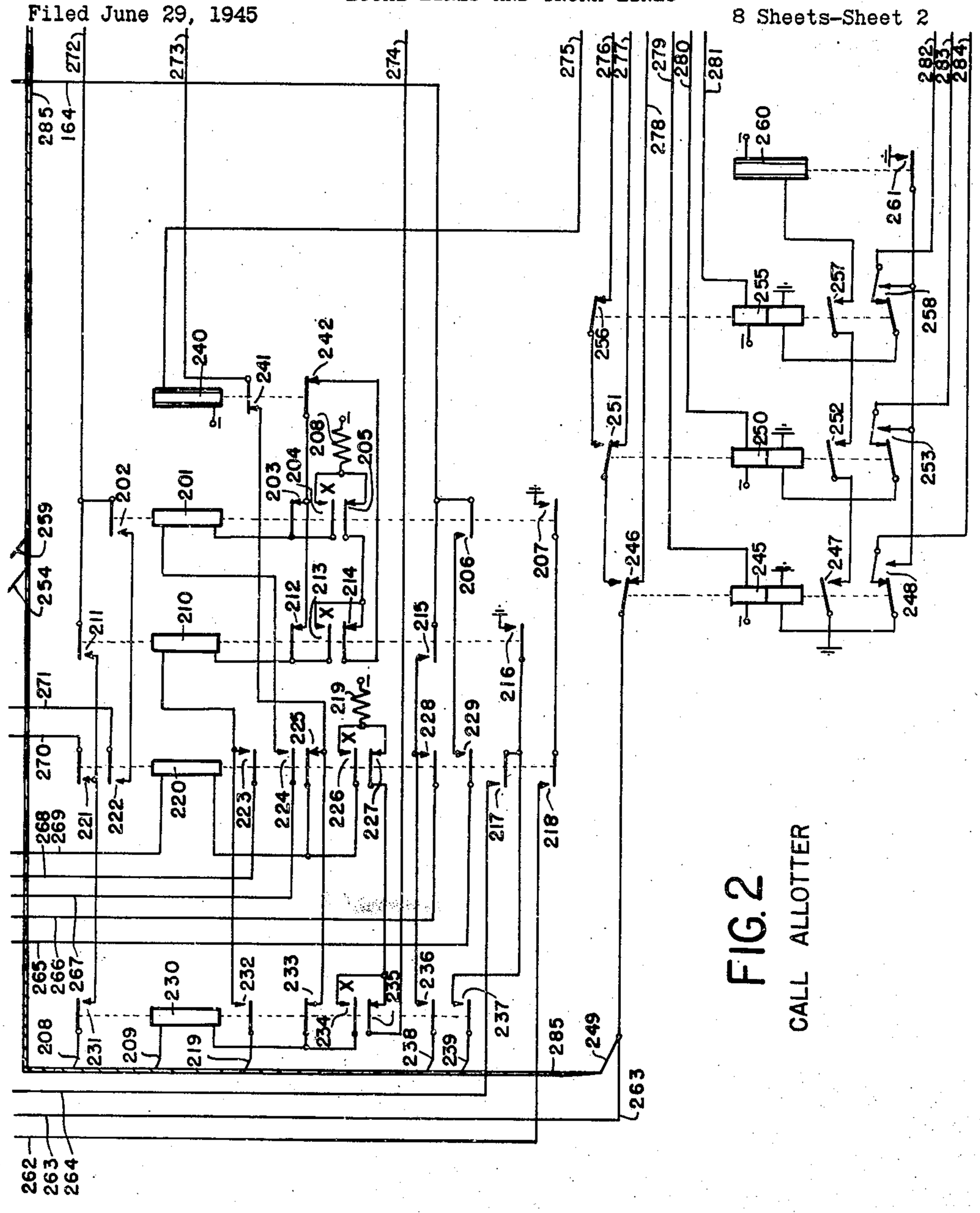

FIG. 2

CALL ALLOTTER

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FIG. 3

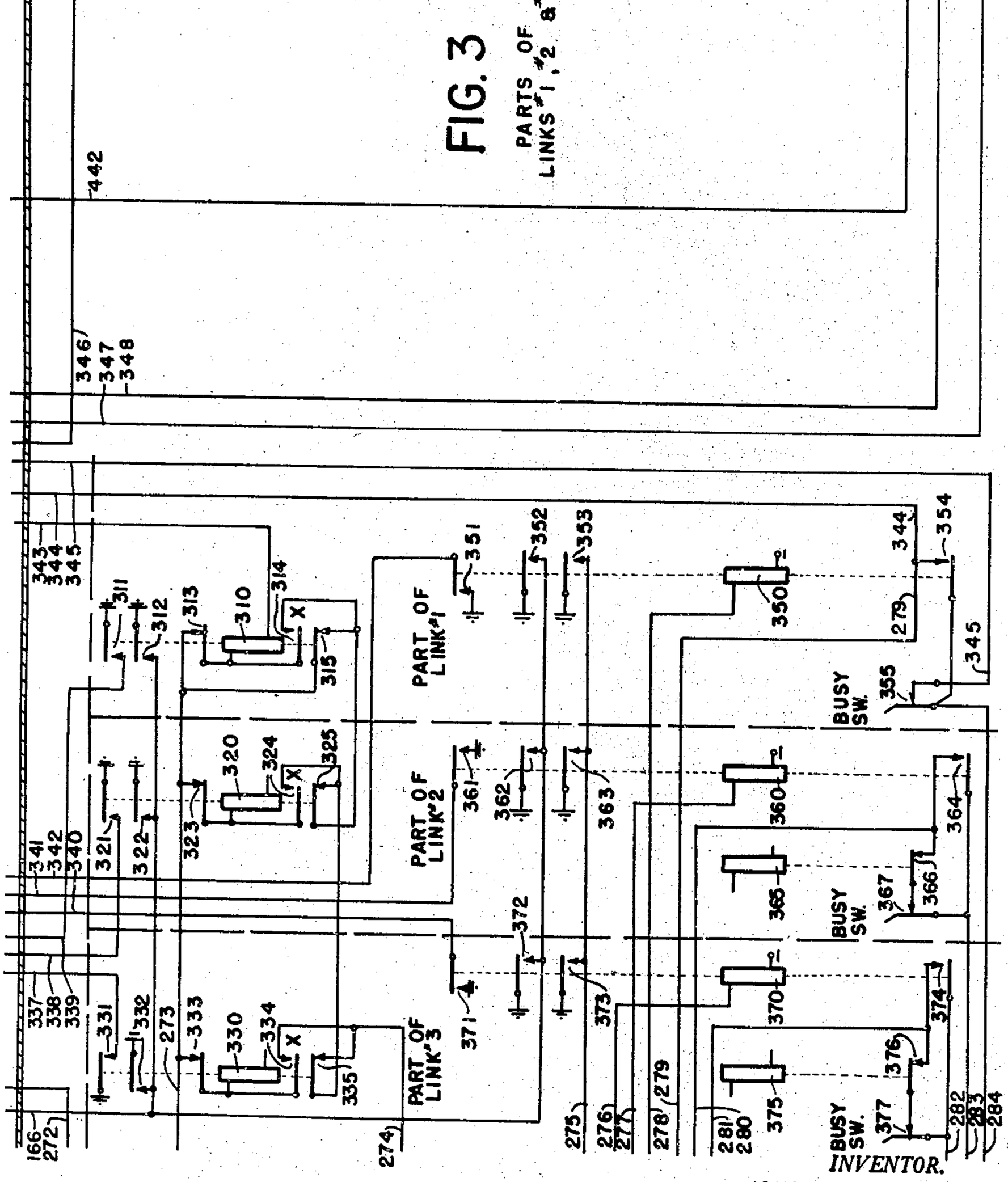

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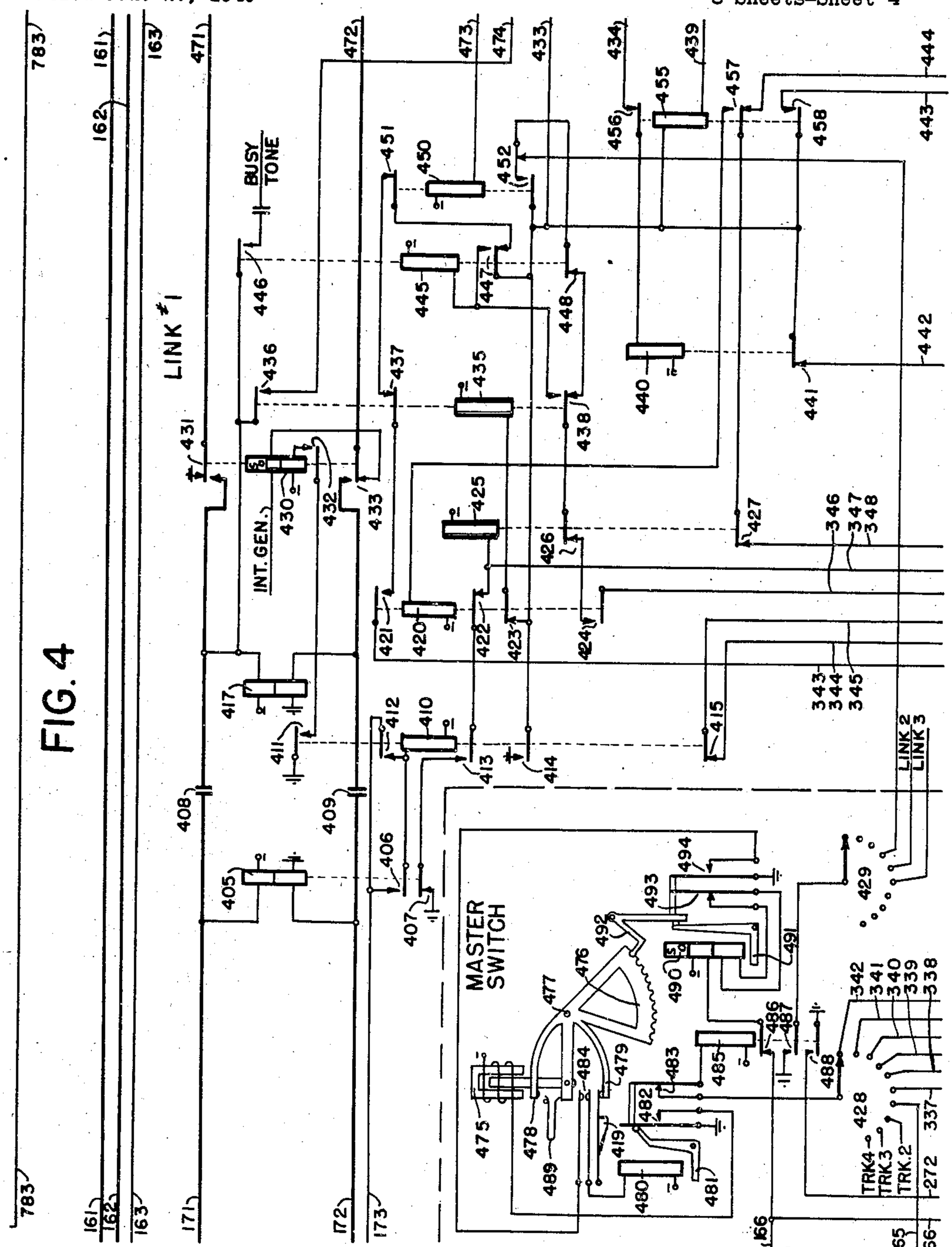
FIG. 4



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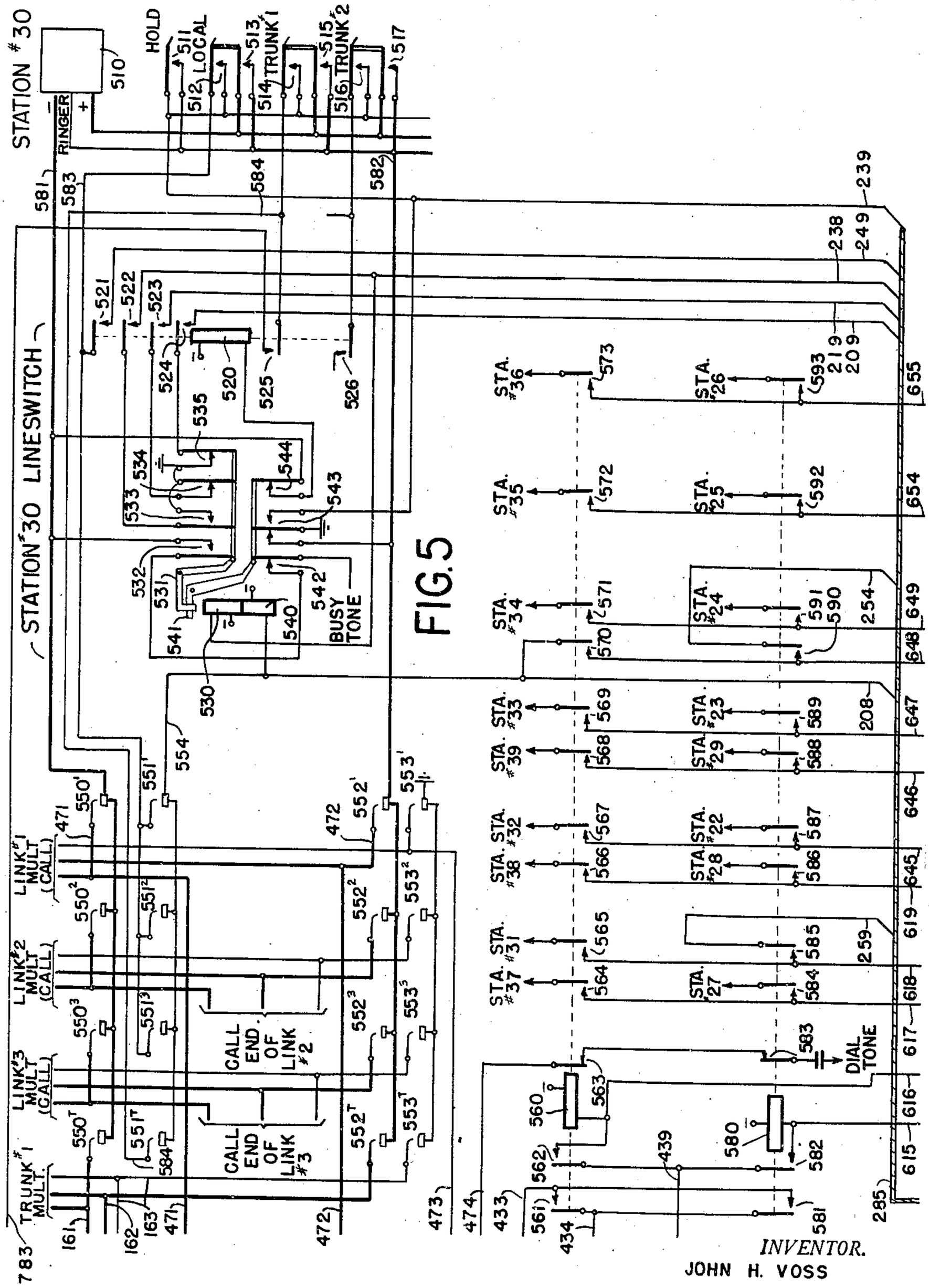

FIG. 5

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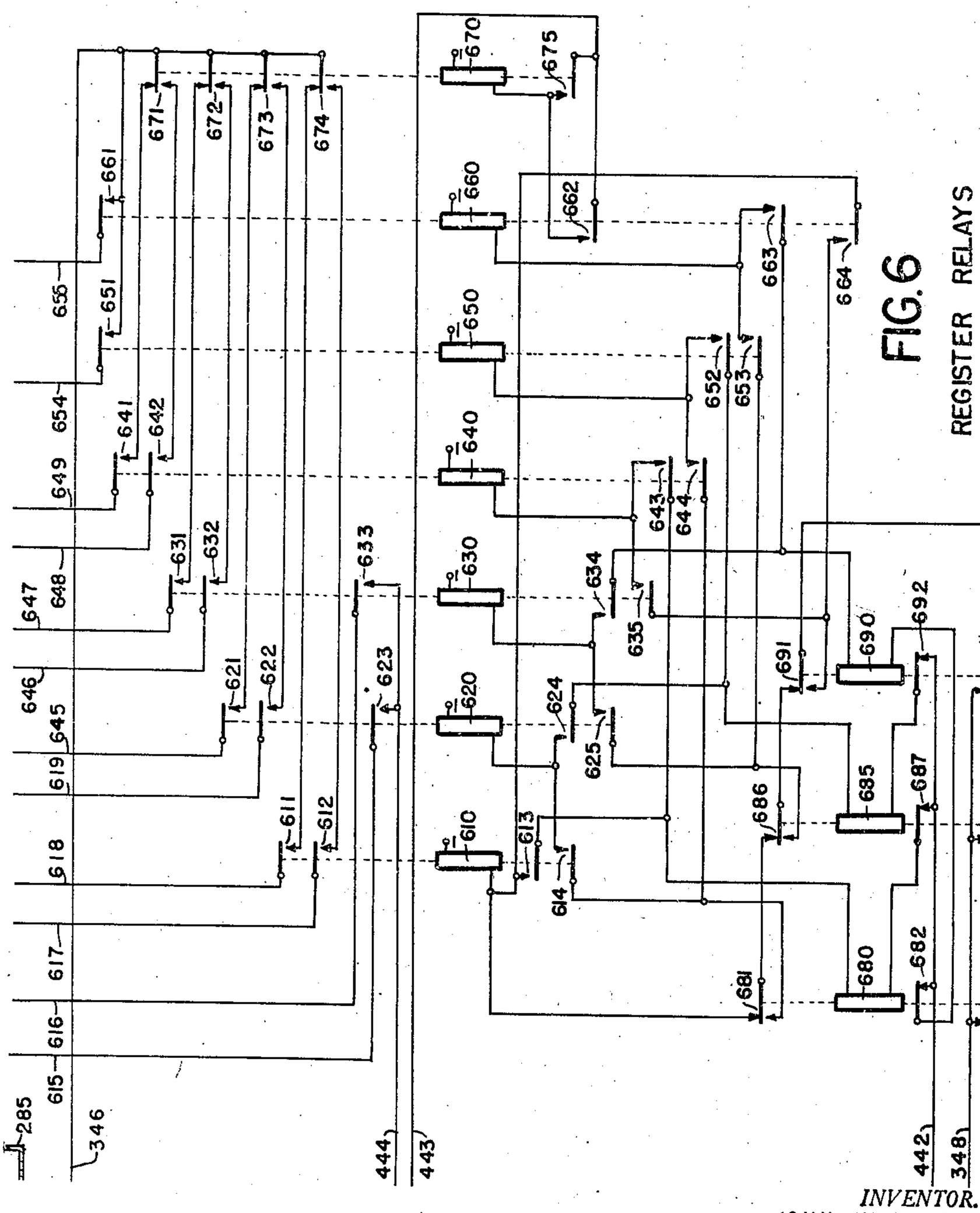

FIG. 6

REGISTER RELAYS

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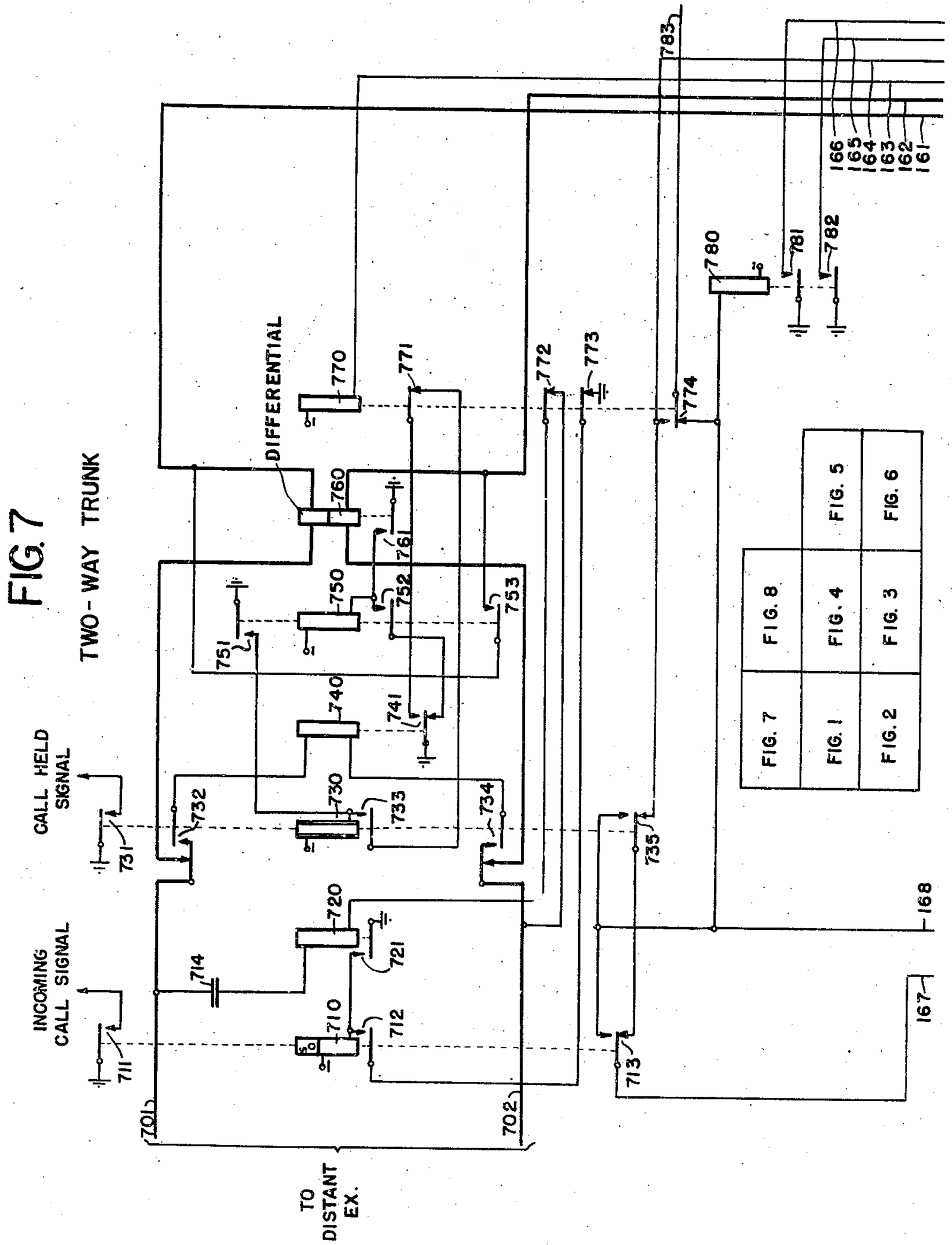
FIG. 7

TWO-WAY TRUNK



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Filed June 29, 1945 8 Sheets-Sheet 8

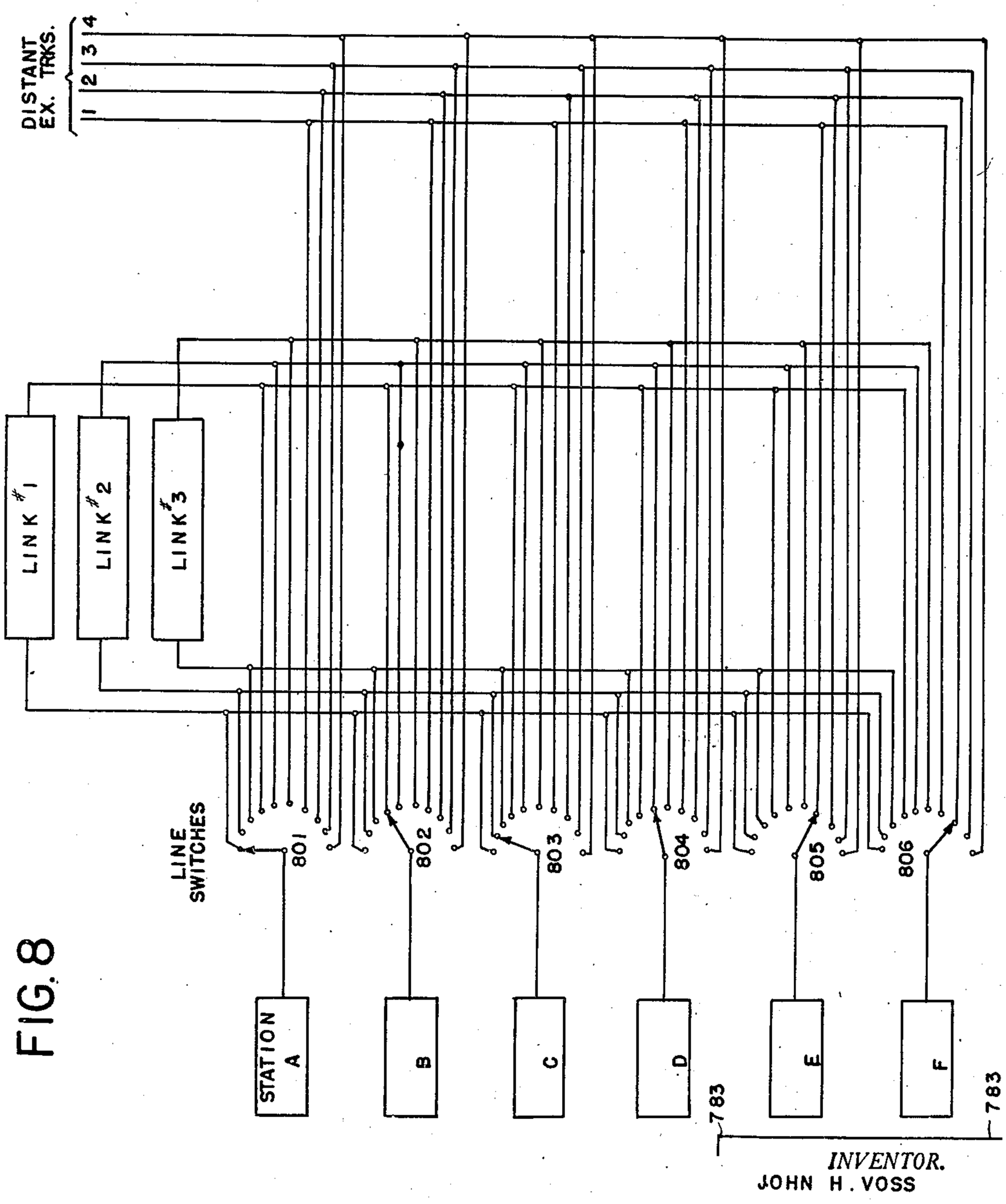

FIG. 8

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UNITED STATES PATENT OFFICE

2,486,231

PRIVATE AUTOMATIC TELEPHONE EXCHANGES EMPLOYING NONNUMERICAL SWITCHES FOR INTERCONNECTING LOCAL LINES, AND FOR INTERCONNECTING LOCAL LINES AND TRUNK LINES

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Application June 29, 1945, Serial No. 602,231

27 Claims. (Cl. 179—18)

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The present invention relates in general to telephone systems, and more particularly to systems of the type commonly known as private automatic telephone exchanges.

Private automatic telephone exchanges are installed in business and other establishments for providing local service between a relatively small number of local telephone stations, and for completing connections between the local telephone stations and another telephone exchange over trunk lines.

An object of the invention is to provide an economically arranged private automatic telephone exchange wherein the minimum amount of switching equipment is required to enable a local telephone station to connect with a particular trunk line extending to another telephone exchange, and which can be manufactured very inexpensively, without sacrificing the desirable service facilities usually provided in more costly types of private exchanges.

Another object of the invention is to provide a new and novel arrangement whereby interconnections between the local telephone stations in the local automatic exchange, and interconnections between local telephone stations and trunk lines leading to a distant exchange, are completed by means of non-numerical switches under the control of the local telephone stations.

A further object of the invention is to provide in the local automatic exchange novel arrangements whereby certain local telephone stations are permitted to call through to a distant exchange over the trunk lines interconnecting the two exchanges, and other local telephone stations are automatically barred from connecting with the trunk lines when they attempt to make outgoing trunk calls to the distant exchange.

A still further object of the invention is to provide in the local automatic exchange special service facilities additional to the facilities ordinarily provided for the handling of trunk connections between the local exchange and the distant exchange. These additional facilities include novel means for enabling certain of the local telephone stations to connect automatically with a previously established trunk-line connection whenever such local telephone stations, initiate a call for the particular engaged trunk-line, means for completing outgoing trunk calls for the local telephone stations normally barred from making such calls directly over the trunk lines, and means for establishing a conference circuit connection between any trunk line and two or more local telephone stations.

Another object of the invention is to provide new and novel circuit means in an automatic

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telephone exchange of the foregoing character for accomplishing the various telephone connections in a simple and efficient manner.

A feature of the invention is tht provision of an improved call allotter which controls the extension of marking designations to a single master switch for the purpose of operating the master switch to cause the connection of the non-numerical switches of the local telephone stations to local interconnecting links or two-way trunk lines. The call allotter so controls the extension of the marking designations to the master switch that one local station non-numerical switch is effective at a time and, therefore, there can be no false local link or trunk-line assignments due to simultaneous calls for connections.

Another feature of this invention resides in the circuit arrangement whereby a calling local telephone station is given a distinctive signal when actuating the connect key associated with a previously engaged trunk line for indicating to the calling telephone station that the particular trunk line is in prior use. The calling local telephone station thereupon actuates the connect key associated with another trunk line and, assuming that this latter trunk line is free, the actuation of the second trunk connect key causes the connection of the calling telephone station with the idle trunk line.

A further feature of the invention is the provision in each trunk line of a novel self-locking holding circuit which does not guard the trunk line from another calling local telephone station after the calling local station which set up the holding condition in the particular trunk line releases from the held trunk line. Hence, a local telephone station normally barred from directly connecting with a trunk line for the purpose of making an outgoing trunk call to the distant exchange, can connect with a held trunk line and complete an outgoing call to the distant exchange.

A still further feature of the invention relates to the reduction of switching equipment. Each trunk line from the distant exchange is directly accessible to the non-numerical switches of the local telephone stations, and connections between the trunk lines and the local telephone stations are completed without using the local interconnecting links in any manner.

Another feature of the invention is the accessing of each two-way trunk line from the local telephone stations by means of three separate control leads, each control lead terminating at a different point in the trunk line, thereby providing facilities so that certain local telephone stations can connect with any trunk line on both incoming calls from and outgoing calls to the dis-

tant exchange, other local telephone stations can connect with the trunk lines only when answering incoming trunk calls, and still other local telephone stations can connect with the trunk lines on both incoming and outgoing trunk calls even though the selected trunk line is in prior use.

There are other objects and features of the invention having to do for the most part with the circuit details necessary to carry out the objects and features above mentioned.

The various objects and features of the invention will be understood best from a perusal of the following detail description of the drawings comprising Figs. 1 to 8 inclusive, which show by means of the usual circuit diagrams a sufficient amount of apparatus to enable the invention to be described and understood.

Fig. 1 illustrates, at the left-hand edge, two local station telephone instruments each equipped with a series of interlocking push buttons by means of which a person at the associated station telephone can make and receive local calls, make and receive trunk calls, and hold a trunk call. Two lineswitch circuits, one for station #21 and one for station #20, are shown at the center of Fig. 1. The wipers and banks associated with the two line switches are shown at the right of Fig. 1, together with the multiple connections to other lines switch banks.

Fig. 2 shows, in the upper portion, the "units" and "tens" relays associated with the local stations for permitting one call at a time to be registered for extension to a local interconnecting link or to a distant-exchange trunk circuit. In the lower portion of Fig. 1 are shown the relays which pre-assign a free local interconnecting link.

Fig. 3 shows the portions of local interconnecting links #1, #2 and #3 which co-operate with the relays of Fig. 2 for connecting local stations to the local interconnecting links.

Fig. 4 shows in its lower left-hand corner a master switch for aligning the plungers of the station line switches with the proper contacts of the banks connected to the local interconnecting links and to the distant-exchange trunk circuits. The balance of Fig. 4 shows most of the relays and circuit of local interconnecting link #1.

Fig. 5 shows in its upper right-hand corner the telephone instrument and associated interlocking keys for local station #30. At the upper center, is shown the lineswitch circuit associated with local station #30 and, at the upper left, the wipers and banks of line switch #30 together with the multiple connections to other lineswitch banks. In the lower portion of Fig. 5 are shown two switching relays associated local interconnecting link #1.

Fig. 6 shows the register relays for registering the digits dialled by a calling local station when making a call to another local station.

Fig. 7 shows, in the upper portion, the relays and circuit of distant-exchange trunk #1. In the lower portion of Fig. 7 is a plan illustrating the order in which the drawings may be assembled to form a continuous circuit diagram.

Fig. 8 illustrates in simple diagrammatic form the association of three local interconnecting links and four distant-exchange trunk lines with the banks of the local-station lineswitches.

The telephone system disclosed in Figs. 1 to 7 inclusive is an automatic telephone system wherein all the local telephone stations may connect with each other and may answer incoming calls from a distant exchange, other local telephone stations may also make outgoing calls to the distant exchange, and certain local telephone stations enjoy all of these services and, in addition, may connect with a previously engaged trunk line.

Referring now to Fig. 1, all local stations, such as stations #20 and #21, are each equipped with a standard well-known automatic telephone instrument comprising a cradle-type receiver and transmitter handset piece, a cradle switch and associated contact springs, an induction coil, and a ringer. Since the arrangements of these components and the interwiring of same are well known, no detail circuit diagrams of the instruments are included in Fig. 1, the instruments at stations #20 and #21 being represented by squares 10 and 110 respectively. Associated with each telephone instrument is a set of key switches mechanically interlocked with each other and with the cradle switch in a manner similar to that disclosed in Patent No. 1,783,310 dated December 2, 1930. Each station telephone instrument is fitted with a common local-call connecting key switch, a common trunk-line holding key switch, and an individual connecting key switch for each trunk line. In Fig. 1, two of the individual trunk-line connecting key switches are shown for each of stations #20 and #21, which provides sufficient key switch equipment to illustrate properly the interwiring between the key switches.

Each local station line terminates at the switching equipment in a plunger lineswitch of the well-known 10-trunk self-aligning type such as is disclosed in the patent to Obergfell, No. 1,720,342, issued July 9, 1929, wherein the plunger, when released, returns immediately to the control of a master switch. The lineswitch associated with a local station is "plunged" into a local interconnecting link or a distant-exchange trunk line, as directed by the operation of the related connecting key switch at the local-station telephone, the proper lineswitch bank being selected by the action of the master switch. The master switch is of the well-known solenoid type similar to that disclosed in Patent No. 1,185,510, dated May 30, 1916, in which a U-shaped spring moves the switch wipers step by step in one direction under the control of an escapement and, when the last wiper bank contact has been reached, a solenoid quickly returns the switch wipers back to the starting point.

Each local interconnecting link is permanently wired to two separate trunks of the lineswitch banks, one of these two trunks permitting a calling local station to connect with the link, and the other trunk enabling the calling local station to connect with a desired local station through the link. The distant-exchange trunk lines each have one appearance in the lineswitch banks. The relationship of the links and the distant-exchange trunk lines to the lineswitch bank trunks is shown in simple diagrammatic form in Fig. 8 wherein station A is connected to station B by way of lineswitch 801, link #1 and lineswitch 802: station C to station D by way of lineswitch 803, link #2 and lineswitch 804: station E to trunk line #1 by way of lineswitch 805; and station F to trunk line #2 by way of lineswitch 806. It is obvious that other arrangements of links and trunk lines may be employed.

The local-station lines are divided into groups of ten lines each. For example, group #1 con-

sists of lines #10 to #19 inclusive, and group #2, of lines #20 to #29 inclusive. Similarly, group #3 consists of lines #30 to #39 inclusive, and so on for other groups. In order to simplify the drawings, this disclosure includes equipment for only stations #20 and #21 of group #2 and for station #30 of group #3. It should be understood, however, that groups #2 and #3 respectively consist of stations #20 to #29 inclusive and stations #30 to #39 inclusive, and that related lineswitches, relays, contacts and wiring, although not shown, are similarly provided. Also, other groups can be included.

It should be further understood that while a plurality of battery connections are shown in the drawings, they are preferably the same battery. Also, in order to simplify the drawings further, details of the ringing current, dial and busy tone generators have been omitted, as well as contacts for closing the starting circuits of the generators.

The relay-type call alotter illustrated in Fig. 2 permits one initiated call from the local stations to be registered at a time for extension to a local interconnecting link or to a distant-exchange trunk line. The three local interconnecting links shown in Fig. 8 are allotted in numerical sequence in the manner well known in conventional all-relay systems. The tens relay 220 is associated with local station group #2, and the tens relay 230 with local-station group #3. Tens relays for other local-station groups would be connected in a similar manner. Ten units relays are provided, but only the first units relay (relay 201) and the tenth units relay (relay 210) are shown in Fig. #2, it being understood that units relays 202 to 209 inclusive would be wired in a manner similar to that shown for relays 201 and 210. The energizing circuits for the tens relays and the units relays are each chained in series circuits through the respective relays for preventing more than one tens relay and one units relay from operating at one time. Hence, a second local station cannot be connected with a local link or a trunk line while another local station is being connected with a local link or a trunk line. The tens relay chain circuit is continued in series through relays 310, 320 and 330 of local links #1, #2 and #3 for preventing a local link from connecting a called local station with the link while another station is being connected with a local link or a trunk line, and vice versa.

The six relays designated 610 to 660 inclusive in Fig. 6 register the impulses from a local station making a local call. These relays advance in the well known manner, in accordance with the digit dialed, digit "1" operating relay 610, digit "2" relays 610 and 620 in succession, and so on with digit "6" operating relays 610, 620, 630, 640, 650 and 660 in succession. Digit "7" operates relay 610 a second time: digit "8," relays 610 and 620 a second time: digit "9," relays 610, 620 and 630 a second time; and digit "0" relays 610, 620, 630 and 640 a second time.

Facilities are provided so that certain local stations may be restricted from making outgoing calls over the distant-exchange trunk lines. Provision is also made for conference service on trunk calls.

The invention having been described generally, a detailed operation of the equipment will now be given. For this purpose it will be assumed that the call allotter shown in Fig. 2 has pre-assigned local interconnecting link #1, and that there are no local or trunk calls in progress. With these conditions of operation, the equipment is in the position shown in the drawings.

Local calls

Briefly, local calls are completed in the following manner: The person at the calling station lifts the handset piece from the cradle of the telephone, depresses the local-call connecting key into the operated position where it locks and, after receiving dial tone, dials the telephone number of the desired local station. If the called station is not busy, the station will be rung automatically and intermittently. If the called station is in use, the person at the calling station will receive busy tone. The release of the local connection is under the control of the person at the calling station.

In order to describe a local call in detail, it will now be assumed that station #20 desires to call station #30. Responsive to the lifting of the handset piece and the subsequent depressing of the local-call connecting key at station #20, line relay 20 is operated from ground by way of contact 43 of station #20 lineswitch, conductor 82, contact 13 of local-call connecting key, direct-current loop through telephone 10, conductor 81, contact 44 of station #20 lineswitch, winding of relay 20 to negative battery. At armature 24, relay 20 completes the circuit to tens relay 220 from ground by way of contact 35 of station #20 lineswitch, armature 24, conductor 269, winding of relay 220, armatures 225, 241, conductor 273, armatures 315, 325, 335, conductor 274, armatures 235, 227, resistance 219 to negative battery. Tens relay 220 operates and locks to ground by way of conductor 269, winding of relay 220, armature 226, resistance 219 to negative battery.

At armature 223, tens relay 220 completes the circuit to units relay 210 from ground by way of contact 34 of station #20 lineswitch, armature 23, conductor 268, armature 223, winding of units relay 210, armatures 212, 242, 214, 205, resistance 208 to negative battery. Units relay 210 operates and locks to ground by way of conductor 268, armature 223, winding of units relay 210, armatures 213, 205, resistance 208 to negative battery. At armature 216, units relay 210 connects ground to the local start conductor 263 by way of armatures 216, 217, conductor 264, contact 12 of local-call connecting key, conductor 83, armature 21 to local start conductor 263. Ground on the local start conductor 263 completes the circuit to start relay 350 of local interconnecting link #1 by way of armature 246 and working contact, conductor 278, winding of start relay 350 to negative battery, causing start relay 350 to operate. Local interconnecting link #1 was pre-assigned for use in this call in the manner described in the following paragraph.

The local interconnecting links are pre-assigned in numerical sequence by means of the call allotter relays 245, 250, 255 and 260 operating in a cyclic manner well known in all-relay systems. Relay 245 is associated with link #1, relay 250 with link #2, relay 255 with link #3, and relay 260 is common to relays 245, 250 and 255. When all four relays are at normal, the circuit to relay 260 is completed from ground, armatures 247, 252, 257, winding of relay 260 to negative battery, causing relay 260 to operate. At armature 261, relay 260 completes the circuit to relay 245 from ground, armature 261, resting contact of armature 246, conductor 264.

busy switch 355, conductor 345, armature 415, conductor 344, conductor 279, upper winding of relay 245 to negative battery Relay 245 operates and locks to ground, lower winding of relay 245, armature 248 and working contact, conductor 284, busy switch 355, conductor 345, armature 415, conductor 344, conductor 279, upper winding of relay 245 to negative battery. At armature 246 and working contact relay 245 extends local start conductors 263 and 249 to start relay 350, thereby pre-assigning link #1. In a like manner to that just described for the operation and locking of relay 245, relay 260 also causes relays 250 and 255 to operate and lock. At armature 251 and working contact, relay 250 closes a point in the circuit of start relay 360 associated with link #2; and, at armature 256 and working contact, relay 255 similarly closes a point in the circuit of start relay 370 associated with link #3. It is obvious that start relay 360 of link #2 cannot be extended to local start conductors 263 and 249 until relay 245 associated with link #1 is restored, and that start relay 370 of link #3 cannot be extended to local start conductors 263 and 249 until both relay 245 associated with link #1 and relay 250 associated with link #2 are restored. Relay 245 is restored when link #1 is seized by a call originated by a local station, and relay 250 then extends local start conductors 263 and 249 to start relay 360, thereby pre-assigning link #2. In a similar manner, relay 255 extends local start conductors 263 and 249 to start relay 370 when relay 250 restores, thereby pre assigning link #3. When relay 255 restores as link #3 is seized, the circuit to relay 260 is completed from ground, armatures 247, 252 and 257 in series, winding of relay 260 to negative battery, causing relay 260 to operate and again complete the operating circuits to relays 245, 250 and 255. With all three relays 245, 250 and 255 operated and locked, link #1 is again pre-assigned to local start conductors 263 and 249. Relay 260 is slow to release, and armatures 248, 253 and 258 are fitted with contacts of the make-before-break type, to insure that relays 245, 250 and 255 will be locked in the operated positions.

Returning now to the description of the call originated at local station #20, start relay 350 is operated in the manner previously described. At armature 353, relay 350 completes the circuit to relay 240 in the call allotter from ground, armature 353, conductor 275, winding of relay 240 to negative battery; and, at armature 351, connects ground to the contact at the top of master switch bank 428 by way of conductor 342 to mark the answering end of link #1 in master switch bank 428. At armature 352, relay 350 completes the circuit to lock magnet 490 of the master switch from ground, armature 352, conductor 166, armature 486, winding of lock magnet 490 to negative battery; and, at armature 354, completes a multiple holding circuit to relay 245 to insure that relay 245 will remain locked until start relay 350 is restored. The ground on the top contact of master switch bank 428 completes the circuit to stop magnet 485 by way of contact 483 of trip magnet 480, causing stop magnet 485 to operate and open the circuit to lock magnet 490 at armature 486 before lock magnet 490 has had sufficient time to operate. The master switch, therefore, does not move from the bank position shown in Fig. 4, and the plungers of all lineswitches are aligned with the

corresponding trunk to the answering end of link #1.

The operation of stop magnet 485 also completes the circuit to pull-down magnet 40 of station #20 lineswitch from ground by way of armature 488, conductor 272, armatures 211, 221, conductor 270, conductor 254, winding of pull-down magnet 40 to negative battery, the operation of pull-down magnet 40 causing the plunger of station #20 lineswitch to plunge into the bank trunk connected to the answering end of link #1. The direct-current loop of station #20 telephone is thus extended to link #1 by way of conductor 81, bank contact 50', conductor 171, upper winding of line relay 405, negative battery, ground, lower winding of line relay 405, conductor 172, bank contact 52', conductor 82, and contact 13 of local-call connecting key, causing line relay 405 in link #1 to operate.

The operation of pull-down magnet 40 also operates contacts 32, 33, 34, and 35 through the medium of armature 31, and contacts 42, 43 and 44 through the medium of armature 41. Contact 43 completes a holding circuit for pull-down magnet 40 from ground, contact 43 and working spring, contact 12 of local-call connecting key, conductor 83, bank contact 51', conductor 254, winding of pull-down magnet 40 to negative battery, thus retaining station telephone #20 connected to link #1 as long as the calling person keeps the handset piece from the telephone cradle. At the resting spring of contact 43, ground is removed from line conductor 82; and, at contact 44, line relay 20 is disconnected from line conductor 81, causing line relay 20 to restore. The line circuit of station #20 is now clear of attachments. At contact 34, the circuit to units relay 210 is opened, causing units relay 210 to restore; and, at contact 35, the circuit to tens relay 220 is opened, causing tens relay 220 to restore. Contacts 42, 32 and 33 perform no functions at this time. Line relay 20 restoring opens additional points in the circuits to tens relay 220 and units relay 210 at armatures 24 and 23 respectively, and, at armature 21, removes ground from local start conductor 263, causing start relay 350 to restore.

The operation of line relay 405 in link #1 completes the circuit to relay 410 from ground by way of bank contact 53', conductor 173, armature 406, winding of relay 410 to negative battery, causing relay 410 to operate and lock to ground on conductor 173 by way of armature 412. At armature 414, relay 410 completes the circuit to relay 435 from ground, armatures 414, 423, winding of relay 435 to negative battery, causing relay 435 to operate; and, at armature 415, opens the circuit of relay 245 in the call allotter, causing relay 245 to restore. At armature 246 and resting contact, relay 245 transfers local start conductors 263 and 249 to start relay 360 of link #2. The restoration of relay 245 makes link #1 busy to other calls because the circuit to start relay 350 is open at the working contact of armature 246.

At armature 351, start relay 350 of link #1 upon restoring removes ground from the top contact of master switch bank 428, causing stop magnet 485 to restore: at armature 352, opens the circuit to lock magnet 490 (now closed at armature 486) before lock magnet 490 has had sufficient time to operate; and, at armature 353, opens the circuit to relay 240 of the call allotter. The call allotter is now in a position to accept another call, with link #2 pre-assigned to local

start conductors 263 and 249. The restoration of tens relay 220 and units relay 210 open additional points in the circuits previously opened by the restoration of line relay 20.

Dial tone is returned from link #1 to the calling person at station #20 by way of armatures 583, 563, conductor 474, armature 436, and condenser 408 as a signal to dial the number of station #30. When the calling person at station #20 dials the digit "3," line relay 405 in link #1 correspondingly de-energizes and re-energizes three times. With the first de-energization of line relay 405, the circuit to relay 425 is completed from ground, armatures 407, 413, 422, winding of relay 425 to negative battery, causing relay 425 to operate. A multiple circuit is also completed from armature 407 by way of armatures 413, 422, conductor 347, armatures 691, 686, 681 and associated resting contacts, winding of register relay 610 to negative battery, causing relay 610 to operate and lock to ground by way of armatures 414, 441, conductor 442, armature 687, winding of relay 680 and armature 613, relay 680 operating on this locking circuit. The second re-energization of line relay 405 completes the circuit to register relay 620 from ground, armatures 407, 413, 422, conductor 347, armatures 691, 686 and associated resting contacts, armature 681 and working contact, armature 614, winding of register relay 620 to negative battery, causing register relay 620 to operate and lock from ground, armatures 414, 441, conductor 442, armature 692, winding of relay 685 and armature 624, relay 685 operating on this locking circuit. At armature 687, relay 685 opens the locking circuit to relays 680 and 610, causing these two relays to restore. The third de-energization of line relay 405 completes the circuit to register relay 630 from ground, armatures 407, 413, 422, conductor 347, armature 691 and resting contact, armature 686 and working contact, armature 625, winding of register relay 630 to negative battery, causing register relay 630 to operate and lock from ground, armatures 414, 441, conductor 442, armature 682, winding of relay 690 and armature 634, relay 690 operating on this locking circuit. At armature 692, relay 690 opens the locking circuit to relays 685 and 620, causing these two relays to restore. Shortly after the third re-energization of line relay 405, relay 425 restores, its slow-to-release action preventing its release during the dialling of the digit "3."

At armature 427, relay 425 completes the circuit to relay 560 from ground, armature 693, conductor 348, armatures 427, 457 and resting contact, conductor 444, armature 633, conductor 616, winding of relay 560 to negative battery, causing relay 560 to operate. At armature 563, relay 560 opens the dial tone circuit to station #20. At armature 561, relay 560 completes the circuit to relay 440 from ground, armature 414, conductor 433, armature 561, conductor 434, armature 456, winding of relay 440 to negative battery, causing relay 440 to operate. At armature 441, relay 440 opens the locking circuit to relays 690 and 630, causing these two relays to restore. As a result of relay 630 restoring and, at armature 633, removing ground from the winding of relay 560, relay 455 operates in series with relay 560 over the circuit from ground, armature 414, winding of relay 455, conductor 439, armature 562, winding of relay 560 to negative battery, this circuit also retaining relay 560 in the operated position. At armature 456, relay 455 opens the circuit to relay 440, causing relay 440 to restore. The register

relays are now in position to receive the second digit from the calling station.

When the calling person at station #20 dials the second digit "0," line relay 405 in link #1 correspondingly de-energizes and re-energizes ten times. With the first de-energization of line relay 405, the circuit is completed to relay 425 from ground, armatures 407, 413, 422, winding of relay 425 to negative battery, causing relay 425 to operate. A multiple circuit is also completed from armature 407 to register relay 610, causing register relay 610 to operate and lock in series with relay 680 in the manner previously described. The second de-energization of line relay 405 causes register relay 620 to operate and lock in series with relay 685 in the manner previously described. At armature 687, relay 685 opens the locking circuit to relays 680 and 610, causing these two relays to restore. The third de-energization of line relay 405 causes register relay 630 to operate and lock in series with relay 690 in the manner previously described. At armature 692, relay 690 opens the locking circuit to relays 685 and 620, causing these two relays to restore. The fourth de-energization of line relay 405 completes the circuit to register relay 640 from ground, armatures 407, 413, 422, conductor 347, armature 691 and working contact, armature 635, winding of register relay 640 to negative battery, causing relay 640 to operate and lock to ground by way of conductor 442, armature 687, winding of relay 680, and armature 643, relay 680 operating on this locking circuit. At armature 682, relay 680 opens the locking circuit to relays 690 and 630. The fifth de-energization of line relay 405 completes the circuit to register relay 650 from ground, armatures 407, 413, 422, conductor 347, armatures 691, 686 and associated resting contacts, armature 681 and working contact, armature 644, winding of relay 650 to negative battery, causing relay 650 to operate and lock to ground by way of conductor 442, armature 692, winding of relay 685, and armature 652, relay 685 operating on this locking circuit. At armature 687, relay 685 opens the locking circuit to relay 680 and 640.

The sixth de-energization of line relay 405 completes the circuit to register relay 660 from ground, armatures 407, 413, 422, conductor 347, armature 691 and resting contact, armature 686 and working contact, armature 653, winding of relay 660 to negative battery, causing relay 660 to operate and lock to ground by way of conductor 442, armature 682, winding of relay 690 and armature 663, relay 690 operating on this locking circuit. At armature 692, relay 690 opens the locking circuit to relays 685 and 650. At armature 662, relay 660 completes the circuit to relay 670 from ground, armatures 414, 458, conductor 443, armature 662, winding of relay 670 to negative battery, causing relay 670 to operate and lock to ground on conductor 443 by way of armature 675. The seventh de-energization of line relay 405 completes the circuit to register relay 610 from ground, armatures 407, 413, 422, conductor 347, armature 691 and working contact, armature 664, winding of relay 610 to negative battery, causing relay 610 to operate and lock to ground by way of conductor 442, armature 687, winding of relay 680, and armature 613, relay 680 operating on this locking circuit. At armature 682, relay 680 opens the locking circuits to relays 690 and 660. The eighth de-energization of line relay 405 causes register relay 620 to operate and lock in series with relay 685 in the manner previously described. At armature 687, relay 685 opens the

locking circuits to relays 680 and 610. The ninth de-energization of line relay 405 causes register relay 630 to operate and lock in series with relay 690 in the manner previously described. At armature 692, relay 690 opens the locking circuit to relays 685 and 620. The tenth de-energization of line relay 405 causes register relay 640 to operate and lock in series with relay 680. At armature 682, relay 680 opens the locking circuits to relays 690 and 630.

Shortly after the tenth re-energization of line relay 405, relay 425 restores, its slow-to-release action preventing its release during the dialling of the digit "0." At armature 427, relay 425 completes the circuit to relay 420 from ground, armature 683, conductor 348, armatures 427, 457 and working contact, winding of relay 420 to negative battery, causing relay 420 to operate. At armature 424, relay 420 connects the winding of busy relay 445 to the winding of pull-down magnet 540 of the dialled station #30 by way of armature 438 and working contact, armatures 426, 424, conductor 346, armature 671 and working contact, armature 642, conductor 648, and armature 570, but neither busy relay 445 or pull-down magnet 540 can operate under this condition as both are connected to negative battery.

Should station #30 be in use at this moment, pull-down magnet 540 would have been operated by ground on conductor 554, and this ground multipled to armature 570 will now operate busy relay 445 by way of conductor 648, armatures 642, 671 and working contact, conductor 346, armatures 424, 426, 438 and working contact (before relay 435 has time to restore due to its circuit being opened at armature 423), winding of busy relay 445 to negative battery, causing busy relay 445 to lock to ground by way of armatures 414, and 447 and working contact. At armature 446, busy relay 445 extends busy tone to the station #20 telephone to inform the calling person that station #30 is in use.

Should station #30, however, not be in use at the moment, busy relay 445 in line #1 will not operate because the negative battery through the winding of busy relay 445 meets the negative battery through pull-down magnet 540 of the dialled station #30. Under this condition, relay 435 upon restoring shortly afterward because its circuit was opened at armature 423, completes the circuit to relay 310 from ground, armatures 414, 447 and resting contact, 451, 437, 421, conductor 343, winding of relay 310, armatures 313, 315, 325, 335, conductor 274, armatures 235, 227, resistance 219 to negative battery. Relay 310 operates and locks to ground on conductor 343 by way of winding of relay 310, armatures 314, 325, 335, conductor 274, armatures 235, 227, resistance 219 to negative battery. Relay 310 is wired in the chain circuit of the tens relays 220 and 230 (Fig. 2) in the call allotter in order that the master switch will be operative by one call at a time. At armature 311, relay 310 grounds the fourth contact from the top of master switch bank 428 by way of conductor 339; and, at armature 312, completes the circuit to lock magnet 490 of the master switch from ground, armature 312, conductor 166, armature 486, winding of lock magnet 490 to negative battery, causing lock magnet 490 to operate.

The operation of lock magnet 490 causes armature 491 to disengage lock lever 492 from the tenth notch in sector 476, and U-spring 489 drives sector 476 counter-clockwise, sector 476 being pivoted at 477. As wiper 428 of the master switch makes contact with the fourth contact from the top of bank 428, the circuit to stop magnet 485 is completed from ground, armature 311, conductor 339, wiper 428 in engagement with the fourth contact from the top of bank 428, contact 483 of trip magnet 480, winding of stop magnet 485 to negative battery. The operation of stop magnet 485 opens the circuit to lock magnet 490 at contact 486, causing armature 491 to restore and permit lock lever 492 to engage the fourth notch from the right in sector 476, thereby arresting the motion of sector 476. The plungers of all idle lineswitches (in this disclosure the plungers of lineswitches #21 and #30) are correspondingly aligned by the master switch shaft in the well-known manner opposite the bank trunk connected to the calling end of link #1. As wiper 429 of the master switch makes contact with the fourth contact from the top of bank 429, the circuit to the pull-down magnet 540 of the dialled station #30 is completed from ground, armature 487, wiper 429 in engagement with the fourth contact from the top of bank 429, resting contact of armature 452, armatures 448, 438, 426, 424, conductor 346, armature 671 and working contact, armature 642, conductor 648, armature 570, winding of pull-down magnet 540 to negative battery, the operation of pull-down magnet 540 causing the plunger of station #30 lineswitch to plunge into the bank trunk connected to the calling end of link #1. Conductors 471 and 472 of link #1 are thus extended to station #30 line circuit by way of bank contact 550' and 552' respectively, and the circuit to relay 450 is completed from ground, bank contact 553', conductor 473, winding of relay 450 to negative battery, causing relay 450 to operate. At armature 451, relay 450 opens the circuit to relay 310, causing relay 310 to restore. The restoration of relay 310 frees the call allotter and the master switch for use in another call. At armature 452 and working contact, relay 450 shifts the holding circuit of pull-down magnet 540 to ground by way of armature 414.

The operation of pull-down magnet 540 also operates contacts 532, 533, 534 and 535 through the medium of armature 531, and contacts 542, 543 and 544 through the medium of armature 541. At the resting spring of contact 543, ground is removed from line conductor 582; and, at contact 544, line relay 520 is disconnected from line conductor 581. The line circuit of station #30 is thus cleared of attachments in preparation of the ringing circuit to station #30 telephone 510. Contacts 532, 533, 534, 535 and 542 perform no functions at this time. The ringing loop to station #30 telephone 510 is completed from ground in link #1 by way of armature 431 and resting contact, conductor 471, bank contact 550', conductor 581, ringer loop in telephone 510, conductor 582, bank contact 552', conductor 472, armature 433 and resting contact, upper winding of ringing cut-off relay 430 to interrupted generator. The ringer at station #30 telephone 510 is operated automatically and intermittently until the called station answers or the calling person at station #20 abandons the call.

Responsive to the closing of the direct-current line loop when the handset piece at telephone 510 is lifted from the cradle and the related local-call connecting key is depressed, ringing cut-off relay 430 operates and locks to ground by way of armatures 411 and 432. At the resting contacts of armatures 431 and 433, relay 430 disconnects the ringing current from station #30 line circuit;

and, at armatures 431 and 433 and associated working contacts, completes the talking circuit between stations #20 and #30. Transmission battery is supplied to station #20 telephone through the windings of line relay 405, and to station #30 telephone through the windings of impedance coil 417. The depressing of the local-call connecting key at telephone 510 into the locked operated position causes a multiple circuit for pull-down magnet 540 to be completed from ground, working spring of contact 543, contact 512 of local-call connecting key, conductor 583, bank contact 551', conductor 554, winding of pull-down magnet 540 to negative battery.

After the conversation between the persons at stations #20 and #30 has been completed, and responsive to the calling person at station #20 returning his handset piece to the telephone cradle, the local-call connecting key at telephone 10 is automatically released and returns to the normal position. The holding circuit of pull-down magnet 40 is, consequently, opened at contact 12 of the local-call connecting key, and the plunger of station #20 lineswitch is withdrawn from the bank trunk leading to the answering end of link #1. The bank contacts 50', 51', 52' and 53' are opened by the withdrawal of station #20 lineswitch plunger, and the plunger is automatically aligned with the shaft of the master switch in the well-known manner. Responsive to the called person at station #30 returning his handset to the cradle, the local-call connecting key at telephone 510 is automatically released and returns to the normal position, opening the multiple holding circuit to pull-down magnet 540 at contact 512. Pull-down magnet 540, however, is held in the operated position over the circuit through armature 570 of relay 560.

The restoration of armature 41 by the release of pull-down magnet 40 opens an additional point in the circuit of pull-down magnet 40 at the working spring of contact 43: at contact 43 and resting spring, connects ground to line conductor 82 of station #20; and, at contact 44, connects line relay 20 of station #20 lineswitch to line conductor 81. The line circuit of station #20 is now at normal.

Line relay 405 of link #1 is restored when its loop circuit is opened by the replacement of the handset piece on the cradle at station #20. The locking circuit to relay 410 of link #1 is opened at bank contact 53', and relay 410 restores. At armature 411, relay 410 opens the locking circuit to ringing cut-off relay 430, causing relay 430 to restore. At armature 414, relay 410 opens the holding circuits to relays 455 and 560 in series, the holding circuit to relays 680 and 640 in series, the holding circuit to relay 670, and the holding circuit to pull-down magnet 540 of station #30 lineswitch, causing these five relays and pull-down magnet 540 to restore. At armature 457, relay 455 opens the circuit to relay 420, relay 420 restoring.

The restoration of pull-down magnet 540 of station #30 lineswitch causes the withdrawal of the associated plunger from the bank trunk leading to the calling end of line #1. The bank contacts 550', 551', 552' and 553' are opened by the withdrawal of station #30 lineswitch plunger, and the plunger is automatically aligned with the shaft of the master switch. The circuit to relay 450 is opened at bank contact 553', and relay 450 restores. Link #1 is now in the normal position, available for re-assignment to

other calls in numerical sequence with links #2 and #3.

The restoration of armature 541 by the release of pull-down magnet 540 opens an additional point in the circuit of pull-down magnet 540 at the working spring of contact 543: at contact 543 and resting spring, connects ground to line conductor 582 of station #30; and, at contact 544, connects line relay 520 of station #30 lineswitch to line conductor 581. The line circuit of station #30 is now at normal.

Local interconnecting links #2 and #3 are also used to complete local connections in a manner similar to that just described for link #1 with the minor exceptions that start relays 360 and 370 respectively are employed instead of start relay 350, and correspondingly related bank contacts are utilized instead of the bank contacts mentioned in the foregoing description.

Outgoing trunk calls

Any non-restricted local station may originate an outgoing trunk call to the distant exchange by lifting the handset piece from the telephone cradle and depressing one of the trunk-line connecting keys into the operated position where it locks. If the trunk line thus selected is in use, busy tone will be returned to the telephone at the calling local station, and the calling person thereupon depresses another trunk-line connecting key, the operation of the latter key automatically releasing the first mentioned connecting key. Assuming now that the second selected trunk line is free, then the calling person is connected through to the distant exchange over that trunk line, and dial tone is returned to the calling person if the distant exchange is of the automatic type, or an operator responds to the call if the distant exchange is of the manual type.

Assuming further that the selected free trunk line is trunk line #1, that the call is originated at station #30, (Fig. 5) and that no other calls are in progress, then line relay 520 is operated from ground by way of contact 543 of station #30 lineswitch, conductor 582, contact 515 of trunk-line #1 connecting key, direct-current loop through telephone 510, conductor 581, contact 544 of station #30 lineswitch, winding of relay 520 to negative battery. At armature 524, relay 520 completes the circuit to tens relay 230 from ground by way of contact 535 of station #30 lineswitch, armature 524, conductor 209 in cable 285 through Figs. 6 and 3 to Fig. 2, conductor 209 in Fig. 2, winding of relay 230, armatures 233, 241, conductor 273, armatures 315, 325, 335, conductor 274, armatures 235, 227, resistance 219 to negative battery. Tens relay 230 operates and locks to ground by way of conductor 209, winding of relay 230, armatures 234, 227, resistance 219 to negative battery.

At armature 232, tens relay 230 completes the circuit to units relay 210 from ground by way of contact 534 of station #30 lineswitch, armature 523, conductor 219 in cable 285 through Figs. 6 and 3 to Fig. 2, conductor 219 in Fig. 2, armature 232, winding of units relay 210, armatures 212, 242, 214, 205, resistance 208 to negative battery. Units relay 210 operates and locks to ground by way of conductor 219, armature 232, winding of units relay 210, armatures 213, 205, resistance 208 to negative battery. At armature 216, units relay 210 connects ground to trunk start relay 780 of trunk line #1 by way of armatures 216, 237, conductor 239 in cable 285 through Figs. 3 and 6 to Fig. 5, conductor 239 in Fig. 5, con-

tact 514 of trunk-line #1 connecting key, armature 525, conductor 783, armature 774 and resting contact, winding of relay 780 to negative battery, causing relay 780 to operate. At armature 782, relay 780 connects ground to the fourth contact from the left of master switch bank 428 by way of conductor 165 to mark trunk line #1 in master switch bank 428. At armature 781, relay 780 completes the circuit to lock magnet 490 of the master switch from ground, armature 781, conductor 166, armature 486, winding of lock magnet 490 to negative battery. The operation of lock magnet 490 causes armature 491 to disengage lock lever 492 from sector 476, and U-spring 489 drives sector 476 counter-clockwise.

Assuming now that wiper 428 of the master switch is in engagement with the third contact from the left of bank 428 (this bank contact representing trunk line #2) when lock lever 492 is withdrawn from sector 476, then the counter-clockwise motion of sector 476 causes wiper 428 to successively engage the second bank contact from the left and then the first contact. At this point, finger 478 of sector 476 is almost in mechanical contact with finger springs 484 associated with trip magnet 480. Further counter-clockwise movement of sector 476 causes sector finger 478 to close the contacts of finger springs 484, and the circuit to trip magnet 480 is thereby completed from ground, contact 494 of lock magnet 490, finger springs 484, winding of trip magnet 480 to negative battery, causing trip magnet 480 to operate. At contact 482, trip magnet 480 completes the circuit to solenoid 475, and solenoid 475 overcomes the power in U-spring 489, driving sector 476 clockwise. Just after this reverse movement of sector 476 is started, sector finger 478 moves from engagement with finger springs 484, but latch 419 is in mechanical engagement with the tip of the operating spring of contact 482, thus retaining armature 481 and contact 482 operated in the manner well known in this type of master switch. Hence, the circuit to solenoid 425 remains complete at contact 482.

As sector 476 reaches its extreme clockwise position, sector finger 479 lifts the spring attached to latch 419 sufficiently to release latch 419 from engagement with the operating spring of contact 482. Armature 481 is thus restored and the circuit to solenoid 475 is opened at contact 482. At this point, U-spring 489 starts driving sector 476 counter-clockwise because lock magnet 490 is still in the operated position and sector 476 is free from lock lever 492. As wiper 428 makes contact with the fourth contact from the left of bank 428, the circuit to stop magnet 485 is completed from ground, armature 782, conductor 165, fourth contact from the left of bank 428, wiper 428, contact 483, winding of stop magnet 485 to negative battery, causing stop magnet 485 to operate. The operation of stop magnet 485 opens the circuit to lock magnet 490 at contact 486, causing armature 491 to restore and permit lock lever 492 to engage the fourth notch from the left in sector 476, thereby arresting the motion of sector 476. The plungers of all idle lineswitches are now aligned opposite the bank trunk connected to trunk line #1.

The operation of stop magnet 485 also completes the circuit to pull-down magnet 540 of station #30 lineswitch from ground by way of armature 488, conductor 272, armatures 211, 231, conductor 208 in cable 285 through Figs. 3 and 6 to Fig. 5, conductor 208 in Fig. 5, winding of pull-down magnet 540 to negative battery, the operation of pull-down magnet 540 causing the plunger of station #30 lineswitch to plunge into the bank trunk connected to trunk line #1. The direct-current loop of station #30 telephone is thus extended to trunk line #1 by way of conductor 581, bank contact 550^T, conductor 161, upper winding of relay 760, armature 732 and resting contact, conductor 701, trunk line #1 line relay loop at the distant exchange, conductor 702, armature 734 and resting contact, lower winding of relay 760, conductor 162, bank contact 552^T, conductor 582, and contact 515 of trunk-line #1 connecting key, causing the line relay at the distant exchange to operate in a conventional manner. Relay 760 does not operate over the circuit just traced because its windings are differentially connected and now oppose each other. The closing of bank contact 553^T completes the circuit to relay 770 from ground, bank contact 553^T, conductor 163, winding of relay 770 to negative battery, causing relay 770 to operate. At the resting contact of armature 774, relay 770 opens the circuit to trunk start relay 780, causing relay 780 to restore: at armature 774 and working contact, switches trunk start conductor 783 to conductor 164, thereby making trunk line #1 busy to other calls; and, at armature 772, disconnects ringing relay 720 from across the trunk line, thus clearing the trunk line of attachments.

The operation of pull-down magnet 540 also operates contacts 532, 533, 534 and 535 through the medium of armature 531, and contacts 542, 543 and 544 through the medium of armature 541. Contact 543 completes a holding circuit for pull-down magnet 540 from ground, contact 543 and working spring, contact 514 of trunk-line #1 connecting key, conductor 584, bank contact 551^T, conductor 554, winding of pull-down magnet 540 to negative battery, thus retaining station #30 telephone connected to trunk line #1 as long as the calling person keeps the handset piece from the telephone cradle. At the resting spring of contact 543, ground is removed from line conductor 582; and, at contact 544, line relay 520 is disconnected from line conductor 581, causing line relay 520 to restore. The line circuit of station #30 is now clear of attachments. At contact 534, the circuit to units relay 210 is opened, causing units relay 210 to restore; and, at contact 535, the circuit to tens relay 230 is opened, causing tens relay 230 to restore. Contacts 542, 532 and 533 perform no functions at this time. Line relay 520 restoring opens additional points in the circuits to tens relay 230 and units relay 210 at armatures 524 and 523 respectively; and, at armature 525, removes ground from trunk start conductor 783.

At armature 782, relay 780 of trunk line #1 upon restoring removes ground from the fourth contact from the left of master switch bank 428, causing stop magnet 485 to restore; and, at armature 781, opens a point in the circuit to lock magnet 490. The call allotter is now in a position to accept another call. The restoration of tens relay 230 and units relay 210 opens additional points in the circuits previously opened by the restoration of line relay 520.

Should the distant exchange be of the automatic type, dial tone is returned to the calling person at station #30 as a signal to proceed with the dialling. In response to the dialling at station #30, the switches in the distant exchange

are operated in the well-known manner to complete the connection desired. Transmission battery is supplied to station #30 telephone from the distant exchange.

Should the distant exchange be of the manual type, the operation of the line relay at the distant exchange causes the related line signal on the manual switchboard to indicate that a call is awaiting attention on trunk line #1. In response to the operator at the distant exchange answering the call, the calling person at station #30 advises the operator of the connection desired, and thereupon the operator proceeds with the completing of the desired connection in the well-known manner. In this instance also, transmission battery is supplied to station #30 telephone from the distant exchange.

After the conversation between station #30 and the distant exchange has been completed, and responsive to the calling person at station #30 returning his handset piece to the telephone cradle, the trunk-line #1 connecting key at telephone 510 is automatically released and returns to the normal position. The holding circuit of pull-down magnet 540 is opened at contact 514 of trunk-line #1 connecting key, and the plunger of station #30 lineswitch is withdrawn from the bank trunk leading to trunk line #1. The bank contacts 550^T, 551^T, 552^T and 553^T are opened by the withdrawal of station #30 lineswitch plunger, and the plunger is automatically aligned with the shaft of the master switch in the well-known manner. The opening of the direct-current loop to the distant exchange by the replacement of the handset piece on the cradle at station #30 causes the equipment at the distant exchange to be restored. If the distant exchange is of the automatic type, the switches are released in the well-known manner and trunk line #1 is made available for other calls. In the case where the distant exchange is manual, the operator receives disconnect supervision when the calling person at station #30 replaces the handset piece on the cradle. At bank contact 553^T, the circuit to relay 770 is opened, causing relay 770 to restore. At armature 774 and resting contact, relay 770 switches trunk start relay 780 to truck start conductor 783, thus making trunk line #1 available to calls from local stations. At armature 772 and resting contact, relay 770 bridges ringing relay 720 across trunk line #1, making trunk line #1 available to calls from the distant exchange.

The restoration of armature 541 by the release of pull-down magnet 540 opens an additional point in the circuit of pull-down magnet 540 at the working spring of contact 543: at contact 543 and resting spring, connects ground to line conductor 582 of station #30; and, at contact 544, connects line relay 520 of station #30 lineswitch to line conductor 581. The line circuit of station #30 is now at normal.

Considering now the case where trunk line #1 is in use at the time the trunk-line #1 connecting key at station #30 is depressed for the origination of an outgoing call to the distant exchange, then the operation of line relay 520 of station #30 lineswitch does not complete the circuit to trunk start relay 780 of trunk line #1 through contact 514 of trunk-line #1 connecting key, contact 525 of line relay 520 and trunk start conductor 783 as was previously described for the case where trunk line #1 was not in use. Instead, ground on trunk start conductor 783 by way of contacts 514 and 525 is extended through armature 774 and working contact, conductor 164, armatures 215, 236, conductor 238 in cable 285 through Figs. 3 and 6 to Fig. 5, conductor 233 in Fig. 5 to winding of cut-off magnet 530 of station #30 lineswitch and negative battery, thus causing cut-off magnet 530 to operate. In this instance, the plunger of lineswitch #30 does not plunge into the bank trunk connected to trunk line #1 because cut-off magnet 530 operates armature 531 only. Cut-off magnet 530 locks to ground by way of contacts 533 and 522, and connects busy tone to line conductor 581 by way of contacts 542 and 532 to inform the calling person that trunk line #1 is in use. The handset piece is then replaced on the cradle to open the circuit of line relay 520 which in turn opens the locking circuit of cut-off magnet 530 at armature 522, and cut-off magnet 530 restores and disconnects busy tone from line conductor 581 at contact 532. The calling person at station #30 may then originate a trunk call over another trunk line by lifting the handset piece and depressing a trunk-line connecting key other than trunk-line #1 connecting key.

Considering now the case where a local station is restricted from making outgoing calls to the distant exchange, the trunk start conductors from the lineswitch of such a restricted station are not connected to the respective trunk start relays (such as relay 780 through armature 774 and resting contact for trunk line #1). Instead, each trunk start conductor from the respective contact of the restricted station's lineswitch is connected to an armature of another relay in the trunk-line circuit. For example, station #21 is indicated as being restricted from making outgoing calls to the distant exchange, and trunk start conductor 167 from contact 125 of line relay 120 is shown connected to armature 713 of trunk line #1 instead of to armature 774 as is the case of start conductor 783 from contact 525 of line relay 520. Now, when the calling person at station #21 lifts the handset piece from the cradle and depresses trunk-line #1 connecting key, the circuit to cut-off magnet 130 of station #21 lineswitch is completed from ground by way of armatures 207, 218, conductor 262, contact 114 of trunk-line #1 connecting key, armature 125, conductor 167, armature 713 and resting contact, armature 735 and resting contact, conductor 164, armatures 206, 229, conductor 265, winding of cut-off magnet 130 to negative battery, causing cut-off magnet 130 to operate. In this instance, the plunger of lineswitch #21 does not plunge into the bank trunk connected to trunk line #1 because cut-off magnet 130 operates armature 131 only. Cut-off magnet 130 locks to ground by way of contacts 133 and 122, and connects busy tone to line conductor 181 by way of contacts 142 and 132 to inform the calling person that he cannot connect with trunk line #1. Should the calling person then attempt to connect with the other trunk lines, busy tone will be returned in each instance.

Incoming trunk calls

It will now be assumed that an incoming trunk call is received over conductors 701 and 702 of trunk line #1 from the distant exchange. Ringing current by way of conductor 701, condenser 714, winding of ringing relay 720, armature 772 and conductor 702 causes ringing relay 720 to operate. At armature 721, relay 720 completes the circuit to relay 710, causing relay 710 to operate and lock to ground by way of armatures 773 and 712. At armature 711, relay 710 completes the circuit to trunk line #1 incoming call

signal, or signals, to advise the local stations that an incoming call on trunk line #1 is awaiting attention. At the resting contact of armature 713, relay 710 disconnects trunk start conductor 167 from armature 735; and, at armature 713 and working contact, extends trunk start conductor 167 to the winding of trunk start relay 780 to make it possible for station #21 to answer this trunk call. Stations #20 and #30 are already in a position to answer this trunk call, as trunk start conductor 168 is connected directly to the winding of trunk start relay 780, and trunk start conductor 783 is connected to the winding of trunk start relay 780 through armature 774 and resting contact.

Assuming further that a person at station #21 decides to answer this trunk call, then the lifting of the handset piece at telephone 110 and the depressing of the related trunk-line #1 connecting key completes the circuit to line relay 120, and the operation of line relay 120 causes the subsequent operation of tens relay 220 and units relay 201 in a manner similar to that described in the preceding section titled "Outgoing trunks calls" for the operation of tens relay 220 and units relay 210. The operation of tens relay 220 and units relay 201 completes the circuit to trunk start relay 780 from ground, armatures 207, 218, conductor 262, contact 114 of trunk-line #1 connecting key, armature 125, trunk start conductor 167, armature 713 and working contact, winding of relay 780 to negative battery, causing relay 780 to operate. At armature 782, relay 780 connects ground to the fourth contact from the left of master switch bank 428 by way of conductor 165 to mark trunk line #1 in master switch bank 428. At armature 781, relay 780 completes the circuit to lock magnet 490 of the master switch from ground, armature 781, conductor 166, armature 486, winding of lock magnet 490 to negative battery. The master switch accordingly moves the plungers of all idle lineswitches into alignment with the bank trunk connected to trunk line #1 in the manner described in the preceding section titled "Outgoing trunk calls."

The operation of stop magnet 485 when wiper 428 of the master switch engages the fourth contact from the left of bank 428 completes the circuit to pull-down magnet 140 of station #21 lineswitch from ground, armature 483, conductor 272, armatures 202, 222, conductor 271, conductor 259, winding of pull-down magnet 140 to negative battery, the operation of pull-down magnet 140 causing the plunger of station #21 lineswitch to plunge into the bank trunk connected to trunk line #1. The direct-current loop of station #21 telephone is thus extended to trunk line #1 by way of relay conductor 181, bank contact 150^T, conductor 161, upper winding of relay 760, armature 732 and resting contact, conductor 701, supervisory and transmission battery loop at the distant exchange, conductor 702, armature 734 and resting contact, lower winding of relay 760, conductor 162, bank contact 152^T, conductor 182 and contact 115 of trunk-line #1 connecting key. Relay 760 does not operate over the circuit just traced because its windings are differentially connected and now oppose each other. The closing of bank contact 153^T completes the circuit to relay 770 from ground, bank contact 153^T, conductor 163, winding of relay 770 to negative battery causing relay 770 to operate. At the resting contact of armature 774, relay 770 opens one circuit path to trunk start relay 780; at armature

774 and working contact, switches trunk start conductor 783 to conductor 164, thereby making trunk line #1 busy to calls from other local stations associated with start conductor 783: at armature 773, disconnects ground from the locking circuit to relay 710, causing relay 710 to restore; and, at armature 772, disconnects ringing relay 720 from across the trunk line. At armature 711, relay 710 opens the circuit to the incoming call signal, or signals: at the working contact of armature 713, opens the circuit to trunk start relay 780, causing relay 780 to restore; and, at armature 713 and resting contact, switches trunk start conductor 167 to conductor 164 by way of armature 735 and resting contact, thereby making trunk line #1 busy to other calls over start conductor 167.

The operation of pull-down magnet 140 also operates contacts 132, 133, 134 and 135 through the medium of armature 131, and contacts 142, 143 and 144 through the medium of armature 141. Contact 143 completes a holding circuit for pull-down magnet 140 from ground, contact 143 and working spring, contact 114 of trunk-line #1 connecting key, conductor 184, bank contact 151^T, conductor 259, winding of pull-down magnet 140 to negative battery, thus retaining station #21 telephone connected to trunk line #1 as long as the person at station #21 keeps the handset piece from the telephone cradle. At the resting spring of contact 143, ground is removed from line conductor 182; and, at contact 144, line relay 120 is disconnected from line conductor 181, causing line relay 120 to restore. At contact 134, the circuit to units relay 201 is opened, causing units relay 201 to restore; and, at contact 135, the circuit to tens relay 220 is opened, causing tens relay 220 to restore. Contacts 142, 132 and 133 perform no functions at this time. At armature 782, relay 780 upon restoring removes ground from the fourth contact from the left of master-switch bank 428, causing stop magnet 485 to restore; and, at armature 781, opens a point in the circuit to lock magnet 490. The call allotter is now in a position to accept another call. Transmission battery is supplied to station #21 telephone from the distant exchange.

After the conversation between station #21 and the distant exchange has been completed, and responsive to the person at station #21 returning his handset piece to the telephone cradle, the trunk-line #1 connecting key at telephone 110 is automatically released and returns to the normal position. The holding circuit of pull-down magnet 140 is opened at contacts 114 of trunk-line #1 connecting key, and the plunger of station #21 lineswitch is withdrawn from the bank trunk connected to trunk line #1. The bank contacts 150^T, 151^T, 152^T, and 153^T are opened by the withdrawal of station #21 lineswitch plunger, and the plunger is automatically aligned with the shaft of the master switch. At bank contact 153^T, the circuit to relay 770 is opened, and relay 770 restores. At armature 774 and resting contact, relay 770 switches trunk start relay 780 to trunk start conductor 783, thus making trunk line #1 available to calls from local stations. At armature 772 and resting contact, relay 770 re-connects ringing relay 720 across trunk line #1, making trunk line #1 available to calls from the distant exchange.

Holding and transferring trunk calls

In order to describe how persons at local stations can hold a trunk call (either incoming or outgoing) while making a local call, it will be

first assumed that station #30 is connected in a trunk call over trunk line #1 in the manner explained in detail in the section titled "Outgoing trunk calls." The distant-exchange person is advised by the person at station #30 to wait on the line for a few moments. The person at station #30 then depresses the common trunk-line holding key into the operated position where it locks, this action connecting ground to the lower winding of relay 760 in trunk line #1 by way of contact 543 and working spring of station #30 lineswitch, contact 511 of common trunk-line holding key, conductor 582, bank contact 552^T and conductor 162, and also unlocking trunk-line #1 connecting key. Trunk-line #1 connecting key restores to the normal position. The connecting of ground to the lower winding of relay 760 shunts out this winding and causes relay 760 to operate on its upper winding over the circuit from ground, contact 543 and working spring of station #30 lineswitch, contact 511 of common trunk-line holding key, direct-current loop through telephone 510, conductor 581, bank contact 550^T, conductor 161, upper winding of relay 760, resting contact of armature 732, conductor 701 to negative battery at the distant exchange.

At armature 761, relay 760 completes the circuit to relay 750 over an obvious circuit, causing relay 750 to operate and lock to ground by way of contacts 741 and 752. At armature 753, relay 750 bridges the windings of relay 760 across the trunk circuit to the distant exchange in order to retain the holding and supervisory conditions unchanged at the distant exchange. At armature 751, relay 750 completes the circuit to relay 730, causing relay 730 to operate. At armatures 732 and 734 and respective working contacts, relay 730 replaces the holding bridge previously connected across the trunk circuit at armature 753 with the winding of relay 740, thereby maintaining the holding and supervisory conditions unchanged at the distant exchange. The relay 760 holding bridge is opened at the resting contacts of armatures 732 and 734. Armatures 732 and 734 are fitted with contacts of the make-before-break type to insure continuity of the holding bridge across the trunk circuit.

The returning of trunk-line #1 connecting key at station #30 telephone to normal position by the operation of the common trunk-line holding key opens the circuit to pull-down magnet 540 at contact 514, and the plunger of station #30 lineswitch is withdrawn from the bank trunk connected to trunk line #1. The bank contacts 550^T, 551^T, 552^T and 553^T are opened by the withdrawal of station #30 lineswitch plunger, and the plunger is automatically aligned with the shaft of the master switch. The opening of bank contact 553^T opens the circuit to relay 770, and relay 770 restores. At armature 774 and resting contact, relay 770 extends trunk start conductor 783 to trunk start relay 780, thereby making trunk line #1 accessible to all local stations associated with trunk start conductor 783. At armature 735 and working contact, relay 730 extends trunk start conductor 167 to trunk start relay 780, thereby making trunk line #1 accessible to all local stations associated with trunk start conductor 167. The restoration of armature 541 by the release of pull-down magnet 540 opens an additional point in the circuit of pull-down magnet 540 at the working spring of contact 543: at contact 543 and resting spring, connects ground to line conductor 582 of station #30; and, at contact 544, connects line relay 520 of station #30 lineswitch to line conductor 581.

The restoration of relay 770 occurs before relay 740 operates from the distant-exchange loop, and relay 730, consequently, locks to ground by way of armature 741 and working contact, armature 771 and armature 733 before its operating circuit is opened at armature 751. Relay 730 is of the slow-to-release type to insure continuity of operation. At armature 731, relay 730 completes the circuit to trunk line #1 call-held signal, or signals, to inform the local stations that a distant-exchange connection is being held on trunk line #1.

After the person at station #30 has operated the common trunk-line holding key to connect a holding bridge across trunk line #1, he next depresses the local-call connecting key into the operated position where it locks. The line relay 520 of station #30 lineswitch, tens relay 230, units relay 210 and local start relay 350 (assuming that local link #1 has been pre-assigned) operate to cause the master switch to align the plunger of station #30 lineswitch with the bank trunk leading to the answering end of local link #1 in the manner described in detail in the section titled "Local calls." Pull-down magnet 540 is then automatically operated to cause the plunger of station #30 lineswitch to plunge into the bank trunk leading to the answering end of local link #1, thus connecting station #30 telephone with line relay 405 of link #1. The person at station #30, upon receiving dial tone, dials the number of the desired local station, and the connection between the two local stations is completed in the manner described in the section titled "Local calls."

The person at station #30 may return to the held distant-exchange connection on trunk line #1, or the person at the called local station may accept the held trunk connection. In either case, access to trunk line #1 is obtained by depressing trunk-line #1 connecting key at the local station, and the plunger of the local-station lineswitch is caused to plunge into the bank trunk leading to trunk line #1 in the manner previously described in the section titled "Outgoing trunk calls." Ground on conductor 163 then causes relay 770 in trunk #1 to operate, and at armature 771 relay 770 opens the locking circuit to relay 730. The restoration of relay 730 removes the winding of relay 740 from across the trunk circuit at the working contacts of armatures 732 and 734, causing relay 740 to restore; and, at the resting contacts of armatures 732 and 734, re-connects trunk conductors 701 and 702 to the windings of relay 760. The talking circuit is now complete between the local station and the distant exchange over trunk line #1. At armature 731, relay 730 opens the circuit to trunk-line #1 call-held signal, or signals. At armature 774 and working contact, relay 770 switches trunk start conductor 783 to conductor 164, thus making trunk line #1 busy to calls from other local stations associated with trunk start conductor 783. At armature 735 and resting contact, relay 730 switches start conductor 167 to conductor 164 by way of armature 713 and resting contact, making trunk line #1 busy to calls from other local stations associated with start conductor 167.

Busy over-ride on trunk calls

As previously explained in the section titled "Incoming trunk calls," trunk start relay 730 of trunk line #1 is normally connected to trunk start conductor 783 through the resting contact of armature 774. Consequently, when trunk line #1

is taken into use, trunk start relay 780 is disconnected at the resting contact of armature 774 by the operation of relay 770 over conductor 163 and, therefore, no idle local station associated with trunk start conductor 783 can have access to busy trunk line #1. Similarly, trunk start relay 780 is disconnected from trunk start conductor 167 at the working contacts of armatures 713 and 735 and, hence, no idle local station associated with trunk start conductor 167 can have access to busy trunk line #1. Trunk start relay 780, however, is directly connected to trunk start conductor 168 without contact intervention and, consequently, any local station associated with trunk start conductor 168 has access to trunk line #1 regardless of whether trunk line #1 is in use or not.

It is thus apparent that station #20, for example, automatically over-rides the busy guard condition on an established trunk connection between the distant exchange and another local station when the handset piece at station #20 is lifted and the related trunk-line connecting key is depressed. This busy over-ride feature enables the person at station #20 to exercise a supervisory control over trunk calls involving other local stations, and to obtain a trunk line when all the trunk lines are in use by requesting the persons on a particular trunk connection to relinquish the trunk line.

Conference service on trunk calls

The busy over-ride feature described in the preceding section titled "Busy over-ride on trunk calls" enables a conference call to be held on a trunk connection by two or more local stations. Such local stations are associated with trunk start conductor 168 in the manner shown in Fig. 1 for station #20.

Now, when one of the local stations associated with trunk start conductor 168 has connected with trunk line #1, for example, and then desires to have another local station join in the conversation, a holding bridge is connected across trunk conductors 701 and 702, in the manner described in detail in the section titled "Holding and transferring trunk calls." Next, the second local station is called over a local interconnecting link, in the manner described in the section titled "Local calls," and is instructed to connect with trunk line #1. Since both the calling and called local stations are associated with trunk start conductor 168, it is inconsequential which station connects with trunk line #1 first, as both stations automatically over-ride the busy condition when the respective trunk-line #1 keys are depressed. Transmission battery is supplied to the local stations over the trunk line from the distant exchange, and the permissive number of local stations on the trunk line is governed by the desired quality of transmission.

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

1. In a telephone system, subscribers' lines each having two connect keys, individual lineswitches terminating said subscribers' lines, two groups of trunks accessible to said lineswitches, a master switch for directing said lineswitches, means controllable over a calling subscriber's line responsive to the actuation of one of the two keys of said calling line for operating said master switch to position the lineswitch of said calling line in alignment with a trunk of one of said groups and then automatically cause said lineswitch to seize said one trunk, said means also controllable over said calling line responsive to the actuation of the other key of said calling line for operating said master switch to position the lineswitch of said calling line in alignment with a trunk line of said other group and then automatically cause said lineswitch to seize said one trunk of said other group.

2. In a telephone system, an exchange, subscribers' stations therein each having a connect key, lineswitches associated with said stations, a pre-selected link accessible to said lineswitches for extending connections from said stations, control equipment including directive switching mechanism for causing the lineswitch of a calling station to seize said pre-selected link said control equipment controlled by the operation of said key at said calling station.

3. In a telephone system wherein lineswitches terminate subscribers' stations, at least two connect keys at each of said stations, trunk lines accessible to said lineswitches in common, the number of said trunk lines equalling the number of said connect keys at each of said stations, each said trunk line associated with one of said connect keys at each of said stations, a master switch for controlling said lineswitches, means responsive to the actuation of one of said connect keys at one of said stations for operating said master switch to cause the lineswitch of said one station to connect with the trunk line associated with said operated connect key.

4. In a telephone system wherein lineswitches terminate subscribers' stations in a local exchange, a local link accessible to said lineswitches for extending local connections from said stations, a distant exchange, trunks accessible to said lineswitches for extending trunk connections from said stations to said distant exchange, a local connect key and trunk connect keys at each of said stations, the number of said trunk keys at each of said stations equalling the number of said trunks, each said trunk key at each of said stations fixedly related to a designated one of said trunks, a master switch, means including said master switch responsive to the operation of said local key at a calling station for causing the lineswitch of said calling station to seize said local link, means including said master switch controlled by said calling station over said seized local link for causing the lineswitch of a desired called station to seize said local link, means for completing a talking connection between said calling and called stations over said seized local link, and means including said master switch responsive to the operation of a trunk key at a second calling station for causing the lineswitch of said second calling station to seize the trunk related to said operated trunk connect key.

5. In a telephone system, a plurality of subscribers' lines each having a key, a plurality of trunk lines accessible to said subscribers' lines, a common directive switching mechanism, means responsive to the actuation of the key of a calling subscriber's line for operating said mechanism to cause the connection of said calling line with one of said trunk lines, means for freeing said mechanism and rendering it available for subsequent use in response to the connection of said one subscriber's line with said one trunk line, and means thereafter controlled by the calling subscriber over said one trunk line for operating said mechanism to cause a desired called subscriber's line to also connect with said one trunk line.

6. In a telephone system, trunk lines, subscribers' lines each having a key, a common directive mechanism for causing the connection of said subscribers' lines with said trunk lines, means responsive to the actuation of the key of a calling subscriber's line for operating said mechanism to cause the connection of said calling subscriber's line with one of said trunk lines, means responsive to the connection of said subscriber's line with said one trunk line for freeing said mechanism and rendering it available for subsequent use, means thereafter controlled by the calling subscriber over said subscriber's line and said one trunk line for operating said mechanism to cause a desired called subscriber's line to also connect with said one trunk line, means responsive to the connection of said called subscriber's line with said one trunk line for releasing said mechanism for use by other subscribers' lines, means for signalling said called subscriber's line, and means responsive to the operation of the key of said called subscriber's line for completing a talking connection including said called subscriber's line, said one trunk line and said calling subscriber's line.

7. In a telephone system, a plurality of lines each having a lineswitch individual thereto, a plurality of trunks accessible to paid lineswitches, a master switch, means responsive to the extension of a call to a line for operating said master switch, means responsive to the extension of a call from a line for operating said master switch, either said operation of said master switch automatically causing the lineswitch of the line over which the call is being extended to seize one of said trunks.

8. In a telephone system wherein lineswitches individual to the subscribers' lines are controlled by a single master switch and have access in common to a group of trunks, means responsive to the initiation of a call on a subscriber's line for operating said master switch to position the lineswitches of all idle subscribers' lines and the lineswitch of said calling line in alignment with one of said trunks, means for maintaining the lineswitches of said idle lines in said aligned positions while said master switch causes the lineswitch of said calling line to seize said one trunk, and means controlled over said calling line and said seized trunk for causing said master switch to operate the lineswitch of a desired called line to seize the trunk previously seized by said calling line.

9. In a telephone system wherein lineswitches individual to the subscribers' lines have access in common to a group of trunks and are controlled by a single master switch, means controlled by a calling line for operating said master switch to align the lineswitches of all idle lines and the lineswitch of said calling line with one of said trunks, means for maintaining the lineswitches of said idle lines in said aligned positions while said master switch operates the lineswitch of said calling line to seize said aligned trunk, means controlled over said calling line and said seized trunk for causing said master switch to operate the lineswitch of a desired called line to seize said aligned trunk, means for signalling said called line over said seized trunk, and means responsive to the answering of said called line for connecting said calling and called lines together over said seized trunk.

10. In a telephone system, subscribers' lines, a trunk line accessible to said subscribers' lines, a key on each of said subscribers' lines, said keys related in common to said trunk line, means responsive to the operation of the key of a calling subscriber's line for causing said calling line to seize said trunk line and establish a talking connection thereto, means in said trunk line responsive to the establishment of said talking connection for preparing a busy guard circuit in said trunk line to make said trunk line unavailable to other calling subscribers' lines, means responsive to the operation of the key of a second calling subscriber's line in an attempt to cause said second subscriber's line to seize said trunk line for connecting said busy guard circuit in said trunk line to said second subscriber's line, and means in said second subscriber's line operated by said busy guard circuit for returning a distinctive signal to the subscriber on said second line to indicate that said trunk line is in prior use.

11. In a telephone system, subscriber's lines, a lineswitch terminating each said subscriber's line, a trunk line accessible to said lineswitches, a master switch for controlling said lineswitches, means operated over a calling subscriber's line for controlling said master switch to cause the lineswitch of said calling line to seize said trunk line, means operated over a second calling subscribers' line for attempting to control said master switch to cause the lineswitch of said second calling line to seize said engaged trunk line, and means in said engaged trunk line for preventing said last means from controlling said master switch.

12. In a telephone system wherein lineswitches individual to the subscribers' lines are controlled by a common master switch, a trunk accessible to said lineswitches, a connect key on each subscriber's line, means controlled over a calling subscriber's line responsive to the operation of the connect key of said calling line for causing said master switch to position the lineswitch of said calling line in alignment with said trunk, means in said master switch for operating the lineswitch of said calling line to seize said trunk, means in said trunk responsive to said lineswitch of said calling line seizing said trunk for establishing a guard circuit in said seized trunk to guard said seized trunk from intrusion by other calling subscribers' lines, means in all said subscribers' lines for transmitting a busy tone to the related subscribers, said last means in any subscriber's line operated by said guard circuit in said seized trunk when the connect key of said last subscriber's line is actuated in an attempt of said last subscriber's line to connect with said trunk.

13. In a telephone system, subscribers' stations, lineswitches terminating said stations, a group of links accessible to said lineswitches for extending connections from said stations, a single master switch for controlling said lineswitches, a link allotter common to said stations, means in said allotter for pre-selecting an idle one of said links for subsequent use in a call from any one of said stations, means responsive to one of said stations initiating a call for extending a start circuit through said allotter to said pre-selected link, means in said pre-selected link responsive to the completion of said start circuit for transmitting a link designation corresponding to said pre-selected link to said master switch and for completing a start circuit to said master switch, means controlled by said master switch responsive to the completion of said last mentioned start circuit and the said transmission of said link designation for positioning the lineswitch of said calling station in alignment with said pre-

selected link, and means in said master switch for thereafter operating said positioned lineswitch of said calling station to seize said pre-selected link.

14. In a telephone system wherein the subscriber's lines terminate in lineswitches and a plurality of links are accessible to said lineswitches for completing connections between said lines, an allotter common to all said lines, means in said allotter for pre-selecting an idle one of said links, a single master switch, means controlled over a calling line and said allotter for causing said master switch to position the lineswitches of all idle lines and the lineswitch of said calling line in alignment with said pre-selected link, means for maintaining the lineswitches of said idle lines at rest while said master switch operates the lineswitch of said calling line to seize said pre-selected link, and means controlled over said calling line and said seized link for causing said master switch to operate the lineswitch of a desired called line to seize the link previously seized by said calling line.

15. In a telephone system, subscribers' stations each having a connect key, lineswitches terminating said stations, a plurality of trunks accessible to said lineswitches for extending connections from said stations, a master switch for controlling said lineswitches, a call allotter common to said stations, means in said allotter for pre-selecting an idle one of said trunks, means responsive to the operation of the key at a calling station for completing a circuit through said allotter to said pre-selected trunk, means in said pre-selected trunk responsive to the completion of said circuit for extending a trunk-identification marking corresponding to said pre-selected trunk to said master switch and for completing a start circuit to said master switch, means operated by said master switch responsive to the completion of said start circuit and the said extension of said trunk-identification marking for aligning the lineswitches of all idle stations and the lineswitch of said calling station with said pre-selected trunk, and means for maintaining the lineswitches of said idle lines at rest while said master switch operates the lineswitch of said calling station to connect with said pre-selected trunk.

16. In a telephone system, subscribers' lines terminating in lineswitches, a plurality of trunks accessible to said lineswitches for extending connections from said lines, a common master switch for controlling said lineswitches, a trunk connect key on each said line, a common control equipment accessible to said lines for controlling said master switch, said control equipment responsive to the operation of the trunk connect key on a calling line for causing said master switch to operate the lineswitch of said calling line to connect with one of said trunks, and means in said control equipment for preventing said control equipment from responding to the operation of the trunk connect key on a second calling line until the lineswitch of said first calling line has connected with said one trunk.

17. In a telephone system, subscribers' stations, local links accessible to said stations for extending local connections from said stations, a distant exchange, trunk lines accessible to said stations for extending trunk connections from said stations to said distant exchange, an individual trunk connect key for each of said trunk lines and a common local-link connect key at each of said stations, common control means accessible to said stations and responsive to the operation of one of said trunk connect keys or the local-link connect key at a calling station for causing said calling station to connect with said related trunk line or one of said local links dependent upon the particular key operated, said control means unresponsive to the operation of any one of the keys at another calling station until said first calling station has connected with said one trunk line or said one local link.

18. In a telephone system, subscribers' stations, lineswitches terminating said stations, a common master switch for controlling said lineswitches, a two-way trunk line accessible to said lineswitches, certain ones of said subscribers' stations restricted from making outgoing trunk calls over said trunk line, a trunk connect key at all of said stations, means in said trunk line responsive to the establishing of an incoming trunk call on said trunk line for preparing a control circuit to said master switch, said control circuit completed responsive to the operation of the trunk connect key at a station answering said incoming call, the operation of said trunk connect key also extending the lineswitch operating circuit of said answering station to said master switch, the completion of said control circuit operating said master switch for completing the lineswitch operating circuit of said answering station and thereby causing said lineswitch of said answering station to seize said trunk line, means in said trunk line for preventing the completion of said control circuit by the operation of the trunk connect key at any one of said certain stations when said certain one station attempts to make an outgoing trunk call, the said non-completion of said control circuit preventing the lineswitch of said certain one station from seizing said trunk line.

19. In a telephone system, a local exchange including a trunk to another exchange, local lines permitted to make outgoing trunk calls over said trunk, local lines restricted from making such outgoing trunk calls, a common switching mechanism for controlling the connection of said lines with said trunk, control means in said trunk for completing an operating circuit to said switching mechanism, said control means accessible only to said lines permitted to make outgoing trunk calls and effective upon the initiation of an outgoing trunk call by any one of said non-restricted lines, said switching mechanism responsive to the completion of said operating circuit for causing the calling non-restricted line to connect with said trunk, the non-accessibility of said control means to said restricted lines preventing said restricted lines from making outgoing trunk calls.

20. In a telephone system, subscribers' lines terminating in individual lineswitches, trunk lines accessible to said lineswitches, a single master switch for controlling said lineswitches, a hold key on each of said subscribers' lines common to all said trunk lines, means controlled over a calling subscriber's line for operating said master switch to cause the lineswitch of said calling line to seize one of said trunk lines, means in said seized trunk line thereafter controlled by the actuation of the hold key on said calling line for establishing a hold bridge across said seized trunk line, and means for releasing said calling line from said held trunk line.

21. In a telephone system, subscribers' stations each having a lineswitch, trunks accessible to said lineswitch, a common master switch for operating said lineswitches, an individual trunk connect key at each of said stations for each of said trunks, a single holding key at each of said sta-

tions common to all said trunks, means controlled over a calling station responsive to the actuation of one of said trunk connect keys for controlling said master switch to cause the lineswitch of said calling station to connect with the corresponding trunk, means controlled by the actuation of the holding key at said calling station for establishing a holding bridge across said connected trunk, means for releasing said calling station from said held trunk, means thereafter operative over any calling station responsive to the actuation of the related trunk connect key for controlling said master switch to cause the lineswitch of said last calling station to connect with said held trunk, the connection of said last calling station with said held trunk automatically removing said holding condition.

22. In a telephone system having at least two groups of subscribers' stations, a trunk line accessible to all said stations, a control lead common to the stations in one of said groups and terminating in said trunk line, a control lead common to the stations in another one of said groups and also terminating in said trunk line, control means in said trunk line accessible to both said control leads and operative over either one responsive to a station associated with said one control lead initiating a call for said trunk line, means responsive to the operation of said control means for causing the calling station to seize said trunk line and establish a talking connection thereto, means responsive to said calling station seizing said trunk line for preventing further access to said control means over the control lead from the stations in one of said groups, the stations in the other group having continuous access to said control means over their control lead.

23. In a telephone system, two groups of subscribers' stations, a lineswitch terminating each said station, a trunk line accessible to said lineswitches, a common master switch for operating said lineswitches, a control lead from each of said station groups terminating in said trunk line, control means accessible to said control leads and operative over either one of said control leads responsive to a station in the related group initiating a call for said trunk line, the operation of said control means controlling said master switch to cause the lineswitch of said calling line to seize said trunk line, and means responsive to the seizing of said trunk line by said lineswitch for disabling the control lead from one of said station groups.

24. In a telephone system having three groups of subscribers' stations, a two-way trunk line accessible to all said stations, a separate control lead common to the stations in each of said groups and terminating in said trunk line, control means in said trunk line accessible to said three control leads and operative over either one of two of the control leads responsive to a station associated with said one control lead answering an incoming trunk call on said trunk line or initiating an outgoing trunk call for said trunk line, said control means also operative over the third control lead responsive to a station associated with said third control lead answering an incoming trunk call but not operative over said third control lead when any station associated with said third control lead attempts to make an outgoing trunk call to said trunk line, and means responsive to the operation of said control means for causing the station operating said control means to seize said trunk line and establish a talking connection thereto.

25. In a telephone system, three groups of subscribers' stations, a two-way trunk line accessible to said groups of stations, a control lead from each of said three groups terminating in said trunk line, control means in said trunk line accessible to said control leads, said control means operative over any one of the control leads responsive to a station in the related group answering an incoming trunk call on said trunk line, said control means also operative over two of said control leads but not over the third control lead when a station in the related group of stations initiates an outgoing trunk call, means responsive to the operation of said control means for causing the station operating said control means to seize said trunk line, means responsive to the seizing of said trunk line for preventing further access to said control means over the control leads from two of said groups of stations, the remaining control lead having permanent access to said control means.

26. In a telephone system wherein subscribers' stations are in more than one group and each station terminates in an individual lineswitch, a trunk line accessible to all said lineswitches, a common master switch for controlling said lineswitches, means for permitting the lineswitches of one group of said stations to connect with said trunk line when said trunk line is engaged, means controlled by a calling station for operating said master switch to cause the lineswitch of said calling station to seize said trunk line, means controlled over said one station and said seized trunk line for holding said seized trunk line, means thereafter operated by said one station for connecting with a desired called station of said one group, means controlled by said first station for again operating said master switch to cause said lineswitch of said first station to seize said held trunk line, the reconnection of said first station with said held trunk line automatically removing said holding condition, and means controlled by said second station for operating said master switch to cause the lineswitch of said second station to seize said engaged trunk line and establish a talking connection with said first station and said trunk line in multiple.

27. In a telephone system, a plurality of subscribers' stations, each of said stations terminating in a non-numerical switch, a plurality of links for connecting said stations together, a master switch, said master switch controlled by a calling station for causing the non-numerical switch of said station to seize one of said links, said master switch thereafter controlled by said station over said link for causing the non-numerical switch of a desired called station to connect with said link seized by the non-numerical switch of said first station.

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