July 19, 1949. G. W. MITCHELL 2,476,888

TOLL LINE REMOTE GROUP BUSY SIGNALING

Filed Feb. 19, 1948 2 Sheets-Sheet 1

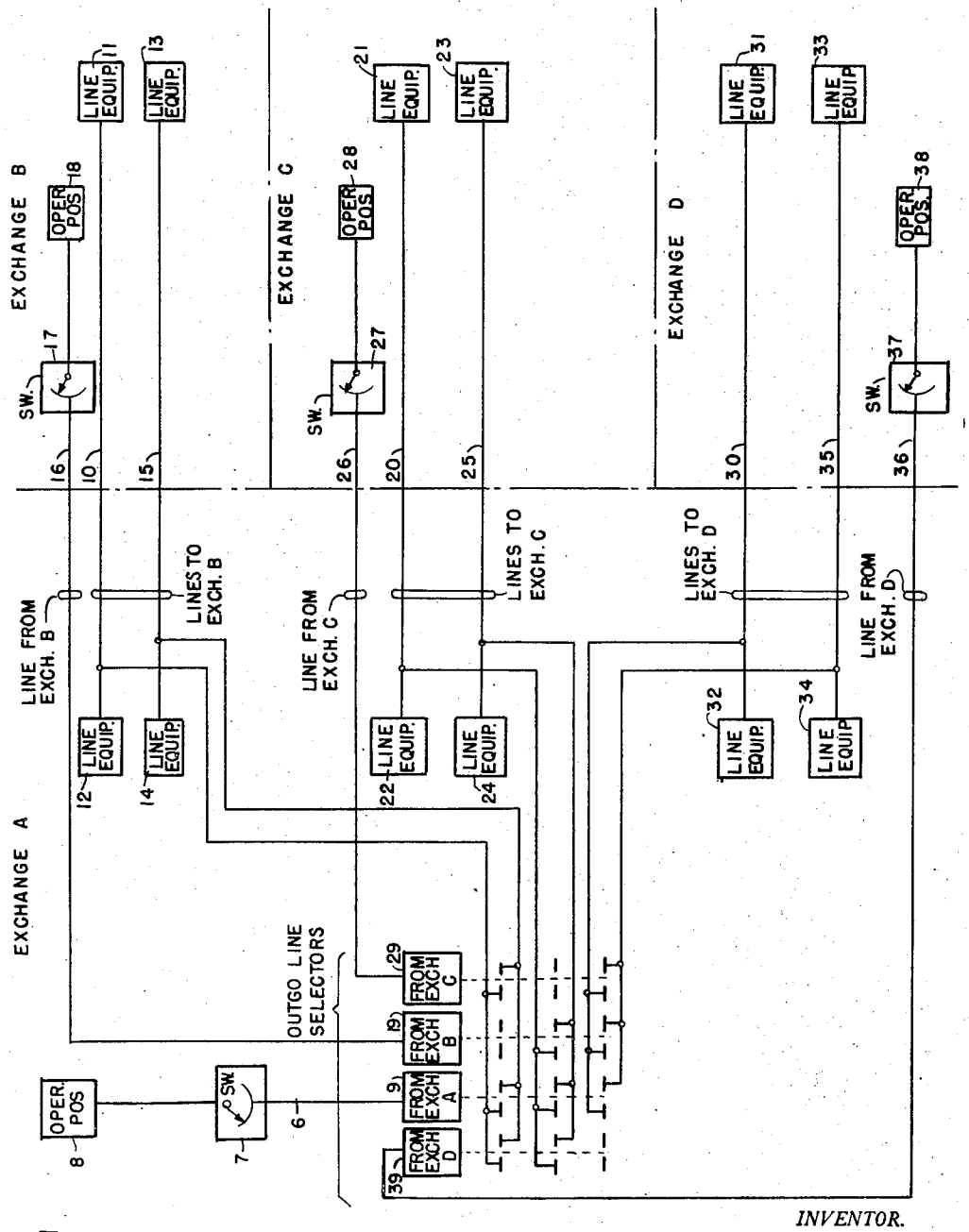


FIG. 1

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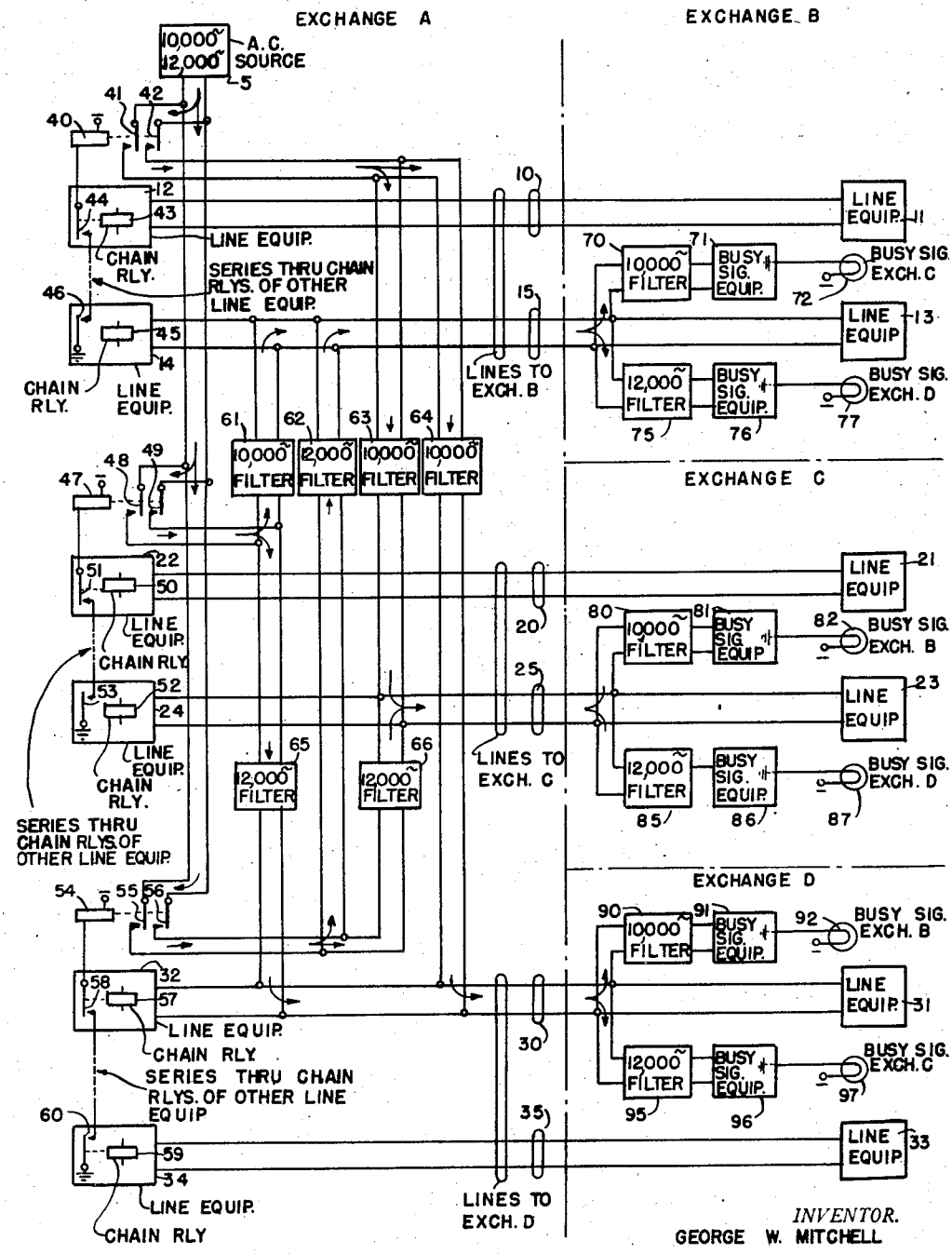


FIG. 2

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Patented July 19, 1949 2,476,888

UNITED STATES PATENT OFFICE

2,476,888

TOLL LINE REMOTE GROUP BUSY SIGNALING

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Application February 19, 1948, Serial No. 9,413

10 Claims. (Cl. 179—27)

1

The present invention relates in general to supervisory circuit arrangements whereby "group busy" indication is given at distant exchanges whenever a group of line (toll) circuits outgoing from a center, or tandem, exchange to another distant exchange become busy.

In a network of exchanges including a number of terminating exchanges and a tandem exchange common to the terminating exchanges, an operator in a terminating exchange having need for a line circuit from the tandem exchange to another terminating exchange ordinarily must make an attempt to gain access to such a line circuit regardlessly of whether all of the line circuits to the other terminating exchange are in use. In the instances where the operator receives busy indication when attempting to appropriate a line circuit of a group, she must make one or more further attempts until a free line circuit is obtained. Such repeated unsuccessful attempts result in loss of operator time and the useless occupying of inter-exchange circuit facilities.

It is an object of the invention to overcome the above described deficiency in inter-exchange line circuit operation by providing a new and novel line circuit group busying arrangement wherein a group busy signal, related to a group of line circuits from a tandem exchange to a terminating exchange, is located in each other terminating exchange having access to said related line circuit group, and this group busy signal is operated whenever all the line circuits of said group of line circuits are simultaneously occupied.

A feature of the invention resides in the novel manner in which a line circuit group busy signal in a terminating exchange is operated from the tandem exchange over one of the regular line circuits from the tandem exchange to the terminating exchange.

Another feature of the invention relates to the provision of more than one line circuit group busy signal in a terminating exchange for giving group busy supervision of more than one line circuit group from the tandem exchange to more than one other terminating exchange, over a line circuit, or circuits, of the group from the tandem exchange to the first mentioned terminating exchange in a new and novel manner.

A further feature of the invention concerns a novel circuit arrangement wherein the superimposition of an alternating current of a non-voice frequency on a line circuit from the tandem exchange to a terminating exchange causes the operation of a busy signal in the terminating exchange.

2

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 foregoing.

The various objects and features of the invention will be understood best from a perusal of the following description of the drawings comprising Figs. 1 and 2, which show by means of the usual circuit diagrams a sufficient amount of apparatus to enable the invention to be described and understood.

Referring now to the drawings—

Fig. 1 is a single-line circuit diagram showing a tandem exchange A having line circuits extending to three terminating exchanges B, C and D, and also means for enabling calls initiated in the tandem exchange and in any of the terminating exchanges to seize a line circuit to one of the terminating exchanges.

Fig. 2 shows the tandem exchange, the three terminating exchanges, and the line circuits of Fig. 1 and, in addition, means for applying an alternating current, or currents, to certain of the line circuits for causing the operation of related busy signals in the terminating offices.

Two line circuits are shown in Figs. 1 and 2 from the tandem exchange A to each of the terminating exchanges, line circuits for terminating exchange B being designated by the reference characters 10 and 15, for terminating exchange C by the characters 20 and 25, and for terminating exchange D by the characters 30 and 35. It should be understood, however, that any required number of line circuits may be provided between the tandem exchange and each terminating exchange.

Line circuit 10 terminates at the tandem exchange A in a line equipment 12 and at terminating exchange B in a line equipment 11. Similarly, line circuit 15 terminates in line equipments 14 and 13 respectively at the tandem exchange and terminating exchange B: line circuits 20 and 25 terminate respectively in line equipments 22 and 24 at the tandem exchange and in line equipments 21 and 23 at terminating exchange C; and line circuits 30 and 35 terminate respectively in line equipments 32 and 34 at the tandem exchange and in line equipments 31 and 33 at terminating exchange D. These line equipments may be of any well-known type and circuit arrangement, according to preference or requirement and, therefore, it is considered unnecessary to detail any particular ar-

rangement in this disclosure. In Fig. 2 for the tandem exchange end, enough of a chain circuit arrangement is shown associated with the line equipments of the line circuits for each terminating exchange to properly demonstrate the functioning of the line circuit group busy supervision.

The line circuit selectors 9, 19, 29 and 39 in the tandem exchange A (Fig. 1) may be of any conventional type of selector switch, but as depicted comprise the well-known Strowger selector switch having controlled vertical movement and automatic rotary movement. These line circuit selectors have one level of bank contacts multiplied together for each terminating exchange, and contacts in each bank level are connected to the line circuits from the tandem exchange to the related terminating exchange. It should be understood at this time that while only one line circuit selector is shown in Fig. 1 for each of the four exchanges, line circuit selectors are provided for each exchange according to traffic requirements.

The selection units 7, 17, 27 and 37 each respectively represent any desired train of conventional switches required in the related exchanges for selecting a free line circuit selector in the tandem exchange as represented by the reference characters 9, 19, 29 or 39. Since the present invention is not concerned with the details of such selection units or trains, it is considered unnecessary to include further details of the selection units or trains in this specification.

Operator units 8, 18, 28 and 38 represent conventional operator positions and the related positional control equipments for enabling one or more operators in each of the four exchanges to select and control a free line circuit selector in the tandem exchange through the media of selection units 7, 17, 27 and 37, as the case may be. In the instance of these operator units also, the present invention is not concerned with the exact details of the operator positions and related positional control equipment arrangements, it being understood that any well-known or conventional arrangement may be utilized.

The alternating current source 5 (Fig. 2) may be of any well-known type of generating equipment capable of producing currents of at least two frequencies. It should be understood, however, that the two frequencies indicated for the generating equipment in Fig. 2 are for explanatory purposes only and do not impose any particular limitations or restrictions.

The filters indicated by the reference characters 61, 62, 63, 64, 65, 66, 70, 75, 80, 85, 90 and 95 in Fig. 2 may be of any well-known type of filter tuned to pass alternating current of a particular frequency. As in the case of the alternating current generating equipment, the frequencies indicated for the various filters are for explanatory purposes only and correspondingly do not impose any particular limitations or restrictions.

The busy signal equipments 71, 76, 81, 86, 91 and 96 in Fig. 2 each comprise any suitable arrangement of equipment and circuit arrangement capable of responding to an input of alternating current (supplied by the related filter 70, 75, 80, 85, 90 or 95) and as a result of such response then causing the operation of the related busy signal 72, 77, 82, 87, 92 and 97.

Having described the equipment and apparatus, a detailed description of the operation will now be given.

Assuming first that an operator in exchange

B wishes to extend a connection to exchange C, then by means of the positional equipment (not shown) of operator unit 18 (Fig. 1) the operator controls the switch train represented by selection unit 17 to select a free outgoing line selector in the tandem exchange A, which free selector is now assumed to be selector 19 reached over line circuit 16. Next, the operator controls selector 19 (by dialing the digit "2") to raise the associated shaft and wipers of selector 19 to the second level of the selector bank, whereupon selector 19 then automatically rotates its wipers into the second level of the bank in a well-known manner. If line circuit 20 outgoing from tandem exchange A to terminating exchange C is not in use at this time, then the wipers of selector 19 will stop on the first contacts of the second level of the bank, and the operator equipment represented by unit 18 is automatically connected to line circuit 20, also in a well-known manner. If, however, line circuit 20 is in prior use at the time selector 19 tests the first contacts of the second level of the bank, then the wipers of selector 19 are automatically rotated to the second contact of the second level of the bank, and the operator equipment in exchange B is automatically connected to line circuit 25 (assuming that line circuit 25 is free at this time). Should both line circuits 20 and 25 be in prior use, then the operator in exchange B will receive a conventional busy indication.

From the preceding operation explanation, it will be readily apparent that the operator in exchange C can alternatively control selector 29 to select either line circuit 30 or 35 outgoing from tandem exchange A to terminating exchange D by dialing the digit "1" and thereby cause selector 29 to raise its wipers to the first level of the switch bank. It will also be apparent that an operator in exchange C can control selector 29 in tandem exchange A (over line circuit 26) to select either line circuits 10 or 15 to terminating exchange B, or to select either line circuits 30 or 35 to terminating exchange D: that an operator in exchange D can control selector 39 in tandem exchange A (over line circuit 36) to select either line circuits 10 or 15 to terminating exchange B, or to select either line circuits 20 or 25 to terminating exchange C; and that an operator in tandem exchange A can control selector 9 (over line circuit 6) to select either line circuits 10 or 15 to terminating exchange B, to select either line circuits 20 or 25 to terminating exchange C, or to select either line circuits 30 or 35 to terminating exchange D.

Assuming now that line circuits 10 and 15 outgoing from tandem exchange A to terminating exchange B are in use, for example, as a result of an operator in exchange A having controlled selector 9 to connect with line circuit 10, and an operator in exchange C having controlled selector 29 to connect with line circuit 15, then the chain relays 43 and 45 in line equipments 12 and 14 (Fig. 2) are operated in a well-known manner to complete an obvious circuit to relay 40, causing relay 40 to operate. At armatures 41 and 42, relay 40 extends the alternating current supply from generator 5 to filters 63 and 64 in multiple. Both of these filters are tuned to pass alternating current of 10,000 cycle frequency, filter 63, therefore, causing the alternating current of 10,000 cycle frequency to be superimposed on line circuit 25 outgoing from tandem exchange A to terminating exchange C, and filter 64 causing the alternating

current of 10,000 cycle frequency to be superimposed on line circuit 30 outgoing from tandem exchange A to terminating exchange D.

Filter 80 in bridge of line circuit 25 at exchange C is tuned to pass alternating current of 10,000 cycle frequency and, therefore, causes the alternating current superimposed on line circuit 25 by means of filter 63 to be extended to busy signal equipment 81. Means (not shown) associated with busy signal equipment 81 responds to the impressed alternating current in a well-known manner, and other means (not shown) also associated with busy signal equipment 81 responsive to the action of said first means of busy signal equipment 81 causes ground potential to be extended to busy signal 82 thereby to complete the circuit of busy signal 82. The glowing of busy signal 82 indicates to the operator, or operators, at exchange C that all of the line circuits (10 and 15) outgoing from the tandem exchange to terminating exchange B are in use. Now should a demand for a connection from exchange C to exchange B be initiated while line circuits 10 and 15 are in prior use, it will be unnecessary for an operator at exchange C to attempt to select a line circuit from tandem exchange A to exchange B until busy signal 82 ceases to glow. Operator time which would otherwise be expended in repeated testing is conserved, and useless occupations of line circuits from exchange C to tandem exchange A are avoided.

Filter 90 in bridge of line circuit 30 at exchange D is also tuned to pass alternating current of 10,000 cycle frequency, and therefore, causes the alternating current superimposed on line circuit 30 by means of filter 64 to be extended to busy signal equipment 91. As a result of the passing of 10,000 cycle alternating current to busy signal equipment 91, busy signal 92 is caused to glow in a manner similar to that described in the preceding paragraph for the glowing of busy signal 82 at exchange C. The glowing of busy signal 92 indicates to the operator, or operators, at exchange D that all of the line circuits (10 and 15) outgoing from tandem exchange A to terminating exchange B are in use. As a consequence of this group busy supervision at exchange D, the conservation of operator time and the efficient occupation of the line circuits from exchange D to tandem exchange A become realities.

Assuming now that line circuits 20 and 25 outgoing from tandem exchange A to terminating exchange B are in use instead of line circuits 10 and 15, then the chain relays 50 and 52 in line equipments 22 and 24 at tandem exchange A are operated in a well-known manner to complete an obvious circuit to relay 47, causing relay 47 to operate. At armatures 48 and 49, relay 47 extends the alternating current supply from generator 5 to filters 61 and 65 in multiple. Filter 61 is tuned to pass alternating current of 10,000 cycle frequency but not alternating current of 12,000 cycle frequency. Filter 65 is tuned to pass alternating current of 12,000 cycle frequency but not alternating current of 10,000 cycle frequency. Filter 61, therefore, causes 10,000 cycle alternating current to be superimposed on line circuit 15 outgoing from tandem exchange A to terminating exchange B, and filter 65 causes 12,000 cycle alternating current to be superimposed on line circuit 30 outgoing from tandem exchange A to terminating exchange D. Filter 70 in bridge of line circuit 15 at exchange B is tuned to pass alternating current of 10,000 cycle frequency and, therefore, causes the 10,000 cycle alternating current superimposed on line circuit 15 by means of filter 61 to be extended to busy signal equipment 71, which functions (in the manner similar to that previously described for busy signal equipment 81) to cause the glowing of busy signal 72. The operators at exchange B are thuswise informed that all of the line circuits (20 and 25) outgoing from tandem exchange A to terminating exchange C are in use. Filter 95 in bridge of line circuit 30 at exchange D is tuned to pass alternating current of 12,000 cycle frequency and, therefore, causes the 12,000 cycle alternating current superimposed on line circuit 30 by means of filter 65 to be extended to busy signal equipment 96 which functions (in the manner previously described for busy signal equipment 81) to cause the glowing of busy signal 97. The operators at exchange D are thuswise informed that all of the line circuits (20 and 25) outgoing from tandem exchange A to terminating exchange C are in use.

It will also be apparent that when line circuits 30 and 35 outgoing from tandem exchange A to terminating exchange D are in use, filter 75 in exchange B will pass 12,000 cycle alternating current to busy signal equipment 76 thereby to cause the glowing of busy signal 77, and filter 85 in exchange C will pass 12,000 cycle alternating current to busy signal equipment 86 thereby to cause the glowing of busy signal 87.

It will be further apparent that the line circuits outgoing from tandem exchange A to any two of the terminating exchanges B, C and D may be in use at the same time and, therefore, there will be both 10,000 cycle and 12,000 cycle alternating current superimposed on one of the line circuits outgoing from tandem exchange A to the remaining third terminating exchange. Assuming now that the third terminating exchange is exchange B, then filter 70 will pass 10,000 cycle alternating current to busy signal equipment 71 but not 12,000 cycle alternating current, and filter 75 will pass 12,000 cycle alternating current to busy signal equipment 76 but not 10,000 cycle alternating current. As a consequence of the functioning of busy signal equipments 71 and 76, busy signals 72 and 77 glow to respectively indicate that all of the line circuits outgoing from tandem exchange A to terminating exchanges C and D are in use.

The frequencies of alternating current indicated in Fig. 2 are well above the upper cut-off point of ordinary voice currents and, therefore, are superimposed on a line circuit outgoing from tandem exchange A to any one of the terminating exchanges regardlessly of whether the particular line circuit is already in use on a telephone conversation.

It should be understood that while one embodiment of the present invention is disclosed and described in the preceding specification, the invention is not limited to the particular form or application shown, but is entitled to the equivalents thereof within the scope of the appended claims.

I claim:

1. In a telephone system, first and second terminating exchanges, a tandem exchange, lines from said tandem exchange to both said terminating exchanges, said lines to said first exchange accessible to calls initiated in said tandem exchange or said second exchange, said lines to said second exchange accessible to calls initiated in said tandem exchange or said first exchange, a source of alternating current, a supervisory sig-

nal in each said terminating exchange, means responsive to a simultaneous occupancy of all said lines to one of said terminating exchanges for causing the superimposition of said alternating current on one of said lines to said other terminating exchange, and means responsive to said superimposition of said alternating current for causing the supervisory signal in said other terminating exchange to function, thereby to indicate in said other terminating exchange that all said lines to said one terminating exchange are occupied.

2. In a telephone system as claimed in claim 1 wherein said source of alternating current is of a non-voice current frequency.

3. In a telephone system, first and second terminating exchanges, a tandem exchange, lines from said tandem exchange to each said first and second exchanges, means for connecting calls initiated in said tandem exchange to idle ones of said lines to either said first or said second exchange, means for connecting calls initiated in said first exchange to idle ones of said lines to said second exchange, means for connecting calls initiated in said second exchange to idle ones of said lines to said first exchange, a source of non-voice frequency alternating current, a chain circuit common to said lines to one of the terminating exchanges operative when all said lines to said one terminating exchange are in use, a supervisory signal in the other terminating exchange, means responsive to an operation of said chain circuit for superimposing said alternating current on one of the lines to said other terminating exchange, and means responsive to said superimposing of said alternating current for causing said supervisory signal to operate and thereby indicate that all said lines to said one terminating exchange are in use.

4. In a telephone system as claimed in claim 3 wherein said means responsive to an operation of said chain circuit comprises a filter tuned to pass said alternating current.

5. In a telephone system as claimed in claim 3 wherein said means responsive to an operation of said chain circuit comprising a filter tuned to pass said alternating current, and wherein said means responsive to said superimposing of said alternating current includes a filter tuned to pass said superimposed current.

6. In a telephone system, a plurality of terminating offices, a tandem office, trunks from said tandem office to each of said terminating offices, means for completing calls between said terminating offices over said trunks from said tandem office to said terminating offices, a source of non-voice frequency alternating current, a chain circuit common to the trunks from said tandem office to one of said terminating offices operative when said trunks to said one terminating office becomes busy, a filter associated with one of said trunks from said tandem office to each of said other terminating offices, said filters tuned to pass said alternating current, a signal in each of said other terminating offices, means responsive to an operation of said chain circuit for connecting said alternating current to each of said filters thereby to cause each said filter to extend said alternating current to its associated trunk, and means in each said associated trunk responsive to said extension of said alternating current for causing said signal in each of said other terminating offices to operate, thereby to indicate in all said other offices that all of said trunks from said tandem office to said one terminating office are busy.

7. In a telephone system, first, second and third terminating offices, a tandem office, lines from said tandem office to each of said terminating offices, means for completing calls from said tandem office to said terminating offices over said lines, means for completing calls between said terminating offices over said lines, alternating currents of two different frequencies, means responsive to a simultaneous occupancy of all the lines to said first terminating office for superimposing said alternating current of one of said frequencies on one of the lines to said second terminating office and for superimposing said alternating current of said other frequency on one of the lines to said third terminating office, a signal in each of said second and third terminating offices, means responsive to said superimposing of said one frequency for operating said signal in said second terminating office, means responsive to said superimposing of said other frequency for operating said signal in said third terminating office, said operations of said two signals indicating in said second and third terminating offices respectively that all the lines from said tandem office to said first terminating office are in the occupied position.

8. The telephone system as claimed in claim 7 wherein the two different frequencies of said alternating currents are above the range of voice current frequencies.

9. In a telephone system, A, B, C and D offices, lines from said A office to said B, C and D offices, means for completing calls from said A office to said B, C and D offices over said lines, means for completing calls between said B, C and D offices over said lines, alternating currents of two different frequencies, means for superimposing said alternating current of one of said frequencies on one of said lines to said D office when all said lines to said B office become busy, means for superimposing said alternating current of said other frequency on said one line to said D office when all said lines to said C office become busy, two busy signals in said D office, means responsive to a superimposing of said one frequency on said one line to said D office for causing one of said busy signals to function, and means responsive to a superimposing of said other frequency on said one line to said D office for causing said other busy signal to function.

10. The telephone system as claimed in claim 9 wherein said means for superimposing said alternating current of said one frequency includes a filter tuned to pass said one frequency but not said other frequency, wherein said means for superimposing said other frequency includes a filter tuned to pass said other frequency but not said one frequency, wherein said means responsive to a superimposing of said one frequency includes a filter tuned to pass said one frequency but not said other frequency, and wherein said means responsive to a superimposing of said other frequency includes a filter tuned to pass said other frequency but not said one frequency.

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No references cited.