

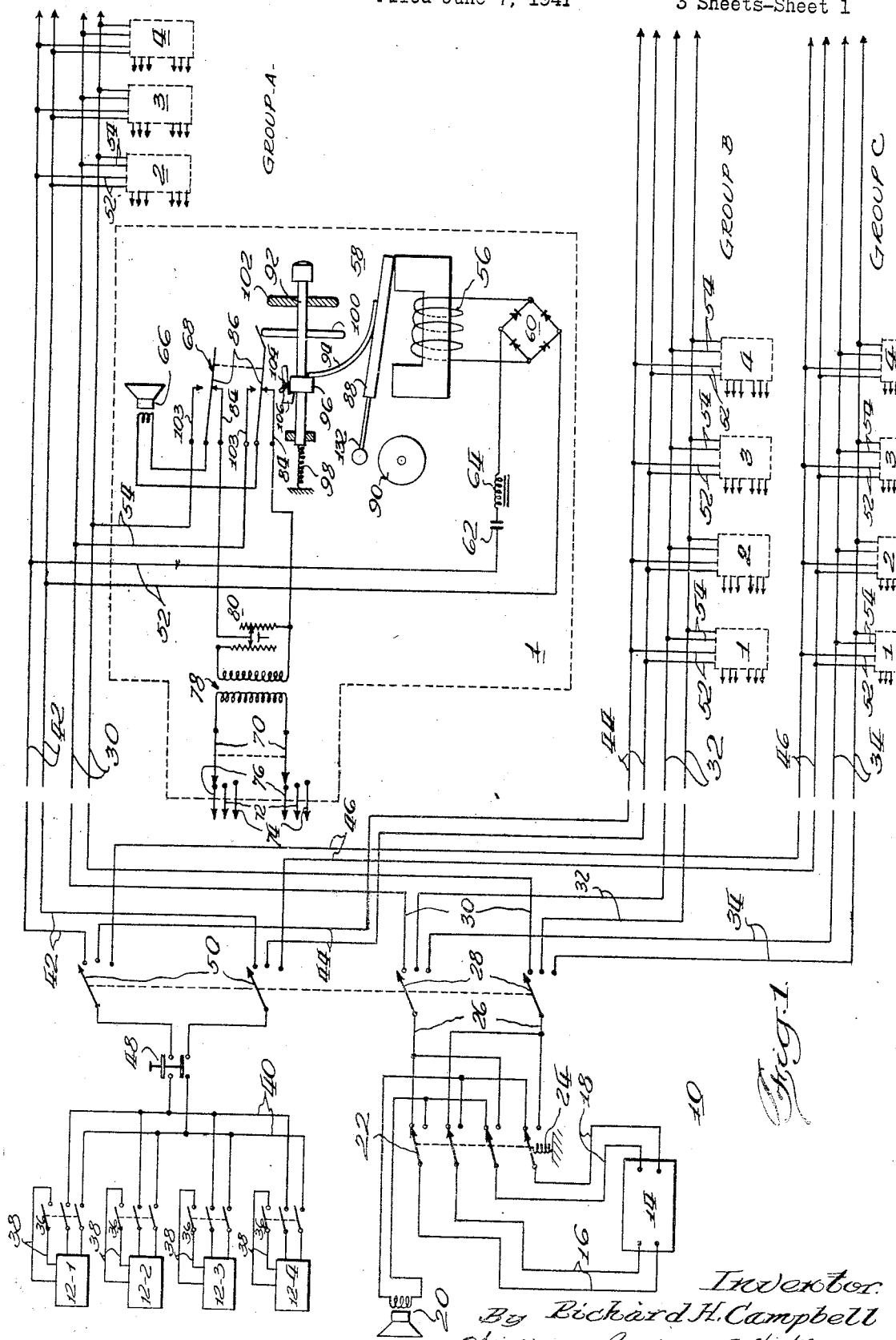
April 27, 1943.

R. H. CAMPBELL
COMMUNICATION SYSTEM

2,317,358

Filed June 7, 1941

3 Sheets-Sheet 1



April 27, 1943.

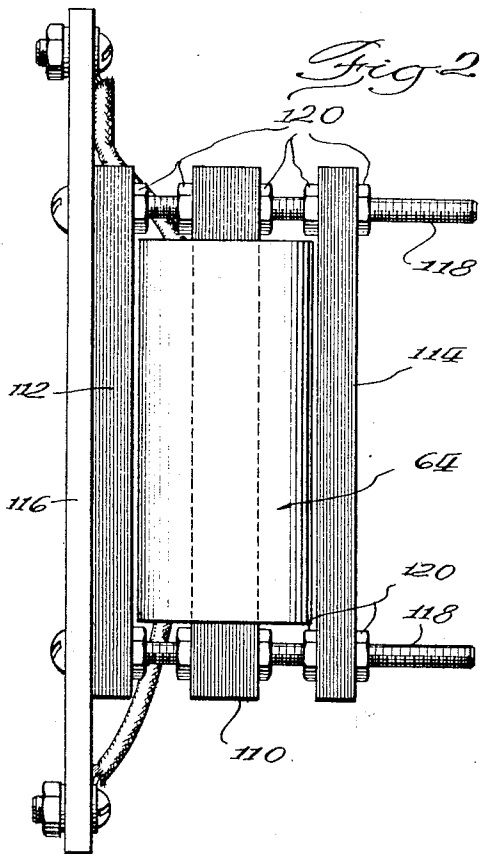
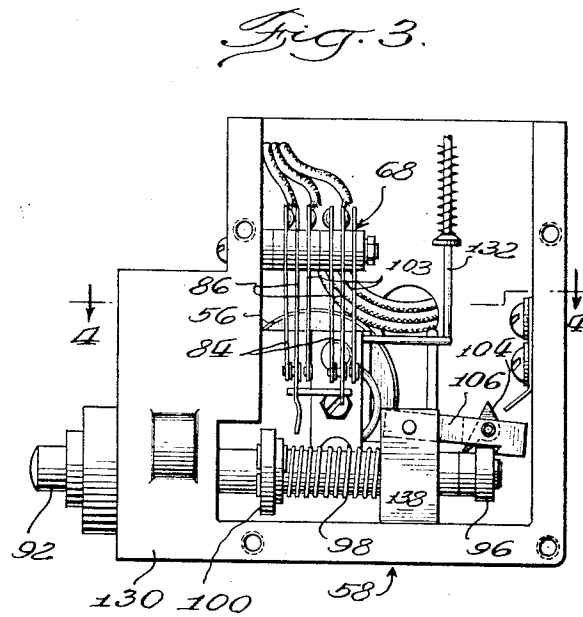
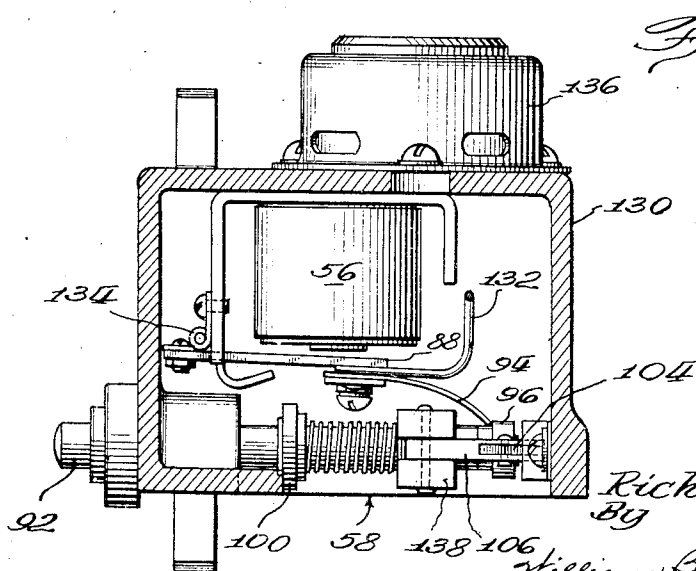
R. H. CAMPBELL

2,317,358

COMMUNICATION SYSTEM

Filed June 7, 1941

3 Sheets-Sheet 2



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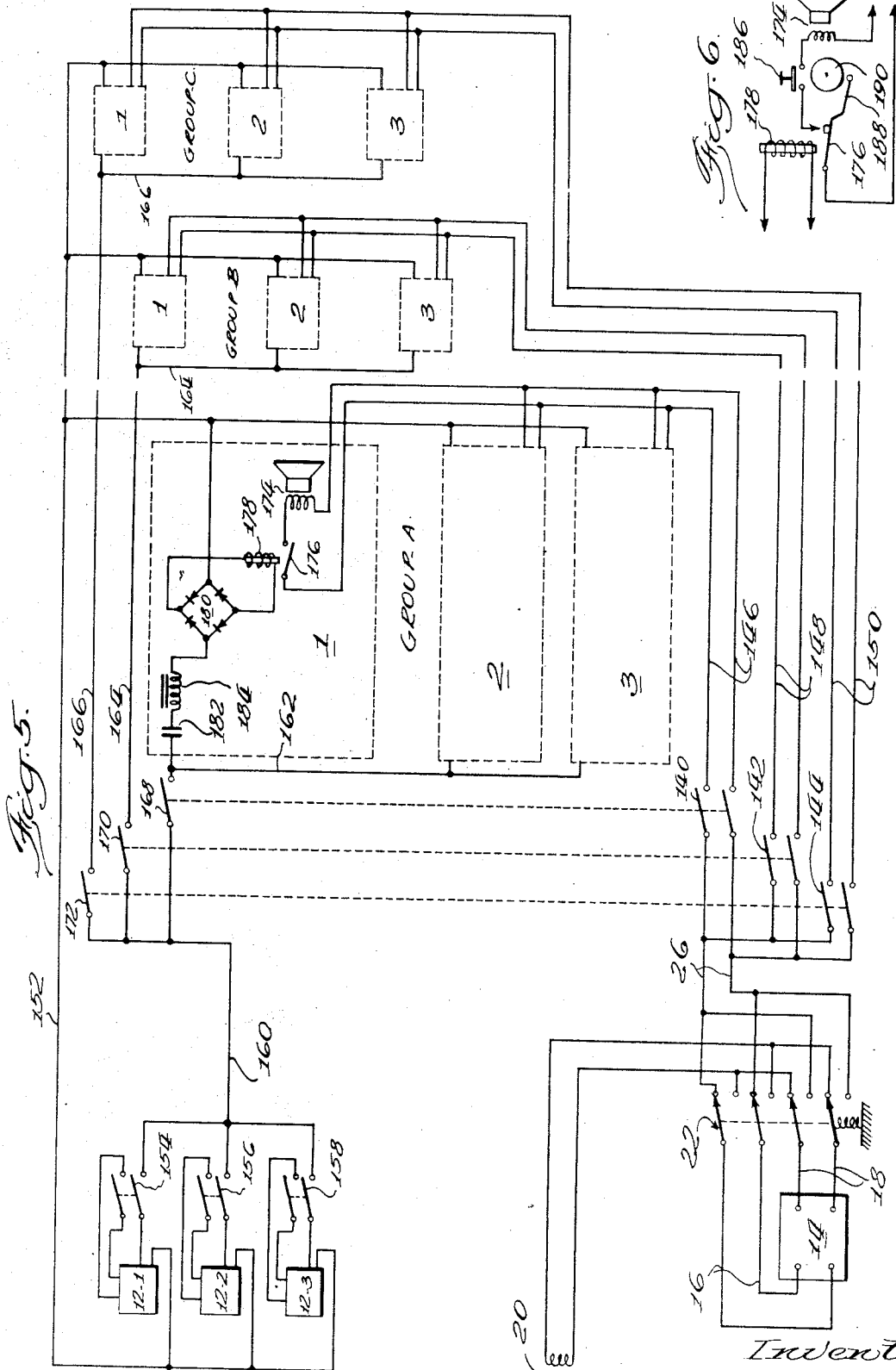
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R. H. CAMPBELL
COMMUNICATION SYSTEM

2,317,358

Filed June 7, 1941

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,317,358

COMMUNICATION SYSTEM

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Application June 7, 1941, Serial No. 397,098

27 Claims. (Cl. 179—1)

The present invention relates to communication systems and more particularly to intercommunication systems of the loud-speaking type, and has for its primary object the provision of a new and improved system comprising a central station and a large number of substations located at a distance from the central station.

In a system of the type under consideration, it is desirable that the number of conductors be reduced as much as possible and that the selection of stations, both for signalling and communication, be simplified to prevent operating difficulties. These ends are attained by the present invention.

One of the objects of the present invention is to provide a new and improved arrangement for signalling a selected station which may be one of a number on the same communication circuit.

A further object of the present invention is to provide a new and improved station signalling arrangement wherein the stations are signalled by signal voltages of different frequencies.

Another object of the invention is to provide a new and improved inductance for tuning the signal circuits at the substations.

A further object of the invention is to provide a new and improved arrangement for indicating at the called station that it is being called or has been called so that a person may be advised of a call even though not present at the time.

A further object of the invention is to provide a new and improved arrangement wherein only the called station or stations may be connected to the communication circuit so that undesired eavesdropping is prevented.

A further object of the invention is the provision of a new and improved relay normally connecting a loudspeaker at a substation to one circuit and adapted to be conditioned upon energization by a signal voltage for manual operation to close a communication circuit and adapted, further, upon release after such manual operation, to return to its initial position until again energized.

Other objects and advantages of the present invention will become apparent from the ensuing description, in the course of which reference is had to the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of a system embodying the invention;

Fig. 2 is a side elevation of an inductance coil used in the tuned signal responsive circuit at each of the substations and diagrammatically illustrated in Fig. 1;

Fig. 3 is a side elevational view (with cover

removed) of the control relay provided at each of the substations;

Fig. 4 is a cross-sectional view of the relay taken along the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 1 of another system embodying certain features of the present invention; and

Fig. 6 is a fragmentary view of a modification of the system of Fig. 5.

The system illustrated diagrammatically in Fig. 1 may be seen to consist of a central station 10 and a plurality of groups of substations A, B and C. While only three groups have been illustrated, the number may be varied to meet the demands of any particular installation. Each group includes four substations indicated by the reference characters 1, 2, 3 and 4. Here again, while only four substations are illustrated, the number may be varied to meet the requirements of any installation. If the number of stations in a group are varied, then the number of signal voltage generators or oscillators 12, to which reference will be had shortly, will have to be varied accordingly so that the number of oscillators is equal to the number of stations in the group including the greatest number.

The central station includes a normally operative amplifier 14 having an input circuit 16 and an output circuit 18. The amplifier may be of any well-known construction and consequently has been illustrated diagrammatically only. The central station includes also a permanent magnet type loudspeaker 20 utilizable also as a microphone and selectively connectable to either the input or output of the amplifier by a communication direction control switch 22 biased as by a spring 24 to connect the loudspeaker to the output and to connect a communication circuit 26 to the input. In the displaced position of the switch, the connections of the loudspeaker and communication circuit to the amplifier are reversed. Communication may thus be carried on in opposite directions between the central station and selected substations.

The selection of substations is effected in part by a group selector switch 28, and in part by the particular oscillator 12 that is used. The group selector switch normally occupies an off position and may be operated to connect circuit 26 to any of interstation circuits 30, 32, or 34 leading to the stations of groups A, B, and C, respectively. These interstation circuits may aptly be termed "communication circuits" as distinguished from signalling circuits, which are to be referred to shortly.

As already indicated, the central station includes also a plurality of sources of signal voltage, indicated as the oscillators 12. Inasmuch as each of the groups of substations includes four stations, four oscillators 12—1, 12—2, 12—3 and 12—4 have been shown—these being utilized for calling stations 1, 2, 3 and 4 of the various groups. These oscillators may conveniently be of the electronic type and preferably adjusted to produce frequencies between about 200 and 1000 cycles. Good results have been obtained in a system including eight oscillators arranged to produce the following frequencies: 170, 230, 300, 390, 490, 600, 720, and 1000. The oscillators have been illustrated diagrammatically as they may be of any well-known types having stable operating characteristics.

According to one of the features of the present invention, these oscillators are arranged normally to be inoperative, but are conditioned for instantaneous operation when selected for use. This arrangement is possible by supplying the various tubes with cathode heater current at all times and completing the "B" supply circuits upon selection for use. Each oscillator is thus provided with a combined output and "B" supply controlling switch 36, operable simultaneously to complete the "B" supply circuit 38 and to connect the oscillator output to a bus line 40.

The signal voltage of selected frequency is supplied to the groups of substation signal circuits 42, 44, and 46 individual to groups A, B, and C, respectively, through a push button switch 48 and a signal circuit selector switch 50 operable simultaneously with the group selector switch 28. The push button switch 48 is provided to enable audible signals at the substations to be operated in accordance with some desired code when communication is not desired, but if it is desired to indicate some other fact to the person at the substation, as, for instance, that the person's presence is desired at the central station or the like.

The apparatus at each substation is identical, so that only that at station 1 of group A has been illustrated in detail. Each station is connected to its group signal and communication circuits through the branch circuits 52 and 54. Signal circuit 52 is permanently connected to a winding 56 of a novel control relay, indicated as a whole by reference character 58, through a full wave rectifier 60 and a condenser 62 and an inductance coil 64, the condenser and inductance coil having characteristics to provide series resonance so that the relay will be energized sufficiently to operate its armature only when the signal circuit is supplied with voltage of predetermined frequency. For instance, relay 60 at station 1 of group A (or at any of the other groups) is responsive only to voltage of the frequency supplied by oscillator 12—1. The inductance coil is of a novel construction illustrated in Fig. 2 and to be described later.

Each of the sub-stations also includes a loudspeaker 66 of the permanent magnet type utilizable also as a microphone. The loudspeaker is normally disconnected from the communication circuit by a switch 68 which is manually operable but which cannot be operated to change the circuit connections until the relay 58 has been energized in response to a signal voltage. Operation of the relay conditions the switch for manual operation as well as results in the production of a visual signal that a call has been received, as will be described more fully shortly.

The loudspeaker is normally connected to a

program selector switch 70 so that the person at a station may select one program by operating switch 70 to connect it to circuit 72 or another by operating it to connect to circuit 74. The program selector switch is normally connected to circuit 76, an "off" circuit, so that no matter what the position of the selector switch, the loudspeaker may be energized by an emergency call from apparatus not shown herein but disclosed in the co-pending application of Normal H. Reeve, Serial No. 397,117, filed June 7, 1941.

The loudspeaker is connected to the program selector switch through a transformer 78, an L pad 80 having a stop 82 to prevent disconnection of the speaker from the circuit, and the fixed and movable blades 84 and 86 of switch 68.

When the relay 58 is operated in response to the application of a signal voltage of proper frequency, the relay armature 88 is attracted simultaneously to ring bell 90 and to release switch operating rod 92 by moving latch 94 from in front of a collar 96 on the rod. The rod is pushed out by a compression spring 98 until stopped by a second collar 100 striking a support 102. The outward projection of the rod serves as a visual indication of the reception of a call.

After the switch operating rod 92 has been released as just described, it may be pushed in to operate switch 68 and disconnect the loudspeaker 66 from the program channel and to connect it to the communication circuit through fixed contacts 103. This is possible by reason of a pivoted finger 104 on a pivoted latch 106, which normally prevents the rod from being pushed inwardly, and which, upon movement of collar 96 to the right, rotates to provide a camming surface allowing the collar to go past the latch when the lever is depressed or moved to the left, as viewed in Fig. 1. When the lever is released the collar 96 is caught by latches 94 and 106 and the lever is effectively prevented from being pushed in until the relay is again operated.

When the lever is held in its innermost position to connect the loudspeaker to the communication circuit, communication may be carried on between the central station and the substation alternately in opposite directions as determined by the position of the communication direction control switch 22 at the central stations. When communication is thus being carried on between the central station and a selected station, other stations are prevented from listening to the conversation as the loudspeakers thereat cannot be connected to the communication circuit until the relays have been operated.

The central station may, if so desired, communicate with more than one station of a group by successively calling the stations.

The inductance coil 64 is constructed and arranged so that it operates with increased efficiency, that it is shielded against external metal objects and that it may be easily adjusted to provide series resonance with condenser 62. All these features are provided by laminations located axially of and positioned on opposite sides of the coil. Referring now to Fig. 2 the coil 64 may be seen to surround a laminated core 110 and to be disposed substantially centrally of laminations 112 and 114. The laminations and core are positioned relative to each other and supported on an insulating plate 116 by non-magnetic bolts 118 and nuts 120 whereby the position of the coil relative to the laminations 112 and 114 may be readily adjusted.

The location of the laminations axially of and

on opposite sides of the coil increases the efficiency of the coil as they provide an additional low reluctance path for the flux. Furthermore, since they are adjustable relative to the coil and its core, they provide a vernier adjustment of the frequency response of the tuned circuit. This means that the condenser capacity can be off 10 or 15% from what it should be and still be usable. The laminations also shield against the effect of external metal objects which tend to decrease the Q of the circuit, and thus broaden the frequency response of the coil.

The relay 58 is illustrated in detail in Figs. 3 and 4. The relay coil 56 and switch 68 are mounted in a metallic casing 130 designed to be closed by a suitable cover mounting the bell 90 adapted to be struck by a clapper 132 secured to the armature 88. The armature is pivotally secured to the solenoid frame and is biased away from the relay winding by a spring 134. The armature also supports the latch 94. The solenoid and switch connections lead to a plug type receptacle 136 mounted at the side of the casing.

The switch operating rod 92 is slidably mounted in one of the casing walls and an upright boss 138 which is forked at its upper end pivotally to mount the latch 106. In the indicated (and normal) position the rod cannot be pushed in because the latch 106 catches the collar 96 rotatably mounted on the rod and the rod is prevented from moving out by latch 94. When the winding 56 is energized by a signal voltage of proper frequency, the armature is picked up to cause clapper 132 to strike the bell and latch 94 is released so that the rod is moved outwardly by spring 98. The latter surrounds the rod and abuts against boss 138 and collar 100 also rotatably mounted on the rod. When the rod is pushed in subsequent to its release, as above described, it can be pushed in far enough to cause collar 100 to actuate the movable switch blades 86 out of engagement with contacts 84 and into engagement with contacts 103. During this movement latch 106 is prevented from catching collar by the pawl 104 pivotally mounted between the forked end of latch 106 for limited angular movement relative to the latch.

The relay is of relatively simple construction when considered in the light of the functions it performs. Furthermore, it may be constructed readily and economically.

The embodiment of the invention illustrated in Fig. 5 illustrates the application of the principles thereof to a system wherein the central station may establish communication circuits with selected substations without the necessity of operators at the latter operating switches and wherein a substation may be selected simply by closure of two switches, one selecting the group in which substation is located and the other the frequency for the particular substation.

The central station 10 includes the oscillators 12-1, 12-2, 12-3, the amplifier 14 having input and output connections 16 and 18, the loudspeaker-microphone 20, the communication control switch 22 and communication circuit 26, just as the central station 10 of the previously described embodiment. The communication circuit 26 is adapted to be connected by individual switches 140, 142 and 144 to interstation circuits 146, 148 and 150, leading to the groups of substations A, B and C, respectively.

The oscillators have one side connected to a common conductor 152 leading to all substations and the other sides are adapted to be connected

by combined frequency selector and "B" supply switches 154, 156 and 158 to a bus line 160. The bus line is adapted to be connected to signal circuits 162, 164 and 166 individual to groups A, B and C by switches 168, 170 and 172 coupled for operation simultaneously with switches 140, 142 and 144, respectively.

The substations are all identical and consequently station 1 of group A only has been illustrated in detail. It includes a loudspeaker microphone 174 adapted to be connected to interstation communication circuit 146 upon closure of switch 176, which is closed by energization of relay winding 178 by a signal voltage of predetermined frequency, i. e., that supplied by oscillator 12-1. The winding is connected across the output terminals of rectifier 180 the input of which is connected across signal circuit 162 and the common conductor 152 through the series resonant circuit including condenser 182 and inductance coil 184.

Substations 2 and 3 of group A are similarly arranged, i. e., the loudspeakers thereat are adapted to be connected to circuit 146 by a switch controlled by a relay energized by voltages of predetermined frequencies supplied thereto from oscillators 12-2 and 12-3, respectively. The substations of groups B and C are similarly constructed and arranged.

In operation, the central station selects the group in which a substation to be called is located by closure of the proper communication and signal circuits and the particular substation in the group by operation of the proper oscillator switch. For instance, let it be assumed that the operator at the central station desires to communicate with station 1 of group A. In this event the switch 140-168 is closed to connect the signal circuit to the oscillator bus line 160 and to connect the communication circuit 26 to interstation circuit 146. Thereafter, the operator closes switch 154, which connects the output of oscillator 12-1 across the signal circuit. The oscillator voltage is thus supplied to the tuned circuit and the rectifier 180, and the relay winding 178 is energized sufficiently to close switch 176, thereby connecting the loudspeaker 174 to circuit 146. Thereafter, communication in opposite directions is carried on under the control of the operator at the central station who manipulates the communication direction control switch between its talk and listen positions.

In the event the operator at the central station desires to communicate with station 2 of group A, the procedure outlined above is followed, except that the oscillator 12-2 is used, and in the event station 3 is to be called, then the oscillator 12-3 is used.

In the event the central station desires to communicate with any of the substations of group B, then the switch 142-170 is closed and the desired substation called by closure of the proper oscillator switch. In the event communication is desired with a station of group C, the above outlined procedure is followed, except for the closure of switch 144-172.

In the last described embodiment it is possible for the central station to eavesdrop on the various substations by closing the proper circuit selecting switch and connecting the proper oscillator to the signal circuit. This results in the connection of the loudspeaker to the communication circuit so that the operator at the central station may listen to conversation at the substation. This is not possible in the modi-

fication of Fig. 6 where the substation is provided with a normally open push button switch 186 in series with the loudspeaker and the relay operated switch 176. According to this modification, the switch 176 has attached to its end a bell clapper 188 adapted to strike a bell 190 when the switch is closed, thereby to give an indication of a call at the substation.

While the system of the present invention has been illustrated in conjunction with manually operable station and signal circuit selecting switches, manual selection and control of the operativeness of the oscillators and a manual coding switch, it should be understood that it is not so limited. These various switches may be operated automatically, as by a suitable dial type control conventionally utilized in telephone circuits.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In an intercommunicating system, the combination including, a central station having operatively associated therewith a source of alternating current signal voltage, a substation having operatively associated therewith means responsive to said signal voltage, a communication circuit between said stations, a signal circuit extending to said substation from said source of signal voltage, switch means at said central station for effecting the connection of the signal voltage source to said signal circuit, and communication circuit controlling means operatively associated with said substation operated by said signal voltage responsive means.

2. In an intercommunicating system, the combination including, a central station having operatively associated therewith a source of alternating current signal voltage, a substation having operatively associated therewith means responsive to said signal voltage, a normally open communication circuit between said stations, a signal circuit extending to said substation from said source of signal voltage, switch means at said central station for effecting the connection of the signal voltage source to said signal circuit, means operatively associated with said substation operated by said signal voltage responsive means for conditioning said communication circuit for completion, and manually operable means at said substation for effecting the completion of said communication circuit.

3. In an intercommunicating system, the combination including, a central station having a source of alternating current signal voltage and communication means, a substation having means responsive to said signal voltage, separate communication and signal circuits between said stations, simultaneously operable switch means at said central station for connecting said source and said communication means to said signal and communication circuits, and communication circuit controlling means at said substation operated by said signal voltage responsive means.

4. In an intercommunicating system, the combination including, a central station having a source of alternating current signal voltage and communicating means, a substation having means responsive to said signal voltage, communication and signal circuits between said stations, simultaneously operable switch means at said central station for connecting said source and said communication means to said signal and communication circuits, means at said substation operated by said signal voltage responsive means for con-

ditioning the communication circuit for completion thereof, and manually operable means at said substation for completing said communication circuit.

5. In an intercommunicating system comprising a central station and a plurality of substations, the combination including, a plurality of sources of alternating current signal voltage of different frequencies, and equal in number to the number of substations, operatively associated with the central station, means responsive to one of said frequencies operatively associated with each of said substations, communication and signal circuits extending from said central station and said signal voltage sources to all of said substations, switch means at said central station for selectively effecting the connection of said signal voltage sources to said signal circuit, and communication circuit controlling means operatively associated with each substation operated by the associated signal voltage responsive means.

6. In an intercommunicating system, the combination including, a central station, a plurality of groups of substations, each group including one or more substations, a plurality of sources of alternating current signal voltage of different frequencies, and equal in number to the number of substations to be called separately in the largest group, operatively associated with the central station, means responsive to one of said frequencies operatively associated with each of the substations of each group, communication and signal circuits extending from said central station and signal voltage sources to all of the substations of each group, switch means at said central station for selectively effecting the connection of said sources of signal voltage to selected signal circuits, and communication circuit controlling means operatively associated with each substation operated by its associated signal voltage responsive means.

7. In an intercommunicating system comprising a central station and a plurality of substations, the combination including, a plurality of sources of alternating current signal voltage of different frequencies, and equal in number to the number of substations, operatively associated with the central station, means responsive to one of said frequencies operatively associated with each of said substations, communication and signal circuits extending from said central station and said sources of signal voltage to all of said substations, switch means at said central station for selectively effecting the connection of said signal voltage sources to said signal circuits, means operatively associated with said substations operated by the signal voltage responsive means associated therewith for conditioning said communication circuit for completion, and manually operable means at said substations for effecting the completion of said communication circuit.

8. In an intercommunicating system, the combination including, a central station, a plurality of groups of substations, each group including one or more substations, a plurality of sources of alternating current signal voltage of different frequencies, and equal in number to the number of substations to be called separately in the largest group, located at the central station, means responsive to one of said frequencies located at each of the substations of each group, communication and signal circuits extending from said central station to all of the substations of each group, switch means at said central station for selectively connecting said sources of

signal voltage to selected signal circuits, means at said substations operated by the signal voltage responsive means thereat for conditioning said communication circuit for completion, and manually operable means at said substations for completing said communication circuit.

9. In an intercommunicating system, the combination including, a station having operatively associated therewith an electronic oscillator for supplying an alternating current signal voltage, said oscillator being normally inoperative and conditioned for immediate operation upon closure of a circuit, a signal circuit leading from said oscillator, and switch means for connecting said oscillator to said signal circuit and completing said first mentioned circuit to render said oscillator operative.

10. In an intercommunicating system, the combination including, a station having operatively associated therewith an electronic oscillator for supplying an alternating current signal voltage, said oscillator being conditioned for immediate operation upon closure of its "B" supply circuit, a signal circuit leading from said oscillator, and switch means for simultaneously connecting said oscillator to said signal circuit and closing said "B" supply circuit.

11. In an intercommunicating system, the combination including, a station having operatively associated therewith a plurality of sources of alternating current signal voltage, said sources being normally inoperative and conditioned for immediate operation upon closure of a circuit, a signal circuit leading from said sources, and switch means selectively operable to connect said sources to said signal circuit and to close said first mentioned circuit to render said sources operative.

12. In an intercommunicating system, the combination including a station having operatively associated therewith a source of alternating current signal voltage, said source being normally inoperative and conditioned for immediate operation upon closure of a circuit, a plurality of signal circuits leading from said source, switch means for conditioning said source for connection to selected signal circuits, and other switch means for simultaneously completing said connection to a selected circuit and closing said first mentioned circuit to render said source operative.

13. In an intercommunicating system, the combination including, a station having operatively associated therewith a plurality of sources of alternating current signal voltage, said sources being normally inoperative and conditioned for immediate operation upon closure of a circuit, a plurality of signal circuits leading from the sources, switch means for conditioning said sources for connection to selected signal circuits, and other switch means for selectively and simultaneously completing connection of said sources to selected signal circuits and the first mentioned circuit of the selected source to render it operative.

14. In an intercommunicating system, the combination including, a central station having operatively associated therewith a source of alternating current signal voltage, said source being normally inoperative and conditioned for immediate operation upon closure of a circuit, a substation having operatively associated therewith means responsive to said signal voltage, a communication circuit between said stations, a signal circuit extending to said substation from

said source of signal voltage, switch means at said central station for simultaneously effecting the connection of said source to said signal circuit and the closing of said first mentioned circuit to render said source operative, and communication circuit controlling means at said substation operated by said voltage responsive means.

15. In a system according to claim 14, including a number of substations connected to the signal circuit and wherein the central station has operatively associated with it an equal number of sources of signal voltage of different frequencies and switch means for selectively connecting said sources to said circuit and simultaneously rendering operative the selected source.

16. In an intercommunicating system, the combination including, a central station having operatively associated therewith a source of signal voltage, a substation, a communication circuit extending between said stations, a signal circuit extending from said source of signal voltage to said substation, switch means at said central station for effecting the connection of said source to said signal circuit, switch means operatively associated with said substation normally breaking the communication circuit extending to the substation, means operable at the substation to actuate said switch means to close said communication circuit, means normally preventing operation of said means to actuate said switch means, and means responsive to said signal voltage to render said last mentioned means inoperative, whereby said actuating means may be operated to actuate said switch means into communication circuit closing position.

17. In an intercommunicating system, the combination including, a central station having a source of signal voltage, a substation, communication and signal circuits extending between said stations, switch means at said central station for connecting said source to said signal circuit, switch means at said substation normally breaking the communication circuit thereat, an actuating member biased away from the switch means and manually operable toward the switch means to close said circuit, an abutment on the member and a pair of latches engaging opposite sides thereof for preventing movement of the member in either direction, means responsive to said signal voltage to move one of said latches to permit the biasing means to move the member away from the switch means and visually indicate a call, and means associated with the other of said latches to render it ineffective to prevent movement of the member in a direction to close said switch means, whereby the member may be moved to close said switch means.

18. In an intercommunicating system, the combination including, a central station having operatively associated therewith a plurality of sources of signal voltage of distinctive characteristics, a plurality of substations, communication circuits extending between said central and all of said substations, signal circuits extending between said sources of signal voltage and all of said substations, switch means at said central station for selectively effecting the connection of said sources to said signal circuit, switch means operatively associated with each substation normally breaking the communication circuit extending to the substation, means at each substation operable to actuate said switch to close said communication circuit, means normally preventing operation of said means to actuate said switch, and means operatively associated

with each substation responsive to one of said signal voltages for rendering said last mentioned means inoperative, whereby said actuating means may be operated to actuate said switch means into communication circuit closing position.

19. In an intercommunicating system, the combination including, a central station, a plurality of groups of substations, and signal and communication circuits extending from the central station to each substation of the various groups; said central station including two way communication means and a selector switch for selectively connecting said means to the communication circuits individual to said groups, a plurality of electronic oscillators providing signal voltages of different frequencies, said oscillators being normally inoperative and conditioned for operation upon completion of the "B" supply circuits, a common output circuit for said oscillators, switch means for selectively connecting said oscillators to said output circuit and simultaneously completing the "B" supply circuit of the selected oscillator, and a selector switch for selectively connecting the selected oscillator to the signal circuits individual to the groups, the two selector switches being coupled for conjoint operation; the substations of each group having tuned means connected to their signal circuits and responsive to but one of said frequencies, switch means normally breaking the communication circuit, means operable to actuate said switch means to close said circuit, means normally preventing operation of said means so to actuate the switch means, and means operable by said tuned means for rendering said last mentioned means inoperative and in responsive to the application of signal voltage; whereby the operator at the central station can select any group of substations by operation of the selector switches and any substation of a group by utilizing the desired oscillator and whereby the communication circuit is completed by the operator at the selected substation by closure of the switch means thereat.

20. A system according to claim 19, wherein the means operable by said tuned means for rendering inoperative the means preventing operation of the switch actuating means also operates visual and audible signals to indicate calls.

21. In an intercommunicating system, the combination including, a central station having a source of alternating current signal voltage, a substation having means responsive to said signal voltage, communication and signal circuits between said stations, said signal responsive means being connected to said signal circuit and controlling said communication circuit, means for producing an audible signal at said substation operated by said signal voltage responsive means, switch means at the central station for partly connecting the source of signal voltage to said signal circuit, and other switch means for selectively closing said circuit for brief periods to operate said audible signal.

22. In an intercommunicating system, the combination including, a central station, a plurality of groups of substations, and signal and communication circuits extending from the central station to each substation of the various groups; said central station including two way communication means and selector switches for selectively connecting said means to the communication circuits individual to the groups, a plurality of electronic oscillators providing signal voltages of different frequencies, said oscillators

being normally inoperative and conditioned for operation upon completion of their "B" supply circuits, a common output circuit for said oscillators, switch means for selectively connecting said oscillators to said output circuit and simultaneously completing the "B" supply circuit of the selected oscillator, and selector switches for selectively connecting the selected oscillator to the signal circuits individual to the groups, the two selector switches for each group being coupled for conjoint operation; the substations of each group having tuned means connected to their signal circuits and responsive to but one of said frequencies, switch means normally breaking the communication circuit, and means operable by said tuned means for closing said switch means to complete the communication circuit upon application of the voltage of said one frequency to its signal circuit.

23. In an intercommunicating system, the combination including, a central station, a plurality of groups of substations, and signal and communication circuits extending from the central station to each substation of the various groups; said central station including two way communication means and selector switches for selectively connecting said means to the communication circuits individual to the groups, a plurality of electronic oscillators providing signal voltages of different frequencies, said oscillators being normally inoperative and conditioned for operation upon completion of their "B" supply circuits, a common output circuit for said oscillators, switch means for selectively connecting said oscillators to said output circuit and simultaneously completing the "B" supply circuit of the selected oscillator, and selector switches for selectively connecting the selected oscillator to the signal circuits individual to the groups, the two selector switches for each group being coupled for conjoint operation; the substations of each group having tuned means connected to their signal circuits and responsive to but one of said frequencies, two switches each normally breaking the communication circuit, one of said switches being manually operable into circuit closing position, means operable by said tuned means for closing the other switch upon application of the voltage of one of said frequencies to its signal circuit, and an audible signal operable by said last mentioned means.

24. A relay, including in combination, a solenoid, an armature, switch means occupying a predetermined position, a manually operable member movable in one direction for operating said switch means into another position, means for biasing said member for movement in the opposite direction, means normally preventing operation of said member in either direction, said means including an abutment on said member and a latch normally engaging one side of said abutment and operable by said armature to release the member upon energization of said solenoid for movement in said opposite direction by said biasing means, and a latch normally engaging the other side of said abutment and a pawl mounted thereon to permit the member to be moved in said one direction past said latch to operate said switch means into its other position, subsequent to release of the member by said solenoid.

25. A relay, including in combination, switch means normally occupying one position, manually operable means for operating said switch into another position, said means being movable in one direction from a normal position to operate

said switch means into another position, means for biasing said means for movement in the opposite direction, means for normally restraining movement of said means in either direction, and a solenoid for rendering ineffective one of said movement preventing means, and means operable upon movement of said manually operable operating means after operation of said solenoid for rendering said other movement preventing means inoperative.

26. An inductance coil, including in combination, a core of magnetic material, a coil wound about said core, a bar of magnetic material, and

non-magnetic means for adjustably supporting said bar in spaced relationship to said coil and core with its ends in proximity to the ends of said core.

- 5 27. An inductance coil, including in combination, a laminated core of magnetic material, a coil wound about said core, a pair of laminated bars of magnetic material of lengths substantially equal to that of said core, and non-magnetic
10 means for adjustably mounting said bars on opposite sides of said coil and its core.

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