

Aug. 10, 1943.

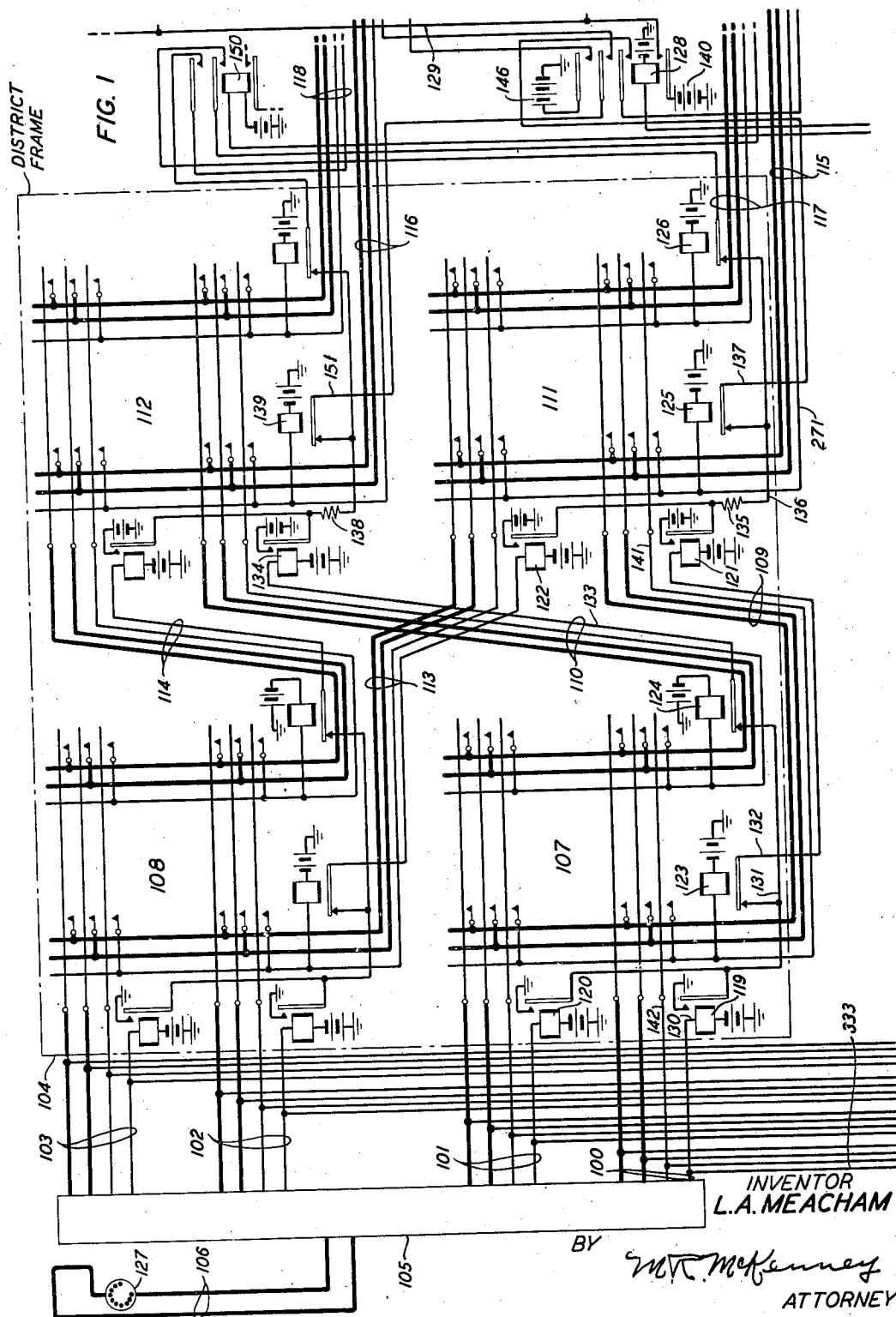
L. A. MEACHAM

2,326,478

SELECTION SYSTEM

Filed Feb. 17, 1942

4 Sheets-Sheet 1



Aug. 10, 1943.

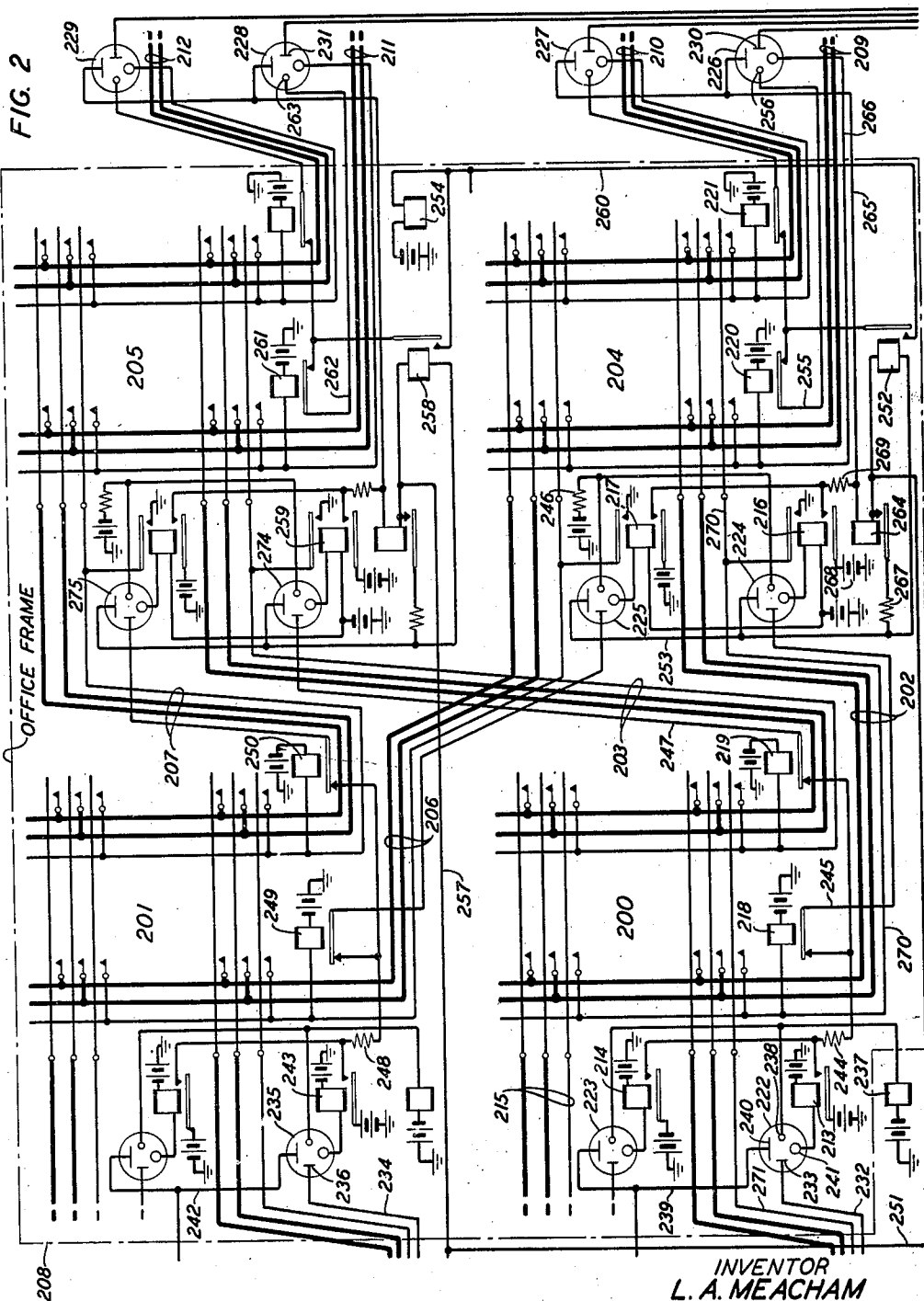
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2,326,478

SELECTION SYSTEM

Filed Feb. 17, 1942

4 Sheets-Sheet 2



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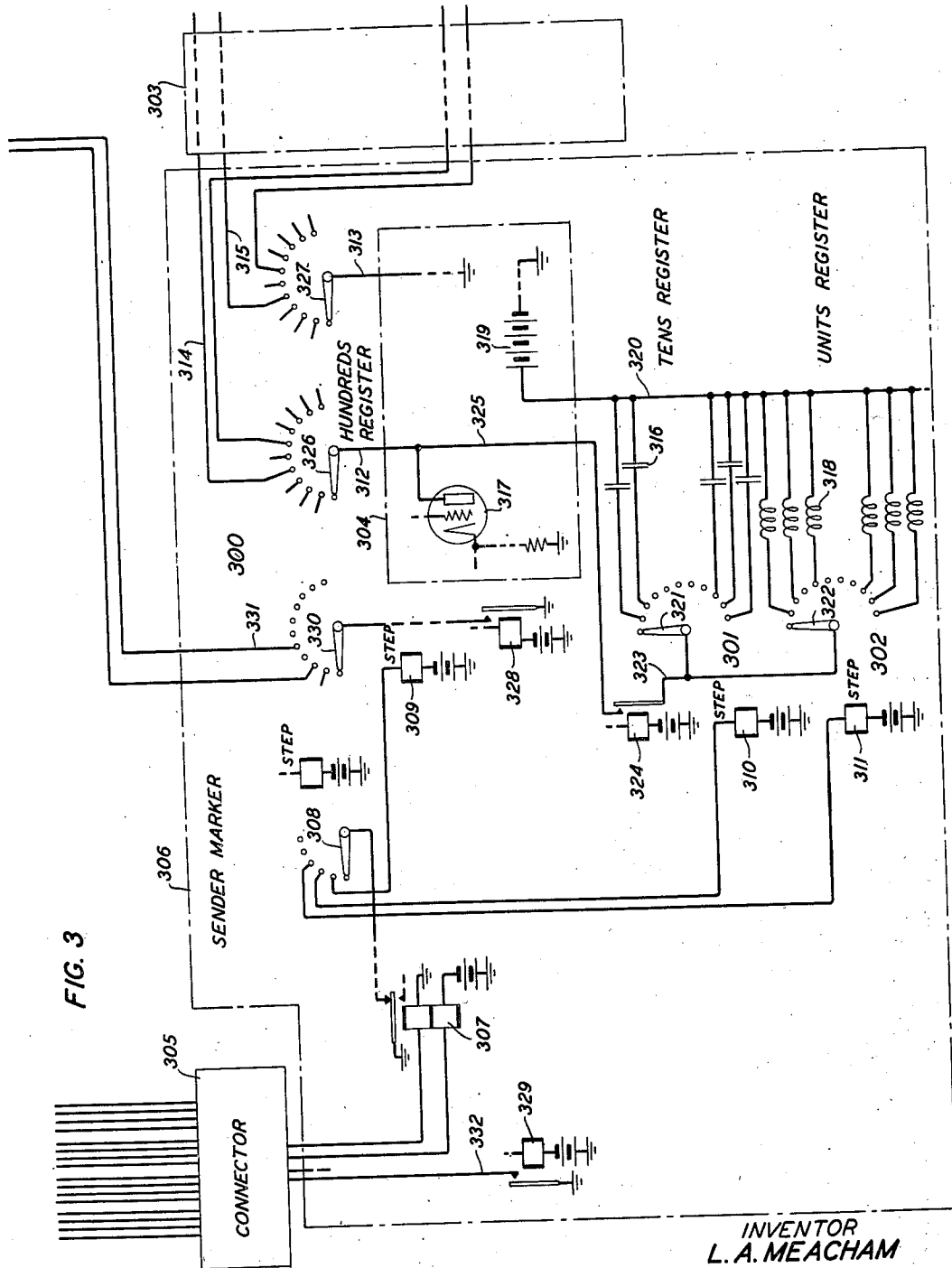
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SELECTION SYSTEM

Filed Feb. 17, 1942

4 Sheets-Sheet 3



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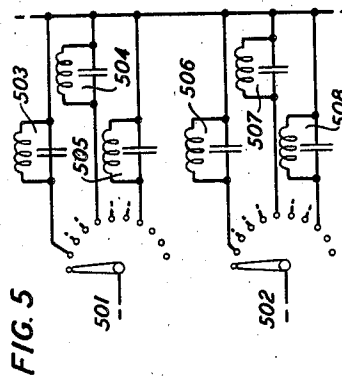
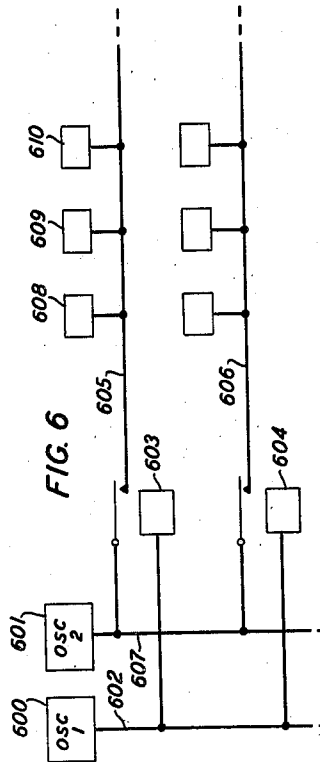
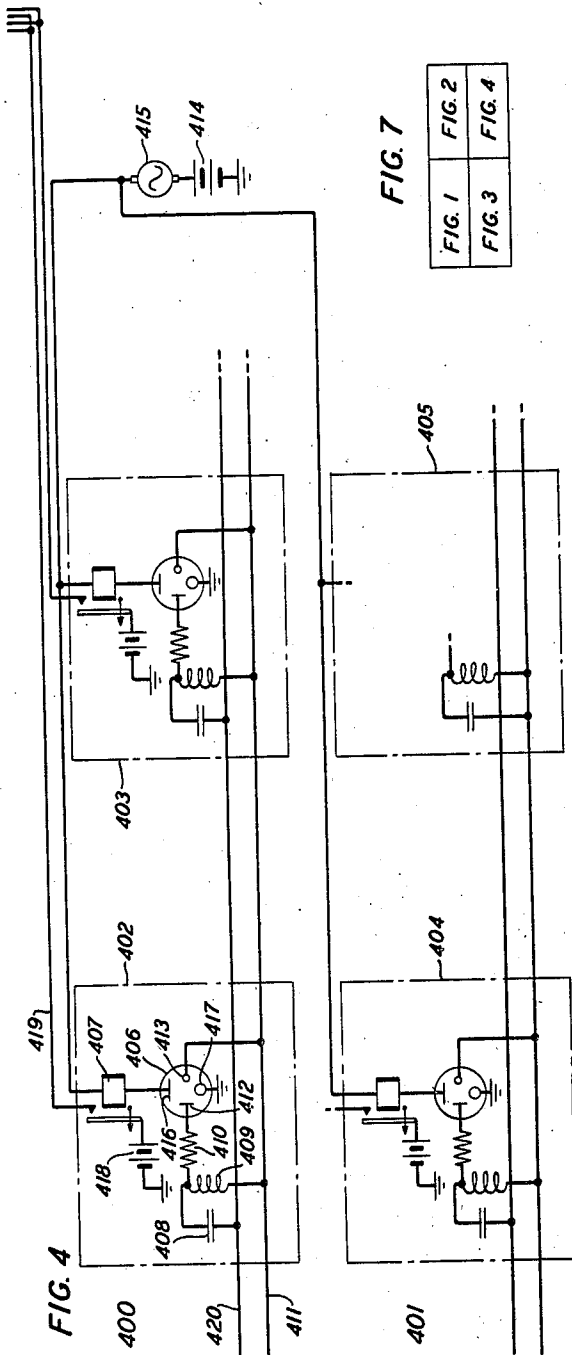
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SELECTION SYSTEM

Filed Feb. 17, 1942

4 Sheets-Sheet 4



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2,326,478

SELECTION SYSTEM

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Application February 17, 1942, Serial No. 431,236

6 Claims. (Cl. 179-18)

This invention relates to selection systems and particularly to systems of this character when used for the purpose of establishing telephone or other communication connections.

The objects of the invention are to minimize as much as possible the common controlling equipment used in the establishment of connections through switching stages; to simplify these controlling equipments; to improve the means whereby the controlling equipment receives and utilizes the designations to effect the desired selections in the switching stage; and in other respects to effect improvements in systems of this general character.

It has been the practice heretofore in automatic telephone switching systems, and particularly in those employing stages of crossbar switches for establishing connections, to provide common senders and markers for performing the numerous controlling and operating functions involved in the establishment of a telephone connection through the switching stages. Usually the marker, which is common to one or more stages of crossbar switches, receives the designation information from the sender, associates itself through frame connector switches to the desired frames of crossbar switches, tests the various serially related links extending through these switches and then, having found an idle channel, proceeds to operate the magnets of the switches to extend the incoming circuit over the idle channel to the desired outgoing circuit.

According to the foregoing objects of the present invention advantages are realized over these prior switching systems by means of a new and improved system in which a single controlling mechanism, associated with the crossbar switching stage and replacing to a large extent the common senders and markers heretofore used, serves to receive the incoming designation impulse series and to utilize these for making a direct selection of the desired one of a plurality of outgoing lines or groups of lines. More specifically this simplified mechanism or sender-marker is equipped with an oscillation generator which is capable of being tuned automatically to produce oscillations of a large number of distinct frequencies. The oscillation generator is tunable by means of a plurality of inductance and capacitance networks which are selectable in accordance with the values of the digits transmitted to the sender-marker over the incoming line. The several frequencies produced by the oscillator correspond respectively to the lines or groups of lines outgoing from the switching stage; and tuned circuits, which are

provided individually for these lines or groups of lines, respond to the particular frequencies chosen by the incoming designations to cause the selection of the desired outgoing line or group of outgoing lines. Thereafter, the controlling circuits associated with and forming a part of the switching stage serve to cause the automatic selection of an idle channel comprised of serially related links through the switching stage to complete the connection from the calling incoming line to a desired idle outgoing line.

The foregoing and other features of the invention will be discussed more fully in the following detailed specification.

In the drawings:

Figs. 1 to 4, when arranged as illustrated in Fig. 7, disclose a portion of an automatic telephone system incorporating the features of this invention.

Fig. 1 illustrates a frame of switches in a selective switching stage together with a number of trunks incoming thereto;

Fig. 2 illustrates a succeeding frame of switches in the switching stage together with a number of trunks outgoing therefrom;

Fig. 3 shows a sender-marker for controlling the switches in said switching stage;

Fig. 4 shows a number of tuned circuits associated with the outgoing trunks;

Fig. 5 shows a modification of the oscillator tuning circuits in the sender-marker; and

Fig. 6 illustrates a modification of the selection mechanism of the sender-marker.

While the invention is not limited to selective systems in which any specific type of switch is used for performing the switching operations, it is particularly useful in such systems when switches of the crossbar type are employed. For a better understanding of the construction and operation of crossbar switches and of the various circuits and mechanisms used in controlling them in the establishment of telephone connections, reference may be had to the patent to Reynolds 2,021,329 of November 19, 1935 and to the patents to Carpenter 2,093,117 of September 14, 1937, and 2,235,803 of March 18, 1941.

Referring to the drawings, the incoming trunks such as trunks 100, 101, 102, 103 appear in and are distributed among the primary crossbar switches of the first or district frame 104. These trunks may come from any destination. For convenience they are illustrated as coming from a non-numerical switching stage 105 through which calls are extended to them automatically from subscribers' lines, such as subscriber's line 106.

The number of switches on the district frame 104 may be chosen arbitrarily, depending upon the particular conditions existing. It is, however, convenient to assume that there are ten primary switches 107, 108, etc., in which the incoming trunks appear. Trunks 100 and 101 appear in switch 107 and trunks 102 and 103 in switch 108, and it will be noted that each trunk appears in only one of the originating switches. The secondary switches of the district frame 104, of which there may also be ten, are interconnected with the primary switches by means of link circuits. For example, the ten links 109, 110 outgoing from the primary switch 107 extend respectively to the ten secondary switches 111, 112. Similarly, the ten links 113, 114 extending from the primary switch 108 appear respectively in the ten secondary switches, and the same is true of the links outgoing from each of the other eight primary switches.

Each of the district frames, such as the frame 104, is connected with the office frames by means of junctors outgoing from the district secondary switches and incoming to the office primary switches. If it is assumed that there are ten office frames, there are correspondingly ten groups of office junctors outgoing from the district frame and appearing respectively in the ten office frames. For example, the ten junctors 115, 116, etc., outgoing from the ten respective district secondary switches 111, 112, appear respectively in the ten office primary switches 200, 201, etc. In like manner the other nine groups of junctors including the group 117, 118 are distributed to the primary switches of the other nine office frames, not shown. Like the district frame, the primary and secondary switches of the office frame 208 are interconnected with link circuits. The ten link circuits 202, 203 outgoing from primary office switch 200 appear respectively in the ten office secondary switches 204, 205; and the ten links 206, 207 outgoing from the primary switch 201 appear in the ten secondary switches 204 and 205.

The trunks 209, 210, 211, 212, etc., outgoing from the switching stage are distributed among the ten secondary office switches 204, 205, etc. These trunks may be divided in any suitable manner in groups of varying sizes. For the purpose of illustration it will be assumed that trunks 209 and 211 belong to one group and that trunks 210 and 212 belong to a second group.

The crossbar switches are provided with select magnets, each of which is individual to an incoming circuit and serves when energized to prepare the switch for subsequently connecting the incoming circuit to any one of the outgoing circuits. For example, the primary office switch 107 is provided with select magnets 119 and 120 which are individual respectively to the incoming trunks 100 and 101 and serve to prepare the switch for extending these trunks over any of the outgoing links 109 and 110. The office secondary switch 111 is provided with select magnets 121, 122 which are individual respectively to the incoming links 109 and 113; the office primary switch 200 is provided with select magnets 213, 214 which are individual to the incoming junctors 115 and 215; and the office secondary switch 204 is provided with select magnets 219 and 217 which are individual respectively to the incoming links 202 and 206. The switches are also provided with hold magnets, one for each of the outgoing circuits. When one of these hold magnets is operated following the previous energization

of a select magnet, the full operation of the switch takes place, and the incoming circuit represented by the energized select magnet is connected to the outgoing circuit individual to the energized hold magnet. Thereafter the select magnet may be deenergized, the connection being held by the continued energization of the hold magnet. In the switch 107 the hold magnets 123 and 124 are individual respectively to the outgoing lines 109 and 110; in the switch 111 the hold magnets 125 and 126 are individual respectively to the outgoing junctors 115 and 117; in the switch 200 the hold magnets 218 and 219 are individual respectively to the outgoing links 202 and 203; and in the switch 204 the hold magnets 220 and 221 are individual respectively to the outgoing trunks 209 and 210.

In addition to the select magnets the primary and secondary switches of the office frame are provided with space discharge tubes, there being one of these tubes for each select magnet. For example, tubes 222 and 223 are individual to the select magnets 213 and 214 of the switch 200, and tubes 224 and 225 are individual respectively to the select magnets 216 and 217 of the switch 204. The purpose of these tubes is to enable the simultaneous preparation of all switches in the stage so that a connection may subsequently be completed from any incoming trunk through an idle channel to any desired outgoing trunk. This preparation is made by energizing all of the select magnets representing links in the idle channels. Since, however, attempts may be made to prepare two or more idle channels through the same switch in the desired direction or directions, it is essential to prevent the operation of more than one select magnet at a time. The energization of a single select magnet is accomplished by the discharge tubes which are so arranged in a common circuit that the discharge of one of them creates a blocking voltage which prevents all others from discharging. Thus the successfully operated tube brings about the energization of the associated select magnet to prepare the switch for that particular channel while the other channels through the same switch remain disabled.

The testing and switch preparing operation is initiated by applying an electrical condition to the calling incoming trunk appearing in a particular one of the district primary switches. This condition causes a test potential to be projected simultaneously over all links outgoing from the said particular originating switch to all of the ten secondary district switches in which these links appear, causing the operation of the corresponding select magnets of the secondary switches. The operation of the secondary select magnets causes the test potential to be further projected over all idle junctors outgoing from such secondary switches to the corresponding primary office switches, causing the operation of the associated select tubes and magnets. The operation of the primary office select magnets causes the further extension of the test potential over all idle links extending to the corresponding secondary office switches. The test potential applied to these idle links causes the corresponding select tubes at the secondary office switches to ionize their control or starting gaps. However, these secondary office select tubes do not operate sufficiently to cause the energization of the corresponding select magnets. Thus all channels in the whole switching stage which extend from the particular originating switch containing the calling incoming trunk and which are idle at the

time the test is made are placed in readiness for use by the energization of the corresponding select magnets and tubes. Thereafter the completion of the switch operation is initiated by placing an electrical condition on a desired one of the outgoing trunks 209, 210, 211, etc. These outgoing trunks are provided with individual discharge tubes 226, 227, 228 and 229, and the selection of the desired trunk is indicated by the operation of the individual tube. The operation of the individual trunk tube first causes full ionization of the office secondary select tube and then causes the successive operation of the hold magnets of the office secondary switch, the office primary switch, the district secondary switch and the district primary switch, all corresponding to a prepared idle channel extending between the calling originating trunk and the chosen outgoing trunk. The operation of these hold magnets completes the connection between the incoming and outgoing trunks.

The selection of a desired outgoing trunk group is performed by a sender-marker associated with the district frame in which the calling incoming trunk appears and which is connectable to the particular office frame in which the desired group of outgoing trunks appears. Since the greater part of the testing and selecting operations is accomplished in the switching stage itself, much of the equipment heretofore required in the senders and markers may be omitted from the sender-marker used in the present system. One of these simplified sender-markers is illustrated in Fig. 3 of the drawings. It includes three registers 300, 301 and 302 which are responsive respectively to the three series of code impulses transmitted by the calling subscriber to represent the office or trunk group designation. A three digit code enables a thousand different selections, the hundreds register 300 serving to select one of ten hundreds groups, the tens register 301 serving to select one of ten subgroups in the hundreds group, and the units register 302 serving to select the particular unit in the subgroup.

These trunk group selections are effected by choosing, first, one of ten groups of tuned circuits, and then one of the hundred tuned circuits in the chosen group. Two of these groups of tuned circuits 400 and 401 are illustrated. The group 400 includes one hundred individual circuits 402, 403, etc., each of which is tuned to respond to a particular one of one hundred different frequencies. Similarly, the group 401 includes one hundred tuned circuits 404, 405, etc., which are tuned to respond respectively to the same one hundred frequencies. Each of the tuned circuits comprises a space discharge tube, a relay and a tuning network. Tuned circuit 402, for example, includes the discharge tube 406, relay 407 and a tuning circuit comprising a capacitance 408, inductance 409 and resistor 410. When one of these tuned circuits responds to its characteristic frequency, the relay operates and applies operating potential to the tubes which are individual to the outgoing trunks of the group represented by the tuned circuit.

The hundreds register 300 in the sender-marker responds to the first code digit and selects the corresponding one of the ten groups of tuned circuits 400, 401. Thereafter the tens and units registers 301 and 302 respond to the next two digits and select corresponding values of capacitance and inductance for inclusion in the circuit of the variable frequency oscillating

generator 304 to produce a current of the particular frequency corresponding to the tuned circuit of the selected group which represents the desired outgoing trunk group.

Since the several groups of tuned circuits 400, 401, etc., are associated with the outgoing trunk groups and may be accessible to a plurality of different sender-markers, a connector 303 is provided for connecting the markers to the groups of tuned circuits.

A detailed description of the operation will now be given. For this purpose assume that the subscriber of line 106 wishes to set up a telephone connection over the route represented by the group containing trunks 209, 211. The initiation of the call causes the operation of the non-numerical switching stage 105 to extend the subscriber's line over an idle incoming trunk, such as trunk 100, to the directive switching stage. The selection of the trunk 100 also results in the operation of the connector 305 to associate the trunk with the sender-marker 306.

The subscriber's line 100 is now extended to the impulse relay 307 in the sender-marker, and the subscriber proceeds to operate his dial 127 to transmit the digits representing the designation of the desired trunk group. The three series of digit impulses are received by the relay 307, which is associated successively by the steering switch 308 with the stepping magnets 309, 310 and 311 of the hundreds, tens and units registers 300, 301 and 302. These registers are set in accordance with the values of the corresponding code digits to register the code in the sender-marker. Assume that the hundreds register 300 is advanced to its fifth position, that the tens register 301 is advanced to its third position, and that the units register 302 is advanced to its fifth position. In position 5 the register 300 connects the output conductors 312 and 313 of the oscillator 304 to conductors 314 and 315 which extend through the connector 303 to the group of tuned circuits 400. In position 3 of register 301 the capacitance 316 is connected in circuit with the discharge tube 317 of the oscillator 304. In position 5 of register 302 the inductance 318 is connected in parallel with capacitance 316 in circuit with the tube 317. More specifically, the circuits for the selected capacitance and inductance may be traced from the positive pole of battery 319, conductor 320 through capacitance 316 and brush 321 and in parallel therewith through inductance 318 and brush 322 to conductor 323 through the closed contacts of relay 324, which relay is operated at this time, conductor 325 to the plate circuit of the tube 317. The values of the capacitance 316 and the inductance 318 in this circuit cause the oscillator 304 to produce in the output circuit thereof current of a frequency which represents the desired one of the hundred tuned circuits 400, which in turn represents the desired group of trunks 209, 211.

Before proceeding further with the selection effected by the tuned oscillator in the sender-marker, a description will be given of the manner in which the switching stage performs an automatic test of the channel links therethrough and prepares all of the idle channels for the ultimate selection of a desired one thereof.

At some suitable time following the selection of the sender-marker 306 and preferably following the setting of the hundreds register 300, control circuits are closed in any well-known manner for operating relays 328 and 329. Re-

lay 328 closes a circuit from ground through its closed contacts, switch arm 330 (position 5), conductor 331, winding of relay 128 to battery. Relay 128 relates to the office frame 208 in which the desired trunk group appears and serves to complete control circuits for the links extending from the district frame 104 to the office frame 208. This relay is selected under the control of the register 300 which has been positioned in accordance with one of the code digits. If desirable the selection may, of course, be placed under the control of two of the code digit registers. In a similar manner relay 150 relates to another frame of office switches and serves to perform a corresponding function with respect to the links outgoing from the district frame 104 to such other office frame.

Relay 329 in operating closes a circuit from ground through its contacts, through conductor 332, connector 305, conductor 333, conductor 130, winding of select magnet 119 to battery. Magnet 119 operates to prepare the switch 107 for connecting the calling incoming trunk 100 to any idle one of the ten outgoing links 109, 110. If link 109 is idle the hold magnet 123 is in its normal condition, and a test circuit is closed from ground through the contacts of magnet 119, conductor 131, normal contacts of magnet 123, conductor 132 through the winding of the select magnet 121 of the secondary switch 111. Magnet 121 operates and prepares the switch 111 for connecting the incoming link 109 to any idle one of the ten outgoing junctors 115, 117. Likewise, if link 110 outgoing from switch 107 is idle, the grounded conductor 131 is extended through the normal contacts of magnet 124, conductor 133, through the winding of select magnet 134 to battery. In a similar manner circuits are closed corresponding to all other idle links outgoing from the primary switch 107.

Assuming that junctor 115, which is the only junctor outgoing from the switch 111 to the desired office frame 208, is idle, a test circuit is closed from battery through the contacts of operated magnet 121, resistor 135, conductor 136, normal contacts of magnet 125, conductor 137, closed contacts of relay 128, conductor 232 to the starting anode 233 of select tube 222. Likewise if junctor 116 is idle, a test circuit is closed from battery through the contacts of magnet 134, resistor 138, contacts of hold magnet 139, conductor 151, closed contacts of relay 128, conductor 234 to the starting anode 236 of the select tube 235. Since the negative pole of battery is connected through the inductance 237 to the starting cathode 238 of tube 222, the tube ionizes its starting gap, and a circuit is closed as follows through the main discharge gap of the tube: positive pole of battery 140, closed contacts of relay 128, conductor 129, conductor 239, main anode 240, main cathode 241, winding of select magnet 213 to the negative pole of battery. In like manner the tube 235 discharges, and a circuit is closed from battery 140 over conductor 129, conductor 242, main anode and main cathode of tube 235, winding of select magnet 243 to the negative pole of battery. And in a similar manner the select tubes of other office primary switches of the frame 208 are discharged provided there are corresponding idle links extending from the primary switch 107 and thence from the corresponding secondary district switches. It will be noted that the inductance 237 is common to the starting cathodes of all tubes in the switch 200. As soon as the

starting gap of one of these tubes ionizes a potential is produced by the inductance 237 which lowers the voltage across all other tubes to prevent a second one from energizing its starting gap in case a test should be made at this time from some other district frame. Also there is sufficient resistance in the inductance coil 237 to maintain the lockout voltage after the initial transient is dissipated. Thus only one of the select tubes in each of the office primary switches 200, 201 can energize at a time.

If at this time the link 202 outgoing from the switch 200 to the switch 204 is idle, a test circuit is closed from the positive pole of battery through the contacts of select magnet 213, resistor 244, normal contacts of hold magnet 218, conductor 245 to the starting anode of the tube 224. Similarly if the link 203 is idle the negative pole of battery is extended through resistor 244, normal contacts of hold magnet 219, conductor 247 to the starting anode of select tube 274. Likewise, if the links 206 and 207 outgoing from the switch 201 are idle, circuits are closed from the negative pole of battery through the contacts of select magnet 243, common resistor 248, thence through the normal contacts of hold magnets 249 and 250 and over the corresponding conductors to the control anodes of the select tubes 225 and 275. Thus all four of the tubes illustrated, tubes 224, 225, 274 and 275, have starting potential applied to their starting anodes. And, of course, all other select tubes are similarly prepared which correspond to idle channels extending to the remaining secondary office switches. Since the negative pole of battery is connected through the common resistance 246 to the starting cathodes of all tubes in the switch 204, the first one of these tubes to ionize its control gap sets up a potential across the resistance 246 which lowers the voltage of the control gaps of the remaining tubes to prevent another one of them from ionizing. And the same is true of the remaining secondary office switches. Thus only one select tube succeeds in ionizing its control gap in each of these secondary switches. It will be assumed that the tube 224 of switch 204 and the tube 274 of the switch 205 are the ones that ionize their control gaps.

When tube 224 ionizes its control gap, a circuit is established from the positive pole of battery 146, contact of relay 128, conductor 251, through the winding of relay 252, conductor 253, main anode of tube 224, main cathode through the winding of select magnet 216 to the negative pole of battery. Relay 252 operates in this circuit, but its resistance is too high to permit sufficient current to flow to operate the select magnet 216. Assuming at this time that the trunk 209 of the desired group is idle, a circuit is closed from the negative pole of battery through the common inductance 254, conductor 260, contacts of relay 252, normal contacts of select magnet 220, conductor 255 to the starting cathode 256 of tube 226. Also in the switch 205 the ionization of the control gap of tube 274 prepares a circuit from the positive pole of battery 146, conductor 257, through the winding of relay 258 thence through the main gap of the tube 274 and the winding of select magnet 259 to the negative pole of battery. Relay 258 operates, but the select magnet 259 remains deenergized. If at this time the trunk 211 of the desired group is also idle, a circuit is closed through the common inductance 254, conductor 260, contacts of relay

258, normal contacts of select magnet 261, conductor 252 to the starting cathode 263 of tube 228.

Thus a negative potential is applied through the common inductance 254 to the starting cathodes of all tubes corresponding to idle trunks 209, 211 of the desired group. It will also be noted that negative potential is applied through the common inductor 254 and through the normal back contacts of the hold magnets to the starting cathodes of the tubes of all idle trunks of all other groups appearing in switches which have their corresponding relays 252, 253 operated. In other words, the test which has been made through the district and office frames of the switching stage as above explained, prepares the idle channels through these frames for connection to the idle trunks of all groups outgoing from the secondary office switches. However, since only one group is desired, namely the group containing the trunks 209 and 211, the selection is confined to a trunk in this group under control of the sender-marker in a manner which will now be explained.

Returning now to the point in the description where the oscillator 304 is tuned by the digits registered on registers 301 and 302, it may be assumed that the frequency thus produced by the oscillator is the one to which the circuit 402 is tuned. Therefore the discharge tube 405 will operate to the exclusion of the corresponding tubes of all other tuned circuits in the group. The circuit between the oscillator and the tuned circuit 402 may be traced from conductor 312, brush 326, conductor 314 through the connector 303, conductor 429, capacitance 408, inductance 409, conductor 411, connector 303, conductor 315, brush 327 to conductor 313. Since the input circuit of the tube 405 is tuned to this particular frequency, a voltage of sufficient magnitude to ionize the control gap of the tube is applied through the resistor 410 to the starting anode 412 and to the starting cathode 413. The starting gap ionizes, the main gap of the tube discharges, and current flows from the positive pole of battery 414, alternating current generator 415, winding of relay 407, main anode 416, main cathode 417 to ground. The relay 407 operates and applies the positive pole of battery 418 over conductor 419 to the starting anode 230 of tube 226, to the starting anode 231 of the tube 228 and similarly to the starting anodes of all tubes individual to other trunks in this group. Since as above described negative potential has already been applied to the starting cathodes of these tubes, one of them will commence the ionization of its control gap. As soon as this occurs a voltage is developed across the common inductance 254 which lowers the voltage across the gaps of all other tubes to prevent another one from completing its ionization. Assuming that the tube 226 is one that successfully ionizes its control gap, effecting the selection of the trunk 209 for use, a circuit is completed from battery 146, conductor 251, winding of relay 264, conductor 265, main anode and cathode of tube 226, conductor 266 through the winding of the hold magnet 229 to battery. Relay 264 operates in this circuit, but its resistance is too high to permit the operation of the hold magnet 229. When relay 264 operates it closes a circuit in shunt of relay 252 traceable from battery on conductor 251, contacts of relay 264, resistor 267 thence through the tube 224 and select magnet 216. The magnet 216 operates in this circuit and prepares the switch 204 for operation. Magnet

216 closes a low resistance path from the positive pole of battery 268 through the contacts of magnet 216, resistor 269, conductor 255 and thence as traced through the tube 226 and hold magnet 229. Magnet 229 operates in this circuit and completes the operation of the switch to connect link 202 to the selected idle outgoing trunk 209. It will be noted that current in the common resistor 267 develops a lockout voltage to prevent the operation of a second one of the select tubes of switch 209 in the event that the starting gap of a second tube should ionize following the operation of the chosen tube 224. Likewise the common resistor 269 develops a lockout voltage after tube 226 operates to prevent the operation of another tube associated with the trunks outgoing from switch 204.

When magnet 216 operates it closes a circuit from ground through its contacts, conductor 270 through the winding of hold magnet 218. Magnet 218 operates the switch 200 to connect the junctor 115 to the link 202. The grounded conductor 270 is now extended through the contacts of the switch thence over conductor 271 through the winding of hold magnet 125 to battery. Magnet 125 operates the switch 111 to connect the junctor 109 to the link 115. The grounded conductor 271 is thus extended through the contacts of switch 111 over conductor 141 through the winding of hold magnet 123 to battery. Magnet 123 operates switch 107 to connect the calling incoming trunk 100 to the link 109. Thus the calling trunk 100 is extended through the links of the district and office switches to the selected idle outgoing trunk 209. In the well-known manner a control ground potential is applied to the conductor 142 of the trunk 100 to hold the magnets 123, 125, 218, and 229 after the winding of magnet 216 has been deenergized.

At the proper time following the extension of the connection through the switching stage the circuit of relay 128 is opened in the sender-marker and this relay releases. The release of relay 128 quenches all of the operated select tubes of the primary office switches, including tubes 222 and 235. The quenching of these tubes permits the release of the associated magnets 213, 243, etc. The release of the select magnets removes the operating potential from the starting anodes of the select tubes of the office secondary switches. The release of relay 128 also causes the release of relays 252 and 264 and magnet 216 and quenches tube 224. The release of magnet 216 quenches tube 226, thus restoring the control relays, magnets and tubes of switch 204, while the established connection is held by the hold magnet 229. Also at the proper time relay 329 in the sender-marker releases and opens the energizing circuit of the select magnet 119. The release of the select magnet 119 removes ground potential from conductor 131 permitting the release of all operated select magnets of the secondary district switches, such as magnets 121, 134, etc.

The connection having been established through the selective switching stage, the sender-marker 305 can now be released in any well-known manner. Upon release of the sender-marker the registers 300, 301 and 302 and the steering switch 303 are restored to their normal positions.

Fig. 5 shows a modification of the reactance elements selectable by the registers 301 and 302 for tuning oscillator 304. In this figure reactance units selected by both the tens and units registers comprise both inductance and capacitance.

For example, the tens register switch 501 selects one of ten reactance units 503, 504, 505, each of which is composed of an inductance and a condenser in parallel. Similarly the units register switch 502 selects any one of reactance units 506, 507, 508, etc., each of which is similarly composed of an inductance and a condenser in parallel. The advantage of using parallel inductances and condensers in each unit is an improvement in the range of the antiresonant impedance of the combined elements introduced into the oscillator circuit.

Fig. 6 shows an alternative arrangement of the tunable selecting mechanism in the sender-marker. In this figure the marker is provided with two oscillators 600 and 601, each of which is capable of being tuned to produce a plurality of distinct frequencies. One or more than one of the code digits transmitted to the sender-marker serve to tune the oscillator 600 to produce in its output circuit 602 a distinctive frequency corresponding to the digit. This frequency is selected by the corresponding one of the tuned circuits 603, 604, etc., to effect the selection of the desired one of a number of groups 605, 606 of tuned circuits. The succeeding digits serve to tune the second oscillator 601 to produce in its output circuit 607 a particular frequency for selecting one of the plurality of individual tuned circuits 608, 609, 610 of the selected group. Thus the first two digits of the code may serve to select one of the groups 605, 606, and the last two digits of the code may serve to select one of the individual circuits 608, 609, 610 of the selected group. The oscillators 600 and 601 may be tunable to produce the same or different distinctive frequencies.

The discharge tubes disclosed herein may be of any well-known type such as those having gas-filled envelopes and cold cathodes. A tube of the type having a separate control or starting gap formed by a starting anode and a starting cathode is disclosed in the patent to Holden No. 2,273,958 of Feb. 24, 1942.

What is claimed is:

1. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of trunks appearing in said switches, said trunks having different designations, means for receiving and registering the different designations corresponding to said trunks, a generator for generating voltage of a plurality of different frequencies, a plurality of tuned circuits connectable to said generator, each of said circuits being tuned to and responsive to voltage of a different one of said frequencies, means dependent on the designation registered by said registering means for causing said generator to generate voltage of a corresponding one of said frequencies and to apply said voltage to said tuned circuits, means controlled by the tuned circuit which responds to the generated voltage for selecting the corresponding one of said trunks for use, and means for operating said switches to establish a connection over the selected trunk.

2. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of trunks appearing in said switches, said trunks having different designations, means for receiving and registering the different designations corresponding to said trunks, an oscillation generator for generating voltage of a plurality of different frequencies,

means dependent on the designations registered for varying the tuning of said oscillator to generate voltages of a corresponding one of said frequencies, a plurality of tuned circuits, each tuned to and responsive to a different one of said frequencies, means for connecting said oscillator to said tuned circuits, means controlled by the tuned circuit which responds to the generated voltage for selecting the corresponding one of said trunks for use, and means for operating said switches to establish a connection over the selected trunks.

3. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of trunks appearing in said switches, said trunks having different designations, means for sending impulses corresponding to said designations, registers responsive to said impulses for registering the designations of said trunks, an oscillation generator for generating voltage of a plurality of different frequencies, tuning means selectable by said registers for tuning said oscillator to produce voltage of a corresponding frequency, a plurality of tuned circuits each tuned to and responsive to a different one of said frequencies, means for connecting said oscillator to said tuned circuits, means controlled by the tuned circuit which responds to the generated voltage for selecting the corresponding one of said trunks for use, and means for operating said switches to establish a connection over the selected trunks.

4. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of trunks appearing in said switches, said trunks having different designations, means for sending impulses corresponding to said designations, registers responsive to said impulses for registering the designations of said trunks, an oscillation generator for generating voltage of a plurality of different frequencies, inductances and capacitances of different values, said registers serving to select different combinations of said inductances and capacitances to tune said oscillator to produce a voltage of the corresponding frequency, a plurality of tuned circuits, each tuned to and responsive to a different one of said frequencies, means for connecting said oscillator to said tuned circuits, means controlled by the tuned circuit which responds to the generated voltage for selecting the corresponding one of said trunks for use, and means for operating said switches to establish a connection over the selected trunks.

5. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of groups of trunks appearing in said switches, said trunk groups having different designations, means for transmitting impulses corresponding to the different trunk group designations, means for receiving and registering said impulses, a generator for generating voltage of a plurality of different frequencies, a plurality of tuned circuits connectable to said generator, each of said circuits being tuned to a voltage of a different one of said frequencies, means dependent on the designation registered for causing said generator to produce voltage of the corresponding frequency and to apply said voltage to said tuned circuits, means controlled by the tuned circuit which operates in response to the said voltage for selecting the corresponding one of said trunk groups, and means for operating said switches to establish a connection over an idle trunk of the selected group.

6. The combination in a telephone system of a switching stage comprising a plurality of automatic switches, a plurality of groups of trunks appearing in said switches, said trunk groups having different designations, means for transmitting impulses corresponding to the different trunk group designations, a selecting and controlling mechanism common to said trunk groups, said mechanism including registers and an oscillation generator, said registers responding to said impulses for registering the designations of said trunk groups, means controlled by said registers for tuning said oscillator to produce a plurality

of different frequencies which correspond respectively to said trunk groups, a plurality of tuned circuits connectable to said oscillation generator, said circuits being tuned respectively to said frequencies, means controlled by the tuned circuit which responds to the generated voltage for selecting the corresponding one of said trunk groups, means for selecting an idle trunk in the selected group, and means for operating said switches to establish a connection over the selected idle trunk.

LARNED A. MEACHAM.