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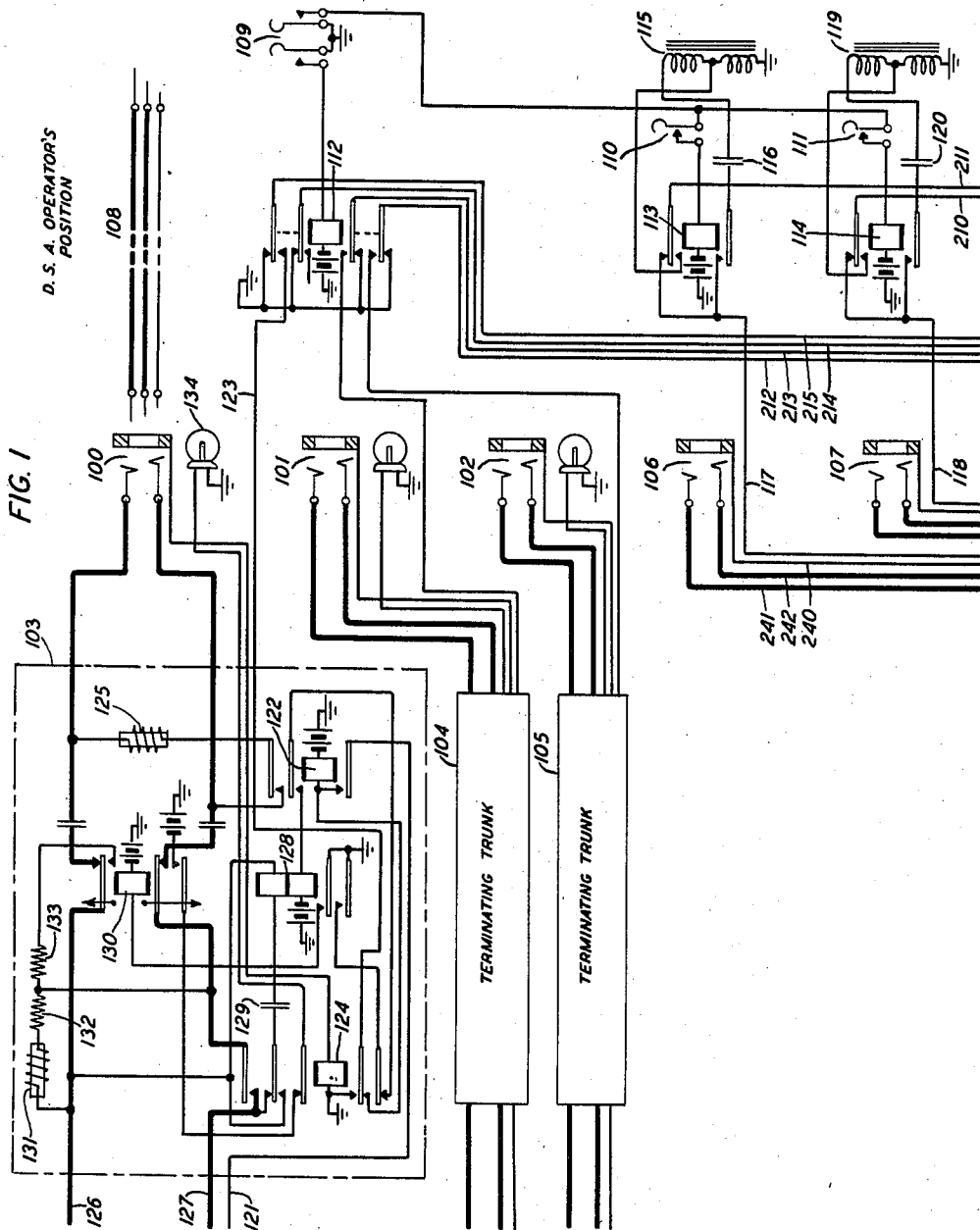
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BRANCH EXCHANGE

Filed Aug. 14, 1941

2 Sheets-Sheet 1



INVENTOR
J. F. DAHL
BY
P. C. Smith
ATTORNEY

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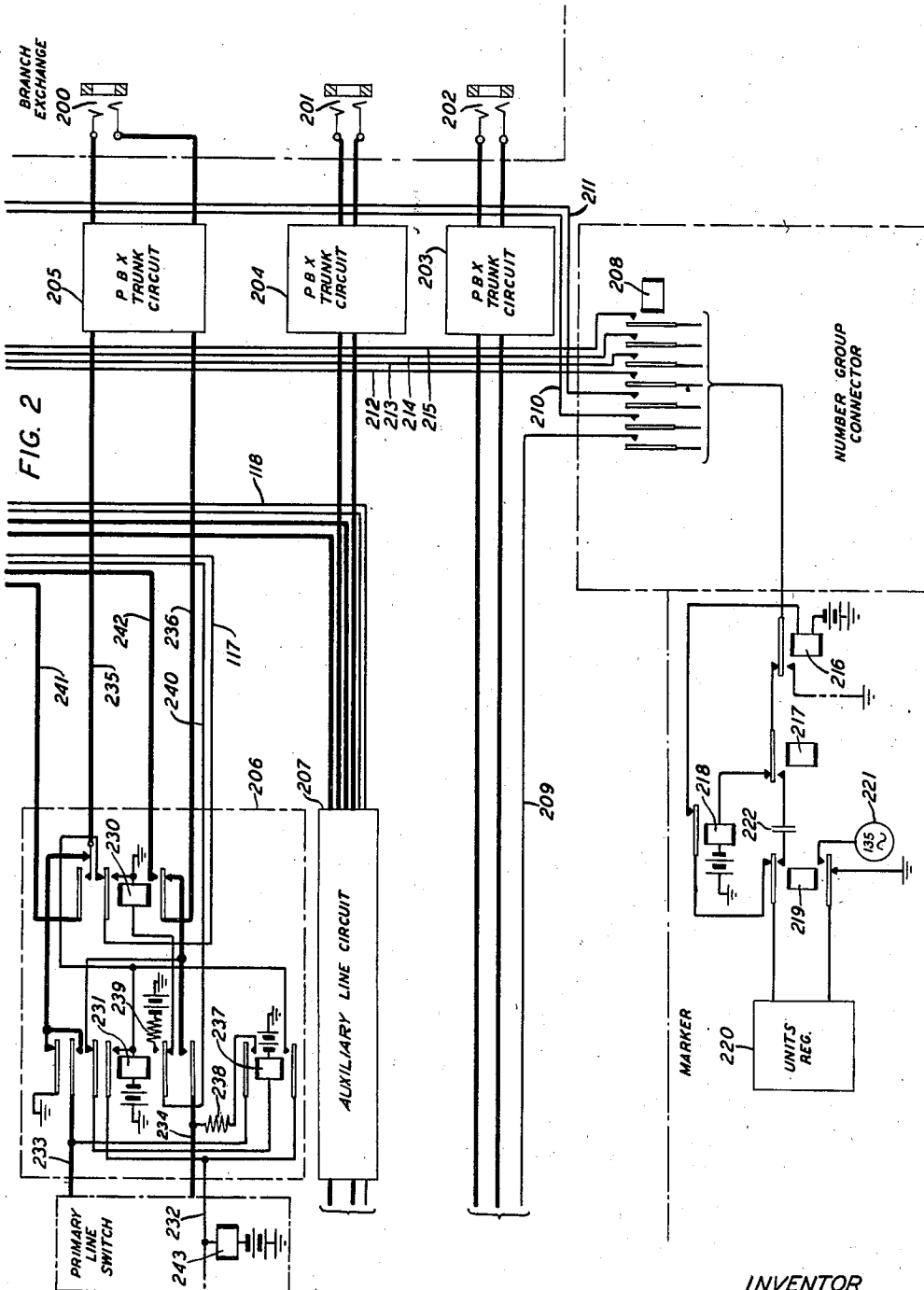
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INVENTOR
J. F. DAHL
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

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BRANCH EXCHANGE

Jack F. Dahl, Millburn, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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12 Claims. (Cl. 179—27)

This invention relates to telephone systems and has for its object to facilitate the handling of call overloads directed to individual subscribers.

The telephone service of certain subscribers, such as ball clubs, is normally handled by a branch exchange having a small number of trunks. On occasions, however, for example when the weather is uncertain, the number of incoming inquiry calls will not only monopolize these trunks, preventing outgoing calls, but, where the branch exchange is connected with a crossbar central office, the unsuccessful calls may employ so much of the terminating equipment that other subscribers may also be made inaccessible.

To obviate this difficulty, in accordance with the present invention a group of terminating trunks appearing in jacks at a central office operator's position, is added to the group of branch exchange trunks and these trunks are normally made busy. When a period of traffic congestion occurs, the operator may be informed by the office alarms or by inquiries from subscribers and will then remove the busy condition from the lines appearing at her position.

In order to permit calls to be originated at the branch exchange, one or more of the regular two-way trunks are provided with means whereby they may be made busy to terminating calls. This means is made dependent on the removal of the busy condition from the extra terminating lines. The trunks which are marked busy to the terminating equipment also appear in jacks at the central office operator's position to permit the operator to obtain the information necessary to reply to the inquiry calls and also to permit the completion of calls other than inquiry calls.

In the crossbar system connections to and from the subscriber's line are made over the primary and secondary line switches and the line hold magnet of the primary switch may be operated by either the originating or terminating control equipment. Therefore to mark a line busy to terminating calls only, the circuit over which the terminating control equipment operates the line hold magnet must be opened and ground connected thereto while the circuit over which the originating control equipment operates the line hold magnet must be maintained and must not be grounded.

If the subscriber on a line so marked originates a toll call, however, the toll operator, before completing the desired connection makes a

number checking connection with the calling line. In making such a connection, the marker applies alternating current to the circuit of the line hold magnet which is normally returned over the previous connection to cause the operation of a signal at the toll operator's position. Therefore in order to permit toll calls to be made over the branch exchange trunks which are removed from terminating service, the operation of the make-busy means inserts in the hold magnet operating circuit, means, comprising a grounded autotransformer and a condenser, which is non-conducting to the direct current by which the hold magnet might be operated but does conduct the alternating current employed in number checking.

These features of the invention will be more apparent from a consideration of the following description in connection with the drawings in which:

Fig. 1 shows the operator's position at the central office, and

Fig. 2 shows the branch exchange and a part of the terminating control equipment.

A crossbar telephone system of the type with which the circuits of the present disclosure are adapted to function is disclosed in U. S. Patent 2,232,371 to J. W. Dehn et al., February 18, 1941, while a system showing number checking applied to a slightly different crossbar telephone system may be found in U. S. Patent 2,105,921 to F. A. Korn, January 18, 1938.

At the branch exchange operator's position appear jacks 200, 201 and 202 in which terminate two-way trunks connecting the branch exchange with the equipment at the central office. The trunk circuits 203, 204 and 205 represent the equipment at the branch exchange individual to each trunk and since they do not enter into the present invention they have been merely indicated. As many such trunk circuits are provided as desirable for normal service.

The auxiliary line circuits 206 and 207 are inserted at the central office in the trunks terminating in jacks 200 and 201 in order to give access from the DSA operator to the branch exchange. Only a limited number of the branch exchange trunks would be so modified.

At the DSA operator's position appear jacks 100, 101, 102 to which are connected terminating trunks 103, 104 and 105. As many of these terminating trunks and jacks are provided as seems desirable, perhaps two or three times the number of two-way trunks normally serving the branch exchange.

Jacks 106 and 107 connect with the auxiliary line circuits 206 and 207. The cord circuit 108 has been shown schematically only and may be any cord circuit standard for such a position.

Referring briefly to the control circuits, as set forth in the Dehn et al. patent above mentioned, the wanted line number is registered in the marker which identifies the group of twenty numbers including the wanted number and from that identification selects a number group connector which connects the test terminals of the twenty lines corresponding to the twenty numbers to the marker. In the marker, a relay is connected to each of the twenty lines to test it and then a circuit is closed under the control of the units register to operate a relay associated with the wanted line if that line is idle. In the case of a group of trunks this circuit may be extended to operate the relay associated with the first idle trunk of the group.

For example, in testing the trunks serving the branch exchange under consideration the twenty block relay 208 is operated and connects the test leads 209 to 215 of trunks constituting the trunk group to the marker. One of these leads extends over the back contacts of relays 216 and 217 to the winding of relay 218 and battery. Therefore, if trunk circuit 203 is busy, relay 218 is operated. After an interval a circuit is closed from ground over back contacts of relay 219 through the units register 220 to the armature of relay 218. If trunk 203 is idle and relay 218 is not operated the circuit extends to the winding of relay 216 and battery. Relay 216 in operating disconnects the test relay and prepares the direct current operating circuit for the hold magnet.

If trunk 203 is busy the circuit is extended as shown in detail in the above-identified Dehn et al. patent to operate the relay corresponding to the first idle trunk in the group.

When a number checking connection is made relays 217 and 219 are operated and alternating current from source 221 is connected over front contacts of relay 219, through the units register 220, condenser 222, front contact of relay 217 and back contact of relay 216 to the test conductor of the trunk and thence to the sleeve conductor of the connection outgoing to the toll operator's position.

Conductor 209 and the test conductors associated with the other unmodified trunks extend directly to the test terminals and the hold magnets of the corresponding trunks.

Conductors 212 to 215 and the test conductors of the other terminating trunks extend to armatures on relay 112. With relay 112 normal, ground is connected over the back contacts of relay 112 to the test conductors to mark these terminating trunks busy. At times of traffic congestion, key 109 is operated, closing an obvious circuit for relay 112. Relay 112 operates to extend these conductors to trunk circuits 103, 104, 105, etc.

Conductors 210 and 211 are connected to armatures of relays 114 and 113, respectively. With these relays unoperated the conductors are connected over back contacts of these relays and conductors 118 and 117 to the auxiliary line circuits 207 and 206. When key 109 has been operated to make the terminating trunks available, keys 110 and 111 may be operated, closing circuits for relays 113 and 114, respectively. With relay 113 operated, test conductor 211 is connected to the mid-point of retardation coil 115. One terminal of coil 115 is connected to ground there-

by marking the test conductor busy to the direct current test circuit of the marker. The other terminal of coil 115 is connected through condenser 116 and the lower front contact of relay 113 to conductor 117 leading to auxiliary line circuit 206. Relay 114 functions in a similar manner to insert coil 119 and condenser 120 between conductors 210 and 118. It will be seen that coils 115 and 119 act as autotransformers to transmit the alternating current used in number checking to the originating side of the circuit while preventing the passage of the direct current used in operating the line hold magnet.

The operation of the terminating trunk circuit will now be considered.

Assuming that trunk circuit 103 is the first idle one of the group, the marker tests the circuit over conductor 215, front contact of relay 112, conductor 123, inner lower back contact of relay 124, winding of relay 122 to battery. Therefore the test relay such as relay 218 does not operate and when, subsequently, ground is connected to conductor 215, relay 122 operates, extending this ground over its lower front contact to conductor 121, over which the line hold magnet is operated. With the switches operated ground from the incoming trunk circuit holds both the hold magnet and relay 122 operated. Relay 122 connects coil 125 across the tip and ring of jack 100 to provide cord circuit supervision.

When the incoming trunk applies ringing current to the tip and ring conductors 126 and 127, relay 128 operates in a circuit extending from conductor 126 through the upper winding of relay 128, condenser 129, outer upper back contact of relay 124 to conductor 127. Relay 128 locks in a circuit from battery through its lower winding, inner upper contact of relay 122, outer lower back contact of relay 124 to ground at the outer lower contact of relay 128. At its inner lower contact relay 128 closes a circuit for relay 130. Relay 130 in operating opens the talking circuit and connects resistance 133 in parallel with coil 131 and resistance 132 to prepare a tripping circuit for the ringing current. Relay 130 also closes a circuit from battery over its lower front contact, inner upper back contact of relay 124 to lamp 134 and ground.

When the operator inserts the plug of a cord at her position in jack 100, to which lamp 134 is individual, battery on the sleeve of the cord extends over the sleeve of jack 100 to the winding of relay 124 and ground. Relay 124 operates, extinguishes lamp 134, disconnects relay 122 from conductor 123 and connects direct ground thereto. At its outer upper front contact relay 124 closes one break in the talking circuit and completes the tripping bridge prepared by relay 130. It disconnects relay 128 from conductor 127, closes a discharge circuit for condenser 129 and opens the locking circuit for relay 128 which now releases, opening the circuit of relay 130, but relay 130 is slow to release to maintain the tripping bridge for a sufficient time to operate the ringing cut-off relay at the incoming trunk. When relay 130 releases, the talking circuit is closed through from the incoming trunk to the operator's cord. Coil 131 and resistance 132 remain connected across the incoming tip and ring conductors to operate the supervisory relay of the incoming trunk.

When the operator withdraws her cord, relay 124 releases, restoring trunk 103 to normal and opening the connection between conductors 126

and 127 to permit the incoming trunk circuit to restore.

The auxiliary line circuit 203 will now be described. If the trunk has not been made busy to terminating calls, the test circuit from the marker extends as above described to conductor 117 and over the inner upper back contact of relay 230 to the winding of relay 231 and battery. When the marker connects ground to conductor 117 relay 231 operates, extending ground over its inner upper front contact to conductor 232 to operate the line hold magnet 243. After the switches have operated, ground from the incoming trunk serves to lock relay 231. With relay 231 operated tip and ring conductors 233 and 234 are connected over the outer front contacts of relay 231 and the outer back contacts of relay 230 to conductors 235 and 236 leading to the P. B. X. trunk circuit 205. Relay 231 also connects battery through resistance 239 to conductor 240 to mark the trunk busy at the DSA operator's position. At the end of the call the release of the switches releases relay 231 and restores the circuit to normal.

On a call originated at the branch exchange, a bridge is closed across conductors 235 and 236, completing a circuit from ground at the outer upper back contact of relay 231, outer upper back contact of relay 230, conductor 235, through the bridge in trunk circuit 205, conductor 236, lower back contact of relay 230, inner upper back contact of relay 231 to the winding of relay 237 and battery. Relay 237 operates, connecting resistance 238 between conductors 233 and 234 to simulate the removal of the receiver and to start the functioning of the originating control circuits. At its lower contact, relay 237 connects relay 231 to conductor 232 so that relay 231 operates when the connection has been extended to the originating sender. Relay 231 locks to conductor 232 and connects conductors 233 and 234 to conductors 235 and 236 over back contacts of relay 230 to permit the branch exchange operator to dial into the sender. The ground which operates and locks relay 231 extends over the inner upper back contact of relay 230 to conductor 117 to mark the trunk busy to terminating calls.

If the DSA operator wishes to call the branch exchange or to extend a connection thereto, she tests the sleeves of jacks 106 and 107 in the usual manner. Assuming that she finds no busy battery on jack 106, when she inserts the plug of her cord in that jack, battery from the sleeve of the cord completes a circuit over the sleeve of jack 106, conductor 240, lower back contact of relay 231 to the winding of relay 230 and ground. Relay 230 in operating disconnects relay 231 from conductor 117 and connects ground to that conductor to mark the trunk busy to terminating calls. Relay 230 connects the tip and ring conductors 235 and 236 from the trunk circuit 205 to conductors 241 and 242 leading to jack 107 to establish the talking circuit.

The above operations take place as above described when the two-way trunk is not marked busy to terminating calls. It will be apparent that even with relay 114 operated, calls originated at the branch exchange or the operator's position proceed without interference. For terminating calls, the test circuit from the marker finds ground through coil 115, while the operating circuit of relay 231 is opened by the insertion of condenser 116. In the case of a toll call outgoing from the branch exchange, relay 231 is held operated over conductor 232. When the marker con-

nects with conductor 211 and applies the number checking alternating current thereto, this current can flow over the upper front contact of relay 113, through the lower winding of coil 115 to ground. Current induced in the upper winding flows through condenser 116, lower front contact of relay 113, conductor 117, inner upper back contact of relay 230, inner upper front contact of relay 231 to conductor 232 and thence over the outgoing connection back to the marker as described in the previously mentioned Korn patent.

What is claimed is:

1. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a plurality of subgroups, each subgroup terminating at a different office and means for normally marking one of said subgroups busy.

2. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of trunks appearing at said subscriber's branch exchange and a supplementary subgroup, an operator's position at the central office, said supplementary subgroup of trunks appearing at said operator's position, means for normally marking said supplementary subgroup busy and means for removing said busy condition to permit incoming calls to be answered by said operator.

3. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of two-way trunks appearing at said subscriber's branch exchange and a supplementary subgroup of terminating trunks appearing before an operator at the central office.

4. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of two-way trunks appearing at said subscriber's branch exchange and a supplementary subgroup of terminating trunks appearing before an operator at the central office, means for normally marking said supplementary subgroup busy and means for removing said busy condition to permit incoming calls to be answered by said operator.

5. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of two-way trunks appearing at said subscriber's branch exchange and a supplementary subgroup of terminating trunks appearing before an operator at the central office, means for marking certain of said two-way trunks busy to terminating calls and means to permit said operator to extend a call received over one of said supplementary trunks to one of said busy marked two-way trunks.

6. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of two-way trunks appearing at said subscriber's branch exchange and a supplementary subgroup of terminating trunks appearing before an operator at the central office, means for marking certain of said two-way trunks busy to terminating calls, operator controlled means for determining whether one of said two-way trunks is in use, and means to permit said operator to extend a call received over one of said supplementary trunks to said one of said busy marked two-way trunks.

7. In a telephone system, a group of trunks serving a single subscriber, said group of trunks comprising a subgroup of two-way trunks appearing at said subscriber's branch exchange and a supplementary subgroup of terminating trunks appearing before an operator at the central office, means for marking certain of said two-

way trunks busy to terminating calls, said marking means being effective only if the busy condition has been removed from said supplementary trunks, and means to permit said operator to extend a call received over one of said supplementary trunks to one of said busy marked two-way trunks.

8. In a telephone system, a subscriber's line, a test terminal for said line, a switch for extending connections to and from said line, a magnet for operating said switch, a terminating marker for controlling said switch, means to connect said marker with said test terminal, direct current means in said marker to operate said magnet over said test terminal in completing a connection to said line, alternating current means in said marker for number checking a connection from said line, and means associated with said test terminal to render said direct current means ineffective without disabling said alternating current means.

9. In a telephone system, a subscriber's line, a test terminal for said line, a switch for extending connections to and from said line, a magnet for operating said switch and connected with said terminal, a terminating marker for controlling said switch, means to connect said marker with said test terminal, direct current means in said marker to operate said magnet over said test terminal in completing a connection to said line, alternating current means in said marker for number checking a connection from said line, and means to open the connection between said test terminal and said magnet and to insert therein a circuit element conductive only for alternating current.

10. In a telephone system, a subscriber's line, a test terminal for said line, a switch for extending connections to and from said line, a magnet for operating said switch and connected with said terminal, a terminating marker for controlling said switch, means to connect said mark-

er with said test terminal, direct current means in said marker to operate said magnet over said test terminal in completing a connection to said line, alternating current means in said marker for number checking a connection from said line, and means to open the connection between said test terminal and said magnet and to insert therein a grounded autotransformer.

11. In a telephone system, a branch exchange trunk, a test terminal for said trunk, a switch for extending connections to and from said trunk, a magnet for operating said switch, a terminating marker for controlling said switch, means to connect said marker with said test terminal, direct current means in said marker to operate said magnet over said test terminal in completing a connection to said trunk, alternating current means in said marker for number checking a connection from said trunk, and means to adapt said trunk to make outgoing calls only, comprising means to open the connection between said test terminal and said magnet and insert therein a grounded circuit element conducting only alternating current.

12. In a telephone system, subscribers' lines, test terminals for said lines, switches for extending connections to and from said lines, magnets for operating said switches, a terminating marker for controlling said switches, means to connect said marker with any one of said test terminals, direct current means in said marker to operate one of said magnets over said test terminal in completing a connection to the associated line, alternating current means in said marker for number checking a connection from said line, and means associated with certain of said test terminals to render said direct current means ineffective without disabling said alternating current means to permit the associated line to make outgoing calls only.

JACK F. DAHL.