Oct. 27, 1942. W. H. T. HOLDEN 2,299,898

TELEPHONE SYSTEM

Filed Oct. 16, 1941 4 Sheets-Sheet 1

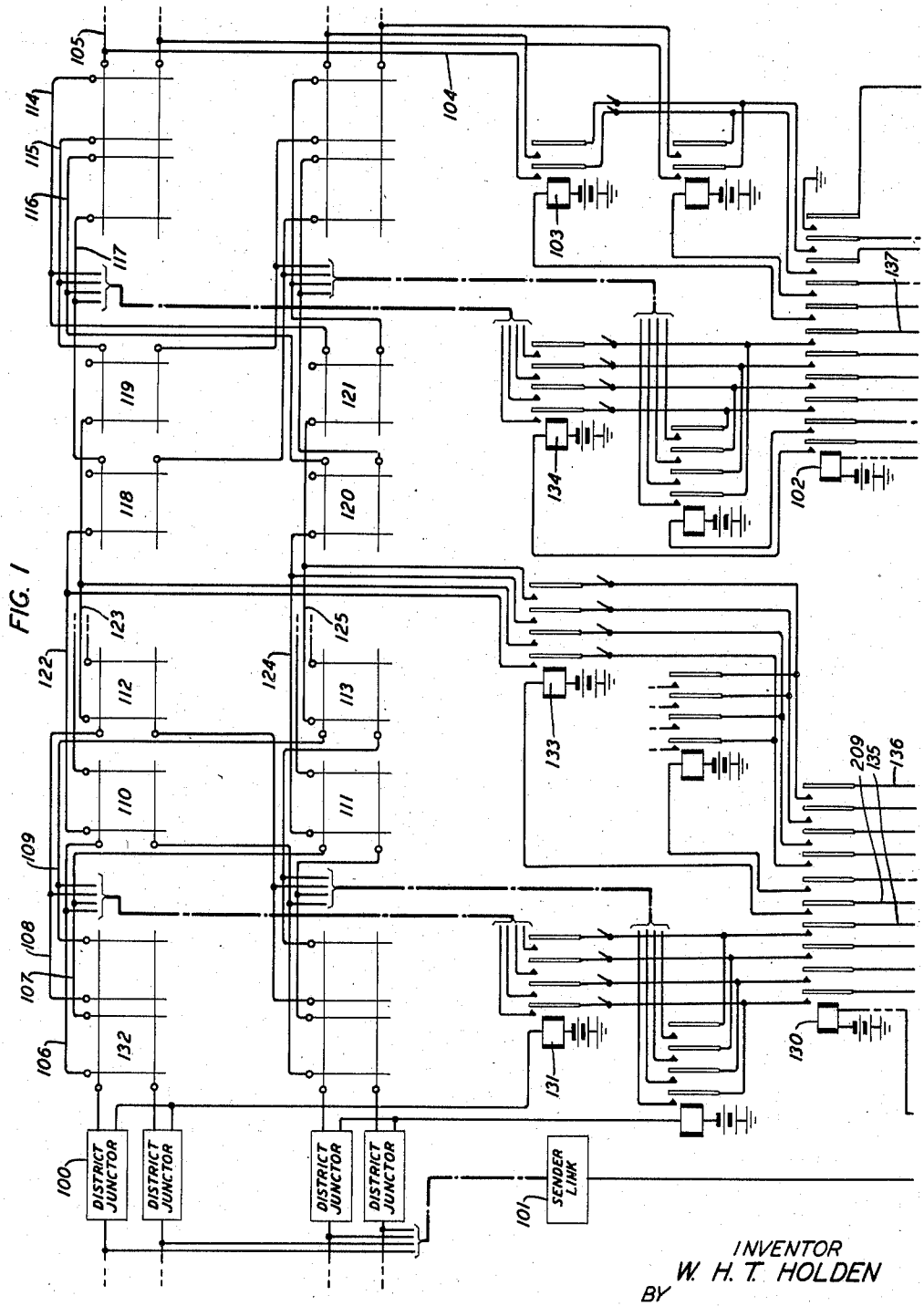


FIG. 1

INVENTOR
W. H. T. HOLDEN
BY
P. C. Smith
ATTORNEY

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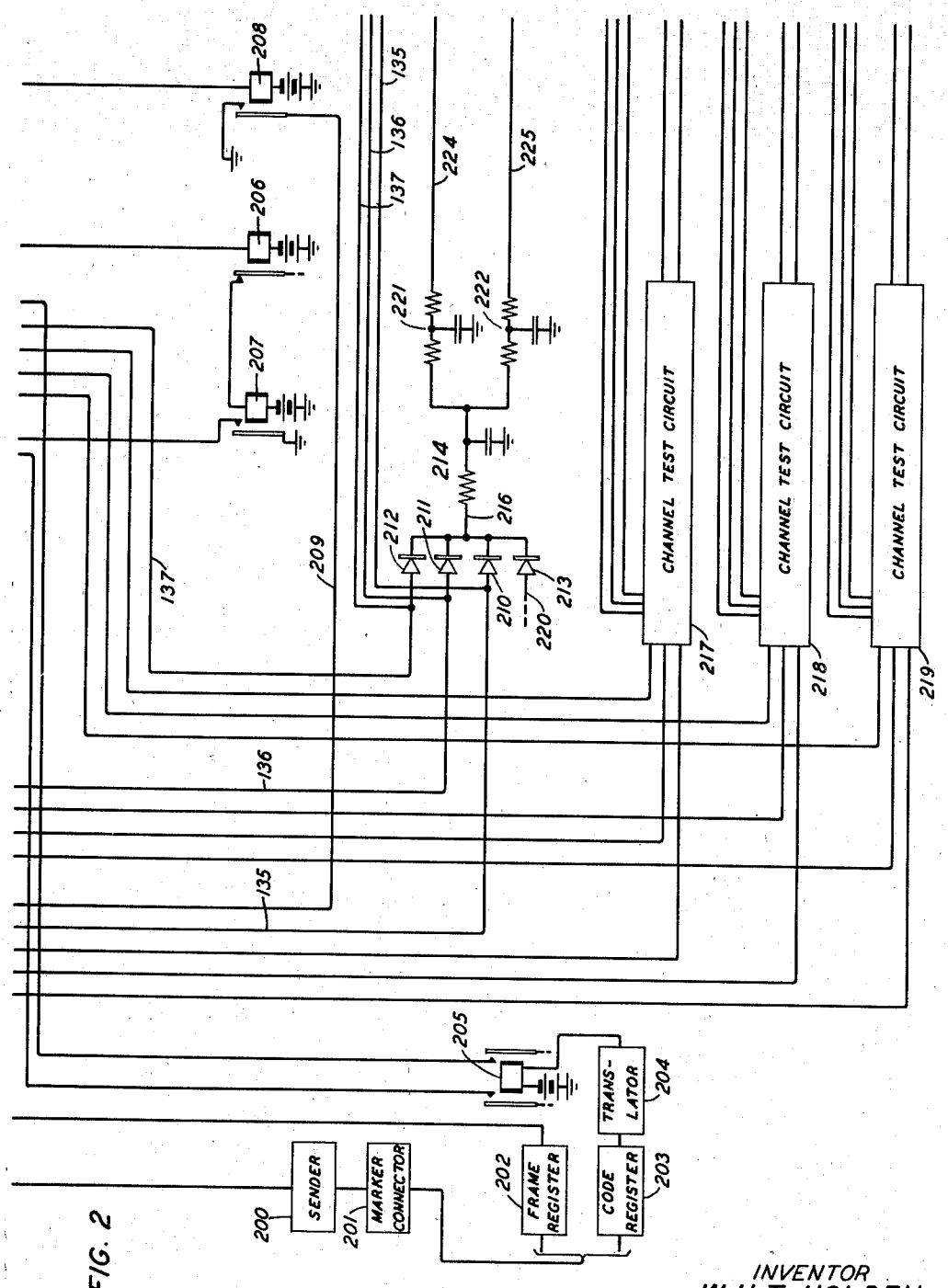


FIG. 2

INVENTOR
W. H. T. HOLDEN

BY
P. C. Smith

ATTORNEY

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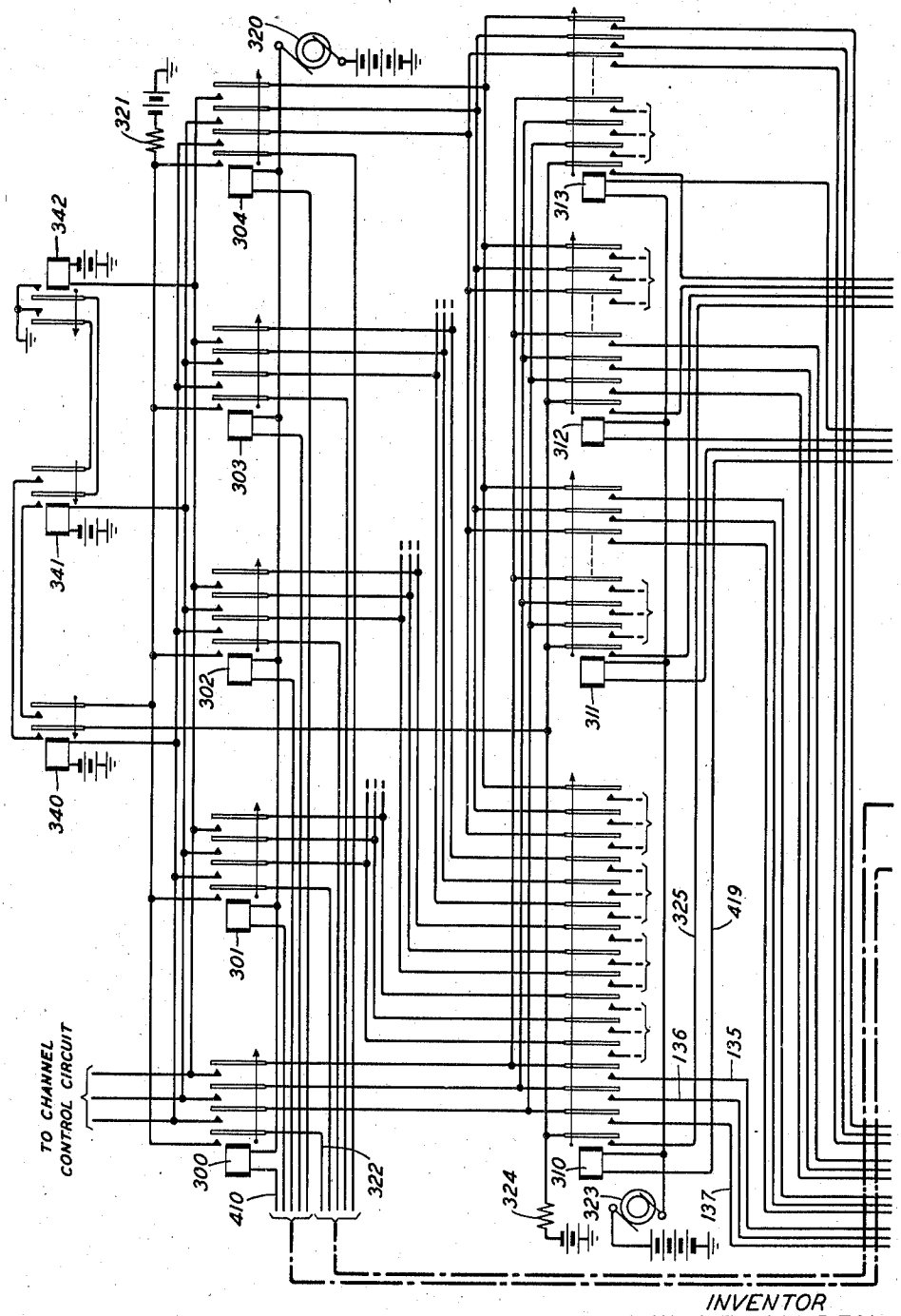


FIG. 3

INVENTOR
W. H. T. HOLDEN
BY
P. C. Smith
ATTORNEY

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TELEPHONE SYSTEM

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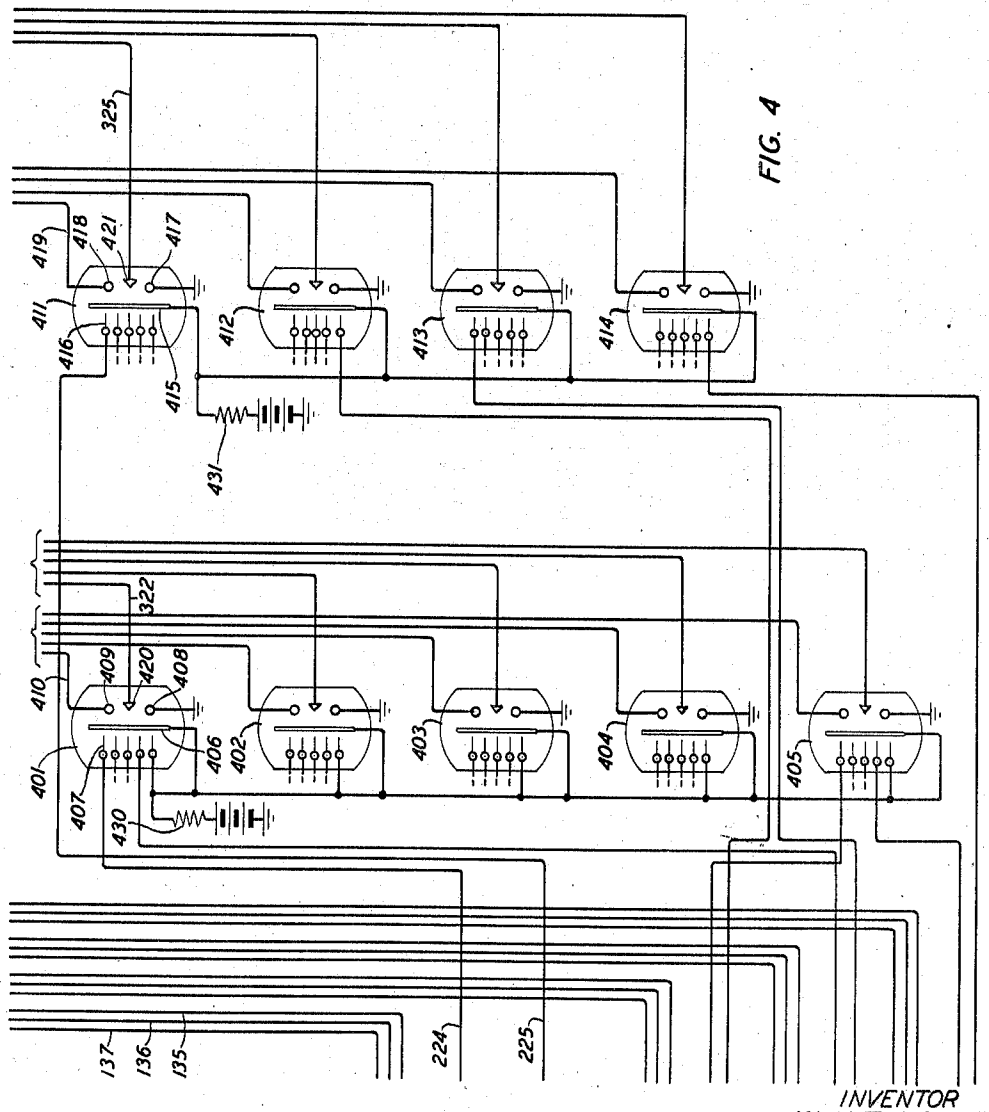


FIG. 4

INVENTOR
W. H. T. HOLDEN
BY
P. C. Smith
ATTORNEY

Patented Oct. 27, 1942

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

William H. T. Holden, Woodside, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application October 16, 1941, Serial No. 415,226

6 Claims. (Cl. 179—18)

This invention relates to telephone systems and has for its object to simplify the selection of connecting circuits in such systems.

In the crossbar dial system, the extension of a connection from a calling line to a called line is controlled by common equipment known as senders and markers. Each connection takes place in two stages, one connecting the calling line by way of a district junctor to an outgoing trunk and the other connecting the trunk to the called line. In each stage the marker receives an indication of the identity of the originating and terminating circuits and connects therewith. It then tests for and selects an idle channel and operates the switches making up the channel to complete the connection between the originating and terminating circuits.

In accordance with the present invention improved means is provided for testing such channels.

More specifically, the test conductors of the three links forming a channel are connected through rectifiers to a common point and thence to start cathodes of a pair of multicathode gas-filled tubes. By means of a series of delay circuits the first idle channel is effective to operate the connected tubes which in turn identify the channel and connect the switch operating circuits through to the channel control circuits of the marker.

The invention will be more clearly understood from a consideration of the following description read in connection with the drawings in which:

Fig. 1 shows a set of crossbar switches connecting district junctors with outgoing trunks, as well as the district and office frame connectors;

Fig. 2 shows in diagrammatic form a sender and parts of a marker and the details of a part of the channel test circuit;

Fig. 3 shows the relays which connect the channel control circuit to the selected channel; and

Fig. 4 shows the gas-filled tubes for selecting and identifying an idle channel.

Fig. 3 should be placed at the right of Fig. 1 with Figs. 2 and 4 below Figs. 1 and 3, respectively.

This channel testing circuit is especially adapted for use in a crossbar dial system of the type disclosed and claimed in U. S. Patent 2,235,803, granted to W. W. Carpenter on March 18, 1941.

When a call is initiated, the calling line is automatically extended to an idle district junctor such as junctor 100 and through the associated sender link 101 to an idle sender 200. The designation of the wanted line is recorded in the sender which, as soon as it has received the designation of the wanted office, connects itself through the marker connector 201 to an idle marker including frame register 202 and the code registers 203. The office code is transferred to the code registers 203 and is translated by means indicated as translator 204 to bring about the operation of a route relay 205. Route relay 205 at its left contact closes a circuit for operating the office frame connector represented by multicontact relay 102. With relay 102 operated, route relay 205 operates relay 103 to connect a group of trunks leading to the wanted office to the trunk test relays of the marker. For example, the test conductor 104 of trunk 105 is connected over contacts of relays 103 and 102 to the winding of test relay 206. As set forth in the above-identified Carpenter patent, the trunk test relays are arranged in a chain and an idle trunk is selected by a circuit extending over the front contacts of busy trunk test relays and the back contact of the first idle test relay to the corresponding trunk select relay. Assuming that trunk 105 is idle and relay 206 unoperated, the idle trunk 105 is identified by the operation of relay 207.

Referring to Fig. 1 it will be apparent that junctor 100 has access to twenty district links, of which links 106 to 109 have been indicated. Each of these links appears in a different one of the district secondary switches 110 to 113. Similarly trunk 105 has access to twenty office links, of which links 114 to 117 are shown. Each of these office links appears in a different one of the office primary switches 118 to 121. Each district frame is connected to every office frame by means of office junctors, one office junctor extending between a given district secondary switch and a given office primary switch. For example, office junctor 122 connects switch 110 to switch 118, junctor 123 connects switch 112 to switch 119, etc.

Therefore, between district junctor 100 and trunk 105 there are twenty channels, determined by the respective district and office frames and each comprising a particular district link, office junctor and office link, all of which must be idle to make the channel available for use.

In order to test all of these elements, the marker must make a connection therewith. When the district junctor 100 was connected with the sender 200, a registration was made in the sender 200 of the number of the frame on

which the district junctor 100 was located and this registration was transferred to frame register 202 of the marker. Under the control of the frame register 202, the proper district frame connector is selected and a multicontact relay 130, individual to the marker, is operated. The district junctor 100 operates a relay 131 common to the ten junctors appearing in the district primary switch 132. Relays 131 and 130 connect the test leads of the twenty district links 108 to 109, etc., through to the marker.

When office frame connector relay 102 operated, it closed a circuit for relay 206 which is individual to the office frame and which, in operating, closes a circuit from ground over conductor 209, contact of relay 130 to the winding of relay 133 and battery. Relay 133 being operated under the joint control of means individual to the office and district frames may be used to select the group of office junctors 122 to 125 connecting those frames and extend their test conductors to the marker.

When the idle trunk was selected by the operation of relay 207, a circuit was closed from ground over a contact of relay 102 to the winding of relay 134 and battery. Relays 134 and 102 extend the test conductors of the office links 114 to 117 to the marker.

When the above-traced connections have been made the channels are tested. The circuits for testing the channel comprising district link 109, office junctor 125 and office link 114 have been shown in detail.

The test circuit of district link 109 extends over contacts of relays 131 and 130 to conductor 135, and cuprous oxide rectifier or varistor 210; the test circuit of office junctor 125 extends over contacts of relays 133 and 130 to conductor 136 and varistor 211; the test circuit of office link 114 extends over contacts of relays 134 and 102 to conductor 137 and varistor 212. The varistors 210, 211 and 212 are connected together and to the channel test conductor 216.

The other channels have their elements connected to similar channel test circuits shown schematically at 217, 218 and 219. Conductor 220, connected through varistor 213 in parallel with conductors 135, 136 and 137 may be grounded from a pattern relay, the function of which is to mark channels unavailable as described in the above-identified Carpenter patent.

Channel test conductor 216 is connected to a delay network 214 which in turn is connected in parallel to two identical T networks 221 and 222. Conductors 224 and 225 outgoing from networks 221 and 222, respectively, are connected to individual starting cathodes in two sets of multielement gas-filled tubes. The five tubes 401 to 405 each have four starting cathodes thus providing one starting cathode per channel. The four tubes 411 to 414 each have five starting cathodes, thus also providing one starting cathode per channel. Each channel test conductor is connected to one starting cathode in each set, the conductors connected to one tube in one set being connected to different tubes of the second set so that each channel is associated with a different pair of tubes.

The starting anodes of the tubes in each set are connected together and to a 50-volt positive battery through the 100,000 ohm resistances 430 and 431.

As set forth in the above-mentioned Carpenter patent, busy channel elements are grounded, while idle channel elements are connected to a negative battery of approximately 50 volts. If any element is grounded, the potential on test conductor 216 is reduced nearly to zero. The delay networks 214, etc. provide slightly different delays for each channel so as to create an order of preference for the channels. Therefore the idle channel having the shortest delay will permit the starting gaps in the corresponding tubes to break down, which thereby prevents the breakdown of any other tubes.

Assuming the channel connected to test conductor 216 is idle and has the shortest delay, the start gap between start anode 406 and start cathode 407 breaks down, causing the main gap to break down and complete a circuit from ground on main cathode 408 through the main gap to main anode 409, conductor 410, winding of relay 300 to source 320, supplying a pulsating current of superimposed alternating and direct current. Relay 300 connects negative battery through resistance 321 over its inner contact to conductor 322 and electrode 420 of tube 401, locking the tube operated.

Similarly, the starting gap between start anode 415 and start cathode 416 breaks down, completing a circuit from ground on main cathode 417 through the main gap to main anode 418, conductor 419, winding of relay 310 to a source 323 similar to source 320. Relay 310 connects battery through resistance 324 over its inner contact to conductor 325 and electrode 421 of tube 411, locking that tube. Relays 310 and 300 are equipped with copper sleeves so that they can operate and hold in series with the pulsating current supply.

Each of the relays 310 to 313 operated from tubes 411 to 414 connect five sets of channel test leads to the armatures of relays 300 to 304, while the operation of one of the relays 300 to 304 connects one set of channel test leads to the channel control circuit. By this arrangement nine tubes and nine relays are employed to perform the function of the sixty relays employed in the cited Carpenter patent.

It is, of course, to be understood that other tube and relay arrangements may be used without departing from the spirit of the invention.

When the channel control circuit connects ground to the channel test leads to operate the switch magnets, relays 340, 341 and 342 operate, connecting ground over their contacts in series to resistances 321 and 324 to quench the tubes and release the marker. These relays are slow to operate, so that the magnets may be locked before their operating circuits are opened.

What is claimed is:

1. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as busy or idle, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, gas-filled tube means connected to said channel test conductors, means to supply starting potential to said gas-filled tube means when all sections of the channel are marked idle and means to selectively operate said gas-filled tube means to identify an idle channel.

2. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as busy or idle, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, gas-filled tube means connected to said channel test conductors, means to supply starting potential to said gas-filled tube means when all sections of the channel are marked idle, delay circuits interposed in said channel test conductors, said delay circuits having different periods to set up a preference relationship between said channels and means to selectively operate said gas-filled tube means to identify an idle channel.

3. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as busy or idle, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, two sets of gas-filled tubes, means controlled over said channel test conductors to operate one tube in each of said sets and means under the control of said operated tubes to select an idle channel.

4. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as busy or idle, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, two sets of gas-filled tubes, means controlled over said channel test conductors to operate one tube in each of said sets to identify an idle channel, channel operating circuits and means under the joint control of said operated tubes to connect the section test conductors of said identified channel with said channel operating circuits.

5. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as busy or idle, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, gas-filled tube means connected to said channel test conductors, means to supply starting potential for said gas-filled tube means to said channel test conductors from the idle channel sections connected therewith, means controlled from busy channel sections to render ineffective the potential supplied to the channel test conductors connected therewith, and means to selectively operate said gas-filled tube means connected with a channel, all sections of which are idle.

6. In a telephone system, incoming circuits and outgoing circuits, a plurality of channels each comprising a plurality of sections for connecting an incoming circuit to an outgoing circuit, a test conductor for each of said channel sections, means for marking said section test conductors as idle by connecting negative battery thereto and busy by connecting ground thereto, and means for testing each channel comprising means for connecting the test conductor of each channel section to a unidirectional current carrying device, the devices connected with sections of the same channel being arranged to be conductive in the same direction and connected in multiple to a channel test conductor, gas-filled tube means connected to said channel test conductors, means to supply starting potential for said gas-filled tube means to said channel test conductors from the negative battery on the idle channel sections connected therewith, means controlled from busy channel sections to connect ground to the channel test conductors to render ineffective the negative potential connected thereto, and means to selectively operate said gas-filled tube means connected with a channel, all sections of which are idle.

WILLIAM H. T. HOLDEN.