April 9, 1940. R. E. COLLIS ET AL. 2,196,250

TELEPHONE SYSTEM

Filed June 17, 1938 2 Sheets-Sheet 1

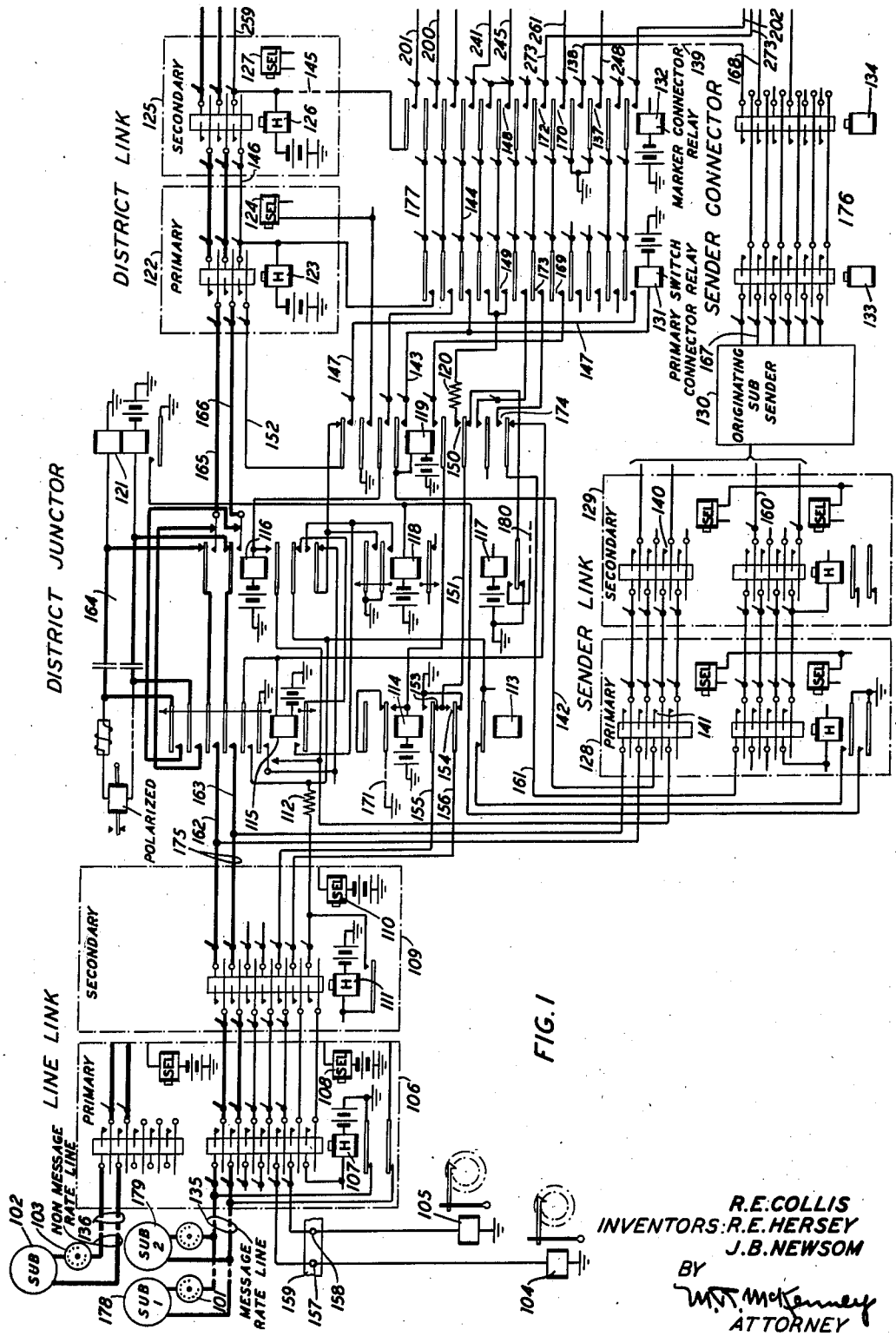

FIG. 1

INVENTORS: R.E. COLLIS
R.E. HERSEY
J.B. NEWSOM

BY W.T. McKenney
ATTORNEY

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TELEPHONE SYSTEM

Filed June 17, 1938 2 Sheets-Sheet 2

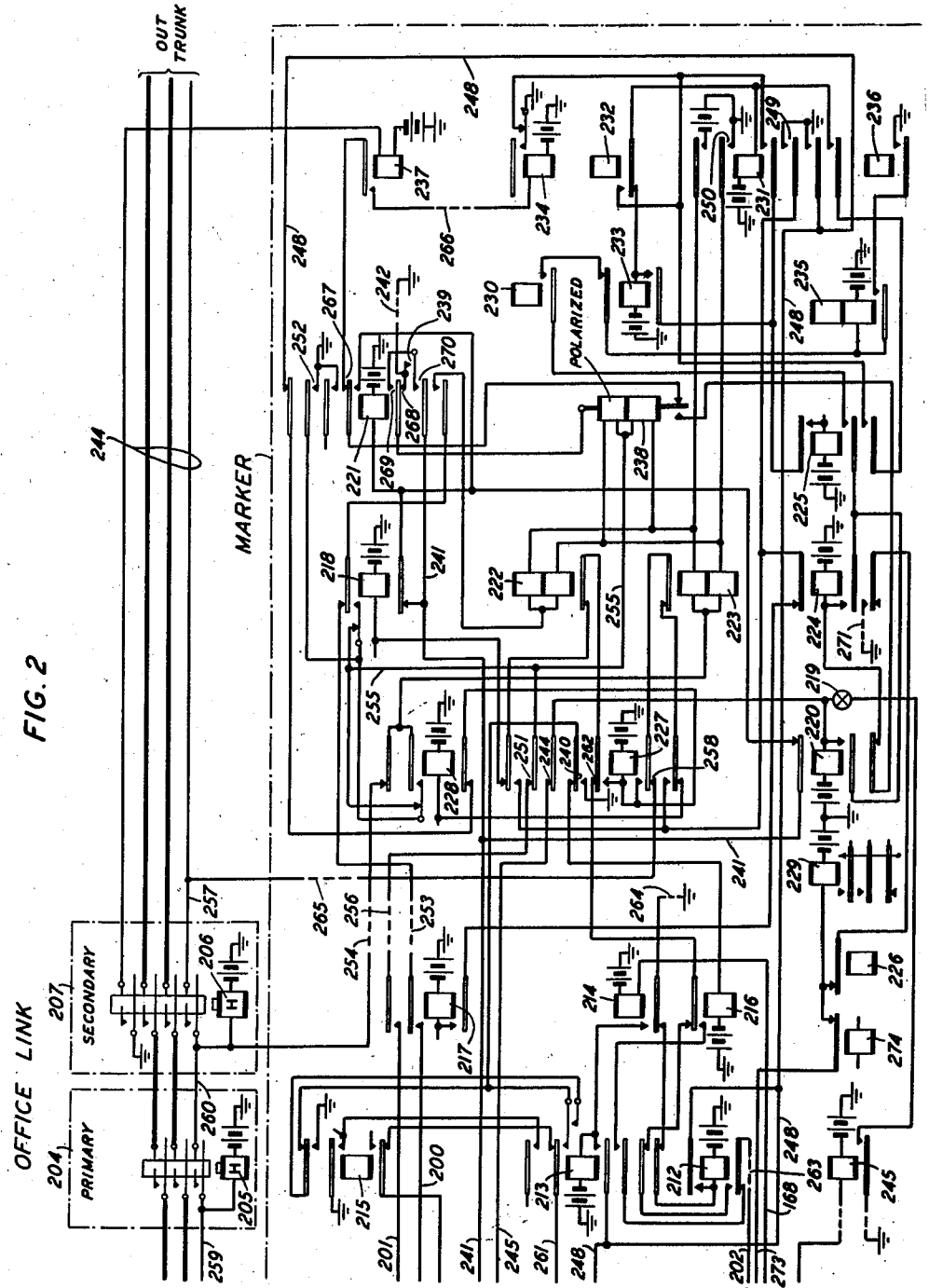

FIG. 2

R.E. COLLIS
INVENTORS: R.E. HERSEY
J.B. NEWSOM

BY M.T. McFarney
ATTORNEY

Patented Apr. 9, 1940 2,196,250

UNITED STATES PATENT OFFICE

2,196,250

TELEPHONE SYSTEM

Raymond E. Collis, Summit, Ralph E. Hersey, Madison, N. J., and James B. Newsom, Great Neck, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 17, 1938, Serial No. 214,352

8 Claims. (Cl. 179—9)

This invention relates to telephone systems and particularly to systems in which charges are made automatically for the service rendered to the subscribers.

It has been common practice heretofore in automatic telephone systems to provide message registers for subscribers' lines and to operate these registers automatically at suitable times in the progress of establishing or disestablishing conversational connections to assess charges against the subscribers who initiate the calls. The circuit for operating a subscriber's message register in these automatic systems usually extends from common controlling equipment through the contacts of the line switch or line finder that serves to extend the calling line to the selector switches and controlling equipment. After passing through the contacts of the line switch or finder, the operating circuit is then connected by way of suitable cross-connecting frames to the message register individual to the subscriber's line.

An object of the present invention is to increase the reliability of systems of the foregoing character and to obtain a greater assurance of the registration of all calls made by the subscribers.

A feature of the invention is a system in which connections are established by means of automatic switches under the control of a common controlling mechanism or marker, and in which the marker makes a test at a certain stage in the progress of establishing a connection to determine whether the operating circuit for the register of the calling line is intact and in proper condition for the subsequent operation of the register. If the message register circuit is found to be intact, the marker proceeds in the regular manner with the further establishment of the connection, and at some subsequent time the operating current is applied to the message register circuit to operate the register and assess the call. However, if the marker is not satisfied with the test of the register operating circuit, it refuses to proceed with the establishment of the connection. Failing to obtain his connection, the calling subscriber may consult an operator who will order the trouble-man to investigate and remedy the cause of the trouble.

Another feature of the invention is a system having some lines equipped with message registers and also having lines of other classes, and in which the marker receives a class-of-service indication whenever a call is made by a line other than a message rate line and from this information knows that the message register test should be omitted. Having this information, the marker omits the test that it would otherwise make and proceeds to establish the connection for the calling line the same as it would had it made a satisfactory test in case a message rate line were calling.

A further feature of the invention is a system of the character above described in which service to any message rate subscriber's line may be denied him by opening the operating circuit of his message register. When any subscriber attempts to make a call after the message register circuit of his line has been opened to deny him service, the marker in making its usual test finds that the register circuit is open and refuses to set up the connection for him. The subscriber, on making inquiry of the operator, will learn why he has been unsuccessful in obtaining the telephone connection.

These and other features of the invention will be described more fully in detail in the following specification and will also be set forth in the accompanying claims.

In the drawings accompanying the detailed specification, Figs. 1 and 2 taken together illustrate, partly in detail and partly in diagram, the equipment of a central office system embodying the features of the present invention.

Fig. 1 shows subscribers' lines of different classes appearing in the line link switches of the central office and also illustrates the district selector switches and a central office sender for controlling them, together with other controlling and connecting equipment; and

Fig. 2 illustrates an office selector switch for extending the calling lines to outgoing trunks and a marker which cooperates with the central office sender to control the operation of the district and office switches.

The invention is disclosed in an automatic telephone system in which automatic switches of the cross-bar type are used as the medium for extending connections from subscribers' lines over trunks to other subscribers' lines. These cross-bar switching mechanisms are controlled by register senders at the central office, which receive the designations from the calling subscribers' dials, and by decoder markers, which are connectable to the senders for receiving information from the senders, and which are also connectable to the proper switch frames for the purpose of testing the outgoing trunks and for testing the connecting links and for operating the magnets of

the cross-bar switches to establish the connections.

While the system disclosed is not limited to the use of cross-bar switches of any particular type, reference may be had to the patent to Reynolds, 2,021,329 of November 19, 1935, for an understanding of the construction and operation of a switch suitable for use in such systems. Because of the complicated nature of these systems, and since it is not necessary to an understanding of the invention that the system in all of its details be disclosed, much of the circuits and equipment has been eliminated in the present disclosure for the sake of simplicity. And in the following descriptions reference will be made to numerous operations which are not fully disclosed in all of their details. Wherever such references occur it will be understood that the circuits and equipment so referred to are already old in the prior art, and in particular reference is here made to the following for a detailed disclosure of all operations and equipment referred to herein but not specifically disclosed: Carpenter Patent 2,093,117 of September 14, 1937; and Carpenter application Serial No. 214,356, filed June 17, 1938.

The subscribers' lines appear in the contacts of primary line link switches. For example, the two-party message rate line 135 and the non-message rate line 136 appear in the contacts of the primary switch 106. The primary switches are connected by links to secondary line link switches, such as the secondary switch 109, and these secondary switches in turn have access to district trunk or junctor circuits extending to the primary district cross-bar switches, such as the primary switch 122. The primary district switches in turn have access through links to secondary district switches, such as the secondary switch 125. The secondary district selectors are connected by links to the primary office selectors. the primary office selectors having access in turn to secondary office selectors which in turn have access to the outgoing trunks, such as the trunk 244. Two of the office selectors, primary switch 204 and secondary switch 207, are illustrated.

The district junctors have access through cross-bar sender link switches to common register senders. For example, the district junctor 175 and other similar junctors have access through primary and secondary link switches 128 and 129 to any one of a number of common register senders, such as the sender 130. The register sender 130 is connectable to an idle one of the controlling markers, such as the marker illustrated in the lower part of Fig. 2, through sender connectors 176. The markers are connectable to the frames of district and office switches by means of frame connectors. One of the district frame connectors 177 is illustrated. This frame connector serves to connect the marker shown in Fig. 2 and other markers to the district frame including the primary and secondary district selectors 122 and 125. Similar frame connectors, not shown in detail herein, are provided for connecting the markers to the office frames.

When a message rate subscriber on the two-party line 135 or a non-message rate subscriber on line 136 removes his receiver from the switchhook to initiate a call, he will be automatically connected through the primary and secondary line link cross-bar switches to a district junctor circuit. Said district junctor then makes connection with an idle originating subscriber sender 130 via primary and secondary cross-bar switches 128 and 129. Usually five pairs of primary cross-bar switches and five secondary switches are employed to gain access to a common group of senders. When an idle sender is connected, a dial tone is given to the subscriber and he proceeds to operate his dial, such as the dial 101 or the dial 103, in accordance with the number of the party he is calling. When the sender completes registering the office code portion of the wanted subscriber's number, it seizes an idle decoder marker, such as shown in Fig. 2, out of the common group, through the sender connector 176. Said decoder marker then functions to receive the code from the sender and translates the same for setting up certain conditions in the sender according to the nature of the terminating central office. Another function of the marker is to select an idle trunk and an idle path to it from the district junctor and to operate selecting and holding magnets in the district link and office link frames to close the path through to the trunk. If the marker cannot find idle elements to form a continuous connection from the district junctor to the idle trunk which is selected, it attempts to select an idle trunk on the mate office frame and then attempts to find an available channel to it from the district junctor. Each trunk group is divided into two subgroups which appear respectively in the office switches of a pair of mate frames. If the marker fails to find an idle trunk or an idle channel thereto, it notifies the sender which then chooses another marker. The second marker goes through the same operations except that a trunk in an alternate route is sought. If there is no alternate route it searches again among the trunks of the original route. If the second marker trial is unsuccessful, a third marker is seized which directly establishes connection with an overflow circuit. When a connection is established through the district and office switches, the marker is released and the sender proceeds to complete the connection to the called station or to an operator who will connect to the called station.

A detailed description will now be given of the particular features of this invention. Assuming the decoder marker of Fig. 2 has just been seized by the sender as above mentioned and has been connected to the proper district frame, the operation of multi-contact marker connector relay 132 at contact 137 closes ground to lead 248, which may further be traced through top outer contact of relay 221 and through bottom contact of relay 228 to battery through winding of relay 227. The latter relay thereupon operates and locks through its front contacts and the break contacts on relays 222 and 223 to ground at contact 249 on relay 231. Relay 231 may be assumed to have operated just after the sender connector relays 133 and 134 first connected the sender to the marker. Marker connector relay 132 also closes a circuit for connecting the district link through to the district junctor circuit, which path may be traced from ground over lead 138 through the contacts of certain relays in the decoder indicated at 139, thence through top outer contacts of sender connector relays 134 and 133 for operating a relay in the sender. This same ground is extended through the sender link via contacts 140 and 141, thence over lead 142 and through the winding of relay 119 of the district junctor to battery. The operation of the latter relay extends

its operating path over lead 143 to battery through district link primary switch connector relay 131 which operates and likewise extends the operating ground over lead 144, contact on marker connector relay 132, lead 241, top break contact on relay 220, and through winding of relay 221 to battery. Ground under control of a number of decoder marker relay contacts indicated at 242 thus locks relay 221 operated and is also extended back over leads 241, 144, 143 and 142 in order to hold relays 131 and 119 operated, and including the operated relay in the sender above mentioned.

The decoder marker having been seized, now receives, from the sender, information on the code portion of the number as dialed by the subscribed and proceeds to test for an idle trunk and an idle channel through the district and office frames to such trunk. When a channel is selected, relays 222 and 223 operate each over a path traced from ground at contact 250 on relay 231 through its own bottom winding. Said path for relay 222 may further be traced through bottom outer contact of relay 221, top outer armature and contact of relay 218, through other marker relay contacts indicated at 253, top inner contact of relay 217, lead 200, thence through contacts on marker connector relays 132 and 131 to battery through the primary holding magnet 123 of the district link. Similarly the path for relay 223 may be further traced through top outer contact of relay 228 and through other marker relay contacts indicated at 254, thence to battery through the secondary holding switch magnet 206 on the office link frame. The primary district and office secondary switch holding magnets operate in the circuits above traced as well as relays 222 and 223, assuming of course, said channel is idle. The latter relays, however, open holding circuit for relay 227 as previously mentioned, causing said relay to release and at contact 251 to close a path for operating the district link secondary holding switch magnet 126 and office link primary switch magnet 205. Said path may be traced from ground at contact 252 on operated relay 221, thence through normal contacts in parallel on relays 218 and 228 to lead 255, contact 251 on relay 227 and through other marker relay contacts indicated at 256, top outer contact on relay 217, lead 201, thence through a contact on connector relay 132 and junctor relays indicated at 145 to battery through holding magnet 126 and over lead 259 to battery through holding switch magnet 205. The operating ground for magnets 126 and 205 is thereupon extended over leads 146 and 260 to the windings of the primary district and secondary office switch magnets respectively, thereby shunting out the ground through the bottom windings of relays 222 and 223 to these same magnets as previously traced, causing relays 222 and 223 to release. The release of relay 222 with relay 227 released, thus closes a circuit for operating relay 218 traced from battery through winding of said relay, top outer break contact of relay 227, normal contact of relay 222, contact 262 on relay 227, thence through armature and front or back contact of relay 216, contacts on relay 213, contacts and bottom armature of relay 212, through other contacts on marker relays indicated at 263, lead 202, thence through contacts on connector relays 132 and 131 to lead 147 which is now connected through a contact on operated relay 119 to lead 152, and then to ground at the winding of holding magnet 123 as previously traced. Relay 218 thus operates to indicate that the sleeve lead 152 is properly connected. Similarly the release of relay 223 with relay 227 released closes a circuit for operating relay 228 traced from battery through winding of said relay, bottom outer contact of relay 227, normal contact of relay 223, contact 258 on relay 227, thence through other marker relay contacts indicated at 265 to the sleeve 257 of the outgoing trunk which is now grounded through the operation of holding magnet 206 previously described. Relay 228 thus operates to indicate that the trunk sleeve is properly connected. With relays 218 and 228 operated thereby removing direct ground through contact 252 from lead 255, all holding magnets will be held operated through contact 251 on relay 227 to ground through top winding of relay 238, thereby operating the latter relay. Relays 218 and 228 also connect direct ground to the windings of relays 222 and 223 respectively to maintain the latter in a non-operated position.

When relay 227 released as above described it also closed a circuit from battery through the windings of relay 220 over contact 244 on relay 227, lead 245, contact 148 on marker connector relay 132, thence through contact 149 on primary switch connector relay 131, resistance 120, contact 159 on operated relay 119, lead 151, thence through contact 153 or 154 on relay 114 over lead 155 or 156 through secondary and primary line link switch contacts, terminals 157 or 158 on message register connecting rack 159, to ground through party line message register 104 or 105. The register, of course, does not operate under this test condition but the operation of relay 220 at its top contact opens the path to ground on lead 241 previously traced, said path being the last one of three paths that have been holding relay 221 operated. A second path for holding the latter relay operated was opened at the bottom contact when relay 218 operated as previously described, and a third path for holding relay 221 operated was opened when relay 238 operated as previously described.

It will be understood in connection with tracing the above path of message registers 104 and 105 that relay 114 may or may not be operated depending on whether relays 214 and 213 in the marker of Fig. 2 have operated. The originating subscriber sender 130 makes a two-party test of the calling subscriber's line before sending dial tone to the calling station, records this information, and at the completion of the dialing of the office code transmits it to the marker circuit. If, for example, the message rate subscriber at station 173, the flat rate subscriber 102, or an operator, is calling, then the sender conveys this information to the marker by withholding a ground connection from the lead 167. If the message rate subscriber at station 179 is calling, the sender grounds lead 167 traced thence through the sender connector relay contacts over lead 168 to battery through winding of relay 214 in the marker. The operation of the latter relay in turn operates relay 213 in a circuit traced from battery through winding of said relay, front contact and armature of relay 214 to ground through other marker relay contacts indicated at 264. Relay 213 then locks over lead 248 to ground on contact of relay 231 until the marker connector relay 132 operates when it holds to ground at contact 137 on said relay. The operation of marker connector relay 132 extends the circuit of relay 114 to the top inner

armature of relay 213 of the marker over a path traced from battery through the winding of said relay, bottom inner contact of relay 119, contacts 169 and 170 on connector relays 131 and 132 respectively, and lead 261. Assuming subscriber at station 179 is calling, relay 213 would then be operated so that the circuit of relay 114 as just traced may further be traced to ground at contact 240 on relay 227 which is still operated at this time. Relay 114 once operated, locks to ground through other relay contacts in the district junctor circuit indicated at 171, thereby remaining operated for the duration of the connection so that subscriber at station 179 will be charged for the call when completed.

Referring to the test of the message register circuit above described, if this circuit is intact, relay 220 of the decoder marker circuit will operate and the marker will start releasing due to the closure of a circuit for relay 234 traced from battery through winding of said relay, thence through the contacts of a number of other marker relays indicated at 266 and contact on relay 237 which operated when the secondary office link holding magnet 206 operated. The circuit through winding of relay 234 is further traced through contact 267 on relay 221 which is now released, normal contact on relay 238, thence through contact 268 on relay 221 to ground through contacts on other marker relays indicated at 242. The operation of relay 234 then locks under the control of numerous operated relays (not shown) which must release before relay 234 can release. Relay 234 also removes ground which has been holding relays 231 and 233 operated. These and other relays open the office and district link start leads and also remove the off-normal battery and ground from the numerous relays that were operated and locked during the marker stage, and these relays release. The last one of them to release finally opens the locking circuit for relay 234. The marker is thus dismissed and from this point on the originating sender directs the setting up of the connection. When the sender has completed its function, it operates relay 115 by connecting ground to lead 160 which may be traced through contacts on sender link frames 129 and 128, lead 161 thence through bottom armature and back contact of relay 119 to battery through winding of relay 115. The latter relay thus extends the talking conductors 162 and 163 via the impedance-condenser transmission bridge 164 to the trunk conductors 165 and 166 leading toward the called subscriber's station.

When conversation is over and the subscriber releases, the message register 104 or 105, depending on which party made the call, is operated by the application of current to conductor 180, the circuit extending through contacts of relays 117 and 118 to conductor 151.

If the relay 220 in the marker fails to operate due to the subscriber's message register lead being open for any reason, relay 221 will not release following the operation of relay 238. That is, locking ground through relay contacts indicated at 242 of the marker continues to hold relay 221 operated over a path traced through contacts 239 and 270 to lead 241, thence through the top normal contact on relay 220 and through winding of relay 221 to battery. Since relay 221 does not release, it will be obvious that primary switch connector relay 131, district junctor relay 119, and the operated relay of the sender above-mentioned, likewise do not release following the operation of relay 238 previously described. Thus, a path is closed for operating relay 224 traced from battery through its winding and bottom outer contact of relay 220, left front contact and armature of relay 238, contacts 269 and 239 on operated relay 221, thence to ground through other decoder marker relay contacts indicated at 242. Relay 224 then locks to ground through contacts on operated relays 225, 230, 235 and 236 and normal contact of relay 233. Relay 224 at its bottom front contact connects ground, traced through other decoder marker relay contacts indicated at 271, through an armature and normal contact on relay 226 to battery through slow operate relay 229 which starts the decoder marker releasing in the usual manner. While the latter relay is operating, said ground path as just traced is also connected from this point, through contacts of relay 274 of the decoder marker to lead 273, thence through contacts 172 and 173 on marker connector relays 132 and 131 to the front contact 174 on operated relay 119, thence over lead 161, through primary and secondary sender link switches 128 and 129, and lead 160 to the subscriber's sender 130 as a trouble release indication to the sender. Relay 224 at its top contact also opens the holding path for relay 217 thereby releasing the district and holding magnets so that these will be released and prevent setting up the connection.

The failure of relay 220 to operate thus results in causing the decoder to fail in setting up the connection and gives the sender a trouble release signal. As described in the above-noted Carpenter application Serial No. 214,356, filed June 17, 1938, the sender will make three trials in an attempt to set up the call and on the third trial, if the register circuit is still open, the contacts of relay 274 in the series circuit will be operated which prevents the operating ground for relay 229 from being connected to lead 273. The sender under this condition does not receive a trouble release signal. The relay 234 is operated and the decoder marker restores to normal and the sender proceeds to cut the district through and release itself, even though the decoder did not set up the district and office cross-points to a trunk, such as trunk 244. This then will result in the subscriber not being connected to whatever line he is calling but instead the district merely being held from his line with the sender and decoder released. When the subscriber calls the trouble condition to the attention of the operator, the trouble-man will correct it and restore the service to the subscriber's line. If, however, the message register lead had been opened at the cross-connecting rack 159 by the telephone company in order to deny service to that subscriber he will be so informed.

When an operator or a subscriber of some other class, such as the subscriber of the flat rate line 136, originates a call, the sender when seized by the sender link will register the class of service of the calling line as well as the district frame through which the call is coming. Then when an idle decoder marker is connected to the sender, this information will be passed along to said marker as recorded in the sender, all in the usual manner as described in the above-noted Carpenter application Serial No. 214,356, filed June 17, 1938. This and other information is recorded in the decoder marker by the operation of certain other relays called class-of-service relays. One of these class relays, relay 245, is illustrated. Therefore, on operator class calls and on lines

not equipped with message registers such as flat rate and coin lines, class relay 245 will be operated. Class relay 245 causes the operation of test relay 220 in a circuit from ground through the contact of relay 245, terminal 219, through the winding of relay 220 to battery. From this point on the marker will be dismissed and the originating sender will direct the setting up of the connection just as above described when a message rate line was found to be intact.

In the foregoing description it has been assumed that the message rate line illustrated is a two-party line. It is obvious, however, that similar service may be given to single party message rate lines. On all such calls by subscribers of message register lines, the marker obtains a class-of-service indication from the sender and utilizes this information for the purpose of making a test of the message register circuit at the proper time in the process of setting up the connection. This test has the purpose of determining whether or not the message register circuit, over which the subscriber's message register is operated to charge him for the call, is intact and is in proper operating condition. Since the marker will normally perform this test as a part of its regular function in establishing a connection unless it is otherwise prevented from doing so, means is provided, as fully described hereinabove, for notifying the marker whenever it is called upon to set up a connection from a calling line that is not equipped with a message register. In this way the marker is able to omit the test of the message register circuit and to proceed with the establishment of the connection independently of such a test.

Since the successful completion of the connection by the marker depends upon the continuity of the message register circuit, this circuit affords a simple and convenient means for denying service to a subscriber. By merely opening the message register lead at the frame 159 any subscriber may be prevented from initiating calls and obtaining connections with other subscribers.

What is claimed is:

1. In a telephone system, a subscriber's line having a message register individual to said line, an operating circuit for said message register, automatic switches, switch controlling markers for controlling the selective operation of said switches to extend the connections from said subscriber's line, means for taking one of said markers into use in response to a call by said line, means in said marker for making a test of the subscriber's line to determine whether said message register operating circuit is intact, and means effective in case the marker is not satisfied by said test for preventing the further extension of the calling line.

2. In a telephone system, a subscriber's line having an individual message register, an operating circuit for said message register, automatic switches, a common switch controlling mechanism for controlling the selective operation of said switches to extend a connection from said subscriber's line, means in said controlling mechanism for making a test to determine whether the operating circuit of said register is in an open or a closed condition, and means effective in case the test indicates the operating circuit to be in an open condition for preventing the operation of said automatic switches to extend the calling line.

3. The combination in a telephone system of a subscriber's line having an individual message register, an operating circuit for said message register, automatic switches, a common switch controlling marker, means in said marker for making a test of the operating circuit of the message register of a calling subscriber's line, means under the control of said marker for causing the selective operation of said switches to extend the calling line in case the test by said marker finds the message register operating circuit to be in standard condition, and means in said marker to prevent the operation of said automatic switches to extend the calling line in case the test by said marker finds the message register operating circuit to be in an unstandard condition.

4. In a telephone system, a subscriber's line of the message rate class, a message register individual to said line, a second subscriber's line of another class, an operating circuit for said message register, automatic switches, a switch controlling marker for controlling the selective operation of said switches to extend connections from said subscribers' lines, means responsive to a call by the subscriber of the message rate line for causing the marker to make a test of the operating circuit of the individual message register, means under the control of said marker and dependent on the result of said test for controlling the selective operation of said switches to extend the calling message rate line, and means responsive to the initiation of a call on said second-mentioned line for causing said marker to omit said test and to control the selective operation of said automatic switches to extend a connection from said second-mentioned line.

5. In a telephone system, a subscriber's line of the message rate class, an individual message register for said line, an operating circuit for said message register, a second subscriber's line of a different class, automatic switches, a common switch controlling marker, means responsive to a call on either of said lines for taking said marker in use, means in the marker effective when a call is made on the message rate line for testing the operating circuit of the individual message register to determine whether said circuit is in a standard condition, and means effected if the test by said marker is satisfactory for causing the marker to control the selective operation of said switches to extend the calling message rate line, class indicating means responsive to a call on said second-mentioned line for establishing in the marker an indication of the class of the calling line, and means in said marker responsive to said class indicating means for simulating a satisfactory test of a message register operating circuit when said second line makes a call to allow said marker to control said automatic switches to extend said second-mentioned calling line.

6. The combination in a telephone system of a subscriber's line having an individual message register, an operating circuit for said register, automatic switches, a plurality of markers, each arranged to make a definite number of successive trials to establish a connection through said switches, means in each marker for making a test to determine whether said message register operating circuit is effective, and means effective in case the marker is not satisfied with said test and depending upon which trial is being made for causing a new trial to be made with an idle one of said markers to establish the connection.

7. The combination in a telephone system of

a subscriber's line having an individual message register, an operating circuit for said register, automatic switches, a plurality of markers for controlling said switches, each arranged to make a limited number of trials to establish a given connection through said switches, means in each marker for testing the subscriber's line to determine whether said message register operating circuit is in working condition, means in each marker effective to cause a new trial by an idle one of said markers provided the marker is not satisfied with the test of the subscriber's line and the limited number of trials have not been made, and means in each marker operative when the marker is engaged in the final trial for preventing the establishment of the connection through said switches in case the marker is not satisfied with the test of the subscriber's line.

8. In a telephone system, a subscriber's line of the message-rate class, a message register individual to said line, a subscriber's line of another class, an operating circuit for said message register, automatic switches, register senders and markers for controlling the selective operation of said switches to extend connections from said lines, means for taking one of said senders and one of said markers into use in response to a call by either one of said lines, means in the marker controlled by the sender for establishing a class indication identifying the class of the calling line, means in the marker for making a test of said message-rate line when the same is calling to determine whether the message register operating circuit is intact, means controlled by said class indicating means in the marker for causing the omission of said test when said other line is calling, and means effective in case the marker is not satisfied by said test for preventing the further extension of the calling line.

RAYMOND E. COLLIS.
RALPH E. HERSEY.
JAMES B. NEWSOM.