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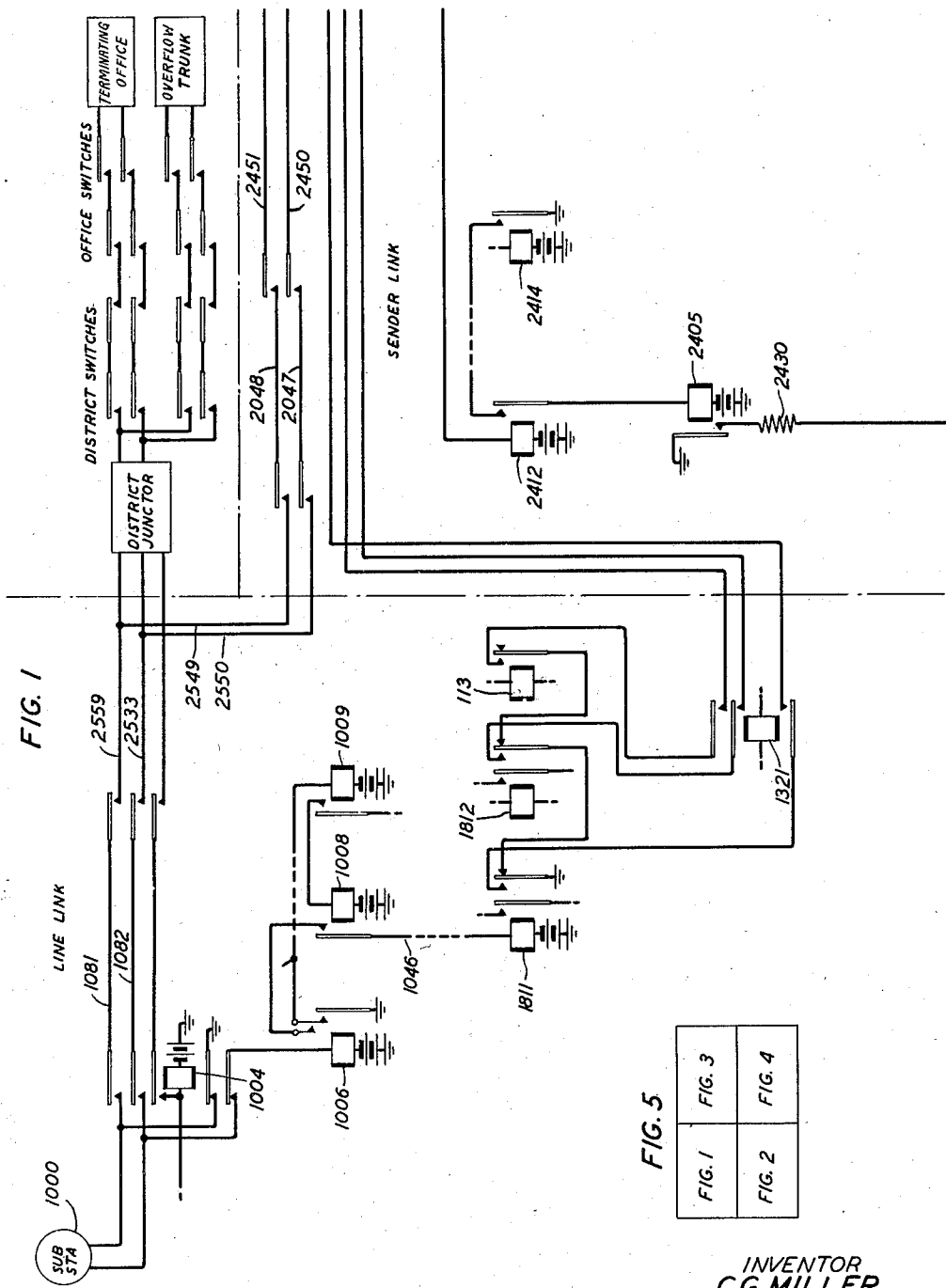
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2,274,083

SENDER CONTROL SYSTEM

Filed Sept. 11, 1940

4 Sheets-Sheet 1



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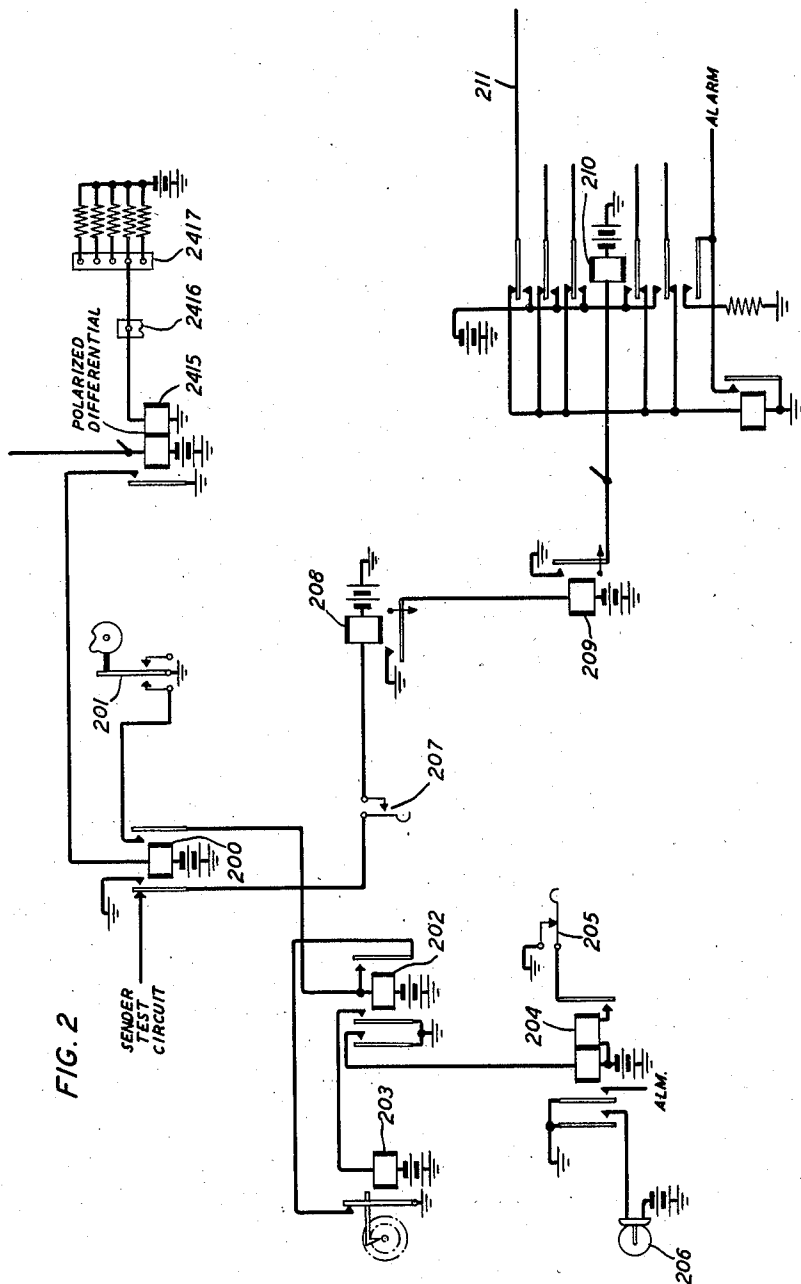
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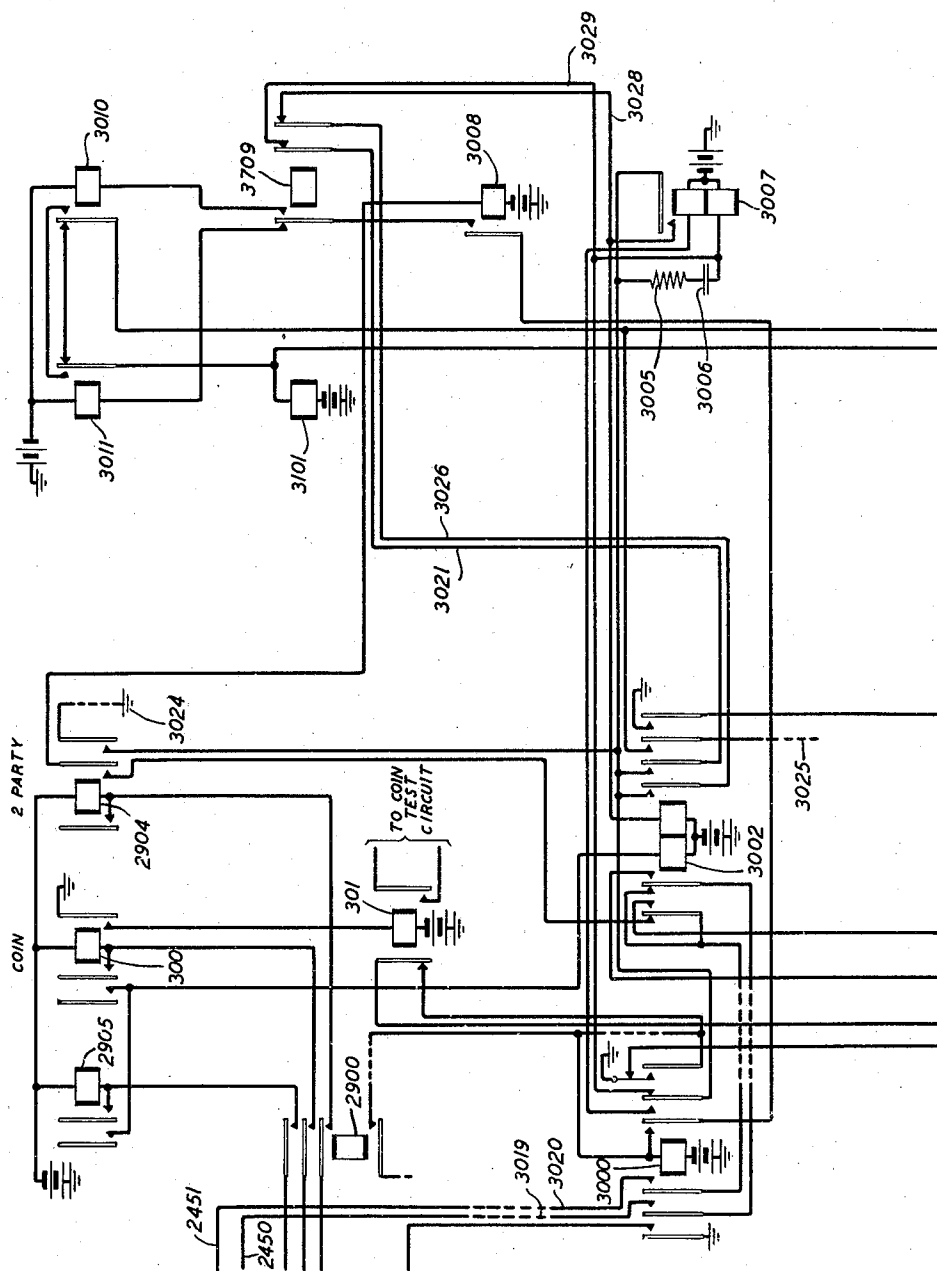
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FIG. 3



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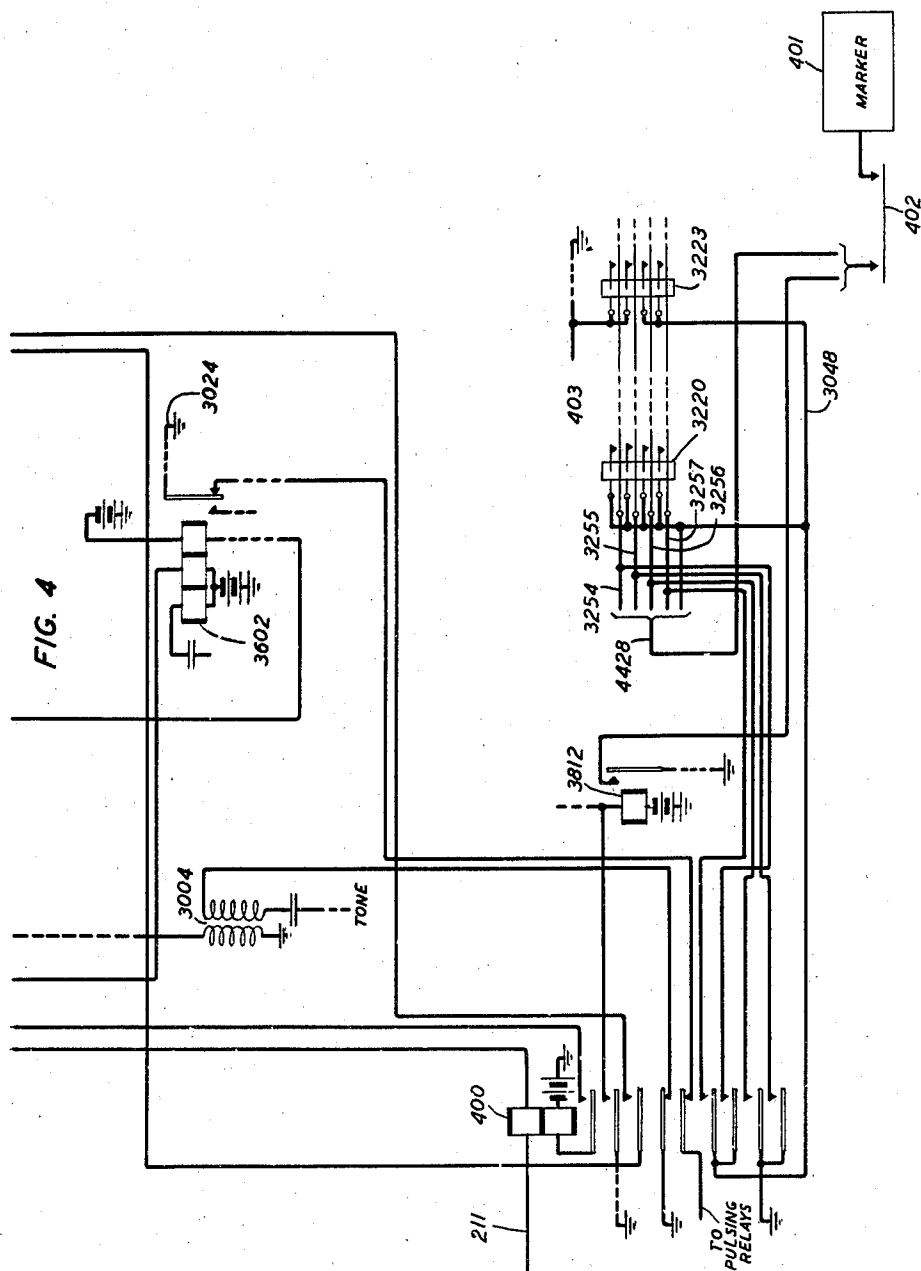
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4 Sheets-Sheet 4



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2,274,083

SENDER CONTROL SYSTEM

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17 Claims. (Cl. 179—27)

This invention relates to telephone systems and has for its object the reduction of delays due to peak traffic loads.

In designing telephone offices the amount of control equipment to be provided is based on handling ordinarily heavy traffic loads with a given small delay, and there is practically no delay during the greater part of the time. On rare occasions some event will cause an unusual rise in the number of calls originated at a particular office, resulting in a shortage of control equipment which may persist for an appreciable length of time. Slow dialing by unfamiliar subscribers when an office is first introduced into service may also result in overloaded control equipment and undue delays. Heretofore there has been no positive means for telling the subscriber of delay in cases of a shortage in control equipment.

In accordance with the present invention, means is provided for giving special treatment to a proportion of the incoming calls when the originating control devices or senders are approaching an all busy condition. This treatment may consist of giving an equipment busy signal or it may lie in rerouting the call to an A operator.

Means is provided under the control of a relay operated when a predetermined number of groups of originating senders are busy to remove a certain number of senders from regular service and arrange them to direct the calling line by which they are seized to an overflow trunk immediately. Since this takes from one to two seconds as against an average of from fifteen to sixteen seconds for completing a call, the senders removed from regular service can dispose of eight to ten calls while the senders in regular service dispose of one call.

Moreover, the allocation, when an overload becomes imminent, of particular senders to the rapid disposition of calls entering them mitigates very materially the condition arising from subscribers dialing before senders are connected to their lines. This premature dialing takes place when undue delay occurs, and the senders, as they connect to the lines, receive either partial sets of pulses or no pulses at all, are thereby held out of other service for unusual periods of time awaiting pulses which fail to arrive, and an overloaded sender group situation is pyramided.

Peak traffic conditions of a degree of severity which this invention cares for persist but for short periods of time when the invention is in

use. Calls disposed of temporarily by the senders made special when an overload impends are not connected to the subscribers called, but are given an equipment busy signal, and consequently are in large measure repeated later. However, the probability of these calls then being placed at a time of sender group overload, or of impending overload, is very much less than when they first were placed because of the short duration of the traffic peaks.

When the invention is used at times of impending overload to route calls entering the specially arranged senders to A operators, then the rerouted calls are completed by giving the wanted number orally to the A operators. These operators use A operators' senders which are not subject to subscriber delays in dialing and also are not likely to be carrying peak traffic at the same time as the other senders.

It is by one or the other of the foregoing methods, then, that the invention functions in taking care of traffic peaks without unduly increased delay in the connection of control equipment.

The senders removed from regular service are at the same time arranged to prevent the transmission of dial tone and to make dialing ineffective if the subscriber should start to dial without waiting for dial tone, and a marker is seized and a special code transmitted thereto immediately after the sender is taken for use. In such senders also, the party line test check is canceled and calls from coin lines may or may not be completed in the usual manner.

In the marker the special code causes the operation of a route relay which may be cross-connected to direct the connection from the line to an overflow trunk which transmits an all equipment busy tone to the calling line, or the route relay may direct the line to an A operator's position, who can then complete the call.

These and other features of the invention will be more clearly understood from a consideration of the following description in connection with the drawings, in which:

Fig. 1 shows a subscriber's line and parts of the line link and sender link, a district junctor and district and office switches;

Fig. 2 shows the traffic register circuit;

Figs. 3 and 4 show portions of an originating sender; and

Fig. 5 shows the arrangement of Figs. 1 to 4.

The drawings show the modifications necessary in a standard originating sender of the cross-bar telephone system in order to embody therein the features of the invention. Such a

standard sender is shown and described in detail in Patent 2,235,803, granted on March 18, 1941 to W. W. Carpenter, and for convenience in consulting that disclosure, the same reference characters have been used wherever possible.

As set forth in the above-mentioned Carpenter patent, when a sender has been seized and is ready to handle a call, relay 3000 operates, in turn operating one of the individual sender busy relays 2412—2414 in the sender link circuit. The senders are arranged in groups of ten and as each sender is seized the corresponding busy relay 2412, 2414, etc., is operated. When all of the senders of a group are busy, a group busy relay 2405 is operated over a chain circuit extending over the front contacts of the individual busy relays. Relay 2405 in operating connects ground through resistance 2430 to battery through the left winding of relay 2415. As other groups of senders become busy, similar group busy relays connect similar resistances to the left winding of relay 2415 in parallel with resistance 2430, thereby increasing the current flow through that winding. Relay 2415 is a polarized relay of the permanent magnet type and its two windings are differentially connected. The right winding of the relay is cross-connected through terminal blocks 2416 and 2417 to some one of the associated resistances. These resistances are graded in value so that the current through the right winding may be set at a desired value by connecting with the proper resistance. The current flow through the right winding tends to hold the relay contact open while that through the left winding tends to close it. Due to the differential arrangement of the windings the relay will remain non-operated until its left winding receives sufficient operating current to prevail over the right winding and the polarizing effect of the relay structure.

When the predetermined number of sender groups for example six, have become busy, relay 2415 operates, in turn operating relay 200. With relay 200 operated, interrupter 201 is connected to relay 202 and the relay follows the interrupter, operating meter 203 and relay 204. Relay 202 locks to a back contact of meter 203 to insure the operation of meter 203, which scores once for every interrupter operation, thereby recording the duration of the group's busy condition. Relay 204 locks under the control of key 205, lights lamp 206 and sounds an alarm.

Responding to the alarm, the maintenance man may attempt to silence the alarm by opening key 205, and note whether the condition clears itself or persists. If it persists, as indicated by the intermittent operation of the alarm, he may close key 207, thereby operating relays 208 and 209 and, in turn, relay 210. Relays 208 and 209 are slow to release and are used to prevent release of relay 210 if the number of senders busy should drop during a short period of lighter traffic to a point where relay 2415 releases.

With relay 210 operated, battery is connected to conductor 211 leading to the sender shown and to four similar conductors leading to four other senders which are not shown. This battery connection serves to place the sender in condition for giving special handling to calls reaching it. According to the arrangement being described there is one relay 210 for fifty senders and each relay 210 marks five senders or ten per cent for special service, which is one sender for each sender frame.

A brief outline of the normal operation of the

parts of the system shown is now given as a basis for describing the invention further:

When a call is originated, for example by the subscriber at substation 1000, line relay 1006 is operated, in turn operating horizontal group relay 1009 through a preference arrangement, not shown. With relay 1009 operated, relay 1008 is operated to connect ground from the inner contact of line relay 1006 to conductor 1046 and thence to the relay 1811 which indicates the position of line 1000 in its group of ten lines. Relay 1812 and relay 113 are connected with other line relays of the same group. As set forth in the above-identified Carpenter patent, the position of the line in the group is used to identify the class of service to which the line belongs, and therefore the operation of one of the relays 1811, 1812, 113, etc., may be used to transmit this information to the sender. In the present disclosure relay 1811 is connected to individual lines, relay 1812 to two-party lines and relay 113 to coin lines.

After a line has been isolated to be served, the line link is connected with a sender link serving a group of district junctors which includes an idle district and for which there are idle sender link switches leading to idle groups of senders. This connection is established by means of relay 1321. The sender link then picks an idle district junctor, an idle sender and a set of switches to connect them and makes a temporary connection with the sender, during which relay 2900 is operated and the class of service registration is set up on relays 2905, 300, 2904, etc., these relays being connected to contacts of relays 1811, 113 and 1812, respectively. Relays 2905 and 300 operate relay 3002, which is operated from relay 3007 under the control of relay 2904 on calls from two-party lines. While relay 2900 is operated, a circuit is completed for relay 3000 which locks under the control of relays not shown. Relay 3000 operates the sender busy relay 2412. When the primary and secondary sender selectors have been operated, relay 2900 is released and the dialing circuit is closed from ground through the left winding of dial tone coil 3004, outer left front contact of relay 3002, inner left front contact of relay 3000, conductors 3020, 2451, 2048, 2549, 2559, 1081 which connect the sender and line switches, through substation 1000, through the line and sender switches over conductors 1082, 2533, 2550, 2047, 2450 and 3019, middle left contact of relay 3000, inner left front contact of relay 3002, middle winding of relay 3602 to battery.

The subscriber, hearing the dial tone, operates his dial, intermittently releasing relay 3602, which closes a circuit from ground on conductor 3024 over the back contact of relay 3602 and a back contact of relay 400 to control the pulsing relays. When the office designation has been recorded, marker 401 is connected over marker connector 402 to the cross-bar register 403 from which it receives the office designation and from it controls the extension of the calling line through the district junctor and over the district and office switches to the terminating office, after which the marker is released. The sender either controls the equipment at the terminating office or transmits the numerical designation to that office before returning to normal.

Assume now that a peak overload has occurred, key 207 has been operated and battery has been connected to conductor 211. With relay 3000

normal, that is, as soon as the sender has finished with the call being handled, a circuit is completed from battery on conductor 211, upper winding of relay 400, outer right normal contacts of relay 3000 to ground. When relay 3000 operates following the seizure of the sender, a locking circuit is closed for relay 400 from battery over the lower winding and inner lower front contact of relay 400, left back contact of relay 301, to ground at the outer right alternate contacts of relay 3000. Relay 400 is therefore held operated until the sender completes its function with a calling line, even though battery may be removed from conductor 211 in the meantime.

When the line has been connected to the sender and relay 3602 operated, ground is connected to the second lower contact of relay 400 which operates relay 3812 to summon a marker. At its four lower contacts relay 400 connects direct ground to conductors 3255 and 3256 and connects checking conductor 3048 to conductors 3257 and 3254, thereby establishing a special code in the marker which will be translated to cause the marker to connect the line to an overflow trunk. As mentioned above, where desirable the marker may cause the line to be connected to an A operator's position by varying the cross-connections on the route relay operated in response to the special code.

In order to discourage dialing by the subscriber, which would serve no purpose and would be likely to delay his receipt of busy tone or the response of the A operator, relay 400 in operating opens the primary circuit of the dial tone coil 3004. In addition, it opens the connection between the pulsing contact of relay 3602 and the pulsing relays so that, if the subscriber operates his dial without waiting for the dial tone, no registration will be made which might interfere with the operation of the marker.

When a call is received from a two-party line, class of service relay 2904 is operated. In this case, the sender tests the line before dialing starts to determine which party is calling. Normally the sender retests the line after dialing is completed, and compares the two tests to detect attempts to charge the call to the wrong party. With relay 2904 operated, relay 3002 is not operated immediately thereafter, as in the case of relay 2905. When relay 3000 operates, the tip and ring conductors are connected over the left front contacts of relay 3000, the left back contacts of relay 3002 in parallel and thence over the inner right front contact of relay 2904 to the winding of relay 3008 and battery. If the tip party is calling, the line is grounded and relay 3008 operates. If the ring party is calling, no ground is present and relay 3008 does not operate. If relay 3008 operates, a circuit is closed from ground over the outer and inner right front contacts of relay 3000, front contact of relay 3008, back contact of relay 3709, winding of relay 3011 and battery.

When relay 2904 first operated, it connected ground over its outer right contact to the lower winding of relay 3007 through resistance 3005 and condenser 3006, and until relay 3000 operates, this ground also extends over the inner right back contact of relay 3000 to the lower winding of relay 3007 in shunt of condenser 3006 and resistance 3005, energizing that relay in a direction to hold its contact open. When relay 3000 operates, this ground is transferred to the upper winding of relay 3007 to operate it, but due to the charging of condenser 3006 the operation

is delayed to give time for the test above described. When relay 3007 closes its contact, relay 3002 is operated and locks under the control of relay 3709 and the sender is ready to receive dial pulses. This test is not affected by the operation of relay 400 in the senders selected for special service. With relay 3002 operated and relay 3709 normal the energizing circuit for the lower winding of relay 3007 is restored, as well as the shunt around condenser 3006, thereby causing relay 3007 to open its contact.

In normal operation, relay 3709 operates following the completion of dialing and releases relay 3002. With relay 3002 released, the tip and ring conductors are again connected to relay 3008, which, if operated, operates relay 3010 over the left front contact of relay 3709. Relay 3709 also opens the circuits for the lower winding of timing relay 3007, permitting that relay to reoperate, in turn reoperating relay 3002. When the sender is ready to release, conductor 3025 is grounded and if relays 3011 and 3010 are both operated or both non-operated a circuit is closed from ground on conductor 3025, third right front contact of relay 3002, over both front or both back contacts of relays 3010 and 3011 to the winding of relay 3101 and battery. The operation of relay 3101 starts the chain of events which result in the release of the sender. If this relay fails to operate, the sender times out and the connection cannot be completed.

Since none of the calls given special handling is completed by this sender, this check of the party test is canceled by the operation of relay 400 which closes a circuit for relay 3101 over the third contact of relay 400 to the third right contact of relay 3002 in shunt of the contacts of relays 3010 and 3011.

For those offices where the specially handled calls are directed to an A operator's position which is not equipped for coin collection or refund, the special handling of calls from coin box lines is canceled by the class of service relay 300. With relay 300 operated, in turn operating relay 391, the locking circuit of relay 400 is opened and, as soon as relay 3000 operates, opening the operating circuit of relay 400, relay 400 releases, restoring the sender to normal service. Where specially handled calls are routed to an overflow trunk the back contacts of relay 301 may be permanently connected together, and calls from coin lines handled the same as other calls.

What is claimed is:

1. In a telephone system, telephone lines, automatic switching equipment, register senders, means in said register senders under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when the senders-busy condition is such as to indicate the likelihood of an imminent traffic peak for giving special routing to a proportion of the originating calls.

2. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when a predetermined busy condition of said control equipment occurs for modifying certain of said control equipment to give calling subscribers an overflow signal.

3. In a telephone system, telephone lines, automatic switching equipment, control equipments,

means in said control equipments under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when a predetermined busy condition of said control equipments occurs for modifying a predetermined fraction of said control equipments to give an overflow signal to a proportion of the originating calls.

4. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, means effective when a predetermined busy condition of said control equipment occurs for giving special routing to a proportion of the originating calls, and means to render said special routing means effective during a predetermined period following the termination of said busy condition.

5. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, means effective when a predetermined busy condition of said control equipment occurs for giving a special routing to a proportion of the originating calls, and means to render said special routing means effective during short predetermined periods of interruption of said busy condition.

6. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when a predetermined busy condition of said control equipment occurs for rendering certain of said control equipment unresponsive to subscriber control and for arranging said certain control equipment to immediately connect a calling line with an overflow signal means.

7. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when a predetermined busy condition of said control equipment occurs for rendering certain of said control equipment unresponsive to subscriber control and for arranging said certain control equipment to immediately connect a calling line with an operator's position.

8. In a telephone system, telephone lines, automatic switching equipment, control equipment, means in said control equipment under the control of a subscriber on one of said lines for operating said switching equipment to connect said line with a second line for conversation, and means effective when a predetermined busy condition of said control equipment occurs for rendering certain of said control equipment unresponsive to subscriber control and for arranging said certain control equipment to immediately connect a calling line with a special trunk.

9. In a telephone system, telephone lines, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, decoder

markers operated in accordance with registered designations for controlling said switching equipment to extend a calling line to the office in which the wanted line is located, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said modifying means for preventing the registration of a line designation.

10. In a telephone system, telephone lines, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, decoder markers operated in accordance with registered designations for controlling said switching equipment to extend a calling line to the office in which the wanted line is located, means effective when the senders-busy condition is such as to indicate the likelihood of an imminent traffic peak for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said modifying means for preventing the registration of a line designation.

11. In a telephone system, telephone lines, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, decoder markers operated in accordance with registered designations for controlling said switching equipment to extend a calling line to the office in which the wanted line is located, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said modifying means for transmitting a special designation to one of said decoder markers to cause said decoder marker to extend the calling line to an overflow signal means.

12. In a telephone system, telephone lines, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, decoder markers operated in accordance with registered designations for controlling said switching equipment to extend a calling line to the office in which the wanted line is located, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said modifying means for preventing the registration of a line designation and for transmitting a special designation to one of said decoder markers to cause said decoder marker to extend the calling line to an overflow signal means.

13. In a telephone system, telephone lines having a plurality of substations thereon, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, means for testing a calling line and identifying the calling substation before said designation is recorded, means for retesting said line after said designation is recorded, means for preventing the release of said sender if said test and retest do not identify the same substation, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special routing to originated

calls directed thereto, and means under the control of said modifying means for canceling said retest and for releasing said sender.

14. In a telephone system, telephone lines having a plurality of substations thereon, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, means for testing a calling line and identifying the calling substation before said designation is recorded, means for retesting said line after said designation is recorded, means for preventing the release of said sender if said test and retest do not identify the same substation, decoder markers operated in accordance with registered designations for controlling said switching equipment to extend a calling line to the office in which the wanted line is located, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said modifying means for preventing the registration of a line designation, for transmitting a special designation to one of said decoder markers to cause said decoder marker to extend the calling line to an overflow signal means, and for canceling said retest and releasing said sender.

15. In a telephone system, telephone lines of a plurality of classes, automatic switching equipment, register senders, means in said senders for registering the designation of wanted telephone lines, means for recording the class of a calling line, means operated when a predetermined busy

condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said class recording means for rendering said modifying means ineffective.

16. In a telephone system, telephone lines of a plurality of classes, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, means for recording the class of a calling line, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said class recording means if the calling line is of a particular class for rendering said modifying means ineffective.

17. In a telephone system, telephone lines of a plurality of classes, automatic switching equipment, register senders, means in said senders for registering the designations of wanted telephone lines, means for recording the class of a calling line, means operated when a predetermined busy condition of said control equipment occurs for modifying a percentage of said senders to give special handling to originated calls directed thereto, and means under the control of said class recording means if the calling line is one equipped with a coin box for rendering said modifying means ineffective.

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