

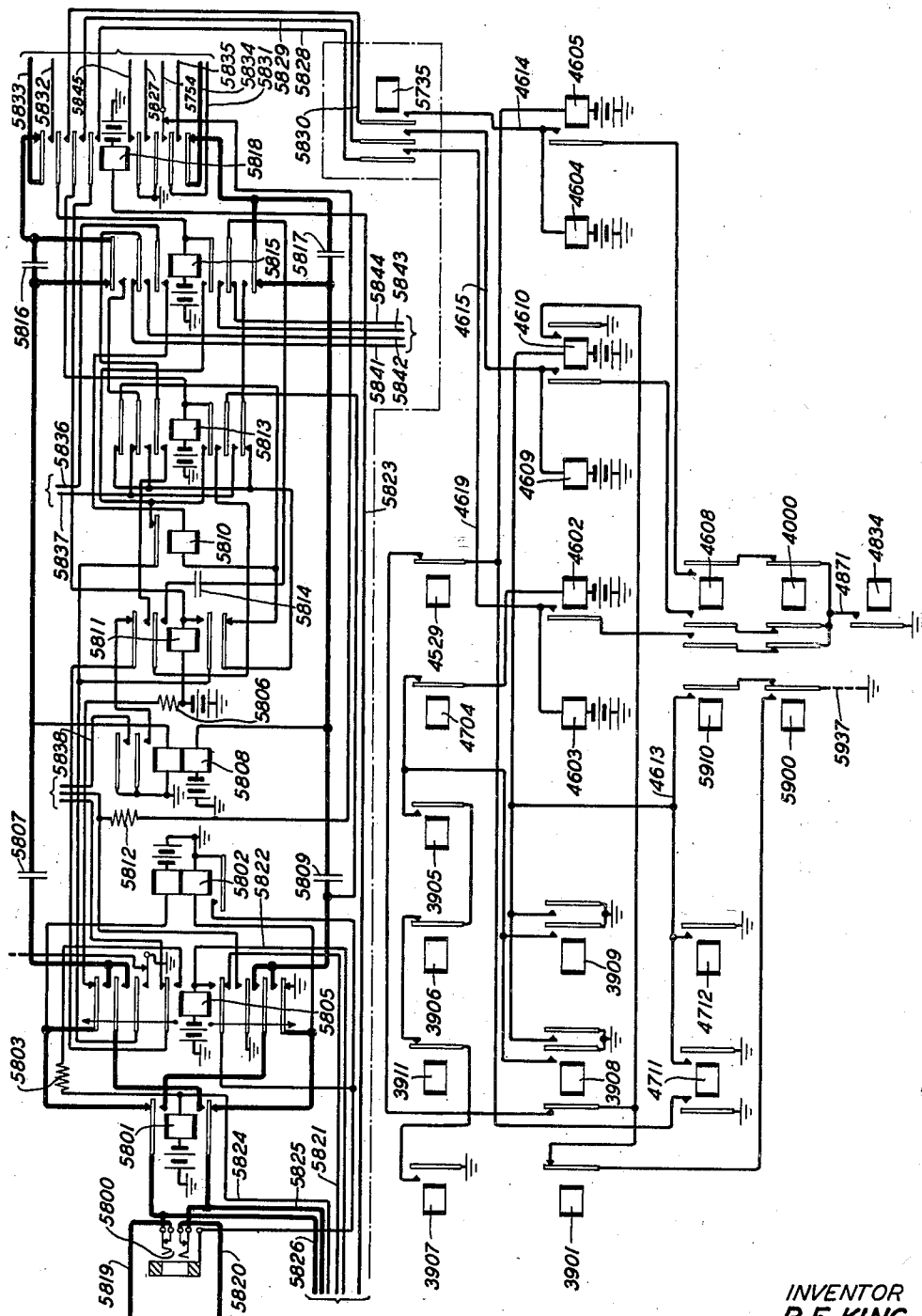
Feb. 1, 1938.

R. E. KING

2,107,154

TELEPHONE SIGNALING SYSTEM

Filed March 11, 1936



INVENTOR
R.E. KING
BY *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE

2,107,154

TELEPHONE SIGNALING SYSTEM

Ralph E. King, East Orange, N. J., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application March 11, 1936, Serial No. 68,254

6 Claims. (Cl. 179—9)

This invention relates to telephone systems and has for its object to simplify the handling of uncompleted calls in cross-bar telephone systems.

In the cross-bar system, the selection and testing of wanted lines and the switches for completing connections thereto is performed by control equipment known as a marker. Heretofore when a called line was busy or no switches were available for completing the connection, the marker extended the calling line to a busy back or overflow trunk which transmitted the proper signal to the calling subscriber.

In accordance with the present invention, the incoming junctor over which the call reaches the terminating equipment at an office is provided with a plurality of relays operated in certain combinations by the marker to control the signaling of the wanted subscriber and the registration of the call and operated in further combination to transmit information regarding uncompleted calls.

More specifically the incoming junctor is provided with a ringing control relay, a reversing relay and a free call relay. The ringing relay when operated alone or in combination with the reversing relay causes the application of ringing current to the called line while the free call relay prevents the registration of a completed call on the calling subscriber's meter. The reversing relay normally merely reverses the connection of the ringing current to the called line so that the subscriber whose ringer is connected to the tip conductor will be signaled. However, when the reversing relay is operated in combination with the free call relay it causes the transmission of a busy line signal to the calling subscriber and when operated in combination with both the ringing relay and the free call relay, it causes the transmission of an all-trunks busy signal to the calling subscriber.

The present invention finds embodiment in a cross-bar system of the type disclosed in the application of W. W. Carpenter, Serial No. 68,262, filed March 11, 1936, now Patent No. 2,089,921, issued August 10, 1937, where the circuits of the marker above referred to are completely disclosed and to which reference is made for a description of the system as a whole. In the drawing which accompanies the following specification, the same reference numerals are employed as in the Carpenter patent in order to facilitate this reference.

The drawing includes a complete showing of a junctor incoming from a dial office, together

with a number of relays from the control circuit or marker. Relay 5735 represents the two relays in the incoming connector which connect the junctor with the marker.

When the junctor is seized at the distant office a bridge is closed across conductors 5819 and 5820, thereby completing a circuit for relay 5802 over the back contacts of relay 5801. Relay 5802 closes a circuit from ground over its front contact, inner lower back contact of relay 5805 to conductor 5821 to initiate the operation of the terminating sender connector, which establishes a connection between the junctor and a terminating sender. When this connection has been established, battery, from the pulsing relay of the sender, and ground are connected to conductors 5819 and 5820 in parallel with the windings of relay 5802, after which the sender operates relay 5801, cutting off relay 5802 during registration.

The number is recorded in the sender and the sender connects with an idle marker as described in the Carpenter patent. When registration is complete relay 5801 is released and relay 5802 reoperated. Conductor 5822 is also grounded at this time, operating relay 5805 which locks under the control of relay 5802.

After the designation has been transferred from the sender to the marker, and the marker has seized the line choice, it establishes a direct connection with the junctor by means of the incoming connector represented by relay 5735 and then grounds conductor 5823 to operate relay 5818 and complete the connection between the junctor and marker.

In the marker, when the incoming connector has been operated, relay 4608 operates over a circuit which tests for the normal condition of the ringing control, and ringing reverse relays, certain number checking relays, the overflow and busy-back relays. This relay prepares three signaling circuits leading toward the incoming junctor. Relay 4834 which operates at the completion of the connection with the junctor supplies the necessary ground for these circuits.

The marker proceeds to test the wanted line, after which it receives an indication of the location and nature of the line. These functions take place as described in the above-identified Carpenter patent.

If the line is idle and an individual line, one of four relays such as relay 5900 is operated to indicate the frame on which the line is located. Ground is connected to conductor 5937 for all calls except number checking calls either

throughout the call in the case of individual or party lines, or as soon as terminal hunting is finished with large groups of private branch exchange lines. Therefore, when relay 5900 operates, it closes a circuit from grounded conductor 5937, front contact of relay 5900, back contact of relay 3901 which is operated on local intercepted calls, left back contact of the busy-back relay 3908, back contact of number checking relay 4529 to the winding of relay 4605. Relay 4605 closes a circuit from ground over the front contact of relay 4834, right back contact of relay 4000, right front contact of relay 4608, front contact of relay 4605 to the winding of relay 4604 and over conductor 4614, inner contact of relay 5735, conductor 5830, third upper contact of relay 5818, winding of ringing control relay 5815.

Relay 5815 locks over the back contact of relay 5810 to ground at the second upper front contact of relay 5805. It opens the shunts around condensers 5816 and 5817 and prepares the ringing circuit from generator ground on conductor 5837, inner upper back contact of relay 5813, outer upper front contact of relay 5815 to the upper back contact of relay 5818 and from the machine ringing source on conductor 5836, over the inner upper front contact of relay 5815, winding of relay 5810, over the lower back contact of relay 5811 or the outer upper and lower back contacts of relay 5813, outer lower front contact of relay 5815 to the outer lower back contact of relay 5818.

The locking ground of relay 5815 extends back over the operating circuit of that relay to the winding of relay 4604 as an indication that the trunk relay has been operated and locked.

When the marker has established and tested the connection between the incoming junctor and the wanted line, it releases relay 5818 which connects ground from the second lower front contact of relay 5805 through resistance 5812 over the normal contacts of relay 5818 to conductor 5754 to hold the switch hold magnets. The release of relay 5818 also completes the ringing circuit. The release of the marker takes place as described in the above-mentioned Carpenter patent.

When the wanted subscriber's station is located on a party line and requires to be rung over the tip conductor, the line choice connector operates one of four relays including relay 5910 to indicate this fact and the location of the line. With relay 5910 operated, ground on conductor 5937 is extended over the back contacts of the relays like relay 5900, front contact of relay 5910 to battery through the winding of relay 4610. Relay 4610 connects ground from the front contact of relay 4834, the inner left back contact of relay 4000, and the inner left front contact of relay 4608 over the left contact of relay 4610 to battery through the winding of relay 4609 and over conductor 4615, middle contact of relay 5735, conductor 5829, second upper contact of relay 5818, winding of relay 5813 and battery. Relay 5813 locks over the back contact of relay 5810 to ground at the second upper front contact of relay 5805, returning the locking ground over conductor 5829 to hold relay 4609.

Relay 4610 also closes a circuit from ground at its right contact, back contact of relay 3908, back contact of relay 4529 to battery through the winding of relay 4605. Relay 4605 causes the operation of relays 5815 and 4604 as above described. With both relays 5813 and 5815 op-

erated, the ringing circuit extends from the ringing source on conductor 5836 over the inner upper front contact of relay 5815, winding of relay 5810, lower back contact of relay 5811, outer upper front contact of relay 5813, outer upper front contact of relay 5815 to the upper back contact of relay 5818, which is closed to the tip conductor 5833 when relay 5818 releases. Generator ground is connected over the outer lower front contacts of relays 5813 and 5815 to the outer lower back contact of relay 5818, where it is extended to ring conductor 5834 when relay 5818 releases.

In either of these cases when the called subscriber answers, relay 5810 operates, opening the locking circuits of relays 5813 and 5815. Relay 5815 recloses the shunts around condensers 5816 and 5817, permitting relay 5808 to operate in series with the called line. Relay 5808 grounds conductor 5838 to provide a supplementary holding circuit as described in the Carpenter patent above referred to. It also closes a circuit from ground over its inner contact, upper back contact of relay 5811, inner upper front contact of relay 5805, resistance 5803 to battery through the winding of relay 5801. Relay 5801 reverses the connection of battery and ground through the windings of relay 5802 to the incoming conductors to transmit a supervisory signal to the originating equipment. If this equipment is provided with call charging apparatus, it will respond to this signal to charge the call.

When a call for a free line is handled, the line choice connector operates relay 3907 in the marker. Relay 3907 closes a circuit from ground at its front contact, over the back contacts of relays 3911 and 3906 which identify manual or toll incoming junctors, over the front contact of relay 3905, which is operated to indicate that the calling junctor is one from a dial office, back contact of number checking relay 4704 to the winding of relay 4602 and battery. Relay 4602 connects ground from conductor 4871 over the outer left contacts of relays 4000 and 4608 to battery through the winding of relay 4603 and over conductor 4619, the outer contact of relay 5735, conductor 5828, inner upper front contact of relay 5818 to the winding of relay 5811 and battery. Relay 5811 locks over its lower front contact to ground at the second upper front contact of relay 5805. For such a call, relay 5900 or one of that group of relays will also be operated, in turn operating relays 4605, 5815 and 4604. Relay 5815 prepares the ringing circuit as before. Free lines are never party lines, and, therefore, relays 4510 and 5813 are never operated for a free call.

With relay 5811 operated, the circuit of relay 5801 is opened and no charging signal is transmitted to the calling office when relay 5808 operates on the response of the called subscriber.

If the wanted line, or the last line of a terminal hunting group, is busy when tested, the busy-back relay 3908 is operated from the line testing relays. Relay 3908 at its outer right contact closes an obvious circuit for relay 4610 and at its inner right contact closes a circuit for relay 4602 over the back contact of relay 4704. At its left contact it opens the circuit by which relay 4610 normally operates relay 4605. Therefore, relays 5811 and 5813 are operated together and lock as described above. Since relay 5815 is not operated, no ringing may take place. Instead, a circuit is closed from a source of low tone on

conductor 5844, over the middle lower back contact of relay 5815, condenser 5814, inner upper front contact of relay 5811, middle lower front contact of relay 5813 over the outer lower front contact of relay 5805, lower back contact of relay 5801, ring contact of jack 5800 to conductor 5820, transmitting a tone signal to the calling subscriber. At the same time ground interrupted at the rate of sixty interruptions per minute is connected over conductor 5841, inner upper back contact of relay 5815, inner upper front contact of relay 5813, outer upper front contact of relay 5811, inner upper front contact of relay 5805, resistance 5803 to the winding of relay 5801 and battery, causing relay 5801 to reverse the line connections at the same rate as an individual line busy signal. These reversals are too short to affect the charging equipment.

After the line has been tested and found idle, if no idle channel can be found so that an "all trunks busy" condition arises, relay 3909 is operated from the channel test relays. Relay 3909 closes circuits for relays 4602 and 4610 and, since relay 3908 is unoperated, relay 4610 also operates relay 4605. Therefore, relays 5811, 5813, and 5815 are all operated. Relay 5815 prepares the ringing circuit at its contacts, but with both relays 5811 and 5813 operated the ringing circuit is opened and ringing does not take place. Under this condition, the tone circuit above traced is transferred from the low tone on conductor 5844 to a high tone on conductor 5843 and the circuit of relay 5801 is transferred from the sixty per minute interrupter to one which operates at one hundred twenty interruptions per minute. Therefore, two distinctive signals of the all trunks busy condition are given to the calling office.

Relays 4711, 4712, 4704, and 4529 are used in connection with a number checking call which employs a different type of junctor. Relays 4704 and 4529 open the normal circuits for relays 4602 and 4605, while a relay not shown opens conductor 5937. Relays 4712 and 4711 close direct circuits for relay 4610 alone or with relay 4605 to signal the failure or success of the number check.

What is claimed is:

1. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a plurality of relays associated with said trunk circuit, means responsive to the operation of one or more of said relays in the successful establishment of a connection to signal the called subscriber's line, an additional relay, and means responsive to the operation of one or more of said plurality of relays in combination with said additional relay, in accordance with different causes of failure to successfully establish a connection to give a discriminating indication to the calling subscriber's line of the cause of said failure.

2. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a ringing relay and a reversing relay associated with said trunk circuit, means controlled by said ringing relay alone or in combination with said

reversing relay to signal the called subscriber's line, a free call relay and means responsive to the operation of said free call relay in combination with said reversing relay alone or with said reversing relay and said ringing relay together to signal the calling subscriber's line.

3. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a control device, a plurality of relays associated with said trunk circuit, means in said control device to operate one or more of said relays in response to the successful establishment of a connection, means under the control of said relays when so operated to signal the called subscriber, an additional relay, means in said control device to operate one or more of said relays in combination with said additional relay responsive to failure to establish a connection and means under the control of said relays and said additional relay to signal the calling subscriber.

4. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a control device, a plurality of relays associated with said trunk circuit, means in said control device to operate one or more of said relays in response to the successful establishment of a connection, means under the control of said relays to signal said called line, an additional relay, means in said control circuit responsive to finding said called line busy to operate said additional relay with one of said plurality of relays and means under the control of said additional relay and said one relay to indicate to the calling line that the called line is busy.

5. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a control device, a plurality of relays associated with said trunk circuit, means in said control device to operate one or more of said relays in response to the successful establishment of a connection, means under the control of said relays to signal said called line, an additional relay, means in said control device effective if no connecting means is available to operate said additional relay and said plurality of relays, and means under the control of said additional relay and said plurality of relays to indicate to the calling line that no connecting means is available.

6. In a telephone system, a trunk circuit, means for establishing connections from a calling subscriber's line to a called subscriber's line, a ringing control relay and a reversing relay, means responsive to the operation of said ringing control relay alone or in combination with said reversing relay, responsive to the successful establishment of connections to signal the called subscriber's line, a free call relay, and means responsive to the operation of said free call relay in combination with said reversing relay alone or with said reversing relay and said ringing relay responsive to a failure to successfully establish connections to transmit a signal to the calling subscriber, indicating the cause of said failure.

RALPH E. KING.