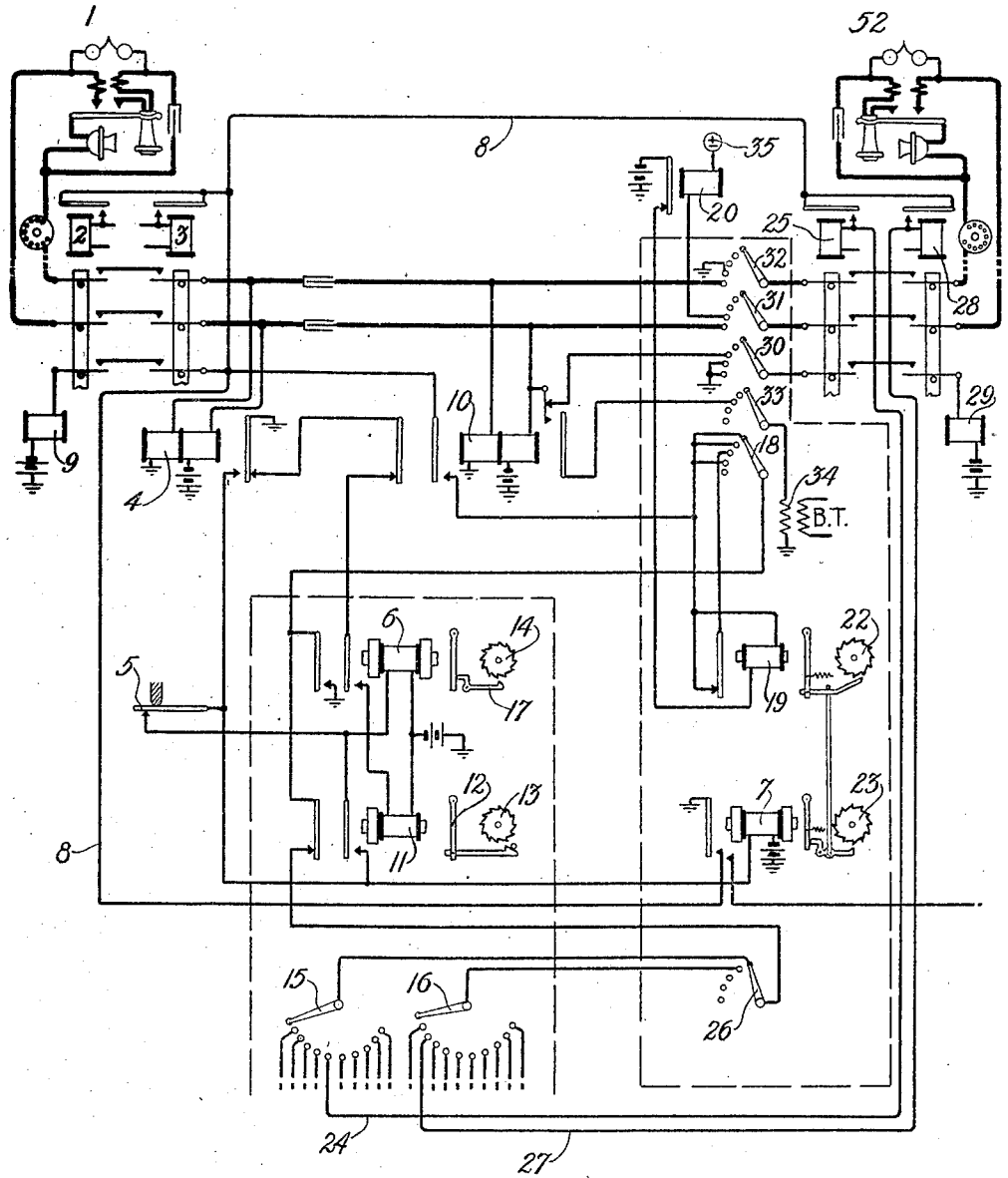
April 14, 1925. 1,533,181

C. L. GOODRUM

TELEPHONE SYSTEM

Filed Sept. 8, 1920



Inventor:
Charles L. Goodrum
by A. C. Skinner. Att'y.

Patented Apr. 14, 1925. 1,533,181

UNITED STATES PATENT OFFICE.

CHARLES L. GOODRUM, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed September 8, 1920. Serial No. 408,973.

To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at New York, State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and particularly to subscriber controlled machine switching systems of the type known as the relay full automatic system.

The object of the invention is to provide a simple and efficient direction switch for marking the path of the call and effecting the interconnection of two subscribers' lines wherein all of the functions required of a modern apparatus of this nature are performed.

A feature of the invention is the use of certain magnets as both propelling and holding magnets and slow acting relays, and placing the control of each in the other whereby the total number of relay and magnet windings is materially reduced.

The invention will be more fully comprehended from the following detailed description of the drawing which is a diagrammatical representation of one form of the invention as applied to a relay full automatic telephone system.

For a complete understanding of such a system, reference may be had to the patent to E. E. Clement, No. 1,107,152, issued August 11, 1914.

In the upper left-hand portion of the drawing is shown a substation 1, which may be connected with a substation 52 shown in the upper right-hand portion of the drawing. Substation 1 may be connected with a connector switch arrangement through the use of two relays as fully disclosed in the Clement patent referred to. Similarly, the connector arrangement may extend the connection through the contacts of another pair of relays to the called substation 52. The connector arrangement herein shown, forms the main body of the drawing. In the lower part of the drawing toward the center, there is a broken line rectangle enclosing two magnets and a pair of wipers. These magnets are the propelling and holding magnets for propelling and holding a shaft on which are secured two wipers 15 and 16. The magnet 11 is provided with a quick acting armature 12 for stepping the shaft through medium of a ratchet wheel 13 on its forward stroke. The magnet 6 is a holding magnet which, upon energizing, allows a holding pawl 17 to drop into the teeth of a ratchet 14 also secured to the wiper shaft. Each of the magnets 6 and 11 is provided with armatures slowly responsive to their denergization through which each magnet has control of the other.

Toward the right is a broken line enclosed space including a side switch arrangement which comprises a stepping magnet 19 and a holding magnet 7. The stepping magnet 19 is provided with a quick acting armature to engage the ratchet wheel 22 on its backward stroke. The magnet 7 is a holding magnet similar in all respects to the holding magnet 6. The ratchet wheels 22 and 23 are secured to a shaft which carries wipers 18, 26, and 30 to 33 inclusive.

When the subscriber at substation 1 removes his receiver from its switch hook, circuits are established for the energization of relays 2 and 3 whereby the calling subscriber's line is extended to the connector switch organization and the line relay 4 is energized. Relay 4 in attracting its armature extends a ground through its front contact to the winding of magnet 7, which, through its left-hand armature and front contact places a holding ground on conductor 8 to the third conductor of the link circuit. This ground is extended to the winding of cut-off relay 9 and to the armatures and contacts of relays 2 and 3 to hold them energized during the call. Ground is also extended from the armature and front contact of relay 4, through the off-normal contact 5, controlled by the shaft carrying wipers 15 and 16, through the winding of magnet 6 to battery and ground. Magnet 6 in becoming energized allows the holding pawl 17 to drop into the ratchet 14. Through its outer left-hand armature, magnet 6 places a ground on side switch wiper 18 in its first position and thence through the winding of magnet 19, the back contact and armature of relay 20 to battery and ground. Magnet 19 becomes energized but does not cause the rotation of the ratchet wheel 22 until it later become de-energized. The connection is now in a stable

condition awaiting the receipt of impulses from the calling subscriber's line.

It will be assumed that the subscriber at substation 1 wishes to communicate with the subscriber at a substation numbered 52, he will, therefore, cause a series of five impulses in the form of five short interruptions of the calling subscriber's line to be sent. Relay 4 in response to the five interruptions will retract its armature five times in quick succession. Upon each retraction of the armature of relay 4, a circuit will be established from ground, armature and back contact of relay 4, outer left-hand armature and back contact of relay 10, inner left-hand armature and front contact of magnet 6, and the winding of magnet 11 to battery and ground. The right-hand armature of magnet 11 will respond to each of these impulses, while the left-hand armatures will respond to the impulses as a whole. Upon the first step of the wipers 15 and 16 the off-normal contact 5 will be opened but a substitute circuit for the energization of magnet 6 will be intermittently closed through the front contact and inner left-hand armature of magnet 11. At the end of this series of impulses, wiper 15 will be moved to its fifth contact connected, in this case, to conductor 24. After a short interval, magnet 11 will retract its left-hand armatures thereby opening the circuit for magnet 6. The armatures of magnet 6 are slow to release and before they release a circuit will be established from ground, front contact and outer left-hand armature of magnet 6, outer left-hand armature and back contact of magnet 11, wiper 26 in its first position, wiper 15, conductor 24, winding of relay 25 and thence to a battery connection (not shown). Relay 25 attracts its armatures and locks to the ground on conductor 8. In a short interval magnet 6 will retract its armatures whereupon the circuit for magnet 19 will be opened and it will become deenergized thereby engaging the ratchet wheel 22 and moving the wipers controlled thereby into their second positions. Holding pawl 17 will be withdrawn from the teeth of the ratchet 14 and the wipers 15 and 16 restored to normal whereupon the off-normal contact 5 will be closed. Upon the closure of off-normal contact 5, an ordinary energizing circuit for magnet 6 will be established and magnet 6 will again become energized causing, in turn, the energization of magnet 19. The connection is again in a stable position awaiting the receipt of a further series of impulses.

In accordance with our assumption, the subscriber at substation 1 will now cause a series of two impulses to be sent whereupon the wipers 15 and 16 will be stepped to their second positions in the manner heretofore described. Shortly after this series of impulses, magnet 11 will retract its left-hand armatures and a ground will be extended from the wiper 26, the wiper 16, to conductor 27 and thence through the winding of relay 28 to a battery connection (not shown). Relay 28 will attract its armatures and lock up to the ground on conductor 8. A short interval thereafter, magnet 6 will become deenergized, in turn causing the deenergization of magnet 19 whereupon the side switch wipers are stepped to their third position contacts. The pawl 17 is withdrawn from the ratchet 14 and the wipers 15 and 16 and the off-normal contact 5 are returned to their normal positions. Magnet 6 is again energized whereupon magnet 19 is again energized, this time, however, through its own left-hand armature and back contact.

Assuming in the first place that the called line 52 is busy, a ground will be found on the third or test conductor leading to the winding of cut-off relay 29. This ground will be extended through the side switch wiper 30, the normal contacts of the right-hand armature of relay 10, the right-hand winding of relay 10 to battery and ground, whereupon relay 10 will become energized and the ground will be extended from conductor 8 through the inner left-hand armature and front contact of relay 10 to the winding of magnet 19, to hold this magnet energized and prevent the movement of the side switch wipers into their fourth position. Relay 10 locks up through its right-hand armature and alternate contact, the third position of side switch wiper 33, the winding of busy tone transformer 34 to ground. Busy tone is thereupon supplied to the right-hand winding of relay 10 and by induction is transmitted to the substation 1. The subscriber at substation 1 recognizing the busy tone hangs up his receiver and relay 4 retracts its armature whereupon the magnet 7 becomes deenergized and retracts its holding pawl from the ratchet wheel 23 thereby returning its associated side switch wipers to their normal position. Magnet 7 removes the ground from the third conductor 8 whereupon the relays locked up thereto become deenergized and the connection, as a whole, will be restored to normal.

If we assume that the called substation 52 is idle, then no ground will be found on the third conductor and relay 10 will not become energized. Magnet 19 therefore, upon energizing, will break its own circuit at its left-hand armature and on its back stroke will move the side switch wipers into their fourth position whereupon ringing current will be transmitted from the source of ringing current 35 through the winding of relay 20, the side switch wiper 31, over the loop of the called subscriber, side switch wiper 32 on its fourth position contact to ground. Current traveling over

this circuit is insufficient to cause the energization of relay 20 until the subscriber at substation 52 in answer to the summons of his bell, removes his receiver from its switch hook, thereupon relay 20 becomes energized and in attracting its armature breaks the circuit of magnet 19 whereupon the side switch wipers are moved into their last positions. In this position, the connection between substation 1 and substation 52 is completed. Talking battery is supplied to the calling line through the windings of relay 4 and to the called line through the windings of relay 10, both of which relays are energized during the continuance of the conversation. At the end of the conversation, the subscriber at substation 1 replaces his receiver on his switch hook, thereby causing the deenergization of magnet 7. Magnet 7 in retracting its armatures restores the side switch wipers to their normal positions and removes the ground from the holding conductor 8 whereby the connection is restored to normal.

What is claimed is:

1. In a telephone system, a direction switch for marking the path of a call, comprising a set of conductors arranged in one principal direction, a set of conductors arranged in a second principal direction, means for electrically distinguishing a conductor in each set, said means including a pair of wipers, propelling means for said wipers, holding means for said wipers, and circuits for said propelling means and said holding means mutually and directly controlled thereby.

2. The combination with a stepping magnet and a holding magnet, of an armature controlled by said stepping magnet quickly responsive to the energization and deenergization of said magnet, an armature controlled by said stepping magnet slowly responsive to the deenergization thereof for controlling said holding magnet, and an armature controlled by said holding magnet slowly responsive to the deenergization of said magnet for controlling said stepping magnet.

3. In a telephone system, a direction switch for marking the path of a call, comprising a wiper, propelling means for said wiper, holding means for said wiper, a circuit for said holding means controlled by said propelling means, and a circuit for said propelling means controlled directly by said holding means.

4. In a telephone system, a direction switch for marking the path of a call, comprising a wiper, a propelling magnet for said wiper, a holding magnet for said wiper, an armature on said propelling magnet for directly controlling said holding magnet, and an armature on said holding magnet for directly controlling said propelling magnet.

5. In a telephone system, a direction switch for marking the path of a call, comprising a wiper, a propelling magnet for said wiper, a holding magnet for said wiper, an armature on said propelling magnet slowly responsive to the deenergization thereof for controlling said holding magnet, and an armature on said holding magnet slowly responsive to the deenergization thereof for controlling said propelling magnet.

6. In a telephone system, a direction switch for marking the path of a call, comprising a wiper, a propelling magnet for said wiper, a holding magnet for said wiper, a quick acting armature on said propelling magnet for moving said wiper, a slow acting armature on said propelling magnet for controlling said holding magnet, a slow acting armature on said holding magnet for holding said wiper, and a slow acting armature on said holding magnet for controlling said propelling magnet.

In witness whereof, I hereunto subscribe my name this 28th day of August A. D., 1920.

CHARLES L. GOODRUM.