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TELEPHONE SYSTEM

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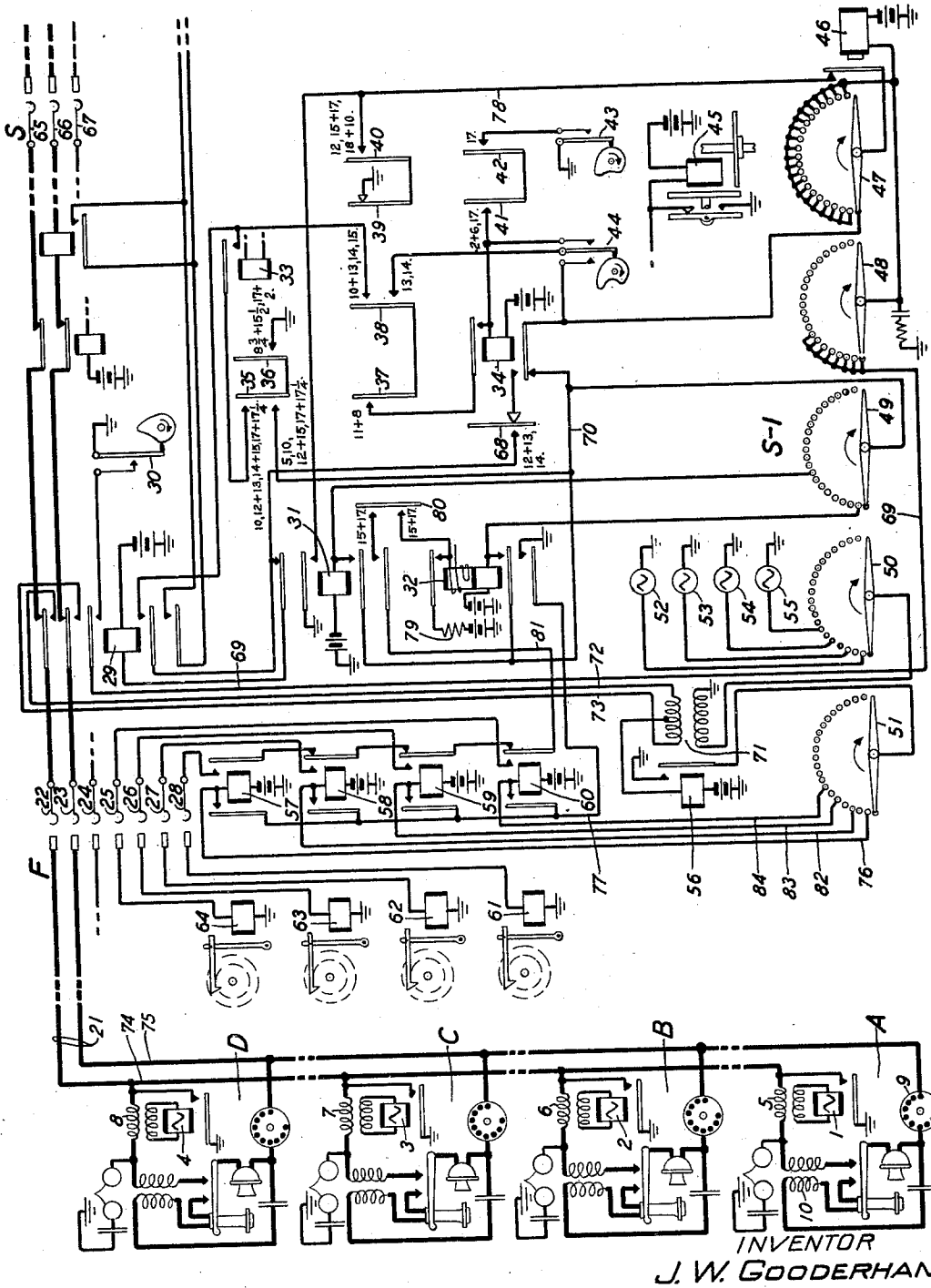

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to the identification of the calling station on a party line.

The objects are to enable the performance of a speedy and reliable test of a party line to ascertain the calling substation, to enable this test without encumbering the line with ground or other interfering connections during conversation, and to otherwise improve systems of this character.

According to this invention, each of the substations on a four-party line is equipped with an alternating current relay selectively responsive to current of a particular frequency. The central office is provided with four sources of alternating current, each of a frequency corresponding to one of the substation relays, together with means for applying these sources in succession to the line to make the identifying test. When the source corresponding to the relay at the calling station is applied, sufficient current flows to operate the relay at the substation which in turn applies a direct ground potential to the line causing the operation of a test relay at the central office, which results in the identification of the called station and the subsequent operation of the message register individual to that station.

The invention is illustrated in the accompanying drawing, which shows a party line terminating in a line finder switch together with means at the central office for performing the identification tests and for selectively operating the message registers.

The subscriber's line 21 has four substations A, B, C and D. These stations are equipped respectively with alternating current responsive relays 1, 2, 3 and 4. These relays are inductively connected to the line by means of the transformers 5, 6, 7 and 8 respectively. Each relay attracts its armature in response to alternating current of a particular frequency, which differs from the frequency to which any of the other relays is responsive. At the central office the line terminates in the bank of a line finder switch F, which is diagrammatically illustrated by the brushes 22 to 28 inclusive. The line finder F is directly connected to a selector switch S having the brushes 65, 66 and 67, which is also illustrated in part diagrammatically. The selector switch S has access to succeeding selectors (not shown).

The line finder and selector disclosed in this system may be of the panel type similar to the one described in the patent to Craft et al., No. 1,123,696, granted January 5, 1915. The control and operating circuits for a selector switch of this character are shown and described in detail in the patent to Kopp No. 1,589,402, granted June 27, 1926, and also shown in the patent to Stern et al., No. 1,395,977, granted November 1, 1921.

The stations A, B, C and D are provided at the central office with individual message registers 62, 62, 63 and 64, which are selectively operated to assess calls against the corresponding stations on the line. The registers are selected as the result of an identification test performed at some convenient time after the subscriber initiates the call. The test is made by means of the alternating current sources 52, 53, 54 and 55, each of a different frequency, and the results of this test are recorded on the relays 57, 58, 59 and 60.

A detailed description will now be given, and it will be assumed for this purpose that the subscriber at station A initiates a call. In response to the initiation of the call, the line finder F operates to seize the calling line 21. Thereupon, the subscriber manipulates his impulse transmitter 9 to set up the called designation in a register sender (not shown) at the central office. The register sender proceeds to control the selector switch S and succeeding switches to extend the connection to the called subscriber's line as is fully described in the above-mentioned patents to Kopp and to Stern et al.

When the called party answers, the direction of current flow over the trunk with whose terminals the brushes 65, 66 and 67 of the selector S are in contact, is reversed, thereby causing the operation of the polarized supervisory relay 33. At this time the sequence switch 45 has advanced to some position such as position 13, in which it remains during conversation. As soon after the relay 33 operates as the interrupter 44 closes its right

contacts, a circuit is completed from battery through the winding of relay 34, right contacts of said interrupter, contacts of sequence switch spring 38, contact of relay 33, upper contact of sequence switch spring 38, contact of relay 33, upper contact of sequence switch spring 35, to ground at the contact of sequence switch spring 36. Relay 34 operates and locks through its upper contact, contact of sequence switch spring 37, thence as above traced to ground at sequence switch spring 36. As soon after relay 34 has operated as the interrupter 44 closes its left contacts, a circuit is completed from battery through the winding of relay 29, uppermost contact of relay 31, contacts of sequence switch spring 68, lower front contact of relay 34, left contacts of interrupter 44, thence as above traced to ground at sequence switch spring 36. Relay 29 operates and locks in a circuit from battery through its winding, uppermost contact of relay 31, inner lower contact of relay 29 and contact of relay 33 to ground at sequence switch spring 36.

The brushes 47 to 51 inclusive of the stepping switch S—1 are now advanced by the alternate operation and release of the stepping magnet 46 to control the testing of the line 21. With the brushes in any one of positions 1 to 8 inclusive, position 1 being the normal position, a circuit is closed, after relay 29 is operated, through the winding of the magnet 46 each time the continuously driven interrupter 30 closes its contacts. This circuit may be traced from battery through the winding of the magnet, brush 48, positions 1 to 8, conductor 69, inner upper contact of relay 29 to ground at the contacts of the interrupter 30. The release of the magnet 46 each time the circuit is opened causes the advance of the brushes one step. After the brushes are advanced beyond position 8, the magnet 46 is no longer under the control of the interrupter 30.

With the stepping switch S—1 in position 2, a circuit is closed from battery through the lower winding of relay 32, brush 49, conductor 70 to ground through sequence switch springs 35 and 36. Relay 32 operates and locks through its lower winding and inner lower contact to the grounded conductor 70. Relay 32 prepares a circuit for operating the calling subscriber's message register after conversation has been completed.

With the stepping switch in position 2, another circuit is closed from the grounded source of alternating current 52 through the brush 50, primary winding of the transformer 71 to ground. The secondary winding of the transformer 71 is connected through conductors 72 and 73 to the subscriber's line 21. The circuit over the subscriber's line may be traced from the right-hand terminal of the secondary winding of said transformer over conductor 72, uppermost front contact of relay 29, brush 22, thence over the tip conductor 74 of said line through the primary winding of transformer 5, through the primary winding of the induction coil 10, through the switchhook contacts, talking transmitter, impulse transmitter 9 and returning over the ring conductor 75, brush 23, upper middle front contact of relay 29, conductor 73, to the left-hand terminal of the secondary winding of transformer 71. Current flowing from the source 52 through the primary winding of transformer 71 induces current of the same frequency in the secondary winding and this current flows over the subscriber's line and through the transformer 5. It will be assumed that the frequency of source 52 is such as to cause the operation of relay 1 at the calling substation A. Relay 1 operates and completes a circuit from ground through its armature and contact over the tip conductor 74, thence as above traced to conductor 72, through a portion of the secondary winding of transformer 71 through the winding of relay 56 to battery. A parallel circuit is completed from the grounded armature of relay 1 through the transformer 5 and induction coil 10, switchhook contact, talking transmitter and impulse transmitter 9 over the ring conductor 75, thence to conductor 73 and through the other portion of the secondary winding of transformer 71 and the winding of relay 56 to battery. Relay 56 operates in this circuit and closes a circuit from ground through its armature and contact, brush 51 in position 2, conductor 76, winding of the register relay 57 to battery. Relay 57 operates and locks in a circuit from battery through its winding and left contact, conductor 77, to ground at the lower contact of relay 32.

The stepping switch S—1 continues its advance through positions 3, 4, 5, 6, 7 and 8 and in so doing applies the sources 53, 54 and 55 in succession to the transformer 71. However, this is without effect since the relay 1 responds only to the source 52 and since only the substation A is calling.

When the stepping switch S—1 reaches position 9, a circuit is closed from battery through the winding of relay 31, brush 49, to the grounded conductor 70. Relay 31 operates and locks to conductor 70. Relay 31 at its uppermost contact opens the circuit of relay 29, and this relay releases. Relay 31 in operating connects ground potential through its inner upper contact over conductor 78, contact and armature of magnet 46, brush 47, winding of magnet 46 to battery. The magnet 46 operates and opens its own circuit and advances the brushes to position 10. Since the terminals with which the brush 47 is associated are connected together the switch continues to advance until it has reached its normal position 1. The appa-

ratus remains in this position during conversation.

When the called subscriber replaces his receiver on the switchhook, relay 33 releases, and sequence switch 45 is advanced from the talking position to some subsequent position, such as position 17, to cause the operation of the message register of the calling party. The release of relay 33 opens the holding circuit of relay 34, and the latter relay releases. Relays 31 and 32 are now held in a circuit though their windings and locking contacts, conductor 70, back contact of relay 34, brush 47, position 1, armature and contact of the magnet 46, conductor 78, through the inner upper contact of relay 31 to ground. While the sequence switch 45 is advancing from position 15 to position 17, a metering circuit is closed from battery through the resistance 79, upper contact of relay 32, contacts of sequence switch spring 80, lowermost contact of relay 31, conductor 81, right-hand armatures and back contacts of relays 60, 59 and 58 in series, right armature and front contact of relay 57, brush 28, through the winding of message register 61 to ground. The register 61 operates and charges the call against substation A.

When the sequence switch reaches position 17 and as soon thereafter as interrupter 43 closes its contacts, a circuit is completed from battery, through winding of relay 34, contacts of sequence switch springs 41 and 42 to ground at the contacts of interrupter 43. Relay 34 operates and opens the holding circuit of relays 31 and 32. Relay 34 may be held energized in the manner shown in detail in the above-mentioned patent to Kopp to permit the release of relays 31 and 32 as the sequence switch 45 advances to subsequent positions. The release of relay 32 opens the holding circuit of relay 57. From this point, the release of the line finder and selector switches takes place in any well-known manner, such as explained in the above mentioned patents to Kopp and to Stern et al.

Assume next that the call is initiated at substation B. In this case the relay 56 does not operate when the stepping switch moves into position 2 since current induced by the source 52 does not cause the operation of relay 2 at the calling substation. In position 4 of the stepping switch however, current from the source 53 is connected to the transformer 71, and the induced current in line 21 is of the proper frequency to operate the relay 2 at substation B. Relay 2 applies ground potential to the tip and ring conductors of the line 21 in the manner already explained in connection with substation A, and relay 56 operates. Relay 56 applies ground potential over brush 51, conductor 82, winding of relay 58 to battery. Relay 58 operates and locks through its left contact to the grounded conductor 77. The switch S—1 continues to step, and sources 54 and 55 are connected to the transformer 71, but nothing further happens since these sources are not of the proper frequency to operate relay 2. At the end of conversation when the sequence switch 45 is passing from position 15 to position 17, the metering circuit is completed from battery through the resistance 79, thence as traced over conductor 81, right back contacts of relays 60 and 59, right front contact of relay 58, brush 27, winding of message register 62 to ground. The register 62 operates and charges the call to substation B.

Assume next that the call is initiated by substation C. In this case nothing happens when the sources 52 and 53 are connected to the transformer 71. However, when the stepping switch S—1 reaches position 6, source 54 is connected to the transformer 71, and the current induced in the line 21 is of the proper frequency to operate relay 3 at the calling substation C. Relay 3 causes the operation of relay 56 as explained, and relay 56 completes a circuit over brush 51, conductor 83, winding of relay 59 to battery. Relay 59 operates and locks through its left contact to the grounded conductor 77. Subsequently, when the sequence switch 45 is moving from position 15 to position 17, the metering circuit is completed over conductor 81, right back contact of relay 60, right front contact of relay 59, brush 29, winding of message register 63 to ground. The register 63 operates and charges the call to substation C.

Assume finally that the call is initiated at substation D. In this instance, the stepping switch first applies the sources 52, 53 and 54 without effect. As the switch reaches position 8, source 55 is connected to the transformer 71, and the current induced in the line 21 is of the proper frequency to cause the operation of relay 4 at substation D. Relay 4 applies ground potential to the line to cause the operation of line 56. Relay 56 closes a circuit from ground over brush 51, conductor 84, through the winding of relay 60 to battery. Relay 60 operates and locks to the grounded conductor 77. As the sequence switch 45 passes from position 15 to position 17, the metering circuit is completed over conductor 81 to the right front contact of relay 60, brush 25, winding of register 64 to ground. Register 64 operates and charges the call to substation D.

While the invention has been illustrated in connection with a particular type of system, it is to be understood that it is not so limited but may be embodied in various kinds of systems.

What is claimed is:

1. In a telephone system a line having a plurality of stations thereon, relays, one at each station, said relays being responsive each to current of a different frequency,

means for applying to said line currents of different frequencies, and means controlled by the operation of said relays for identifying said stations.

2. In a telephone system a line having a plurality or stations thereon, relays, one at each station, said relays being responsive each to alternating current of a different frequency, a plurality of sources of alternating current, each of a different frequency, means for connecting said sources to said line, and means controlled by the operation of said relays for identifying said stations.

3. The combination in a telephone system of a line having a plurality of substations thereon, relays, one at each of said stations, said relays being responsive each to alternating current of a different frequency, a plurality of sources of alternating current, each of a frequency corresponding to one of said relays, means for successively applying said sources to said line in a definite order, and means responsive to the operation of any one of said relays for identifying the corresponding substation.

4. The combination in a telephone system of a line having a plurality of substations thereon, relays, one at each of said substations, said relays being responsive each to current of a different frequency, a plurality of sources of alternating current, each of a frequency corresponding to one of said relays, a test circuit, means controlled by the subscriber for including the relay of the calling substation in said test circuit, means for connecting said sources of current to said test circuit, and means responsive to the operation of one of said relays in the test circuit for identifying the corresponding substation.

5. In a telephone system a subscriber's line having a plurality of substations thereon, relays, one at each of said stations, said relays being responsive each to alternating current of a different frequency, message registers, one for each of said substations, a plurality of sources of alternating current, each of a frequency corresponding to one of said relays, means for applying said sources to the line in succession, means controlled by said relays for identifying the calling substation, and means controlled by the identifying means for selectively operating the message register individual to the calling substation.

6. In a telephone system, a line having a number of stations thereon, relays, one at each of said stations, said relays being responsive each to current of a different frequency, a number of sources of current, each of a different frequency, means for connecting said sources to the line to selectively operate the relay at the calling station, said relays in operating serving to apply potential to said line, and means responsive to the application of potentials by said relays to said line for identifying said stations.

7. In a telephone system, a line having a plurality of stations thereon, relays, one at each station, said relays being responsive each to current of a different frequency, a test circuit including the conductors of said line, means under the control of a calling subscriber for closing the test circuit to render effective the relay at the calling substation, means for selectively operating said relays, circuits closed by said relays in operating for applying ground potential to said test circuit, and means responsive to the application of ground potential to said test circuit for identifying said stations.

8. The combination in a telephone system of a line having a plurality of substations thereon, relays, one at each of said stations, said relays being responsive each to alternating current of a different frequency, a plurality of sources of alternating current, each of a frequency corresponding to one of said relays, means including a step-by-step switch for successively applying said sources to said line in a definite order, and means responsive to the operation of any one of said relays for identifying the corresponding substation.

In witness whereof, I hereunto subscribe my name this 4th day of June, 1930.

JOHN W. GOODERHAM