

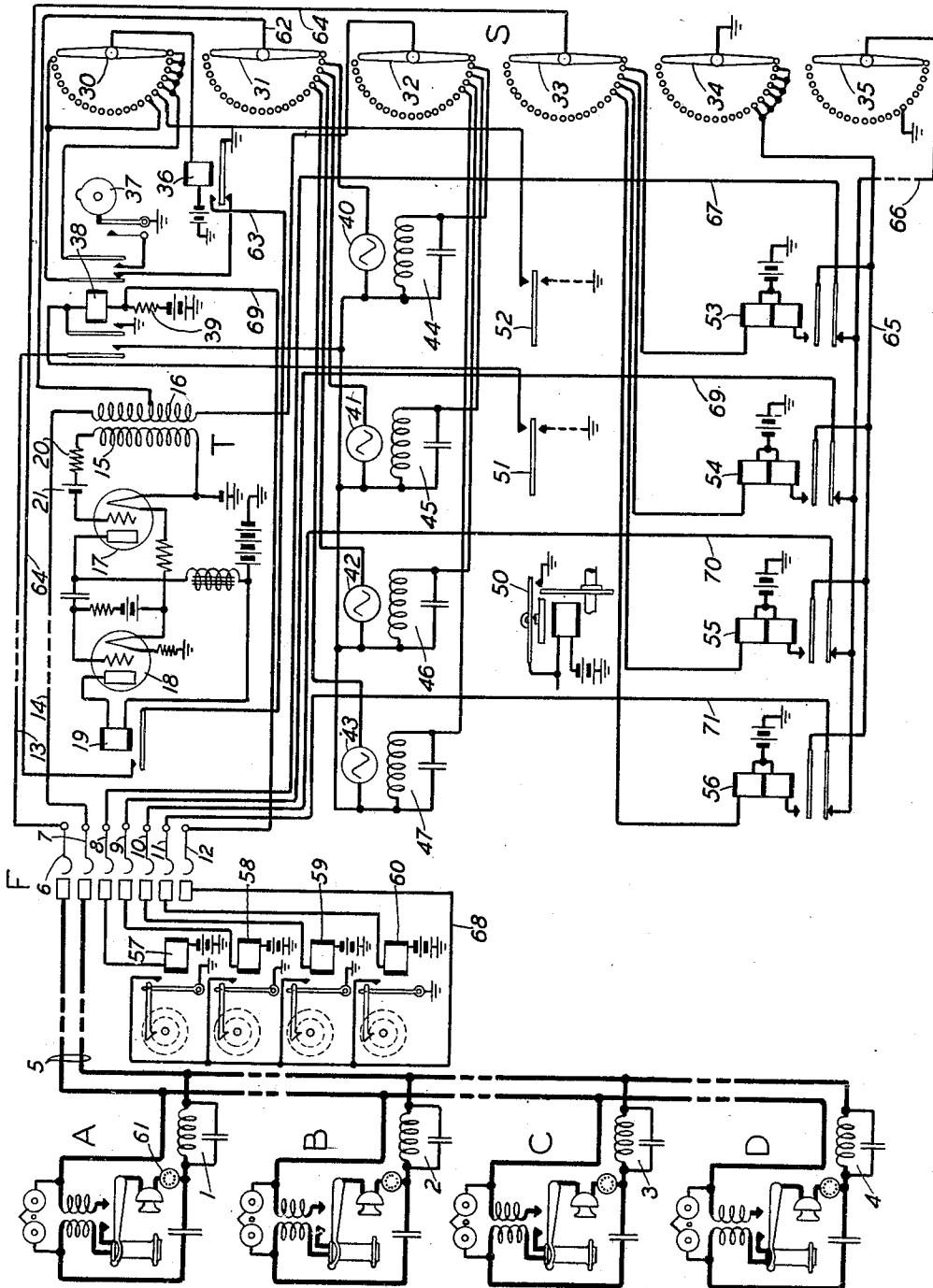
May 10, 1932.

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1,857,827

TELEPHONE SYSTEM

Filed Oct. 4, 1930



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TELEPHONE SYSTEM

Application filed October 4, 1930. Serial No. 486,377.

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

The objects are to secure a positive and reliable test of a party line to identify the calling station, to enable the performance of such a test without the use of connections which interfere with signaling or conversation, to simplify the equipment, and to otherwise improve systems of this character.

According to this invention, each substation on a party line is equipped with an impedance or network, which differs from that at each of the other stations on the same line, and the central office is provided with a series of balancing networks, one for each of the substations. The central office is also equipped with a number of sources of alternating current each of a different frequency. The networks and frequencies are so selected that, when a current of a given frequency is applied to the line, the network at a given calling station is balanced by the corresponding network at the central office such that no current flows in the operating circuit. By applying all sources in succession, each substation may be tested, and the calling station will be identified due to the fact that a balanced condition between the networks is secured and no operating current flows, whereas for each of the non-calling stations an unbalanced condition exists and current flows.

An advantage of this invention is that the identification of the calling party is made possible without the use of complicated and expensive equipment at the substations and without the necessity of ground connections that interfere with the quality of transmission during conversation.

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 5 has four substations, A, B, C and D. These stations are equipped respectively with networks 1, 2, 3 and 4, each network consisting of a reactance coil and a condenser.

At the central office, the subscriber's line 5 terminates in the contact bank of the line finder switch F. The finder F serves to extend the line when calling to a first selector switch which, together with other selectors, responds to impulses transmitted from the substation to complete the connection to the desired line. The selector switches are not disclosed in the drawing, and the finder F is only partially illustrated. These switches may be of any suitable type such as the panel switch described in the patent to Craft et al. 1,123,696, granted January 5, 1915. The control and operating circuits for switches of this character are shown and described in detail in the patent to Kopp 1,589,402, granted June 22, 1926, and also in the patent to Stearn et al. 1,395,977, granted November 1, 1921.

The central office is provided with four sources of alternating current 40, 41, 42 and 43, each of a different frequency from the others. Associated with these four sources of current are the balancing networks 44, 45, 46 and 47. The circuits are so arranged that each of the several sources of alternating current and its associated network are connected across a portion of the transformer T, while the remaining portion of the transformer is connected to the party line 5. The networks at the substations, the balancing networks at the central office, and the sources of alternating current are so selected that when a particular source is connected to the line a balanced condition prevails in the transformer T, provided a particular substation is in a calling condition, whereas if some other substation is calling an unbalanced condition occurs. The secondary winding 15 of the transformer T is connected to an amplifier 17, which in turn is connected

to a detector 18 for the purpose of taking a record of the balanced and unbalanced conditions of the line as a result of the test. The amplifier 17 and the detector 18 may consist of ordinary three-electrode thermionic discharge devices.

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 5. Thereupon the subscriber manipulates his impulse transmitter 61 to set up the called designation in a register sender (not shown) at the central office. The register sender proceeds to control the selector switches to extend the connection to the called line as is fully described in the above-mentioned patents to Kopp and Stearn et al. At some convenient time in the establishment of the connections, such as when the called subscriber answers, a circuit is completed for the relay 38. This circuit may be traced from battery through the resistance 39, winding of the relay, thence through contacts of sequence switch spring 51 to ground. The spring 51, which is controlled by the sequence-switch magnet 50, will have been driven into some advanced position in the manner set forth in the above-noted patents to Kopp and Stearn et al. Relay 38 operates and locks through its inner left contact to ground. When the constantly driven interrupter 37 again closes its contacts following the operation of relay 38, an operating circuit is completed for the stepping switch S, which advances from position to position under control of the stepping magnet 36 to perform the successive tests of the party line 5. This operating circuit may be traced from battery through the winding of magnet 36, brush 30, in position 1 of the switch S, outer right contact of relay 38 to ground through the contacts of the interrupter 37. The magnet 36 energizes, and, when the interrupter opens its contacts, the magnet deenergizes to advance the brushes 30 to 35 inclusive to the second-position terminals.

In position 2 of the control switch S, the source 40 and balancing network 44 are associated with the transformer T and with the line 5 to test the substation A. The circuit from source 40 may be traced from the right-hand terminal thereof, brush 31, conductor 62, through the upper half of the primary winding 16 of the transformer T, thence over conductor 14, brush 7, over the ring side of the line 5 through the network 1 and through the switchhook contacts and returning over the tip conductor brush 6, conductor 13, outer left contact of relay 38, to the opposite terminal of the source 40. At the same time, the source 40 is connected through the balancing network 44 and the lower half of the transformer winding 16. This circuit

may be traced from the right-hand terminal of source 40, brush 31, conductor 62, through the lower half of winding 16, brush 32, through the network 44 to the left-hand terminal of the source 40. Since, as assumed, the station A is calling, current flows over these two circuits through both sections of the transformer winding 16, and since the network 44 balances the network 1, the potentials in the winding 16 neutralize each other so that no potential exists across the secondary winding 15 of the transformer T. The secondary winding 15 of the transformer T is connected through the resistance 20 and battery 21 to the grid or control element of the amplifier 17. Since no change occurs on the control element no corresponding change results in the plate circuit of the amplifier 17, and consequently no change occurs in the plate circuit of the detector 18 and the relay 19 remains inert.

On the next closure and opening of interrupter 37, the switch S advances to position 3, and the next source 41 and the balancing network 45 are similarly connected to the transformer T and the line 5. In this case the network 45 does not match the network 1 at the calling station A with the result that a potential is impressed on the control electrode of the amplifier 17 resulting in the flow of current in the plate circuit. This flow of current in the plate circuit of the amplifier 17 causes a change in the potential of the control element of the detector 18, which in turn causes a flow of current in the output circuit of the detector including the relay 19. Relay 19 responds to this flow of current and closes its contact.

On the next closure of the interrupter 37, the magnet 36 operates preparatory to advancing the brushes of the switch S to the fourth position. The magnet by operating completes a circuit from ground through its front contact, conductor 63, contact of relay 19, conductor 64, brush 33 (position 3) upper winding of relay 54 to battery. Relay 54 operates and locks through its lower winding and contact, conductor 65, brush 34 to ground. When the interrupter 37 again opens its contacts, the magnet 36 releases to advance the brushes of switch S into position 4 and also opens the energizing circuit of relay 54. The source 41 is now disconnected from the line, and from the transformer T. In position 4 the source 42 and network 46 are rendered effective, and, since an unbalanced condition again occurs, relay 19 operates, provided it had time to release following the disconnection of source 41.

On the next closure of interrupter 37, magnet 36 operates preparatory to advancing the switch into position 5 and also closes a circuit over conductor 63 through the contact of relay 19, conductor 64, brush 33, (position 4) upper winding of relay 55 to battery. Relay

55 operates and locks through its lower winding to the grounded conductor 65. When the interrupter 37 opens its contacts, the switch advances into position 5, and source 42 is disconnected.

In position 5, the last source 43 and the associated network 47 are connected to the transformer and to the line, and, since an unbalanced condition occurs, the relay 19 is operated. Upon the next closure of the interrupter 37, the magnet 36 energizes, and a circuit is completed through the contact of the magnet and the relay 19 over conductor 64, brush 33 in position 5, through the upper winding of relay 56 to battery. Relay 56 operates and locks through its lower winding to the grounded conductor 65. When the interrupter 37 opens its contacts, the switch S advances into position 6, and the source 43 is disconnected.

At the end of conversation, the sequence switch 50 is driven into some advanced position, and a circuit is completed from ground through the contacts of spring 52, brush 30 in position 6, winding of stepping magnet 36 to battery. As soon as this circuit is again opened, magnet 36 advances the brushes of the switch S into position 7 where registration takes place. The circuit for operating the register may be traced from ground to the brush 35, conductor 66 through the lower back contact of relay 53, conductor 67, brush 8, through winding of message register 57 to battery. The register 57 operates and charges the call against the calling substation A. When the register 57 fully operates it closes a circuit from ground through its armature and contact, conductor 68, brush 12, conductor 69 through the resistance 39 to battery. This shunts the relay 38 which releases. Upon the release of relay 38, a circuit is completed from ground through the back contact of magnet 36, inner back contact of relay 38, brush 30 in position 7, through the winding of magnet 36 to battery. Magnet 36 interrupts its own circuit and advances the brushes of the switch S into position 8, which may be the next normal position of the switch. By multiplying the conductors appearing in the banks of the switch in an obvious manner the switch may perform its second cycle of operations starting from position 8.

When the switch S moves out of position 7, ground is disconnected from conductor 65, and relays 54, 55 and 56 release. At the end of conversation the connection is released in the well-known manner.

Should a call be initiated at the substation B, a similar series of tests are performed. In this case relays 53, 55 and 56 operate, whereas relay 54 remains inert due to the fact that the network 45 balances the network 2 at the substation B. With relay 54 inert, the metering circuit may be traced over conductor 66 through the lower back contact of re-

lay 54, conductor 69, brush 9, through the winding of register 58 to battery. Thus, the call is charged to the substation B.

When the substation C initiates a call, the test results in the operation of relays 53, 54 and 56 whereas relay 55 remains inert. In this case the metering circuit extends over conductor 66 through the lower contact of relay 55, conductor 70, brush 10 through the winding of register 59 to battery.

Finally, when the substation D initiates a call, the test results in the operation of relays 53, 54 and 55 while relay 56 remains deenergized. With relay 56 deenergized the metering circuit is closed over conductors 66 and 71 through the brush 11 and the winding of the register 60.

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. For example, the invention may be incorporated in a system employing switches of the step-by-step type or in systems in which connections are partially completed by switches and partially completed by operators.

What is claimed is:

1. In combination, a line having a number of stations thereon, impedance elements of different values, one at each station, a plurality of sources of current of different characteristics, other impedance elements, and means for connecting said sources of current to said line and to said other impedance elements to identify the stations on said line.
2. The combination in a telephone system of a line having a number of stations thereon, impedance elements of given values, one at each station, a plurality of sources of current, each of a different frequency, a plurality of other impedance elements, each arranged to match the impedance element at one of said stations when a source of current of a given frequency is applied to the line, and means for successively connecting said sources in operative relation to said line and to said other impedance elements to identify the stations on said line.
3. In combination, a line having a number of stations thereon, networks, one at each station, a plurality of sources of current, other networks, each arranged to produce a balanced condition when connected in operative relation to a network at one of said stations and to one of said sources of current, and means for operatively connecting said sources of current and said latter networks to the line.
4. In combination, a party line having a number of stations thereon, a central office in which said line terminates, networks, one at each of said stations, each network being operatively connected to the line when the party is calling, a plurality of other networks at

the central office, each arranged to balance
the network at a given station when connect-
ed to the line, a plurality of sources of alter-
nating current, each of a different frequency,
5 a plurality of registers, one for each station,
means for successively connecting said
sources of current to the line and to the suc-
cessive networks at the central office, and
means operated in accordance with the bal-
10 anced or unbalanced condition of the line for
selectively controlling the operation of said
registers.

In witness whereof I hereunto subscribe
my name this 3rd day of October, 1930.

15 LELAND J. STACY.

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