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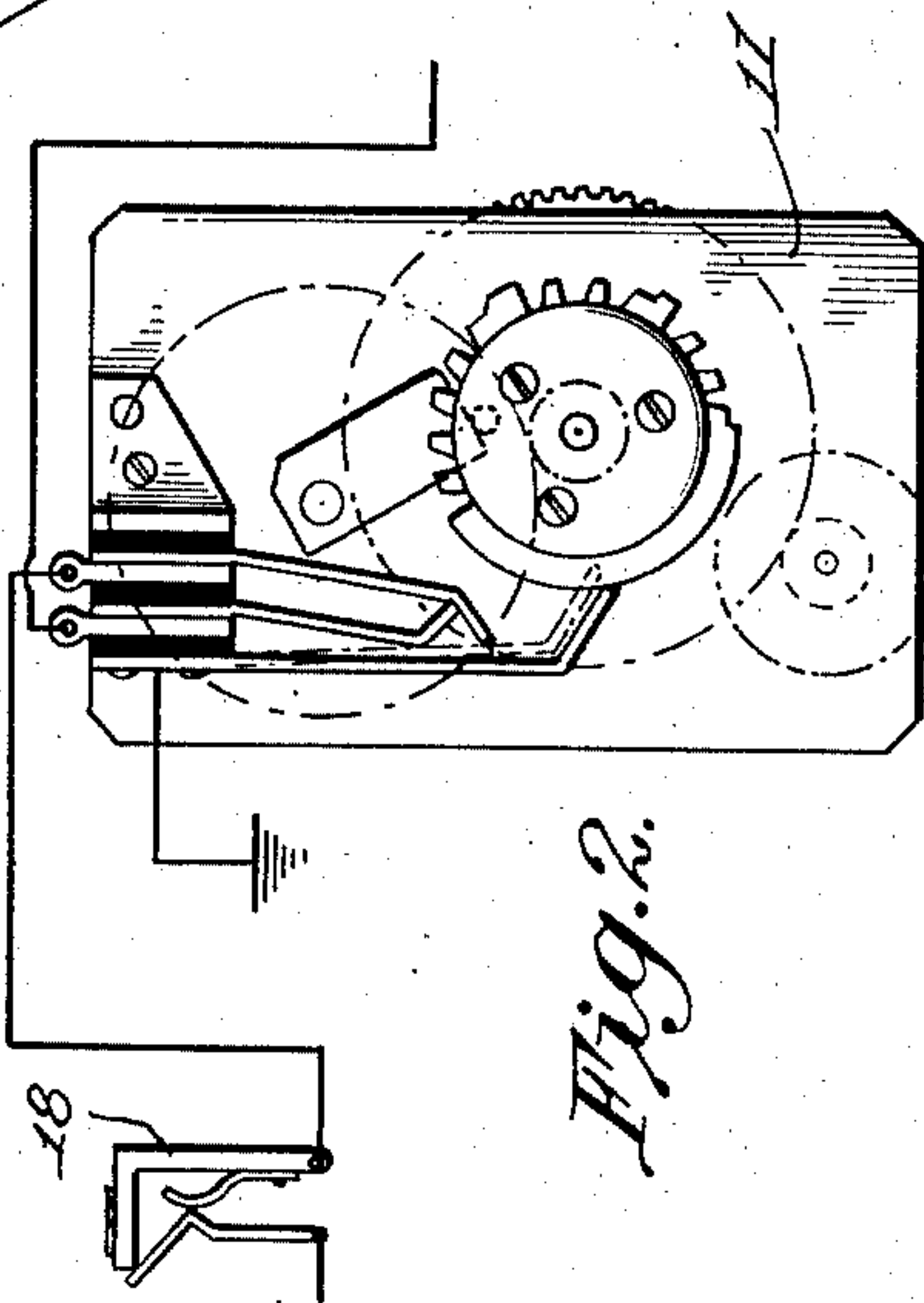
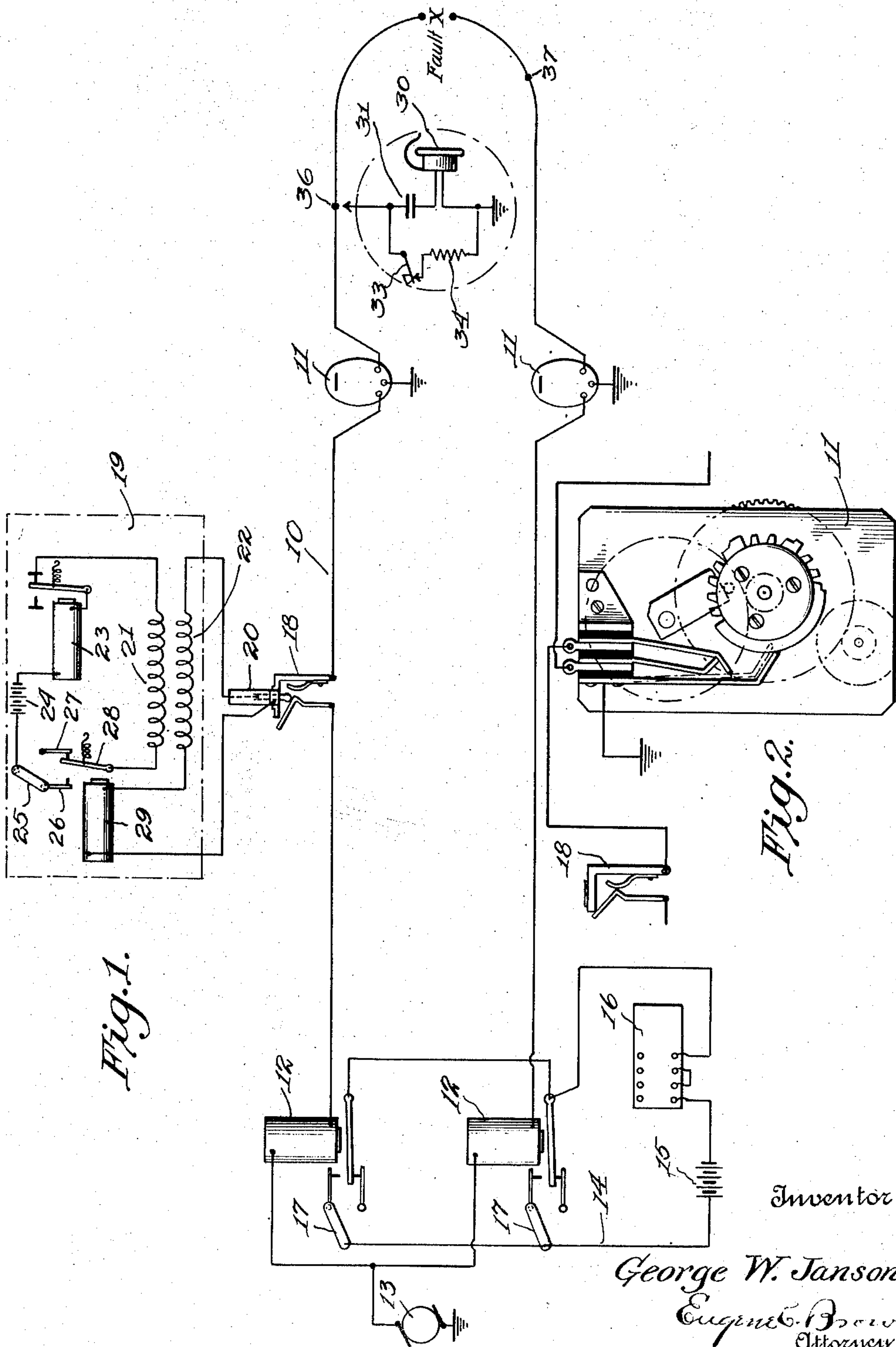
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LOCATING FAULTS ON MESSENGER CALL CIRCUITS

Filed Aug. 28, 1924

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

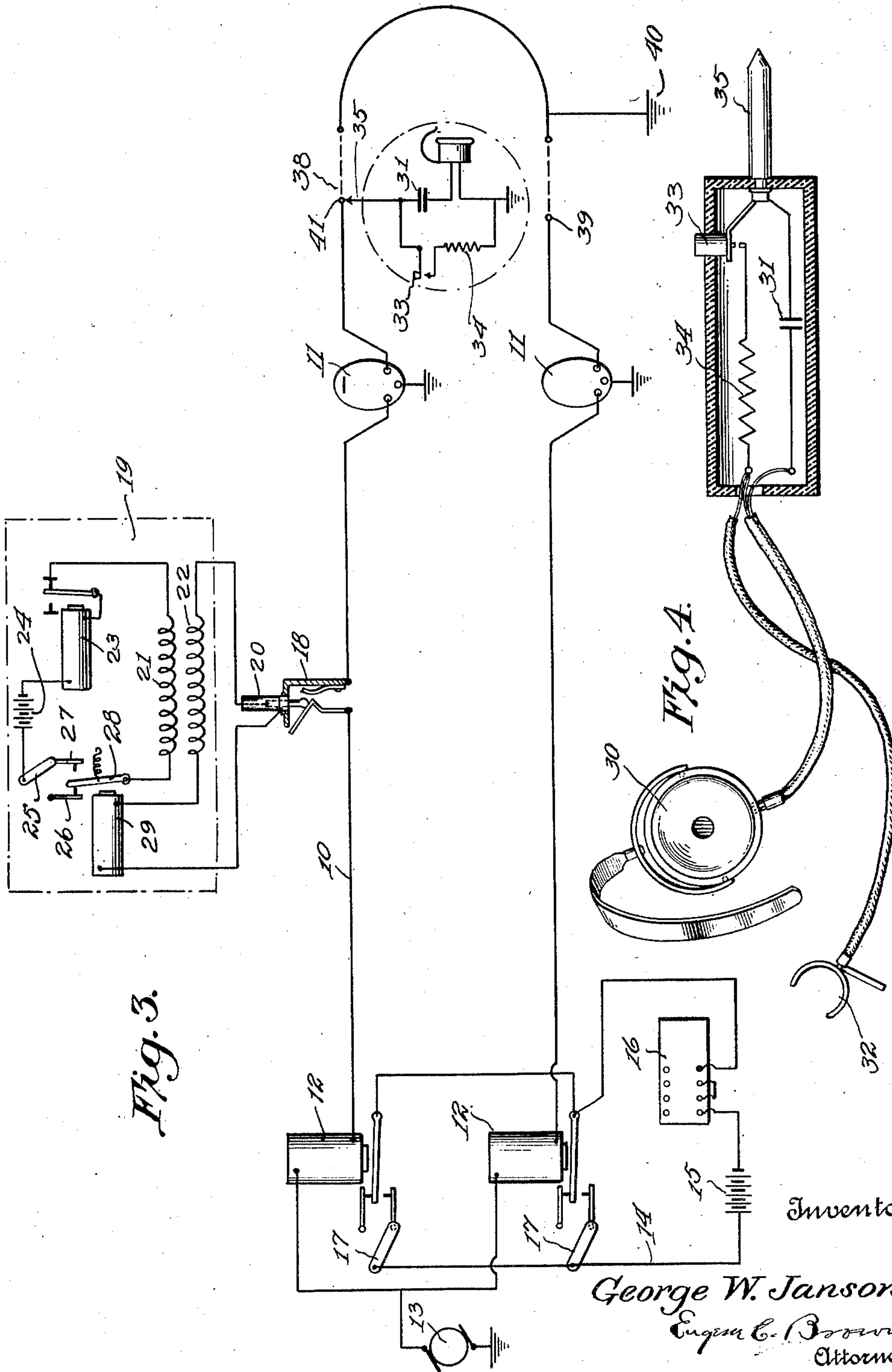


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE

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LOCATING FAULTS ON MESSENGER-CALL CIRCUITS

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This invention relates to a system and apparatus for line testing and for the location of faults on a line, such as "opens" or "grounds".

5 While the system is herein illustrated as applied to a messenger circuit, it obviously may be installed and applied to any other circuits, and it may be used for various tests that are frequently necessary to be made
10 upon line circuits.

The system and apparatus which constitute my invention are designed to transmit over the line a distinctive tone and the system is so arranged that the tone transmission
15 can be controlled by the lineman.

The operation of my system will be understood from the drawings and the following specification.

In the drawings:

20 Fig. 1 illustrates my testing system as applied to a messenger call circuit in which there is an "open";

Fig. 2 shows the conventional call box used in such circuits;

25 Fig. 3 shows my line testing system as applied to the same circuit when a "ground" is on the circuit; and

Fig. 4 shows the lineman's apparatus used in testing.

30 My system is illustrated herein as applied to a messenger call circuit. Such call circuits comprise a loop 10 in which a plurality of call boxes 11 are installed, the office end of each arm of the loop being provided with a relay
35 12, and the loop being connected to a grounded source of current 13. The relay 12 operates circuit 14 which includes a source of current 15 and a recorder 16. Such call circuits are provided with means for automatically indicating a fault on the line, and such
40 means also indicate whether the fault is an "open" or a "ground".

When a fault exists on such a messenger call circuit the line conductors and the office
45 apparatus are so divided that they operate as two distinctly separate circuits. The switch arms 17 are shifted to one position or the other, depending on whether the fault is an "open" or a "ground", as shown in Figs. 1
50 and 3. My line testing system does not

necessitate any change in the call circuit except for the installation of a jack 18 at the central office in one arm of the loop. My system comprises one set of apparatus 19 which
55 may be installed at the central office and provided with a plug 20 which may be inserted in the jack 18 at any time that it becomes necessary or desirable to test the line or to locate any faults therein. The central office
60 apparatus 19 comprises an induction coil having a primary winding 21 and a secondary winding 22. The primary winding 21 is in a tone current generating circuit which, in addition to the winding 21, contains the
65 buzzer 23, the source of current 24, the switch arm 25 with fixed contact points 26 and 27, and the armature 28. In series with the secondary winding 22 of the induction coil is a relay 29 which is arranged to operate the
70 armature 28. When the plug 20 is inserted into the jack 18, the relay 29 and the secondary winding 22 are inserted into the line and in series with it. When the fault to be
75 located is an "open", the switch arm 25 is connected to the contact 26, as shown in Fig. 1, and when the fault to be located is a "ground" the switch arm 25 is connected to the contact 27, as shown in Fig. 3.

In addition to the apparatus installed at the central office, which is to be in series
80 with a line in order to impose the tone current on the line, the lineman is provided with a portable apparatus illustrated in Fig. 4 which he carries along to apply to the line at
85 any point. The lineman's portion of the apparatus consists primarily of a telephone receiver 30 in series with a condenser 31, a ground connection 32, a manually operated switch 33, and resistance 34. The manually
90 operated switch and the resistance are shunted across the telephone receiver and the condenser. The apparatus is also provided with a pointed connecting rod 35 for electrically connecting this apparatus with the line.

In this system the application of the tone
95 current to the line is controlled entirely by the lineman at any point at which he may apply his portable testing set. The operation of the tone generating current is controlled by the relay 29 and the circuit for this
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relay is under the direct control of the line-
 man by means of his portable set. By alter-
 nately closing and opening the key 33, after
 he has applied the pointed rod 35 to the line,
 the lineman can first cause a tone to be im-
 pressed on the circuit and then cause it to
 cease when he is making his tests as herein-
 after described. He can thus know definitely
 that he is on one side or the other of a "fault."
 I shall now describe the operation of this
 system as it is used for the location of an
 "open" in the loop. As has already been
 stated herein above, if the fault to be located
 is an "open" the switch arm 25 in the tone
 current generating circuit is connected to the
 contact point 26. The plug 20 is then in-
 serted in jack 18, whereby the induction coil
 winding 22 and the relay 29 are inserted in
 series with the line. In view of the fact that
 the line is "open" circuited at the faulty point,
 there is no current passing through the re-
 lay 29, and the tone current generating circuit
 is therefore open and no tone is transmitted
 through the line. The lineman now applies
 his apparatus to the line by means of the con-
 necting rod 35 at the point 36. This com-
 pletes the circuit of the relay 29 through the
 condenser and the telephone receiver. The
 condenser will draw a charge of current which
 will cause a click to be heard in the telephone
 receiver. 13 being the source of direct cur-
 rent, this will not energize relay 29 and the
 tone current generating circuit will remain
 open. If, now, the lineman closes switch 33,
 the relay 29 will be energized and the tone
 current generating circuit will close at 26,
 28, and the tone current will be imposed upon
 the line through the induction coil and will
 be heard at the telephone receiver by the line-
 man. This indicates to the lineman that he
 has an uninterrupted connection with the re-
 lay 29 and hence he concludes that the point 36
 is positioned between the relay 29 and the
 fault. Now, had the lineman's tests been ap-
 plied on the other side of the fault, such as at
 the point 37, a similar click in the receiver
 would have been heard. Depressing the man-
 ually operated switch 33 would obviously have
 caused a current to flow from the source 13 to
 ground through the resistance 34, but the
 tone current generating circuit being on the
 opposite side of the "open" would not operate
 in such a way as to impose current upon the
 line. The tester will then know that the
 fault is between the point 37 and the relay 29.
 When the fault to be located is a "ground"
 such as is shown at 40 in Fig. 3, the switch
 arm 25 is shifted to the position in which it
 connects with contact point 27. The appara-
 tus 19 is connected to the line circuit as de-
 scribed heretofore. In view of the ground
 connection 40, there is a complete circuit from
 the source of current 13 through the relay 12
 to the relay 29, winding 22 and ground 40.
 The relay 29, therefore, stays energized and

maintains the armature 28 against contact
 26, whereby the tone current generating cir-
 cuit is left inoperative. If, now, the line
 wire is "opened" as at 38, the armature 28
 will be released and the tone current will be
 impressed upon the line which can be heard
 by the lineman applying the test set to the con-
 ductor at the point 41. This indicates to the
 lineman that he has uninterrupted connection
 from the point 41 to the relay 29, and that
 there is no fault or ground on that connection
 between the point 41 and the relay 29. He
 therefore knows that the point 41 is posi-
 tioned between the relay 29 and the ground
 40. At times, due to the fact that the high
 frequency alternating current generated by
 the tone current generating circuit may be
 transmitted to other wires by induction, this
 tone may be heard on both sides of the "open"
 line wire. If, for any reason, the lineman
 desires to know which of the conductors is
 directly connected to the central office appa-
 ratus, he can determine that fact by applying
 the test set to each of the wires with the switch
 33 closed. This constitutes nothing more
 than a repetition of the test for an "open", as
 explained herein above. Now, if the lineman
 had chosen to apply his testing outfit to the
 point 39, then no tone would have been de-
 tected by the telephone receiver on either of
 the conductors, for the ground 40 maintains
 the circuit of the relay 29 closed, and the re-
 lay 29 is maintained energized despite the
 "open" point 39, with the result that the tone
 current generating circuit remains inopera-
 tive.

It is often desirable to know which of the
 two conductors at any call box, or at any
 other point on a messenger call circuit, is con-
 nected at one of the office terminals. The ap-
 paratus described in this specification can
 now obviously be used for this purpose by
 connecting the relay and tone current gen-
 erating circuit equipment at one of the ter-
 minals. If the loop, on investigation, nor-
 mally carries current, the tone current gen-
 erating circuit should be connected to the
 contact 27 of the relay 29; and if the loop is
 normally "open" or not connected to any
 source of current, the tone current generat-
 ing circuit should be connected at the point
 26. The circuit may then be opened at the
 testing point, and an attempt may be made
 to control the transmission of the tone cur-
 rent on each of the conductors. This control
 will only be effective over that conductor
 which is primarily connected to the relay 29.
 While I have herein illustrated and de-
 scribed my testing system and apparatus as
 applied to a messenger call circuit, it is ob-
 vious to a person skilled in the art that such
 system and apparatus may be applied to any
 other circuit and may be used for any other
 form of testing in addition to that of locat-
 ing faults.

I claim:

1. In a line testing system, an induction coil comprising a primary and a secondary winding, a tone current generating circuit
5 connected to the primary winding, a relay connected to the secondary winding and controlling the operation of the tone current generating circuit, and means adapted to be connected to the line at any point for causing
10 the relay to close said tone current generating circuit.

2. A line testing system employing a portable testing set responsive to a tone current comprising a tone current generating circuit,
15 a relay connected in the line for controlling the operation of said tone current generating circuit in response to line conditions and selective means in said tone current generating circuit for enabling the tone current to
20 be generated either upon energization or de-energization of said relay.

3. A line testing system employing a portable testing set responsive to a tone current comprising a tone current generating circuit,
25 a relay responsive to line and test set conditions for controlling said tone current generating circuit, a primary winding in said tone current generating circuit, an inductively disposed secondary winding in series
30 with said relay and the line and selective means in said tone current generating circuit for enabling the tone current to be generated either upon energization or de-energization of said relay.

35 4. A line testing system for determining the location of open circuit or ground conditions in a line by means of a testing set responsive to tone current comprising a relay responsive to line and test set conditions, a
40 secondary winding in series with said relay and line, a two position armature for said relay, a tone current generating circuit controlled by said armature, selective means for enabling said armature to operate said tone
45 current generating means in either position and a primary winding in said tone current generating circuit.

In testimony whereof I affix my signature.
GEO. W. JANSON.

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