

Sept. 18, 1923.

1,468,101

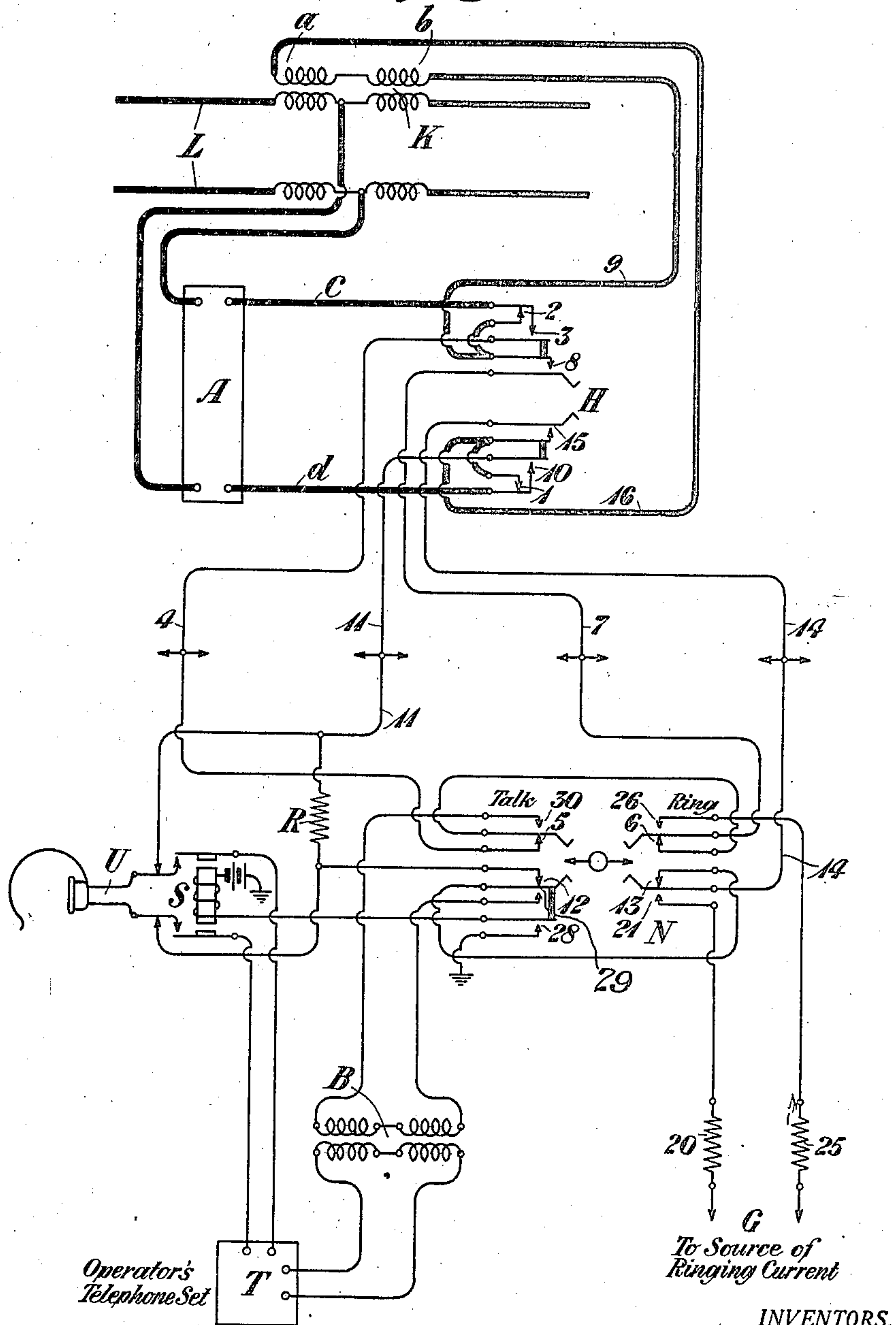
A. B. CLARK ET AL

TESTING CIRCUITS

Filed Dec. 26 , 1919

2 Sheets-Sheet 1

Fig. 1.



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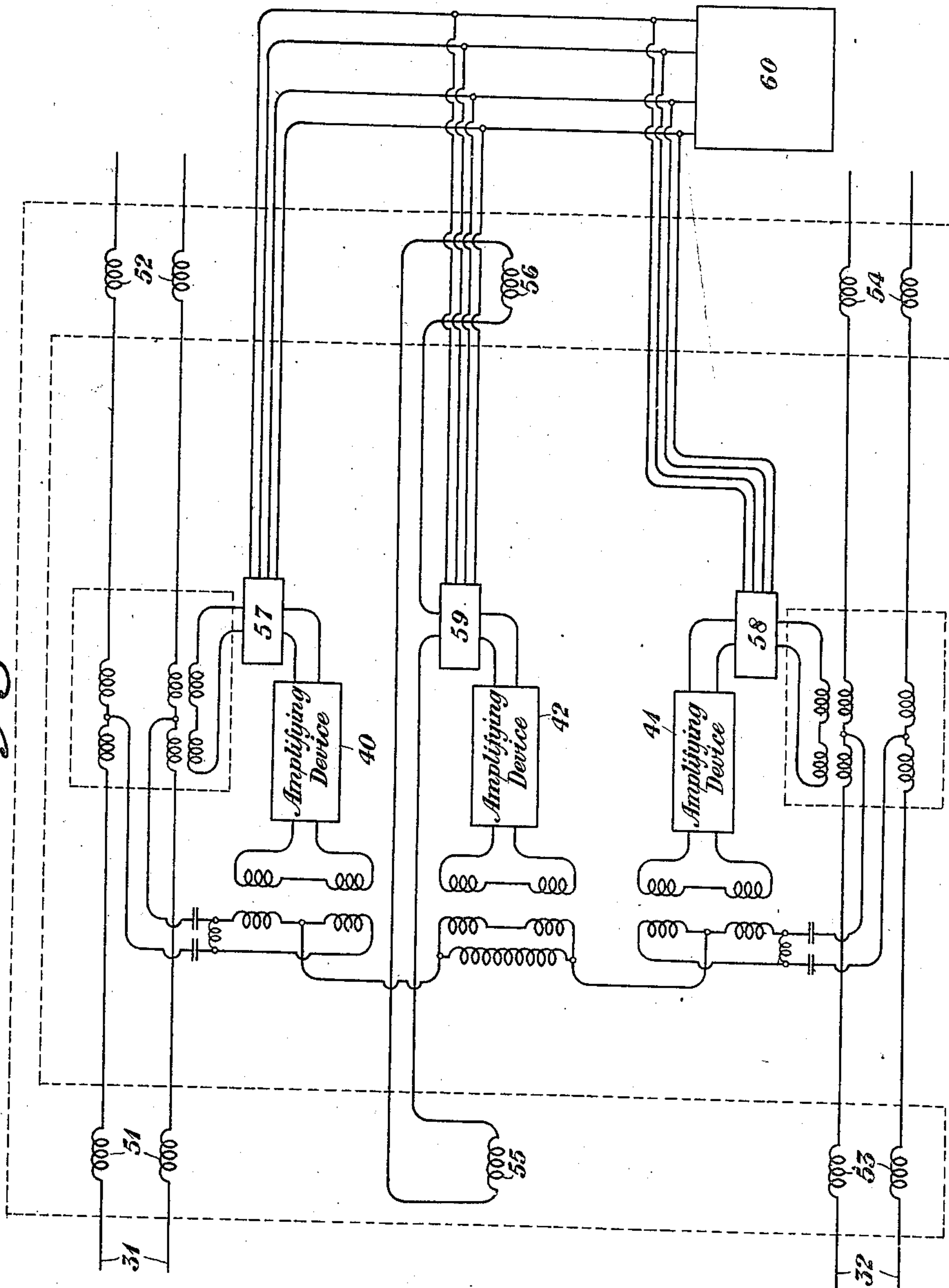
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Fig. 2.



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ALVA B. CLARK, OF BROOKLYN, NEW YORK, AND GEORGE CRISSON, OF HOBOKEN, NEW JERSEY, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TESTING CIRCUITS.

Application filed December 26, 1919. Serial No. 347,519.

To all whom it may concern:

Be it known that we, ALVA B. CLARK and GEORGE CRISSON, residing at Brooklyn and Hoboken, in the counties of Kings and Hudson and States of New York and New Jersey, respectively, have invented certain Improvements in Testing Circuits, of which the following is a specification.

This invention relates to testing circuits, particularly to circuits for the testing of telephone lines having repeaters associated therewith.

The arrangement of this invention is particularly useful in testing the circuits of phantom groups, equipped with repeaters of the type shown and described in the application by O. B. Blackwell for patent on "telephone repeaters" filed May 29, 1919, Serial Number 300,556. The principal characteristic novel feature of the invention resides in the fact that the testing apparatus is associated with the circuits of the repeaters rather than with the line conductors, so that tests may be made as readily on the phantom as on the side circuits and without causing disturbances in any of the other circuits of the group.

Various other features and objects of the invention will be readily understood from the following description thereof having reference to the accompanying drawing in which Fig. 1 shows in diagrammatic view one specific form of embodiment of the invention, and Fig. 2 shows an application of the invention to a plurality of telephone circuits.

Referring to Fig. 1, A designates an amplifier and K a transformer, which together constitute a repeater for currents in the conductors L, the amplifier and transformer being associated with each other by a circuit which extends from the midpoints of transformer K through the amplifier to the winding *a—b* of the transformer, this circuit being termed herein, as usual in the art, the local circuit of the repeater. The connection of the amplifier A and transformer K is that commonly known in the art as a two way-one element or 21 repeater. Associated with this circuit, in this instance with the output of the amplifying device, is a key H, the contacts of which normally

hold the local repeater circuit closed. When, therefore, key H is in its normal position, the repeater operates in the usual manner, i. e. current from conductors L enters the amplifier A, whereby current of augmented value is caused to flow through conductors *c* and *d*, normally closed contacts 1 and 2 of the key and wires 9 and 16 into the winding *a—b* of the transformer K, whereby it is returned to the line, as well understood in the art.

To monitor on the circuit the operator actuates the key H and connects thereby a resistance R in series with the local circuit of the repeater, so that this circuit now comprises conductor *c*, contact 3 of key H, conductor 4, contacts 5 and 6 of a key N, conductor 7, contact 8 of key H, conductor 9, winding *a—b*, wire 16, contact 15 of key H, wire 14, contacts 13 and 12 of key N, resistance R, conductor 11, contact 10 of key H and conductor *d*. A receiver U is connected in parallel with resistance R over the normally closed contacts of the relay S, and this receiver responds to the voice currents in the circuit, so that the operator may listen in, or monitor, on the line circuit.

The key designated N is associated with the normally open contacts of the key H. It is provided with a right and a left set of contacts, the former of which serves to associate a source of ringing current G with the local circuit of the repeater and the latter, to associate the operator's set T therewith, as we shall now describe.

To ring over the line, the operator leaves the key H in its operated position and throws the handle of key N to the right. This establishes the following connections: from source G, through resistance 20, contact 21 of key N, conductor 14, contact 15 of key H, conductor 16, winding *a—b*, conductor 9, contact 8 of key H, wire 7, contact 26 of key N, resistance 25 to the other terminal of source G. Ringing current is thus caused to flow through transformer K, whereby it is applied to the conductors L.

To talk over the line the operator leaves key H in its actuated position but reverses key N so that its left contacts are operated. This causes the energization of the relay S, current for which flows over the contact 28

of key N to ground. Relay S in actuating its contacts disconnects the receiver from the resistance R and associates the same with the operator's set which is now associated with the winding $a-b$ through the medium of the transformer B, the connections extending from terminal a through conductor 16, contact 15, conductor 14, contacts 13 and 29 of key N, transformer B, contacts 30 and 6 of key N, conductor 7, contact 8, conductor 9 to terminal b .

The operator may thus monitor, ring or talk over the line according to the positions of keys H and N. The key H, it will be observed, is separate for each telephone line, but the key N and all the other parts of the testing apparatus may be made common to any number of lines by connecting together the corresponding conductors 4, 11, 7 and 14 from the said lines, as indicated in the drawing. Since each of these conductors leads to a normally open contact of the key H, the testing apparatus is associated only with that one of the lines, for which the key H is in an operated position. By means of simple circuits and inexpensive apparatus we are thus enabled to test any one of the lines in a station.

The repeater described above may be any one of a number of repeaters connected with a plurality of telephone circuits, these latter being physically independent circuits, or groups containing phantom circuits. This latter arrangement is shown, for illustrative purposes only, in Fig. 2, in which 31 and 32 represent two physical circuits which are at the same time to be used in phantom arrangement. The physical or side circuit 31 has associated with it a repeater which may be of the so-called 21-type, being the same as that shown in Fig. 1 and comprising an amplifying element 40. Similarly, the physical or side circuit 32 has a repeater comprising the amplifying element 41. In each of these side circuits there are connected windings 51, 52 and 53, 54 which cooperate with windings 55, 56 and a repeater including the amplifying device 42. Connections are also made from the midpoints of the windings bridged across the physical circuits, these connections leading directly or through a transformer, to one side of the amplifying device 42. As thus described, the circuit is one which may be used for phantom operation and in its specific form does not constitute a part of our invention. The circuit is described in fuller detail in the Blackwell application hereinbefore referred to and is an improvement in phantom operation. The circuit does not constitute a part of our invention but is adapted to make use of our testing circuit and we show it for illustrative purposes only.

Connected with the local circuit of each amplifying device we have shown conven-

tionally at 57, 58 and 59 the switch mechanism H of Fig. 1. Also we have shown conventionally at 60 the testing apparatus of Fig. 1. Bearing in mind the switching mechanism of Fig. 1, it is seen that the testing apparatus 60 is adapted to be connected with any one of the amplifying elements upon suitable operation of the particular switch H corresponding to that amplifying element, and in particular it may be connected with the amplifier 59 of the phantom circuit to test this circuit without interfering in any way whatsoever with the operation of the two side circuits.

Although this Fig. 2 illustrates an arrangement adapted for phantom circuits, it is obvious that this phantom circuit may be replaced by an independent physical circuit and further it is seen that its use is not limited to three such circuits but that an indefinite number of telephone circuits may be associated together to the testing apparatus 60, and each or any one of said circuits may be tested with the same apparatus and independent of each of the other circuits. This is for the reason that all the changes in the connection are made in the local circuit of the repeater corresponding to the line to be tested and not in the connections to the line conductors.

The invention is not limited to use with the particular type of repeater illustrated but is applicable as well to other types of repeaters; nor is it limited to the particular arrangement of apparatus shown herein, it being readily understood that many changes and modifications may be made within the scope of the following claims without departing from the spirit and scope of the invention.

What we claim is:

1. In combination, a line circuit, an amplifier therefor, and testing apparatus for said circuit associated with the local circuit of said amplifier.
2. In combination, a line circuit, a two-way, one-element repeater therefor comprising an amplifier and a transformer with one winding in the line and another winding in the output circuit of the amplifier, testing apparatus for said line circuit adapted for monitoring, ringing or talking, and means to associate the apparatus with said amplifier and transformer for monitoring and for associating the apparatus with the transformer and excluding the amplifier for ringing and talking.
3. In combination, a line, a two-way one-element repeater therefor comprising an amplifier and a transformer associated with the line and with the output of the amplifier, a source of ringing current, a source of voice current, a monitoring receiver, a key for connecting the monitoring receiver in series in the output of the amplifier or for dis-

sociating said amplifier and selectively connecting the ringing source or the source of voice current to the said transformer.

4. In combination, a line, a two-way one-
5 element repeater therefor comprising an amplifying device and a transformer associated with the line and with the output of the amplifier, a source of ringing current, a telephone set, and a key for dissociating
10 said amplifier and selectively connecting the ringing source or the telephone set to the said transformer.

5. In combination, a line, a repeater comprising an amplifying device and a transformer connected to said line, testing apparatus, a key for associating said testing apparatus with said transformer, the testing apparatus comprising a source of ringing current, a telephone set, and a key for selectively associating said source or said set
20 with said transformer.

6. A testing apparatus adapted for use with a telephone line and an amplifier comprising a telephone set and a ringing source;
25 a key for associating said apparatus with the amplifier and line and normally permitting monitoring without interruption of the talking current; and a second key for selectively associating the set or the ringing
30 source with the line.

7. In combination, a line circuit, an amplifier associated therewith having a local

circuit, a monitoring device for said line and means for associating said device with said local circuit.

8. In combination, a repeater comprising an amplifying device and a transformer, a monitoring device, a key for at times interposing said monitoring device between said
40 amplifying device and transformer, a source of ringing current, a talking set, and a second key for dissociating said amplifying and monitoring devices from said transformer and selectively associating therewith
45 the source of ringing current or the talking set.

9. In an arrangement for testing any line circuit of a phantom group, repeaters for said circuit, said repeaters having local circuits, testing devices for said line circuits,
50 and switching devices for selectively associating said devices with the local circuits of said repeaters.

10. The method of testing a line circuit which consists in causing a transfer of
55 energy between the line circuit and the testing device through the local circuit of an amplifier.

In testimony whereof we have signed our names to this specification this 23rd day of
60 December, 1919.

ALVA B. CLARK.
GEORGE CRISSON.