

C. S. DEMAREST.
ELECTRICAL TESTING CIRCUITS.
APPLICATION FILED NOV. 6, 1919.

1,399,695.

Patented Dec. 6, 1921.

2 SHEETS—SHEET 1.

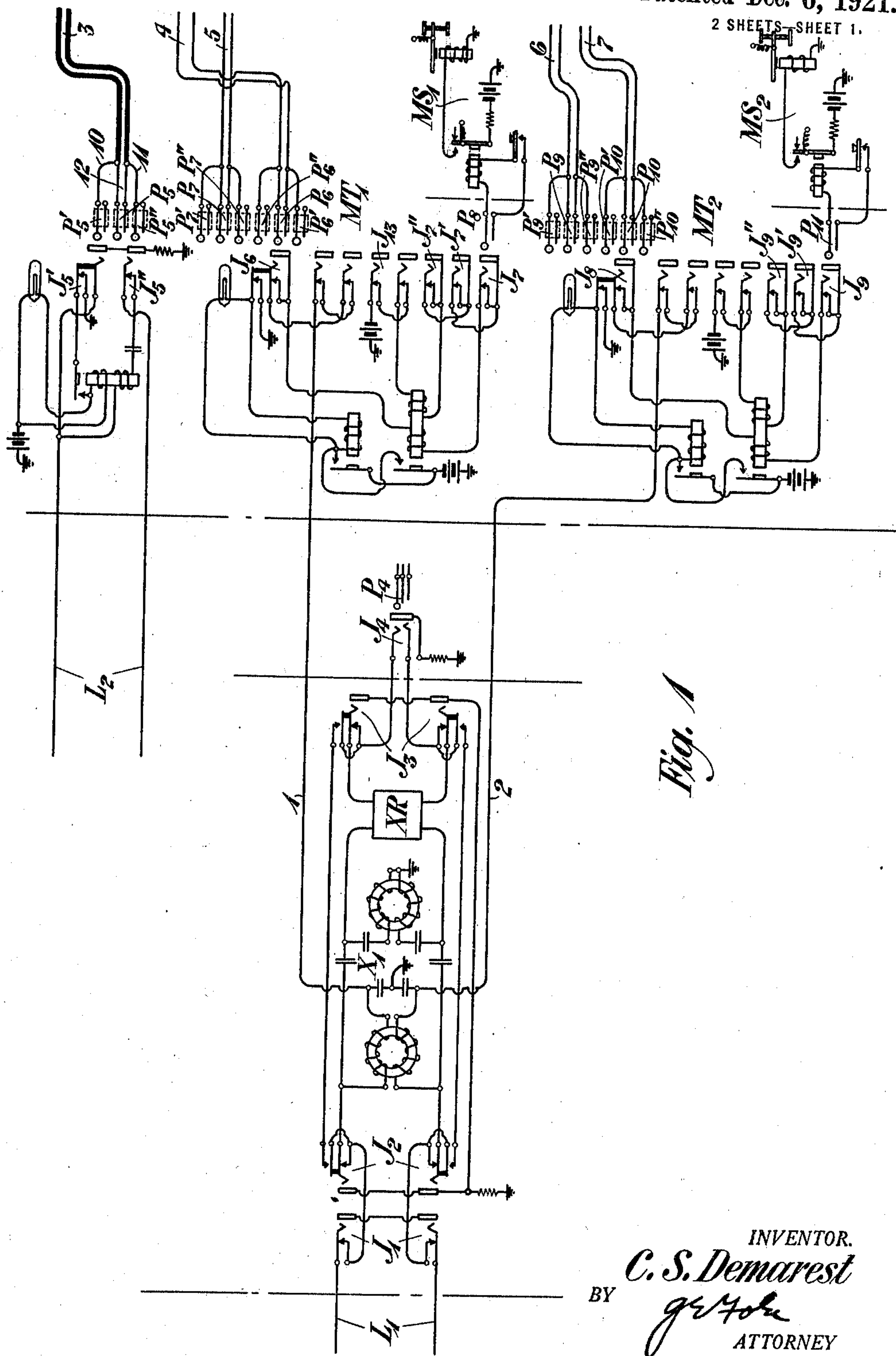


Fig. 1

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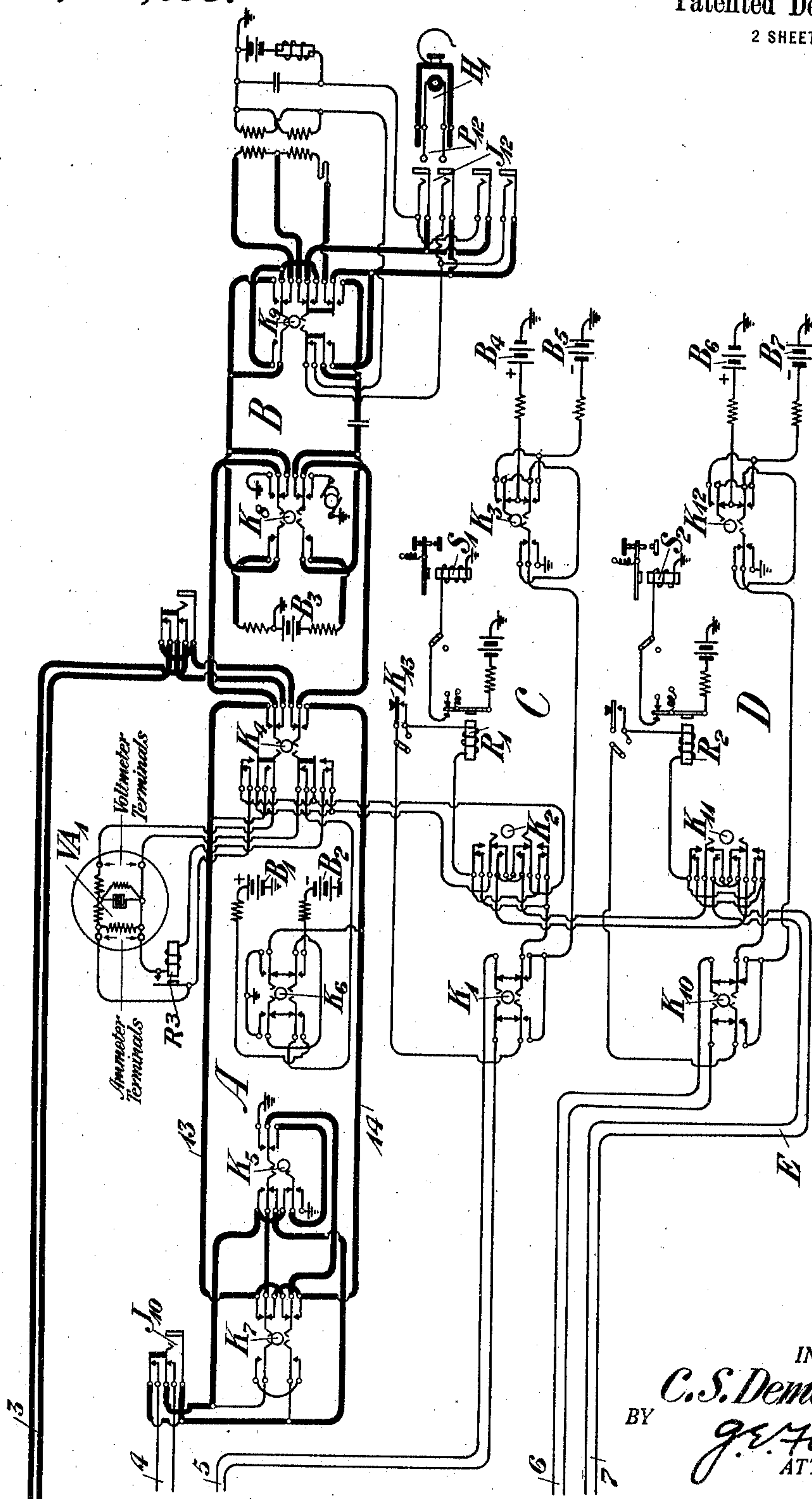


Fig. 2

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UNITED STATES PATENT OFFICE.

CHARLES S. DEMAREST, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL TESTING-CIRCUITS.

1,399,695.

Specification of Letters Patent.

Patented Dec. 6, 1921.

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To all whom it may concern:

Be it known that I, CHARLES S. DEMAREST, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Electrical Testing-Circuits, of which the following is a specification.

This invention relates to electrical testing circuits and more particularly to a circuit adapted for testing telegraph circuits superimposed upon long distance telephone lines.

Testing circuits in use hitherto for testing the condition of telegraph circuits superimposed on telephone lines, comprise what is commonly known as a test circuit and also one or more Morse test circuits. The so-called test circuit is adapted to make the ordinary tests for circuit trouble such as, for instance, those to determine the presence of an open circuit, a short circuit or a ground upon the line under test, or to determine the polarity and the voltage of the Morse battery associated with the line under test. This circuit is equipped with a plurality of batteries of suitable potentials, switching means for applying potentials of opposite polarities to the line under test and a combination voltmeter and ammeter for measuring the potentials and currents in the said circuit. The test circuit has also connected with it an operator's telephone set, in order to render it practicable to maintain telephone conversation either over the line under test or over a trunk or subscriber's line extending from the testing office. The Morse test sets comprise Morse telegraph equipment having sources of direct current associated therewith, whereby potentials of opposite polarities may be applied to the lines and switching means for connecting the ammeter winding of the said voltmeter-ammeter with the said telegraph circuit, in order that the various pieces of apparatus may be adjusted for the proper current flow.

Experience has shown that the arrangement just described is too inflexible, in that certain parts of the circuit are so related as to prevent their separate use simultaneously. For example, the telephone set is connected with the test circuit in such manner that telephone conversation cannot be carried on while tests are being made with the other apparatus associated with the

said circuit. It is desirable sometimes to carry on a telephone conversation over one line circuit while tests are being made over another line circuit and accordingly one of the objects of this invention is to provide switching means whereby the telephone equipment may be connected either with separate cords, thereby forming a telephone circuit separate and distinct from the test circuit, or the said equipment may be connected directly with the test circuit.

Another object of this invention is to provide a special cord circuit for connecting the ammeter winding of the combination voltmeter-ammeter with a line under test, the said cord circuit being separate and distinct from the test circuit heretofore referred to, and to provide switching means which will render it impossible to connect the voltmeter winding with the test circuit at the same time that the ammeter winding is connected with either the special cord circuit or with the Morse test circuits.

Other objects of this invention will appear from the following description when read in connection with the drawing, Figure 1 of which shows a transmission line adapted for joint telephone and telegraph use and also a ringdown telephone trunk line, and Fig. 2 shows the testing arrangement comprising a test circuit, a telephone circuit, two Morse test circuits, and the special ammeter cord circuit.

In Fig. 1 L_1 represents a transmission line adapted for joint telephone and telegraph use, terminating at a toll test board in the jacks J_1 and looped to contacts of the jacks J_2 . Associated therewith is the composite apparatus X_1 and the composite ringer XR , both of which may be of any well known type. The telephone circuit terminates at a telephone switchboard in the jack J_4 , which is adapted to cooperate with the plug P_4 of a toll cord circuit located at the said switchboard. The telegraph branches 1 and 2 extend from the composite apparatus X_1 to the Morse terminals MT_1 and MT_2 , respectively, which are located at the Morse board. The terminal MT_1 has associated therewith a plurality of jacks, J_7 , J_7' and J_7'' , by means of which a plurality of Morse subscriber lines represented by the line MS_1 , may be connected with the Morse line. The jack J_6 of this terminal is known as the loop-

ing jack, the tip contact or line side of the jack being connected by means of the branch 1 to one side of the line L_1 and the sleeve contact being connected with the subscriber's equipment and therefore is referred to as the drop side of the jack. The Morse terminal MT_2 , which is similar to MT_1 , has a plurality of subscriber's jacks, J_9 , J_9' and J_9'' , with which may be connected a plurality of Morse subscriber's lines similar to MS_2 . This terminal also has a looping jack J_8 , similar to jack J_6 .

L_2 represents a ringdown telephone trunk circuit which terminates at the Morse board in jacks J_5' and J_5'' . The pairs of conductors 3, 4, 5, 6 and 7 extend from the cord terminals of the Morse board to the circuit arrangement shown in Fig. 2 which is located at the Morse board. Each of these pairs of conductors terminates in three separate cords, each cord terminating in a separate plug, which is of the two-conductor type, having tip and sleeve contacts only. One of the said cords is connected with the tip side of the line, another is connected with the ring side of the line and the third is connected with both the tip and ring sides of said line. Thus, for example, the tip side of pair 3 is connected with cord 10, which terminates in plug P_5' . The ring side of the said pair is connected with cord 11, which terminates in plug P_5'' and both sides of the said pair are connected with cord 12, which terminates in the plug P_5 . Each of the remaining pairs, 4, 5, 6 and 7, are terminated in three cords each cord having a separate plug. By means of the plurality of cords and plugs associated with each connecting pair, either the tip side alone or the ring side alone, or both sides together, may be connected with the testing arrangement shown in Figure 2.

In Fig. 2, we have in reality five separate circuits which, taken in combination, constitute the arrangement for testing the circuits shown in Fig. 1. These circuits are represented by the letters A, B, C, D and E. A represents the so-called test circuit which may broadly be understood as extending from the plugs associated with pair 4 to key K_4 . B represents a telephone circuit which extends from the plugs associated with pair 3 to the telephone transmitter and receiver shown to the right of the drawing. C and D represent Morse test circuits, each having Morse telegraph equipment associated therewith, and adapted to have the ammeter winding of the voltmeter-ammeter VA_1 connected therein by operation of the keys K_2 and K_{11} respectively. E represents the ammeter test circuit which extends from the plugs associated with the cord 7 to the ammeter winding of the combination instrument.

The test circuit A comprises a key K_4 ,

which when moved to the right connects the telephone apparatus of the circuit B with the test circuit A and when moved to the left connects the voltmeter winding of the combination instrument with the circuit A. The movement of this key to the left also disconnects the ammeter winding of the said instrument from the ammeter test circuit E and short circuits the latter circuit. Associated with the circuit A are the Morse batteries B_1 and B_2 , which are poled oppositely and are adapted to be connected with the test circuit by the key K_6 . The key K_5 is adapted, when thrown to the right, to open the tip side of the line and to ground the ring side in series with the voltmeter. The movement of this key to the left opens the ring side of the circuit and grounds the tip side in series with the voltmeter. Key K_7 , when moved to the right, reverses the connection of the conductors 13 and 14 with the sides of pair 4. The movement of this key to the left short-circuits the two sides of pair 4.

The telephone circuit B comprises an operator's head set H_1 , which is adapted to be connected by the insertion of the plugs P_{12} in the jacks J_{12} . The key K_9 , when moved to the right, connects the receiver of the telephone set across the circuit in a monitoring relation. The movement of the key to the left connects the set with the circuit in a talking relation. The key K_8 , when moved to the right, applies ringing current to the line and when moved to the left connects a battery B_3 across the circuit, in order to provide talking current for an instrument such as a lineman's test set, which may be connected across the distant end of the telephone line with which the telephone circuit might be connected.

The Morse test circuit C comprises Morse key K_{13} , a relay R_1 and a sounder S_1 . The key K_3 is adapted normally to connect battery of positive polarity with the line, but by moving the key to the right the polarity may be changed. The movement of the key to the left disconnects the local battery from the line and grounds the line circuit. The key K_1 , when moved to the right, connects the local Morse testing equipment with the drop side of the Morse terminal circuit and when moved to the left, the line side of the circuit. The movement of the key K_2 connects the ammeter winding of the combination instrument in series with the Morse testing equipment. In a similar manner the various corresponding pieces of apparatus associated with the circuit D perform the same functions as those in the circuit C.

The circuit E, which may be termed the ammeter test circuit, may be considered as extending from the plugs associated with the pair 7 through the contacts of keys K_{11} , K_2 and K_4 to the ammeter winding of the

combination instrument. It has been noted that the key K_4 when operated toward the left disconnects the ammeter winding of the combination circuit from the conductors that normally serve to connect it with the circuits C, D and E. When key K_4 is normal the operation of the key K_2 will serve to connect the ammeter with the circuit C and disconnect it from the conductors between key K_2 and key K_{11} and short circuit the said conductors. Furthermore, when keys K_4 and K_2 are in their normal positions, the operation of key K_{11} will connect the ammeter with the circuit D and disconnect it from the circuit E and short circuit the conductors of circuit E. The nature of the invention will be more fully understood from the following description of the manner in which the various circuits operate:

In the operation of the test circuit A, if it is desired, for example, to measure the potential across the Morse line and drop, the plug P_6 of the looping cord is inserted in the looping jack J_6 of the Morse terminal MT_1 and the key K_4 is moved toward the left. This connects the voltmeter winding across the line and drop and indicates approximately the total voltage acting in the circuit. If key K_5 is moved to the right when the key K_4 is operated, as above described, the tip side of the circuit is opened and the ring side connected to ground. The voltmeter will then indicate approximately the potential of the battery connected with the battery jack J_{13} of the Morse terminal MT_1 and the direction of the deflection will indicate the polarity. If keys K_4 and K_5 are both operated to the left and plug P_6 remains connected with the jack J_6 , the ring side of the testing circuit is opened and the tip side will be grounded through the voltmeter. The voltmeter will then indicate the potential and the polarity of the battery connected with the distant end of the line. The batteries B_1 and B_2 are adapted for use in making voltmeter tests for continuity, crosses, or grounds upon the Morse circuit. These tests, which are made in the well known manner, may be effected by the operation of the various keys associated with the test circuit A.

The mode of operation of the telephone circuit B is as follows:

The plug P_5' , which is associated with the tip side of the telephone circuit, is inserted in jack J_5' and the plug P_5'' which is associated with the ring side of the telephone circuit is inserted in the jack J_5'' . As a result, the ringdown telephone trunk circuit L_2 is connected with the telephone circuit of the testing arrangement shown in Fig. 2. If it is desired to talk over this line, the key K_6 is operated to the left, thereby connecting the telephone equipment with the line. If

it is desired to listen on the circuit, the key K_6 is moved to the right, thereby disconnecting the receiver from the telephone set and connecting it directly to the circuit in series with the condensers. If in the process of talking it is desired to supply battery to the instrument connected with the distant end of the line, the key K_8 is operated toward the left, thereby bridging the battery B_3 across the telephone circuit. The telephone circuit loops through the right hand contacts of key K_4 in such a manner as to be normally disconnected from the test circuit A, but adapted to be connected thereto by the operation in a right hand direction of the key K_4 . It will be seen, therefore, that by means of the switching arrangement the telephone circuit B may be used to carry on a telephone conversation over the line L_2 , for example, at the same time that the circuit A is being used to make various circuit tests upon the telegraph circuit connected with the Morse terminal MT_1 . If the plugs P_6' and P_6'' of the test cords had been connected with the jacks J_5' and J_5'' of the line L_2 in order to make circuit tests upon the line L_2 , designed for telephone transmission solely, then the telephone set associated with the circuit B might be connected with the test circuit A by moving the key K_4 to the right and used in connection with said circuit. The arrangement shown in Fig. 2 provides means for combining the test circuit A and the telephone circuit B, when conditions render such use desirable or necessary, and for rendering them separate and distinct circuits in order to provide for carrying on telephone conversation over one circuit when tests are being made over a different circuit.

The mode of operation of the Morse test circuits C and D being substantially the same, a description of one will therefore apply to the other. If the plug P_7 of the looping cord of the Morse test circuit C is inserted in the looping jack J_6 of the Morse terminal MT_1 and all keys of the test circuit are normal, the Morse relay and key will be connected in series with the circuit associated with the Morse terminal MT_1 and signals may thus be transmitted from the test cord to the various Morse stations connected with the line. If it is desired to determine the magnitude of the current in the telegraph circuits or to adjust the resistance in the Morse battery taps or the duplex sets to the proper value, the ammeter winding of the combination instrument VA_1 may be connected in the circuit by the operation of the key K_2 . This connects the ammeter winding in series with the circuit C and the line and drops circuits of the Morse terminal MT_1 . In a similar manner the ammeter winding may be connected with the circuit D by the operation of the key K_{11} , but the am-

meter circuit is so arranged that should keys K_2 and K_{11} be operated simultaneously, the ammeter will be connected with circuit C and no interference between the circuits C and D will result therefrom. Furthermore, if key K_4 should be operated to the left in order to connect the voltmeter winding with the test circuit A, the conductors of the ammeter test circuit will be short-circuited and the voltmeter winding will be connected to the test cords. This, therefore, avoids interference between Morse circuits when the Morse test sets and the test circuit A are being used simultaneously for testing different line circuits.

If it is desired to determine the magnitude of the current in a circuit, in order to make certain adjustments, this may be done by means of the circuit E. The pair 7 of this circuit terminates in a looping cord and single cords, with which are associated the plugs P_{10} , P_{10}' and P_{10}'' . If, for example, the looping plug P_{10} is inserted in the jack J_8 of the Morse terminal MT_2 and keys K_4 , K_2 and K_{11} of the testing arrangement are in their normal positions, the ammeter winding of the voltmeter-ammeter will be connected in series with the Morse circuit connected with the terminal MT_2 . In this manner adjustments of apparatus for the desired current flow may be readily made by means of this simple circuit, while the other more complex circuits are being used to make the tests for which they are specially adapted. A relay R_3 is inserted in the circuit of the ammeter winding of the combination voltmeter-ammeter in order to protect the instrument against excessive currents. This relay is designed to operate at a definite current value within the limit of the safe carrying capacity of the ammeter winding. As soon as the relay operates, the winding is short-circuited through the armature of the relay when operated, and the ammeter winding is thus protected. It will be apparent, therefore, that this invention provides means for facilitating the connection of a single composite instrument with a plurality of circuits, which means are likewise adapted to prevent the simultaneous connection of the said instrument with any two of a plurality of test circuits.

Although this invention has been shown embodied in a particular form or circuit arrangement, it is apparent that it is not limited to such form or arrangement, but is capable of embodiment in other forms and arrangements, without departing from the spirit of the appended claims:

What is claimed is:

1. In a testing system, the combination of a test circuit adapted for connection with an electrical transmission line and having a measuring instrument associated therewith but normally disconnected therefrom, a tele-

phone circuit adapted for connection with a second electrical transmission line and switching means for connecting either said telephone circuit or said measuring instrument with said test circuit.

2. In a testing system, the combination of a test circuit adapted to measure the voltage of a transmission line, a telephone circuit, a second test circuit adapted to test Morse lines, a combination voltmeter and ammeter adapted for connection with said first and said second test circuits, means for combining said telephone circuit with said first test circuit and means for connecting the ammeter winding of said instrument with said second test circuit.

3. In a testing system, the combination of a voltage test circuit, a current test circuit, a Morse test circuit, a combination electrical measuring instrument adapted to indicate voltage and current values, switching means for connecting the voltage winding of said instrument with said voltage test circuit and to short-circuit said current test circuit, and switching means associated with said Morse test circuit to connect the ammeter winding of said instrument with the said Morse circuit when said first switching means is normal and to short-circuit said current test circuit.

4. In a testing system, the combination of a measuring instrument, a test circuit normally connected thereto, a plurality of test circuits normally disconnected from said instrument, switching means associated with each of said plurality of test circuits for connecting said instrument thereto and adapted to short-circuit the conductors of the test circuit normally connected with said instrument.

5. In a testing system, the combination of a test circuit adapted for connection with a transmission line, a second test circuit adapted also for connection with a transmission line, an electrical measuring instrument adapted to show voltage and current values, said measuring means being normally connected with said second test circuit and switching means associated with said first mentioned test circuit for connecting the voltage winding of said instrument thereto, said switching means being adapted to disconnect said instrument from said second test circuit and to short-circuit the conductors of said second test circuit.

6. In a testing system, the combination of a plurality of test circuits, a meter, a signaling circuit, a plurality of line circuits, and means to disconnect the said meter from one of said test circuits and to connect said test circuit with said signaling circuit.

In testimony whereof, I have signed my name to this specification this 5th day of November, 1919.

CHARLES S. DEMAREST.