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ELECTRICAL TESTING SYSTEM

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2 Sheets-Sheet 1

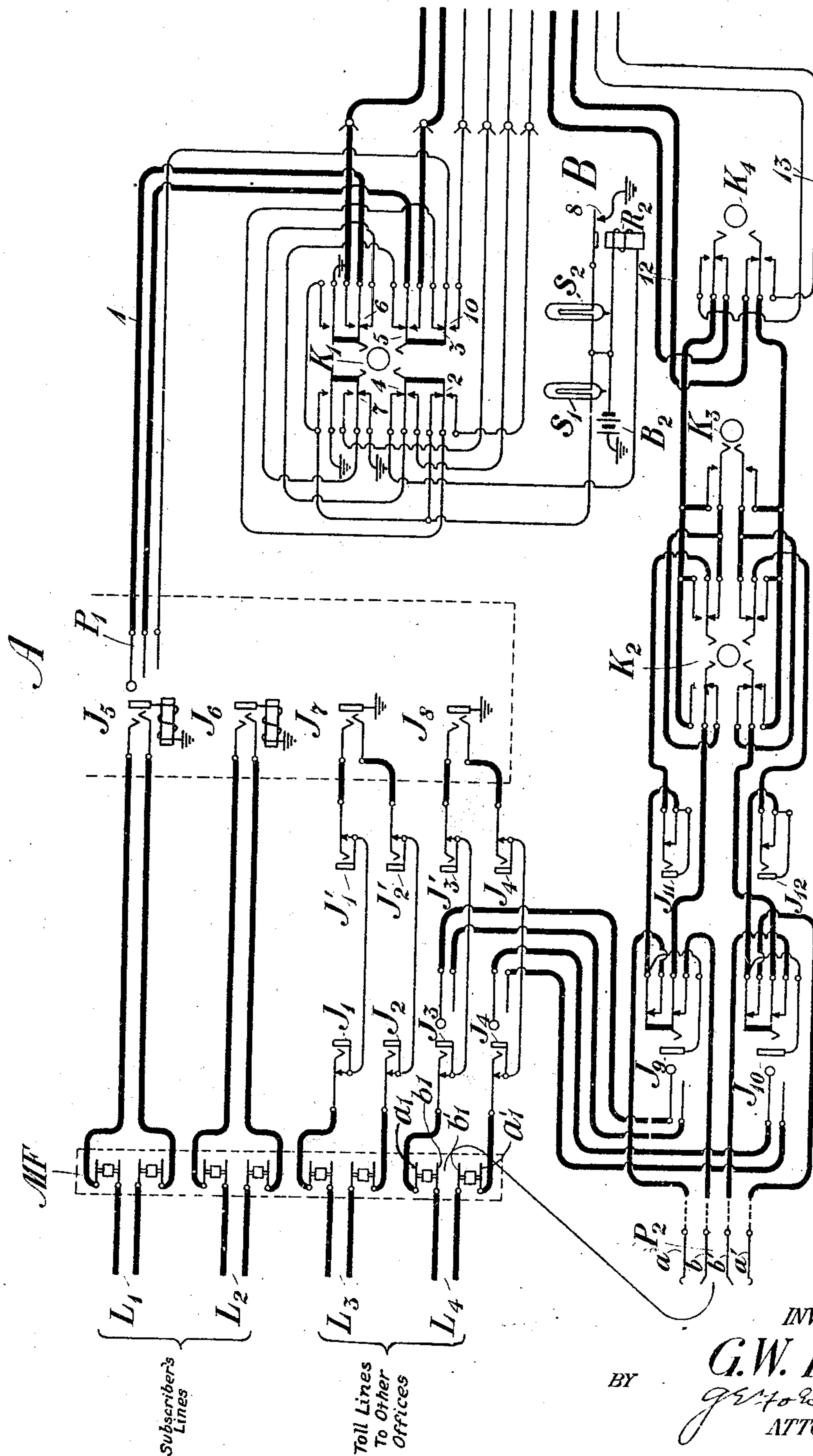


Fig. 1

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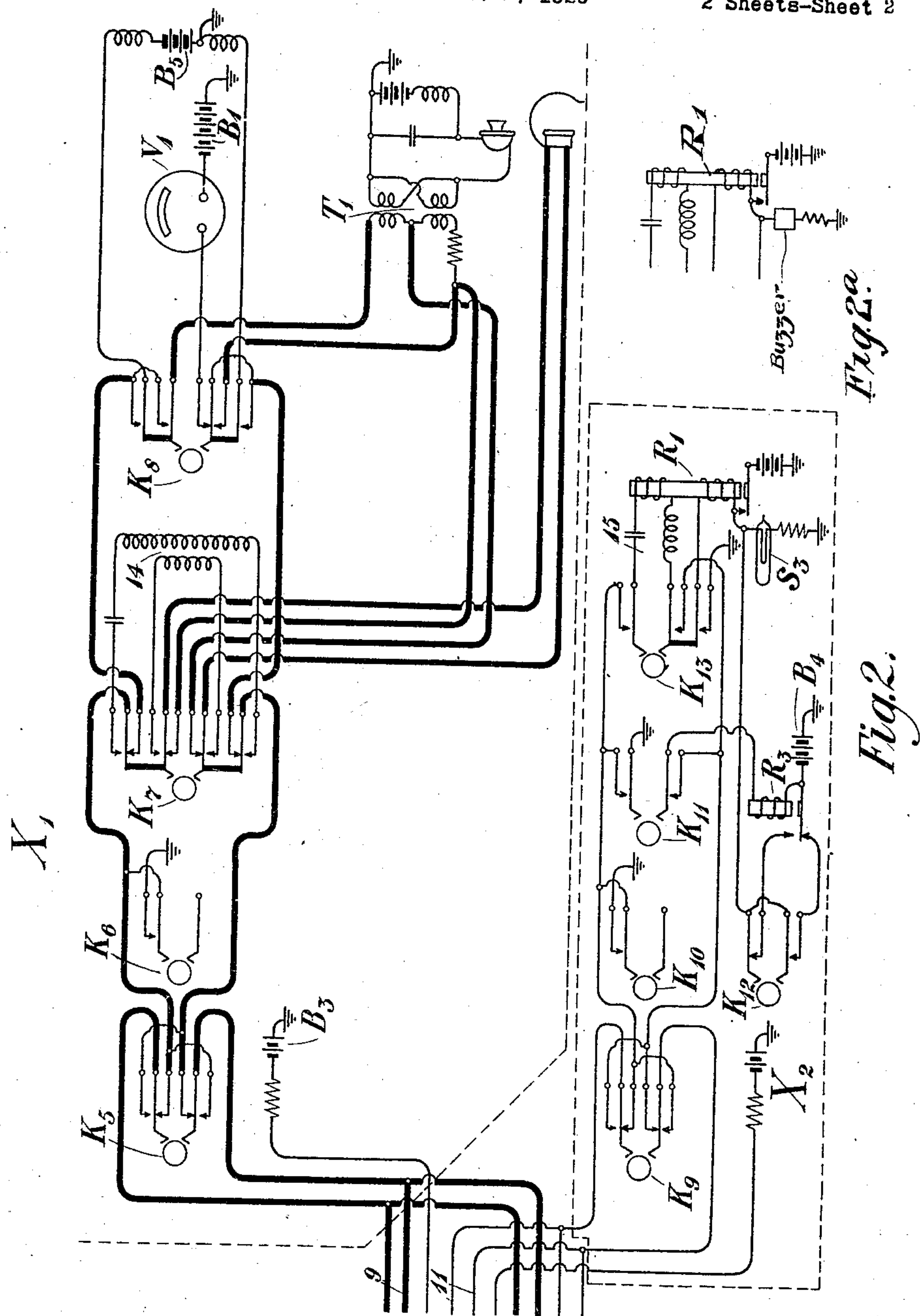
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

GEORGE W. KUHN, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL TESTING SYSTEM.

Application filed February 7, 1920. Serial No. 356,836.

To all whom it may concern:

Be it known that I, GEORGE W. KUHN, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Electrical Testing Systems, of which the following is a specification.

This invention relates to electrical testing systems and more particularly to an arrangement adapted for testing telephone or telegraph signaling circuits.

In testing systems heretofore used it has been customary to provide at the central office a test trunk or a group of such trunks extending for example from the switchboard, main distributing frame or jack panel to a test desk for the purpose of connecting telephone lines of various types with the testing circuits and apparatus located at the test desk. These test trunks normally terminated in jacks at the test desk which was equipped with a cord or a plurality of cords as a part of the permanent and fixed apparatus of the test desk to connect the test trunks with the testing circuits. One of the objects of this invention is to provide a test desk which is substantially cordless, that is, free from cords that form a part of the permanent key shelf equipment. In order to establish temporary connections between circuits which loop through the test desk and the testing circuit itself, patching cords of the well known removable type are provided, which form no part of the fixed apparatus of the test desk.

Furthermore it has been found desirable to divide into two separate testing circuits certain features which formerly were combined in a single testing circuit. Thus for example the volt-meter circuit, embracing a source of testing potential, and reversing and grounding keys together with a telephone circuit constitute what is hereinafter referred to as the primary testing circuit. Certain other features are grouped together in what is hereinafter referred to as the secondary testing circuit. Another object of this invention is to provide in connection with each test trunk from the test desk to the switchboard switching means for connecting the said trunk with either the primary or the secondary testing circuits. This invention also provides similar switching means associated with the test trunks from the test desk to the main distributing frame,

and with the patching cords within the test desk itself for connecting these circuits with either of said testing circuits.

Another object of this invention is to provide means for connecting together lines such as two incoming toll lines, so that the connecting link may be connected with either the primary or secondary testing circuits whereby the looped circuits may be supervised and tested.

These and other objects of the invention will be made clear from the following description when read in connection with the attached drawing embracing Figures 1 and 2, which when Fig. 2 is placed to the right of Fig. 1 shows a plurality of line circuits of various types, testing circuits and switching circuits adapted to connect the testing circuits with line circuits; and Fig. 2^a shows a detail of Fig. 2.

In Fig. 1, L_1 and L_2 represent subscribers' lines extending from the switchboard A to subscribers' stations. L_3 and L_4 represent two toll lines which extend from the switchboard A to other offices, and for the purpose of description it will be understood that they extend to two different offices. The lines L_3 and L_4 loop through the series jacks J_1, J_2, J_3 and J_4 and J_1', J_2', J_3' and J_4' , which are preferably located in the test desk B at the office in which switchboard A is located. The lines L_1, L_2, L_3 and L_4 are cross connected at the main frame MF with the drop side of the circuits, the line side and the drop side of each circuit being connected with the inner and the outer springs respectively of the protector at the distributing frame.

At the switchboard A the jacks J_5, J_6, J_7 and J_8 , serve to terminate the lines L_1, L_2, L_3 and L_4 , respectively. Also at this switchboard, and preferably at what is known as the "trouble position" thereof, is located plug P_1 , having a cord associated therewith which serves to terminate a test trunk 1 extending from the test desk B to the switchboard. Although a single plug and trunk are shown, it is to be understood that a plurality of these trunks and plugs may be provided depending upon the volume of testing. Associated with each trunk is a key K_1 , adapted to connect the trunk and any line that may be connected therewith with either the primary testing circuit X_1 or the secondary testing circuit X_2 . The

key K_1 has associated therewith the lamps S_1 and S_2 , S_1 indicating the connection of the trunk 1 with any of the circuits terminating at the switchboard, and S_2 responding to direct current signals transmitted over a line with which the trunk 1 may be connected, as, for example, the operation of the switchhook of a subscriber's telephone set.

Associated with the test trunk to the main frame is a group of jacks J_9 , J_{10} , J_{11} and J_{12} , which together with certain cords afford the means for connecting the lines L_3 and L_4 directly with the testing circuits X_1 and X_2 and also afford means for establishing a supervised looping connection between the lines L_3 and L_4 . Connected with the test trunk to the main frame and located at the main frame is a four-conductor plug P_2 which is adapted for insertion between the protector springs at the main frame, the contacts a and a' establishing connection with the drop side of the circuit and the contacts b and b' connecting with the line side of the same circuit. It should be noted that the connection between the line side and the drop side of a circuit is not opened when the said circuit is connected with the test trunk to the main frame either by means of cords between jacks J_1 , J_2 , J_3 , J_4 and jacks J_9 and J_{10} , or by inserting plug P_2 in the protector springs at the main frame. The circuit thus connected with the test trunk has its line and drop sides connected through the contacts of certain jacks and keys related to the test trunk, and the through connection between the line and the switchboard will be opened only by some subsequent operation. Associated with the test trunk to the main frame is a key K_2 which when operated towards the left serves to split the circuit and to connect the line side of the circuit with the testing circuits, and when operated to the right to split the circuit and to connect the drop side of the circuit with the testing circuits. Key K_3 is adapted to connect the test trunk with the testing circuits, without splitting said trunk when key K_2 is in its normal position. K_4 is a switching key designed to connect the test trunk and any associated circuit with either the testing circuit X_1 or X_2 .

Fig. 2 shows schematically two testing circuits X_1 and X_2 . In X_1 we have represented the principal features of the well known telephone line testing circuit. V_1 represents a volt meter having connected thereto a testing battery B_1 of suitable potential. Battery B_5 is adapted to supply talking current to a line with which the circuit X_1 may be connected. Associated with the testing circuit X_1 is a reversing key K_5 , adapted to reverse the connection of the tip and ring conductors with respect to the volt meter and testing battery. The key K_6 is designed to connect one side of the line with ground.

The keys K_7 and K_8 connect the telephone set T_1 with the testing circuit, the key K_7 establishing simply a monitoring connection and the key K_8 a complete talking connection. The circuit X_2 is designed to cooperate with the circuit X_1 in the performance of certain tests and is also adapted to operate independently of X_1 in the performance of other tests. The key K_9 is designed to reverse the connections of the two sides of the line, and key K_{10} to ground one side of the said line. Keys K_{11} and K_{12} are designed to control the signaling apparatus functioning in a supervisory capacity and assisting the test man in clearing trouble upon certain circuits, which will be more fully described hereafter. The key K_{13} serves to bridge across the sides of the circuit X_2 the relay R_1 which serves to operate the lamp S_3 whenever a ring-down signal is received over a line with which the circuit X_2 may be connected.

Having in mind the foregoing description of the circuits in which the invention is embodied, and the functions they perform, the invention will be made clear from the following description of the mode of operation of these circuits. Let it be assumed that an outside troubleman has called the office over the subscriber's line L_1 , and established communication with the operator at A. The operator will thereupon connect the said line with the test trunk 1 by inserting the plug P_1 in the jack J_5 , which establishes a circuit from battery B_2 , lamp S_1 , contacts 2 and 3 of key K_1 sleeve contacts of plug P_1 and jack J_5 and cut-off relay to ground, thus lighting lamp S_1 to attract the attention of the testman. The cut-off relay of line L_1 is also operated thereby.

Since the battery B_2 is connected through the winding of relay R_2 with the ring side of the line and the tip side of the line is normally grounded over the contacts 6 and 7 of key K_1 , the relay R_2 would respond when the troubleman's telephone set was bridged across said line, and the lamp S_2 would be lighted by current from the battery B_2 , through contact 8 of relay R_2 . The lighting of the lamp S_2 leads the test man to operate the key K_1 towards the right, thereby connecting the line L_1 over the test trunk 1 and the conductors 9 with the testing circuit X_1 . By the operation of the key K_8 associated with the circuit X_1 , the test man would be enabled to talk with the troubleman on the line L_1 . By the operation of the key K_1 , the relay R_2 would be released, due to the opening of the contact 5, which would extinguish the lamp S_2 but the release of the cut-off relay of line L_1 is prevented however by flow of current from the battery B_3 of the circuit X_1 , over contact 10 of key K_1 and the sleeve circuit heretofore traced.

The test man after communicating with the lineman will probably test the circuit by means of the volt meter and the keys K_5 and K_6 to determine whether or not the line is O. K. If the test shows that the fault still exists on the line it will necessitate further inspection and work on the part of the troubleman. Since the major portion of line testing is done with the apparatus of the circuit X_1 , it is undesirable to tie up this apparatus with the particular circuit upon which the troubleman is trying to locate a fault especially if at the same time there are other lines upon which tests are desirable. In order therefore to release the circuit X_1 and at the same time to maintain the continuity of the circuit between the test desk and the troubleman in the field, the key K_1 is operated towards the left which serves to connect the line L_1 and the trunk 1 with the secondary testing circuits X_2 . If the key K_{11} of circuit X_2 is also operated, the relay R_3 and battery B_4 will be connected with the circuit and the said relay will be responsive to the bridging of the troubleman's telephone set across line L_1 . The operation of relay R_3 will effect the lighting of lamp S_3 thus indicating to the testman that the troubleman wants to talk to him. The testman will then operate the key K_1 to the right to connect the test trunk with the circuit X_1 with which the telephone T_1 is associated. It will be seen from the foregoing that this arrangement provides a cordless test desk having a plurality of test trunks to the switchboard, each having a signal to indicate when the test trunk has been connected with a line, also a signal responsive to the connection of a telephone set across the said line, switching means adapted to connect the line under test with each of a plurality of testing circuits, one of the said testing circuits having a relay associated therewith, which is responsive to the connection of the telephone set with said line.

The test trunk from the test desk to the main frame facilitates the connecting of the testing circuits with the line circuits at some point between their terminals such as the main frame, jack panel, etc., instead of at a terminating point such as the switchboard. The function of this test trunk will be made clear from the following description of the various ways in which it may be used.

In order to determine whether a circuit trouble exists on the drop side or on the line side of the main frame, a testing connection may be made by inserting the plug P_2 between the spring contacts at the main frame in a manner that is well known to those familiar with the art. This does not split the circuit which still remains closed through the contacts of jacks J_9 , J_{10} , J_{11} and J_{12} and of the key K_2 . Since it is desirable

to test or listen in on the circuit before opening it, this may be done by operating the key K_3 and K_7 , which will serve to connect the receiver of the set T_1 of the circuit X_1 with the line circuit which the plug P_2 is connected. By operating the key K_2 to the left, the line conductors associated with the contacts b and b' will be connected through the key K_4 and conductors 12 with the circuit X_1 by means of which the usual test for the location of faults may be made. By operating the key K_2 to the right, the conductors of the drop side of the circuit will be connected over the contacts a and a' , and conductors 12 with the circuit X_1 . In this way a determination may be made whether the fault in a circuit exists on the line side of the main frame or on the drop side of the frame.

After this preliminary test has been made, the test man will operate the key K_4 which serves to connect the test trunk to the main frame with the circuit X_2 . If the test showed the fault to be on the line side of the circuit, that is to say outside the office, a troubleman would be sent to locate and, if practicable, clear the trouble. In order to facilitate communication between the troubleman and the testman, suitable signaling means have been provided at the test desk. If the circuit upon which the troubleman is working is, for example a subscriber's line, the testman will maintain key K_{11} operated which serves to connect to the test trunk relay R_3 and battery B_4 which respond to the bridging of the troubleman's telephone set across the said line. If, for example, the circuit at fault is a toll line, key K_{13} will be operated which connects across the test trunk relay R_1 which responds to ringing current and lights the lamp S_3 . Upon the receipt of a signal in either way, the testman will take up the call in the regular way. If the trouble exists within the office that is to say on the drop side of the main frame, the key K_2 will be operated to the right, and the keys K_4 and K_{11} will also be operated. If the trouble is a short circuit, or a ground on the ring side of the line current will flow from battery B_4 over the ring side of the circuit to ground either at the fault, or, if short circuited, at the contact of key K_{11} . This will cause the operation of the relay R_3 which in turn will cause the lighting of the lamp S_3 or the operation of an audible signal such as a buzzer as shown in Fig. 2^a. If a buzzer is used in place of or in addition to the lamp S_3 , the continued operation of the buzzer during the time necessary to locate the trouble would be annoying. Accordingly, the key K_{12} is operated, which by the opening of its upper contact, opens the circuit through the lamp

S₃ and the buzzer. When the short circuit has been cleared, the relay R₃ will be released, thereby allowing its armature to fall back, which closes a circuit from battery
 5 B₄ through the lower contact of key K₁₂ to the lamp or the buzzer associated therewith. The lighting of the lamp or the operation of the buzzer indicates to the testman that the fault has been cleared. It will be seen
 10 from the foregoing that this arrangement provides a test trunk adapted to connect each of a plurality of testing circuits with a line circuit at some point between the terminals of the said line circuit without
 15 rendering the said line circuit discontinuous. The test trunk, is, however designed to be split, whereby either the line side or the drop side of a line circuit connected thereto may be connected with either of said testing
 20 circuits in order to be tested or to have connected thereto suitable signaling apparatus responsive to signals from a troubleman working upon said line circuit.

Furthermore it is practicable to make
 25 tests upon lines such as L₃ and L₄ which loop through jacks at the test desk by connecting the jacks such as J₃ and J₄ with the jacks J₉ and J₁₀ by means of cords having plugs at each end adapted for insertion in
 30 their respective jacks. It will be seen that when a connection by means of double plugged cords as shown in Fig. 1 has been established and the key K₂ remains in its normal position, the test trunk and its asso-
 35 ciated line circuit L₄ are not split at the test desk but continue to be connected with the jack J₈ at the switchboard A. The line L₄ may be tested in each direction from the jacks J₃ and J₄ in a manner similar to that
 40 pursued when the plug P₂ was inserted in the spring contacts of the main frame, heretofore described.

If as previously stated, the line L₃ is assumed to extend to a different office from
 45 that to which the line L₄ extends and it is desired to connect these two circuits together at the test desk B in order to form a continuous circuit between these two different offices and at the same time super-
 50 vise at the test desk the connection thus established, it may be done in the following manner. The line jacks J₁ and J₂ may be connected with the jacks J₉ and J₁₀ respectively, by means of single conductor cords
 55 which connect together the tip contacts of the respective pairs of jacks. In like manner the line jacks J₃ and J₄ may be connected with the jacks J₁₁ and J₁₂, respectively. It will be seen therefore that the
 60 tip side of line L₃ will be connected with the tip contact of jack J₉ and through the contacts of key K₂ and the tip contact of jack J₁₁ with the tip side of the line L₄. Similarly the ring side of the line L₃, which
 65 is associated with the jack J₂ will be con-

nected with the ring side of the line L₄, which is associated with the jack J₄.

It will be seen from the foregoing that all of the terminal apparatus associated
 70 with the drop side of the lines L₃ and L₄ has been disconnected therefrom by the insertion of the plugs of the cords in the jacks J₁, J₂, J₃ and J₄. When this looping connection has been established it may be
 75 supervised and tested by the manipulation of the proper keys associated with the test trunk and the testing circuits. By the operation of the keys K₃ and K₇ a high impedance repeating coil 14 is bridged across
 80 the looped circuit. If it is desired that the distant offices of the lines L₃ and L₄ shall be able to signal the office at which the test desk is located, this may be done
 85 by operating keys K₃, K₄ and K₁₃. As the result of the operation of these keys, the looped circuit formed from the lines L₃ and L₄ still remains unopened at the test desk
 90 B but has bridged across it the relay R₁ which is responsive to ringing current transmitted over either lines L₃ or L₄. The retardation coil 15 inserted in series with
 95 the winding of the relay R₁ is adapted to cut down transmission losses when the relay is bridged across the looped circuits. From the foregoing it is apparent that this
 100 arrangement provides a simple means for looping circuits that terminate in the same office and for supervising the circuits thus established. Such supervision may be maintained either by means of the telephone cir-
 105 cuit T₁ of the circuit X₁ or by means of a ring down relay such as the relay R₁ of the circuit X₂.

Although this invention has been shown embodied in a specific form, it is apparent
 105 that it is capable of embodiment in other forms within the scope of the appended claims.

What is claimed is:

1. In a testing system, the combination
 110 of a telephone line circuit terminating at a switchboard but adapted to loop through a plurality of jacks located at a test desk, a plurality of testing circuits, a test trunk
 115 for connecting with any of said testing circuits, a plurality of patching cords to connect said line circuit with said test trunk, the said test trunk having switching means
 120 associated therewith whereby said line circuit may be opened for testing in each direction from said point of opening.

2. In a testing system, the combination
 125 of a plurality of telephone line circuits adapted to terminate at a switchboard, each circuit having a plurality of jacks associated therewith and located at a test desk through which the said line circuits loop,
 130 a plurality of testing circuits, a test trunk for connecting with each of said testing circuits, a plurality of cords adapted to con-

nect with the said test trunk the line side of each line circuit whereby the incoming line circuits may be connected together, the said test trunk having means associated therewith for connecting the looped line circuits with the said testing circuits for supervision and testing.

3. In a testing system, the combination of a plurality of line circuits, a plurality of test trunks extending from a test desk to a switchboard each adapted for connection with any line circuit, a plurality of testing circuits and a plurality of switching means individual to each test trunk to connect the respective trunk with any of said testing circuits.

4. In a system for testing signaling circuits, the combination with a subscriber's circuit of a switchboard at which the said circuit is terminated, a toll circuit also terminating at the said switchboard, a test-desk having jacks therein through which the said toll circuit loops, a plurality of testing circuits, a testing trunk extending from the said test-desk to the said switchboard

and having means to connect the said subscriber's circuit with any of said testing circuits, and a second testing trunk also having means to connect the said toll circuit with any of said testing circuits.

5. In a system for testing signaling circuits, the combination with a subscriber's circuit of a switchboard at which the said circuit is terminated, a toll circuit also terminating at the said switchboard, a test-desk having jacks therein through which the said toll circuit loops, a testing circuit having a galvanometer and a telephone set connected therewith, a second testing circuit having connected therewith a signaling device responsive to signals transmitted over either the said subscriber's circuit or the said toll circuit, and testing trunks having means to connect the said subscriber's circuit and the said toll circuit respectively with either of said testing circuits.

In testimony whereof, I have signed my name to this specification this 5th day of February, 1920.

GEORGE W. KUHN.