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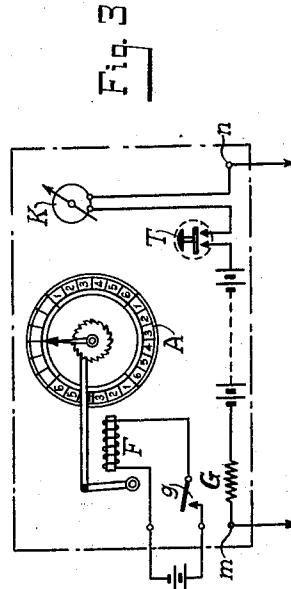
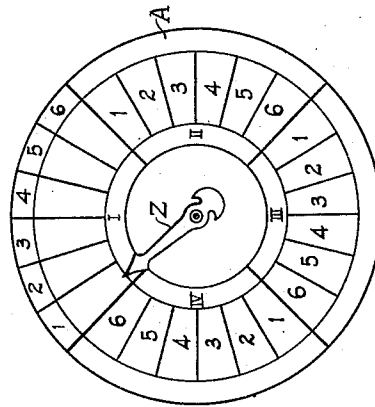
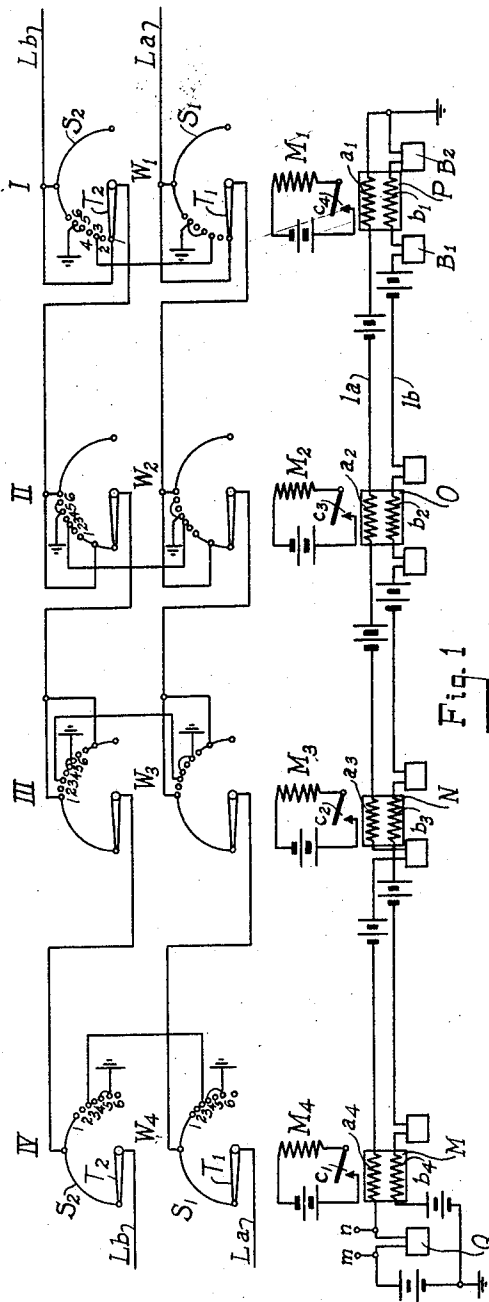
1,699,415

G. WETZEL

TELEPHONE SYSTEM

Filed Sept. 30, 1927

2 Sheets-Sheet 1



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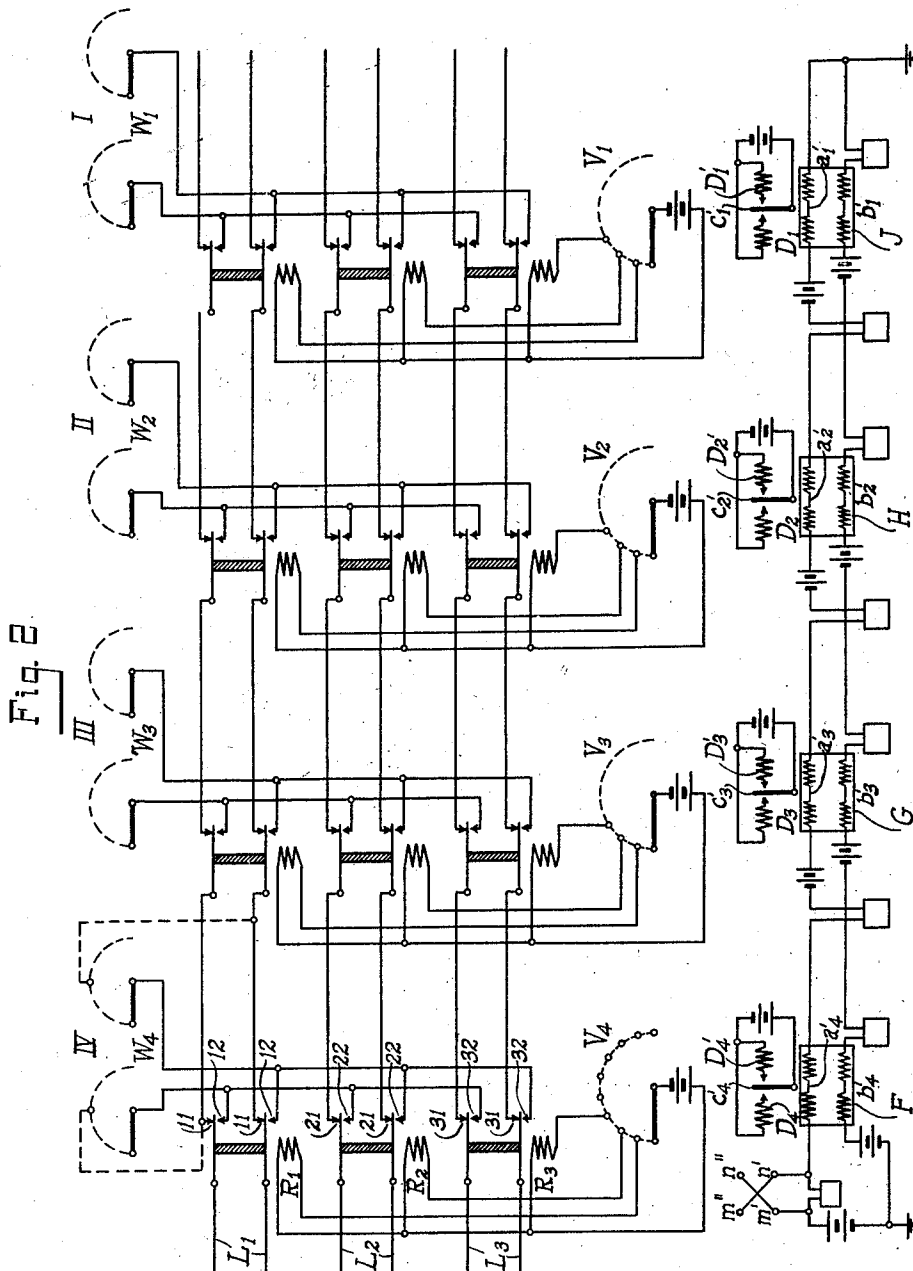
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed September 30, 1927, Serial No. 222,976, and in Germany November 20, 1926.

The present invention relates in general to telephone systems, more particularly to the testing of the lines of a telephone system, and the principal object of the invention, briefly stated, is a new and improved testing system, which enables a testman to determine the electrical characteristics of a long telephone line from a centralized point.

According to the objects of this invention, a telephone line of considerable length, for example a toll line, is divided into a plurality of sections, and at each section point, there is provided a switching mechanism through the operation of which the line is opened, shorted, or grounded at that point, thereby enabling the testman to determine the electrical characteristics of the line by means of the usual and well known telephone testing devices.

According to a further object of this invention, the switching devices, located at the section points of the telephone line, are operated in synchronism, over a separate or control circuit, to progressively test the telephone line at succeeding section points.

Further objects of the invention, not specifically mentioned here, will be best understood from the detailed description and claims which follows:

The drawings comprising Figs. 1 to 4, inclusive, show sufficient details to enable a clear understanding of the invention.

In Fig. 1, I show a telephone line LA and LB, divided into sections I, II, III and IV, provided with the switch mechanism W^1 to W^4 , respectively, located at the division points. The switch mechanisms are under the control of the magnets M^1 to M^4 , respectively, and the magnets are operated over the control circuit 1^a-1^b .

In Fig. 2, I show the invention adapted to test a group of lines, such as L^1 , L^2 and L^3 , those lines being respectively divided at the points I, II, III and IV, with the switches V^1-V^4 and W^1-W^4 , respectively located at the division points. These switches are controlled over the control line shown at the bottom of the figure, through the medium of the relays F, G, H, and J.

In Fig. 3, I show the details of the test control, which includes the impulse transmitter T, indicator A, stepping magnet F, and volt meter K.

In Fig. 4, I show a detail view of the indicator A.

Referring now more particularly to Fig. 1, the toll transmission line LA and LB, is assumed to be a line of considerable length, divided at the division points I, II, III, IV. At each division point is located a testing switch W, such as W^1 , including the wipers T^1 and T^2 , which sweep over the banks S^1 and S^2 , respectively. This switch may preferably be of the type of the well known rotary line switch, whose wipers are moved in a step by step direction in a single plane over a bank of contacts. The switch wipers T^1 and T^2 are driven by the motor magnet M^1 , under the control of the contacts C^1 , which are contacts on the relay P. At each switching station the signalling devices B^1 and B^2 are also located, these are assumed to be Morse signalling devices. The particular type of devices B^1 and B^2 is immaterial, as they do not form a part of the present invention. The control circuits, however as has been previously indicated, are assumed to be Morse circuits, operating independently of the testing equipment by the usual low potential current supplied by the batteries shown in the circuit. The relays such as M, N, O, P, are high potential relays, which do not respond to the currents which operate the Morse signalling devices B^1 and B^2 . If for example the testman desires to determine the condition of the toll line LA, LB, at the switching points I, II, III, IV, he removes the signal Q and connects the test control box, shown in Fig. 3 to the circuit. Terminals m and n of the test box are connected to the terminals m and m , respectively, of the control circuit, thereby inserting in the control circuit 1^a and 1^b the relay G, the test battery, impulsing device T, and the voltmeter K. The addition of the test battery to the control circuit raises the potential therein to a point sufficiently high to permit the relays M, N, O, P to operate, thereby rendering the switches W^1 to W^4 , inclusive, responsive to manipulations of the calling device T. Since it is assumed that the despatcher first desires to investigate the conditions at switch point I, he will operate the calling device to transmit one impulse. Relay G and the test mechanism, and relays M, N, O, P will all operate responsive to this impulse. Relay G closes contact g , thereby completing a circuit for the magnet F of the indicator A, at the test device, advancing the indicator alarm X one

step to position 2. Relays M, N, O, respond to close their respective contacts C¹, C², C³ thereby completing circuits for the motor magnets M², M³ and M⁴, which energize to advance the wipers of the switch mechanism W², W³ and W⁴, one step, this advance being without particular effect at this time since the contacts now engaged by the respective wipers are multiplied to the contacts upon which the wipers were resting, thereby producing no circuit changes. Relay P responds, and closes the contact C⁴ to close a circuit for the magnet M¹, to advance the switch mechanism W¹ one step, onto contacts 2. Wipers T¹ and T² when positioned up on their respective second bank contacts, open the conductors La and Lb to measure the capacity of those conductors, since they are open circuited, and he may also determine the insulation resistance of the conductors with respect to ground, and also with respect to each other. After he has performed these tests to his satisfaction, he reoperates his calling device to transmit another impulse, to move the switch W¹ to W⁴ inclusive, another step, so that their wipers are resting on their respective contacts 3. W² to W⁴ again produce no useful result by this movement. Switch W¹ in moving to position 3, short circuits the line conductors La and Lb, traceable from the left hand end of La, through the wiper T¹ and the bank contact S¹ from the switch W⁴, the wipers and banks of switches W³ and W², wiper T¹ of the switch W¹ in its third bank contact, wiper T² of the switch W¹, and its third bank contact through the upper wipers of the switches W², W³, and W⁴ and their respective bank contacts, to the line conductor Lb. The testman may now make a continuity test of the line conductors and may measure their combined resistance. When the testman has completed these tests, he operates the calling device T to transmit another impulse, to step the switch wipers another step. Switch W¹ in moving to position 4, places a ground upon the line conductor La through the wiper T¹ and its fourth bank contact, and at the same time the wiper T² of the switch W¹ engages an open contact, thereby leaving the line Lb open, the test man may determine the continuity of the line La, and the insulation resistance between the lines La and Lb.

When the testman again operates his calling device T, the switches are advanced another step, and conditions at the switching point I are reversed, that is, Lb is grounded and line La, is disconnected. The same test have been applied to the line in the reversed order. Responsive to the dialling of another digit, the switches are moved another step, and both of the line conductors are grounded. After the test man has completed his test in position 6 with both line conductors grounded, he reoperates the impulsing device

to move the switches W¹ to W⁴ inclusive, another step, bringing the switch W¹ into engagement with its 7th bank contact position, at which point the line conductors La and Lb are again connected through.

It will be noted that the switch W² is now engaging its bank contact 1, preparatory to performing the same switching and testing operations just enumerated, at the position point II, so that the next six impulses will remove the switch W² from its contacts 1 to 6 inclusive, opening, shorting and grounding the lines La and Lb at point II, in the manner just described. After the six impulses have been delivered to the motor magnets of the switches to apply the tests at the division point II, the wipers of the switches are standing in such a position that the wipers of the switch W³ engage their contacts 1 so that the next six impulses will move the switches to apply the same test at the division point III. Similarly at the end of the transmission of these impulses, switch W⁴ engages its contact #1, thereby positioning it to be responsive to the next six impulses to apply the test at the division point IV.

Thus it will be seen that by repeated operations of the calling device T and the application of the testing devices well known in telephony, a testman can determine the condition of the line La and Lb by dividing it at section points, and applying the test at each section, locating the fault as existing between two of the switching points. The testman is constantly informed as to where he is applying the test by the indicator Z moving over the dial A, it being noted that the dial is divided into four major sections labeled I to IV, inclusive, and that each of these major sections are divided into six parts indicating the six tests to be applied at the various switching points. In an installation of the kind just described, the dial A shown in Fig. 4 would be labeled in each of the substations of the four major sections as follows:

1. La and Lb switched through.
2. La and Lb disconnected.
3. La and Lb shorted.
4. La grounded, Lb open.
5. Lb grounded, La open.
6. La and Lb grounded.

Referring now to Fig. 2, I have shown a modification of the present invention adapting it to control three lines L¹, L² and L³. In this embodiment of my invention, polar relays F, G, H, and J are inserted in the control circuit. Polar relay F comprising windings a'⁴ and b'⁴ control the contact C'⁴, and energizes in one direction to close the circuit to the magnet D⁴ to control the switch W⁴, this switch being similar to the switches described hereinbefore, is operated to apply to the test at the point IV. When the polar relay F is operated in the opposite direction to

energize the magnet D^4 , the selecting switch V^4 is operated to determine to which one of the three lines the tests are to be applied. Instead of running the lines directly through the switch wipers as in the embodiment shown in Fig. 1, the lines are run through the relays R^1 , R^2 , and R^3 , respectively. With R^1 in its normal position, line L^1 is connected directly through the switching section; when relay R^1 is energized, it closes contacts 12, and the line L^1 is connected through to the switch W^4 , so that on the operation of that switch, the aforementioned tests may be applied to the line L^1 . Similarly the energization of relay R^2 connects the line L^2 to the switch W^4 to permit the application of the tests to the line L^2 , and the operation of relay R^3 which connects the line L^3 to the switch W^4 to permit the application of the test to the line L^3 .

When the testman desires to make a test on a particular one of the lines shown in Fig. 2, he connects two test mechanisms, to the control circuit at points $m' n'$ and $m'' n''$. These test mechanisms are similar to the one shown in Fig. 3. The device connected to points $m'' n''$, is altered in that the indicator a indicates lines instead of sections and tests, and the battery in the mechanism is of sufficient potential to operate the relays F, G, H, J when it opposes the batteries normally in the circuit. An operation of the calling device of this test mechanism, operates the polar relays to move contacts C^4-C^1 to the right, thereby closing the circuits of magnets D^4-D^1 respectively, to operate those magnets, which control the switches V^4-V^1 respectively. By this operation, the testman selects one of the lines, for example, L^1 , the switches V moving their wipers in position to energize the relays R^1 , to connect the line L^1 to the switches W , at the four switching points. The testman is apprised of the selection, by the indicator associated with the calling device he has operated.

The testman now operates the calling device of the test mechanism which is connected to the points $m' n'$, to operate the polar relays F, G, H, J in the opposite direction. Contacts C^4-C^1 now close the circuits of magnets D^4-D^1 respectively, to operate the switches W^4-W^1 . By repeated operation of the calling device, the line L^1 may be tested in the precise manner hereinbefore pointed out.

Having thus described my invention, what I consider new, and desire to have protected by Letters Patent, is pointed out in the appended claims.

What is claimed is:

1. In a telephone system, a plurality of

telephone lines each divided into sections, means including a selecting switch at each of said sections for altering said lines, means for selecting one of said lines, and means for operating said selecting switches in unison to alter said selected line at its sections in a prescribed order.

2. In a telephone system, a plurality of telephone lines each divided into sections, a selecting switch at each of said sections, wipers on said switch, contacts engaged by said wipers, means of selecting one of said lines and means for operating said selecting switches to move said wipers over their respective contacts, and means including circuits controlled by said wipers for applying a series of testing conditions to said line at each of its sections in order.

3. In a telephone system, a line, a plurality of selecting switches associated with said line, wipers on said switches, contacts over which said wipers move, testing circuits prepared through a group of said contacts in each of said switches, means for operating said switches simultaneously to move said wipers into engagement with said contacts said contact groups being so arranged that at any time only one switch wipers are in engagement with a test group, and means controlled through said wipers and test contacts for testing the condition of said line.

4. In a telephone system, a plurality of lines each divided into sections, a line selector and a testing switch at each of said sections, a control circuit associated with said lines, and means for first operating the line selectors, over said control circuit to select one of said lines and for then operating the testing switches to apply testing conditions to said selected line.

5. In a telephone system, a plurality of lines each divided into sections, a line selector and a testing switch at each of said sections, a control circuit associated with said lines, polarized relays in said control circuit, means for applying current to said control circuit to operate said relays in one direction and for reversing said current to operate said relay in the opposite direction and means controlled by said relay operated in the first direction for operating said selectors to select a line and controlled by said relay operated in the opposite direction for operating said test switches to apply test conditions to said selected line.

In witness whereof, I hereunto subscribe my name this 6th day of September, A. D. 1927.

GUSTAV WETZEL.