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J. HERMAN

TELEGRAPH SIGNALING SYSTEM

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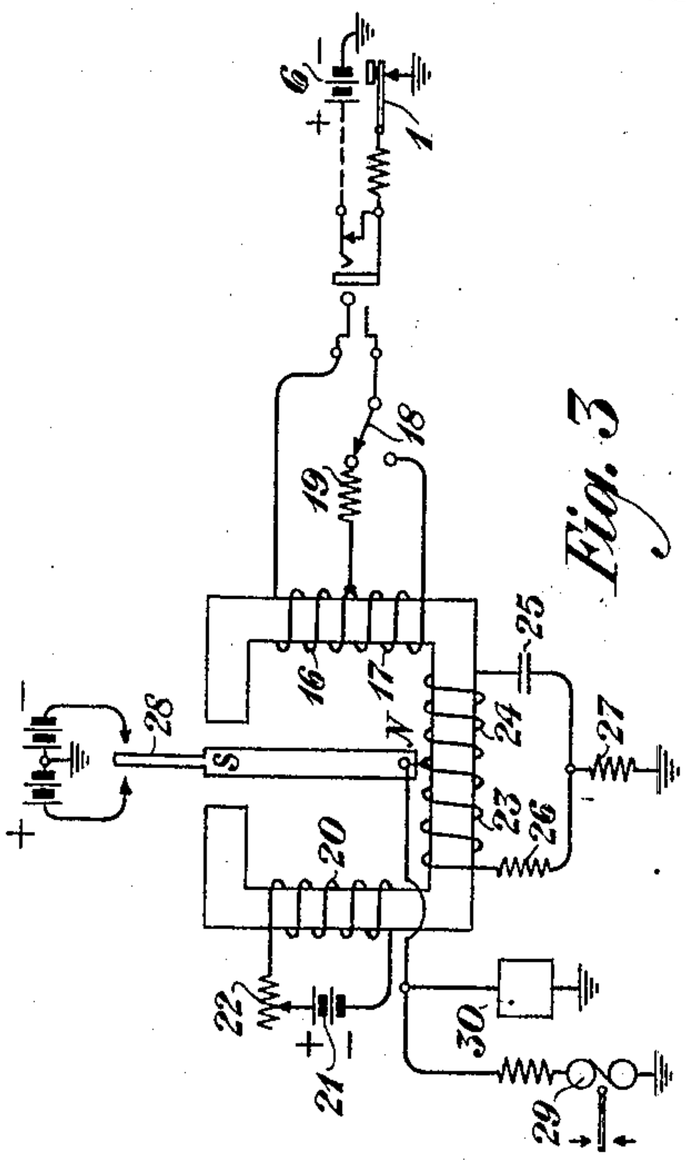

Fig. 1

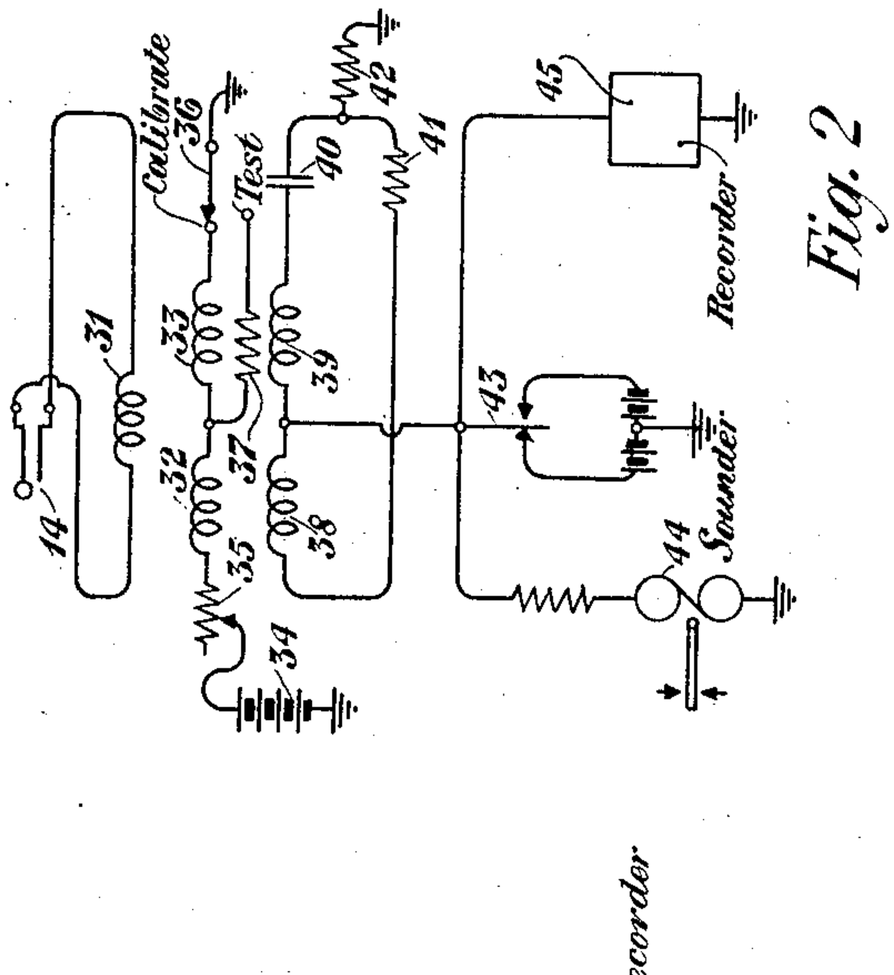

Fig. 2

Fig. 3

INVENTOR
J. Herman

BY

ATTORNEY

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JOSEPH HERMAN, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEGRAPH SIGNALING SYSTEM.

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To all whom it may concern:

Be it known that I, JOSEPH HERMAN, a citizen of the Republic of Austria, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Telegraph Signaling Systems, of which the following is a specification.

This invention relates to telegraph signaling systems and particularly to means for the removal of bias from a polar relay operating in a telegraph loop or other open and close circuit.

It is frequently necessary to take tape records in a telegraph loop circuit and particularly while the subscriber is sending. A polar relay provided with two balanced windings is generally used for this purpose. It is well known to those familiar with the art that subscribers' loop circuits are operated on the open and close principle, viz, when the key is closed current will flow through the loop and operate a pole changer at the terminal office by means of which an impulse of predetermined polarity will be applied to the line circuit. Upon the opening of the key at the subscriber's station current will cease to flow through the loop, and the pole changer will thereupon transmit an impulse of opposite polarity over the line circuit. Since it is desirable for the making of these tape records to use a polar relay, and since the circuit by which such relay is controlled operates on the open and close principle and not upon the reversal of polarity principle, it becomes necessary to provide a biasing circuit for the polar relay and to carefully adjust the magnitude of the biasing current so that the armature of the relay will be moved to one of its contacts when current flows through the loop circuit and will be moved to its other contact by virtue of the action of the biasing winding when current ceases to flow through the loop circuit.

In order to avoid interference with the subscriber's service it has been customary to adjust the relative values of the currents in the loop circuit and in the biasing circuit only when the loop circuit is idle, viz, when the subscriber is not transmitting signals thereover. The method adopted consisted in connecting a meter into each of the two circuits and adjusting the biasing circuit until the current therein is one-half that in the loop circuit. When using such method, it is necessary to interrupt the subscriber if the circuit is in use at the time or to delay the adjustment of the relay until the subscriber stops sending.

It is the object of this invention to eliminate the disadvantages inherent in the former practice so that full and complete adjustment may be made while the subscriber is sending and without interfering with the transmission of his signals.

This invention will be clearly understood from the following description when read in connection with the attached drawing of which Figure 1 shows one form of embodiment of the invention; Fig. 2 shows a modification of the polar relay recording circuit which may be substituted for the similar circuit shown in Fig. 1; and Fig. 3 shows schematically the arrangement of the windings upon the polar relay set forth in Fig. 1.

In Fig. 1, A represents a Morse subscriber station comprising a key 1, a line relay 2 and a sounder 3, which station is connected by means of the loop 4 with the pole changer 5 at the terminal station B. The pole changer 5 has connected therewith a source of potential 6 from which current will flow through the subscriber's loop whenever the key 1 is closed and will operate the line relay 2 and also the said pole changer. Connected with the pole changer 5 is a source of potential 7 by means of which impulses of opposite polarity may be applied through the armature of the pole changer and conductor 8 to the arms 9 of the line circuit with which are connected the line 10 and the artificial line 11. Bridged across the arms 9 is a polar relay 12 by means of which received impulses cause the operation of the receiving apparatus which, for the sake of simplicity, is not shown. Since this invention is concerned with circuits that operate on the open and close principle, of which the Morse subscriber's loop is a good example, I have shown the line apparatus, such as the pole changer and the main line circuit, in very simple form in order to avoid confusion.

Connected with the subscriber's loop circuit, and particularly with conductor 4, is a jack 13 through which the loop circuit is normally closed. This jack is adapted to

receive the plug 14 of the monitoring relay by means of which the tape records heretofore mentioned might be made. It will be seen that when the plug 14 is inserted in the jack 13 the contact 15 is opened and the loop circuit is rendered continuous through the loop windings of the polar relay. The circuit of the monitoring relay, normally connected with the loop circuit, comprises two windings 16 and 17, preferably equal, which are adapted to be connected serially with the loop circuit when the arm of the switch 18 is upon the contact designated "Test". The winding 17 is paralleled by a resistance 19 which is equal to the resistance of winding 17. When the arm of the switch 18 is upon the contact indicated "Calibrate", the winding 16 and the resistance 19 will be connected serially in the loop circuit. It is important to notice that regardless of the position of the switch 18 the resistance connected into the loop circuit remains the same. A third winding 20 of this relay is connected with the source of potential 21 and a variable resistance 22, and these three elements constitute the biasing circuit of this relay. Two other windings 23 and 24 are connected in the manner shown in the drawing with a condenser 25 and resistances 26 and 27, and the circuit comprising these various elements constitutes the vibrating circuit of this relay. This circuit is electrically connected with the armature 28 which is adapted to swing between two contacts connected with sources of potential of opposite polarity. The armature in addition to being connected with the vibrating circuit is connected with a polarized sounder 29 and also with a recording device 30 which may be of any well known type such as a tape-recorder.

The arrangement of the windings upon the core of the polar relay and the connection of this relay with the operating circuit is shown schematically in Fig. 3. The invention will be apparent from the following description read in connection with Figs. 1 and 3. The monitoring relay should first be adjusted mechanically so that its armature 28 will vibrate freely between its contacts when the biasing circuit and the circuit connected with the subscriber's loop are open. Assuming the armature 28 to be on its left-hand contact, current will flow from its positive contact through winding 23 and resistances 26 and 27 to ground, and a charging current will also flow through winding 24, condenser 25 and resistance 27 to ground, charging the said condenser. The flow of current through winding 23 will produce a flux in such direction as to draw the armature 28 from its left-hand contact. Thereupon, the condenser 25 discharges through the circuit including resistance 26, and windings 23 and 24, the direction of flow being such as to produce flux in the same direction as that produced by current from the battery through winding 23. This added impulse quickens the movement of the armature 28 towards its right-hand contact. As soon as the armature reaches the latter contact the negative pole of the battery is connecting with the windings 23 and 24, setting up flux in an opposite direction to that created by the positive pole and causing the armature to move back to its left-hand contact. The armature will thus vibrate freely so long as the biasing circuit and the circuit connected with the subscriber's loop are open. The biasing circuit is then closed and the relay is connected with the loop circuit by inserting the plug 14 in the jack 13. It is desirable to point out that the currents in the biasing circuit and in the circuit of the windings connected with the loop circuit should be in such directions that the effect produced by the windings of the respective circuits will be opposed to each other. This is clearly shown in Fig. 3. The switch 18 is set upon the contact marked "Calibrate" so that the winding 16 and the resistance 19 will be connected with the loop circuit while signals are transmitted over the loop by operating key 1. The resistance 22 in the biasing circuit is then adjusted until the armature of the relay vibrates whenever the subscriber transmits a dash, viz, whenever he closes the key of his circuit, which vibration is indicated by the operation of the polar sounder 29. When this condition has been attained, it will be seen that the effect of the biasing winding 20 upon the armature 28 is approximately equal and opposite to the effect of the winding 16 connected with the subscriber's loop. The two effects thus neutralize each other and permit the vibrating circuit to control the action of the armature, causing it to vibrate between contacts in the manner before described. If the switch 18 is now moved to the contact designated "Test", the two windings 16 and 17 will be connected serially with the loop circuit, and while the current flowing through the loop is the same as it was when the switch 18 was connected with the contact marked "Calibrate", the effect of such current upon the armature 28, viz, the flux produced, is twice as great as before. It will accordingly be seen that when the key 1 is open the biasing winding 20 controls the armature 28 keeping it, for example, against its left-hand contact. As soon as key 1 is closed, current through windings 16 and 17 causes the armature to move to its opposite contact. This is the condition for unbiased operation of the monitoring relay by the signal current in the subscriber's loop.

Fig. 2 shows a variation of the monitoring relay shown in Fig. 1. In Fig. 2 there is only one winding 31 connected in series with the loop circuit. The biasing circuit com-

prises a plurality of windings 32 and 33, a source of potential 34, a variable resistance 35, a fixed resistance 37, the magnitude of which is equal to that of the winding 33, and a switch 36 by means of which either the winding 33 or the resistance 37 may be connected into the biasing circuit. The vibrating circuit, similar to that in Figs. 1 and 3, includes the windings 38 and 39, the condenser 40, and resistances 41 and 42. The armature 43 is connected not only with the vibrating circuit but also with the polarized sounder 44 and the recording device 45.

In order to adjust the circuit shown in Fig. 2 so that the current in the biasing circuit may be approximately one-half that which flows through the winding 31, the plug 14 is inserted in the jack 13 while signals are being transmitted from the subscriber's station A over the loop circuit. Current will accordingly flow through the winding 31 and will act upon the armature 43 tending, for example, to hold it against the contact shown in the figure. With the arm of the switch 36 upon the contact point marked "Calibrate", the resistance 35 is varied until the current flowing through the biasing circuit is sufficient to cause the armature 43 to vibrate, which would be manifested by the operation of the polar sounder 44. Under this condition the effect of the current flow through the windings 32 and 33 in series is substantially equal and opposite to the effect of the signaling current through the winding 31 so that the armature is controlled by the vibrating circuit as described in connection with Fig. 1. Since the windings 32 and 33 are substantially similar and equal, the effect of the biasing circuit may be reduced one-half by cutting out the winding 33. This is done by moving the arm of switch 36 to the "test" contact which connects the resistance 37 in series with the winding 32 and the other elements of this circuit, and since the resistance of 37 equals that of winding 33 the current flow through winding 32 remains the same as before, but the effect of the biasing circuit is only one-half as great as that of winding 31.

The arrangement shown in Fig. 1 is believed to be the preferable form, because the operating force upon the relay never exceeds the normal operating force. In the case of the circuit shown in Fig. 2, the operating force during calibration is twice the normal value whenever the subscriber opens his key. This effect may prevent proper adjustment of the relay due to the large amount of residual magnetism. Furthermore, in the case of the arrangement shown in Fig. 1, any mechanical biasing in the relay is neutralized by means of the biasing current. In the case of Fig. 2, however, only one-half the mechanical biasing is neutralized because of the fact that the biasing force is reduced to one-half its value when switching from the calibrating position to the test position.

When the monitoring relay shown, for example, in Fig. 1, is properly adjusted, the armature 28 will swing from one contact point to another as the circuit of the subscriber's loop is alternately closed and opened. Consequently sources of opposite polarity will be connected through the armature 28 with some form of recording device actuated by impulses of opposite polarity connected with the conductor 30. Such recording device might be a siphon recorder by means of which a tape record of the signals transmitted over the subscriber's loop might readily be obtained.

Although this invention has been disclosed as embodied in a particular form and arrangement of parts, it is not so limited but is capable of embodiment in other and different forms within the scope of the appended claims.

What is claimed is:

1. In a telegraph system, the combination with a subscriber's loop circuit characterized by the opening and the closing of the circuit for the transmission of signals, of a polarized monitoring relay connected with the said loop circuit having a sectionalized line winding, each section being substantially equal in magnitude to the other and all sections being normally effectively in series with the said loop circuit, means for substituting for one of said sections a resistance element equal in magnitude to the said section, a biasing winding having a source of current and current controlling means connected in series therewith, and a vibrating circuit to effect the vibration of the relay armature.

2. In a polarized relay, the combination with an operating winding connected with a line circuit, of a biasing winding having means to vary the current therein, a vibrating circuit arranged to cause the relay armature to vibrate, the said operating winding being arranged in two substantially equal parts normally in series, and means to effectively disconnect one of said parts and to substitute therefor a resistance in series with the other part, the said resistance being substantially equal in magnitude to the disconnected part of the said winding.

3. In a polarized relay, the combination with an operating circuit comprising two connected windings, a resistance connected with the junction point of the said windings, switching means for effectively connecting into said circuit both of said windings in series, or one of said windings in series with the said resistance, a biasing winding having means to vary the current therein, the said operating winding and biasing winding being so poled as to effect the armature of

the said relay in opposite manner, and a vibrating circuit causing the relay armature to vibrate between its contacts when the currents in the operating and biasing windings substantially neutralize each other.

4. The method of adjusting for proper operation a polar relay of the type defined by claim 2 connected with a circuit operating on the open and close principle, which consists in varying the current flow in the biasing winding until the effect thereof on the armature is substantially equal and opposite to the effect produced upon the armature by the line current flowing through one of said line windings in series with a resistance element of equal magnitude, then effectively disconnecting the said resistance from the line circuit and substituting another line winding therefor.

5. In a circuit of the type defined by claim 2, the method of adjusting the polar relay for proper operation which consists in varying the current in the biasing winding until it neutralizes the effect of the current in the line winding, and detecting the condition of neutralization by the free vibration of the armature of the relay controlled by the vibrating circuit.

In testimony whereof, I have signed my name to this specification this 6th day of December 1923.

JOSEPH HERMAN.