Feb. 14, 1933. W. J. TIETZ 1,897,596

INSTRUMENT FOR VARYING ELECTRICAL POTENTIAL

Filed July 12, 1927

Fig. 1.

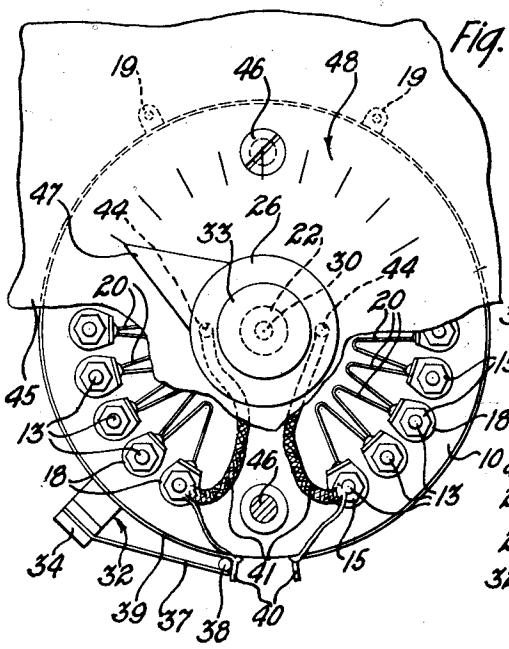


Fig. 3.

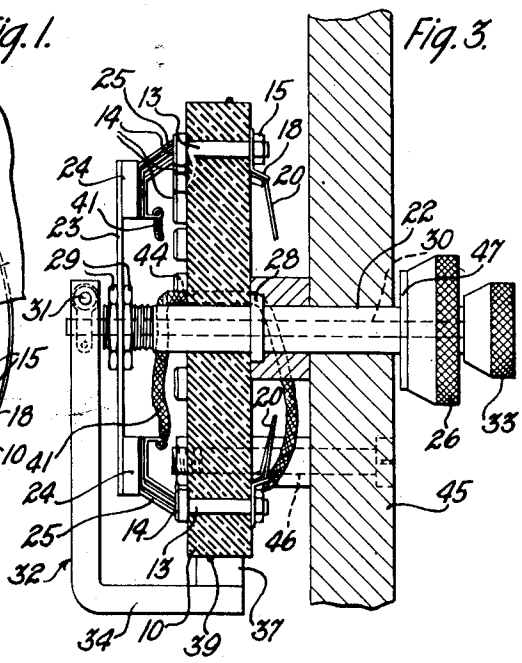


Fig. 4.

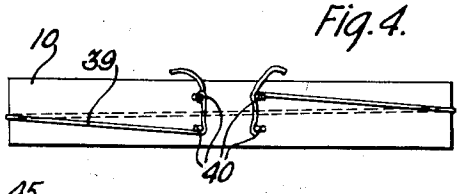


Fig. 2.

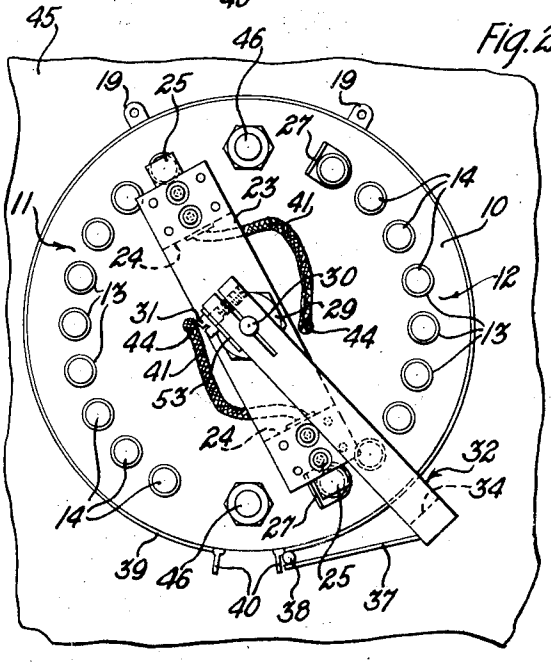
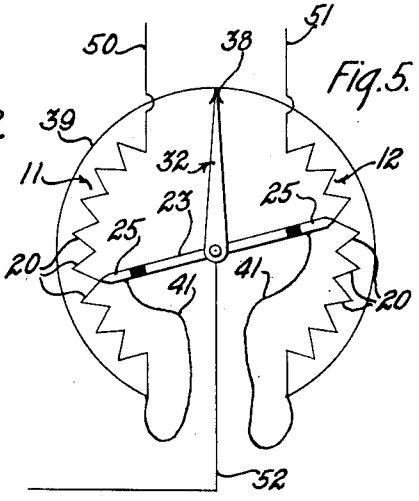


Fig. 5.



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1,897,596

UNITED STATES PATENT OFFICE

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INSTRUMENT FOR VARYING ELECTRICAL POTENTIAL

Application filed July 12, 1927. Serial No. 205,088.

This invention relates to instruments for varying electrical potential, and more particularly to a construction of potentiometer for producing such changes in potential as are desirable in currents flowing through electrical measuring circuits.

One form of this invention has been found particularly advantageous for use in balancing ratio arms of test circuits for measuring for cross-talk the various types of loading coils and loading units used in phantom circuits in the telephone art, the coils being used in audio frequency alternating current circuits. Experience has proven that to measure such coils for cross-talk accurately and efficiently it is desirable that the circuit through the potential varying instrument have no reactance and also because of its use in audio frequency alternating current circuits experience has taught that it is desirable to reduce to a minimum "dead end" effects and losses.

The object of this invention is to provide a substantially non-reactive potentiometer which is adapted to exclude resistance from one circuit simultaneously with its inclusion in another circuit in a simple and expeditious manner.

To attain the aforementioned object the present invention contemplates a potentiometer, wherein an approximate adjustment is obtained by a rotary double contact arm controlling the inclusion and exclusion of fixed units of substantially non-reactive resistance, while the actual and final adjustment is obtained by another rotary arm carrying a finger which contacts with a single slide wire resistance, the resistances not included in the circuit being short circuited to eliminate "dead end" effects and losses when used in an audio frequency alternating current circuit. The slide wire resistance is arranged in the form of a single helical loop whereby the point of engagement of the contact finger is continually shifting during a movement therearound, thus distributing the wear on the finger across substantially the entire surface thereof.

Other objects and advantages of this invention will more fully appear from the accompanying detailed description taken in connection with the accompanying drawing, which illustrates one embodiment of this invention, in which

Fig. 1 is a fragmentary elevation of a potentiometer embodying the features of this invention mounted on a supporting panel which is partly removed to show a portion of the potentiometer.

Fig. 2 is a rear view thereof;

Fig. 3 is a side view, partly in section, with the rotary contact arms shown in vertical alignment;

Fig. 4 is a fragmentary end view of Fig. 1 illustrating the helically arranged slide wire, and

Fig. 5 is a schematic electrical circuit diagram of the potentiometer.

Referring to the drawing wherein like numerals refer to similar parts throughout the various figures, a circular base 10 composed of insulating material, in the present instance phenol fibre, is provided with two groups 11 and 12 of contact points, each comprising eight equally spaced radially arranged contact members 13 extending through apertures provided in the base 10, one end of each member having a flat head 14 forming a contacting surface, the other end being threaded for the reception of a nut 15 which secures the member 13 and an L-shaped terminal 18 therefor against the upper surface of the base 10, as viewed in Fig. 1. The end contact members 13 of each group at its upper end (Figs. 1 and 2) is provided with an outwardly extending terminal 19 for connecting the potentiometer to an outside circuit. Non-reactive resistance units 20 of a "hair pin" formation are formed from a suitable resistance wire which is bent at its midpoint between successive pairs of the contact members 13 and electrically connected to the terminals 18. Journaled centrally upon the base 10 is a sleeve 22 (Fig. 3) carrying at one end a double contact arm 23 (Figs. 2 and 3) having fixed to opposite ends thereof but insulated therefrom by blocks 24 of phenol fibre a plurality of bronze contact members 25 arranged to engage successively the flat heads 14 of the contact members 13, the opposite end

of the sleeve having fixed thereto a knob 26. The widths of the engaging faces of the contact members 25 are such that they span the space between successive contact points. An angularly disposed stop member 27 is associated with each end contact member 13 of the group 12 thereof to confine the movement of the contact members 25 carried at either end of the arm 23 to their respective groups of contact heads 14. Suitable pressure is maintained between the members 25 and the contact heads 14 to provide a firm mechanical and electrical contact in the following manner: The sleeve 22 is provided with an annular shoulder 28 which engages one face of the base 10, the contact arm 23 being adjustably mounted upon the sleeve 22 by a pair of nuts 29 threaded onto the sleeve at opposite faces of the arm 23. It will be apparent that by threading the nuts 29 toward the right as viewed in Fig. 3 that the arm 23 will follow, the shoulder 28 of the sleeve 22 being drawn up against the base 10 with the arm 23 flexing, thereby maintaining a firm mechanical and electrical contact between the members 25 and the contact heads 14.

Concentrically arranged within the sleeve 22 is a rotatable shaft 30 which projects from opposite ends thereof. Upon the left end of the shaft 30 (Fig. 3) is clamped, by means of a screw 31, an L-shaped arm 32, the opposite end of the shaft carrying a knob 33. A short arm 34 of the L-shaped arm 32 which is formed to lie adjacent the periphery of the circular base 10 has fixed thereto one end of a resilient contact finger 37, the opposite end thereof carrying a contact member 38 in the form of a silver rod which is arranged to engage a slide wire 39 disposed in the form of a single helical loop upon the peripheral surface of the base 10 and tied to and soldered at opposite ends to pins 40 fixed in the base at spaced points at the bottom thereof, as viewed in Fig. 1. The slide wire 39 is extended from the pins 40 and electrically connected by soldering or brazing at opposite ends thereof to the terminal 18 of the contact member 13 at the lower end of each of the groups 11 and 12 of the contact members (Fig. 1) and from these latter mentioned terminals to the contact members 25 at opposite ends of the contact arm 23 by flexible conducting leads 41, the leads passing through apertures 44 suitably arranged in the base 10 to the opposite face thereof and thence to the members 25 to which they are soldered (Fig. 3).

The potentiometer may be mounted upon a supporting panel 45 by diametrically opposite screws 46 passing through the base 10 and suitably disposed spacing collars. For indicating to an operator the total of the resistance units 20 cut into the circuit, the knob 26 has fixed thereto a pointer 47 which registers with a scale 48 marked upon the front of the panel 45.

For testing one type of loading coil for cross-talk, potentiometers of approximately 3 ohms resistance are required. In the potentiometer hereinbefore described this required resistance is secured with sufficient closeness by providing sixteen resistance units of 0.32 ohms each and one slide wire of approximately 0.5 ohms resistance. As hereinbefore described the resistance units 20 are divided into two groups of eight each and in the operation of the potentiometer the double contact arm 23 cuts one resistance unit out of one side of the circuit for each unit cut into the other side of the circuit. Thus it will be apparent that the total resistance is the same at all times and equal to eight units of 0.32 ohms, or a total of 2.56 ohms plus the resistance 0.5 ohms provided by the slide wire 39, or a total of 3.06 ohms. By connecting opposite ends of the slide wire 39 to the resistance units 20 which are farthest removed from the audio frequency alternating current supply lines which are connected to the terminals 19 by means of the flexible leads 41, which it will be apparent results in short circuiting all of the resistance units not cut into the circuit, "dead end" effects and losses are reduced to a minimum.

The arrangement of the slide wire 39 in the form of a single helical loop around the periphery of the base 10 provides for a continually shifting point of contact of the silver rod 38 of the contact finger 37 during the movement thereof around the slide wire, thus distributing the wear on the rod across substantially the entire width thereof.

Fig. 5 illustrates a circuit diagram of the potentiometer. When the potentiometer is included in a circuit for balancing the ratio arms of the hereinbefore mentioned type of test circuit (not shown) a coarse adjustment is first effected by adjusting the arm 23, which adjustment is hereinbefore described, due to the simultaneous cutting of one side of the circuit of one of the resistance units 20 for each unit cut into the other side of the circuit, it will be apparent, results in the total resistance of the instrument remaining constant. The final balancing adjustment is obtained by adjusting the arm 32 along the slide wire 39. Thus the current will flow in parallel paths through conductors 50 and 51, which are connected through the ratio arms to be balanced, to one side of an audio frequency alternating current supply line, through the cut-in resistance units 20 of each group 11 and 12 to the contact members 25 carried at opposite ends of the arm 23 where the resistance units 20 not cut into the circuit will be short circuited to eliminate "dead end" effects and losses, the current flowing from the contacts 25 through the flexible leads 41 to the opposite ends of the slide wire 39 and

thence to the contact member 38 carried by the arm 32 which is connected by a conductor 52 to the other side of the current supply line, thus completing the circuit through the potentiometer. A terminal 53 for the conductor 52 is provided upon one side face of the arm 32 adjacent its pivot point (Figs. 2 and 3).

Although this invention as herein illustrated and described is particularly well adapted for use in balancing the ratio arms of the hereinbefore referred to test circuit for measuring for cross-talk the various types of loading coils and loading units used in phantom circuits in the telephone art, it should be understood that it is broadly applicable for producing such changes in potential or current as are desirable in currents flowing through electrical circuits in general.

What is claimed is:

1. In a potentiometer, a circular base, a plurality of groups of sub-divided resistance elements circularly arranged upon one face of the base, a rotary multi-contact member concentrically journaled upon the base for successively establishing electrical connections with certain of the resistance elements of one of the groups and simultaneously therewith disconnecting an equal number of the resistance elements from the other group, another resistance element in the form of a helical loop arranged upon the peripheral surface of the base, means for electrically connecting the two resistances and a rotary contact member disposed concentrically with the multi-contact member upon the base for establishing a continuous and variable electrical connection with the loop resistance element.

2. In a potentiometer, two groups of resistance elements each having one of their ends connected to lead wires of an electrical circuit, a multi-contact arm for establishing electrical connections with certain of the resistance elements of one of the groups and simultaneously therewith disconnecting an equal number of the resistance elements from the other group, a slide wire resistance element connected to the ends of the groups of resistance elements opposite their connections with the lead wires of the electrical circuit and connected with the multi-contact arm, and a single contact arm electrically connected to the electrical circuit for making a sliding contact with said slide wire resistance element.

In witness whereof, I hereunto subscribe my name this 24th day of June A. D., 1927.

WILLIAM JOHN TIETZ.