Nov. 10, 1942. D. S. W. KELLY 2,301,884

POTENTIOMETER DEVICE

Original Filed Feb. 25, 1938

Fig. 1

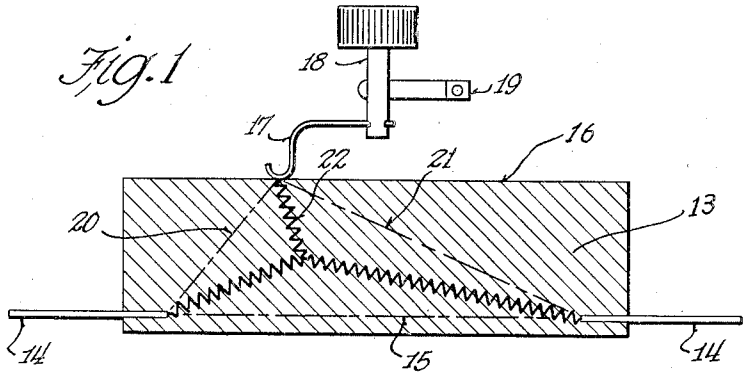


Fig. 2

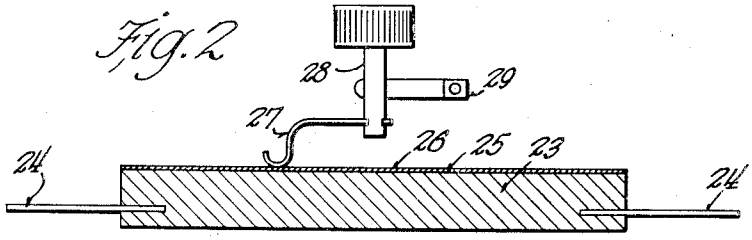
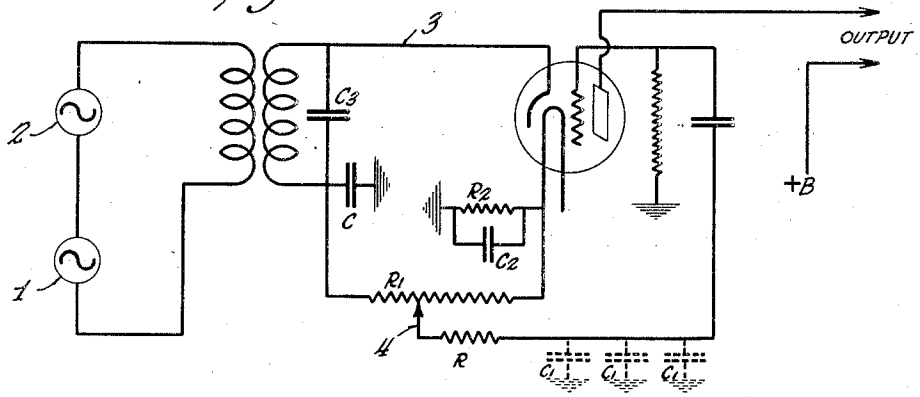


Fig. 3



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POTENTIOMETER DEVICE

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Original application February 25, 1938, Serial No. 192,494. Divided and this application June 18, 1941, Serial No. 398,529

8 Claims. (Cl. 201—48)

This invention relates to an improved form of potentiometer for use in radio or other high frequency circuits and resides in a novel form of construction of the same wherein there is inherently embodied in the movable branch electrical path a fixed, or relatively fixed, resistance of substantial amount in excess of resistance incidental to contact resistance between the contactor and the contact surface it engages, which substantial resistance, acting in conjunction with reactance provided in the circuit with which the potentiometer is used, results in filtering out of current of undesirable frequency and at the same time discontinuity in the variation of resistance characteristics of the potentiometer as the movable contact is moved is very substantially diminished.

This application is a division of my copending application Serial No. 192,494, filed February 25, 1938, for Potentiometer which application has issued as Patent No. 2,250,959.

One object of this invention is to provide in the branching adjustable electrical path of a potentiometer a sufficient resistance so that reactance conveniently provided or inherently existing in high frequency circuits render such resistance effective as a filtering resistance for current of undesirable frequency.

Another object of the invention is to provide a potentiometer such that when used in radio receiver circuits adjustment thereof during operation of the receiver does not give rise to objectionable noise.

A further object of this invention is to avoid the necessity of any external or additional parts, or the installation thereof, and to provide a potentiometer having the improved characteristics above noted without requiring more than a resistance element and a traveling contact.

The potentiometer of this invention may be employed generally in electron tube and high frequency circuits, but the best mode of use for the same now known to me is in radio receiver circuits and specific forms of this invention well adapted to this use are described herein. It is intended, however, that protection to be granted hereon be not unnecessarily restricted thereby, but that such protection extend to the limits of the inventive concept disclosed herein, limited only by the scope of the claims appended hereto.

Adjustable resistors of the potentiometer type are, among other uses, used as volume controls in radio receivers. Often the adjustable resistor is used in series with the second detector or rectifier as the output load resistor and in this circuit there is impressed across the terminals of the adjustable resistor the rectified audio frequency potential, as well as a part of the inaudible high frequency potential which, in the case of a superheterodyne circuit, is of the frequency of the intermediate frequency amplifier. It is desirable to prevent these high frequencies from reaching the output circuit of the adjustable potentiometer and ordinarily filter circuits are provided specifically for this purpose.

For example, shown in Fig. 3 is a conventional diagram of a combined rectifier amplifier stage of a familiar type of radio receiver circuit. As diagrammatically indicated at 1—2, two oscillatory generators of different frequency, corresponding in the case of a superheterodyne receiver to the impressed inaudible high frequency potential of the intermediate frequency amplifier and the audio frequency of the modulated signal, are shown. In accordance with the familiar principles of filtering, both frequencies are active in plate lead 3, while C—2, ground, and C are provided to divert as large a fraction as possible of the high frequency potential from R—1, which has impressed across it the main part of the rectified audio impulses. Through contactor 4, volume control is obtained by continuous selective tapping of R—1 to impress the desired intensity of potential fluctuation upon the grid of the out-put stage.

In order to prevent the affecting of the grid of the out-put stage by undesired high frequency impulses, which are productive of the well-known phenomenon called "hash," as well as other well-known disturbing effects upon the audio elements of the circuit, resistor R may be interposed, which, in conjunction with the distributed capacity indicated by C—1 causes the diversion back through ground and C—2 of such high frequency impulses. In accordance with the well-known principles of filtering, there is thus an attenuation with the aid of R of undesirable high frequency current, providing R is of sufficient magnitude, running ordinarily between 30,000 ohms and 1 megohm, in the case of an ordinary broadcast receiver with an intermediate frequency of about 465 k. c., and as low or lower than 1000 ohms in the case of higher frequencies. In many other circuits the resistor R in direct conjunction with a potentiometer resistance R—1 and in conjunction with inherent or external reactance will act to produce a desired frequency discrimination. In all cases this resistance is a substantial amount and often an appreciable

fraction of the overall resistance of the principal resistance element of the potentiometer.

The invention further consists in the several features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawing:

Fig. 1 is a side elevation in section of one form of potentiometer of this invention;

Fig. 2 is a side view of another form of the potentiometer of this invention; and

Fig. 3 is a diagram of an electrical circuit indicating a potentiometer with side branch circuit resistance.

It is the discovery of this invention that a potentiometer may be so constructed that within the elements composing the potentiometer itself, without additional parts or the provision of any external parts, a substantial amount of resistance may be provided in the movable branching path of the potentiometer itself and at the same time a potentiometer is provided in which variation of the movable path gives rise to a diminished amount of noise.

One form of potentiometer of this invention is illustrated in Fig. 1, wherein a principal resistance element 13 is shown in section. Element 13 is provided with fixed electrical contacts 14, furnishing electrical access to the fixed electrical path of the potentiometer. Laterally displaced an appreciable distance from the direct electrical path, indicated roughly by the dot-and-dash line 15, is a contact surface 16. Arranged for contact with surface 16 is the sliding shoe 17 mounted on shaft 18 against which contact brush and terminal 19 bears. The electrical paths from shoe 17 to contacts 14 are roughly indicated by dot-and-dash lines 20 and 21. As stated above, surface 16 is laterally displaced from line 15 and is displaced a sufficient amount so that the resistances measured along the lines 20 and 21 in summation exceed the resistance measured along the line 15 by a substantial amount, as defined above, so that substantial resistance is effectively in the branch path between the part 17 on the one hand and the fixed contacts 14 on the other hand. In a potentiometer so constructed the effective electrical paths may be roughly indicated, as shown by the conventional zig-zag resistance symbol shown in Fig. 1, in which the resistance of the branching movable path of the potentiometer is represented by the zig-zag line 22.

When the potentiometer of the form shown in Fig. 1 is inserted in place of the potentiometer R—1 of Fig. 3, an external resistor in the place of R may be dispensed with and frequency discrimination nevertheless obtained through the inherent function of the potentiometer of this invention, represented diagrammatically by the zig-zag line 22 of Fig. 1. Of course, a similar result is obtained in any other equivalent application in a radio or other circuit.

In Fig. 2 is shown another form of the potentiometer of this invention. In this form a principal resistor element 23 is provided to which there is secured, in electrical contact therewith, fixed contacts 24. Upon the upper surface of element 23 there is deposited, in electrical contact therewith, a thin layer of high resistance material 25, having on its upper surface the contacting surface 26 over which sliding contact shoe 27 travels. Contact shoe 27 is connected, as described in connection with the other forms of this invention, to shaft 28, which is in electrical contact with brush and terminal 29.

High resistance layer 25 is composed of appropriate material and provided with such thickness that the resistance between contact shoe 27 and element 23 is of a substantial amount, as defined above, said resistance being effectively between the part 27 on the one hand and the fixed contacts 24 on the other hand. In a potentiometer so constructed, the movable branching electrical path inherently possesses that type of resistance which in Fig. 3 is indicated by the resistor R, and, upon substitution of the potentiometer shown in Fig. 2 for the potentiometer R—1 in Fig. 3, an external resistor in the place of R may be dispensed with.

In the case of either potentiometer shown in Figs. 1 or 2, the noise-producing, or transient-producing, effect upon movement of the contact shoe, due to discontinuity or nonhomogeneity of the resistance material contained in the principal resistor is largely eliminated by reason of the bridging effect of the large side branch resistance of the advantages of all forms of the potentiometers of this invention, beside its high resistance properties, include as a distinct advantage an enhanced quietness of operation upon movement of the movable contact.

What I claim as my invention is:

1. In a potentiometer, a pair of spaced fixed contacts, a body of resistance material interposed between and in electrical contact with said fixed contacts to provide a principal electrical path between said contacts, said body having a contact face adapted to be engaged by a movable contactor, said contact face being disposed in the direction of and alongside of said principal electrical path and laterally displaced therefrom, a movable contactor adapted to move relative to said contact face in electrical contact therewith, the contact area between said contact face and said contactor having an extent in the direction of movement of said contactor which is a minor fraction of the space between said spaced fixed contacts, the extent of the lateral displacement of said contact face from said principal electrical path being of sufficient magnitude to provide in conjunction with the resistivity of the parts of the body of resistance material disposed between said principal electrical path and said contact face, a resistance between said principal electrical path and said movable contactor in all positions thereof in a direction transverse to said principal electrical path, which is substantially in excess of resistance incidental to contact between said contactor and said contact face.

2. In a potentiometer, a pair of spaced fixed contacts, a body of resistance material interposed between and in a electrical contact with said fixed contacts to provide a principal electrical path between said contacts, said body having a contact face adapted to be engaged by a movable contactor, said contact face being disposed in the direction of and alongside of said principal electrical path and laterally displaced therefrom, a movable contactor adapted to move relative to said contact face in electrical contact therewith, the contact area between said contact face and said contactor having an extent in the direction of movement of said contactor which is a minor fraction of the space between said spaced fixed contacts, the extent of the lateral displacement of said contact face from said principal electrical path being of sufficient magnitude to provide in conjunction with the resistivity of the parts of the body of resistance material disposed between said principal electrical path and said contact face, a resistance in excess of 1,000 ohms

between said principal electrical path and said movable contactor in all positions thereof in a direction transverse to said principal electrical path.

3. In a potentiometer suitable for use in electron tube or other high frequency circuits, the combination comprising a body of resistance material forming a resistance element, fixed contacts applied thereto for establishment of an electrical path therethrough, a contact surface on said resistance body, a movable contactor movable over said contact surface while making contact therewith, said contact surface being displaced from the electrical path between said fixed contacts a distance such that the sum of resistances measured between any point on said surface and said fixed contacts exceeds the resistance measured between said fixed contacts by an amount substantially in excess of the resistance incidental to contact resistance between said movable contactor and said contact surface.

4. In a potentiometer suitable for use in electron tube or other high frequency circuits, the combination comprising a body of resistance material forming a resistance element, fixed contacts applied thereto for establishment of an electrical path therethrough, a layer on said resistance element and in electrical contact therewith and exposing a contact surface, said layer being composed of a resistance material and being of such thickness and resistivity that the resistance thereof measured between a point on said contact surface and the body of said contact surface is of a substantial amount, and a movable contact movable over said contact surface while making contact therewith.

5. In a potentiometer, the combination of a resistance element having plural layers of resistance material with the upper layer of high resistance and provided with a contacting surface and a lower layer, contact terminals disposed at opposite ends of the lower layer to establish a fixed electrical path therethrough, a movable contactor arranged to engage said contacting surface and for movement along and in contact with said surface to different positions relative to said terminals, the total resistance of said layers between said terminals in any position of said contactor relative to said terminals being of a substantial amount.

6. In a potentiometer, a pair of spaced fixed contacts, a body of resistance material interposed between and in electrical contact with said fixed contacts to provide a principal electrical path between said contacts, said body having a contact face adapted to be engaged by a movable contactor, said contact face being disposed in the direction of and alongside of said principal electrical path and laterally displaced therefrom, a movable contactor adapted to move relative to said contact face in electrical contact therewith, the contact area between said contact face and said contactor having an extent in the direction of movement of said contactor which is a minor fraction of the space between said spaced fixed contacts, the extent of the lateral displacement of said contact face from said principal electrical path being of sufficient magnitude to provide in conjunction with the resistivity of the parts of the body of resistance material disposed between said principal electrical path and said contact face, a resistance in excess of 30,000 ohms between said principal electrical path and said movable contactor in all positions thereof in a direction transverse to said principal electrical path.

7. In a potentiometer, a pair of spaced fixed contacts, a body of resistance material interposed between and in electrical contact with said fixed contacts to provide a principal electrical path between said contacts, said body having a contact face adapted to be engaged by a movable contactor, said contact face being disposed in the direction of and alongside of said principal electrical path and laterally displaced therefrom, a movable contactor adapted to move relative to said contact face in electrical contact therewith, the contact area between said contact face and said contactor having an extent in the direction of movement of said contactor which is a minor fraction of the space between said spaced fixed contacts, the extent of the lateral displacement of said contact face from said principal electrical path being of sufficient magnitude to provide in conjunction with the resistivity of the parts of the body of resistance material disposed between said principal electrical path and said contact face, a resistance in the neighborhood of 1,000,000 ohms between said principal electrical path and said movable contactor in all positions thereof in a direction transverse to said principal electrical path.

8. In a potentiometer, a pair of spaced fixed contacts, a body resistance material interposed between and in electrical contact with said fixed contacts to provide a principal electrical path between said contacts, said body having a contact face adapted to be engaged by a movable contactor, said contact face being disposed in the direction of and along side of said principal electrical path and laterally displaced therefrom, a movable contactor adapted to move relative to said contact face in electrical contact therewith, the contact area between said contact face and said contactor having an extent in the direction of movement of said contactor which is a minor fraction of the space between said spaced fixed contacts, the extent of the lateral displacement of said contact face from said principal electrical path being of sufficient magnitude to provide in conjunction with the resistivity of the parts of the body of resistance material disposed between said principal electrical path and said contact face, a resistance between said principal electrical path and said movable contactor in all positions thereof in a direction transverse to said principal electrical path, which is substantially in excess of resistance incidental to contact resistance between said contactor and said contact face, whereby oscillating current flowing from said principal electrical path through said movable contactor and bypassing from said movable contactor to said fixed contacts by reason of the capacitative relationship therebetween encounters a predetermined resistance of substantial amount between said principal electrical path and said movable contactor.

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