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A. H. COOPER

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HIGH FREQUENCY VARIABLE RESISTANCE DEVICE

Filed Jan. 28, 1931

Fig. 1.

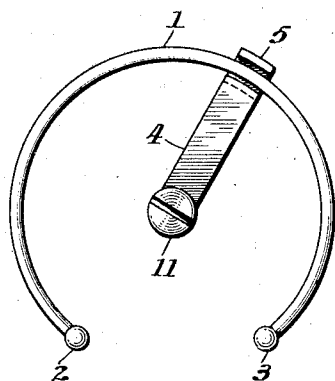


Fig. 2.

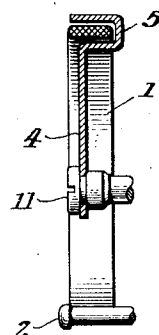


Fig. 3.

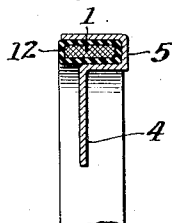
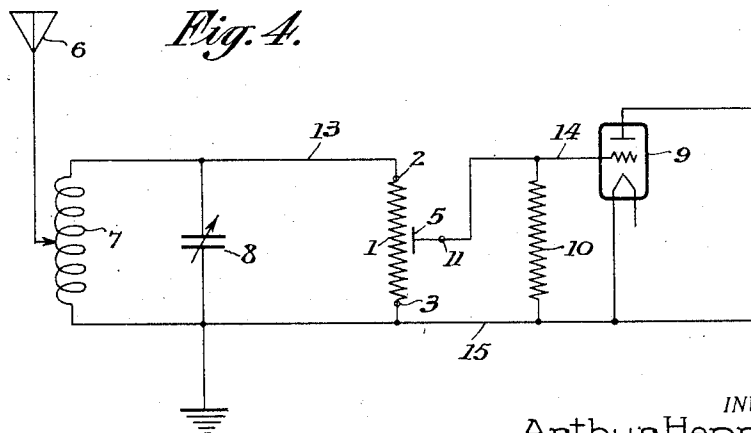


Fig. 4.



INVENTOR.
Arthur Henry Cooper,

BY *J. R. Goldbraugh*
HIS ATTORNEY.

UNITED STATES PATENT OFFICE

ARTHUR HENRY COOPER, OF BALHAM, LONDON, ENGLAND, ASSIGNOR TO VICTOR TALK-
ING MACHINE COMPANY, A CORPORATION OF NEW JERSEY

HIGH FREQUENCY VARIABLE RESISTANCE DEVICE

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An application has been filed in England, January 27, 1930.

The present invention relates to variable resistance devices of the potentiometer type having a resistance element provided with terminals between which by reason of current flow through the resistance element a difference of potential is established, and a movable contact with the resistance element between which contact and one of the first named terminals is thereby applied a selected portion of the total potential existing across the resistance element.

The usual variable resistance device or high resistance potentiometer such, for example, as is used in radio receivers, is of the type in which a movable contact in the form of an arm is made to slide in contact with and along a circular or arcuate resistance element. A sliding contact of this type tends to polish or wear the surface of the element, thereby altering the resistance of the element and frequently impairing the connection provided by the contact with the resistance element so that movement of the contact sets up an intermitting connection causing circuit disturbances resulting in noise in the output of the receiver. Furthermore, the friction of the moving contact upon the resistance element is often sufficient to prevent easy operation or exact adjustment of the variable resistance. This is of particular importance in ganged variable resistances wherein the combined friction load of the several contacts is applied to a single operating means.

Accordingly, it is an object of this invention to provide an improved variable resistance device of the potentiometer type for high frequency circuits which is arranged to overcome the above described and other operating disadvantages of known variable resistances.

In variable resistances for use in association with radio receiving apparatus and the like, dealing with high frequency currents, it has been found that actual physical contact between the moving member or contact and the resistance element is not necessary and the parts may be proportioned to allow a relatively large capacity to exist between the moving member and the resistance element in its

immediate neighborhood or immediately adjacent to it.

Accordingly, there is provided in accordance with the present invention, a variable resistance device in which the movable member or voltage selector member is out of electrical contact or connection with the resistance element, and operates as a potential selecting means by virtue of the capacity between the member and the element. An advantage of this arrangement lies in the fact that the operation is smoother for the reason that a much smaller force is required to operate the device than is necessary in the arrangement where there is actual contact between the movable member and the resistance element, and operating troubles introduced by variations in contact resistance are eliminated.

The invention is illustrated by way of example in the accompanying drawings, in which Fig. 1 shows a plan view of a potentiometer embodying the invention; Fig. 2 a sectional view of the potentiometer of Fig. 1, and on the same scale; Fig. 3 is a fragmentary view in section of the resistance element of Figs. 1 and 2 showing a modification therein, and Fig. 4 is a wiring diagram of a radio apparatus showing the application of the potentiometer of Figs. 1 and 2 applied to a high frequency circuit thereof. The same reference numerals are used in each of the figures to refer to like parts.

Referring now to Figs. 1 and 2 of the drawings, a suitable resistance element 1 in the form of a strip is bent to conform to the arc of a circle and is supported at its ends by pillars 2 and 3 of conducting material, which are adapted to act as, or are in electrical connection with two terminals of the device. At the center of the circle of which the arc 1 forms a part, there is pivotally mounted at 11 an arm 4 of conducting material the outer end 5 of which is arranged to move along the resistance element in spaced capacitive relation thereto.

In the present example the outer end of the arm is bent into the form of U-shaped member, the two limbs of which are at right angles to the arm 4, whereby it encloses two faces and

one edge of the resistance element. As indicated in the drawings, the length of the arm 4 is so proportioned that the resistance element 1 lies between and out of electrical contact with the two limbs of the U-shaped member, and forms in combination therewith what is in effect a condenser with air as the dielectric.

The pivot 11 of the conducting arm 4 is adapted to act as the third terminal of the potentiometer and the width of the arm 4 and the dimensions of the resistance element 1 are so proportioned that the impedance (at the frequencies at which the device is to be used) of the capacity between the arm 4 and that part of the resistance element 1 overlapped by or adjacent to the limbs of the U, is not too great in comparison with that of the resistance element 1.

If desired, because of high voltage between the movable member and resistance element, insulating or dielectric material may be provided in any suitable manner between said member and element. For example, as shown in Fig. 3, insulating material 12 may be provided upon the resistance element 1. Thus, on the two sides facing the limbs of the U-shaped member 5 the insulation forms a protective dielectric covering and at the same time provides a light contact with the arm 4 sufficient to hold the arm 4 in any required position along the resistance element 1. Such insulating material may also serve to locate the U-shaped member in accurately spaced relation with respect to the resistance element.

If it is intended that the device be used as a potentiometer or resistance to regulate higher frequency currents, the overlapping area may clearly be made less than if it is to be used for regulating lower frequency current. It will be clear that the conducting arm 4 may be arranged to cover any desired area of the resistance element to provide any desired capacity relation between the arm and said element.

The application of the potentiometer to the input circuits of a radio receiving apparatus is shown diagrammatically by way of example in Fig. 4 to which attention is now directed.

An antenna 6 is connected to an inductance coil 7 tuned by a variable tuning condenser 8 connected in shunt therewith. The tuned circuit represented by inductance 7 and condenser 8 is connected with an output circuit 13 including the resistance element 1, through terminals 2 and 3. This output circuit is in turn connected with a resistor or second resistance element 10, in the input or grid circuit 14 of an electric discharge device 9, which for example, may be a detector tube for the receiving apparatus. One connection between the resistors or output and input circuits is made by a common ground connection 15 while the opposite or grid side of the input

circuit is capacitively coupled or connected to the output circuit by the variable or movable member 4 represented in the diagram of Fig. 4 by the capacitive end 5 adjacent resistance element 1, and terminal 11. Thus the device or potentiometer 1—5 provides a variable capacitive coupling between said circuits.

With the aid of the potentiometer, the portion of the total voltage across the tuned circuit 7—8 which is passed to the tube 9 may be controlled, and the potentiometer may thus act as a volume control device for the apparatus or receiver.

It should be noted that the potentiometer provides a constant or fixed capacitive coupling with the resistance element in the output circuit while the actual coupling for voltage transfer is variable.

In the present example with tube 9 functioning as a detector, the condenser provided by the capacity between 1 and 5 may be made of such a value that it acts in conjunction with the high resistance 10 in place of the usual grid condenser and resistor 10 acts as the grid leak for detection purposes.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:

1. A variable resistance device including a resistance element and a movable conducting member, means for moving said member along the resistance element in spaced relation thereto and out of electrical connection therewith to provide a predetermined capacitive coupling between them.

2. A variable resistance device including a fixed resistance element and a movable conducting member arranged to move at one end along the resistance element said member being in the form of a U at said end, and the resistance element lying between the limbs of the U in spaced relation thereto, whereby said movable member provides a capacitive coupling with said element.

3. A variable resistance device including a fixed resistance element and a movable conducting member arranged to move along the resistance element in uniform spaced relation to said element, said movable member having a fixed predetermined capacitive coupling with said element.

4. A variable resistance device including a resistance element of predetermined value and a movable conducting member arranged to move along the resistance element, said movable member having a fixed capacitive coupling with said element, and being electrically insulated therefrom.

5. A variable resistance device including a resistance element and a movable conducting member arranged to move along the resistance element, said movable member having a predetermined capacitive coupling with said element, and insulating means interposed be-

tween the resistance element and said conducting member.

6. In a radio apparatus the combination with a pair of circuits adapted to be coupled of means providing a variable capacitive coupling between said circuits, said means including a resistance element connected in each of said circuits, a capacity coupling member arranged to move along one of said resistance elements in fixed capacitive relation thereto, and means providing a circuit connection between said member and the other of said resistance elements.

7. A variable resistance device having negligible frequency characteristics including a resistance element of predetermined value and a movable conducting member, said member being positioned relative to said element in spatial relation thereto.

8. A variable resistance device substantially non-inductive including a resistance element of predetermined value and a movable conducting member, said member being positioned relative to said element in spatial relation thereto.

9. A variable non-inductive resistance device including a resistance element of predetermined value and a movable conducting member, said member being positioned relative to said element in spatial relation thereto.

In testimony whereof, I have hereunto subscribed my name this sixteenth day of January, 1931.

ARTHUR HENRY COOPER.