April 17, 1951 P. ROSENBERG 2,549,389

SINE WAVE POTENTIOMETER

Filed May 9, 1945

FIG. II

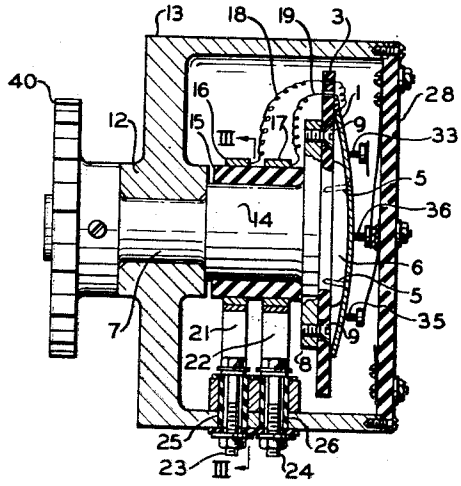


FIG. I

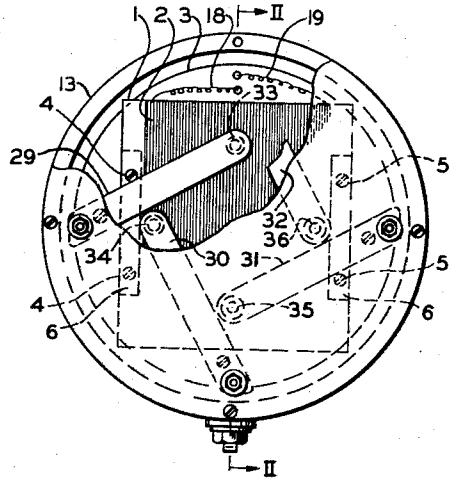


FIG. III

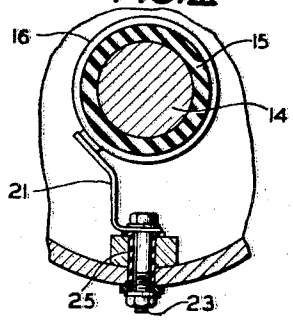


FIG. IV

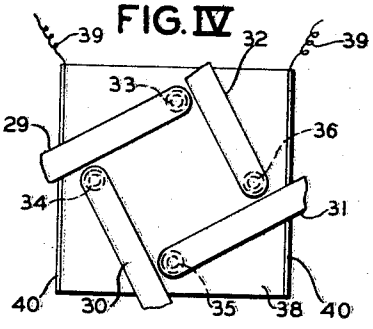


FIG. V

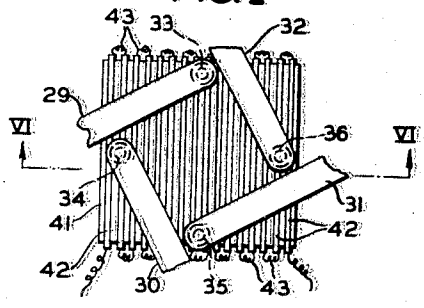


FIG. VI

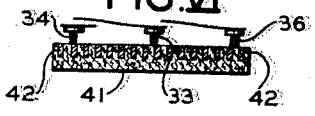
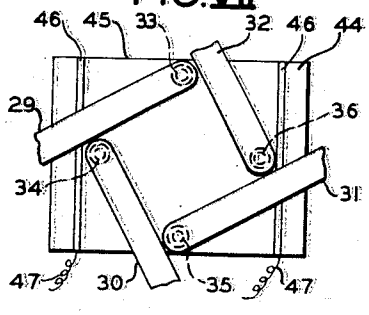


FIG. VII



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Patented Apr. 17, 1951

2,549,389

UNITED STATES PATENT OFFICE

2,549,389

SINE WAVE POTENTIOMETER

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Application May 9, 1945, Serial No. 592,795

18 Claims. (Cl. 201—48)

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The present invention relates to devices for producing voltages or currents which vary sinusoidally and more particularly to a sinusoidal potentiometer.

The potentiometer according to the present invention provides direct and alternating current voltages which vary sinusoidally with the angle of rotation of the shaft of the potentiometer. The invention may have various uses but has particular application in providing potentials having varying amplitudes for deflecting electron beams of cathode ray tubes such as disclosed in the copending application of James F. Koehler, Serial Number 594,044, filed May 16, 1945, for Radio Echo Detection System.

An object of the invention is to provide a potentiometer producing a direct current output of sinusoidal form or an alternating current the amplitude of which varies sinusoidally.

Another object of the invention is to provide a potentiometer having a set of brushes and a coil rotatable relatively to each other arranged to provide a sinusoidal output from the brushes.

These and other objects residing in the arrangement combination and construction of the parts will be apparent from the accompanying drawing in which:

Fig. 1 is an elevation of a potentiometer according to the present invention,

Fig. 2 is a section on the line II—II of Fig. 1,

Fig. 3 is a partial section on the line III—III of Fig. 2,

Figs. 4, 5, and 7 are partial elevations corresponding to Fig. 1 disclosing alternate forms of resistance structures and;

Fig. 6 is a section on the line VI—VI of Fig. 5.

Referring particularly to the drawing, reference character 1 indicates a thin preferably but not necessarily square card of some suitable insulating material on which is wound a fine resistance wire 2 as shown particularly in Fig. 1. The wire 2 is preferably enamel coated and it is in closely adjacent turns in physical contact with one another.

The card 1 is mounted on a disc 3 of insulating material by means of screws 4 and 5 and held in spaced relation thereto by spacers 6. The spacers 6 are in the form of elongated members flat on the side adjacent the disc 3 and arched on the side of the card 1 so as to provide the card 1 with a cambered form. The cambered form of the card is of particular advantage in that when brushes, hereafter to be described, are relatively moved in contact with the wire 2, the wire 2 is more firmly held against displacement as a

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result of the frictional contact of the brushes therewith and the tendency of the brushes to simultaneously contact several wires 2 at one time is minimized.

The disc 3 is mounted on a shaft 7 in any suitable manner. As shown, a plate 8 is secured to the shaft 7 and the disc 3 is secured to the plate 8 by screws 9. The shaft 7 is mounted for rotation in a suitable bearing 12 in the housing 13 provided to enclose the operating parts of the potentiometer. A cylindrical boss 14 is provided at the inner end of the shaft 7 and has telescoped thereonto an insulating sleeve 15. Mounted on the insulating sleeve 15 are slip rings 16 and 17 spaced from one another. The slip ring 16 is connected by a wire 18 to one end of the wire 2 and the slip ring 17 is connected by a wire 19 to the other end of the wire 2.

External connection with the slip rings 16 and 17 is made through spring metal brushes 21 and 22 as shown particularly in Figs. 2 and 3. The brushes 21 and 22 are secured to the frame 13 by bolts 23 and 24 and are insulated therefrom by grommets 25 and 26.

The housing 13 is provided with a cover plate 28 to which are secured spring arm 29, 30, 31 and 32. The inner ends of these spring arms are provided with suitable brushes 33, 34, 35 and 36 respectively. The brushes 33, 34, 35 and 36 are arranged to lie in a circle which falls within the boundaries of the wire 2 on the card 1. The enamel or other insulation from the wire 2 is buffed or otherwise removed from the convex surface of the wire 2 on the card 1 so as to maintain the insulation between the turns of the wire 2 and to permit electrical contact between brushes 33, 34, 35 and 36 and the wire 2.

The outer end of the shaft 7 is provided with a gear 40 as a driving connection whereby the card 1 may be rotated relatively to the brushes 33, 34, 35 and 36. It is, however, contemplated that the card 1 be held stationary while the brushes 33, 34, 35 and 36 are rotated.

The operation of the invention is as follows: A source of direct current is connected through the bolts 23 and 24, which may be constituted as binding posts, to the slip rings 16 and 17 and thus to the ends of the wire 2. As shown in Fig. 1, the brushes 34 and 36 are across the maximum length of the wire 2 and therefore the potential between the spring arms 30 and 32 is a maximum for this position of the card 1 with respect to the brushes 33, 34, 35 and 36. At the same time the length of wire bridged by the brushes 33 and 35 is a minimum and therefore

there is a minimum potential between the spring arms 29 and 31. As the brushes 33, 34, 35 and 36 are rotated relatively to the card 1, the camber thereof will cause the contact surface of the brushes to become and remain rounded, as shown particularly in Fig. 2, to thereby insure a minimum contact of the brushes with the wire 2 of the card 1. This feature is important for the reason that shorting of turns is minimized. Also the uncertainty as to which turns of wire are contacted by each brush, as in the case of wide brushes, is avoided. It will be apparent that as the card 1 is rotated, the amplitude of the potential across the spring arms 29 and 31, and 30 and 32 will gradually rise and fall respectively and will take the forms of sine waves.

Figs. 4 through 7 disclose alternative forms of the resistance element of the invention and in each case, the illustrated resistance element may be substituted for the card 1 in the structures of Figs. 1 and 2, although it is contemplated that differences in materials may require resistance elements of varying sizes.

In Fig. 4 there is disclosed a flat block 38 of carbon or equivalent resistance material, the composition of which may be selected to furnish a resistance of the desired value. Conductors 39 are secured to strips 40, respectively, of material of high conductivity such as copper or silver which are in turn, secured in electrical contact with the block 38 to place a potential thereacross.

In Fig. 5 another form of resistance element is disclosed in the form of a block 41 of fibre, or the like, in which there are recessed a plurality of conducting or resisting bars 42, the edges of which are flush with the surface of the block 41 as shown particularly in Fig. 6. The ends of the bars 42 are connected by conductors 43 to provide a continuous conductor having return bends, which is roughly equivalent to the windings of the wire 2 on the card 1. The conductors 43 may be resistance elements if desired.

In Fig. 7 there is disclosed still another form of the invention wherein a suitable insulating base 44 has the central section 45 thereof coated with a paint or the like having such a conductivity as to provide a resistance element of it. On each side of the central section 45 there is placed a strip 46 of silver or equivalent substance of high electrical conductivity, each of which is in conducting relation with the center painted section 45. One end of each of the conducting strips 46 has connected thereto an electrical conductor 47 for the purpose of connecting a voltage across the resistance provided by the central section 45.

It will be evident from observation of Figs. 4 through 7 that the resistance elements disclosed thereon are associtaed with the contact arms 29, 30, 31 and 32 each having thereon a brush 33, 34, 35 and 36 respectively, that a resistance element equivalent to the card 1 on Figs. 1 and 2 will be provided, and that as the resistance elements having potentials thereacross and brushes are rotated relatively to one another, a sine wave output will be provided.

While the invention has been shown as embodying four brushes and two slip rings in the case of a movable resistance element, it will be apparent that instead there may be four slip rings and four brushes where the brushes are movable instead of the resistance element. Also both the resistance element and the brushes may be rotatable at the same time. Also it is within the scope of the invention that there be more or less than four brushes. One brush is equally within the scope of the invention when it is desired to provide only one output having sine wave voltage and current characteristics. In the claims where the expression circular path is employed it is contemplated that a path less than 360° is encompassed.

Having thus described my invention, what I desire to secure by Letters Patent and claim is:

1. A potentiometer comprising a resistance element having an arched surface, said element comprising a wire of uniform resistance uniformly wound about an arched form of dielectric material, a contact member bearing on said resistance element, said arched surface of said resistance element being arched outwardly in the direction of said contact member, and means for rotating said contact member in a circular path on said resistance element whereby the resistance between said contact member and either terminal of said resistance element varies sinusoidally in proportion to the angle through which said contact member is rotated.

2. A potentiometer comprising a resistance element having an arched surface, said resistance element comprising a wire of uniform resistance uniformly wound on a rectangular, arched form of dielectric material, a pair of oppositely disposed bridging contacts bearing on said resistance element, said arched surface of said resistance element being arched outwardly in the direction of said bridging contacts, and means for relatively rotating said resistance element whereby the resistance between said pair of bridging contacts varies sinusoidally as the angle through which said resistance element is relatively rotated.

3. A potentiometer comprising a resistance element, said element comprising a wire of constant resistance per unit length throughout its entire length uniformly wound on a rectangular form of dielectric material, said form being slightly arched, first and second pairs of bridging contacts, said bridging contacts being angularly separated by 90 degrees and bearing on said resistance element, and means for relatively rotating said resistance element whereby the resistances between each pair of bridging contacts vary sinusoidally in proportion to the angle through which said resistance element is relatively rotated.

4. A potentiometer comprising a shaft mounted for rotation in a bearing, a substantially flat resistance element mounted on said shaft, said resistance element comprising a wire of uniform resistance uniformly wound on a rectangular form of dielectric material, an insulating sleeve mounted on said shaft, two slip rings mounted on, and secured to, said insulating sleeve, a first wire connecting one terminal of said resistance element to one of said slip rings, a second wire connecting the other terminal of said resistance element to the other of said slip rings, spring brushes contacting said slip rings and being electrically joined to terminal posts, and a pair of displaced bridge contacts bearing on said resistance element.

5. A poteniometer comprising, a resistance element formed of a resistance wire wound on an arched rectangular form of insulating material, first and second pairs of bridging contacts bearing on said resistance element and defining respectively first and second mutually perpendicular lines, and means providing for relative rotation between said resistance element and said bridging contacts, whereby the resistance between

contacts of each pair varies sinusoidally in proportion to the rotation angle.

6. A potentiometer comprising, a resistance element formed of a resistance wire uniformly wound upon a rectangular form of insulating material arched about a first axis, means mounting said resistance element for rotation about a second axis perpendicularly intersecting said first axis, and means for mounting in fixed space relation to said second axis a number of contacts yieldably bearing on said resistance element on the convex side thereof.

7. A potentiometer comprising, a rotatable shaft and an arched resistance element attached thereto, and at least one fixed contact bearing upon the convex surface of said arched resistance element, whereby said contact upon rotation of said shaft and resistance element traces a closed path on said convex surface.

8. A potentiometer as in claim 7 wherein said arched resistance element comprises, a rectangular form of insulating material uniformly wound with resistance wire and slip rings supported on said shaft electrically connected to the ends of said resistance wire.

9. A potentiometer comprising, a housing and a shaft journaled for rotation therein, a resistance element affixed to said shaft, a plurality of pairs of spaced contacts secured to said housing and yieldably bearing against said resistance element, said resistance element being electrically connected to points on said housing through means enabling free, continuous rotation of said shaft.

10. A potentiometer as in claim 9 wherein said last-mentioned means comprises a sleeve of insulating material affixed to said shaft, slip rings on said insulating sleeve, and means connecting said resistance element through said slip rings to terminals on said housing, said last means including brushes secured to said terminals and bearing upon said slip rings.

11. A potentiometer as in claim 9 wherein said resistance element comprises a flat homogeneous block of resistive material and a spaced pair of conductive strips disposed in electrical contact with said block.

12. A potentiometer as in claim 9 wherein said resistance element comprises a base of insulating material uniformly covered with a resistive film, a pair of spaced conductive strips disposed in conductive contact with said resistive film throughout the lengths of each strip.

13. A potentiometer comprising a housing and a shaft journaled therein, a resistance element secured to said shaft within said housing, means for insulatedly supporting a slip ring upon said shaft for rotation therewith, means for conductively coupling said resistance element to said slip ring, a terminal post secured to said housing and carrying a brush in yieldable contact with said slip ring, and a contact secured to said housing and arranged to bear against said resistance element during rotation thereof.

14. A potentiometer as in claim 13 wherein said resistance member is arranged to present to said contact a conductive surface having substantially constant resistance as measured between points separated by a fixed distance.

15. A potentiometer comprising a housing, a shaft journaled in said housing and carrying a resistance element formed of resistance wire uniformly wound upon a substantially flat, rectangular form, an insulating sleeve mounted upon said shaft for rotation therewith and carrying a pair electrically separated conductive slip rings connected to the ends of said resistance wire, a pair of terminal posts secured to said housing, a pair of resilient brushes secured to said terminal posts and bearing against said slip rings and a pair of spaced contacts secured to said housing and yieldingly bearing against said resistance wire and arranged to trace a closed path upon the surface of said resistance element during rotation thereof.

16. A potentiometer comprising a resistive surface element having the characteristic of presenting a substantially constant resistance between any two points thereon of fixed separation, means for establishing a voltage gradient on said resistive surface substantially in one direction, and a contact bearing upon said surface and means for relatively rotating said contact and resistive surface.

17. A potentiometer as in claim 16 wherein said resistive surface is arched, said contact being arranged to bear upon the convex surface thereof.

18. A potentiometer comprising a housing and a shaft journaled for rotation therein, a resistance element affixed to said shaft, at least one pair of spaced contacts secured to said housing and yieldably bearing against said resistance element, slip rings insulatively mounted on said shaft and electrically connected to said resistance element, and electrically conductive means mounted on said housing and extending into contact with said slip rings for electrically connecting said resistance element to points on said housing, said slip rings and said last mentioned electrically conductive means enabling free, continuous rotation of said shaft.

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