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A. WARSHER

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POTENTIOMETER

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FIG. 1

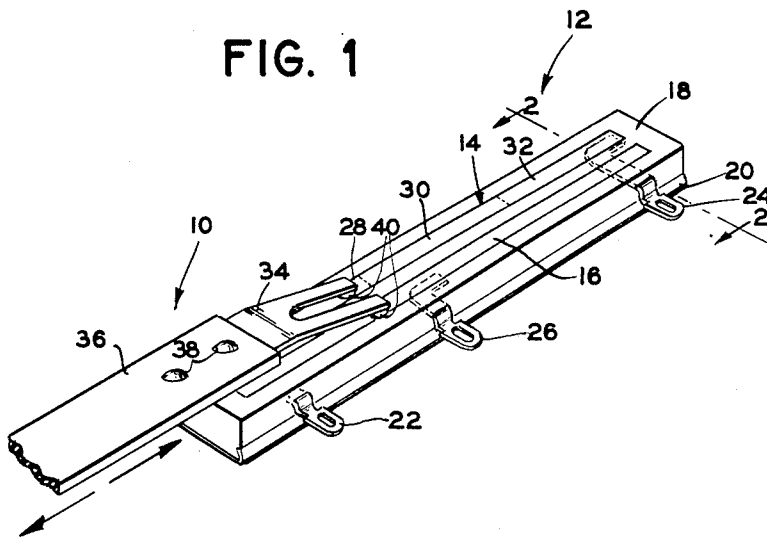


FIG. 2

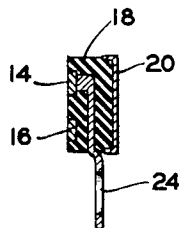
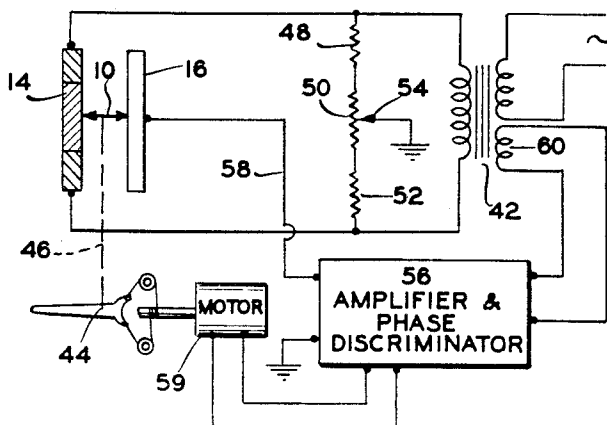


FIG. 3



INVENTOR.
ADOLPH WARSHER
BY

O. J. Brattlie
ATTORNEY

UNITED STATES PATENT OFFICE

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POTENTIOMETER

Adolph Warsher, Maywood, N. J., assignor to Bendix Aviation Corporation, Teterboro, N. J., a corporation of Delaware

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The present invention relates to potentiometers and particularly to potentiometers having linear movement.

Potentiometers used in the past for transforming mechanical movements into corresponding electrical signals have been of the rotary type wherein a rotatably mounted slider is actuated through suitable mechanical linkage. This type of potentiometers has not been entirely satisfactory, however, where the mechanical movements to be transformed into electrical signals vary at a very rapid rate causing heavy wear on the contact surfaces with a consequent increase in contact resistance and fatigue of hairspring type contacts. The present invention contemplates the provision of a novel potentiometer whose sliding member may be actuated at a very rapid rate and yet have a low contact resistance because of very slight wear of the contact surfaces.

One object of the present invention, therefore, is to provide a novel potentiometer for transforming rapid mechanical movements into corresponding electrical signals.

Another object is to provide a novel and simple potentiometer having linear slider movement.

Another object is to provide a novel and effective potentiometer having a resistance track and a collector track in parallel relationship and a slider of very low inertia for providing a continuous connecting jumper between said tracks.

Still another object is to provide a novel and effective potentiometer having spaced linear resistance track and collector track adapted to be short circuited by a slider having a linear movement for producing a voltage across an output dependent on the position of said slider on said tracks.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawing wherein one embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only, and is not intended as a definition of the limits of the invention.

In the drawing,

Fig. 1 is a perspective view of the novel potentiometer,

Fig. 2 is a cross-sectional view of the track assembly taken along line 2—2 of Fig. 1, and

Fig. 3 is a wiring diagram of a system embodying the potentiometer shown in Fig. 1.

For a better understanding of the invention,

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reference is had to Fig. 1 wherein the novel potentiometer is shown as comprising a slider assembly 10 in operative relationship with a track assembly 12 for reciprocal movement relative thereto in the direction of the arrow.

The track assembly comprises a resistance track 14 and a collector track 16 molded into a suitable insulating material 18 backed by a rigid backing plate 20.

Tracks 14 and 16 are made of a material having similar surface characteristics and molded to a glass-smooth finish so as to offer minimum frictional resistance to the contact elements of the slider.

A pair of terminals 22 and 24 are molded in and connected to opposite ends of resistance track 14 and a terminal 26 is molded in and connected to collector track 16.

Resistance track 14 comprises three interconnected sections 28, 30 and 32. Mid-section 30 consists of a high resistance material which may be a mixture of aluminum oxide and organic carbon compounds and the end sections consist of the same oxide material but containing organic carbon compounds having a very low coefficient of resistivity and having the same surface characteristics as the mid-section so as to make a continuous track. The collector track 16 is preferably of the same mixture as that used for the end sections 28 and 32 of track 14. The resistance of mid-section 30 of resistance track 14, which may be controlled by varying the amount of complex carbon, should be large compared to the resistance of the end sections and of the collector track so that the voltage drop through these low resistance elements will be negligible compared to the drop across the high resistance of the mid-section.

It has been found that satisfactory operation is obtained if the total resistance of the mid-section 30 is in the order of 20,000 ohms, and the resistance of the end sections 28 and 32 are in the order of 50 ohms and the collector track and slider contact resistance of the order of 50 ohms.

Slider assembly 10 is shown as comprising a forked slider member 34, which may be made of a conducting material such as beryllium copper, securely attached to a potentiometer actuating member 36 as by rivets 38. In order to provide low contact resistance between the slider and the potentiometer tracks the forked ends of the slider may be provided with 20% iridium-80% platinum tips indicated at 40. The forked ends of the slider are spaced so that they will make contact with both tracks as shown in the drawing. The actu-

ating member 36 may be made of an insulating material such as Bakelite and is confined to move in a path in alignment with the tracks 14 and 16 and biased slightly toward the tracks to insure proper contact pressure at all times between the slider contacts and the tracks.

The potentiometer described above may be used for the same purposes as conventional potentiometers in which case terminals 22 and 24 are connected across a source of electric power and the variable voltage is taken off terminal 26. The potentiometer is, however, particularly well suited for accurately transforming rapid mechanical movements into corresponding electrical variations which may be used for indicating the position of the slider or for positioning a load mechanically coupled to the slider. It has been found to operate satisfactorily at movements of the slider assembly as rapid as 180 cycles per second. There are no pigtailed or spiral connections subject to fatigue, and by using smooth, straight contact surfaces, movements of the slider produce stepless voltage variations, or in other words a pure sine wave which is unobtainable with other types of potentiometers. Furthermore, the resistors have zero temperature coefficient and will not change in value even at extreme temperature changes thereby making it unnecessary to provide means for compensating for temperature variations.

Fig. 3 shows the potentiometer embodied in a system for controlling the movements of a control surface such as an aileron 44 of an aircraft for instance.

In Fig. 3 the potentiometer is represented schematically as having the slider assembly connected to a control surface 44 by a mechanical linkage 46. A power transformer 42 is excited from a source of A. C. voltage and the secondary thereof is connected across resistance track 14. Also connected across the secondary of the transformer is a voltage divider comprising series connected resistors 48, 50, 52. Resistor 50 is provided with a movable slider 54 for positioning control surface 44. Take-off terminal 26 of the potentiometer of Fig. 1 is connected to an amplifier and phase discriminator generally indicated at 56 by a lead 58. A winding 59 of power transformer 42 provides the phase discriminator with a phase comparison. The amplifier and discriminator 56 may be of a type well known in the art and will not be described in detail here. The output of the amplifier and discriminator 56 is connected to a motor 59 adapted for positioning control surface 44 in a suitable manner.

With grounded slider 54 of resistor 50 in mid-position of the voltage divider comprising resistors 48, 50 and 52, the control surface 44 will be in neutral position. Movement of slider 54 in either direction will cause a voltage to be applied to the input of the amplifier to drive motor 59 in such a direction as to cause the control surface to move slider assembly 10 in a direction to rebalance the system and in effect wash out the signal produced by moving slider 54. It should be noted that if the slider should be moved onto the low resistance end portions of the resistance track, the output voltage will remain constant and thus limit the speed of the motor for large excursions of the control surface.

Although only one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit and scope of

the invention as the same will now be understood by those skilled in the art.

I claim:

1. A potentiometer comprising a linear resistance track for having a source of electric power connected thereacross, said resistance track comprising a center portion consisting of a high resistance material and end portions consisting of a low resistance material, said portions forming a continuous stepless track, a linear conducting track mounted in parallel relation to said resistance track and insulated therefrom, and a sliding jumper between said tracks adapted to move along the entire length of said tracks whereby a voltage proportional to the position of said jumper on said mid-portion of said resistance track will appear on said collector track but a substantially constant voltage will be on said collector track when said slider is on either end portion of said track.

2. A potentiometer having rectilinear slider movement comprising a straight composition resistance track including a central portion consisting of a high resistance composition material and end portions of a low resistance composition material, a straight low resistance composition collector track, said tracks being molded in an insulating material in a parallel relationship and having exposed smooth parallel surfaces, means for connecting the respective ends of said resistance track across a source of electric power, an output connected to said collector track, a potentiometer actuating member arranged for linear movements in alignment with said parallel tracks, and a resilient conducting slider supported by said actuating member and biased against said tracks to provide a jumper therebetween and normally positioned on said central portion of said first-named track whereby a voltage will appear across said output of a magnitude depending on the position of said slider on said tracks.

3. In a rectilinear slider potentiometer, a track assembly comprising a straight resistance track and a straight collector track molded in an insulating material in parallel relationship, said resistance track having a high resistance mid-section and low resistance end sections, a potentiometer actuating member mounted for reciprocal movements relative to said parallel tracks and in alignment therewith, a conducting slider mounted on said member and adapted to contact both of said tracks continuously, means for connecting a source of electric power across said resistance track, and an output connected to said collector track whereby a voltage will appear across said output as a function of the position of said slider on said tracks.

4. A potentiometer for use as a follow-up signal developing device in a remote positioning system and adapted for operation by the driven element of such a system, comprising a pair of resistance tracks mounted in parallel relationship and electrically insulated from each other, one of said resistance tracks being of greater resistivity than the other, an actuating member adapted for connection to the driven element and operable thereby, said actuating member being movable linearly of the tracks and in alignment thereof, a conducting slider mounted on said actuating member and adapted continuously to contact both of said tracks to provide a jumper therebetween, and means for connecting a source of electric power across the resistance track having the greater resistivity whereby the position of

the driven element determines the voltage which appears on the track of less resistivity.

5. The combination with a movable control member wherein electrical means are provided for deflecting the control member, of a potentiometer comprising a high resistance track and a low resistance track supported in parallel relationship and electrically insulated from each other, an actuating member connected to said control member and operable thereby having reciprocal movement in alignment with said parallel tracks, a sliding jumper mounted on said actuating member and continuously contacting both of said tracks, and means for applying a constant voltage to the high resistance track whereby the movement of the control member to a deflected position by the electrical means will determine the voltage appearing on the low resistance track.

ADOLPH WARSHER.

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