

March 17, 1953

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2,632,076

VARIABLE DRIVE POTENTIOMETER

Filed Oct. 15, 1951

2 SHEETS—SHEET 1

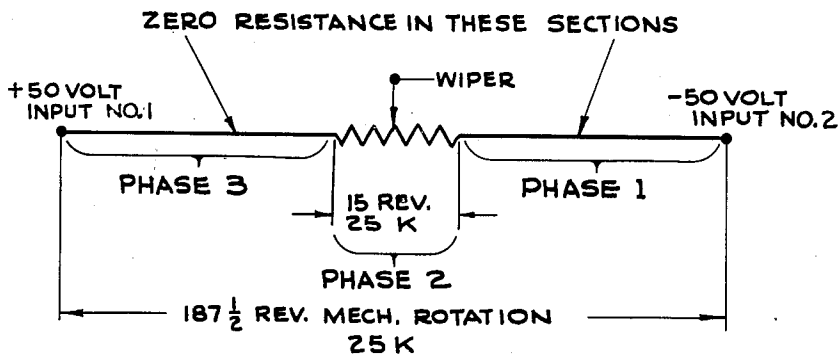


Fig-1

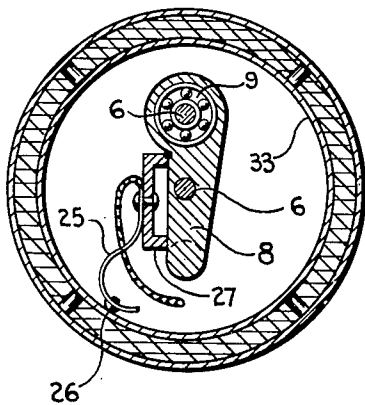
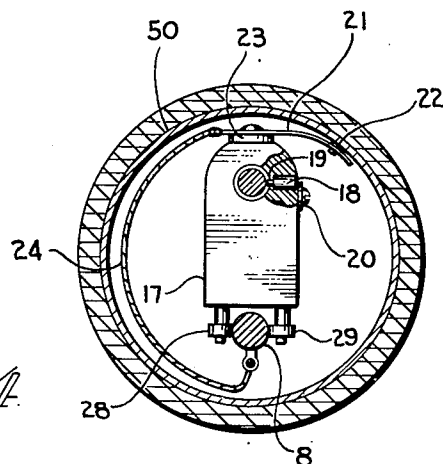


Fig-5

Fig-4



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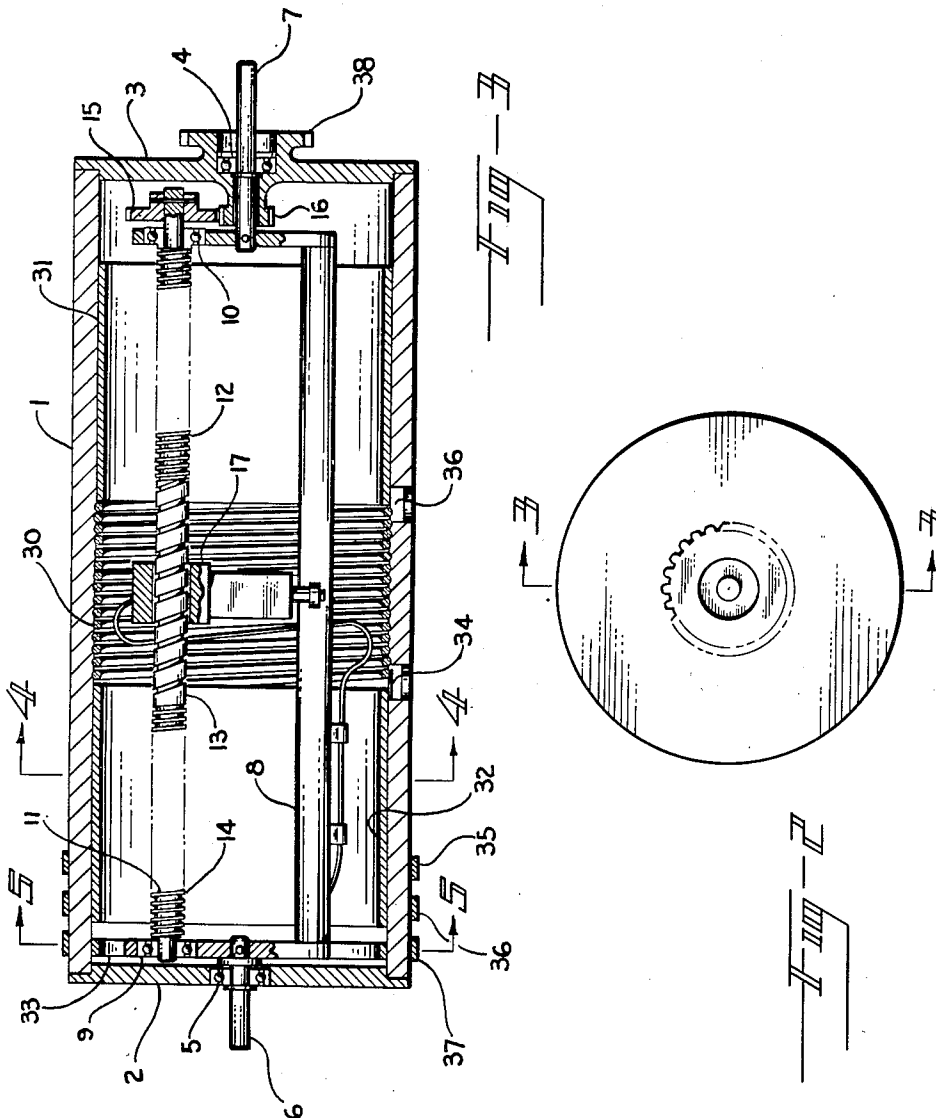
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VARIABLE DRIVE POTENTIOMETER

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2 SHEETS—SHEET 2



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VARIABLE DRIVE POTENTIOMETER

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4 Claims. (Cl. 201—56)

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The present invention relates in general to variable resistors or potentiometers, but more in particular to variable resistors or potentiometers in which the resistance element has the form of a compound helix. The object of the invention is to produce a new and improved variable resistor of this character.

More particularly my invention comprehends a variable resistor or potentiometer which is so constructed so as to enable its resistance or potential to be varied by more than one mechanical input.

The invention also comprehends a variable resistor or potentiometer which is so constructed as to permit its mechanical input shaft to be turned through a considerable number of revolutions without affecting the device's initial resistance or potential and upon further rotation, after this initial predetermined number of turns of the input shaft, varies the resistance or potential linearly or otherwise with an additional predetermined number of revolutions of the shaft. If desired, provision for an additional number of revolutions or phase of operation may be provided, during which the resistance or potential would remain the same as established at the termination of the variable phase.

The foregoing and other features of the invention will be more fully described hereinafter and clarified by the accompanying drawings, in which

Fig. 1 is an electro-mechanical schematic of the device wired as a potentiometer.

Fig. 2 is an end view of the device.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3.

Referring to the drawings, Fig. 1 shows the three phases of operation of the device when wired as a potentiometer. As may be seen from the schematic, assuming input #1 to be equal to +50 volts and input #2 to be equal to -50 volts, the voltage taken from right to left would be as follows: during phase 1 the wiper voltage would be -50 volts due to the substantially zero resistance of the conductor upon which the wiper is riding during this phase. As the wiper embarks upon phase 2 of its travel, it travels over a resistance element of compound helical form and the voltage taken off by the wiper will vary from -50 volts to zero volts at the middle of its travel in phase 2, at which point the plus and minus electrical inputs to opposite ends of the potentiometer will cancel each other out. It therefore fol-

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lows that the voltage taken off by the wiper during the remainder of its travel in phase 2 will vary from zero to +50 volts. Due to the fact that the surface upon which the wiper rides, during phase 3 of its travel, has substantially zero resistance the wiper take off voltage during this phase will remain a constant +50 volts.

Fig. 2 is an end view of the device and Fig. 3 is a sectional view of the device taken on line 3—3 of Fig. 2 in which 1 is the case of the potentiometer which is made of phenolic tubing or some other non conductor, 2 and 3 are the end covers which contain ball bearings 4 and 5 in which shafts 6 and 7 of spider frame 8 revolve.

Spider frame 8 is provided with ball bearings 9 and 10 in which lead screw 11 is mounted. Lead screw 11 does not have a constant lead but rather is divided into three sections—12, 13 and 14—all of which are connected and revolve as a unit, sections 12 and 14 having a lead, for instance, of one twenty second of an inch per revolution, and section 13 a lead of one quarter inch per revolution. Gear 15 is pinned to the right hand end of lead screw 11 and meshes with gear 16 which is cut on the inside of end plate 3.

A rider 17 is mounted on lead screw 11 and carries pin 18 (Fig. 4) in a hole in the body of rider 17. Pin 18 has a small projection 19 which engages the groove in lead screw 11. Pin 18 is retained in the body of the rider by a washer head screw 20.

At the lower edge of the rider two miniature ball bearings 28 and 29 are mounted, whose outer races bear on spider frame 8. The purpose of these bearings is to prevent rider 17 from revolving with lead screw 11.

Rider 17 also carries a spring contact arm 21 upon which is mounted contact 22. The contact arm is insulated from the rider by a phenolic block 23. One end of an insulated wire 24 is soldered to contact arm 21, the other end of the wire being soldered to contact arm 25 (Fig. 5) upon which is mounted contact 26. This contact arm is mounted on insulator 27, which in turn is mounted on the left hand end of spider frame 8. A resistance element 30 is mounted in a helical groove on the inside of case 1. This resistance element is in the form of a compound helix; that is, it is comprised of thin resistance wire wound in helical fashion upon an elongated insulated core which then in turn is formed into a helix.

To the right of resistance element 30 is mounted a sleeve 31 which is made of coin silver or some other metal of high electrical conductivity. To the left of resistance element 30 is a silver sleeve

32 similar to 31. To the left of 32 is a shorter silver sleeve 33 upon which contact 26 (Fig. 5) bears.

When the device is used as a potentiometer, as outlined in the discussion of the schematic shown in Fig. 1, it would be wired as follows: The right hand end of resistance element 30 would be connected to sleeve 31 at 34 and from this junction a wire would be lead in a suitable groove (not shown) in the outside of case 1 to slip ring 35 to which it would be soldered; the left hand end of resistance element 30 would be soldered to sleeve 32 at 36 and a suitable electrical connection (not shown) made between sleeve 32 and slip ring 36; a similar electrical connection (not shown) would be made between sleeve 33 and slip ring 37.

Slip rings 35, 36 and 37 could be replaced by plain lead wires in the event that gear 38, which is affixed to cover 3, was not used as a mechanical input as well as shaft 6 or 7.

The device will, therefore, operate as follows: when input shaft 6 or 7 is turned, spider frame 8 also rotates causing lead screw 11 to travel in an arc about gear 16 on the inside of cover 3. As shown in Fig. 3, gear 15 which is pinned to lead screw 11 meshes with gear 16. Gear 13 will then cause lead screw 11 to rotate and propel the rider 17 along the length of the screw.

It has now become apparent how the operation described in the explanation of the schematic in Fig. 1 is accomplished. Let us assume that the rider and its accompanying contact 22 begin their excursion at the extreme right hand end of portion 12 of lead screw 11; as the input shaft 7 is turned the contact 22 will travel in a helical path along the inside surface of sleeve 31 towards the left. Assuming portion 12 of the lead screw to have a lead of one twenty second of an inch per revolution and gear 15 to have a pitch diameter twice that of gear 16, the pitch of the helix traced by contact 22 on the inner surface of sleeve 31 will be one forty fourth of an inch per revolution. Thus it will be seen that the $81\frac{1}{4}$ revolutions of the shaft 7 in phase 1 will only cause contact 22 to travel approximately two inches. When rider 17 reaches the end of portion 12 of the lead screw it begins to follow portion 13 of the lead screw which might have a lead of one quarter inch per revolution and would cause the contact 22 to follow the helical convolutions of resistance element 30 which would have a pitch of one eighth inch per turn. After the contact 22 has traced the convolutions of resistance element 30 to its left hand end, section 13 of the lead screw ends and the propulsion of the rider 17 and contact 22 is then undertaken by section 14 of the lead screw. As discussed previously, section 14 is identical to section 12 and therefore the travel of rider 17 along these two sections would be the same.

Slip rings 35, 36 and 37 need only be used when the differential feature of the device is employed. In the event that the resistance or potential of the device is required to be varied by two mechan-

ical inputs shafts 6 and 7 would be mounted in bearings (not shown) and another gear (not shown) would be meshed with gears 38 on cover 3. Upon rotation of this auxiliary gear the case 1 of the device is caused to turn and through gears 15 and 16 and lead screw 11 the rider 17 would be caused to travel axially. The case could of course be rotated at the same time as shaft 7.

It is of course obvious that resistance element 30 need not be linear but that selected sections of its length could be of a different value of resistance per inch than other sections.

It is also obvious that sleeves 31 and 32 could be replaced by resistance elements of various types of construction.

I do not limit myself to the precise apparatus shown and described above as this is to be considered merely as a representative form of my invention.

What I claim is:

1. A mechanical device consisting of a cylindrical casing with end caps, a central shaft, a spider frame carried by said shaft, a lead screw rotatably attached to said spider frame, a first gear affixed to one end of the lead screw, a second gear concentric with the central shaft affixed to the inner surface of one end cap and meshing with the first gear, a rider mounted on and engaging the lead screw suitably restrained from rotating with the lead screw, a contact arm mounted on said rider a contact mounted on said arm and bearing on the inner surface of the cylindrical casing so that upon rotation of the central shaft the contact traces a helical path along the inner surface of the cylindrical case.

2. A device as claimed in claim 1 wherein the length of the lead screw is divided into a plurality of sections of varying lead.

3. A device as claimed in claim 1 wherein a helical resistance element is affixed to the inner surface of the cylindrical case to correspond to the helical path traced by the contact.

4. A device as claimed in claim 1 wherein the lead screw is axially divided into three sections the center section being of a greater lead than the end sections, a helical resistance element affixed to the inner surface of the casing opposite the center section of the lead screw, cylindrical metal sleeves affixed to the inner surface of the casing opposite the end portions of the lead screw, each of said sleeves being attached to one extremity of the resistance element.

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