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VARIABLE POTENTIAL DIVIDERS

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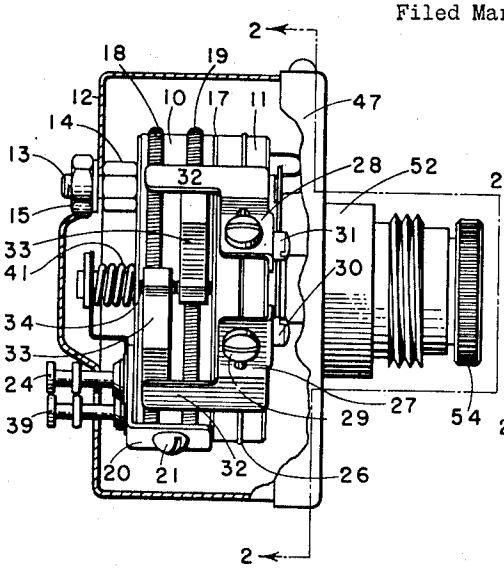


FIG. 1

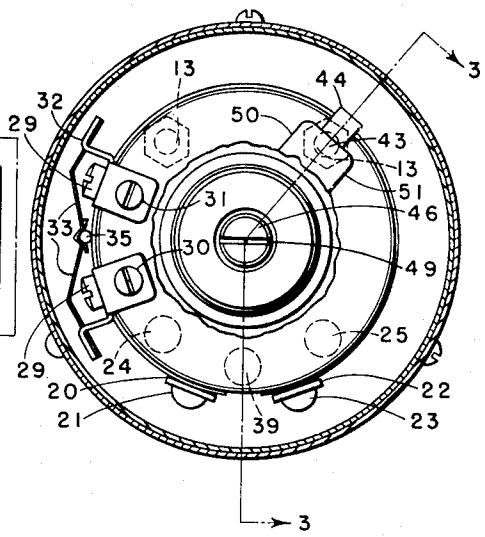


FIG. 2

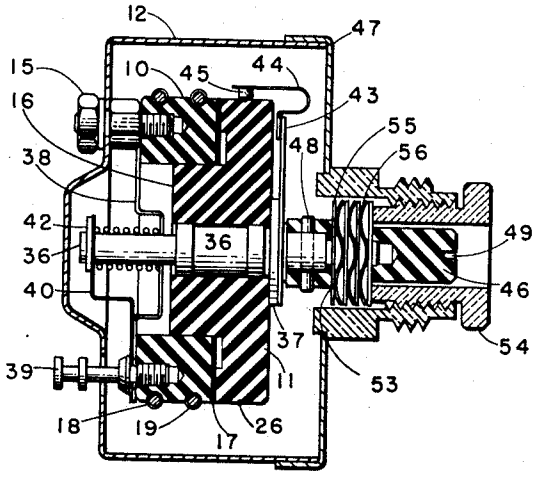


FIG. 3

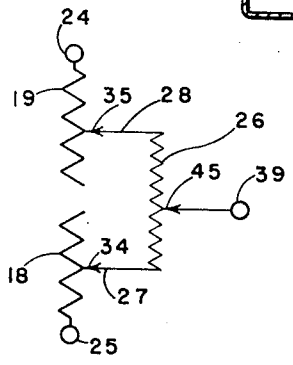


FIG. 4

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VARIABLE POTENTIAL DIVIDERS

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3 Claims. (Cl. 201—48)

This invention relates to variable precision resistors and more particularly to a variable potential or voltage divider.

The conventional voltage divider usually consists of a single resistance mounted on a support of insulating material with a contact slidably engageable with the resistance to enable the user to pick off fractional voltage values representative of the whole or part of the total voltage drop across the resistance. However, the degree in variation of the fractional voltages taken off is limited by the finite resistance of each turn of the resistance causing the voltage to vary in steps the magnitude of which are too great for many applications. As a result, such devices are seldom capable of resolution in excess of 1 part in 1000.

Attempts to overcome this limitation of the conventional adjustable voltage divider have resulted in such instruments as one wherein several separate devices, each with a separate manual adjustment element, and representing decade steps are electrically connected to each other. In order to realize the desired resolution, another type of device consists of a single conductor of relatively low resistance either wound a great number of turns upon a support of a given diameter or a lesser number of turns upon a support of relatively large diameter. In the former case, the device cannot be conveniently and compactly accommodated in an instrument because of its large dimension in an axial direction while the latter type of device is too large in diameter.

It is therefore an object of this invention to provide a new and improved voltage divider which is adjustable.

It is also an object of this invention to provide a high resolution adjustable voltage divider having a single operative or adjustable element.

It is a further object of this invention to provide a relatively simple, compact and less costly adjustable voltage divider adapted to pick off voltages to extreme accuracy to the extent that the device is capable of resolutions in excess of one part in 500,000.

The invention will be better understood from the following description when taken in connection with the accompanying drawing and the scope of the invention will be pointed out in the appended claims.

In the drawing, Fig. 1 is a plan view of the device with an enclosing casing partly broken away to better show in full view important elements of the device; Fig. 2 is a sectional view of the unit taken on the line 2—2 of Fig. 1; Fig. 3 is a sectional view on the line 3—3 of Fig. 2 and Fig. 4 is a diagrammatic sketch of the circuitry involved in the invention.

Referring now to the details of the device illustrated, the principal elements of the unit are mounted on a support of insulating material comprising a pair of blocks or discs 10 and 11 having a generally cylindrical or circular outside configuration. More specifically, support 10 consists of an annular ring of electric insulating material fixedly mounted or supported on an enclosing casing 12 by means of a pair of studs 13. Each stud

comprises a square or hexagonal intermediate portion 14 to serve as a spacer and a pair of threaded shanks, one of which is screwed into or molded in the ring and the other of which projects through an opening in the casing for threaded application of a nut 15 thereon to fixedly bind the ring 10 to the casing 12. Support 11 is also made of electric insulating material and is provided with a portion 16 which projects within the annular support ring 10 and is rotatable with respect thereto. To facilitate smooth rotation of support 11 a washer 17 of fiber material, for example, is interposed between a face of ring 10 and an annular projecting portion of support 11.

The peripheral surface of support 10 is provided with a pair of grooves of semi-circular cross section to accommodate a relatively coarse resistance. The resistance comprises a pair of resistance wires 18 and 19 of relatively high resistance value and helically wound in a series of regularly spaced-apart convolutions upon separate cores in a well known conventional fashion. Resistance 18 is positioned in one of the semi-circular grooves and resistance 19 is disposed in parallel and spaced relationship to resistance 18 in the other groove. Resistances 18 and 19 are of equal resistance value and of the same lineal length but neither resistance occupies the full 360 degrees of their respective grooves. Otherwise, the ends of each resistance are positioned opposite or adjacent each other and the resistances are retained in the grooves by means of a clamp 20 and round head screw 21 which fixedly clamps the cores in the grooves at one of the adjacently positioned ends of the cores while a similar clamp 22 and round head screw 23 is employed to clamp the cores at the opposite and adjacently positioned ends thereof. Both clamps are made of electric conducting material and clamp 20 is also employed to electrically connect one end of the resistances, such as resistance 19, to a terminal lug 24 fixedly mounted on insulating support 10 as shown in Fig. 1. The end of resistance 18 located adjacent the other end of resistance 19, or the end opposite the aforementioned terminal connected end thereof, is likewise electrically connected through clamp 22 to a second terminal lug 25 which is also fixedly mounted on insulating support 10.

The peripheral surface of insulating support 11 is provided with a groove to accommodate a relatively fine or vernier resistance wire 26 which has a lineal length short of the 360 degrees of the groove. Vernier resistance wire 26 is retained in its groove by and the opposite ends of the wire are respectively connected to a pair of electrical conducting elements 27 and 28 which perform a dual function. Each of these elements consists of an L-shaped portion, one leg of which together with a screw 29 serves to retain and make good electric contact with one end of vernier wire 26 while the other leg extends over the outer flat face of insulating support 11. This leg of element 27 and the corresponding leg of element 28 are respectively provided with projecting portions, such as the screw heads 30 and 31, for example, which comprise abutments to serve a function to be pointed out more fully hereinafter.

Electric conducting elements 27 and 28 also serve the function of contact mounting means and for this purpose each of the elements is provided with a relatively rigid portion 32 which projects over the coarse resistances 18 and 19 and a resilient or spring portion 33 which carries a cylindrical contact. Contact 34 supported by contact mounting means 27 is biased into sliding engagement with coarse resistance 18 by the resilient portion 33 while contact 35, which is positioned directly opposite contact 34 as viewed in Fig. 1 and is supported by contact mounting means 28, is biased into sliding engagement with coarse resistance 19. Thus, terminal 25 and coarse

resistance 18 are electrically connected through contact mounting means 27 to one end of the vernier resistance 26 while terminal 24 and coarse resistance 19 are electrically connected through contact mounting means 28 to the other or opposite end of vernier resistance 26.

Insulating support 11 is otherwise provided with a central cylindrical opening therethrough to accommodate a shaft 36 of electric conducting material. Shaft 36 is freely rotatable with respect to both supports 10 and 11 and is provided with a flange portion 37 adjacent one end thereof as better viewed in Fig. 3. The shaft extends through and is freely rotatable within an opening in a relatively rigid bracket 38 which extends diametrically across ring support 10 and is fixedly attached thereto by a flange portion of a third terminal lug 39 which is screwed into the ring support 10. As illustrated, terminal 39 also retains one end of a relatively resilient or springy terminal jumper 40 of electric conducting material. Adjacent the free end of the jumper 40, an opening is provided through which shaft 36 extends. Interposed between bracket 38 and the free end of jumper 40, a coil spring 41 is provided which biases the jumper into good electrical contact with a C washer 42 of conducting material which is retained in a circumferential groove provided in and adjacent to the left hand end of shaft 36. By virtue of the shaft flange portion 37, which abuts the outside flat surface of insulating support 11, it will be understood that spring 41 also biases opposing faces of supports 10 and 11 against fiber washer 17.

Shaft 36 carries a vernier contact arm of electric conducting material and having a rigid portion 43 fixedly mounted on the shaft and rotatable therewith. The contact arm also includes a conducting resilient portion 44 which carries a contact 45 slidably engageable with the fine resistance wire 26. As better illustrated in Fig. 1, abutment portions 30 and 31 of contact mounting means 27 and 28 are in the path of rotation of the rigid portion 43 of the vernier contact arm.

Shaft 36 is also provided with an extension 46 of electric insulating material which extends through a central opening in a removable cover portion 47 of the enclosing casing 12. As better illustrated in Fig. 3, one end of shaft extension 46 is mounted on a reduced section of shaft 36 and is fixed thereto by a cross pin 48 extending diametrically through both the reduced portion of shaft 36 and the insulating shaft extension 46. An operating knob may be mounted on the outer free end of shaft extension 46 or, as illustrated, this end may be provided with a cross slot 49 to accommodate a screw driver.

In operation, terminals 24 and 25 may be connected in a circuit and terminal 39 may be connected to an associate circuit which may be traced back to either terminal 24 or 25. Thus, assuming constant current condition in the first circuit, a constant potential or voltage drop will be established across terminals 24 and 25 by virtue of current flow which may be traced through a circuit from terminal 24, for example, conducting clamp 20 to one end of coarse resistance 19, through this resistance to slidable contact 35, through contact mounting means 28 to one end of vernier resistance 26, through this resistance to the opposite end thereof and contact mounting means 27, slidable contact 34 through coarse resistance 18 to the end thereof connected to conducting clamp 22 and then to terminal 25. Depending upon the positions of contacts 34, 35 and 45 with respect to their associated resistances, it will be apparent that any fraction of the total voltage drop between terminals 24 and 25 may be picked off and applied to a circuit connected to either terminal 24 or 25 and to the third terminal 39 which is electrically connected through terminal jumper 40, C washer 42, conducting shaft 36, contact support arm 43—44 to contact 45 which is slidably engageable with vernier resistance 26.

Assuming, for example, that terminal 24 is the terminal of highest potential and that it is desired to pick off a relatively small fraction of the total potential drop across terminals 24 and 25, shaft extension 46 would be rotated counterclockwise as viewed in Fig. 2 to rotate the vernier contact arm until the edge 50 of the rigid portion thereof engaged the abutment 31. Thereafter, further counterclockwise rotation of shaft extension 46 will cause rotation of insulating support 11 with respect to insulating support 10 and slidable movement of contacts 34 and 35 along coarse resistances 18 and 19 respectively until these latter contacts reach the ends of coarse resistances 18 and 19 adjacent conducting clamp 20. With the various elements thus positioned and assuming further that the other end of the associate circuit connected to the third terminal 39 is electrically connected to terminal 24, zero or no voltage would be picked off and applied to the associate circuit. To realize the particular or precise result desired, the shaft extension may then be rotated clockwise, as viewed in Fig. 2, to slidably move contact 45 along vernier resistance 26 and thereby pick off a relatively small fraction of the total voltage drop between terminal 24 and 25 as determined by the relatively low resistance value of the vernier. In a similar manner and assuming the same connections, the full voltage drop across terminals 24 and 25 may be applied to the associate circuit by rotating shaft extension 46 clockwise for engagement of edge 51 of the rigid portion of the contact arm with abutment 30 to further cause slidable movement of contacts 34 and 35 along the coarse resistances to the ends thereof adjacent conducting clamp 22. Thereafter, of course, a small percentage of the full voltage drop may be subtracted and relatively high percentages thereof may be applied to the associate circuit by counterclockwise rotation of shaft extension 46 and slidable movement of contact 45 along the vernier and with respect to all other elements of the device.

Thus, I have provided a compact and relatively inexpensive triple terminal device having a single manual adjustment element 46 operative to adjust a coarse resistance adjustment to pick off a fractional voltage representative of any part of the total voltage drop across the coarse resistance and also operative to adjust or vary a vernier resistance adjustment to infinitesimally vary the fractional voltage within relatively narrow limits compared to the total voltage.

Inasmuch as this device is intended to be an extremely accurate and highly precise unit, it is important that outside forces such as vibrations do not disturb any setting once it has been made. To insure this aspect, the central opening in removable cover 47 is provided with a boss or bushing 52 threaded internally as illustrated and the shaft extension 46 of insulating material is provided with a shoulder 53. A knurled lock screw 54 is also provided with threads engageable with the internal threads of the cover bushing. Interposed between shoulder 53 and lock screw 54, a plurality of alternately positioned washers 55 and crimped springs or washers 56 of resilient material are mounted on the shaft extension 46 so as to be freely movable in an axial direction with respect thereto. As knurled lock screw 54 is threaded into the bushing the inner end of screw 54 causes compression of resilient washers 56 whereby the supports 10 and 11 of insulating material are biased closer together so as not to be as freely rotatable with respect to each other and the flange 37 of shaft 36 is bound into tighter engagement with support 11 so as to prevent movement of contact 45 with respect to vernier resistance 26. In practice, the bushing 52 is inserted through a slightly larger opening in a panel board and a threaded nut is applied to the outside threads of the bushing to maintain the unit in position on the panel.

While I have, in accordance with the patent statutes, shown and described a particular embodiment of my in-

vention, it will be obvious that changes and modifications can be made without departing from the invention in its broader aspects and, I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a variable potential divider, a first coarse resistance having a given resistance value, a second coarse resistance having a resistance value equal to that of said first resistance, a terminal electrically connected to one end of said first resistance, another terminal electrically connected to one end of said second resistance, a pair of contacts respectively and slidably engageable with said first and second resistances, a support, said contacts being fixedly mounted on said support and so related to said terminals that movement of one of said contacts a given amount toward one of said terminals causes movement of the other of said contacts an equal amount away from the other of said terminals, a vernier resistance electrically interconnecting said contacts, a third contact slidably engageable with said vernier, a third terminal electrically connected to said third contact and a single adjustment element movable with respect to said first and second resistances, said adjustment element being operative to slide said third contact along said vernier resistance and to move said support and thereby adjust said first and second resistances.

2. A precision resistor comprising a pair of supports of insulating material, said supports being movable with respect to each other, a pair of coarse resistances mounted in spaced relationship on one of said supports, a relatively fine resistance mounted on the other of said supports, a pair of contacts mounted on said other support and electrically connected respectively to the opposite ends of said fine resistance, one of said contacts being slidably engageable with one of said coarse resistances and the other of said contacts being slidably engageable with the other of said coarse resistances, a third contact slidably engageable with said fine resistance and a single adjustment member movable with respect to said supports, said adjustment member being operative to slide said third contact along said fine resistance and to move one of said supports relative to the other to adjust said coarse resistances.

3. A precision resistor comprising a pair of supports of insulating material, one of said supports being rotatable with respect to the other, a pair of coarse resistances mounted in spaced and parallel relationship on said other support, a terminal mounted on said other support and electrically connected to an end of one of said coarse resistances, a second terminal mounted on said other support and electrically connected to an end of said other coarse resistance adjacent the end of said one coarse resistance opposite the terminal connected end thereof, a shaft of electric conducting material rotatable with respect to said one support, a third terminal mounted on said other support and electrically connected to said shaft, a fine resistance mounted on said one support of insulating material, a contact slidably engageable with said fine resistance, a support arm for said contact electrically connected to said shaft and rotatable therewith, a pair of adjacently positioned contacts slidably engageable respectively with said coarse resistances and respectively electrically connected to the opposite ends of said fine resistance, separate mounting means for said pair of contacts fixedly mounted in spaced relation on said one support of insulating material, each of said separate contact mounting means having an abutment portion positioned in the path of rotation of said contact support arm, said shaft being operative for rotation of said contact arm between said abutments to cause slidable adjustment of the contact supported on said arm over said fine resistance and operative to cause engagement of said contact arm with either one of said abutments whereby further rotation of said shaft causes rotation of said one support with respect to said other support of insulating material and slidable movement of said pair of contacts with respect to said coarse resistances.

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