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VARIABLE RESISTANCE DEVICE

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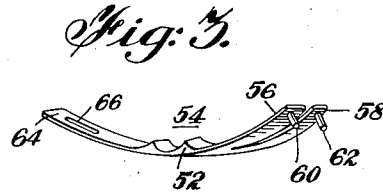
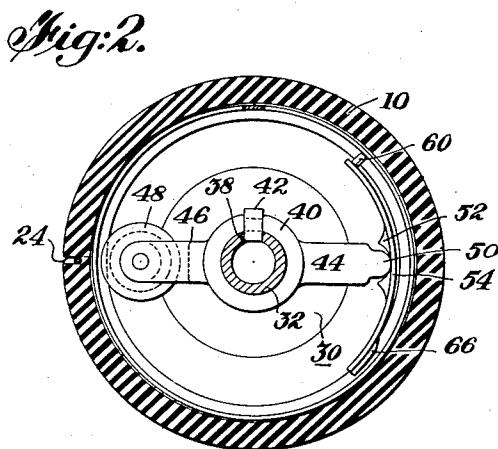
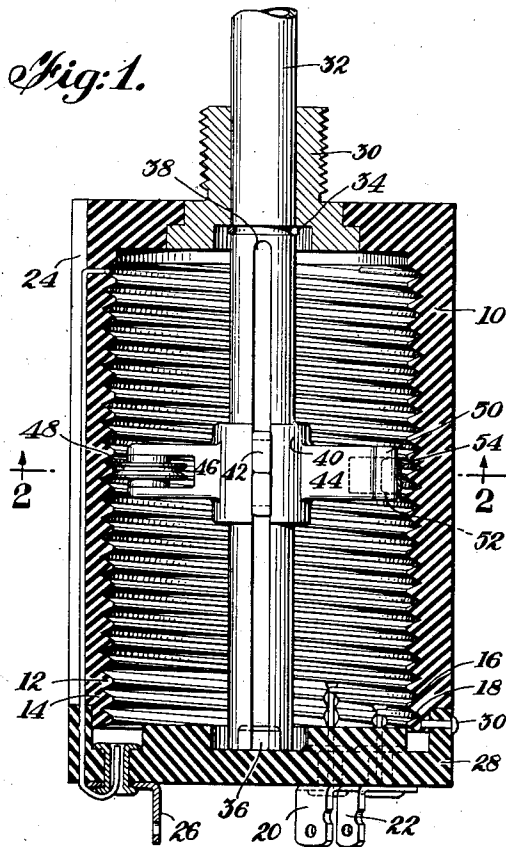


Fig. 4.

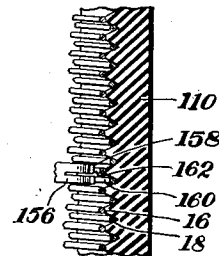


Fig. 5.

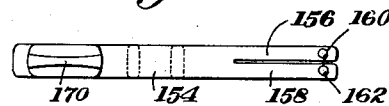
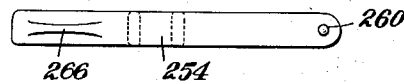


Fig. 6.



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VARIABLE RESISTANCE DEVICE

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20 Claims. (Cl. 201—56)

This invention relates to improvements in variable resistance devices, and more particularly to an internally wound controllable resistor, such as a potentiometer.

An object of this invention is to provide an internally wound variable resistor device incorporating novel resistor-contacting and control members.

Another object of this invention is to provide an internally wound variable resistor whose operating and contact mechanism gives a sure, smooth action, free from backlash.

A further object of this invention is the provision of an operating and contacting mechanism for internally wound variable resistors, whose setting is substantially unaffected by possible end play or wobble of the control shaft.

A specific object of this invention is to provide an accurate internally wound potentiometer containing the greatest length of resistance wire for its size.

Further objects and advantages of this invention will be apparent from consideration of the specification as illustrated by the accompanying drawing of possible embodiments of the invention, in which drawing:

Fig. 1 is a longitudinal cross-sectional view of a preferred form of potentiometer in accordance with the present invention;

Fig. 2 is a transverse cross-sectional view taken along the line II—II of Fig. 1;

Fig. 3 is a perspective view of the wire-contacting mechanism of the potentiometer of Figs. 1 and 2;

Fig. 4 is a partial longitudinal cross-sectional view of a modified potentiometer construction;

Fig. 5 is a bottom view of a modified form of contactor to be used with the potentiometer illustrated in Fig. 4;

Fig. 6 is a bottom view of still another contactor to be used in connection with the potentiometer construction illustrated in Fig. 4.

A preferred embodiment of the invention illustrated in Figs. 1, 2 and 3 illustrates the application of the principles of this invention in connection with an internally wound potentiometer. The structure consists essentially of an insulating shell 10 formed with double internal threads 12 and 14, the bottom of the thread 12 having placed therein a suitable bare conductor wire 16, while in the bottom of the threads 14 is wound a suitable bare resistance wire 18. The wire 16 forms the central variable contacting point for the potentiometer, while the resistance wire 18 forms the resistance bridge for the poten-

tiometer. The conductor wire 16 is provided with an end terminal 20. One end of the resistance wire 18 is connected to a terminal 22, while the other end of this resistance wire may pass through a longitudinal groove 24 on the outside of the shell to a second terminal 26 attached at the same end of the potentiometer as the terminals 20 and 22. It will be obvious to those skilled in this art that if desired, the terminal 26 could be directly attached to the outside of the shell 10 near the upper end of the resistance wire 18 (as seen in the drawing), in which case the groove 24 would not be necessary. The terminals 20, 22 and 26 in the form of invention illustrated, are preferably attached to an end cap 28, also of insulating material, which fits about the lower end of the shell 10 and may be attached thereto by suitable means such as pins 30. The contacts 20, 22 and 26 may be of any suitable construction. In the form shown, they are provided on one side with rivet-like heads which securely fasten them to the end cap 28.

The other end of the insulated shell 10 is provided with a suitable opening seating a bearing member 30 for the control shaft 32. The bearing member 30 may project beyond the shell 10 and be provided with external threads, used to fasten the potentiometer to a panel or other support. The shaft 32 is provided with a small annular depression used as a seat for a retaining spring or collar 34, preventing endwise motion of the shaft in one direction, while the other end of the shaft rests against the end cap 28 and may be centered thereon by a projection 36 formed integrally on one side of the end member. Other suitable shaft-centering and supporting means could, of course, be used.

In accordance with the present invention that portion of the shaft 32 within the potentiometer shell 10 is preferably hollow and is formed with a keyway 38. A resistance control member 40 slides on the shaft 32 but is prevented from relative rotation by means of a key 42, which may be in the form of a metal clip or wire positioned in and about a suitable groove on one side of the control member 40 and projecting downwardly into the keyway 38. The insulated control member 40 is formed with a pair of diametrically opposite arms 44 and 46. The latter rotatably supports a grooved wheel 48 of insulating material which engages the internally formed threads in the shell 10. The other arm 44 supports a novel resistance wire and central conductor contacting mechanism.

In accordance with the present invention, the

arm 44 of control member 40 is formed with a projection 50 of semi-cylindrical form, which seats in a semi-cylindrical abutment formed at the center on the concave side of an arcuate conductive spring 54. One end of the conductive spring 54 is split into two spring arms 56 and 58, from whose convex side respectively project contacts 60 and 62 so spaced as to project and press against the wires in the adjacent internally formed double threads. Thus, one of the contacts, for example 60, will press against the resistance wire 18, while the other contact 62 will press against the conductor wire 16. The other end 64 of the arcuate spring 54 will ride upon the apex of the threads, and in order that this end may truly follow the engagement of the contacts 60 and 62 in the threads, it may be formed with a groove 66 which will directly ride upon and engage the apices of the threads.

The general operation of the potentiometer described above will now be clear to those skilled in this art. Upon rotation of the shaft 32, rotary motion will be imparted to the insulated control member 40. Since this, however, engages the internally formed threads on the shell 10 both through the grooved wheel 48 and the contacts and guides on the arcuate spring 54, this control member will move longitudinally of the shaft 32 whenever the latter is rotated, this motion being permitted by reason of the sliding, keyed construction heretofore described. The contacts 60 and 62 on one end of the arcuate spring 54 will thus engage various portions of the internally wound wires and the relative distance between the neutral point of the potentiometer as represented by the contacted conductor wire and the distance between the ends of the resistance wire 18 will accordingly vary, depending upon the longitudinal and angular position of the control member 40. The provision of a double thread engagement resulting from the use of a thread-engaging wheel 48 as well as through the actual contact 60 and 62, provides a balanced arrangement which serves to give to the potentiometer a smooth and accurate control action. The form of the arcuate spring 54 in which the contacts on one end are balanced by the other end riding upon the apices of the thread, also results in a balanced construction which gives a smooth, free from backlash action no matter in which direction the contacts are rotated. Another novel feature of the present invention is the manner in which motion to the arcuate spring 54 is imparted by the arm 44 of the control member 40. The cylindrical projection 50 on the end of the arm 44 resting in the cylindrical abutment 52 on the contact spring 54 will provide a positive movement of the arcuate spring in either direction but end play of the control member 40 or of the shaft 32 will not affect the seating of the potentiometer since the projection 50 can move longitudinally within the abutment 52. Wobbling of the shaft 32 due to worn bearings will likewise not affect the accuracy of the potentiometer since such wobbling merely causes a rolling of the projection 50 in the abutment 52 without changing the potentiometer set.

It will thus be seen that I have provided a simple but yet extremely accurate potentiometer. Variations in the construction described will occur to those skilled in this art and are contemplated as art of the present invention. For example, in order to obtain slidable non-rotatable mounting of the control member 40 on the central shaft, the latter could be formed

square within the potentiometer shell, in which case the control member 40 would have a square bore and no keyed arrangement would be necessary. The use of a grooved wheel 48 is not required as a proper guiding of the control member 40 could be attained merely by a provision of suitably extending and grooving the outer end of the arm 46. The use of a grooved wheel, however, results in a smoother potentiometer action. Certain other modifications which are to be considered novel features of the present invention will be now described.

In the form of invention illustrated in Fig. 4, it is proposed to wind the neutral conductor wire upon the apices of the internal threads and the resistance wire 18 in the bottom of the threads, in which case, however, a single rather than a double internal thread construction is used. This arrangement is advantageous in that the number of high resistance turns can be doubled, as compared with the double threaded construction of Fig. 1. The construction illustrated in Fig. 4, however, requires a slightly modified type of arcuate spring contactor. In this case, the spring generally designated as 154 is provided, as previously, with one end having split sections 156 and 158 upon which are mounted projecting contacts 160 and 162 respectively. However, since one contact is to engage the wire in the bottom of the threads and the other is to engage the wire on the apices of the threads, the contacts must be of different lengths as illustrated. Additionally, since the apices of the threads are now covered with bare wire, the other end of the arcuate spring is preferably insulated therefrom as shown in Fig. 5. This may readily be done by attaching an insulating shoe 170 to the convex side of the other end of the spring arm 154. The remaining structure will be identical with that illustrated in Figs. 1 and 2 and the operation of the potentiometer will be the same except for the fact that twice as much resistance wire can be used or, conversely, the size of the potentiometer can be cut substantially in half.

Fig. 6 illustrates a modified form of arcuate conductive spring which may be used in connection with the form of invention illustrated in Fig. 4 in place of the conductive spring illustrated in Fig. 5. In the form of invention illustrated in Fig. 6, advantage is taken of the fact that the neutral wire of the potentiometer is wound on the apices of the threads. In this case, therefore, since one end of the conductive spring 254 rides on the apices of the threads, this may be used as one contact, while the other end of the spring 254 will then be provided with only a single contact 260 which will engage the resistance wire in the bottom of the threads. If desired, the one end of the conductive spring 254 engaging the apices of the threads and the conductor wire thereon, may be formed with a pressed out groove 266 to assure good contact and guiding of the spring.

While the invention has been described primarily in connection with an internally wound potentiometer, it will at once be obvious to those skilled in this art that the essential features of the present invention are equally applicable for use in connection with a single internally wound variable resistor or other variable coil. Such a resistor might retain the double threaded construction as illustrated in Fig. 1, in which case merely the second resistance wire lead and terminal would be eliminated. On the other hand, a single threaded variable resistance construc-

tion could be used, in which case the conductor on the apices of the threads as shown in Fig. 4 would probably be eliminated.

While in the form of invention illustrated in Figs. 1 to 3 inclusive, a more balanced construction can be obtained by using double contacts on one end of the conductive spring 54 and a rider on the apices of the threads on the other end of the conductive spring, it is possible to place a wire-engaging contact on opposite ends of the spring 54 somewhat in the manner proposed in Fig. 6 in the connection with the single thread potentiometer construction.

While I have described above the principles of my invention in connection with specific apparatus and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. A variable resistance device comprising, in combination, an internally threaded hollow insulating shell, bare resistance wire positioned in the bottom of the internal threads, a resistance controlling member positioned within said hollow shell and having a pair of diametrically opposite arms, insulated means on the end of one of said arms engaging said internal threads, conductive wire-contacting means engaged by the end of the other arm, and means for rotating said controlling member, whereby, upon rotation, the longitudinal and angular position of said member within said shell is varied by the engagement of said insulated means with the internal threads of the shell and the contacting means engages various corresponding portions of the resistance wire.

2. A variable resistance device comprising, in combination, an internally threaded hollow insulating shell, bare resistance wire positioned in the bottom of the internal threads, a resistance controlling member positioned within said hollow shell and having a pair of diametrically opposite arms, insulated thread-engaging means on the end of one of said arms, an arcuate conductive spring having a central double abutment on its concave side, means on the end of the other arm seating in said abutment, a contact engaging said wire and attached to the convex side of one end of said arcuate spring, thread-engaging means on the convex side of the other end of said arcuate spring, and means for rotating said controlling member, whereby upon rotation, the longitudinal and angular position of said member within said shell is varied by engagement of said insulated means with the internal threads of the shell and the conductive spring is rotated and longitudinally moved in one direction or the other by the action of said other arm on said abutment.

3. The combination according to claim 2, in which said thread-engaging insulating means is a grooved wheel of insulating material.

4. The combination according to claim 2, in which said rotating means is a central rotatable shaft extending through said shell, and in which said control member is slidably but non-rotatably mounted on said shaft.

5. The combination according to claim 2, in which said abutment prevents relative rotation between the end of the other arm and said arcuate spring, but is open at its sides to permit relative longitudinal displacement therebetween.

6. A potentiometer comprising, in combination, a hollow insulating shell provided with a double internal thread, a bare, relatively high resistance wire positioned in the bottom of one thread, a bare, relatively low resistance conductor wire positioned in the bottom of the other thread, a resistance-controlling member mounted within said hollow shell, having a pair of diametrically opposite arms, insulated thread-engaging means on the end of one of said arms, a pair of interconnected wire-engaging contacts engaged by the end of the other arm, said contacts being longitudinally spaced from one another by an amount substantially equal to the difference between the two sets of threads so that one contact engages the high resistance wire and the other the low resistance conductor, and means for rotating said control member, whereby upon rotation the longitudinal and angular position of said member within said shell is varied by the engagement of said insulated means with the internal threads, and the contacts engage various corresponding portions of the resistance and conductor wires.

7. The combination according to claim 6, in which said thread-engaging insulating means is a grooved wheel of insulating material.

8. The combination according to claim 6, in which said rotating means is a central rotatable shaft extending through said shell, and in which said control member is slidably but non-rotatably mounted on said shaft.

9. A potentiometer comprising, in combination, a hollow insulating shell provided with a double internal thread, a bare, relatively high resistance wire positioned in the bottom of one thread, a bare, relatively low resistance conductor wire positioned in the bottom of the other thread, a resistance-controlling member mounted within said hollow shell, having a pair of diametrically opposite arms, insulated thread-engaging means on the end of one of said arms, an arcuate conductive spring split at one end and having a double central abutment on its concave side, means on the end of the other arm seating in said abutment, a contact on the convex side of each split end portion of said conductive spring, said contacts being so displaced that one engages the wire in one thread and the other engages the wire in the other thread, the other end of said conductive spring pressing against the apices of at least one of the threads, and means for rotating said controlling member, whereby upon rotation, the longitudinal and angular position of said member within the shell, and the corresponding engaging portions of said contacts with their respective wires, is varied by rotation of said member and the engagement of said insulated means with the internal threads.

10. The combination according to claim 9, in which the other end of said spring arm is formed with a thread-engaging groove.

11. The combination according to claim 9, in which said abutment prevents relative rotation between the end of the other arm and said arcuate spring but is open at its side to permit relatively longitudinal displacement therebetween.

12. A potentiometer comprising, in combination, an internally threaded hollow insulated shell, a continuous piece of bare, relatively high resistance wire positioned in the bottoms of the internal threads, a continuous piece of bare, relatively low resistance conductor wire mounted on the apices of the internal threads, a resistance-controlling member mounted within said hollow

shell having a pair of diametrically opposite arms, insulating thread-engaging means on the end of one of said arms, a pair of interconnected wire-engaging contacts engaged by the end of the other arm, said contacts being displaced from one another to such an extent that one contact engages the resistance wire in the bottom of the thread and the other contact engages the conductor wire on the apex of the thread, and means for rotating said controlling member, whereby, upon rotation the longitudinal and angular position of said member within said shell is varied by the engagement of said insulated means with the internal threads, and the contacts engage various corresponding portions of the resistance and conductor wires.

13. The combination according to claim 12, in which said thread-engaging insulating means is a grooved wheel of insulating material.

14. The combination according to claim 12, in which said rotating means is a central rotatable shaft extending through said shell, and in which said control member is slidably but non-rotatably mounted on said shaft.

15. A potentiometer comprising, in combination, an internally threaded hollow insulating shell, a continuous piece of bare, relatively high resistance wire positioned in the bottoms of the internal threads, a continuous piece of bare, relatively low resistance wire mounted on the apices of the internal threads, a resistance-controlling member mounted within said hollow shell, having a pair of diametrically opposite arms, insulated thread-engaging means on the end of one of said arms, an arcuate conductive spring split at one end and having a double central abutment on its concave side, means on the end of the other arm seating in said abutment, a pair of contacts on the convex side of each split end portion of said conductive spring, said contacts being so displaced that one end engages the wire in the bottom of the thread and the other contact engages the wire on the apex of the thread, insulated means on the convex side of the other end of said spring, adapted to ride on the apex of the threads, and means for rotating said controlling member, whereby, upon rotation, the longitudinal and angular portion of said member within said shell is varied by the engagement of said insulated means with the internal threads and the contacts engage various corresponding portions of the resistance and conductor wires.

16. The combination according to claim 15, in which said abutment prevents relative rotation between the end of the other arm and said arcuate spring, but is open at its side to permit relatively longitudinal displacement therebetween.

17. The combination according to claim 15, in which said abutment is formed with a limited concave seating surface to permit slight rolling of the means on the end of the other arm relatively to the contact spring.

18. A potentiometer comprising, in combination, an internally threaded hollow insulating shell, a continuous piece of bare, relatively high resistance wire positioned in the bottoms of the internal threads, a continuous piece of bare, relatively low resistance conductor wire mounted on the apices of the internal threads, a resistance-controlling member mounted within said hollow shell, having a pair of diametrically opposite arms, insulated thread-engaging means on the end of one of said arms, an arcuate conductive spring having a double central abutment on its concave side, means on the end of the other arm seating in said abutment, a contact on the convex side of one end of said spring engaging the wire in the bottom of the thread, the convex side of the other end of the conductive spring being pressed against the wire on the apex of the thread, and means for rotating said controlling member, whereby upon rotation the longitudinal and angular position of said member within said shell is varied by the engagement of said insulated means with the internal threads, and the contact and convex side of the other end of the conductive spring relatively engaged varies corresponding portions of the resistance and conductor wires.

19. The combination according to claim 18, in which said abutment prevents relative rotation between the end of the other arm and said arcuate spring, but is open at its side to permit relatively longitudinal displacement therebetween.

20. The combination according to claim 18, in which said abutment is formed with a limited concave seating surface to permit slight rolling of the means on the end of the other arm relatively to the contact spring.

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