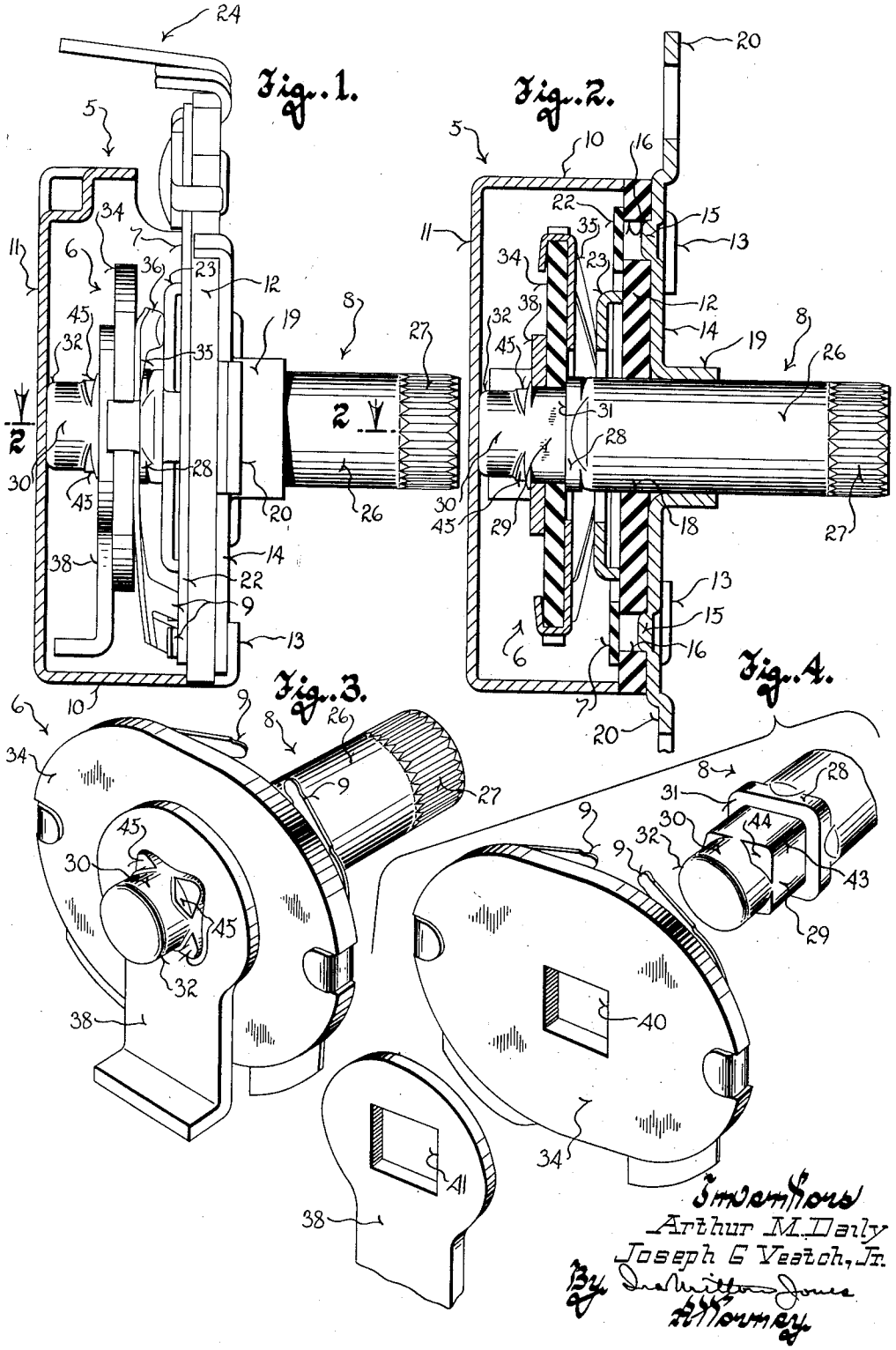
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VARIABLE RESISTOR AND ACTUATOR THEREFOR

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## VARIABLE RESISTOR AND ACTUATOR THEREFOR

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This invention relates to electrical control devices and has more particular reference to improvements in variable resistance controls such as are used in radio and television sets.

In conventional devices of this type the stationary and rotatable elements by which the resistance is controlled are enclosed within a housing having opposing front and back walls, with the stationary resistance element secured to the front wall of the housing. Rotation is imparted to the rotatable element of the device by means of an actuating shaft rotatably journalled in a bushing fixed in the front wall, the shaft having a driving connection with the rotatable element inside the housing which disposes the rotatable element behind the stationary resistance element and in cooperative relationship thereto.

In most instances it has been the practice to preclude axial motion of the actuating shaft in a direction which tends to move the rotatable element out of cooperative relationship with the stationary element by means of a C-washer confined in an annular groove in the shaft adjacent to the outer end of the bushing in which the shaft is journalled, with the result that any endwise thrust upon the shaft was transmitted directly to and borne by the front wall of the housing.

Inasmuch as the rotatable element of the device usually includes spring fingers engaging the stationary resistance element, the C-washer is always positioned so as to hold the spring fingers yieldingly engaged with the stationary resistance element and under a degree of tension most suitable for smooth wiping action of the fingers across the face of the stationary element and for good contact therewith.

Since it is highly desirable that variable resistance control devices of the type here in question be made as small and compact as possible, simplicity of construction has always been one of the main factors governing the success of the device both from the standpoint of size and cost.

Accordingly, it is a general object of this invention to provide a variable resistance control device featuring extreme simplicity of construction.

More specifically it is an object of this invention to provide a resistance control device of the character described wherein end thrust on the operating shaft is transmitted to the housing of the device in a manner which enables elimination of the conventional bushing and C-washer hitherto used for this purpose.

Still another object of this invention resides in the provision of an improved actuating shaft for

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a variable resistance device of the character described which can be formed automatically on a wire upsetting machine to eliminate expensive machining operations thereon.

A further object of this invention resides in the provision of an improved operating shaft for variable resistance control devices wherein the shaft has a main shank portion of uniform diameter projecting through the front wall of the housing of the device and a reduced rear end portion inside the housing upset to provide a thrust bearing on its extremity to engage the rear end wall of the housing and transmit end thrust imposed upon the operating shaft thereto; an abrupt shoulder spaced inwardly of said thrust bearing and facing the same; and a non-circular driver interposed between said shoulder and the thrust bearing and passing through a similarly shaped non-circular hole in the rotatable element of the device to transmit rotation thereto, with portions of said non-circular driver being swaged against the rear side of the rotatable element to clamp the same against the shoulder on the shaft and thus fix the rotatable element to the shaft.

This construction and manner of forming the operating shaft has the important advantage of enabling very close tolerances to be held on the upset inner end of the operating shaft, and especially for the distance between the shoulder against which the rotatable element of the device bears and the inner extremity of the operating shaft which provides the thrust bearing. Since in the device of this invention this dimension determines the contact pressure exerted by the spring contact arms against the stationary resistance element of the device, the invention assures proper tensioning of the contact arms.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction and arrangement of parts substantially as hereinafter described, and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereinafter disclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates one complete example of the physical embodiment of the invention constructed in accordance with the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a side view of a variable resistance device embodying the principles of this invention, the housing of the device being shown in longitudinal section;

Figure 2 is a longitudinal sectional view through Figure 1 taken along the plane of the line 2—2;

Figure 3 is a perspective view of the operating shaft and the rotatable element of the device showing the same sub-assembled; and

Figure 4 is a perspective view showing the elements of the sub-assembly of Figure 3 disassembled but in their proper order of assembly.

Referring now more particularly to the accompanying drawing in which like numerals designate like parts throughout the several views numeral 5 generally designates the housing for the variable resistance device; 6 the rotatable element of the device; 7 the stationary resistance element; and 8 the actuating shaft by which rotation is imparted to the rotatable element 6 to carry contact arms 9 thereon back and forth across the face of the stationary resistance element 7.

The housing 5 comprises a metallic cup-shaped member having a cylindrical side wall 10 and an end or bottom wall 11 which is imperforate at least at the central portion thereof and constitutes the rear wall of the complete unit. At the open end of the cup-shaped housing 5 the side wall 10 bears against the rear face of a terminal plate 12 of insulating material; and the terminal plate, of course, is secured in position defining the front wall of the housing as by means of ears 13 extending forwardly from the side wall of the housing through notches (not shown) in the periphery of the terminal plate and bent over the rear of the plate.

In the present case the tangs 13 also serve to hold a metallic attaching plate 14 against the front face of the terminal plate, and as seen best in Figure 2 the attaching plate is held against rotation relative to the terminal plate as by indentations 15 extending from the underside of the attaching plate and entering apertures 16 in the terminal plate.

Coaxially of the housing the insulating terminal plate 12 is provided with an aperture 18, and the attaching plate has its central portion apertured and drawn forwardly to provide a tubular bearing 19 to rotatably receive the operating shaft 8, so that the shaft is journalled jointly in the bearing 19 and in the aperture 18 of the insulating terminal plate.

From the description thus far, it will be apparent that the bushing conventionally used to journal the operating shaft, and formed as a separate part requiring it to be affixed to the front wall of the control device, is eliminated. This bushing, heretofore, also was used to secure the device to a panel or the like, but in the present instance the attaching plate 14 has apertured lateral extensions 20 which serve this purpose.

According to more or less conventional practice, the stationary element of the control device comprises an arcuate resistance strip 22 mounted on the inner or rear face of the terminal plate in a position encircling a collector ring 23, and both the resistance strip and the collector ring having electrical connections with terminals 24 at the exterior of the housing.

The operating shaft 8 of this invention is provided with a main shank portion 26 of uniform diameter and which extends forwardly through the front wall of the housing provided by the insulating terminal plate 12 and through the bearing 19. The forward extremity of the shaft may have a knob or the like affixed thereto, or it may have longitudinally extending knurling



thereon as shown at 27 to facilitate rotation of the shaft without a knob.

The rear end of the operating shaft which projects into the interior of the housing 5 is shaped in a novel manner to enable the entire shaft including the knurled forward extremity to be made on a wire upsetting machine, thereby practically eliminating costly machining operations on the shaft. Accordingly the inner end of the shaft is upset to provide a head 28 thereon which defines the rear end of the shank portion, the head preferably being of substantially square cross section as shown best in Figure 4; a non-circular driver 29 projecting axially rearwardly from the head and preferably having a square cross section smaller than that of the head but with its sides parallel to the sides of the head; and a reduced extremity 30 which provides a thrust bearing engaged with the imperforate central portion of the rear wall 11 of the housing.

Consequently, the junction between the polygonal driver 29 and the head 28 defines an abrupt shoulder 31 normal to the shaft axis and facing the reduced rear extremity of the shaft, while the extreme end of the operating shaft which provides the thrust bearing preferably is formed with a smooth surface having rounded corners as at 32 to offer as little resistance as possible to rotation of the shaft.

The rotatable element 6 of the device comprises an insulating contact carrying plate 34, a contactor 35 fixed to the plate and disposed at the front side thereof with its arms 9 engaged with the resistance strip 22, and fingers 36 engaged with the collector ring 23. The rotatable element also may include a rotation stop 38 at the rear side of the carrier 34. It will be understood, of course, that in some installations the rotation stop need not be a part of the rotatable element if other means is provided to limit rotation of the operating shaft 8.

The polygonal driver 29 of the shaft projects through similarly shaped polygonal holes 40 and 41 in the insulating contact carrier and the rotation stop respectively to drivingly connect the rotatable element 6 with the operating shaft. Attention is directed to the fact that when the shoulder 31 on the head 28 is engaged with the front face of the contact carrier, the polygonal driver 29 has an axial length such that it projects slightly beyond the rear of the rotation stop 38; and that the corners 43 of the polygonal driver are joined with the cylindrical side of the reduced extremity 30 by generous fillets 44.

According to this invention, therefore, portions of these fillets and the corners of the polygonal driver at the rear extremity thereof are swaged back upon the rear side of the rotatable element 6 as at 45 to clamp the rotatable element against the shoulder 31 to thus hold the rotatable element against axial displacement on the shaft. This swaging operation can be effected by an annular swaging die (not shown) placed over the reduced extremity 30 of the operating shaft which thus may act as a pilot to hold the die properly positioned for the swaging of all four corners of the polygonal driver against the rear of the rotatable element of the device.

As indicated previously, where rotation of the operating shaft is limited by means other than the rotation stop 38, the corners of the polygonal driver would be swaged directly against the rear face of the insulating contact carrier and, of course, the polygonal driver would be foreshort-

ened axially by an amount corresponding to the thickness of the hub portion of the rotation stop 38.

Due to the fact that the inner end portion of the operating shaft is formed automatically on a wire upsetting machine, extremely close tolerances can be held for the axial dimension between the shoulder 34 on the shaft and the inner extremity of the shaft which provides the thrust bearing therefor. This is highly important inasmuch as this dimension determines the amount of pressure with which the contact fingers on the carrier engage the resistance strip 22 and the collector ring 23; and it is advantageous that such contact pressure be held within relatively close limits to assure not only smooth operation of the control device but good electrical contact between the engaging parts as well.

It will also be seen that end thrust on the operating shaft tending to separate the rotatable and stationary elements 6 and 7 is resisted and borne directly by the rear end wall 11 of the housing so as to preclude any decrease in contact pressure in a most simple manner.

From the foregoing description together with the accompanying drawing it will be readily apparent to those skilled in the art that this invention provides an improved variable resistance device featuring ruggedness and simplicity of construction without sacrificing efficient operation of the device over long periods of time.

What we claim as our invention is:

1. In an electrical control instrumentality: a housing having a front wall provided with an aperture, a rear wall which is imperforate at its portion opposite said aperture, and a side wall joining the front and rear walls and holding them in fixed spaced apart relationship; cooperating stationary and rotatable control elements within said housing; means mounting the stationary control element on said apertured front wall between it and the rotatable control element; a drive shaft freely rotatable and axially movable in the aperture in the front wall, said drive shaft having a portion thereof exposed at the front of the housing and another portion thereof within the housing and passing through a hole in the rotatable control element; a rearwardly facing shoulder on the portion of the shaft within the housing, said shoulder overlying the front of the rotatable control element; means for securing the rotatable control element to said other portion of the shaft and against the shoulder thereon including swaged portions on the shaft upset against the rear of the rotatable control element to clamp the same against the shoulder; the cooperating stationary and rotatable control elements including spring means yieldingly urging said elements apart and thereby imposing a rearward end thrust upon the shaft to bias the same toward the rear wall of the housing; and an end thrust carrying rear end portion on the shaft abutting the rear wall of the housing, said end portion in coaction with the rear wall providing the sole means for carrying the end thrust imposed upon the shaft by the spring means, and the distance said rear end portion projects beyond the shoulder determining the location of the rotatable control element with respect to the stationary control element and establishing the tension upon said spring means so that by accurate dimensioning of said distance the desired spring tension is obtained.



2. An operating shaft for an electrical control instrumentality of the type wherein cooperating stationary and rotatable control elements are enclosed within a housing and include spring means yieldingly urging said elements apart, and in which a predetermined spring tension must be accurately maintained to assure proper operation, said shaft comprising: a metal rod having a front end portion providing a cylindrical shank of uniform diameter adapted to be journalled in a bearing on the front wall of the housing and to be freely slidable therein in both directions with its front end exposed at the exterior of the housing, and a non-circular driving portion rearwardly of the shank and smaller in cross section than the shank joined to the shank by an intervening flange-like abutment portion defining a rearwardly facing shoulder directly adjacent to the non-circular driving portion, said non-circular driving portion being adapted to fit a correspondingly shaped hole in the rotatable control element; said shaft having a reduced rear end portion extending back from its non-circular driving portion; and said shaft further having portions at the junction of its reduced rear end portion and its non-circular driving portion adapted to be swaged over a rotatable control element in position on the driving portion to clamp said rotatable control element firmly against the shoulder and thereby locate the rotatable control element at an accurately defined distance from the extremity of the reduced end portion, the reduced end portion being adapted to endwise abut the rear wall of the housing and comprising the sole means for transferring to the housing the end thrust imposed upon the shaft by the spring means of the cooperating control elements so that the distance between the shoulder and the extremity of the reduced end portion predetermines the tension placed upon said spring means.

3. The operating shaft of claim 2 further characterized by the fact that the reduced rear end portion is cylindrical and coaxial with the shank to provide a pilot for the swaging tool used to secure a rotatable control element in position on the non-circular driving portion, and further by the fact that the metal of the shaft is displaced axially forwardly from its rear end to provide the reduced rear end portion, the non-circular driving portion and the flange-like abutment portion.

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References Cited in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,059,813 | Schellenger | Nov. 3, 1936 |
| 2,125,954 | Richter | Aug. 9, 1938 |
| 2,289,115 | Hadley | July 7, 1942 |
| 2,309,798 | Stoekle et al. | Feb. 2, 1943 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 872,040 | France | Jan. 29, 1942 |