

May 28, 1946.

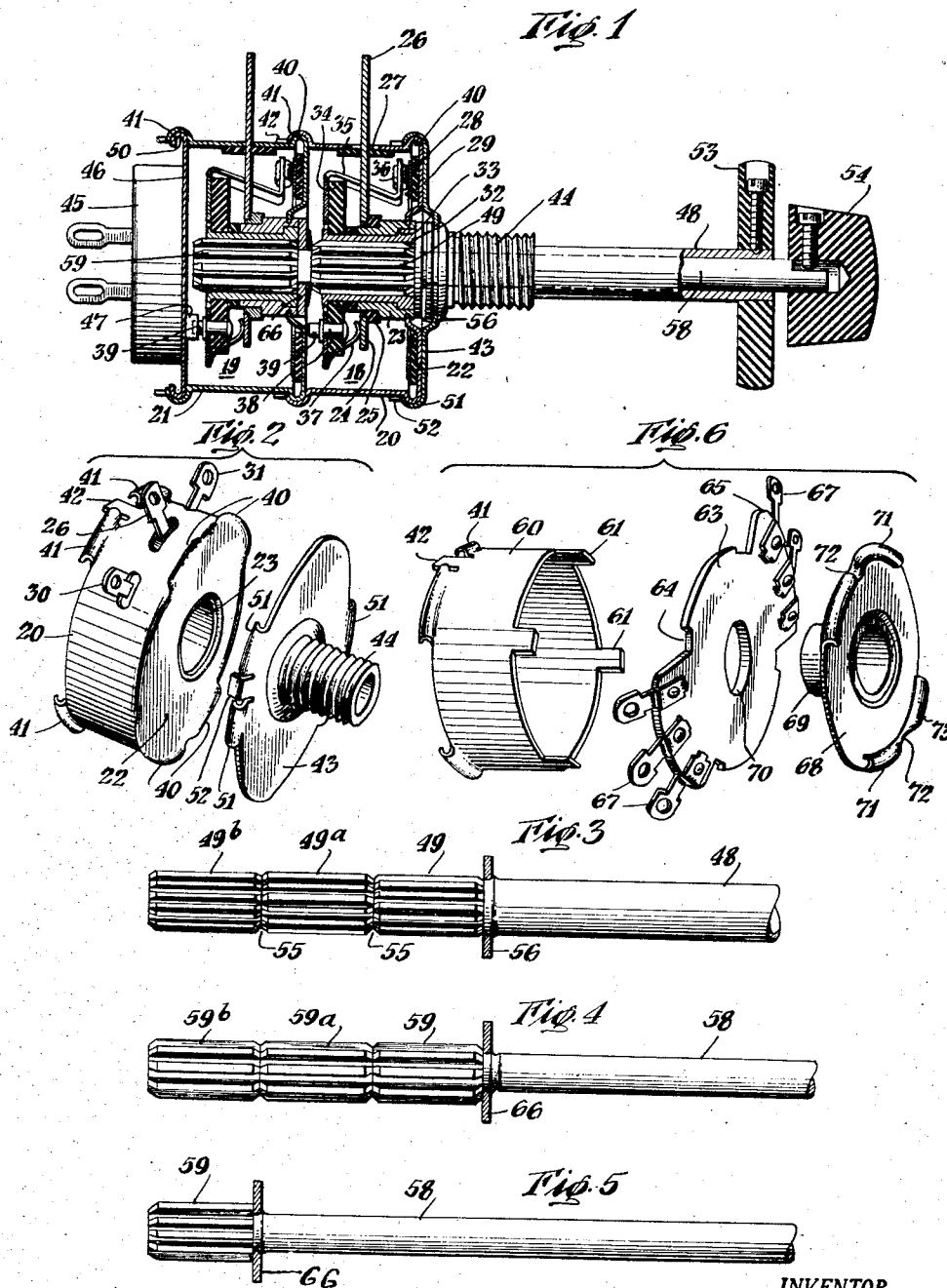
M. J. ARVIN

2,401,037

VARIABLE RESISTANCE DEVICE

Filed Nov. 12, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7

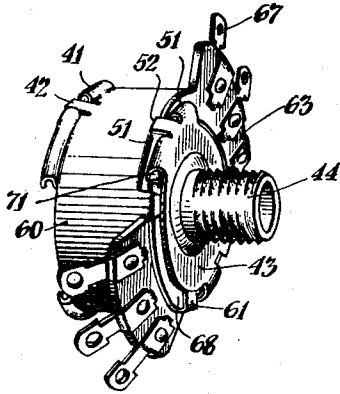


Fig. 9

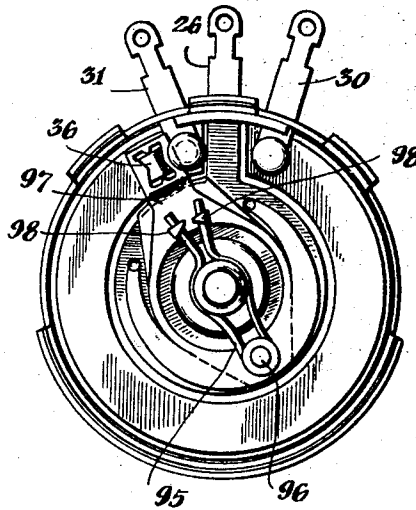


Fig. 8

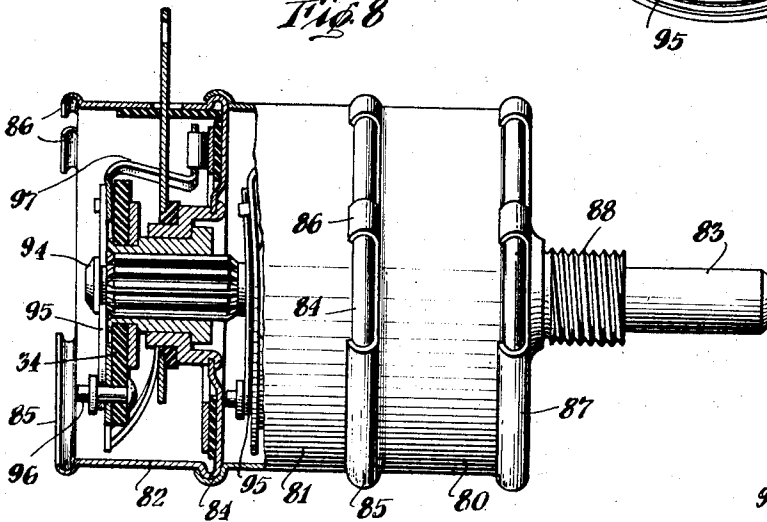


Fig. 10

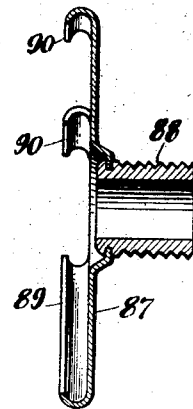
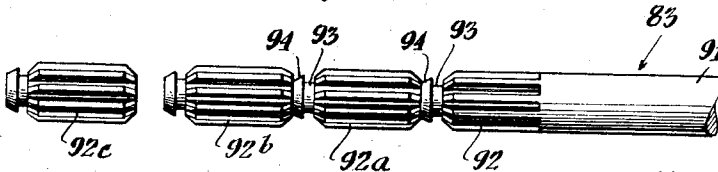


Fig. 11



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## UNITED STATES PATENT OFFICE

2,401,037

## VARIABLE RESISTANCE DEVICE

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13 Claims. (Cl. 201—55)

This invention relates to variable resistance devices such as volume controls which are used in radio receivers, transmitters and allied equipment and electrical and electronic instruments.

An object of the invention is to improve variable resistance devices.

A further object is to produce a variable resistance device made up of interchangeable parts which are adapted to assembly in a variety of ways.

A further object is to improve the parts for variable resistance devices.

Other objects of the invention will be apparent from the description and claims.

Figure 1 is a longitudinal section through an assembled variable resistance device having two volume control sections;

Figure 2 illustrates parts of the assembly and the method of assembling them;

Figures 3 and 4 show standard shafts which can be used in producing the assembly;

Figure 5 shows the shaft of Figure 4 after being cut to adapt it to the assembly;

Figure 6 shows parts of a modified volume control element preparatory to assembly;

Figure 7 shows the partially completed assembly;

Figure 8 shows a triple-section control of further modified construction;

Figure 9 is an end view thereof;

Figure 10 is a section through an end plate for said control; and

Figure 11 illustrates a shaft for the assembly.

Because of the variety of requirements for variable resistance devices in radio receivers and allied equipment, it is now necessary to make, stock and use a large variety of variable resistance devices which are generally similar but which differ from each other either in their requirements for mounting or in their electrical characteristics. It is also often necessary to provide a volume control having two or three variable resistance sections either under common control or separately variable. Heretofore individual volume control units have been produced to meet each requirement and it has been necessary for manufacturers and service men to have a large stock on hand in order to be prepared to supply each type of resistance device when it is required.

The present invention contemplates a variable resistance device or volume control assembled from a few standard parts which can be readily adapted to different requirements. The parts have integral means for quickly attaching them

together. Two or more variable resistance sections may be attached together to produce a multiple volume control when required. A single shaft can be used to control all sections or two or more concentrically interfitted shafts can be provided for separate control of some of the sections. Cover plates, switches and mounting plates are also readily attachable without special tools. Other features of my invention will be evident from the following detailed description.

Referring to the drawings, Figure 1 shows two volume control sections 18 and 19 attached together to provide a tandem control assembly, each section of which has a separate control shaft. The volume controls are housed in cylindrical metal cases 20 and 21, respectively, and are similar in construction so that only the front section 18 (which would be nearest the front panel of the radio set when mounted) will be described in detail.

Case 20 has an end wall 22 at the front end thereof. A generally cylindrical fixed bushing 23 is secured in the central aperture of wall 22 and extends axially through the case 20. A flat contact ring 24 is mounted on bushing 23 inside the case but is insulated therefrom by insulating ring 25. Ring 24 has an integral terminal lug 26 projecting out through an aperture in the cylindrical wall of case 20. A strip of insulating material 27 surrounds lug 26 and closes the aperture.

The resistance element to be varied comprises a ring 28 of insulating material having a carbonaceous resistance surface layer 29 thereon and disposed inside the case against end wall 22. Suitable terminals are provided at the ends of the resistance layer 29 connected to terminal lugs 30 and 31 which extend out through apertures in the wall of case 20 (see Figure 2).

A floating bushing 32 is held within stationary bushing 23 and adapted to rotate within it. Bushing 32 has a retaining shoulder 33 on its front end and a plate 34 of insulating material such as Bakelite secured to its rear end within case 20. A control arm 35 stamped from sheet metal is riveted to insulating plate 34 in spaced relation to the floating bushing and has its arm end disposed adjacent to the surface of resistance layer 29. A cylindrical metal contact 36 is carried by the outer end of arm 35 and slides on the surface of resistance layer 29 in the manner described in Fruth Patent 2,135,809. Control arm 35 also has a small integral contact arm 37 bent down from it into contact with terminal ring 24. Rivet 38 which secures control arm 35 to plate 34 has a projecting pin portion 39 thereon extending

toward the rear open end of the casing for actuating a switch when the occasion requires it.

Externally the cases 20 and 21 are provided around the periphery of their closed ends with raised rim sections 40 formed by drawing or pressing the sheet metal of the case outward at spaced places of the cylindrical outer wall adjacent to its closed end. In the cases 20 as illustrated in Figure 2, two pairs of raised rim sections 40 are provided at diametrically opposed positions. Each pair is separated by a short space which is not raised and each pair occupies slightly less than one-quarter of the circumference. The open ends of cases 20 and 21 are provided at corresponding positions with integrally formed outwardly rounded spring flanges 41 for connecting the cases together. Between each pair of flanges 41 is a short locking tongue 42. The flanges 41 of case 20 are tightly fitted over the rims 40 of case 21 in the assembly of Figure 1 to hold the cases together. The method of assembly will be described later.

In addition to sections 20 and 21 of the assembly it also includes a front end mounting plate 43 having flanges 51 on its outer circumference fitted over rims 40 on case 20 and locking tongues 52. Plate 43 carries a central forwardly extending bushing 44 which is threaded to receive a mounting nut to enable mounting the assembly on a panel.

The assembly also carries a snap-acting A. C. switch 45 mounted on rear end plate 46 which has at its outer circumference rim portions 50 which are held in flanges 41 of case 21. Switch 45 has an actuating arm 47 comprising a pair of spaced parallel flanges adapted to engage opposite sides of pin portion 39 on rivet 38 of resistance sections 19 to which the switch is attached.

A tubular control shaft 48 having a splined end section 49 fitted within floating bushing 32 which has complementary internal splinings provides a control means for resistance section 18. A solid shaft 58 concentrically mounted within shaft 48 and having a splined end section 59 within the floating bushing of section 19 provides a control for that section. Manual control knobs 53 and 54 secured, respectively, to shafts 48 and 58 provide a means for manual control of each variable resistance element.

Prior to assembly shaft 48 may appear as illustrated in Figure 3. It comprises a plain tubular section having a plurality of short splined sections 49, 49a and 49b at one end separated by annular notches 55 to simplify cutting or breaking the shaft between splined sections. A small flat metal ring 56 is tightly fitted on the shaft between the plain section and the first splined section and may be permanently secured thereon by upsetting the shaft as shown in Figure 3.

Figure 4 shows shaft 58 which has a plain section of such outer diameter as to fit within the hollow of shaft 48 and allow free rotation therein. Shaft 58 has three (or more) splined sections 59, 59a and 59b at its end which are of the same dimensions as splined sections 49 on shaft 48. A flat ring flange 66 is also provided on shaft 58 between the plain section and the first splined section 59.

It is understood that shafts 48 and 58 may have any number of splined sections thereon. It is preferred to supply the shafts with the maximum number of splined sections which will ever be required in any assembly. When a particular assembly is made the extra splined sections are cut or broken off to leave the exact number of

sections required for the application contemplated. For example, two of the splined sections 59a and 59b of shaft 58 may be cut or broken away to leave a single splined section 59 remaining as shown in Figure 5. This provides the shaft required for the assembly of Figure 1. The shafts may be made of any suitable metal. Where the metal is rather hard and tough, such as steel, the sections may be removed by a suitable cutting tool. However, if the shaft is made of relatively soft metal, such as aluminum, cadmium or zinc, it will be possible in some cases to break the shafts at the joints when required or to make a preliminary notch with a cutting tool and then to break the shaft sections apart.

The tandem volume control of Figure 1 may be assembled from the standard parts described by first inserting splined section 49 of shaft 48 in the complementary splined interior of floating bushing 32 of resistance section 18, then placing the bushing 44 of end mounting plate 43 over shaft 48 and bringing it up against the end wall 22 of case 20. This step is illustrated in Figure 2, shaft 48 being left off for convenience of illustration. The plate and resistance element are first assembled so that flanges 51 on the plate are aligned with the wide spaces not occupied by rim sections 40 of the case 20 as shown in Figure 2. When plate 43 engages end wall 22, the plate is rotated through 90° whereupon tongues 52, which have been pressed outward by rims 40, will snap into the notches between the pairs of raised rims 40. The end plate is thereby securely attached to the case.

The splined end 59 of shaft 58 is then inserted in the floating bushing of resistance section 19 and the small end of shaft 58 is then inserted in the rear end of hollow shaft 48. Case 21 is brought up against the open end of case 20 and rotated through 90° so that its rim sections 40 are engaged within flanges 41 of section 20 and tongues 42 snap into place to lock the sections firmly and securely together. End plate 46 carrying snap acting A. C. switch 45 is then attached to the open end of section 21 in a similar manner to complete the assembly.

The assembly thus produced and shown in Figure 1 may then be mounted in a suitable panel by a nut attached to bushing 44 and control knobs 53 and 54 may then be attached to the shafts to provide independent manual control of the two separate variable resistance sections 18 and 19 of the assembly.

Figures 6 and 7 show a modified construction for a resistance element section. In this construction the cylindrical casing 60 does not have an integral end wall but is open at both ends. Its inner end is provided with flanges 41 and tongues 42 similar to those provided on cases 20 and 21. Its front end has four integral tongues 61 thereon. A resistance unit having a base disc 63 of sheet insulating material, such as Bakelite or Bakelized fibre, is provided with edge notches 64 to receive tongues 61 when disc 63 is placed against the end of the case. Disc 63 also has flanges 65 on its outer edge carrying terminal lugs 67 which are connected to arcuate resistance and contact surfaces supported on the inner face of the disc. A metal clamping disc 68 is also provided having an integral central bushing 69 thereon of such dimension as to extend through central aperture 70 in disc 63 into the interior of the casing of the resistance element. The edge of disc 68 has a pair of diametrically opposed flanges thereon each extending for

slightly less than one-quarter the circumference of the disc. These flanges are rolled over to provide rounded edges 71 and the middle of each flange is pressed in to provide a short section of smaller diameter 72.

To assemble the element, disc 63 is placed against the end of cylindrical casing 60 with tongues 61 in grooves 64 of the disc. The bushing 69 of the clamping disc is then inserted through aperture 70 so that disc 68 rests against the outer face of disc 63 and tongues 61 are then bent down over the face of disc 68 to clamp the assembly together. A floating bushing and control arm assembly may then be inserted and secured in place.

Figure 7 shows the completed assembly connected to the end mounting plate 43. This is done by placing plate 43 against plate 68 and twisting through 90° to bring flanges 51 over rounded edges 71 of end plate 68. Tongues 52 spring down into the hollows 72.

Figures 8 and 9 illustrate a further modified construction wherein three resistance element sections 80, 81 and 82 are fitted together and are ganged under control of a single control shaft 83 to provide a three-gang unit. In this embodiment the casing of each section is provided with an integral pressed-up rim 84 in its cylindrical surface adjacent to the front end wall thereof. The open end of each casing is provided with a series of flanges. One of the flanges 85 extends for about one-third of the circumference of the casing and a set of three shorter flanges 86 are uniformly spaced about the remainder of the circumference. To assemble two units together, the edge of the rim 84 of one unit is set into flange 85 of another unit and the two cases brought into alignment whereupon flanges 86 will snap over the edge of rim 84 to secure the cases together. An end mounting plate 87 having a central mounting bushing 88 is also provided with similar flanges 89 and 90 to enable it to be attached to the frontmost unit of the series.

The shaft used with this assembly is slightly different in construction and is shown in Figure 11. It comprises a plain section 91 and a series of splined end sections 92, 92a, 92b, 92c alternated with a series of short reduced sections 93 having small tapered flanges 94 thereon. As illustrated in Figure 11 the shaft may originally be provided with the largest number of splined sections that will ever be required and then the sections not required for any particular application are cut off, as is section 92c, leaving a shaft of the desired length.

In order to retain the shaft in place in the assembled control unit a spring wire hairpin clip 95 is clamped under rivet 96 which secured the control arm 97 to its support and has its two arms overlapping opposite edges of the hole in rotor plate 34. The two ends of the wire clip are retained against spreading by a pair of tongues 98 punched up from arm 97. When the case sections have been connected together and shaft 83 is inserted through the bushings from the front end the tapered surface of flange 94 spreads the arms of the hairpin clip allowing them to snap into the groove under flange 94 to lock the shaft in place.

In place of splinings on the shafts and bushings it is also contemplated that other interfitting non-cylindrical forms may be used such as flat-sided cylindrical portions, an interfitting ridge and groove, or a square or polygonal shaft and bushing interior.

It will be seen that a large variety of assemblies can be produced by securing together the standard parts described in various ways. Thus it is possible to make single controls, tandem controls of two to six or more sections under common control of a single shaft or controlled by separate shafts. It is also possible to attach switches when required and to attach various forms of mounting plates to the assembly. The assemblies can also be taken apart readily without destruction and used again in other combinations. With the unit of Figures 6 and 7, it is possible to replace the resistance unit comprising disc 63 and the resistance element carried thereby, in case it wears out or is defective.

While specific embodiments of the invention have been described, it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. A variable resistance device comprising a case having a variable resistance therein and a shaft extending axially from the front end thereof, integral attaching means on said front end of said case, and an end mounting plate having complementary attaching means thereon interfitting with said attaching means on said case, said end mounting plate having a central aperture to accommodate said shaft and having means thereon for securing said plate to a support.

2. A variable resistance element adapted for interconnection with other similar elements or with end plates, said element comprising a cylindrical case having a plurality of spaced integral raised rim sections at one end thereof, the spaces between said raised sections being greater than the length of said sections, and a plurality of correspondingly spaced outwardly rounded flanges at the other end thereof, whereby said element may be connected to a similar element by placing said elements together end to end and rotating them to bring the flanges of one of said elements over the rim sections of another of said elements.

3. A variable resistance element comprising a cylindrical case having a plurality of spaced larger-diameter rim portions at one end of its cylindrical outer wall, said rim portions being spaced about the circumference to leave alternately long and short gaps between them, said long gaps being longer than the combined length of two of said rim portions and one of said short gaps, and correspondingly spaced outwardly rounded flanges along the other end of said cylindrical outer wall and tongues between said flanges in said shorter gaps, whereby said element may be connected in alignment with a second similar element by placing said elements together end to end and rotating them to bring the flanges of one of said elements over the rim portions of the other of said elements and bending said tongues into said short gaps to prevent relative rotation of the elements.

4. A variable resistance element comprising a cylindrical case having spaced projections on its cylindrical surface near one end thereof and correspondingly spaced internally concave flanges projecting parallel to the axis of said case from the other end thereof, whereby said element may be assembled with a second similar element by aligning them end to end and rotating one of them with respect to the other.

5. A variable resistance element comprising a cylindrical case having a larger-diameter rim portion occupying at least part of the circumference of the cylindrical outer wall of said case

at one end thereof and outwardly rounded flanges projecting from the other end thereof, whereby said element may be assembled with a second similar and similarly positioned element by placing the flanges of one element over the rim portions of the other element.

6. A variable resistance element comprising a cylindrical case having a large-diameter rim integrally formed in the cylindrical outer wall of said case at one end thereof and a plurality of outwardly rounded flanges projecting from the other end of said case, a first of said flanges occupying a substantial amount but less than one-half of the circumference and the remainder of said flanges being of shorter circumferential length, whereby said element may be assembled with another similar element by placing the rim of one of said elements in the longer flange of the other of said elements and bringing said elements into alignment whereupon said shorter flanges will snap over said rim to connect said elements together.

7. A variable resistance device comprising a case having an end wall thereon, a bushing centrally mounted in said end wall and extending axially within said case, a rotor rotatably supported in said bushing and having an aperture extending therethrough axially of said case, said rotor having internal keying portions for keying said rotor to a shaft, and a shaft extending into said rotor aperture and having complementary keying portions thereon interfitting with said rotor keying portions, and a flange on said shaft adjacent one end of said rotor to limit its travel into said rotor aperture, and an end plate secured to said case over the end wall thereof, and having a central aperture smaller than said flange to limit the travel of said shaft out of said rotor.

8. A variable resistance element comprising a cylindrical case having an end wall thereon, a bushing centrally mounted in said end wall and extending axially within said case and a rotor rotatably supported in said bushing and having an aperture extending therethrough axially of said case, said rotor having internal keying portions for keying said rotor to a shaft, said case having an enlarged rim at one end of its outer surface and outwardly rounded flanges at its other end, whereby said element can be connected in alignment with another similar element and with a shaft which passes axially through both said elements.

9. A shaft for use in variable resistance de-

vices comprising a cylindrical metal body having a plain body section and a series of keying sections at one end of said body section, said keying sections being separated by reduced sections.

10. A shaft for use in variable resistance devices comprising a hollow cylindrical metal body having a plain hollow body section and a series of hollow keying sections at one end of said body section, said keying sections being separated by reduced sections.

11. A variable resistance element comprising a cylindrical case, a resistance unit comprising an insulating end disc secured to said case and having an arcuate resistance element thereon inside said case, and a metal end wall secured against the outer face of said insulating disc, a fixed central bushing carried thereby extending through a central aperture in said disc, a rotatable bushing mounted for rotation in said fixed bushing and carrying a rotor in said case having a contact arm thereon extending into contact with said resistance element, and a control shaft extending into said rotatable bushing and keyed thereto.

12. A group of interchangeable variable resistance assembly components comprising a plurality of housings, a plurality of telescopic shafts for mounting in said housings, and resistance contact units for mounting in said housings and operable through one or more of said shafts; said housings, shafts, and resistance contact units having integral cooperating assembly formations such that they may be readily, quickly, and repeatedly assembled and disassembled without damaging deformation; and said group of components forming a reservoir from which any one of the following may be formed: an assembly comprising one of said housings, one of said shafts, and one of said resistance contact units; an assembly comprising a plurality of said housings, one of said shafts, and a plurality of said resistance contact units; an assembly comprising a plurality of said housings, a plurality of said shafts, and a plurality of said resistance contact units.

13. A shaft assembly for use in variable resistance devices comprising a plurality of telescoping members, each having at one end a plain body section and a keyed section adjacent to each other, and a collar on each of said telescoping members between said plain body section and said keyed section; the diameters of each of the said keyed sections being substantially the same.

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