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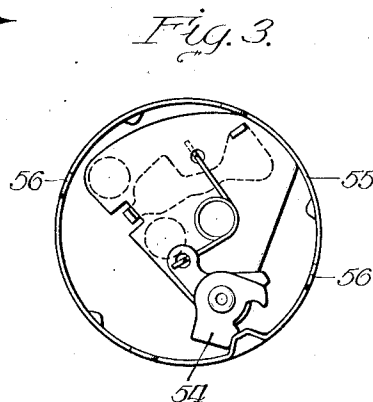
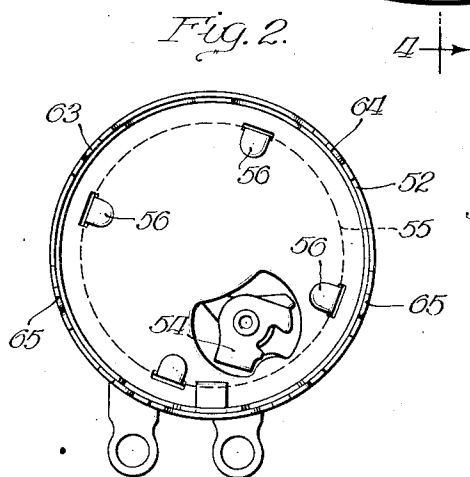
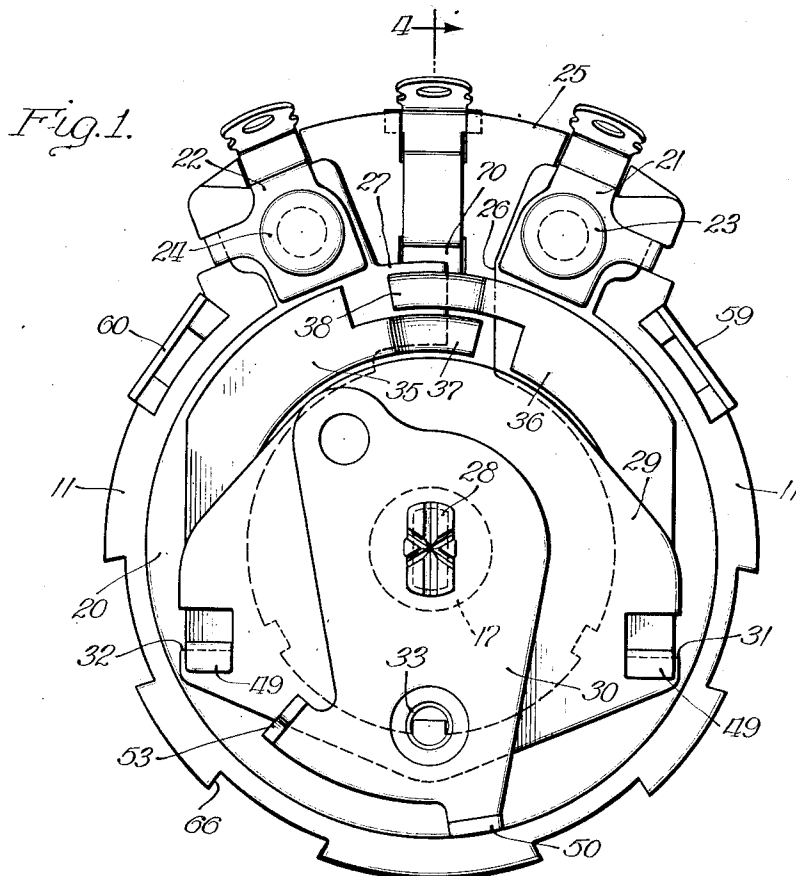
N. C. SCHELLENGER

2,177,290

VARIABLE RESISTANCE DEVICE

Filed July 8, 1938

2 Sheets-Sheet 1



INVENTOR.
Newton C. Schellenger
BY *William H. Huxley, Raymond Knight*
ATTORNEYS.

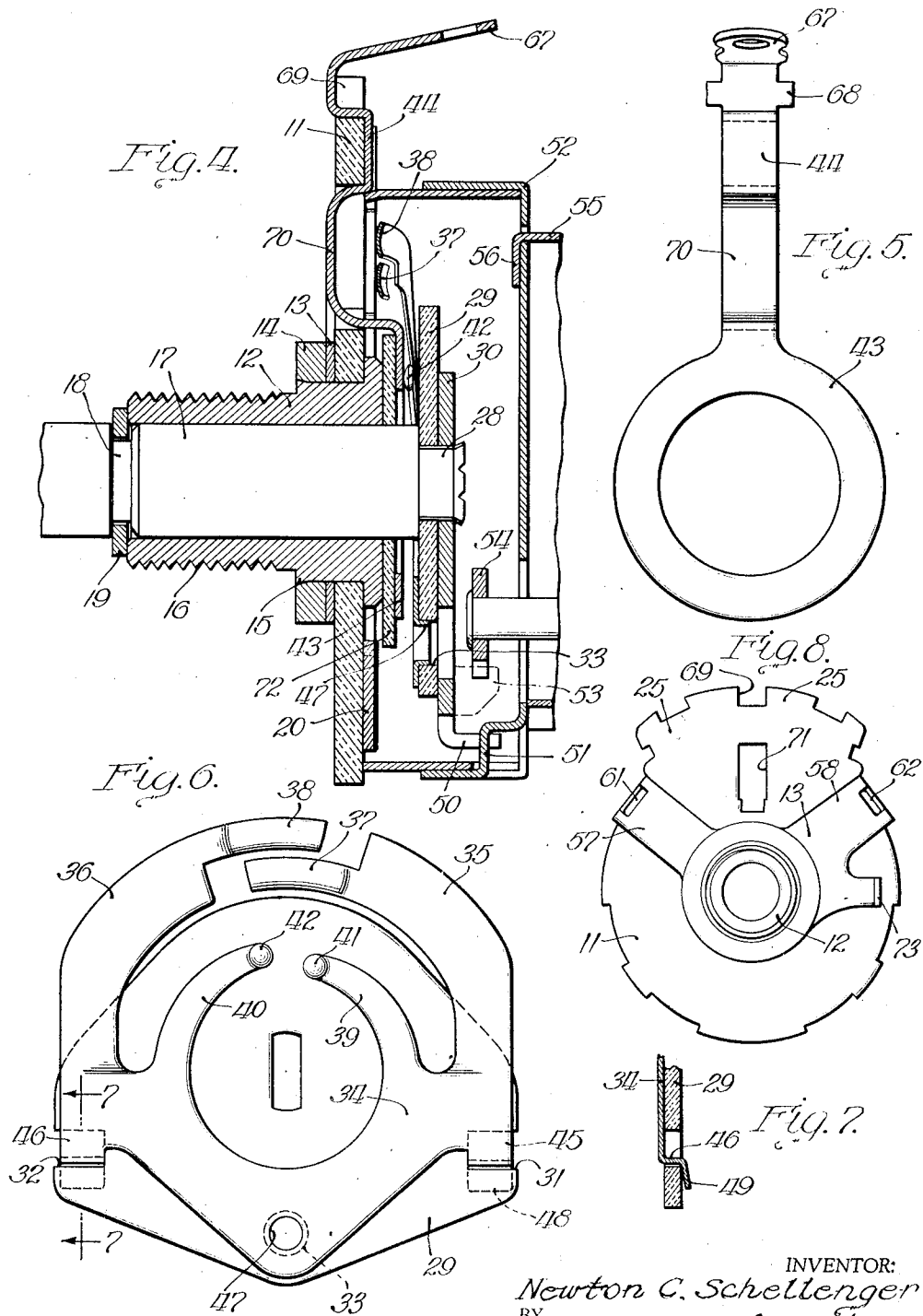
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N. C. SCHELLENGER
VARIABLE RESISTANCE DEVICE

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2 Sheets-Sheet 2



INVENTOR:
Newton C. Schellenger
BY
Milkinson, Husley, Byron, Knight
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,177,290

VARIABLE RESISTANCE DEVICE

Newton C. Schellenger, Elkhart, Ind., assignor to
Chicago Telephone Supply Company, Elkhart,
Ind., a corporation of Indiana

Application July 8, 1938, Serial No. 218,062

19 Claims. (Cl. 201—55)

This invention relates to a new and improved variable resistance device and more particularly to a device of this character adapted for use in highly sensitive circuits.

My invention comprises a variable resistance of the carbonaceous type and of a design adapted for use in combination with a switch attached thereto for joint operation. Devices of such types are commonly employed in volume and tone control circuits in connection with radio receivers and transmitters. In many such uses the signal is greatly amplified beyond the control and consequently it is highly important that the control be so designed and constructed as to be quiet in operation and uniform in its functioning.

It is an object of the present invention to provide a new and improved variable resistance device.

It is a further object to provide a device in which substantially independent multiple contact is made with the resistance unit by movable contact means.

It is also an object to provide a construction in which an effective movable contact is drawn over the resistance strip in either direction of rotation of the movable contact assembly.

It is an additional object to provide a device in which the movable contact arm is assembled with the drive arm by integral connecting elements.

It is a further object to provide a device of this character having a minimum number of current carrying parts and of connections between such parts whereby manufacture and assembly is facilitated and the production of noise or undesired current or resistance variations are materially reduced.

It is also an object to provide an improved grounding plate and base construction and improved means for assembling a cover with the base and grounding plate.

Other and further objects will appear as the description proceeds.

I have shown a preferred embodiment of my invention in the accompanying drawings, in which—

Figure 1 is a face view of the variable resistance device with the cover removed;

Figure 2 is a face view of the cover on a reduced scale;

Figure 3 is a face view of one form of switch adapted for use with a variable resistance, shown on the same scale as Figure 2;

Figure 4 is a section taken on line 4—4 of Figure 1, with parts broken away;

Figure 5 is a plan view of the combined terminal and collector ring;

Figure 6 is a plan view of the drive arm and contact arm in assembled relation;

Figure 7 is a fragmentary section taken on line 7—7 of Figure 6; and

Figure 8 is a view of the outer face of the base of the unit showing the grounding plate in position thereon, this figure being on the reduced scale of Figures 2 and 3.

The improved variable resistance unit comprises the base 11 which may be formed from insulating material, such as Bakelite or other synthetic resin. This base carries the metal thimble 12, the ground plate 13 and the base washer 14, these parts being secured to the base by swaging the thimble as shown at 15. The thimble 12 has a threaded portion 16 adapted to receive a nut (not shown) by means of which it may be secured to a chassis or other supporting structure. The shaft 17 is rotatably carried in the thimble 12 and is provided with a circumferential groove 18 into which is fitted a C-washer 19 for maintaining the parts in assembled relation. The flat resistance element 20 is secured to the base 11 by means of the end terminals 21 and 22 and the rivets 23 and 24, respectively. These terminals and rivets are secured to an extended portion 25 of the base 11. The resistance strip 20 may be formed of any non-conductive material such as synthetic resins, paper or fibre, and carries a coating or resistance film on its upper face. The resistance strip is split at 26 between the terminals 21 and 22, but is provided with an extended portion 27 which is located beyond the terminal 22.

The shaft 17 is provided with an extension 28 which is elongated in cross-section, and passes through similar openings in the drive arm 29 and the stop plate 30. The outer end of this extension 28 is deformed to secure the arm and plate fixedly in position on the inner end of the shaft. The drive arm 29 is formed from sheet insulating material such as Bakelite, and is provided with the notches or cut-away portions 31 and 32 on its lateral edges. It is also provided with the cut-away portion or perforation 33 at an intermediate point. These cut-away portions are for the purpose of detachably securing the contact arm 34 to the drive arm.

The contact arm 34 is formed of resilient sheet metal and may be plated with non-corrosive

metal in order to increase the efficiency of the contact with the resistance strip 20. The contact arm 34 is provided with the oppositely extending arcuate arms 35 and 36 which are provided with the overlapping contact portions 37 and 38. The portions of the arms 35 and 36 directly adjacent to their attaching portion being narrower than the rest of the arms, the application of force on the extremities of the arms to bring them into the plane of the attaching portion effects a twisting of said narrow portions. These contact portions 37 and 38 are rounded in cross-section as clearly shown in Figure 4, for the purpose of securing a better contact upon the resistance strip and for minimizing wear of the resistance film. The contact arm 34 is also provided with the oppositely extending arcuate current transfer arms 39 and 40 which terminate in the convexly rounded portions 41 and 42 adapted to engage the collector ring portion 43 of the combined center terminal and collector ring member 44. It will be noted that the rounded portions 41 and 42 are located at differing radial distances from the axis of rotation of the contact arm 34, so that they engage the collector ring 43 upon separate arcuate paths.

The contact arm 34 is provided with the extended portions 45, 46 and 47 which engage the cut-away portions 31, 32 and 33 respectively, of the drive arm 29. The extended portions 45 and 46 have end portions 48 and 49 turned down approximately parallel with the main body of the contact arm 34 and adapted to engage the upper face of the drive arm 29. The upturned portion 47 in the form shown is tubular in shape and interfits with the cut-away portion 33 which is a circular perforation in the drive arm 29.

The stop plate 30 is provided with the upturned stop lug 50 adapted to engage either side of the stop 51 formed integrally with the metallic cover 52 to limit rotation of the shaft and movable contact. The stop plate 30 is also provided with the upturned lug 53 adapted to engage the operating cam 54 of the attached switch. The attached switch is described in my co-pending application, Serial No. 83,963, filed June 6, 1936, and since the details thereof form no part of the present invention it need not be described further herein. The switch is of the snap variety and is actuated by partial rotation of the cam 54 by transient engagement of the lug 53 with the cam 54 at one end of rotary movement of the shaft 17. The switch is carried in the housing 55 which is secured to the cover 52 by means of the ears 56.

The grounding plate 13 is shown in plan view in Figure 3 and comprises a central portion encircling the thimble 12, together with angularly extending arms 57 and 58 which have upturned portions 59 and 60, as shown in Figure 1, which engage the lateral edges of the extended portion 25 of the base 11. These arms 57 and 58 are provided adjacent the upturned portions, with the slots 61 and 62 adapted to receive securing lugs 63 and 64 formed on the edges of the cover 52, as shown in Figure 2. The cover 52 is provided with a plurality of other securing lugs 65 which interfit in the notches 66 in the edge of the base 11. It will be understood that all of the securing lugs are bent over against the under face of the base or against the under face of the ground plate 13, as the case may be. The grounding plate 13 is also provided with the upturned locating lug 73.

The combined center terminal and collector ring 44, as best shown in Figures 4 and 5, is pro-

vided with the upwardly extending solder lug portion 67 and adjacent the lower end of this solder lug portion it is provided with the lugs 68 which engage the under side of the base 11 adjacent the notch 69 formed in the extended portion 25 of the base. The member 44 has an intermediate depressed portion 70 which has a frictional engagement in an elongated slot 71 formed in the base 11. This portion 70 is located below the extended portion 27 of the resistance strip as shown in Figure 1. The collector ring portion 43 of the unit encircles the shaft 17, but is of such size as to be spaced from the shaft. The insulating washer 72 is fitted about the shaft 17 between the thimble 12 and the collector ring 43 so as to prevent electrical connection between the center terminal and the thimble.

The contact arm, which is best shown in Figure 6, is one of the important features of the construction. This arm is formed from a single piece of metal which includes two oppositely extending overlapping contact portions or runners which engage the resistance strip. The points of contacts of these two runners with the resistance strip are located substantially in the same radial line and short circuit only a very small amount of the resistance element, approximating in actual practice a line contact. It will be noted that since the arms are oppositely extending, one of the contact runners is being pulled and the other pushed in either direction of rotation of the contact arm. Therefore, the total contact effect is identical in either direction of rotation. Further, each contact runner is independent of the other insofar as spring pressure is concerned. Thus a foreign particle or high point on the resistance element encountered by one runner does not affect the contact resistance between the other runner and the resistance element.

The contact arm is further provided with two ears or extensions 39 and 40 which engage the collector ring. Here again the arms are oppositely extending and are independent of each other. They are also located at different radial distances from the axis of rotation so that each rounded end has its own arc of contact with the collector ring. This is important as where multiple contacts are on approximately the same line, the wear from one is different than the wear from the other and poor contact often results. These arms are so formed that the ends bear against the collector ring with sufficient pressure to afford uniformly low contact resistance.

Another important feature of the contact arm construction is that the entire arm is formed of a single piece of material so that there is direct conductive connection between the contact upon the resistance element and the contact on the collector ring. This not only simplifies construction, but makes it more efficient from an electrical standpoint.

The method of securing the contact arm to the drive arm is simple and efficient and requires no extra parts such as rivets or the like. The contact arm is of sufficiently resilient material so that it can be flexed to insert the extended portions 45 and 46 in the notches 31 and 32, moving the contact arm downwardly as shown in Figure 6, until the tubular extension 47 snaps into the perforation 33. The parts are then effectively held in proper relative position. It will be apparent that other forms of cut-away por-

tions or perforations may be used in making the connection.

The unitary terminal and collector ring shown in Figure 5 is a further important novel feature of the invention. This unit assures efficient electrical connection between the collector ring and the solder lug of the terminal since the parts are unitary. This avoids difficulties incident to several elements held together by rivets where high resistance may develop, especially when solder flux runs between the parts. The lugs 68 hold down the terminal end and it fits in notch 69 to prevent lateral movement. The portion 70 of the unit fitting tightly in the slot 71, as it does, holds the combined terminal and collector ring assembled with the base, and together with the portion fitting in the notch 69, serves to positively locate the entire unit relative to the base. While the extension 27 of the resistance element which overlies the portion 70 of this collector and terminal unit does not engage the unit, it does have the advantage of retaining the unit in place and preventing its slipping out of position during further assembling operations on the unit. It will be understood that the primary function of the extension 27 is to serve to support the movable contact runners as they pass beyond the terminal 22 in operating the related switch.

A further important feature of the present construction is the novel ground plate and method of connecting and locating the cover. It has been heretofore customary to provide ground plates which extend merely to the edge of the base and have the cover lugs bent over against their outer faces. It is difficult in large quantity production to always have a swaging operation in assembling the parts which will secure the grounding plates and hold them against movement relative to the base under severe conditions of use or assembly. The locating lug 73 ordinarily extends into a perforation in the chassis upon which the unit is assembled, to assist the clamping action of the mounting nut in preventing rotation of the unit relative to the chassis. Obviously, therefore, if the grounding plate 13 of which the lug 73 is a part is not firmly locked to the base it will not perform the desired function. By having the upturned portions 59 and 60 engage the edges of the extended portion 25 of the base the grounding plate is maintained in fixed relation relative to the base. It is also important that the covers be held upon the unit in fixed relation, this being particularly true when the covers carry switches. The elongated slots 61 and 62 in the grounding plate assure an absolutely rigid connection of the cover in proper position.

While I have shown a preferred embodiment of my invention, it is capable of modification and change to meet varying conditions and requirements and I contemplate such variations in construction as come within the spirit and scope of the appended claims.

I claim:

1. In a variable resistance device of the type suitable for use in radio receivers: an insulating base; a flat arcuate resistance element on one face of the base; a rotatable control shaft projecting through the base; a driving arm of insulating material fixed to the shaft and overlying the flat arcuate resistance element; and a contactor carried by said driving arm between it and the resistance element, said contactor comprising, a single stamping of resilient metal having a

flat attaching portion by which the contactor is attached to the driving arm, and curved arms extending from opposite ends thereof toward each other with their extremities terminating radially opposite each other and formed as rounded contact shoes each independently engageable with the resistance element, said arms being sprung out of the plane of the attaching portion and toward the resistance element.

2. As an article of manufacture, a contactor for small variable resistance units of the type suitable for use in radio receivers, comprising: a single unitary stamping of thin resilient metal having a flat attaching portion adapted to have surface to surface engagement with a flat carrying member; curved arms projecting from opposite ends of the attaching portion and toward each other with the extremities thereof directly opposite each other on a line substantially normal to and bisecting the major axis of the attaching portion, said arms being flexed out of the plane of the attaching portion in the same direction so as to yieldingly oppose being forced into the plane of the attaching portion; and rounded contact engaging portions on the extremities of said arms adapted for sliding engagement with a resistance element suitably positioned with relation to the contactor.

3. As an article of manufacture, a contactor for small variable resistance units of the type suitable for use in radio receivers, comprising: a single unitary stamping of thin resilient metal having a flat attaching portion adapted to have surface to surface engagement with a flat carrying member; curved arms projecting from opposite ends of the attaching portion and toward each other with the extremities thereof directly opposite each other on a line substantially normal to and bisecting the major axis of the attaching portion, said arms being flexed out of the plane of the attaching portion in the same direction so as to yieldingly oppose being forced into the plane of the attaching portion; and rounded contact portions on the extremities of said arms adapted for sliding engagement with a resistance element suitably positioned with relation to the contactor, and the portions of the arms directly adjacent to the attaching portion being narrower than the rest of the arms so that the application of force on the extremities of the arms to bring them into the plane of the attaching portion effects a twisting of said narrow portions.

4. As an article of manufacture, a contactor for small variable resistance units of the type suitable for use in radio receivers, comprising: a single unitary stamping of thin resilient metal having a flat attaching portion adapted to have surface to surface engagement with a flat carrying member; curved arms projecting from opposite ends of the attaching portion and toward each other with the extremities thereof directly opposite each other on a line substantially normal to and bisecting the major axis of the attaching portion, said arms being flexed out of the plane of the attaching portion in the same direction so as to yieldingly oppose being forced into the plane of the attaching portion; rounded contact engaging portions on the extremities of said arms adapted for sliding engagement with a resistance element suitably positioned with relation to the contactor; and a second pair of arcuate arms extending in the same direction as the first named arms from said attaching portion and inside the arc defined by the first named arms, said second

designated arms also being flexed out of the plane of the attaching portion in the same direction as the first named arms and having the extremities thereof provided with rounded surfaces for engagement with a contact member appropriately placed with respect thereto.

5. In a variable resistance device of the character described: a base of insulating material; a shaft rotatably carried by the base and held against inward endwise motion with respect thereto; a flat circular resistance strip on the inner face of the base concentric to the shaft; an insulated driving arm fixed to the inner end of the shaft and overlying the inner face of the base, said driving arm having openings at opposite sides of the shaft; a contactor having contact means engageable with the face of the resistance element and having a flat attaching portion integral with the contact means and engaging the adjacent face of the driving arm, said contact means being sprung out of the plane of the attaching portion toward the resistance element to press against the resistance element; hooks on the attaching portion of the contactor extending through the openings in the driving arm and engaging the outer face thereof to hold the contactor assembled with the driving arm, said hooks necessitating endwise movement for attachment, and means restricting endwise movement of the hooks.

6. In a variable resistance device of the character described: a base of insulating material; a shaft rotatably carried by the base and held against inward endwise motion with respect thereto; a flat circular resistance strip on the inner face of the base concentric to the shaft; an insulated driving arm fixed to the inner end of the shaft and overlying the inner face of the base, said driving arm having openings at opposite sides of the shaft; a contactor having a spring arm engageable with the face of the resistance element and having a flat attaching portion integral with the spring arm and engaging the adjacent face of the driving arm, said spring arm being flexed out of the plane of the attaching portion toward the resistance element to press against the resistance element; hooks on the attaching portion of the contactor extending through the openings in the driving arm and engaging the outer face thereof to hold the contactor assembled with the driving arm, engagement and disengagement of said hooks with the edges of the openings necessitating edgewise shifting of the contactor with respect to the driving arm; and readily separable interengaging means on the contactor and driving arm for holding the contactor against such edgewise motion.

7. In a control of the type having a resistance element, and a contactor slidable thereacross, a rotatable contactor unit comprising: a shaft; a driving arm of insulating material fixed to the shaft and having substantially opposite apertures; a flexible resilient contactor having a flat attaching portion overlying one face of the driving arm; resilient contact arms integral with said attaching portion and projecting therefrom; stepped hooks on said attaching portion projectable through the apertures of the driving arm and engageable in back of one edge thereof upon edgewise motion of the contactor with relation to the driving arm; and interengaging means on the driving arm and the contactor for holding the contactor against edgewise motion after proper engagement of the hooks over the edges of the apertures.

8. In a control of the character described wherein a contactor is slid across the surface of a resistance element: a rotatable shaft; a flat driving head of insulating material secured to the shaft in a plane substantially normal to the axis of the shaft, said driving head having apertures therethrough substantially at opposite sides of the shaft; a spring contactor comprising a single stamping of resilient metal having a flat attaching portion engaging the flat inner face of the driving head and having spring contact arms extending from the attaching portion and substantially concentric with the shaft with the extremities thereof substantially radially aligned and provided with contact portions engageable with the surface of the resistance element, said arms being sprung out of the plane of the attaching portion and away from the driving head so that pressure on the extremities of said arms to move them toward the driving head tends to rock the attaching portion thereof away from said inner face of the driving head; and stepped hooks on the attaching portion of the contactor projecting through said apertures and over the outer edges thereof to oppose such tendency of the attaching portion to be rocked away from the driving head.

9. In a control of the character described wherein a contactor is slid across the surface of a resistance element: a rotatable shaft; a flat driving head of insulating material secured to the shaft in a plane substantially normal to the axis of the shaft, said driving head having apertures therethrough substantially at opposite sides of the shaft; a spring contactor comprising a single stamping of resilient metal having a flat attaching portion engaging the flat inner face of the driving head and having spring contact arms extending from the attaching portion and substantially concentric with the shaft with the extremities thereof substantially radially aligned and provided with contact portions engageable with the surface of the resistance element, said arms being sprung out of the plane of the attaching portion and away from the driving head so that pressure on the extremities of said arms to move them toward the driving head tends to rock the attaching portion thereof away from said inner face of the driving head; stepped hooks on the attaching portion of the contactor projecting through said apertures and over the outer edges thereof to oppose such tendency of the attaching portion to be rocked away from the driving head, the engagement of said stepped hooks with the edges of the apertures holding the contactor against turning about the axis of the shaft with respect to the driving head, and engagement and disengagement thereof with said edges necessitating edgewise motion of the contactor across the driving head; and interengaging means on the contactor and the driving head for holding the contactor against retrograde edgewise motion.

10. In a control of the character described wherein a contactor is slid across the surface of a resistance element: a rotatable shaft; a flat driving head of insulating material secured to the shaft in a plane substantially normal to the axis of the shaft, said driving head having apertures therethrough substantially at opposite sides of the shaft; a spring contactor comprising a single stamping of resilient metal having a flat attaching portion engaging the flat inner face of the driving head and having spring contact arms extending from the attaching portion and substantially concentric with the shaft with the extremities thereof substantially radially aligned

and provided with contact portions engageable with the surface of the resistance element, said arms being sprung out of the plane of the attaching portion and away from the driving head so that pressure on the extremities of said arms to move them toward the driving head tends to rock the attaching portion thereof away from said inner face of the driving head; stepped hooks on the attaching portion of the contactor projecting through said apertures and over the outer edges thereof to oppose such tendency of the attaching portion to be rocked away from the driving head, the engagement of said stepped hooks with the edges of the apertures holding the contactor against turning about the axis of the shaft with respect to the driving head, and engagement and disengagement thereof with said edges necessitating edgewise motion of the contactor across the driving head; and interengaging means on the contactor and the driving head for holding the contactor against retrograde edgewise motion, said last named interengaging connection being maintained by the resilience of the contactor and the tendency for its attaching portion to remain in a common plane.

11. In a control of the character described: a movable contactor; an insulated carrier therefor, said carrier comprising, a base of insulating material having one flat face and having substantially opposite openings therein; and the contactor comprising, a unitary resilient sheet metal stamping having a flat attaching portion engaging the flat surface of said carrier and having a spring arm extending from and sprung outwardly from said attaching portion; stepped hooks projecting from the attaching portion in the direction opposite to that in which the spring arm is sprung for engagement in said openings of the carrier, the extremities of said hooks engaging the edges of the openings at that side of the carrier opposite its flat face which the contactor engages, engagement of said hooks into and over said edges of the openings necessitating edgewise shifting of the contactor across the flat surface of the carrier; and cooperating means on the attaching portion of the contactor and carrier providing a spring detent for holding said contactor against retrograde edgewise shifting upon proper engagement of the hooks in said openings; said hooks being on a line between the spring detent and the opposite boundary of the flat attaching portion of the contactor so that the resilient opposition of the flat attaching portion to flexure out of its plane provides the spring tension for the detent means.

12. As an article of manufacture, a contactor for variable resistance units comprising: a unitary stamping of light resilient metal having a planar attaching portion provided with a central rearward extension having a tit projecting up from one face thereof; stepped hooks on the outer extremities of the attaching portion having risers projecting from the plane of the attaching portion in the same direction as said tit and having end portions extended rearwardly to hook over the edges of apertures in a driving head to which the contactor is securable and to be there held by the engagement of the tit in a suitable aperture in the driving head; and independent arcuate spring arms extending integrally from the ends of the attaching portion in a direction opposite to the way the stepped hooks point, said spring arms being flexed out of the plane of the attaching portion and in the direction opposite that in which the risers of said hooks project, and

the extremities of said arms being formed as rounded contact shoes to slide freely over the surface of a resistance element.

13. As an article of manufacture, a contactor for variable resistance units comprising: a unitary stamping of light resilient metal having a planar attaching portion provided with a central rearward extension having a tit projecting up from one face thereof; stepped hooks on the outer extremities of the attaching portion having risers projecting from the plane of the attaching portion in the same direction as said tit and having end portions extended rearwardly to hook over the edges of apertures in a driving head to which the contactor is securable and to be there held by the engagement of the tit in a suitable aperture in the driving head; independent arcuate spring arms extending integrally from the ends of the attaching portion in a direction opposite to the way the stepped hooks point, said spring arms being flexed out of the plane of the attaching portion and in the direction opposite that in which the risers of said hooks project, and the extremities of said arms being formed as rounded contact shoes to slide freely over the surface of a resistance element; and another pair of smaller spring arms extending from and flexed out of the plane of the attaching portion in the same directions as the first named arms but inside the arc defined thereby, said smaller arms also having rounded contact shoes on the extremities thereof for engagement with a contact surface.

14. In a variable resistance device: a base having a substantially flat surface; a substantially circular flat resistance element on said surface; a central bearing carried by the base; a rotatable shaft journaled in the bearing; a contactor mounted on the shaft and engaging the resistance element; a metal collector ring supported from said flat surface of the base and encircling the shaft but electrically spaced therefrom; means on said contactor riding on the collector ring; the base having a hole under the resistance element; and a terminal strip integral with the collector ring and having an offset portion extending into said hole and thereby dipping under the resistance element, said offset portion having a substantially snug engagement with the sides of the hole.

15. In a variable resistance device: a base having a substantially flat surface; a substantially circular flat resistance element on said surface; a central bearing carried by the base; a rotatable shaft journaled in the bearing; a contactor mounted on the shaft and engaging the resistance element; a metal collector ring supported from said flat surface of the base and encircling the shaft but electrically spaced therefrom; means on said contactor riding on the collector ring; the base having a hole under the resistance element; and a terminal strip integral with the collector ring and having an offset portion extending into said hole and thereby dipping under the resistance element, said offset portion of the terminal strip having a snug frictional engagement with the sides of the hole to thereby hold the collector ring and terminal strip in position on the base.

16. In a variable resistance device, the combination of: a substantially flat insulating base; a bearing carried by the base; an operating shaft journaled in the bearing; a substantially circular flat resistance strip on the inner face of the base and concentric with the axis of the shaft, said resistance strip having its ends spaced a short

distance apart; terminals connected with the ends of the resistance strip and secured to the base, said terminals being spaced apart and the space therebetween being substantially bridged by at least one extended end of the resistance strip; a contactor mounted on the operating shaft and rotatable thereby, said contactor having a shoe sliding on the resistance strip; a metal collector ring between the contactor and said inner face of the base; a contact shoe on the contactor sliding on said collector ring, the base having a hole under the bridging portion of the resistance element; and a terminal strip integral with the collector ring and extending radially therefrom, said terminal strip having an offset portion disposed in said hole to thereby dip under the bridging portion of the resistance strip, said offset portion having a substantially snug engagement with the sides of the hole, and said terminal strip having a wire attaching portion located between the terminals for the ends of the resistance strip.

17. In a variable resistance device: a flat plate-like insulating base; a central bearing carried by the base; a resistance strip on one face of the base substantially concentric with the axis of said bearing; a contactor having an operating member journaled in the bearing and having a contact shoe riding on the resistance strip; a metal collector ring between the contactor and the adjacent face of the base; a contact shoe on the contactor riding on the collector ring; the base having a radial slot under the resistance strip and having a notch in the marginal edge portion thereof radially aligned with the slot; a terminal portion extending outwardly from the collector ring as an integral part thereof, said terminal portion having an offset extending into said slot so as to dip under the adjacent portion of the resistance strip and having another portion entering the notch in the base; and laterally extended lugs on said last named portion engaging under the adjacent edges of the notch,

said lugs and the offset coacting to hold the collector ring and its terminal properly positioned on the base.

18. In an electrical control unit of the character described: a substantially circular flat base having a radially extended portion; a bearing carried by the base; an operating shaft journaled in the bearing; a grounding member overlying the outer face of the base and making electrical contact with the operating shaft; extensions on said grounding member projecting beyond the adjacent edge of the base and engaging the lateral edges of said radially extended portion of the base whereby said grounding member is positively held against rotation about the axis of the operating shaft, said extensions of the grounding member having slots therein; a metal cover for the control unit; and securing lugs on said cover extending through the slots in the grounding plate extensions whereby said cover and grounding plate are firmly electrically and mechanically connected.

19. As an article of manufacture, a combined collector ring and terminal therefor comprising: a unitary stamping having a large flat ring adapted to be slidably engaged by the contact shoe of a suitable contactor; and a terminal strip extending radially outward from the flat ring, said terminal strip having two offset portions spaced radially with respect to the ring and both offset in the same direction from the general plane of the combined collector ring and terminal, the outer offset portion which is farthest from the ring having lateral lugs projecting therefrom and positioned to engage one face of a carrier with which the combined collector ring and terminal is adapted to be assembled while the ring overlies the other face thereof, said lateral lugs extending to a point to engage the bottom of the insulating carrier.

NEWTON C. SCHELLENGER.