Sept. 14, 1937. N. C. SCHELLENGER 2,093,252

ELECTRICAL CONTACTING DEVICE

Filed Dec. 10, 1934

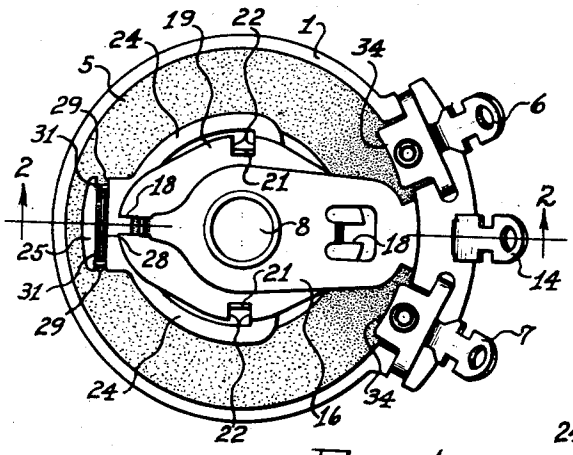


FIG. 1.

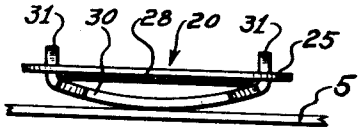


FIG. 3.

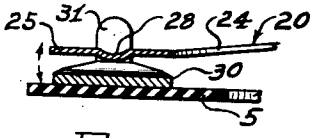


FIG. 4.

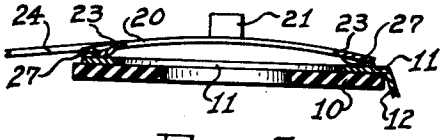


FIG. 5.

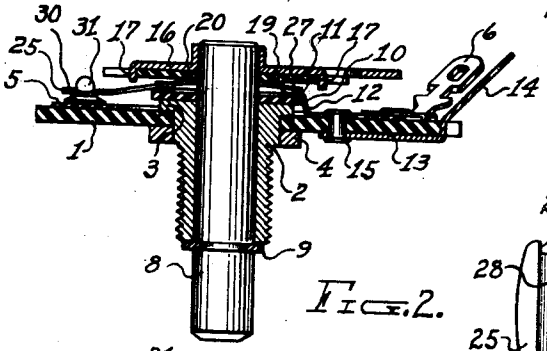


FIG. 2.

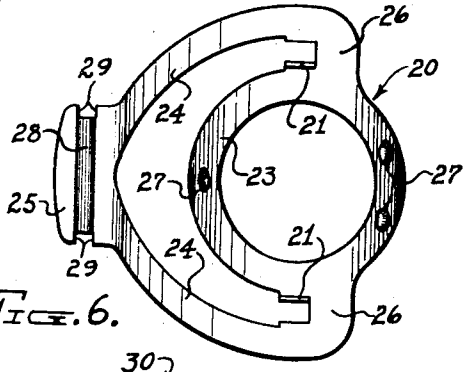


FIG. 6.

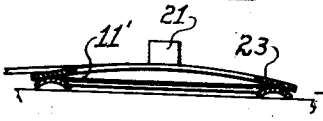


FIG. 12.

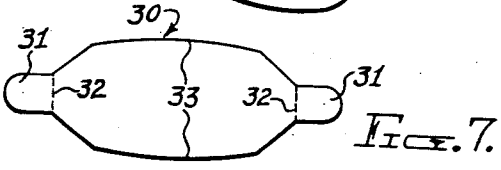


FIG. 7.

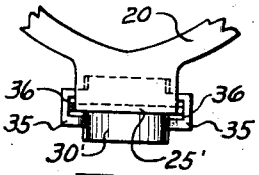


FIG. 9.

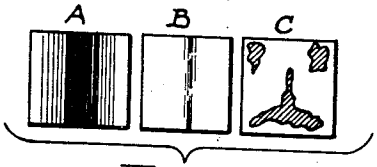


FIG. 8.

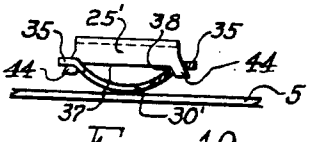


FIG. 10.

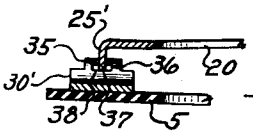


FIG. 11.

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BY.

ATT'Y.

Patented Sept. 14, 1937

2,093,252

UNITED STATES PATENT OFFICE

2,093,252

ELECTRICAL CONTACTING DEVICE

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

Application December 10, 1934, Serial No. 756,717

11 Claims. (Cl. 201—55)

My invention relates to electrical contacting devices, and particularly to such devices that are adapted for use in variable resistors. More specifically, my invention relates to an improved contacting mechanism for use in conjunction with resistance elements of the planar, carbonaceous type, and in variable resistors employing the same, as are extensively used today in radio receiving sets.

In the past few years, radio has been adapted to many new uses, and has been developed to extend over an ever increasing field of new application.

Thus, radio receivers have shed the properties that formerly characterized them as being non-portable units, and have today become standardized as mobile, portable units; readily adaptable to use in vehicles or other devices of a mobile character.

Such adaptations have required that radio receivers be not only compact and portable, but, also, that they possess certain qualifications that will promote and maintain their proper operation under conditions vastly different from those enjoyed by the "stationary" sets.

The new uses to which radio receivers have been put, have brought out various imperfections, resulting from the inadaptability of certain of the component parts to function properly under the altered conditions to which they were being subjected.

Thus, as in the case of the automobile receiver set unit, radio receivers are subjected to much vibration and jolting. Among the undesirable factors arising from such treatment is the one wherein most of the controls or elements of such receivers, which are of a movable or adjustable nature, are easily jarred and vibrated out of adjustment, whereby reception and reproduction are seriously interfered with.

Variable resistors have, heretofore, under such conditions, tended to vary from any given position of adjustment to which they were set. The vibration and jolting that accompanies any vehicle, and particularly automobiles, causes the contactor of a resistor within the vehicle to be raised and lowered into and out of engagement with the resistance element in a vibratory manner. The contactor is thereby caused to "walk" along the element to an out-of-adjustment position.

This factor alone is highly disagreeable, and necessitates that a listener be constantly resetting the controls if continuity of reception is desired. However, there are other undesirable effects arising from these vibratory influences as concerns variable resistors.

It has been difficult to effect contact between a resistance element and a contactor in such a way as to secure a substantial area of contact and a relatively high contact pressure without increasing the operating torque of a variable resistor a prohibitive amount.

Due to the unit pressures existing between the movable elements and the stationary mountings of variable resistors when high contact pressure is sought, the frictional component becomes such a factor as to render the desired contact pressure, as a practical matter, almost unattainable.

Hence, contact pressures have been minimized to a certain extent, whereby the actual area of contact has been, likewise, lessened. The superficial irregularities of an element coupled with the irregularities of the contact surface of a contactor, permit of only partial contact between the two, which is far less than would apparently seem to be the case.

The contact between element and contactor has been impaired further by the vibratory and jostling movements referred to above. A defective, inadequate contact has resulted, which not only lessened the power or volume of an associated circuit, but incited undesirable humming and scratching noises in the reproducer.

It is an object of the present invention to provide a variable resistor wherein the contacting mechanism will not be readily displaced from an adjusted position by outside influences.

It is another object of my invention to provide a variable resistor contacting device that will effect contact substantially throughout an entire area of contact upon the resistance element.

It is still another object of my invention to provide a contacting mechanism for variable resistors that will exert a maximum contact pressure upon the element without increasing the unit pressures between the movable elements and the stationary mountings thereof to any appreciable extent.

It is a further object of my invention to provide a contacting mechanism for a variable resistor that will operate with ease and efficiency; permitting a smooth gradation of resistance values without inciting disturbances in the associated circuit, and which is economical to produce and sturdy in construction.

With the above objects in view and others ancillary thereto, which will be brought out as the description proceeds, I prefer to accomplish one embodiment of my invention as follows:

In a resistor that has a base, an arcuate, carbonaceous element on such base, and a shaft mounting arranged concentrically with such element, I provide my improved contacting mechanism. This mechanism comprises a shaft journalled in the shaft mounting having a drive plate fastened to its end adjacent the element.

Between the drive plate and shaft mounting I provide a cambered, curved, or dished contactor, preferably formed from spring metal. The contactor has driving engagement with the drive plate so as to be rotatable therewith, and is tensioned between the plate and the shaft mounting.

A convex contact shoe of resilient metal is provided at an extremity of the contactor and is pressed into firm engagement with the element by the tension of such contactor to afford a maximum contact pressure over a substantial area of the element.

The shoe is fulcrumed upon the contactor for pivotal movement transverse of the element, and is engaged by the contactor in such a way as to be pulled thereby, rather than pushed.

A collector ring is interposed between the shaft mounting and the contactor whereby parts of the contactor are engaged thereby. These parts are formed so as to reduce the unit pressure, which results in the operating torque being held at a minimum.

The scope of the present invention is set forth with particularity in the appended claims. The invention itself, however, as to details of construction and manner of operation, together with the objects and advantages thereof, may be better understood by reference to the annexed specification, when considered in conjunction with the accompanying drawing, in which:

Fig. 1 represents a plan view of a variable resistor embodying a contacting device made in accordance with the present invention.

Fig. 2 is a vertical sectional view taken along line 2—2 of Fig. 1.

Fig. 3 is a fragmentary, enlarged detail, end view of a contactor arm and shoe constructed in accordance with the present invention.

Fig. 4 is an enlarged, fragmentary, mid-sectional view of a contactor arm and shoe made in accordance therewith.

Fig. 5 is an enlarged, fragmentary, mid-sectional view of part of my contactor arm assembly not shown in Fig. 4.

Fig. 6 is an enlarged plan view of my improved contactor arm.

Fig. 7 is an enlarged plan view of a blank from which my contacting shoe is formed.

Fig. 8 is a composite view illustrating diagrammatically in plan the relative areas contacted by a shoe made in accordance herewith, and other old forms of shoes.

Fig. 9 is a fragmentary plan view of a modified form of contactor.

Fig. 10 is a fragmentary end view of the device shown in Fig. 9.

Fig. 11 is a sectional view taken along line 11—11 of Fig. 9.

Fig. 12 is a fragmentary vertical sectional view of a modified form of contactor arm wiping ring and collector ring assembly.

Referring now more specifically to the drawing, in which like reference characters refer to like parts throughout:

The variable resistor device illustrated in Figs. 1 and 2, which I have chosen to illustrate a particular application of my invention, is, with the exception of the contacting mechanism covered hereby, the same as that shown and described in my copending application Serial No. 741,551, filed August 27, 1934, which has matured into Patent No. 2,041,212, May 19, 1936.

The variable resistance device consists of an insulative base 1 having a centrally disposed aperture therein for the accommodation of a shaft bearing or bushing 2. The bushing is held in place by an enlarged head portion 3 upon one side of the base 1, and a washer 4 on the other side thereof.

A resistance element 5 is secured to the base, and is electrically connected adjacent its ends to terminals 6 and 7.

A shaft 8 is journalled in the bushing 2, and is held against axial movement by a C washer 9, which utilizes the outside end of the bushing 2 as a thrust bearing, and by the contactor mechanism at the other.

Disposed about the shaft, atop the bushing 2, is a disc of insulation 10, which serves to insulate the current collector ring 11 from the bushing, which is usually grounded.

The collector ring 11 has a tail portion 12 that extends to overlie an extension 13 of terminal 14 on an opposite side of the base 1 therefrom. Electrical connection and fastening means is provided for the tail portion 12 and terminal extension 13, by a rivet 15, which connects the two through the base.

Pressed tightly upon the end of the shaft adjacent the resistance element is a drive arm 16, which is provided with downwardly depending fingers 17 that register in slots 18 in the insulative drive plate 19.

Disposed between the drive plate 19 and the collector ring 11, is a contactor arm 20, which has upwardly extending fingers 21 in engagement with the drive plate 19 within notches 22.

From the above assembly it will be seen that when the shaft 8 is rotated, the drive arm 16 is turned therewith. By virtue of the fingers 17 and slots 18 the plate 19 is also rotated, and, in turn, transmits the rotational force to the contactor arm 20 through fingers 21 and notches 22. In this manner the contactor is moved relatively to the resistance element to vary the effective resistance.

The contact arm 20 is punched from a single piece of sheet metal, and is formed with a camber, or cylindrical curve, throughout its entire extent. It is formed of resilient metal and comprises a wiping contact ring 23, spring arms 24, and a shoe engaging portion 25 in which the arms converge.

The arms and ring are integrally connected by the radially off-set portions 26, from which fingers 21 that engage the drive plate 19 are struck-up.

Due to the camber of the entire arm 20, only diammetrically opposed portions of the wiping ring 23 contact the collector ring 11. To reduce the unit pressure, these portions, as indicated at 27, are provided with indentations or dimples to give a greater bearing surface in engagement with the collector ring 11. These indentations 27 prevent the lower corners of the edges of the wiping ring 23 from biting into the collector ring 11.

The contact portion of the wiping ring farthest from the contact shoe exerts a greater pressure upon the collector ring than does the opposite portion nearer the shoe. This is due to the fact that the tensioned spans of both the

wiping ring and the contactor arms have their bearings on the furthest portion, thereby subjecting it to double tension pressure. Thus, to prevent increase in the unit pressure at this point, double bearing surface area should be provided. To this end, I have provided two indentations at the one side of the ring, and one indentation at the other side thereof.

In Fig. 12, I have illustrated a modified form of contacting device wherein the means for reducing the unit pressures between the wiping and collector rings is on the collector ring, instead of on the wiping ring. The indentations 27, shown in other figures herein, are eliminated, and the collector ring 11' is formed with a crown or convex surface as shown. The cylindrical curve of the wiping ring permits the under faces of the ring to lie upon substantial portions of the collector ring; from the center or crown line thereof, outwardly to its periphery. A broad area of contact is provided whereby low unit pressure is assured.

The shoe engaging portion 25 of the contactor is provided with a downwardly depressed, transversely extending ridge 28, which terminates in notches 29 at each of its ends.

The contact shoe 30, is formed from a blank of resilient metal, as shown in Fig. 7. Ears 31 are formed upwardly along the bend lines 32 to register in notches 29 in the end portion 25 of the contactor arm 20, as is shown in Figs. 1 and 3.

The shoe 30 is cambered, or formed to a cylindrical curve throughout its length, likewise shown in Fig. 3.

The ridge 28 engages the shoe upon its inner face adjacent the bend lines and serves as a fulcrum upon which the shoe may pivot transversely of the element as shown by the arrows in Fig. 4. This permits the shoe to tilt and adjust itself to irregularities occurring in the contact surface of the element, which slightly alter the transverse inclination of the surface.

The contact face of the shoe, though convex, is not adapted to rock upon the element, but is merely adapted to present substantially one area of contact to the element at all times. The contactor is adapted to pull the shoe by engaging whichever of the ears 31 is leading in the direction of movement.

The contactor arm 20 is positioned against its own tension between the drive plate 19 and the collector ring 11 to firmly force the resilient shoe into engagement with the element. The formed portions 27 of the wiping ring 23, permit this tension to be much greater than would otherwise be possible.

The shoe 30 is provided with curved edges 33, and is symmetrical throughout, whereby it is reversible and adapted to be placed on the contactor arm 20 with either edge outwardly.

The curved edges of the shoe permit conformance to the curvature of the edges 34 of the terminals 6 and 7 adjacent the contact surface of the element, whereby a clearance of but a few thousandths of an inch is obtained when the contact shoe is moved therepast.

The modified form of arm and shoe shown in Figs. 9, 10 and 11 functions substantially the same as the type hereinbefore discussed. The arm 20 is provided with a downwardly extending portion 25', which has downwardly and outwardly projecting shoe engaging ears 44.

The shoe 30' is blanked and formed from one piece of metal, and has projections 35 extending from opposite peripheral portions. These projections are provided with windows 36 for engagement with the ears 44. The shoe is pulled along with the arm 20 by whichever is the leading projection and ear. No appreciable rocking movement is permitted, although a tilting movement transversely of the element is allowed, for reasons discussed hereinbefore. The edge 37 of the downturned portion 25' of the arm, serves as a fulcrum upon which the edges 38 of the windows 36 in the shoe pivot to allow the transverse tilting of the shoe.

The structure of the present invention has been designed to give, and does give, a maximum area of contact between the contact shoe and the resistance element. This is due to the nature of the shoe and of the element, in view of the high contact pressure afforded by the contactor arm when made in accordance herewith.

The resiliency of the metal shoe permits it to be flattened to a considerable degree upon the element, which is effected as a result of the pressure placed thereon by the spring tensioned contactor arm.

The element itself is yieldable to a certain extent, and thereby tends to conform to the shoe, causing a levelling-off of all irregularities in the contact area of each, and promoting conformity therebetween, whereby contact is effected over substantially all portions within the area of contact of each.

In the composite views of Fig. 8, I have diagrammatically illustrated the effects of the present invention as contrasted with those of the prior art. The squares of each of the diagrams A, B and C of Fig. 8, define what may properly be described as the contact face area of certain types of contact shoes. This refers not to the actual area contacted, but to the area of that face of each of the shoes which is disposed adjacent to, as well as in engagement with, the element.

The diagram B designates the contact face area of a convex shoe of the conventional design. Usually a linear tangency is sought with the element to provide for a fine gradation of resistance values, and to prevent short circuiting of resistance. The shaded areas in diagram B represent the actual areas of contact between the element and such a shoe. This is a liberal representation, and may be considered as representing a high percentage of contact area for such a shoe.

This type of shoe, when employed in a variable resistor that is subjected to jolts or vibration, does not make sufficient contact to engage the element at all times. The meager contact at the areas indicated is completely severed causing interruptions and fluctuations in the circuit with which it may be associated, due to the vibrations or jolts.

To overcome the deficiency of the type shoe operating as in B, a flat shoe has been tried. The usual flat shoe, though apparently lying flush against the element, gives a highly unsatisfactory, insufficient contact.

The shaded areas in diagram C, Fig. 8, represent how butt portions scattered about the shoe actually make contact. This representation, though an arbitrary one, depicts the contact effected between a flat shoe and an essentially flat element, where the shoe is of the more efficient order. In many cases the total contact area is far less than that illustrated here.

As was explained in connection with diagram B, the areas of contact are too meager to main-

tain contact while being subjected to vibrations or jolts.

Diagram A, Fig. 8, is representative of the character of the contact area established by my contacting device.

The contact area has been shaded, and in this connection it will be noted that the central portions are more heavily shaded than the outer portions. This has been done to illustrate the co-action between the element and my shoe responsive to the high contact pressure obtainable from the structures disclosed herein.

The convex surface of the shoe causes the portions adjacent the center thereof to engage the element with the greatest force. This convexity, likewise, causes the greatest depression of the element at this point. Hence, the centers of effort of the tension of the arm, the flattening of the shoe, and the resistance to depression of the element, all are exerted approximately along and adjacent to the transverse centerline of the shoe to cause the area of greatest contact pressure at this point, which is the point of most intimate contact.

From this centerline, the contact pressure diminishes and the intimacy of contact is lessened on each side thereof to an equal degree, but it has been found that practically the entire area of actual contact of the shoe is in intimate engagement with the element throughout.

The desirability of having a broad, deep contact between the element and shoe becomes apparent when the problem of offering maximum resistance to any and all extraneous displacing influences is considered. The shoe and arm may be vibrated in up and down oscillations without at any time coming out of engagement with the element. This is due to the fact that the shoe and element both expand if the pressure is slackened upon the shoe, and by so doing, close any spacing provoked by such vibration. Actually, there would never be any spacing except adjacent the marginal portions of the actual area of contact.

My shoe is particularly desirable for use in variable resistors, since its low, long and gradually curving configuration permits it to track properly and glide smoothly over the element, without causing any undesirable noises or disturbances in the associated circuit.

The lowness of my shoes, as is best illustrated in Figs. 3 and 10, causes the contactor arm to be positioned quite low. This is desirable from several angles. It permits of a saving of space within the unit, permitting of greater compactness of assembly, which is a highly important factor today.

However, its primary usefulness lies in the fact that the pulling action exerted on the shoe by the arm is exceedingly close to the surface of the element. This feature provides that the resultant of the forces acting on the shoe; i. e., the downward force exerted at the center of the shoe perpendicularly to the element, and the lateral pulling force exerted parallel to the element, is disposed at a very small angle to the plane of the element. This insures that the shoe will follow along the element smoothly, without any stubbing or "bouncing", despite the relatively high downward pressure to which the tension of the contactor arm subjects it.

From the foregoing specification it will be seen that I have provided a novel contacting mechanism that is economical to manufacture and durable in construction, and which operates with maximum efficiency.

Radio sets, or other electrical circuits, equipped with devices of the character set forth herein, will operate with unbroken continuity and will be found to stay in adjustment even though they be subjected to severe jarring, jolting or vibratory influences.

I claim as my invention:

1. In a variable resistor, a flat resistance element, a resilient contact shoe in engagement with said element, a resilient actuator engaging said shoe being tensioned to force said shoe into intimate engagement with said element and to pull said shoe thereover, and coupling means causing engagement of the shoe by the actuator at spaced points in a line tangent to the movement of the shoe to permit said shoe to tilt transversely of said element.

2. In a variable resistor, a flat resistance element, a resilient contact shoe in engagement with said element, a cylindrically curved resilient actuator engaging said shoe, means for flattening said actuator to tension the same against said shoe, coupling means between said actuator and shoe to permit said actuator when moving to pull said shoe at all times irrespective of the direction of movement thereof, said coupling means causing engagement of the shoe by the actuator at spaced points in a line tangent to the movement of the shoe whereby said shoe may tilt transversely of said element.

3. In a variable resistor, a contacting mechanism comprising a mounting, a shaft journalled in said mounting, a plate secured to said shaft in spaced relation to said mounting, a curved contactor arm of resilient metal disposed between said mounting and plate being held in a flattened position thereby against its own tension, and a low, resilient shoe pivoted upon said arm for engagement with a resistance element, said pivot comprising spaced pivot points on a line tangent to the arc of movement of the shoe.

4. In a variable resistor, a contacting mechanism comprising a mounting, a shaft journaled in said mounting, a plate secured to said shaft for rotation therewith, a resilient contactor arm disposed about said shaft between said mounting and said plate, said contactor arm being formed to a curve throughout its length; a shoe engaging portion at one end of said arm, and a resilient contact shoe fulcrumed thereon for movement therewith, said fulcrum comprising spaced pivot points on a line tangent to the arc of movement of the shoe.

5. In a variable resistor, a contacting mechanism comprising a stationary collector ring, a contactor arm having an annular member for engaging said ring, a pair of resilient arms disposed about said annular member being spaced therefrom and connected thereto by radially offset portions on said annular member, said arms and annular member each being formed to curves described from co-incident or parallel axes, oppositely placed portions on said annular member engaging said collector ring over substantial areas thereof.

6. In a variable resistor, a contacting mechanism comprising a stationary conductive member having an annular convex surface thereon, a contact arm having a cylindrically curved portion engaging said annular convex surface at substantially diametrically opposite points thereon and spanning the distance intermediate such points.

7. In a variable resistor, a resistance element of the substantially planar type, a contacting mechanism comprising a stationary conductive member having an annular convex surface thereon, a contact arm having a cambered portion spanning said annular convex surface from diametrically opposite points of contact thereon, a contact shoe connected to said arm having engagement with said resistance element, an actuator connected with said contact arm for moving the same relative to said stationary conductive member and for moving said shoe over said element, and means associated with said actuator for flattening said cambered portion of said arm to forcefully hold said shoe against said element.

8. In a variable resistor, a contacting mechanism, comprising a stationary collecting ring having an annular contacting surface thereon, a contact arm having a body portion spanning the annular contact surface, and indentations on the body portion engaging the contact surface at substantially diametrically spaced points.

9. In a variable resistor, a contacting mechanism, comprising a stationary collecting ring having an annular contacting surface thereon, a contact arm having a body portion spanning the annular contact surface and having an arm portion, and indentations on the body portion engaging the contact surface at the side adjacent the arm portion and at a side substantially diametrically opposite thereto.

10. In a variable resistor, a contacting mechanism, comprising a stationary conductive member having an annular contacting surface thereon, a contact arm having a body portion spanning the annular contact surface and having an arm portion, and indentations on the body portion engaging the contact surface at the side adjacent the arm portion and at a side substantially diametrically opposite thereto, said indentations having greater bearing area at the side substantially diametrically opposite the arm portion.

11. In a variable resistor, a contacting mechanism, comprising a stationary conductive member having an annular contacting surface thereon, a contact arm having a body portion spanning the annular contact surface and having an arm portion, and indentations on the body portion engaging the contact surface at the side adjacent the arm portion and at a side substantially diametrically opposite thereto, said indentations comprising a single indentation at the side adjacent the arm portion and a pair of indentations at a side substantially diametrically opposed thereto.

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