July 14, 1959 C. P. MAJKRZAK 2,895,115

SLIDING CONTACT DEVICE FOR TUNING COILS

Filed Oct. 10, 1955 3 Sheets-Sheet 1

Fig. 1

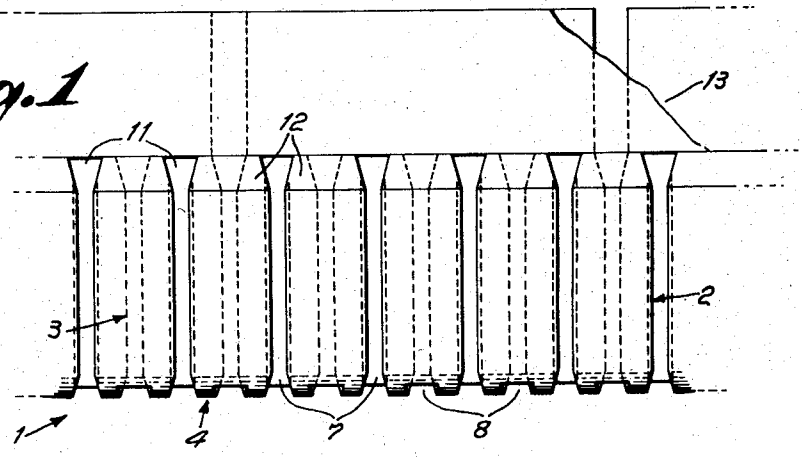
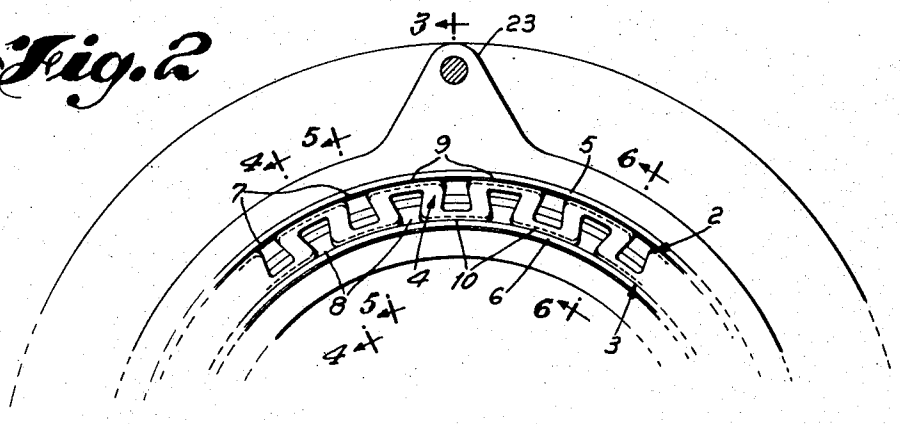
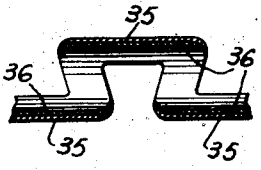


Fig. 2



3

Fig. 7



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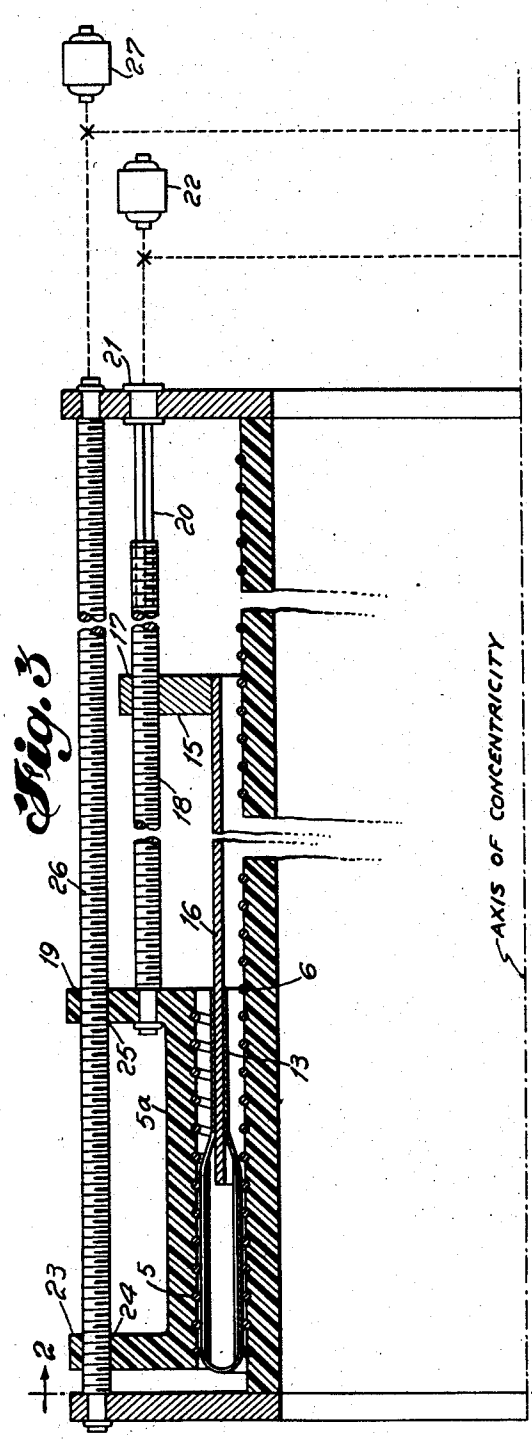


Fig. 3

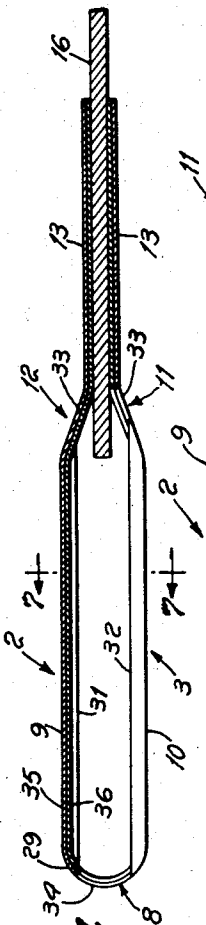


Fig. 4

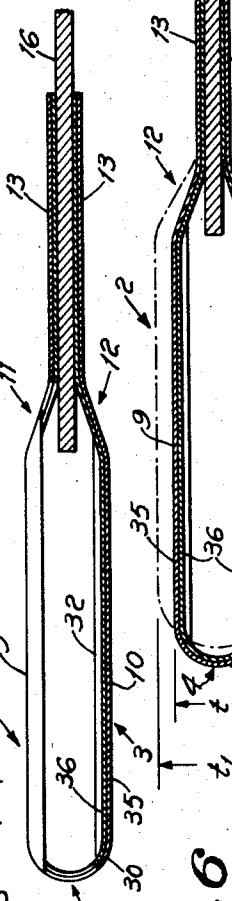


Fig. 5

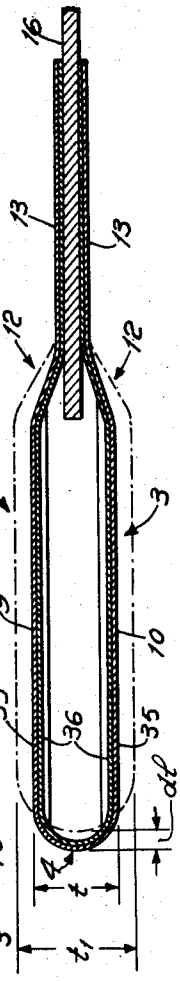


Fig. 6

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Fig. 8

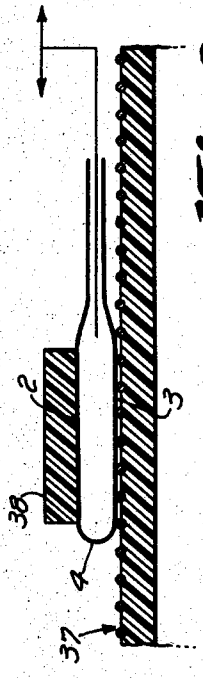


Fig. 9

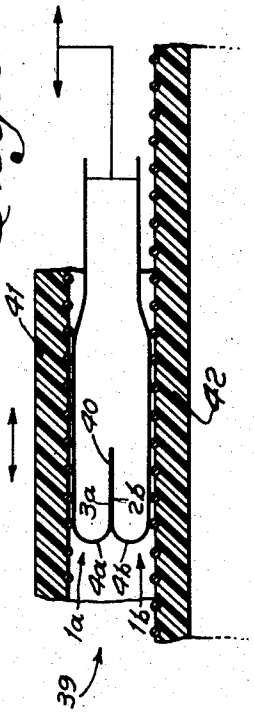


Fig. 10

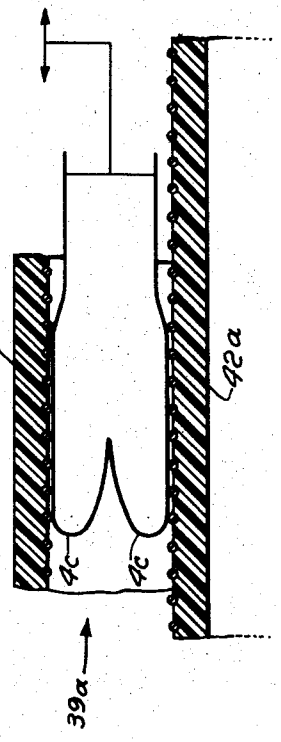
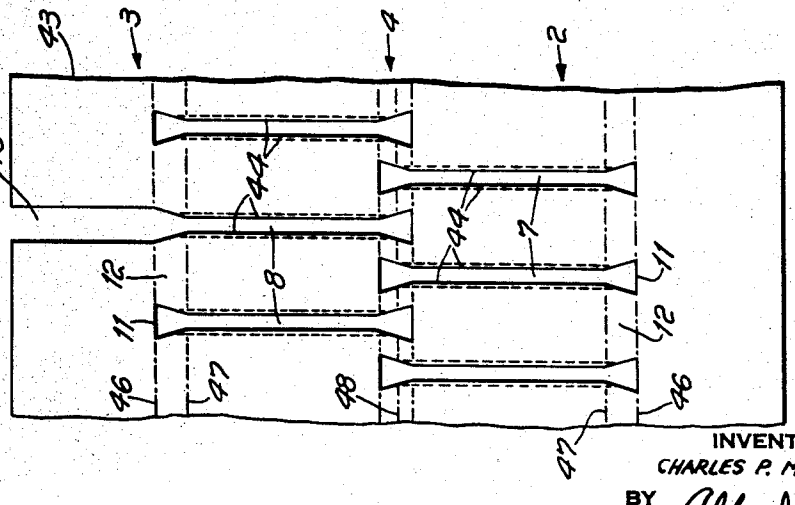


Fig. 11



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United States Patent Office 2,895,115 Patented July 14, 1959

2,895,115

SLIDING CONTACT DEVICE FOR TUNING COILS

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Application October 10, 1955, Serial No. 539,629

12 Claims. (Cl. 336—116)

This invention relates to sliding contact devices for tuning coils and more particularly to a sliding contact device for operation between two concentric tuning coils wherein one of the coils may be movable with respect to the other of the coils.

In the copending application of R. T. Adams et al., Serial No. 476,416, filed December 20, 1954, entitled "A Sliding Contact Device for Tuning Coils," there is disclosed a sliding contact device for encircling a tuning coil including a band of corrugated material having a plurality of contact elements disposed in spaced relation circumferentially thereof for engagement with the turns of a tuning coil. The corrugated shape of the band gives the contact device a resilient characteristic which permits outward radial and circumferential freedom to enable the contact elements to follow variations in the surface of the coil and/or misalignment of the axis of the band and the tuning coil.

The sliding contact device of the aforesaid copending application is extremely useful where the outward radial and circumferential freedom is not restricted, such as would occur when utilized within a tuning coil or between two concentrically-disposed tuning coils. In these two general applications, the tuning coil surrounding the sliding contact device would restrict its freedom of movement and thereby counteract the resilient characteristic of the sliding contact device.

Therefore, it is an object of this invention to provide a sliding contact device whose resilience will not be counteracted by the confinement of a tuning coil disposed relative thereto.

Another object of this invention is to provide an improved sliding contact device for tuning coils which provides substantially constant contact pressure as said device is moved over variations in the surface of the coil.

Still another object of this invention is to provide a sliding contact device having a plurality of contact areas on either one or both sides of said device whose resilient characteristic will enable the maintenance of constant contact pressure as said device is moved over variations in the surface of the coil regardless of whether said device is disposed to encircle the coil, disposed to be within the coil, or disposed between two concentrically-disposed coils, one of said coils being movable with respect to the other of said coils.

A feature of this invention is the provision of a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein and a curved end portion interconnecting adjacent ends of said first and second members, the side wall of at least one of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially thereof, the slots being extended into said curved interconnecting portion.

Another feature of this invention is the provision of an assembly including two devices, as described above, fastened together to dispose the contact areas of each device on opposing sides of said assembly and in an engagement relation with the turns of two concentrically-disposed tuning coils, said assembly being utilized wherein the spacing between the concentric coils is at least equal to twice the thickness of one of such devices.

Still another feature of this invention is the provision of a device, as described above, wherein the side wall of both of said members is of conductive material and includes spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially of each of the members, said slots being extended into said curved interconnecting portion, the contact areas of each member enabling a constant contact pressure between the turns of each one of two concentrically-disposed tuning coils and the sliding contact.

Other features of this invention include the utilization of flexible material for said tubular members and said curved interconnecting portion to provide the contact areas with a resilient characteristic, the forming of said tubular members adjacent the ends of said slots removed from said curved interconnecting portion to provide a flexing member to cooperate in establishing the resilient characteristic of said contact areas, and the forming of the edges of said spaced slots to protrude away from said contact areas to prevent said slots from scoring the tuning coil in movement of the sliding contact device therealong.

The above-mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is an elevational view of the contact device of this invention;

Fig. 2 is an end view of an embodiment of the sliding contact device of this invention taken along line 2—2 of Fig. 3;

Fig. 3 is a longitudinal cross-sectional view taken along line 3—3 of Fig. 2;

Fig. 4 is a cross-sectional view taken along line 4—4 of Fig. 2;

Fig. 5 is a cross-sectional view taken along line 5—5 of Fig. 2;

Fig. 6 is a cross-sectional view taken along line 6—6 of Fig. 2;

Fig. 7 is a cross-sectional view taken along line 7—7 of Fig. 4;

Figs. 8, 9 and 10 are diagrammatic views of other embodiments of the sliding contact device of this invention; and

Fig. 11 is a plan view of the material from which the contact device of this invention is formed.

Referring to Figs. 1–7, inclusive, contact device 1 is illustrated as comprising a tubular member 2, a tubular member 3 of smaller diameter than member 2 and a curved end portion 4 connecting members 1 and 2 together at adjacent ends thereof to form a single unit. The members 2 and 3 and portion 4 include as material thereof a spring metal, such as beryllium copper, to impart a resilient characteristic to device 1. To provide contact areas, the appropriate ones of members 2 and 3 are slotted axially thereof, with these slots extending into the curved portion 4. The member slotted depends upon the utilization of device 1. If device 1 is used within a tuning coil, member 2 would be slotted while if device 1 is employed to encircle a tuning coil, member 3 would be slotted to provide the desired plurality of circumferentially-spaced contact areas.

Device 1 finds its greatest utility in its employment as a contacting device between concentrically-disposed coils 5 and 6, as illustrated in Fig. 2. In this utilization, member 2 would be slotted, as indicated by slots 7, and member 3 would be slotted, as indicated by slots 8. Slots 7 provide a plurality of contact areas 9 in member 2, with

the slots 7 running into curved portion 4 just short of the contact areas 10 of member 3 formed by slots 8. Slots 8, in turn, extend into portion 4 just short of contact areas 9. The portions of slots 7 and 8 extending into portion 4 have a generally V-shaped configuration which cooperates to render device 1 resilient. The slots 7 and 8 extend along the entire length of contact areas 9 and 10, and at a point adjacent the rearward edge of contact areas 9 and 10, the slots 7 and 8 are again given a V-shaped configuration, as illustrated at 11 in Fig. 1. Coextensive with V-slot 11 is a flexure member 12 which renders the rearward edge of contact areas 9 and 10 flexible that amount necessary to follow variations in the surface of the coil and maintain members 2 and 3 parallel to each other when in operation. It will be observed that the contact area 9 of member 2 is in an overlying relationship with respect to slots 8 of member 3, and, conversely, slots 7 of member 2 are in an overlying relationship with respect to contact areas 10 of member 3.

Extending from the line defined by the members 12 and the V-slots 11 is a strip of material 13 which secures device 1 to a means for moving device 1 longitudinally of coils 5 and 6. This means for moving device 1 includes a disk 15 having an axially-disposed cylinder 16 to which is spot welded securing strips 13. Disk 15 includes a threaded aperture 17 therein which accepts screw 18. Screw 18 is fixed at one end thereof in flange 19 of coil form 5*a* and includes at the other end thereof a spline 20 passing through collar 21 which is driven by motor drive 22. Flanges 19 and 23 include threaded apertures 24 and 25 for receipt of screw 26 therein. Screw 26 is driven by motor drive 27 which, through the action of form 5*a* and screw 18, drives both coil 5 and device 1 axially with respect to coil 6 for adjustment of the number of turns which are shorted or grounded out by device 1. By operating motor drive 22, the screw 18 is rotated through means of spline 20 to move device 1 relative to coil 5 and coil 6 independent of coil 5. The means for movement disclosed in Fig. 3 is one half of the total gearing arrangement employed to provide the desired movement, the other half being located on the other side of the axis of concentricity (not shown) and receiving their motive power from motors 22 and 27. The means to move contact device 1 is not restricted to the means disclosed in Figs. 2 and 3; other arrangements for the desired axial or longitudinal movement will be obvious to those skilled in the art. It should be understood that the relative movement of coils 5 and 6 is not limited to the movement of coil 5 but may be caused by movement of coil 6.

As mentioned hereinabove, device 1 may have member 2 slotted for utilization for engagement of a coil surrounding device 1, or member 3 may be slotted for engagement with the turns of a coil about which device 1 is disposed. It is preferable to achieve the optimum resilience of device 1 that each one of members 2 and 3 be slotted, as illustrated in Figs. 1 and 2, regardless of whether device 1 is utilized between two concentrically-disposed coils, within a coil or encircling a coil. The difference between the device 1 for each one of the different applications may be the location of the conductive material on the contact members. In other words, for utilization between two concentric coils, contact areas 9 and 10 would have a conductive characteristic. For utilization within a tuning coil, contact area 9 would have a conductive characteristic, and for utilization about a tuning coil, contact area 10 would have a conductive characteristic.

As mentioned hereinabove, the slots 7 and 8 are extended into portion 4 just short of contact areas 9 and 10. This is illustrated in greater detail in Figs. 4 and 5. This provides a curved leading edge 29 for member 2 and a curved leading edge 30 for member 3 which prevents scoring or cutting the wire forming the turns of a tuning coil. The slots 7 and 8 in portion 4 and the V-shaped slots 11 in the member 12 are conducive to air flow therethrough for purposes of cooling.

Contact areas 9 and 10 have their edges adjacent slots 7 and 8, respectively, turned inwardly, as illustrated by the ribbed portions 31 and 32, which extend the entire length of contact areas 9 and 10, respectively. This inwardly-turned edge of areas 9 and 10 provides a stiffening effect therefor but yet not to that extent that these areas cannot follow variations in the surface of the coil. The ribbed portions 31 and 32 do extend into portion 4 and into member 12. The unribbed portions, as indicated at 33 and 34, enable a deflection of device 1 to cause a change in the thickness thereof designated *t*, as illustrated in Fig. 6. Fig. 6 illustrates the extent to which these unribbed sections 33 and 34 enable contact device 1 to deflect. Under normal use, device 1 has a thickness *t* as defined by the solid line representation of members 2 and 3 and portion 4. Under an unloaded condition, members 2, 3 and 4 will assume the configuration (greatly exaggerated) illustrated by the dotted representation thereof, thus indicating the amount of resilience present in the sliding contact device of this invention. It will be further noted that the length of the contact device 1 changes between the normal loaded condition and the unloaded condition, as designated by *d*1 in Fig. 6.

It will be observed in the detailed sections illustrated in Figs. 4, 5, 6 and 7 that the material from which device 1 is formed is preferably a laminated stock including a conductive metal portion 35 and a spring metal portion 36. In a reduction to practice, the conductive metal portion was coin silver which is an alloy of 90% silver and 10% copper and the spring metal portion was beryllium copper.

As mentioned hereinabove, device 1 has as its principal utilization a shorting means for tuning coils especially disposed between two concentric coils where one coil is movable with respect to the other and especially where the necessary spacing between these coils is of a limited nature. However, as pointed out hereinabove, the application of device 1 is not limited to utilization between concentrically-disposed coils but may be utilized to provide a moving short on the outer surface of a tuning coil or on the inner surface of a tuning coil.

Referring to Fig. 8, there is disclosed therein the utilization of contact device 1 as a moving short for a single coil which in this instance is disposed on the inner surface of device 1 in engagement with member 3. To utilize device 1 in conjunction with coil 37, it is necessary to provide a compression ring 38 fixed to member 2 in a manner to load the sliding contact device 1 and thereby place the resilient characteristic thereof in operation to follow variations in the surface of coil 37.

The disclosure of Fig. 8 is meant to suffice to illustrate the employment of device 1 when the coil 37 is disposed about device 1. In this instance, the radius of curvature of each of the elements disclosed therein would be reversed, and the compression ring 38 would be within coil 37 rather than about coil 37, as disclosed in Fig. 8.

Referring to Figs. 9 and 10, there is disclosed two embodiments of a sliding contact assembly 39 which employs two sliding contact devices 1*a* and 1*b* identical in nature to sliding contact device 1, described hereinabove. Assembly 39 is formed by securing the outer member 2*b* of device 1*b* to the inner member 3*a* of device 1*a*, as indicated at 40. In assembly 39 there will still be the same flexure members to enable the contact assembly to follow variations in the two concentrically-disposed coils 41 and 42, substantially as described hereinabove in connection with device 1. Assembly 39 enables the utilization of a contact device of this invention where the spacing of the coils 41 and 42 is greater than can be accommodated by a single one of the contact devices of this invention.

Fig. 10 illustrates a similar arrangement, as diclosed in Fig. 9, with the exception that the radius of curvature

of portions 4c and 4d has been modified to separate the leading edge of assembly 39a which enables the accommodation of concentric coils 41a and 42a which have a greater spacing therebetween than is present in the arrangement of Fig. 9. The modification of portion 4, as disclosed in Fig. 10, further provides a greater resilient characteristic at the leading edge of assembly 39a.

Referring to Fig. 11, there is disclosed a sheet of material which has punched therein slots 7 and 8 including the V-shaped portions 11. In the punching operation of the sheet material 43, the edges of slots 7 and 8 are ribbed or, in other words, turned away from the contact surfaces 9 and 10, as indicated by dotted lines 44. Certain ones of slots 8 are continued from the V-shaped portion 11 outwardly to the end of the sheet 43, as indicated by slot 45, which enables the member 3 to conform to the diameter to which device 1 is fitted and maintain a parallel relationship between members 2 and 3.

The first step in forming device 1 includes formation of the flexure members 12 by appropriately bending sheet 43 along lines 46 and 47. The next step is the bending of sheet 43 about the center line 48 to form portion 4 to have a given radius of curvature. The thusly-formed linear piece is cut to a desired length to encircle the tuning coil 6, as depicted in Figs. 2 and 3, which then forms the tubular members 2 and 3 as described hereinabove. The tubular device 1 is spot welded or otherwise secured to cylinder 16 to form a continuous band of material. In practice, contact device 1 is held in a welding fixture at the desired inside and outside diameter to fit between concentric coils, said device being placed under a loaded condition. Flange 16 is then welded to strips 13 to provide the contact device with the proper contact pressure and diameters and the desired means for relative movement thereof.

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

I claim:

1. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting together the other ends of said members at a point intermediate said members and axially opposite said curved portions, the side wall of one of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially thereof to engage turns of a coil, said slots being extended into said curved interconnecting portion.

2. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting together the other ends of said members at a point intermediate said members and axially opposite said curved portions, the side wall of one of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially thereof to engage turns of a coil, said slots being extended into said curved interconnecting portion, certain of said slots including V-shaped portions at the ends thereof, the bases of the V-shaped portions comprising the ends of the slots.

3. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting together the other ends of said members at a point intermediate said members and axially opposite said curved portions, the side wall of one of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially thereof to engage turns of a coil, said slots being extended into said curved interconnecting portion, said slots including V-shaped portions at the ends thereof, certain of said V-shaped portions extending into said curved interconnecting portion, and the bases of the V-shaped portions comprising the ends of the slots.

4. A device according to claim 3, wherein said one of said members includes a portion adjacent the end of said slot removed from said curved interconnecting portion having a segment thereof extending inwardly from said contact areas, others of said V-shaped portions being coextensive with said inwardly-extending segment.

5. A sliding contact assembly comprising two contact devices as defined in claim 2, one of said contact devices being disposed concentrically of the other with the outer wall of one engaging the inner wall of the other.

6. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting together the other ends of said members at a point intermediate said members and axially opposite said curved portions, the side wall of both of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of inner and outer contact areas spaced circumferentially thereof to engage turns of two concentrically-disposed coils, the slots of each of said members being extended into said curved interconnecting portion.

7. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting said members together at a distance removed from said curved interconnecting portion, the side wall of both of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of inner and outer contact areas spaced circumferentially thereof to engage turns of two concentrically-disposed coils, the slots of each of said members being extended into said curved interconnecting portion, each of said members includes a portion adjacent the end of said slots removed from said curved interconnecting portion having a first segment thereof at a diameter intermediate the diameters of said first and second members and a second segment thereof joining said contact areas with said first segment, said second segment extending inwardly from said contact areas.

8. A device according to claim 7, further including means to move said contact device axially of said tuning coils, said means to move including a member concentric to said tuning coils having an annular flange member extending therefrom radially of said tuning coil and means to secure said first segment to said flange member.

9. A device according to claim 7, wherein said slots include V-shaped portions at the ends thereof, certain of said V-shaped portions extending into said curved interconnecting portion and others of said V-shaped portions being coextensive with said second segment.

10. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular mem-

ber of smaller diameter than said first member disposed concentrically therein, a first curved end portion interconnecting one end of said first member to the adjacent end of said second member, a third tubular member of smaller diameter than said second member disposed concentrically therein, a fourth tubular member of smaller diameter than said third member disposed concentrically therein, a second curved end portion interconnecting one end of said third member to the adjacent end of said fourth member, means securing said third member to said second member, the side wall of said first and fourth members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially of said first and fourth members to engage turns of two concentrically-disposed coils, the slots of said first and fourth members being extended into their associated curved interconnecting portion.

11. A sliding contact device for inductive tuning coils comprising a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, the side wall of one of said members being of conductive material and having spaced slots disposed generally axially thereof to provide a plurality of contact areas spaced circumferentially thereof to engage turns of a coil, said slots being extended into said curved interconnecting portion, the slots in said first members being staggered with respect to the slots in said second member whereby the contact areas of each of said

members are in an overlying relationship with the slots of concentrically-related ones of said members.

12. A tuning device comprising two concentrically-disposed coils, a first tubular member, a second tubular member of smaller diameter than said first member disposed concentrically therein, and a curved end portion interconnecting one end of said first member to the adjacent end of said second member, means connecting said members together at a distance removed from said curved interconnecting portion, the side wall of both of said members being a conductive member and having spaced slots disposed generally axially thereof to provide a plurality of inner and outer contact areas spaced circumferentially thereof to engage turns of said concentrically disposed coils, the slots of each of said members being extended into said curved interconnecting portion, and further including means to move said contact device axially of both said coils, and means to move one of said coils and said contact device as a unit axially with respect to the other said tuning coil.

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