March 22, 1966 K. STEPHAN ETAL 3,242,271

ELECTRICAL SWITCH AND IMPROVED CONTACT FINGER AND CONTACT CLIP CONSTRUCTION THEREFOR

Filed July 12, 1963 2 Sheets-Sheet 1

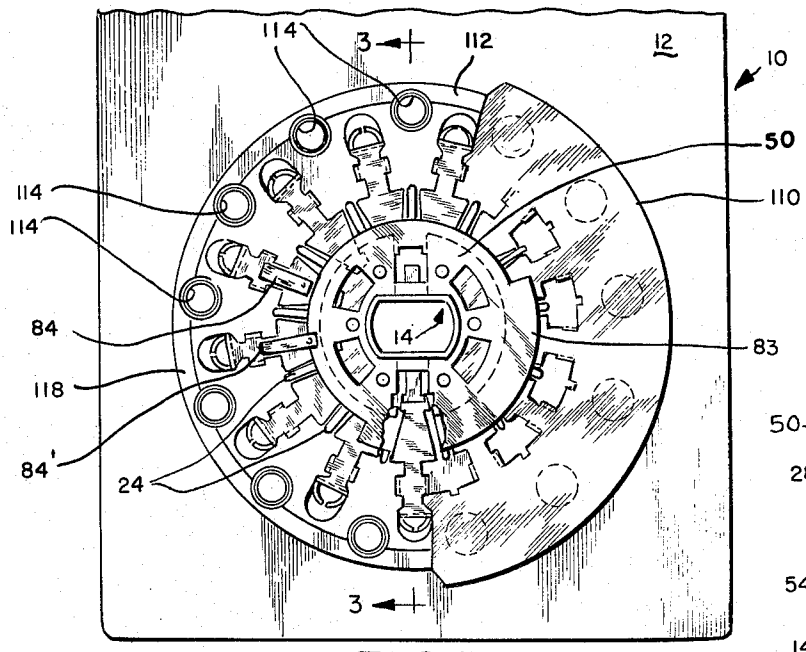


FIG. 1

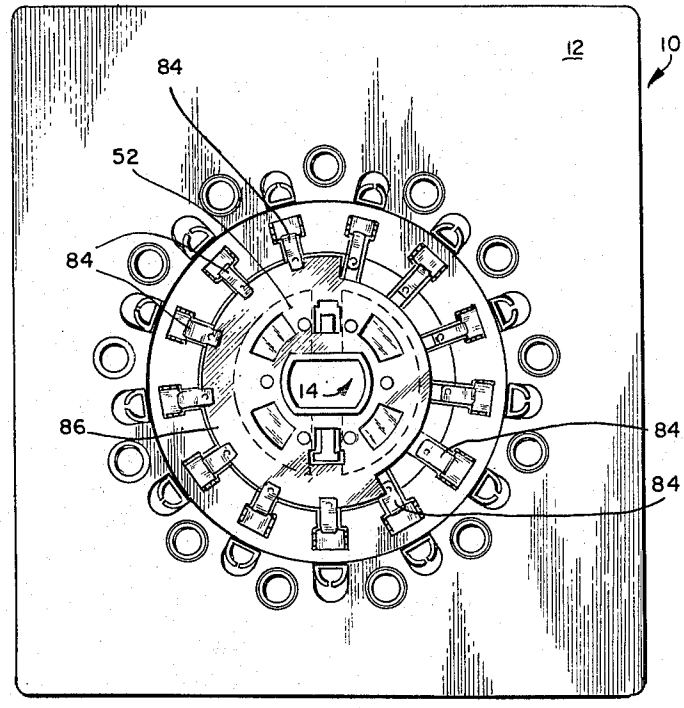


FIG. 2

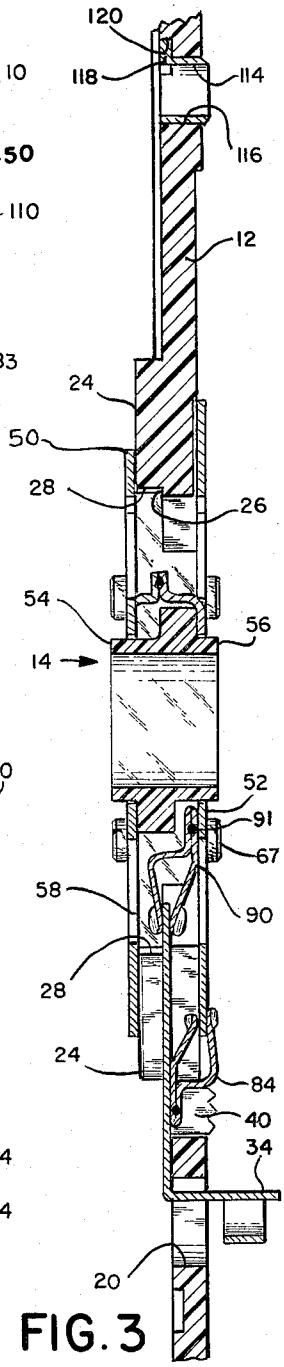


FIG. 3

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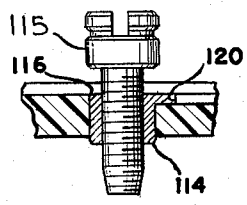


FIG.9

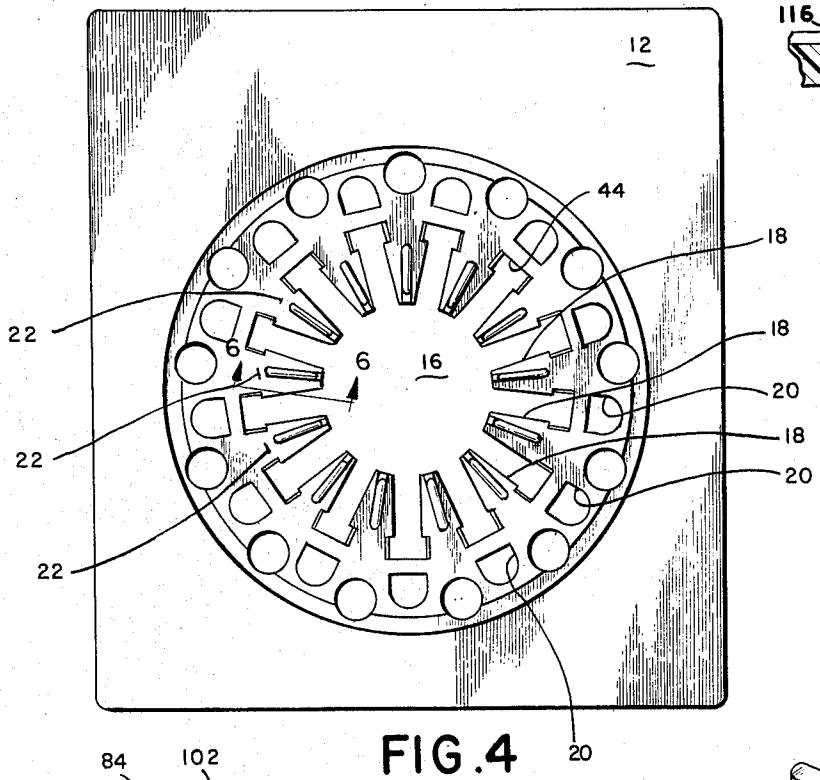


FIG.4

FIG.6

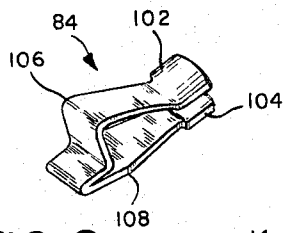
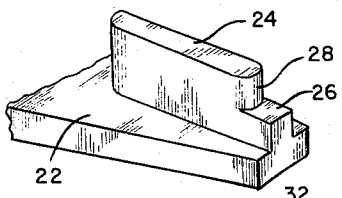


FIG.8



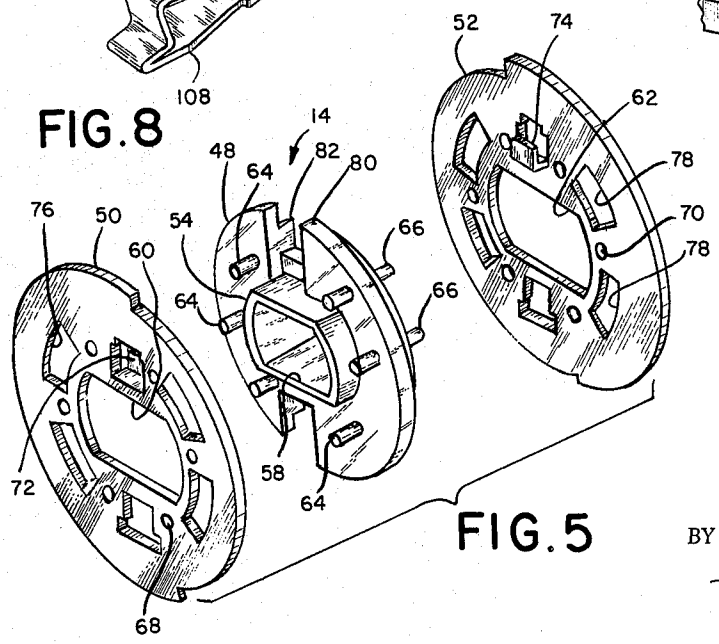


FIG.5

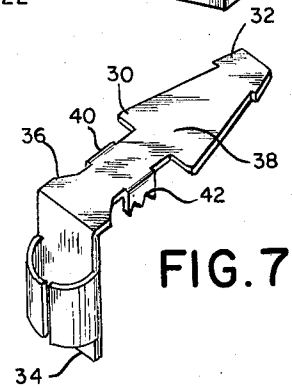


FIG.7

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3,242,271

ELECTRICAL SWITCH AND IMPROVED CONTACT FINGER AND CONTACT CLIP CONSTRUCTION THEREFOR

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Filed July 12, 1963, Ser. No. 294,579
17 Claims. (Cl. 200—11)

This invention relates to switch structures and, more particularly to a tuner-type switch construction.

A general object of this invention is to provide a new, improved and economical tuner switch construction.

Another object of this invention is to provide a switch which will provide consistent and reliable operation, which is easy to assemble, which incorporates a minimum number of parts and which lends itself particularly well to automated procedures.

A further object of this invention is to provide a tuner switch construction wherein excellent electrical characteristics are maintained.

For the achievement of these and other objects of this invention a tuner-type switch is constructed which includes a stator and a rotor mounted for rotation relative to the stator. The stator is preferably provided with a plurality of relatively spaced contact fingers with suitable conductive contacts being mounted on the rotor. A contact clip is electrically and mechanically connected to each of the contact fingers, where required by the circuit, by a fused connection, e.g. a weld, and is arranged for engagement with the conductive contact during relative movement between the rotor and the stator. The fused connection between the clips and the contact fingers provides a dependable, low resistance electrical connection which retains its electrical characteristics over an extended period of time to provide a tuner switch having an increased useful life and one which exhibits consistent operating characteristics over that life.

In accordance with more specific aspects of this invention, the contact fingers are mounted on the stator and the conductive contact on the rotor with the rotor including a contact clip which is arranged for engagement with the contact fingers. If desired, a pair of conductive contacts can be mounted in axial spaced relation on the rotor and contact clips can be connected to both sides of the contact fingers for engagement with both of the conductive contacts. Furthermore, it is contemplated that the rotor and stator be so constructed that the stator provides a bearing for the rotor and also confines the rotor against axial movement in one direction relative to the stator, with one of the conductive contacts arranged to engage the stator and prevent axial movement of the rotor in the opposite axial direction. With this arrangement an extremely versatile, and yet simply constructed, tuner switch construction is provided whereby various multi-level switching arrangements are possible using the same basic elements.

To facilitate automated procedures, the conductive portions are attached to the rotor by a heat sealed connection which permits the use of planar conductive portions and, moreover provides a dependable, long lasting connection which is not adversely affected even by maximum environmental tuner usage.

Another problem encountered in the use of tuner switches of the type just outlined is the desirability of using frequency tuning screws in the switch. Frequency tuning screws are generally threaded into the stator to provide adjustable tuning and this presents a problem in that materials possessing the requisite electrical properties for use as the stator may not possess the necessary mechanical characteristics, i.e. it may not be readily machinable. Hence, in the past there has been a conflict between the electrical and mechanical considerations involved in the selection of the stator material and, oftentimes, the mechanical considerations have placed an undue limitation on the electrical properties of the stator. Accordingly, a further object of this invention is to harmonize the electrical and mechanical considerations in stator design and selection of stator material so as to permit a choice of the stator material on the basis of the electrical considerations alone.

To achieve this latter object, it is contemplated to provide the stator with frequency tuning screw receiving means which include a plurality of inserts in the stator. The inserts are made of a readily threadable material and fit into molded apertures in the stator to provide an adequate anchoring media for the tuning screws without the necessity of performing any machining operations on the stator. In order to facilitate handling and assembly to the stator, the inserts are connected by a continuous band.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the embodiment shown in the drawings, in which:

FIG. 1 is a plan view of a tuner switch;

FIG. 2 is a plan view of the opposite side of a tuner switch;

FIG. 3 is a partial enlarged section view of the tuner switch taken generally along lines 3—3 of FIG. 1;

FIG. 4 is a plan view of the stator block;

FIG. 5 is an exploded perspective view of the rotor;

FIG. 6 is a perspective taken generally along lines 6—6 of FIG. 4;

FIG. 7 is a perspective view of one of the contact fingers;

FIG. 8 is a perspective view of one of the stator contact clips; and

FIG. 9 is a partial section through one of the inserts illustrating a tuning screw as assembled therein.

With particular reference to the drawings, a tuner switch 10 includes a stator block 12 of suitable dielectric material and a rotor assembly 14. As is perhaps most clearly illustrated in FIG. 4, the stator is a generally planar member having a centrally located aperture 16 extending therethrough and rotor assembly 14 is positioned in aperture 16 for rotation relative to the stator. The stator also includes a plurality of relatively spaced, radially disposed slots 18 extending through the stator and opening into aperture 16. An opening 20 is provided adjacent each of the slots 18, these openings being spaced radially from the slots 18 for a purpose which will be more fully described hereinafter. Slots 18 in stator 12 form a plurality of inwardly projecting portions 22 spaced around aperture 16 which (see FIG. 6) each include an integrally molded vertical rib 24. Ribs 24 each have a stepped inner portion defined by a horizontal shoulder 26 and a vertical edge 28 which, as will be more completely described hereinafter, provide a bearing for rotor assembly 14.

Slots 18 and their respective openings 20 cooperate in locating and attaching a plurality of contact fingers 30 to the stator. More particularly, each of the contact fingers includes a terminal portion 34 and a contact portion 36 and are positioned on the stator at the slots 18 with terminal portion 34 positioned in apertures 20 and with a wedge-shaped portion 38 of the contact portion positioned between adjacent ones of the ribs 24. Wedge-shaped portions 38 conform generally to the angular relationship of ribs 24 so that the contact fingers fit between and are held in position and against movement by the ribs. The contact portion 36 of the contact fingers also includes a pair of turned down tabs 40 and 42 which are arranged

to be positioned in the enlarged blind end 44 of each slot 18. With this arrangement, the contact fingers are assembled onto the stator by inserting terminal portions 34 in apertures 20 and locating contact portion 36 between adjacent pairs of ribs 24, tabs 40 and 42 are positioned in ends 44 of slots 18 and are deformed to rigidly grip the stator and hold the contact fingers in their assembled position. With this arrangement portions 32 extend into aperture 16 for engagement by the rotor clips as well be described more fully hereinafter.

Turning now to FIG. 5, the rotor assembly 14 preferably includes a one-piece dielectric rotor body 48 and a pair of rotor contacts 50 and 52. Non-circular projections 54 and 56 are formed at the axially opposed ends of the rotor body with a non-circular aperture 58 extending therethrough to receive a control shaft (not shown). Mounting holes 60 and 62 are formed in contacts 50 and 52 and have a shape conforming to that of the projections 54 and 56 so that they will fit over the projection and, when so positioned, the rotor contacts are held in position on the rotor body.

The rotor body is also provided with nibs 64 extending from one side thereof and nibs 66 extending from its opposite side. Nibs 64 are arranged to register with and fit into openings 68 in rotor contact 50 and nibs 66 are arranged for engagement in openings 70 in rotor contact 52. Nibs 64 and 66 cooperate in mounting the contacts on the rotor and, when the contacts are properly positioned on the rotor, a heat seal connection is made to fix the contacts in position. The heat seal connection is made by deforming nibs 64 and 66, in a manner well known in the art, to provide heads 67 which bear against and hold the rotor contacts to the rotor. The heat seal connection is preferred as it exceeds maximum environmental tuner requirements.

Tabs 72 and 74 are formed on rotor contacts 50 and 52 and are so arranged that, when the rotor contacts are mounted on the rotor body, they are positioned adjacent each other and can be electrically interconnected, for example by spot weld, or the electrical connection therebetween can be eliminated, if desired. Apertures 76 and 78 in rotor contacts 50 and 52 are provided to reduce the capacitance between the rotor contacts.

Rotor body 48 has, in axial cross section, a stepped configuration to provide a flange 80 extending outwardly of a body portion 82. In the assembled tuner switch the flange 80 of the rotor body rests on shoulder 26 of ribs 24 and engages edge 28 which holds the rotor body against radial movement so that it is confined for rotational movement in aperture 16 and relative to the stator. A plurality of stator clips 84 are connected to the contact fingers (see FIGS. 2 and 3) by a spot weld, or other suitable fused joint, which has the particular advantage of providing an adequate mechanical connection of low electrical resistance and one which is virtually insensitive to shock, vibration and heat and retains its desirable electrical characteristics for an indefinite period thereby increasing the useful life of the tuner switch.

To increase the versatility of the tuner switch, a construction which is adaptable to multi-level switching is preferred. More particularly, rotor contacts 50 and 52 include arcuate projections 83 and 86, respectively, and, with slots 18 having been provided in the stator, contact clips can be mounted on both sides of the contact fingers. Contact clips of different lengths are used and this construction can provide tri-level switching and is also adaptable to bi-level switching by eliminating clips of a given length. Contact clips 84 are of uniform length and one or more clips 84' can be used as desired and depending upon the particular application. Clips 84 and 84' are connected to the contact fingers on the same circumferential line, however, the length of clips 84 is such as to only engage projections 83 and 86 of the rotor contacts and the circuits controlled thereby can thus be opened and closed whereas clips 84' will extend beyond these projections for continuous engagement with the rotor contacts. A rotor contact clip 90 is connected to rotor contact 52, or to contact 50 if desired, by a spot weld 91 and, as part of the rotor assembly, is movable into selective engagement with portions 32 of the contact fingers. The particular switch structure described lends itself particularly well to automated procedures, e.g. the connection of the contact fingers along the same circumferential line, and still provide a highly versatile construction. The illustrated arrangement of clips 84 and 84' is merely given by way of example and the clips, long and short, can be positioned on either side of the contact fingers, in any number and in any arrangement as dictated by the particular application.

FIG. 8 illustrates the preferred configuration of the stator clips. One of the shorter stator clips 84 is illustrated, however, it will be appreciated that the configuration of the longer clips is identical as is the configuration of rotor clip 90. Stator clips 84 are preferably formed from a single metallic member which is stamped to provideded contact ends 102 and 104 and is then bent back on itself to align the contact ends with each other and to form a bowed leg 106 and a leg 108 which is angled toward contact 102. Contact ends 102 and 104 are biased toward engagement with each other by the inherent resiliency of legs 106 and 108 and when the clips, 84 and 84', are connected in the tuner, they are arranged to receive respective ones of the rotor contacts 50 and 52 between their contact ends 102 and 104 and rotor clip 90 has its contact end arranged to receive the contact fingers therebetween. This particular clip configuration is preferred since it provides optimum contact pressure and low contact resistance.

In the fabrication and assembly of the tuner switch of this invention, the contact fingers are stamped from a single sheet of material to provide individual contact fingers 30. However, until assembly the fingers are held together at their center for ease of handling, after assembly the central connecting section is cut away. A number of the contact fingers are interconnected by an arcuate inductive segment 110 (see FIG. 1) which is included to provide a measure of frequency tuning during manufacture. The contact fingers and the inductive segment are assembled onto the stator block as was described above. Rotor contact 50 is positioned on rotor body 48 and the rotor assembly assembled to this point is positioned in aperture 16. Rotor contact 52, with contact clip 90 attached thereto is positioned on the rotor body with contact clip 90 arranged for selective engagement with the contact fingers. To permit assembly, the inner end of one of the contact fingers is removed to provide clearance for clip 90. A heat seal connection is then made by deforming nibs 64 and 66 to provide heads 67 to hold the rotor contacts assembled on the rotor body. At this point the clips 84 and 84' can be spot welded to either one or both sides of the contact fingers and in any desired number and arrangement.

As was mentioned above inductive segment 110 provides for some degree of frequency adjustment at the factory whereby the switch is roughly adjusted in accordance with its ultimate application. To provide for fine frequency tuning adjustment, it is common practice to provide a number of frequency tuning screws which can be threaded into and out of the stator block. This has presented problems in the past in that many dielectric materials which possess the desirable electrical properties for use in the stator are not readily machinable and cannot be threaded to accept the frequency screws. Hence, in the past the mechanical requirements of the stator block have placed a limitation on the electrical characteristics thereof. To solve this problem it is proposed to provide a ring 112 which includes a number of hollow inserts 114 which fit into apertures 116 provided in the stator block and located one adjacent each of the contact fingers. For ease of assembly, inserts 114 are preferably interconnected by an annular ring 118 which fits into an annular notch 120 in the stator connecting the

aperture 116. With this arrangement ring 112 can be positioned in the stator 12 with hollow inserts 114 arranged in respective ones of the apertures. Frequency tuning screw 115 can be threaded into the insert (see FIG. 9) and in so doing expand the insert against the walls of apertures 116 to firmly hold the inserts in place and anchor the tuning screws on the stator without requiring any pre-tapping of the inserts to receive the screws. The material of stator 12 can be selected with only the electrical characteristics in mind and the frequency tuning screws can still be provided since the stator can be molded with apertures 116 therein and inserts 114 used in the apertures for receipt of the frequency tuning screws.

As will be evident from FIG. 3 the versatility of this particular tuner switch construction is increased in that, if desired, the rotor contact 50 can be eliminated and the rotor assembly 14 will still be held in position through the combination of rotor flange 80 and rotor contact 52. Furthermore, by using a combination of contact fingers 30 and clips 84 and 84' a switch construction is provided which is readily assembled with the use of automated machinery and procedures and which still provides a wide variety of possible switching configurations; the connections used in assembling the switch exceed the maximum environmental requirements of the tuner.

Although this invention has been illustrated and described in connection with particular embodiments thereof, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What we claim is:

1. Switch apparatus comprising, in combination, a stator of di-electric material having an aperture therethrough, a plurality of contact fingers mounted on said stator in relative spaced relation, a rotor assembly supported in said aperture for movement relative to said stator, said rotor assembly comprising a body portion and a first contact member connected to said body portion, said body portion including a radially extending portion engaging said stator to prevent axial movement of said body in one direction relative to said stator and said first contact member spaced axially from said radial portion and engaging said stator to prevent axial movement of said body portion in an opposite direction, and a plurality of first contact clips mounted on said contact fingers and arranged in the path of movement of said first contact member for selected engagement therewith.

2. The switch apparatus of claim 1 including a second contact member mounted on said body in axial spaced relation from said first contact member and wherein said contact fingers are arranged intermediate said first and second contact members, and contact clips connected to at least one of said opposite sides thereof for selective engagement with said first and second contact members.

3. The switch apparatus of claim 2 including a second contact clip connected to and movable with said first contact member, said contact fingers arranged in the path of movement of said contact clip for selective engagement with said contact fingers.

4. The switch apparatus of claim 3 wherein each of said contact clips includes first and second contact portions biased toward engagement with each other and arranged to receive respective ones of said first and second contact members and said contact fingers therebetween for engagement therewith.

5. The switch apparatus of claim 2 wherein said first and second contact members include a body portion and an arcuate portion forming a radial extension of said body portion, the points of connection of said contact clips to said contact fingers being aligned on a common circumference and at least one of the contact clips on the contact fingers being longer than the others, said one contact clip continuously engaging said body portion and said other contact clips arranged for selective engagement with said arcuate portion.

6. The combination of claim 5 wherein said stator includes means for receiving frequency tuning members comprising a plurality of apertures in said stator and a deformable insert positioned in each of said apertures.

7. A tuner switch comprising, in combination, a stator of dielectric material having an aperture therethrough, a plurality of relatively spaced radially disposed slots in said stator opening into said aperture, contact fingers fixed on said stator at said slots and extending into said aperture whereby opposite sides of said contact fingers are exposed, a rotor assembly supported in said aperture for rotation relative to said stator, said rotor assembly including a rotor body and a pair of planar rotor contacts fixed in axial spaced relationship on said rotor body, stator contact clips electrically and mechanically connected to said contact fingers, said contact fingers arranged intermediate said rotor contacts, and contact clips connected to at least one of said exposed sides thereof for selective engagement with said rotor contacts, and a rotor contact clip electrically connected to at least one of said planar contacts for rotation with said rotor body and arranged for selective engagement with said contact fingers.

8. The tuner switch of claim 7 wherein said contact clips are connected to said contact fingers by a weld joint.

9. The tuner switch of claim 8 wherein said rotor contacts include a body portion and an arcuate portion extending radially from said body portion and wherein said weld joints are arranged in alignment relative to said stator and at least one of said contact clips being longer than the other to continuously engage said body portion with the other contact clips arranged for selective engagement with said arcuate portion.

10. The tuner switch of claim 7 including deformable hollow members, means mounting said deformable members on said stator for receiving frequency tuning screws, frequency tuning screws disposed in and having a threaded engagement with said hollow members.

11. The tuner switch of claim 7 wherein said stator includes a shoulder adjacent to and extending around the periphery of said aperture and said rotor includes a radial flange portion arranged for engagement with said shoulder so that said shoulder provides a bearing surface for and prevents axial movement of said rotor assembly in one direction, and one of said rotor contacts engages said stator to hold said rotor assembly against axial movement in an opposite direction.

12. The tuner switch of claim 11 wherein said shoulder is defined by a plurality of ribs projecting from said stator and each positioned between an adjacent pair of said radial slots, said ribs having a stepped configuration at the inner ends thereof for engagement with said radial flange on said rotor.

13. A tuner switch comprising, in combination, a stator or dielectric material having an aperture therethrough, a plurality of relatively spaced radially disposed slots in said stator opening into said aperture, contact fingers fixed on said stator at said slots and extending into said aperture whereby opposite sides of said contact fingers are exposed, a rotor assembly supported in said aperture for rotation relative to the stator, said rotor assembly comprising a rotor body and a pair of planar contact members connected in axial spaced relationship on said rotor body, stator contact clips electrically and mechanically connected to opposite sides of said contact fingers by a fused connection, and a rotor contact clip electrically connected to at least one of said planar contact members by a fused connection and said contact fingers arranged in the path of movement of said rotor contact clip for selective engagement therewith.

14. A tuner switch comprising, in combination, a stator of dielectric material characterized by an aperture therethrough, a plurality of relatively spaced radially disposed

slots in said stator opening into said aperture, contact fingers fixed on said stator at said slots whereby opposite sides of said contact fingers are exposed, a rotor assembly supported in said aperture for rotation therein relative to said stator, said rotor assembly comprising a rotor body and a pair of planar contact members connected in axial spaced relationship on said rotor body with said contact fingers, positioned therebetween, said planar contact members including a central body and a radial extension, stator contact clips electrically and mechanically connected to opposite sides of said contact fingers, a rotor contact clip electrically connected to at least one of said planar contact members and rotatable with said rotor body, each of said contact clips characterized by first and second arms biased toward engagement with each other and arranged so that respective ones of said planar contact members and said contact fingers are receivable therebetween, the stator contact clips connected to said contact fingers along a common circumferential line and arranged in the path of movement of said planar contact radial extension for engagement therewith, at least one of said stator contact clips being longer than the other and arranged to continuously engage the planar contact body.

15. In a tuner switch including a stator, a member movable relative to said stator, and contacts on said stator and said movable member arranged for selective engagement therebetween upon relative movement between said stator and said movable member; the combination of means for receiving frequency tuning screws including a plurality of apertures in said stator, deformable insert means positioned in each of said apertures, and frequency

tuning members engaged in and movable with respect to said insert means, said tuning members compressing said insert means between said tuning members and the walls defining said stator apertures to hold said tuning members in a selected position relative to said stator.

16. The combination of claim **15** wherein said apertures are connected by a generally annular notch in said stator and said insert means are connected by a generally annular ring positioned in said notch.

17. The combination of claim **16** wherein said tuning members are in the form of screws having a threaded engagement with said insert means.

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