April 15, 1969 H. D. STEINBACK 3,439,298

RADIO FREQUENCY SHIELDED SWITCH

Filed Sept. 2, 1966

FIG. 1

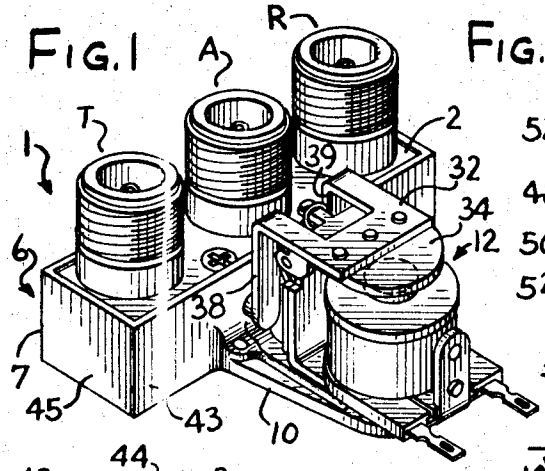


FIG. 4

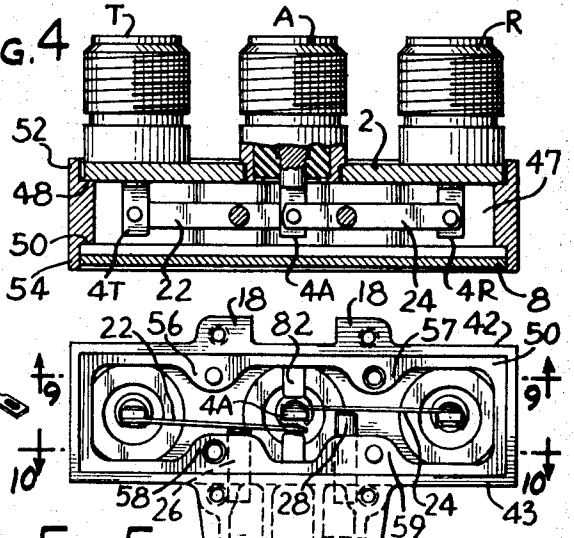


FIG. 2

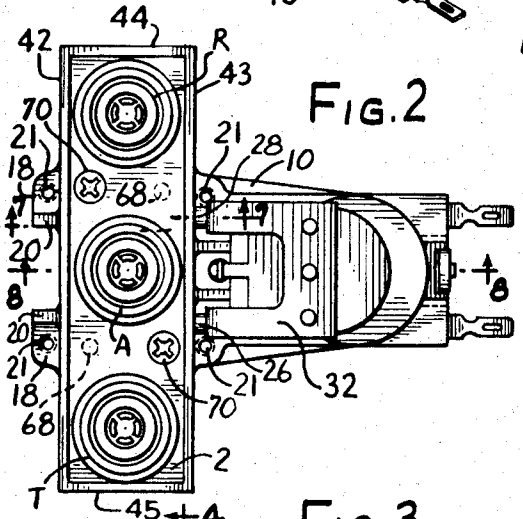


FIG. 5

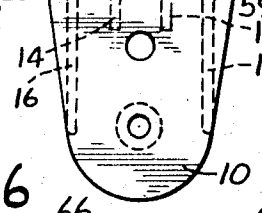


FIG. 6

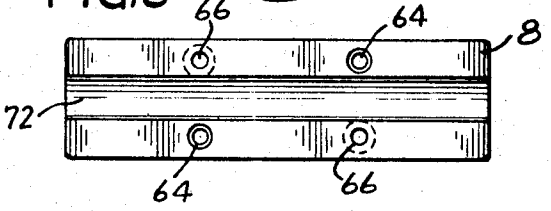


FIG. 3

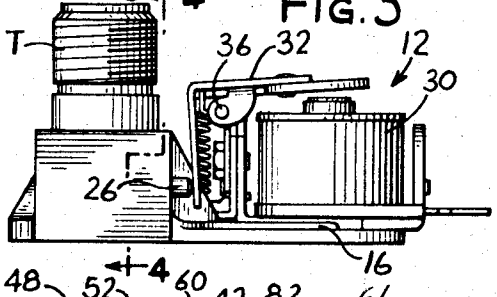


FIG. 7

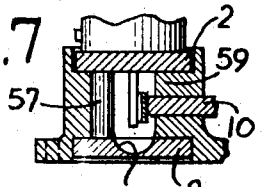


FIG. 8

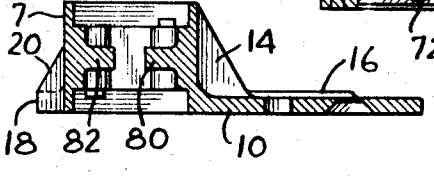


FIG. 9

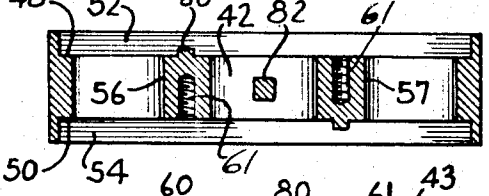
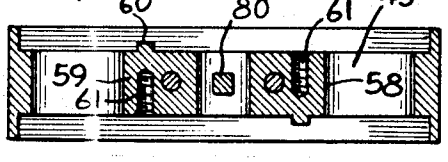


FIG. 10



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RADIO FREQUENCY SHIELDED SWITCH

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Continuation-in-part of application Ser. No. 502,680, Oct. 22, 1965. This application Sept. 2, 1966, Ser. No. 576,936

Int. Cl. H01h *53/02, 36/00*

U.S. Cl. 335—5 5 Claims

ABSTRACT OF THE DISCLOSURE

A radio frequency shielded switch wherein coaxially shielded connectors are mounted on a switch housing the walls of which approximate a continuance of the connector conductors and at least one longitudinal wall has a central groove that extends lengthwise thereof and lengthwise of the switch blade when the blade is in one of its two alternate positions, and the groove spans the chamber intermediate the length thereof.

This invention is a continuation-in-part of my copending application Ser. No. 502,680, filed Oct. 22, 1965, and relates to relay switches for switching connections with radio frequency coaxial lines. In its more specific aspects this invention is concerned with the housing structures for switches of the above character.

In radio-frequency switches the switch blade should be maintained in a position with respect to the surrounding housing to approximate a coaxial cable effect of the housing with respect to the blade. It is one of the objects of this invention to provide a superior housing for producing a close approximation of this effect.

It is a further object of this invention to provide a structure wherein the support for the switch is combined as one piece with the housing. This is preferably a one-piece die-cast unit and, by reason of the fact that it is one piece, it reduces the possibility of the motor mechanism coming out of adjustment with respect to the switch blade or blades actuated thereby.

It is a still further object of this invention to provide a housing constructed to reduce radio frequency losses through the housing, such as would result if there was a possibility for a straight-line high frequency leakage path through the housing. To accomplish this result, the closure for the switch cavity within which the switch blades are located is nested, with respect to the housing, in such a manner as to minimize straight-line radio frequency leakage paths.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

FIG. 1 is an isometric view of a switch embodying the present invention;

FIG. 2 is a plan view of FIG. 1;

FIG. 3 is a side view of the switch;

FIG. 4 is a sectional view taken along line **4—4** of FIG. 3;

FIG. 5 is a bottom plan view of the switch, with the bottom cover removed;

FIG. 6 is a top plan view of the bottom cover of the switch housing;

FIG. 7 is a sectional view taken along line **7—7** of FIG. 2;

FIG. 8 is a sectional view of the switch housing taken along line **8—8** of FIG. 2;

FIG. 9 is a sectional view of the switch housing taken along line **9—9** of FIG. 5; and

FIG. 10 is a sectional view of the switch housing taken along line **10—10** of FIG. 5.

Reference may now be made more particularly to the drawing wherein like reference numerals designate like parts throughout.

A switch embodying the present invention, indicated in general by the reference numeral **1**, is adapted for making and breaking connections selectively between a coaxial connector A and either a coaxial connector T or a coaxial connector R. A, T and R are respectively connected to an antenna, a transmitter and a receiver, the three connectors being of identical construction and each including a central conductor insulated from, and surrounded by, a metallic sheath. The three sheaths are mounted in alignment on a top electrically conductive cover plate **2**. The manner of mounting the coaxial connectors on the plate is more fully illustrated in my copending patent application 502,680 to which reference may be made. It is sufficient here to state that in each connector the conducting sheath fits snugly into a hole in the top plate and is silver soldered in electrical connection therewith, and that the respective connectors terminate in flat terminals **4T**, **4A** and **4R**. These terminals are in an electrically conducting non-magnetic housing **6** that includes a rectangular housing frame **7** which is a die casting having an open top and an open bottom adapted to be closed respectively by the top cover plate **2** and by the bottom cover plate **8**. The frame **7** includes a mounting flange **10** on which is mounted on a relay motor magnet **12** for actuating the switch, as will be hereinafter explained. The flange **10** is stiffened by gussets **14—14** and ribs **16—16**. This flange, together with a pair of flanges **18—18** that are reinforced by gussets **20—20**, constitutes a mounting plate that is integral with the switch housing **6** for mounting the switch housing in place by means of bolts the shanks of which pass through holes **21**. The combination of housing and mounting plate as an integral structure reduces the tolerance and built-up of mating parts, resulting in better relay adjustment.

Flexible switch springs **22** and **24** are riveted at one of their ends to the terminals 4T and 4R respectively, and at their opposite ends in their alternate positions they engage and disengage with the opposite sides of the terminal 4A. The switch blade **22** is spring-biased to a position out of contact with the terminal 4A. The switch blade **24** is spring-biased into engagement with the terminal 4A. The blades are moved to their alternate position from that shown in FIG. **5** by a pair of slidable pins **26**, **28** that are moved simultaneously from the position shown in FIG. 5 to an alternate position extending a short distance further into the housing, upon actuation of the relay motor mechanism **12**. The relay motor mechanism **12** includes an operating electromagnet **30** having an L-shaped heel piece **32** that has a magnetic armature **34**, which is pivoted to swing about a pin **36**, being biased to the position shown in FIG. 3 by a coil spring and being moved from that position clockwise upon energization of the magnet coil **30**. This is a conventional relay actuator. The heel piece has two depending arms **38**, **39** that bear respectively against the pins **26**, **28**. The pins are maintained in position against the arms **38**, **39** by the spring bias of the switch blades **22**, **24** and are moved to their alternate position upon energization of the relay motor **10** to move the switch blades to their alternate position.

Further description will now be given of the shape of the switch cavity in the housing **6**.

The frame **7** includes a pair of longitudinal confronting walls **42**, **43** joined by a pair of transverse walls **44**, **45**. The inner surfaces of the longitudinally extending confronting walls 42, 43, together with the inner surfaces of the top and bottom cover plates **2** and **8**, which also constitute longitudinally extending confronting walls, de-

fine a chamber **47** which is in effect two chambers, one for the switch blade **22** and one for the switch blade **24**, the terminal **4A** being at the juncture of the two chambers. A shoulder **48** extends around the perimeter of the top of the chamber and a similar shoulder **50** extends around the perimeter of the bottom of the chamber, the four peripheral walls of the chamber extending above the shoulder **48**, as indicated at **52**, and below the shoulder **50**, as indicated at **54**. These form a pocket for receiving the top cover plate **2** and a similar pocket for receiving the bottom cover plate **8**, so that the high frequency leakage paths are not straight lines from the interior of the chamber through the junctures between the cover plates and frame **7**. The wall **42** has two inward protuberances **56**, **57** aligned with similar, but not identical, protuberances **58**, **59** formed in the wall **43**. The inner surfaces of the walls **42**, **43** are substantially free of sharp corners, and they join the inner surfaces of the walls **44**, **45** along smooth curves. The pins **26**, **28** are slidable through bores in the protuberances **58**, **59**. Between the four protuberances there is a wide space to permit inspection and adjustment of the terminal at the center of the housing, likewise betwen the protuberances and the respective transverse walls **44**, **45** the chamber is enlarged to permit access for inspection and adjustment of the terminals of T and of R. Each of the protuberances is provided at one end with a centering dowel **60** and at the opposite end with a threaded bore **61**. The centering dowels are at diagonally opposite protuberances at the top surface, and at the opposite diagonals at the bottom of the protuberances. The top side of the bottom cover plate **8** has a pair of countersunk circular bores **64—64** that extend only part way therethrough and into which the bottom centering pins **60** on the surface **50** fit snugly, and a pair of countersunk holes **66—66** for receiving screws that thread into the threaded bores **61**, thus fastening and aligning the cover **8** with the frame **7**. The top plate **2** has two similar countersunk bores **68—68** extending part way into the plate from the bottom thereof and into which the top pins **60** fit snugly, and has two countersunk holes **70—70** through which the shanks of the screws pass and thread into the threaded bores **61**. These accurately center and hold the top plate **2** and the bottom plate **8** with respect to the frame **7**. The bottom plate **8** has an arcuate trough **72** centered along the top surface thereof and extending longitudinally from end to end, as may be seen in FIGS. 6 and 7. The longitudinal axis of this trough is in the plane determined by the parallel longitudinal axes of the terminals T, A and R.

In the switch shown, the blade **24** is in its switch-closed position where it connects the terminal **4R** with the terminal **4A**, and the switch blade **22** is in its open position where it does not connect with the terminal **4A**. Instead, the free end of the blade **22** is grounded by engagement with a protuberance **80**, which is an integral part of the wall **43** and in a position to be engaged by the switch blade **22** when that blade is in its switch-opened position. A similar protuberance **82** is provided for engaging the free end of the switch blade **24** when it moves out of contact with the terminal **4A**. The two protuberances **80**, **82** are rather narrow, as may be seen from FIGS. 9 and 10, and extend into the switching chamber towards the terminal **4A** and stop short of that terminal an amount sufficient for the necessary travel of the respective blades **22** and **24**. By reason of these protuberances, it is not necessary to have a large distance of travel of the switch blades from their open to their respective closed positions, and therefore the power required of the relay motor **12** is very small.

In some instances it is desired to ground only one, or neither, of the two switch blades **22**, **24** in their respective open positions (the position where they do not connect with the terminal **4A**). When this is the case, the corresponding one, or both, of the protuberances **80**, **82** is omitted. When it is desired to omit either or both of the

protuberances **80**, **82** so as not to ground the corresponding switch blade when it is in the open position, the protuberances may be mechanically removed from the casting, or the casting may be originally made without the corresponding one or both of the protuberances.

In one switch constructed in accordance with the present invention, the center-to-center distance between the axis of the inner conductor of the antenna coaxial connector A and the axes of the corresponding connectors T and R was in each instance $1\frac{5}{16}$" or a total distance of $1\frac{7}{8}$" between the axes of the inner conductors of the connectors T and R. In that switch, the length of the switching chamber, between the inner surfaces of the walls **44–45**, was 2.375". The distance between the shoulders **48–50** was 0.376". That switch was particularly adapted for use at frequencies of 1,000 megacycles per second and upward, the length of the switching chamber being appropriate for switching at those high frequencies. The effective switching length of each switch blade **22** or **24** is of the order of one inch, which is a small fraction (less than one fourth) of a half wave length of a radio wave of 1,000 megacycles per second.

It is within the purview of the present invention to provide a motor mechanism for the pins **26**, **28** wherein momentary energization moves the pins from the position shown to their alternate position, and a latch maintains them in their alternate position notwithstanding the deenergization of the motor magnet and wherein the switch blades therefore move to their alternate position upon release of the latch. This arrangement may be accomplished in any of a number of ways, one suitable way being that illustrated in my copending application Ser. No. 502,680, which is herein incorporated by reference.

It is to be understood that the present invention is not limited to the specific embodiment shown, the same being merely illustrative of the principles of the invention.

What is considered new and sought to be secured by Letters Patent is:

1. In an ultra-high-frequency switch including two coaxial connectors, each of which connectors has an inner conductor insulated from and surrounded by an outer conductor, the inner conductors terminating respectively in separate switch terminals, a switch blade having alternate positions for switching connections between the terminals, a shielding housing for the blade, said housing including a chamber in which the blade is located, each of said inner conductors extending into the chamber and said outer conductors being mounted on the housing, the chamber being defined by at least a first pair of confronting walls towards and from which the switch blade moves from one position to its alternate position, the distance between the confronting walls adjacent to an end of the blade being substantially greater than the distance between them intermediate that end of the blade, an actuating member for said blade extending through one of said walls at a portion thereof that is intermediate the ends of said blade, a mounting flange extending from said one wall, electromagnetic operating means mounted on said flange for operating said actuating member, said housing having a second pair of confronting walls extending between the first walls at opposite ends thereof and together therewith constituting lengthwise extending walls of said chamber, the inner surfaces of both pairs of confronting walls being conductive and electrically connected to the outer conductors of the connectors, one of said second pair of walls being releasably secured to the rest of the housing to permit removal thereof for inspection and adjustment of the switch, the inner surface of one of said second pair of walls having a central longitudinally extending arcuate groove therein, the groove substantially spanning the distance between the first-mentioned confronting walls at a portion of said first-mentioned confronting walls thereof which is intermediate the ends of the blade.

2. A combination as set forth in claim **1** wherein the first-mentioned pair of confronting walls constitutes longitudinal walls of the chamber that are joined at their ends

by transverse walls integral therewith and together constituting a rectangular unitary frame, the second pair of confronting walls constituting separate plates.

3. A combination as set forth in claim 2 wherein there is provided means for maintaining the plates and the frame in accurate alignment.

4. A switch as defined in claim 1 wherein the chamber constitutes two communicating sub-chambers, the inner conductor of one of the connectors being in one of the sub-chambers and the inner conductor of the other connector being at the junction of the two sub-chambers, a third coaxial connector having an inner conductor extending into the other sub-chamber, a second switch blade in the other sub-chamber movable between alternate positions for making and breaking switching connections between the inner conductor of the third connector and the inner conductor that is at the junction of the two sub-chambers, an actuating member for said second blade and means operated by said electromagnetic operating means for operating said second switch blade to the closed and open positions respectively in reverse relationship to the operation of the first switch blade.

5. In an ultra-high-frequency switch including two coaxial connectors, each of which connectors has an inner conductor insulated from and surrounded by an outer conductor, the inner conductors terminating respectively in separate switch terminals, a switch blade having alternate positions for switching connections between the terminals, a shielding housing for the blade, said housing including a chamber in which the blade is located, each

of said inner conductors extending into the chamber and said outer conductors being mounted on the housing, the chamber being defined by at least a first pair of confronting walls towards and from which the switch blade moves from one position to its alternate position, an actuating member for said blade extending through one of said walls, said housing having a second pair of confronting walls between the first walls at oppostie ends thereof and together therewith constituting lengthwise extending walls of said chamber, the inner surfaces of both pairs of confronting walls being conductive and electrically connected to the outer conductors of the connectors, the inner surface of one of said second pair of walls having a central longitudinally extending arcuate groove therein, the groove substantially spanning the distance between the first-mentioned confronting walls at a portion of said first-mentioned confronting walls thereof which is intermediate the ends of the blade.

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U.S. Cl. X.R.

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