Oct. 13, 1964 S. LAPIDUS ETAL 3,153,129

COAXIAL SWITCH

Filed Oct. 24, 1960 2 Sheets-Sheet 1

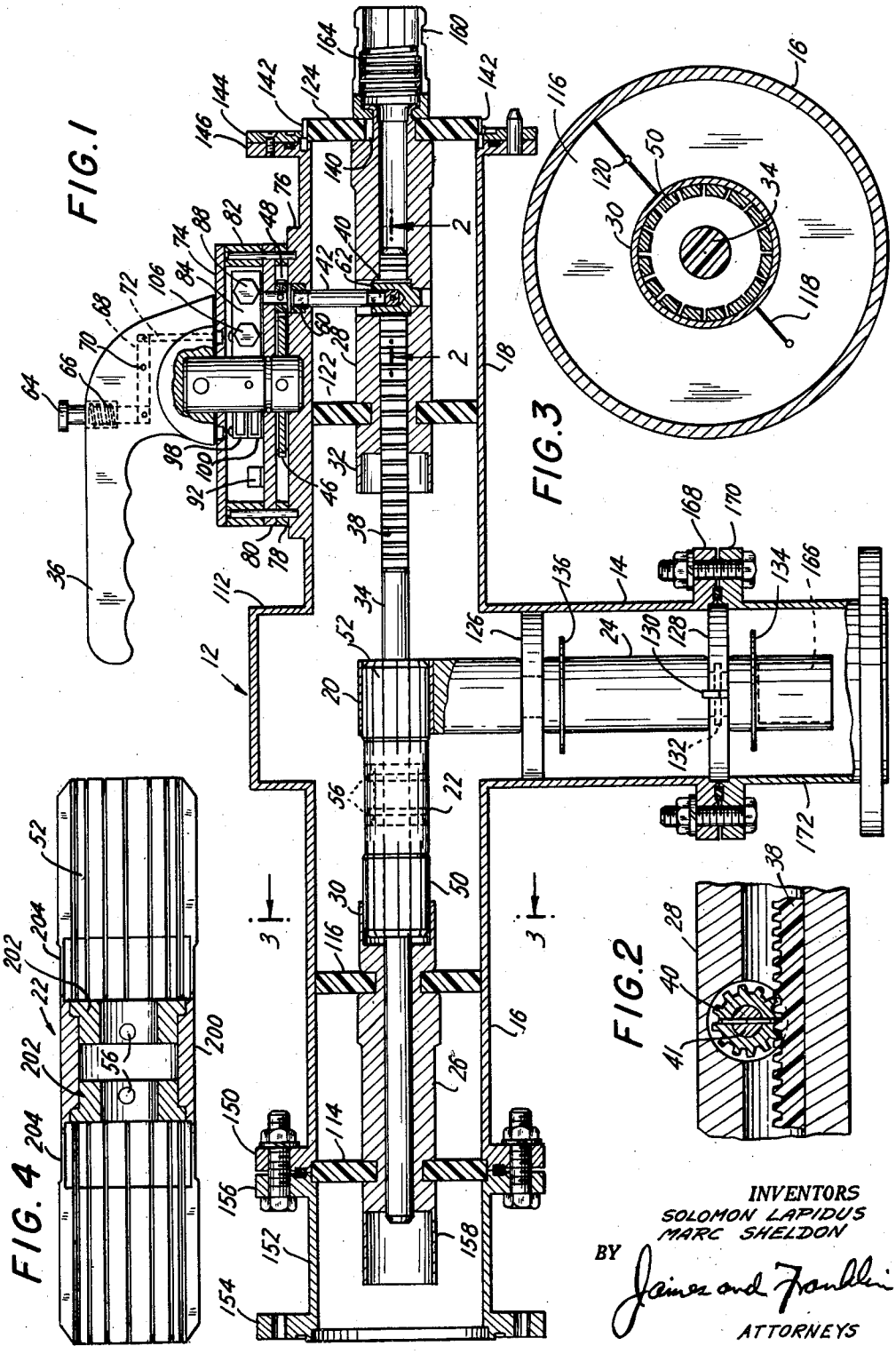


FIG. 1

FIG. 3

FIG. 2

FIG. 4

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COAXIAL SWITCH

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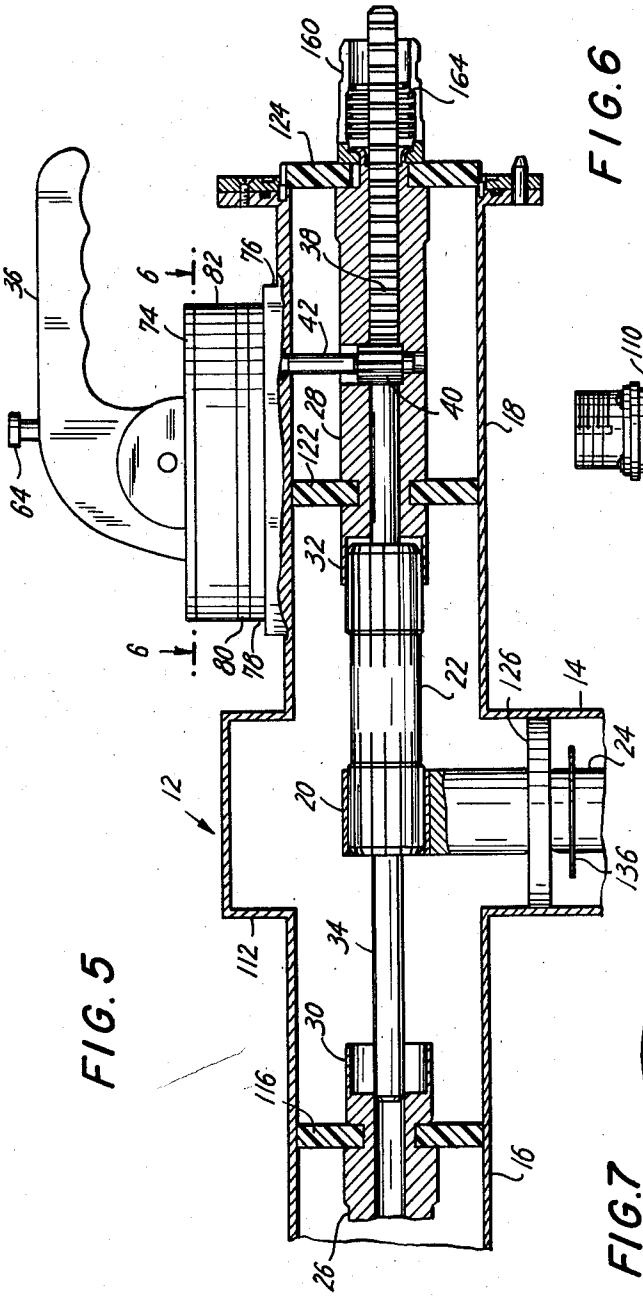


FIG. 5

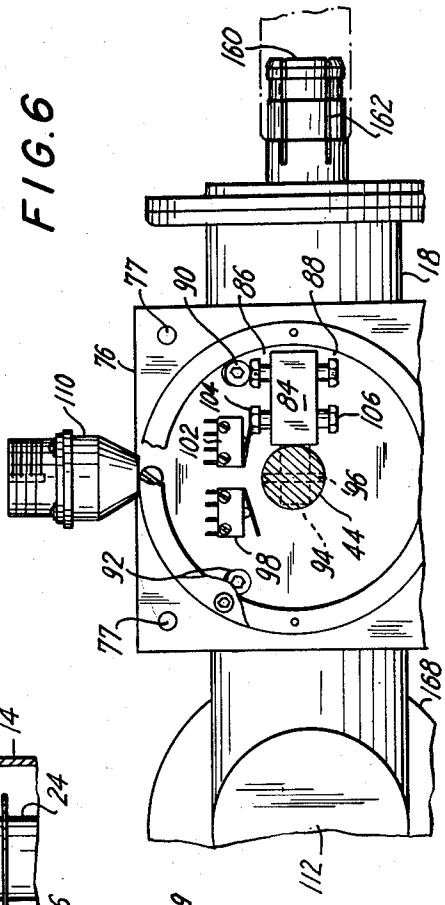


FIG. 6

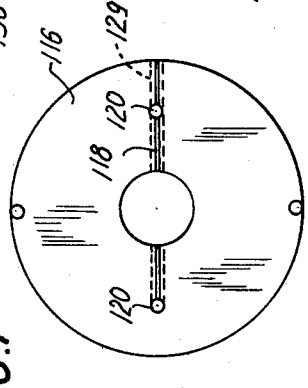


FIG. 7

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COAXIAL SWITCH

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18 Claims. (Cl. 200—153)

This invention relates to electrical switches for high frequency power, and more particularly to a three-port coaxial switch.

The general object of the invention is to improve coaxial switches, especially T-type coaxial switches for handling a large amount of power.

A more particular object is to provide improved control mechanism for operating such a switch. A still more specific object is to provide a manually operable handle which turns a half revolution and which is so mounted that it points in the direction of the branch of the switch which has been connected or made operable.

Still another object is to provide operating mechanism which is compact, and much of which is housed inside the coaxial conductors, without affecting their electrical characteristics.

The switch is of the T-type and includes a slidable element which is moved axially toward one branch or the opposite branch of the T. One object of the invention is to provide an improved slidable element which affords a snug fit and good electrical contact over long periods of use.

Still another object is to provide a switch which handles high power efficiently over a relatively wide frequency range, with a small VSWR (voltage standing wave ratio), and which provides good isolation.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, our invention resides in the coaxial switch elements and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings in which:

FIG. 1 is a section through a coaxial switch of the T-type, embodying features of our invention;

FIG. 2 is a fragmentary view explanatory of a detail;

FIG. 3 is a section taken approximately in the plane of the line 3—3 of FIG. 1;

FIG. 4 is a section through the slidable element;

FIG. 5 is an incomplete section similar to FIG. 1 but showing the switch shifted to the right instead of the left branch;

FIG. 6 is a partial plan view taken in the plane of the line 5—5 of FIG. 4, and drawn to reduced scale; and

FIG. 7 shows an insulation bead for supporting the inner conductor.

Referring to the drawing, the coaxial switch comprises a T-shaped housing 12 providing the hollow outer conductor 14 of the stem or common portion, and the hollow outer conductors 16 and 18 of the two aligned branches of the switch. In preferred form these outer conductors are cylindrical.

There is a common inner conductor 24 running through the outer conductor 14, and terminating at its inner end in a ring 20 which is coaxial of the branches 16 and 18. There is an inner conductor element 22 which is slidable through the ring 20. The branch 16 has a stationary inner conductor 26, and the branch 18 has a stationary inner conductor 28. As usual, the inner conductors are preferably cylindrical and coaxial with the outer conductors.

The inner end 30 of conductor 26 and the inner end 32 of conductor 28 are located at a spacing from the common conductor or ring 20 approximating the length

of the slidable element 22, so that the latter may be used to connect the common inner conductor 24 to one or the other of the branch inner conductors 26 and 28. In FIG. 1 the slidable element 22 is in its left position, and connects the common conductor 24 to the branch conductor 26, while the other branch conductor 28 is isolated. In FIG .5 the slidable element 22 is in its right position, and connects the common inner conductor 24 to the branch inner conductor 28, while the other branch inner conductor 26 is isolated.

An insulation rod 34 extends through the aligned inner conductors 26 and 28 and the slidable element 22. This rod 34 is secured to the slidable element 22, but it is freely slidable in the stationary inner conductors 26 and 28. Thus the rod 34 may be used to move the element 22 between its left hand and right hand positions.

For this purpose the switch in the present case is provided with a handle 36 which is operatively connected to the rod 34. More specifically, a part of the rod has gear teeth to form a rack 38. A small diameter gear 40 is housed in one of the branch inner conductors, in this case the conductor 28, and meshes with the rack 38. An insulation shaft 42 extends from the gear to a point outside the housing for rotation by the handle 36.

Referring to FIG. 1, handle 36 is connected through a shaft 44 to a gear 46. This meshes with a pinion 48 operatively connected to the outer end of shaft 42. The step-up gear ratio between gear 46 and pinion 48 is so selected that the slidable element 22 is moved all the way to one or the other branch conductor by a half turn of the handle 36. Moreover, in preferred form the handle 36 is so mounted that it points in the direction of one branch or the other, and specifically to that branch which has been connected or made operative. In FIG. 1 handle 36 points to the left, and slidable element 22 has been moved to the left. In FIG. 4 handle 36 points to the right, and slidable element 22 has been moved to the right.

The slidable element 22 is a hollow cylinder. It is made of a resilient conductive material, and in the present case it is made of heat treated beryllium copper, which preferably is plated with a hard chromium-plate finish. The end portions 50 and 52 are relatively thin walled and longitudinally slotted to make the same resiliently yieldable. The parts 30 and 32 of the stationary inner conductors constitute cylindrical seats which slidably receive the end 50 or 52 respectively. The ring 20 slidably receives either end 50 or 52 of the slidable element. When, as in the present case, the midportion is rigid or non-yieldable, it is preferably somewhat smaller in diameter than the end portions 50 and 52, so that it will readily slide through the ring 20. However the seats 30 and 32 and the ring 20 are dimensioned to receive the slotted parts of the element 22 with a snug fit which provides a good electrical contact.

The rigid or non-slotted center portion of element 22 receives bushings which are internally dimensioned to receive the insulation rod 34, and it is secured thereto by means of transverse dowel pins 56.

It will be observed that the ends of the slidable element are beveled to facilitate entering the seats. Of course the seats may be beveled instead of the element, and if desired, the seats could be made of smaller diameter with the sliding element received around the outside of the seat instead of inside the seat, in which case the bevels would be in opposite direction. The present internal or hollow seats are preferred because they correspond better to the hollow cylindrical ring 20. With the present arrangement the slidable element always yields in compression, that is, by contraction, instead of being expanded in one position and contracted in the other, as

would be the case if the seats were received inside the slidable element.

The insulation shaft 42 preferably has flats at both ends. The flats 60 at the outer end preferably are perpendicular to the flats 62 at the inner end, and these flats are received slidably between mating flats, and thereby serve to transmit torque to the shaft at the flats 60, and from the shaft to the rack gear 40 at the flats 62. This arrangement has the advantage that the flats function somewhat as universal joints, and thereby accommodate any slight misalignment of the shaft.

Considering some features of the switch in greater detail, the handle 36 may be a standard handle available for purchase in the commercial market. That here shown is made by Barkelew Electric Manufacturing Co. of Middletown, Ohio.

The handle has a depressible thumb button 64 which may be depressed against a compression spring 66. It is connected to a lever 68 pivoted at 70, and the opposite end of which is connected to a lock pin 72. The end of this may be received in either of two diametrically related holes in a cover plate 74, thus anchoring the handle in one end position or the other.

The switch housing 12 as cast, preferably includes an integral platform 76 on which the operating mechanism is mounted. This platform may be square or rectangular in configuration, to provide mounting holes for the switch, shown at 77 in FIG. 6. It receives a lower spacer 78 and a mounting plate 80 (FIGS. 1 and 5) which may be circular in outline. The gear 46 and pinion 48 are received between the platform 76 and the mounting plate 80. The latter supports another and wider spacer 82, and the cover plate 74, which again preferably are circular in outline. The superposed parts 78, 80, 82, and 74 are secured together by appropriate screws, but the section of FIG. 1 happens to pass through locating dowels rather than screws.

The handleshaft 44 passes through cover plate 74 and mounting plate 80, and its lower end is received in a blind bearing hole in the platform 76. The space between mounting plate 80 and cover plate 74 is used to house stops, and also microswitches forming an accessory part of the switch.

Referring to FIG. 6, the shaft 44 carries an arm 84. This has independently adjustable stop screws 86 and 88. Screw 86 bears against a fiixed stop 90 when the switch is in the position shown in FIGS 1 and 6, and the screw 88 bears against a similar fixed stop 92 when the arm 84 has been turned 180 degrees, or is in the position shown in FIG. 5. One end 94 of arm 84 is reduced in dimension and passes diametrically through a mating hole in shaft 44. It is keyed in position by a pin 96.

It is frequently desired to interlock the switch with other mechanism, and to indicate its position on appropriate pilot lamps or indicators. For this purpose the present switch carries four precision switches or so-called microswitches. In FIG. 1 there are two such switches superposed at 98 and 100. On referring to FIG. 6, it will be seen that there are another two such switches at 102, the lower switch being concealed by the upper switch. Each switch has an operating pin engaged by a feeler or tab, as is usual with such switches.

The arm 84 has a pair of opposed, independently adjustable screws 104 and 106. The head of the screw 106 is large enough to simultaneously engage the tabs of the superposed switches 98 and 100, and similarly the head of screw 104 is large enough to simultaneously engage the tabs of the superposed switches at 102. It will be understood that the number of switches may be varied, depending on the needs in any particular case. The wiring from the switches may be led to a multiple pin detachable connector, the female element of which is located in a fitting or holder 110, which is secured to the upper spacer 82 previously referred to.

The cast body 12 of the switch preferably includes a closed cylindrical portion 112. This is a matching stub, and is appropriately dimensioned for that purpose.

Inner conductor 26 is located within outer conductor 16 by insulation discs or so-called "beads" 114 and 116. These may be made of Teflon. They are received in mating annular channels in the inner conductor, and to permit assembly, the beads are slit as shown at 118, 120 in FIG. 7. The material is flexible enough to permit opening of the split disc to be received over the necked portion of the inner conductor.

Similarly, the inner conductor 28 is supported by insulation beads 122 and 124, and the inner conductor 24 is supported by insulation beads 126 and 128. In the case of conductor 24, it is important to orient the same properly so that the axis of ring 20 will remain aligned with the branches. For this purpose the outer periphery of bead 128 is keyed to the housing at 130, and inner conductor 24 is keyed to the bead 128 by means of a diametrical pin 132 (FIG. 1) received in a hole 129 (FIG. 7).

The inner conductor carries metal discs 134 and 136 which are brazed to the inner conductor. They are matching rings to help match the impedance of the common part 14, 24 to the impedance of a standard coaxial line.

It also is important that the inner conductor 28 be properly oriented with respect to the branch 18, and for this purpose the bead 124 is keyed at 140 to the inner conductor 28, and the periphery of the bead is keyed at 142 to a flange plate 144 secured to flange 146 forming a part of the housing.

The particular switch here shown is for use with coaxial line or plumbing of large dimension, specifically standard 3⅛ inch coaxial line. The connections are standard E.I.A. flange connections. The branch 16 has an integral flange 150 which receives a body extension 152 having flanges 154 and 156. This extension is employed because the inner structure 26 terminates in a female socket 158, which is housed within the body.

At the end of the other branch the conductor 28 terminates in a male end 160, or so-called "bullet." This has longitudinal slots, as will be seen at 162 in FIG. 6. The bullet is somewhat resilient, but is made of brass instead of beryllium copper like the slide 22, and it is reinforced by an internal helical spring 164 (FIG. 1). No body extension is used, because the bullet projects from the body.

The common inner conductor 24 is here shown terminating in a female socket 166 (FIG. 1). The body has a flange 168 which receives the flange 170 of a body extension 172 like the body extension 152. Thus the socket 166 is housed within the body. It will be understood that either a male bullet or a female socket may be provided at any of the three ports, as may be needed for any particular installation. Whenever a female socket is provided the body extension is added. In this way one cast body serves for any combination of male and female connections.

Referring to FIG. 4, the slidable element 22 has an unslotted center portion 200 which is somewhat thicker than the remainder of the element. This portion receives a pair of stepped bushings 202 having inner diameter dimensioned to receive the insulation rod 34. The rod is secured in position by diametrical pins at 56. The end portions are slit as far as the middle portion 200, and a zone at 204 adjacent the thickened middle portion 200 is preferably thinned somewhat, thereby increasing the yieldability of the end or contact portions of the slidable element. The diameter of the midportion 200 is somewhat less than that of the end portions, and this reduced diameter is preferably carried through the zone 204 on each side of the midportion 200.

In the specific case here shown the slidable element 22 has 16 slots uniformly distributed around its periphery, as shown in FIG. 3. Each slot is 0.032 inch wide.

The cylindrical ring 20 is longer than the depth of the seats 30 and 32. There is accordingly more surface con-

tact at 20 than at either 30 or 32. To maintain uniform electrical contact, the diameter of seats 30 and 32 is somewhat less than that of the ring 20, so that there is somewhat greater contact pressure where the area is less, thus compensating for the reduced contact area.

The rod 34 is made of insulation, preferably Teflon. The rack gear 40 may be made of metal, preferably stainless steel. It has an adapter 41 (FIG. 2) with flats at 62 (FIG. 1). The insulation shaft 42 is made of an insulation material of sufficient strength. Pinion 48 (FIG. 1) is received on the small end of a coupler, the larger end of which has a flattened hole or socket which receives the flats 60 of shaft 42. In the particular switch here shown the gear ratio between gear 46 and pinion 48 is six to one, so that a half revolution of handle 36 turns the insulation shaft 42 three revolutions. The diameter of rack gear 40 is so selected that these three revolutions move the rack and the slidable element 22 all the way from one end position to the opposite end position.

The diameter of rack gear 40 is preferably kept small so that is is housed fully within the inner conductor 28. This is shown in FIG. 2, in which the rack 38 and its driving gear 40 are fully housed within the inner conductor 28. These parts have no significant effect on the electrical efficiency of the coaxial branch made up of inner conductor 28 and outer conductor 18.

Most of the metal parts of the switch are made of brass, and preferably are silver plated. However, the slidable element 22 is preferably made of a more highly and dependably resilient metal, which in this case is beryllium copper, appropriately heat treated, as well as chrome-plated and polished.

The present switch is dimensioned to be received with standard E.I.A. flange connections directly in a 3⅛ inch coaxial line. However, other connections may be used, for example, the Marmann quick disconnect flange.

The switch was designed to operate over a frequency range of from 755 to 985 mc. and to handle up to 10 kw. average power. The VSWR was not to exceed 1.1 maximum; the insertion loss not to exceed 0.15 db maximum; and the isolation between branches 16 and 18 was to be 30 db minimum. In actual practise the switch greatly exceeds these requirements, and it operates efficiently over the entire frequency range of the transmission line. The isolation may be increased by lengthening the switch.

The switch may be used in a pressurized line. For this purpose the flanges are sealed by the use of O rings, as will be seen in the drawing.

The switch may be scaled down with appropriate modifications for lines of different size, for example 1⅝ inch coaxial line.

It is believed that the construction and method of use, as well as the operation and advantages of our improved switch, will be apparent from the foregoing detailed description. It will also be apparent that while we have shown and described the invention in a preferred form, changes may be made without departing from the scope of the invention, as sought to be defined in the following claims. In the claims the reference to the slidable element being slidable through a "ring" is not intended to exclude an incomplete ring, or any suitable passage extending transversely through the inner end of the common inner conductor.

We claim:

1. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring on the common axis of said branches, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, means at the end of the stem for connection to a coaxial conductor aligned with said stem, aligned means at the ends of the branches for connection to coaxial conductors aligned with one another and with the branches, an insulation rod which is shorter than the combined length of the branches extending through both of said aligned inner conductors and through said slidable element, said rod being secured to said element but being slidable in both of said stationary branch inner conductors, and means mounted on the side of one of the branches operatively connected to said rod to slide said rod longitudinally.

2. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring on the common axis of said branches, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, means at the end of the stem for connection to a coaxial conductor aligned with said stem, aligned means at the ends of the branches for connection to coaxial conductors aligned with one another and with the branches, an insulation rod which is shorter than the combined length of the branches extending through both of said aligned inner conductors and through said slidable element, said rod being secured to both of said elements but being slidable in said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a gear in one of the branches and meshing with said rack, and means passing through the side of the said branch to rotate said gear.

3. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, an insulation rod extending through both of said aligned inner conductors and through said slidable element, said rod being secured to said element but being slidable in both of said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a small diameter gear housed in one of the branch inner conductors and meshing with said rack, said inner conductor being cylindrical and said gear being so small in diameter that it does not project outside the cylindrical surface of said inner conductor, an insulation shaft extending from said gear to a point outside the housing, and means to rotate the aforesaid insulation shaft.

4. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, an insulation rod extending through said aligned inner conductors and slidable element, said rod being secured to said element but being slidable in said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a small diameter gear housed in one of the branch

inner conductors and meshing with said rack, said inner conductor being cylindrical and said gear being so small in diameter that it does not project outside the cylindrical surface of said inner conductor, an insulation shaft extending from said gear to a point outside the housing, a handle manually rotatable for about one-half revolution to point in the direction of one branch or the other, a gear turned by said handle, a pinion meshing with said gear and driving the aforesaid insulation shaft, the step-up gear ratio being such that the slidable element is moved all the way to one or the other branch inner conductor by a half turn of the handle and the handle acts as an indicator of the switch position.

5. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, a single inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, a gear rack connected to said slidable element, a very small diameter gear meshing with said rack, a handle manually rotatable for about one-half revolution to point in the direction of one branch or the other, a large diameter gear turned by said handle, a pinion meshing with said gear and driving the aforesaid rack gear, the step-up gear ratio being such that the slidable element is moved all the way to one or the other branch inner conductor by a half turn of the handle and the handle acts as an indicator of the switch position.

6. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, said slidable element being a hollow cylinder made of resilient conductive material, the end portions of said cylinder being longitudinally slotted with a large number of relatively long slats to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted end portions of the slidable element with a snug fit for good electrical contact.

7. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, said slidable element being a hollow cylinder made of resilient conductive material, the end portions of said cylinder being slightly greater in diameter than the mid portion, said end portions being longitudinally slotted with a large number of relatively long slots to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted ends of the slidable element with a snug fit for good electrical contact.

8. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, said slidable element being a hollow cylinder made of heat treated beryllium copper, the end portions of said cylinder being slightly greater in diameter than the mid portion, said end portions being longitudinally slotted with a large number of relatively long slats to make the same resiliently yieldable, the slots being long enough to pass through a part of the reduced diameter mid portion to increase the yieldability of the end portions, the inner ends of the branch inner conductors terminating in hollow cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted ends of the slidable element with a snug fit for good electrical contact.

9. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, an insulation rod extending through said aligned inner conductors and slidable element, said rod being secured to said element but being slidable in said stationary branch inner conductors, means operatively connected to said rod to slide said rod longitudinally, said slidable element being a hollow cylinder made of resilient conductive material, the end portions of said cylinder being longitudinally slotted with a large number of relatively long slats to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted end portions of the slidable element with a snug fit for good electrical contact.

10. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring on the common axis of said branches, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, means at the end of the stem for connection to a coaxial conductor aligned with said stem, aligned means at the ends of the branches for connection to coaxial conductors aligned with one another and with the branches, an insulation rod which is shorter than the combined length of the branches extending through said aligned inner conductors and slidable element, said rod being secured to said element but being slidable in said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a gear housed in one of the branches and meshing with said rack, means passing through the side of said branch to rotate said gear, said slidable element being a hollow

cylinder made of resilient conductive material, the end portions of said cylinder being longitudinally slotted with a large number of relatively long slots to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted end portions of the slidable element with a snug fit for good electrical contact.

11. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, an insulation rod extending through said aligned inner conductors and slidable element, said rod being secured to said element but being slidable in said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a small diameter gear housed in one of the branch inner conductors and meshing with said rack, said inner conductor being cylindrical and said gear being so small in diameter that it does not project outside the cylindrical surface of said inner conductor, an insulation shaft extending from said gear to a point outside the housing, a rotatable handle, and means gearing said handle to the aforesaid insulation shaft, said slidable element being a hollow cylinder made of resilient conductive material, the end portions of said cylinder being longitudinally slotted to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted element with a snug fit for good electrical contact.

12. A coaxial switch comprising a T-shaped housing providing the hollow outer conductors of a stem and two aligned branches, a common inner conductor through the stem terminating at its inner end in a ring which is coaxial of the branches, an inner conductor element passing through and slidable in said ring, a stationary inner conductor in each branch, with its inner end terminating at a spacing from the common inner conductor approximating the length of the slidable element, whereby the latter may be used to connect said common inner conductor to one or the other of the branch inner conductors, an insulation rod extending through said aligned inner conductors and slidable element, said rod being secured to said element but being slidable in said stationary branch inner conductors, a part of said rod having gear teeth to form a rack, a small diameter gear housed in one of the branch inner conductors and meshing with said rack, said inner conductor being cylindrical and said gear being so small in diameter that it does not project outside the cylindrical surface of said inner conductor, an insulation shaft extending from said gear to a point outside the housing, a handle manually rotatable for about one-half revolution to point in the direction of one branch or the other, a gear turned by said handle, a pinion meshing with said gear and driving the aforesaid insulation shaft, the step-up gear ratio being such that the slidable element is moved all the way to one or the other branch inner conductor by a half turn of the handle, said slidable element being a hollow cylinder made of resilient conductive material, the end portions of said cylinder being longitudinally slotted to make the same resiliently yieldable, the inner ends of the branch inner conductors terminating in cylindrical seats, said seats and the aforesaid cylindrical ring at the inner end of the common conductor being dimensioned to slidably receive the slotted element with a snug fit for good electrical contact.

13. A coaxial switch as defined in claim 2 in which the means extending outward from the rack gear is an insulation shaft which has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear, said flats functioning somewhat as universal joints.

14. A coaxial switch as defined in claim 3 in which the insulation shaft extending outward from the rack gear has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear, said flats functioning somewhat as universal joints at the ends of said insulation shaft and thereby accommodating any slight misalignment of the shaft.

15. A coaxial switch as defined in claim 4 in which the insulation shaft extending outward from the rack gear has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear.

16. A coaxial switch as defined in claim 10 in which the means extending outward from the rack gear is an insulation shaft which has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear.

17. A coaxial switch as defined in claim 11 in which the insulation shaft extending outward from the rack gear has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear, said flats functioning somewhat as universal joints at the ends of said insulation shaft and thereby accommodating any slight misalignment of the shaft.

18. A coaxial switch as defined in claim 12 in which the insulation shaft extending outward from the rack gear has flats at both ends, the flats at one end being perpendicular to the flats at the other end, said flats being received between mating flats and thereby serving to transmit driving torque to the shaft and from the shaft to the rack gear.

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