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SWITCHING DEVICE

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Fig. 3

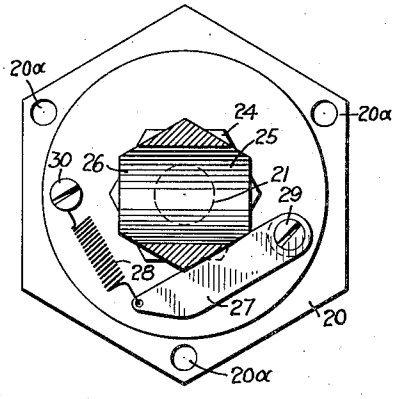
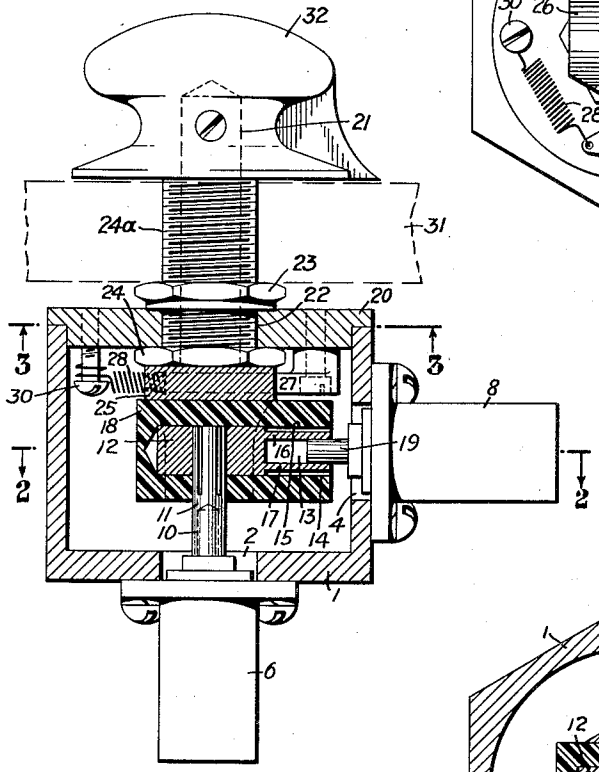


Fig. 1



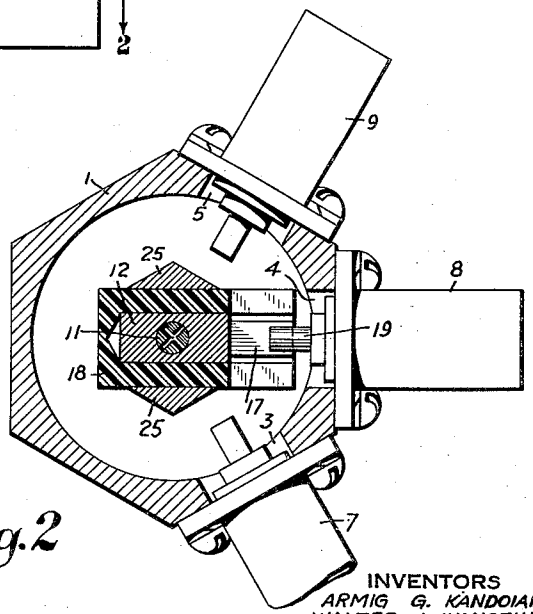


Fig. 2

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SWITCHING DEVICE

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4 Claims. (Cl. 200—6)

This invention relates to switching devices and more particularly to a coaxial transmission switch suitable for switching radio frequencies in the high and very high frequency region.

In the use of apparatus employing elements operating at high and very high radio frequencies, it is often desirable to have simple switching means which, while functioning as simply and directly as conventional switches, will not adversely affect the performance of a radio frequency system in which they are employed. In particular it is desirable that such switches should not attenuate the energy passing through them and that they should not permit cross-over of radio frequency energy by inductive and capacitive coupling between the used and unused portion of the switches. Another consideration in the use of such switches is the ease of manufacture and the economical performance of such manufacture and prefabrication.

In the prior art, switches with the desirable electrical characteristics are available, but the cost of manufacture and prefabrication is prohibited. In one instance a switch consists of an input line of coaxial line receptacle being coaxial with a hexagonal block forming the body of the switch. A coaxial line elbow inside the body is rotated by means of a shaft extending through the body of the switch from the side opposite the input line. The upper end of the elbow is connected to the input line, while the output end may be rotated to any of several output lines located on the side of the hexagonal block, the point of rotation being the center conductor of the input line. The center conductor of the elbow makes contact with the input line by means of a slotted tip inserted into a hole in the input center conductor. The connection to the center conductor of the output line is made by a projecting blade that is squeezed between two open fingers of the center conductor of the output line. The outer conductor of the elbow makes contact by a rotating machined fit. Contact with the output line is furnished by a coaxial sleeve which is pressed by a spring against the inner cylindrical surface of the switch body, and the other end is slotted to form fingers that contact the outer conductor of the main part of the elbow. It will be recognized by those skilled in the art that to provide such a switch, having the desired electrical characteristics, requires a large amount of machine tool operations to form the various fits and connections of the internal parts of the switch. Such machine operations result in a large expenditure of money and time in the manufacture of the parts.

Furthermore, the process of assembling the switch is complicated and lengthy, especially in assuring a good contact between the elbow section and the various output coaxial conductors. Once the contact between center conductors is achieved, there is no certainty that the good contact will be maintained for a reasonable length of time due to the small contact surfaces of both the elbow section and the output lines, and the wearing of these surfaces from use will occur destroying the contact between the usual small contact surface available. These resulting poor contacts will inevitably destroy the desired electrical characteristics. Therefore, it is an object of this invention to provide a switching device suitable for switching high and very high radio frequency energy, which is easy to manufacture and assemble having the desired electrical characteristics in the frequency ranges employed therewith.

A feature of this invention is the employment of a hexagonal block to form the body of the switching device and to comprise the outer conductor between a standard coaxial receptacle functioning electrically as the input line and a plurality of standard coaxial receptacles functioning electrically as the various output lines.

Another feature of this invention is the modification of the input line center conductor by sweating spring metal stock thereto to function as a mechanical pivot for a revolving contactor and electrically as the portion of the center conductor of the coaxial switch to provide an easy means of switching radio frequency energy from the input line to one of several output lines.

Still another feature of this invention is the incorporation of a revolving contactor comprising spring metal stock which is slidably associated with the mechanical pivot and enclosed in a dielectric insulator, said contactor and dielectric material removed in a selected portion to have a spring action and slide over the output line center conductor to make contact therewith, and said contactor completing the center conductor of the coaxial switch for conduction of radio frequency energy to one of several output lines.

A further feature of this invention is the providing of contacting means fashioned from the revolving contactor with a relatively large area as compared with prior art switching devices, for making connection with the center conductor of a selected output line. This large contact area available removes the necessity of machining an accurate detent mechanism as was heretofore required, a detent mechanism to approximately locate the revolving contactor in reference with the output line center conductor will suffice.

Another feature of this invention is the channelled stem of the control shaft which fits over the dielectric covering of the revolving contactor to provide a means to switch the radio frequency energy from one output means to another, said channelled stem cooperating with the detent mechanism to achieve the desired indexing of the selected output line. The channelled stem electrically places a ground potential at the surface of the dielectric material to cooperate in establishing the desired electrical characteristics in the switching device.

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 a sectional view partially in elevation of an embodiment of a switching device in accordance with the principles of this invention;

Fig. 2 is a sectional view partially in elevation taken along line 2—2 of Fig. 1; and

Fig. 3 is a plan view with the cover removed taken along line 3—3 of Fig. 1.

Referring to Figs. 1, 2, and 3, collectively, as the description progresses the structure of the switch will become apparent and details of various members will be clearer. Housing member 1 comprises hexagonal stock cut to the proper length and machined to form a cylindrical interior of the desired dimensions. Apertures 2, 3, 4, and 5 are then centrally bored in the bottom and on three of the hexagonal sides, respectively, as illustrated, to a diameter for receipt of standard coaxial receptacles 6, 7, 8, and 9. Receptacles 6 provides means

for injecting a signal into the switching device and receptacles 7, 8, and 9 provide means for coupling the input signal to one of several utilization devices. The outer conductors of receptacles 6, 7, 8, and 9 are electrically and mechanically associated with housing member 1, thus, the member 1 constitutes a portion of the outer conductor of a coaxial system. The utilization of member 1 as the outer coaxial conductor cooperates in providing a constant surge impedance when switching from one output receptacle to another, thus, an impedance match is maintained within practical limits in the operating frequency range up to 300 mc.

Now that the outer conductor of a coaxial switch is provided, it is necessary to provide an inner coaxial conductor for the conduction of signal energy and means for switching this signal energy from one output line to another as desired. The inner conductor is achieved by modifying the center conductor 10 of receptacle 6 in the following manner. A solid rod of spring metal is drilled at one end to fit snugly over center conductor 10 and grooved approximately as shown in Figs. 1 and 2 to provide a spring action at the other end. Thus a mechanical pivot 11 is fashioned which electrically is a portion of the switching device's center conductor. The drilled end of pivot 11 is sweated or otherwise secured to center conductor 10 to assure mechanical rigidity and electrical continuity.

The remaining portion of the inner conductor of housing member 1 comprises a revolving metallic contactor 12 which is drilled such as to be in a rotatable contact with pivot 11. Contactor 12 is further fashioned to have a cross-wise slot 13, the slot 13 corresponding in width to the diameter of the center conductors of the receptacles 7, 8, and 9. This provides in effect two metallic spring contacts 16 and 17 which can easily make contact with the center conductors of the output receptacles. The revolving contactor 12 is then completely enclosed by a dielectric material 18, except for the area which corresponds to slot 13 enabling the center conductors of the output receptacles to slide through the dielectric material and make contact with the contacts 16 and 17.

It may be observed in Fig. 2 that contact 17, as well as contact 16, is wider than the center conductor 19. Furthermore, due to the cylindrical shape of center conductor 19 and the flat contacting surface of contacts 16 and 17, point contacts are made between contacts 16 and 17 and conductor 19. Therefore, for proper electrical continuity the relationship between contacts 16 and 17 and conductor 19 does not have to be extremely accurate, reducing the amount of machining required to produce such a switching device.

Now that a center conductor for the housing member 1 is provided, a means to switch from one output receptacle to another must be provided along with a detent mechanism to assure an electrical contact between the center conductor of a selected receptacle and the contacts 16 and 17.

As hereinbefore mentioned, housing member 1 acts as the outer conductor of the coaxial switch. A removable cover 20 is provided to close the open end of the hexagonal stock to complete the outer conductor, the cover being fastened thereto by means of machine screws 20*a* as shown in Fig. 3. Cover 20 is also utilized to allow passage of the controlling shaft 21 which enters member 1 coaxially through aperture 22. Shaft 21 is secured to cover 20 by means of lock nuts 23 and 24, cooperating with a standard panel bearing 24*a*. Fastened to the end of shaft 21 by a sweating or similar process is a channel stem 25. Stem 25 is made from hexagonal stock to provide an indexing means and is further hollowed out in a U shape at its end, as shown at 26, to receive the dielectric body 18, thus providing a means to rotate revolving contactor 12 for selection of the desired output receptacle. The position of stem 25 must be such as to detent the rotation of contactor 12 at the selected output receptacle. Associated therewith is the detent mechanism comprising an arm 27 and a spring 28 whereby the arm 27 rests against one of the hexagonal sides of stem 25 to hold it in a selected position by the action of spring 28, as shown in Fig. 3. Arm 27 is pivoted at 29 to allow the rotation of stem 25 for selecting a new output receptacle. The action of the spring 28 secured by screw 30 is to return arm 27 to the proper position to hold stem 25 which in turn properly locates contactor 12 to make contact with the center conductor of the selected output receptacle. To properly achieve the location of contactor 12 with respect to a selected inner conductor, a proper relation of the hexagonal portion or indexing means of stem 25 to housing member 1 must be maintained. This may be accomplished by having the hexagonal faces of stem 25 and housing member 1 in a parallel, concentric relationship.

The switching device may be mounted to a panel 31 and the knob 32 will allow the selection of a particular output receptacle for coupling the input signal in receptacle 6 to a desired utilization circuit connected to either of the output receptacles 7, 8, and 9. By proper positioning of knob 32 and using the pointer type knob, it is possible to tell visually from the panel side which utilization circuit the input signal is being coupled to.

It will be recognized from the above description that the majority of parts employed are standard commercial equipment and need only a very slight modification prior to assembly of the switching device. The machining of parts required is at a minimum, and those parts needing machining are not complicated and tolerances are not prohibited. Furthermore, the assembly is easy and repairing when needed is not complicated. It is felt that this switch far exceeds those in the prior art in the maintenance of electrical characteristics required within practical limits of the frequency range in which it operates, allowing a quick and easy manufacturing of such switches.

The embodiment shown herein incorporates only three output lines, but it is conceivable that the present housing member may be adapted to employ six or even a larger number of output lines if desired. Thus, the embodiment shown herein is not intended to limit this invention to a particular receptacle or a particular number of outer receptacles, but may be easily modified to employ any known coaxial receptacles. Furthermore, there is no reason why the housing member must be limited to a hexagonal shape, any polyhedral shaped housing member may be employed which will increase or decrease the maximum number of output lines adaptable thereto. However, it must be remembered that the geometric shape of the indexing portion of the channelled stem must correspond with the exterior geometric shape of the housing member to have a proper detent operation.

While we have described above the principles of our 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 our invention as set forth in the objects thereof and in the accompanying claims.

We claim:

1. A coaxial switch comprising a housing having a generally cylindrical side wall and two end walls, the first of said end walls being fixed and the second being removable, said first end wall having an aperture therethrough disposed coaxially of the longitudinal axis of said housing, the side wall of said housing having circumferentially spaced apertures therethrough in a given plane, a plurality of coaxial connectors, the inner conductor of said plurality of connectors protruding into said housing coaxially through the apertures of the side wall of said housing and the outer conductor thereof being electrically and mechanically connected to the side wall of said housing, a coaxial connector disposed coaxially of said longitudinal axis having its outer conductor electrically and mechanically connected to said first end wall and its inner conductor in alignment with the aperture

of said first end wall, a tubular dielectric member having an aperture through a side wall thereof, a contactor receivable within said tubular dielectric member having an aperture therethrough in registry with the aperture through the side wall of said dielectric member, a contact means carried on one end of said contactor, means extending the inner conductor of said axially disposed coaxial connector into the registered apertures of said dielectric member and said contactor to position said contactor for rotaton in said given plane, and a control shaft extending through the second end wall of said housing in coaxial relation to the longitudinal axis of said housing, said shaft having a U-shaped end portion to engage said dielectric member whereby rotation of said shaft revolves said contactor about said last mentioned means for selective contact between said contact means and the inner conductors of said plurality of coaxial connectors.

2. A coaxial switch comprising a housing having a generally cylindrical side wall and two end walls, the first of said end walls being fixed and the second being removable, said first end wall having an aperture therethrough disposed coaxially of the longitudinal axis of said housing, the side wall of said housing having circumferentially spaced apertures therethrough in a given plane, a plurality of coaxial connectors, the inner conductor of said plurality of connectors protruding into said housing coaxially through the apertures of the side wall of said housing and the outer conductor thereof being electrically and mechanically connected to the side wall of said housing, a coaxial connector disposed coaxially of said longitudinal axis having its outer conductor electrically and mechanically connected to said first end wall and its inner conductor in alignment with the aperture of said first end wall, a tubular dielectric member having an aperture through a side wall thereof, a contactor receivable within said tubular dielectric member having an aperture therethrough in registry with the aperture through the side wall of said dielectric member, a contact means carried on one end of said contactor, means extending the inner conductor of said axially disposed coaxial connector into the registered apertures of said dielectric member and said contactor to position said contactor for rotation in said given plane, a control shaft extending through the second end wall of said housing in coaxial relation to the longitudinal axis of said housing, said shaft having a U-shaped end portion to engage said dielectric member whereby rotation of said shaft revolves said contactor about said last mentioned means for selective contact between said contact means and the inner conductors of said plurality of coaxial connectors, said control shaft having detent surfaces one corresponding to each inner conductor of said plurality of coaxial connectors, and detent means coacting with said detent surfaces to provide a detent action on said control shaft when said contact means is in contact with one of the inner conductors of said plurality of coaxial connectors.

3. A coaxial switch comprising a generally cylindrical housing having a polyhedral outer surface and two end walls, the first of said end walls being fixed and the second being removable, said first end wall having an aperture therethrough disposed coaxially of the longitudinal axis of said housing, certain of the faces of said outer surface having apertures therethrough in a given plane, a plurality of coaxial connectors, the outer conductor of said plurality of connectors being electrically and mechanically connected to respective ones of said certain faces and the inner conductor of said plurality of connectors protruding into said housing coaxially through the apertures of said certain faces, a coaxial connecter disposed coaxially of said longitudinal axis having its outer conductor electrically and mechanically connected to said first end wall and its inner conductor in alignment with the aperture of said first end wall, a tubular dielectric member having an aperture through a side wall

thereof and a diametrically disposed slot through one end thereof, a contactor receivable within said tubular dielectric member having an aperture therethrough in registry with the aperture through the side wall of said dielectric member and a diametrically disposed slot through one end thereof in registry with the diametric slot of said dielectric member, the diametric slot of said contactor providing flat contact surfaces to establish selectively at least point contact with each of the inner conductors of said plurality of coaxial connectors, a metallic sleeve having one end thereof secured to the inner conductor of said axially disposed coaxial connector and the other end thereof slotted to present a plurality of longitudinal fingers for resilient rotational engagement within the registered apertures of said dielectric member and said contactor, and a control shaft extending through the second end wall of said housing in coaxial relation to the longitudinal axis of said housing, said shaft having a U-shaped end portion to engage said dielectric member whereby rotation of said shaft revolves said contactor about said longitudinal fingers for selective contact between the flat contact surface of the diametric slot of said contactor and the inner conductors of said plurality of coaxial connectors.

4. A coaxial switch comprising a generally cylindrical housing having a polyhedral outer surface and two end walls, the first of said end walls being fixed and the second being removable, said first end wall having an aperture therethrough disposed coaxially of the longitudinal axis of said housing, certain of the faces of said outer surface having apertures therethrough in a given plane, a plurality of coaxial connectors, the outer conductor of said plurality of connectors being electrically and mechanically connected to respective ones of said certain faces and the inner conductor of said plurality of connectors protruding into said housing coaxially through the apertures of said certain faces, a coaxial connector disposed coaxially of said longitudinal axis having its outer conductor electrically and mechanically connected to said first end wall and its inner conductor in alignment with the aperture of said first end wall, a tubular dielectric member having an aperture through a side wall thereof and a diametrically disposed slot through one end thereof, a contactor receivable within said tubular dielectric member having an aperture therethrough in registry with the aperture through the side wall of said dielectric member and a diametrically disposed slot through one end thereof in registry with the diametric slot of said dielectric member, the diametric slot of said contactor providing flat contact surfaces to establish selectively at least point contact with each of the inner conductors of said plurality of coaxial connectors, a metallic sleeve having one end thereof secured to the inner conductor of said axially disposed coaxial connector and the other end thereof slotted to present a plurality of longitudinal fingers for resilient rotational engagement within the registered apertures of said dielectric member and said contactor, a hollow stem extending through the second end wall of said housing in coaxial relation to the longitudinal axis of said housing, a control shaft extending through said hollow stem, said shaft having a portion which is polyhedral in cross section and a U-shaped end portion to engage said dielectric member whereby rotation of said shaft revolves said contactor about said longitudinal fingers for selective contact between the flat contact surface of the diametric slot of said contactor and the inner conductors of said plurality of coaxial connectors, means to secure said stem in position in said second end wall, a detent lever pivotably secured at one end thereof to the inner surface of said second end wall adjacent the faces of the polyhedral cross section portion of said shaft, and a spring secured at one end thereof to said housing and at the other end thereof to the other end of said detent lever to bias said detent lever for parallel alignment against each face of the polyhedral cross section portion of said control shaft as such face is ro-

tated into contact with said lever, said detent lever being so disposed as to provide detent action on said shaft when said contactor is in engagement with one of the inner conductors of said plurality of coaxial connectors.

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