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MULTIPLE CHANNEL COAXIAL SWITCH

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2 Sheets-Sheet 2

Fig. 3.

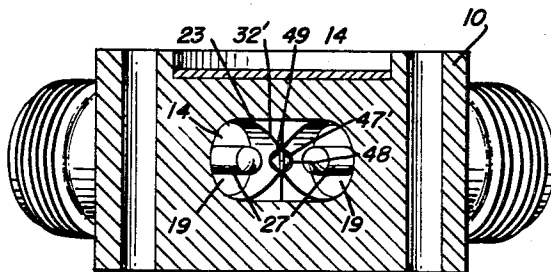


Fig. 5.

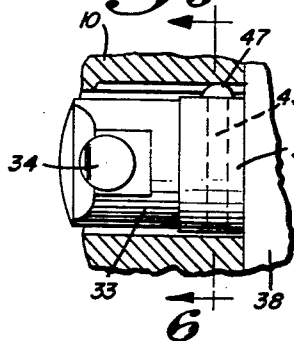


Fig. 4.

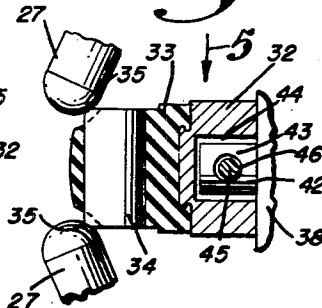


Fig. 6.

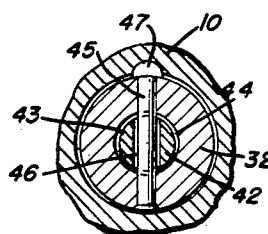
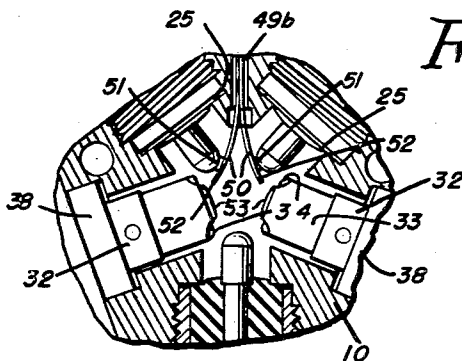


Fig. 7.



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MULTIPLE CHANNEL COAXIAL SWITCH

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9 Claims. (Cl. 333—7)

This invention relates in general to switch mechanisms and relates in particular to a coaxial switch for transmission of super high frequency electrical current.

It is an object of the invention to provide a miniature coaxial switch with a given impedance match wherein electrical energy of radio or higher frequency may be selectively delivered into a first, second or both of two transmission channels at one time, with minimum insertion loss, cross talk and voltage standing wave ratio, over a wide frequency range.

It is a further object of the invention to provide a coaxial switch which is of small size and light weight along with complete environmental resistance as compared to coaxial switching equipment now extensively employed for similar purposes. It is a further object of the invention to provide a coaxial switch having a simple body structure containing therein circuit closing means and also having therein an isolating element which is secured to the body of the switch in such a position that it will effectively minimize coupling effect in adjacent coaxial paths or cross over into an adjacent coaxial path of super high frequency current which is being properly conducted through a selected path within the switch body.

It is a further object of the invention to provide a coaxial switch wherein an isolating element is arranged so that it may be deflected mechanically from side-to-side during the operation of the switch mechanism and in conjunction therewith so that the isolating element effectively accomplishes its intended purpose.

A further object of the invention is to provide in this coaxial switch an isolating element which is in the form of a flexible reed of electro-conductive material adapted to be changed in its operative position by flexure.

A further object of the invention is to provide a coaxial switch wherein the isolating element is of multiple character having parts thereof arranged in spaced relation and being adapted for movement into positions approximate to a central axis of the switch body.

A further object of the invention is to provide a coaxial switch wherein the impedance along respective paths of flow of high frequency transmission is maintained within a predetermined value, and wherein this result is in part obtained by the form and relationship of the axial conductors and the insulator means for supporting the same within the tubular sheaths or walls of the switch which surround the axial conductors.

Further objects and advantages of the invention may be brought out in the following part of the specification wherein parts have been described in detail for competence of disclosure, without intending to limit the scope of the invention which is set forth in the appended claims.

Referring to the accompanying drawings which are for illustrative purposes only:

Fig. 1 is a sectional view to enlarged scale of a preferred form of the invention;

Fig. 2 is an elevational view drawn to reduced scale showing how several of the switches may be assembled in stacked relation;

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Fig. 3 is a cross section taken as indicated by the line 3—3 of Fig. 1;

Fig. 4 is an enlarged fragmentary sectional view showing a bridging conductor in bridging position;

Fig. 5 is a view looking downwardly as indicated by the arrow 5 of Fig. 4;

Fig. 6 is a cross section taken as indicated by the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary sectional view embodying the central portion of Fig. 1 and showing an alternative form of isolating reed.

The preferred embodiment of the invention shown in Fig. 1 has a body 10 in the form of a pentagonal prism. Within the body 10 there is a central opening 11 concentric to the central axis *a—**a* of the body and having a threaded counterbore 12 which communicates with the peripheral face 13 of the body 10. The inner end of the opening 11 communicates with the inner ends of branching openings 14 having counterbores 15 which communicate with the peripheral faces 16 and 17 which lie on the opposite side of the body 10 from the face 13. The branching openings 14 lie on branching axes *b—**b* and *c—**c* which intersect the axis *a—**a* in substantially the center of the body 10.

An axial conductor 18 is supported in the opening 11 by a cylindrical insulator 19, and axial conductors 18*a* and 18*b* are supported in the openings 14 by insulators 19. These insulators 19 are in turn supported by tubular connector members 20 having threads 21 on the inner ends thereof for engagement with the threads of the respective counterbores 12 and 15, and external threads 21' at the outer ends thereof for connecting the tubular members 20 to internally threaded bushings, not shown, by which the outer conductors of coaxial cables may be connected to the switch.

The tubular metal wall portion 22 of the body 10 which surrounds or defines the opening 11 constitutes an outer tubular conductor or sheath around the axial conductor 18 and cooperates therewith to form the central coaxial conductor unit A of the switch. In a similar manner, the tubular metal wall portions 23 of the body 10 which surround or define the openings 14 are outer tubular conductors which cooperate with the branching conductors 18*a* and 18*b* to form the branching coaxial conductor units B and C of the switch, the inner ends of the tubular walls 22 and 23 being joined.

Each of the axial conductors 18, 18*a* and 18*b* has a tubular outer end 24 which is slotted and constricted so as to provide means for connection of the members 18, 18*a* and 18*b* to the axial conductors, not shown, of the customarily employed coaxial cable.

The insulators 19 serve also to seal the openings 11 and 14 against entry of fluids therethrough. Prior to the screwing of the connector members 20 into the counterbores 12 and 15, the inner ends of the insulators 19 project slightly beyond the inner end walls 25 of the members 20 so that when the members 20 are screwed tightly into place, annular portions of the insulators 19 will be brought into sealing engagement with the annular shoulders 26 at the inner ends of the counterbores, and at the same time the end faces 25 of the members 20 will be brought into tight, sealing engagement with the shoulders 26. To cooperate in maintaining a constant impedance along the axial conductors 18, 18*a* and 18*b*, the inner ends 27 thereof are enlarged on the planes of their emergence from the inner ends of the tubular members 20, and each insulator 19 has an annular protrusion 28 surrounding and enclosing a small portion of the enlarged inner end 27 adjacent the transverse plane defined by the annular end wall 25 of the tubular member 20.

Lateral openings 29 extend outwardly from the inner ends of the openings 11 and 14 and have counterbores

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30 communicating with the remaining two peripheral faces 31 of the body 10 on axes $d-d$ which lie in the same plane as the axes $a-a$, $b-b$ and $c-c$ and intersect within the body 10 the point of intersection of the axes $a-a$, $b-b$ and $c-c$. Each axis $d-d$ is at equal angular distances from the axes of the openings 11 and 14 adjacent thereto. In the openings 29 there are metal bodies 32 with attached insulator bodies 33 arranged to support bridging conductors 34 in such manner that when the metal bodies 32 are moved radially inwardly from the positions in which they are shown in Fig. 1, they will be brought into engagement with the spaced inner ends of the respective axial conductors 18, 18a and 18b in the manner shown in Fig. 4. It will be perceived that only the inner corners 35 of the bridging conductors 34 engage the rounded ends of the engaged axial conductors and that all but the end portions of the bridging conductors 34 are surrounded by the insulator bodies 33.

For actuation of the switch elements solenoids 36 are mounted on the body 10, and are provided with shells 37 having cylindrical projections 38 which extend into and are secured in the counterbores 30 of the lateral openings 29. Each solenoid shell 37 has therein a winding 39 in surrounding relation to a solenoid core 40 and an armature member 41 including a stem 42 having an inner end 43 which extends through the projection 38 and engages the metal body 32 so that when the armature 41 is magnetically attracted, the inward shifting of the stem 42 will effect movement of the associated bridging conductor 34 into engagement with the central axial conductor 18 and either of the branching conductors 18a and 18b. The body 32 is secured to the end 43 of the stem 42 for limited universal, but non-rotative movement. This is accomplished by making the opening 44 in the member 32, which receives the end 43 of the stem 42, slightly larger than the stem end 43, and also by making the transverse pin 45, which connects the parts 42 and 43, a loose fit in either of the parts through which it extends. For example, the opening 46 in the stem end 43 is made slightly larger in diameter than that portion of the pin 45 which passes therethrough. Each pin 45 has thereon a rounded head 47 adapted to slide in a slot in the wall of the lateral opening 29 in which it is disposed, the body 32 being thereby prevented from rotation around the longitudinal axis of the stem 42 to maintain operative alignment of the bridging conductors with the axial conductors.

At the point of intersection 32' of the wall portions 23 which define the openings 14 a relatively small hole 47' is drilled on the axis $a-a$ to receive the stem 48 of an isolating element 49 which lies between the inner ends of the axial conductors 18a and 18b. The isolating element 49 and its stem 48 are of metal and the isolating member 48 is in the form of a thin reed arranged so that its width lies in a plane perpendicular to the plane defined by the axes of the axial conductors 18, 18a and 18b. The inner end of the isolating member 49 intersects the point of intersection of the axes $b-b$ and $c-c$. The member 49 minimizes cross talk resulting from the coupling of potential in the unused transmission channel by a signal which is transmitted through a selected transmission channel of the switch.

It will be understood that the member 49, being in the form of a small reed could be characterized by lateral moveability. For example, Fig. 7 shows an isolating element 49b which is of multiplicate form. Specifically, it is bifurcated and comprises two leaf springs 50 arranged in V-relation to each other so that contacts 51 mounted thereon engage the ends of the axial conductors 18a and 18b. The extremities 52 of the leaf springs 50 lie in the paths of movement of the ends 53 of the insulator bodies 33 so that when either solenoid is actuated so as to move its armature inwardly, the inner end 53 of the insulator 33 associated therewith will engage a leaf spring or reed 50 and shift the same into a

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position close to the axis $a-a$, as the selected switch is closed. Both of the switches may be simultaneously closed or they may be separately actuated, as desired by selective energization of the solenoids 35.

We claim:

1. In a coaxial switch: a central coaxial conductor unit; branching coaxial conductor units arranged in Y-relation to said central unit and in V-relation to each other, each of said coaxial conductor units comprising an axial conductor and a tubular conductor surrounding the same, the inner ends of said tubular conductors being joined and the inner end of the axial conductors of said branching conductor units being spaced from the inner end of the axial conductor of the central conductor unit so as to form gaps; an isolating element comprising a slender wall member of electro-conductive material connected to and projecting inwardly from the junction of said tubular conductors of said branching conductor units toward said axial conductor of said central coaxial conductor unit and in angular relation to the axes of said branching conductor units; bridging conductors supported so as to be moved between positions bridging said gaps and retracted positions laterally displaced from said gaps; and means for selectively shifting said bridging conductors between said bridging and retracted positions.

2. A coaxial switch as defined in claim 1 wherein said isolating element is bifurcated and its forked portions are arranged to be deflected from their initial positions angular to the axes of said branching conductor units.

3. A coaxial switch as defined in claim 1 wherein said isolating element is arranged to be deflected from its initial position, and means operated by said means for selectively shifting said bridging conductors to deflect said isolating element from said initial position.

4. A coaxial switch as defined in claim 1 wherein the wall structure forming the juncture of the tubular conductors of said branching coaxial conductor units has therein an opening aligned with said axial conductor of said central coaxial conductor unit, and the isolating element is arranged between the inner ends of the axial conductors of said branching unit, said element having a stem thereon seated in said opening.

5. In a coaxial switch: a flat metallic body having a central opening extending therein from one side and having its inner terminus within the body, said body having a pair of branching openings extending therein from sides of the body opposite to said first named side of said body arranged with their inner ends communicating with the inner end of said central opening, said branching openings being arranged on branching axes disposed in Y-relation to said central opening and in V-relation to each other, and lateral openings respectively extending outwardly from the inner ends of said branching openings and communicating with the inner ends of said central and branching openings; a central axial conductor supported by an insulator within said central opening with the inner end thereof contiguous to the juncture of said central and branching openings; branching axial conductors supported respectively in said branching openings by insulators, the inner ends of said branching conductors being spaced from the inner end of said central conductor; a solenoid unit connected to said body at the outer end of each of said lateral openings comprising an armature extending within the lateral opening, and a coil to actuate said armature; insulator bodies secured on the inner ends of said armatures; bridging conductors supported by said insulator bodies transversely of the axis of said armatures so that when inward movement of the armatures and said insulator bodies occurs, said bridging conductors will be moved into positions wherein the ends thereof will respectively engage the inner ends of said branching axial conductors and the inner end of said central axial conductor; slender metal isolating means extending from the wall of said body at the juncture of said branching openings, said isolating mem-

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ber being positioned at the inner ends of and in angular relation to the axes of said branching axial conductors; and means connected to said body for connecting said axial conductors to the axial conductors of coaxial cables and for connecting the walls of said central and branching openings to the outer conductors of said cables.

6. A coaxial switch as defined in claim 5 wherein said isolating means is in the form of a metal reed disposed with its flat face approximately perpendicular to the plane defined by the axes of said axial conductors.

7. A coaxial switch as defined in claim 5 wherein said solenoids have armatures equipped with means for shifting said isolating means laterally when said armatures are moved inwardly.

8. A coaxial switch as defined in claim 5 wherein said isolating means comprises two side-by-side portions ex-

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tending in V-relation to each other between the inner ends of said branching conductors with the free ends thereof contiguous to said insulator bodies so that as said insulator bodies are moved inwardly they will shift said portions toward the axis of said central opening.

9. A coaxial switch as defined in claim 8 wherein said side-by-side portions consist of leaf springs normally bent so as to lie to V-relation, respectfully in engagement with the inner ends of said branching conductors and being arranged to be flexed from said V-relation toward the axis of said central opening of said body.

References Cited in the file of this patent

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