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CO-AXIAL SWITCH

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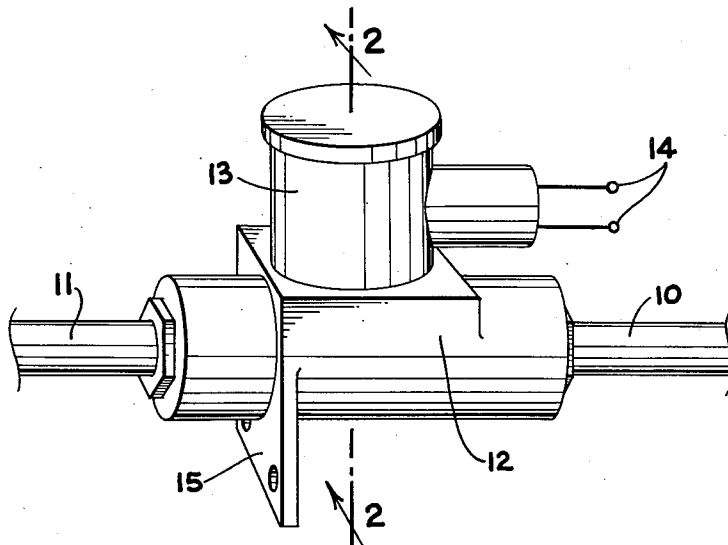


FIG. 1

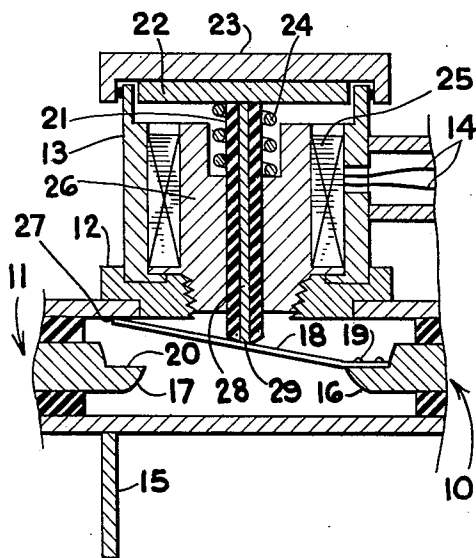


FIG. 2

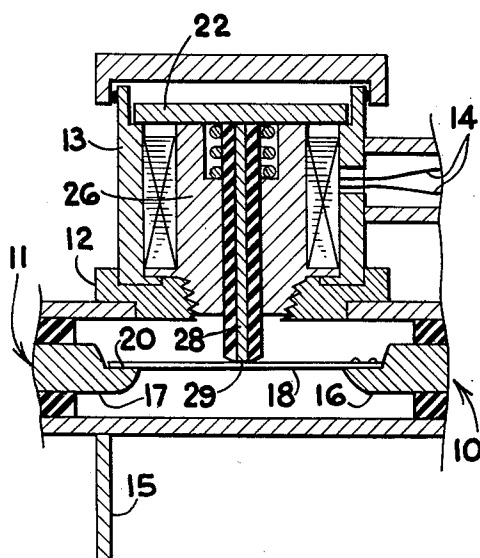


FIG. 3

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1

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CO-AXIAL SWITCH

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1 Claim. (Cl. 333-97)

This invention relates generally to co-axial switches and more particularly to an improved switch for connection in co-axial lines carrying high frequency electro-magnetic energy.

Co-axial switches are well-known in the art and find wide use in high frequency systems. In the design of such switches, it is extremely important that any discontinuities introduced into the co-axial line by the switching components be minimized to avoid possible reflections or loss of power when the switch is in its on position. On the other hand, when the switch is in its off position it is desirable to maximize isolation of the disconnected lines.

In many present day applications, co-axial switches are subject to rugged environmental conditions particularly when employed in missiles. To insure reliability, it is therefore essential that the switching components be capable of withstanding shocks, vibrations, high g loading, and the like. In addition, filters are sometimes employed for limiting the frequencies passed to a receiver. The use of such filters minimizes the possibilities of successful jamming of the signal by unauthorized parties. Filters however, constitute additional components in the high frequency system and in cases where weight and space are important, it would be advantageous to combine the desired filtering action with the co-axial switches themselves.

With all of the foregoing in mind, it is a primary object of the present invention to provide an improved co-axial switch for connecting and disconnecting co-axial lines carrying high frequency electro-magnetic energy incorporating the above-noted desirable features.

More particularly, it is an object to provide an improved co-axial switch which employs moving parts of extremely small mass so that the switch can withstand normally encountered shocks, vibrations, and high g loading without loss of reliability.

Another object is to provide a co-axial switch in which a straight through connection for the inner conductors is effected when the switch is in the "on" position whereby minimum power loss occurs across the switch.

Still another important object is to provide a switch in which only a given frequency band is passed through the switch when in the "on" position to the end that the switch itself serves the dual function of both a switch and filter.

Briefly, these and many other objects and advantages of this invention are attained by providing a conducting body receiving input and output co-axial connectors in opposite ends, the outer conductors of the connector being connected through the body and the inner conductors being axially aligned and terminating in opposing contacts within the interior of the body. A flexible conducting reed is secured at one end to one of the inner contacts and biased laterally so that its free end engages the outer conductor of the other of the contacts. In this position, the switch is in its "off" condition and the one contact to which the reed is connected is grounded thereby providing excellent isolation. An actuating means extends laterally into the body between the connectors to engage the reed and is arranged to move into the body when actuated to urge the free end of the reed into contact with the other of the inner conductors to effect the desired straight through co-axial connection.

The actuating means itself includes a plunger incorpo-

2

rating a conducting portion having a length corresponding to an odd multiple of a quarter wave length of the mean wave length of the electro-magnetic energy. When the actuating means and switch reed are in the "on" position, one end of the conducting portion of the plunger engages the reed and the other end spaced at the odd multiple of a quarter wave length engages the body portion of the switch itself so that a quarter wave stub is provided. Electromagnetic energy of wave lengths different from the quarter wave length defined by the length of the stub will be attenuated whereas electro-magnetic energy of proper wave length defined by the dimensioning of the stub, will pass through the switch, the stub itself appearing as an open circuit.

The plunger may be actuated by electro-magnetic coils so that remote operation of the switch can take place. In this case, the conducting portion of the plunger also serves to complete the magnetic circuit with respect to the coils.

A better understanding of the invention will be had by referring to a preferred embodiment thereof as illustrated in the accompanying drawings in which:

FIGURE 1 is an overall perspective view of the co-axial switch.

FIGURE 2 is a cross section taken in the direction of the arrows 2-2 of FIGURE 1 showing the switching components in the "off" position; and,

FIGURE 3 is a view similar to FIGURE 2 showing the switching components in the "on" position.

Referring first to FIGURE 1, there are shown co-axial line connections 10 and 11 passing into opposite sides of a body member 12. The body 12 includes a conducting material which electrically connects the outer conductors of the lines 10 and 11. Within the interior of the body 12 there is provided a switch component arranged to be actuated by a suitable mechanism within a housing 13. Remote operation of the switch can be effected by passing a signal into a pair of leads 14 passing to the housing 13 as shown. The switch body 12 also includes a mounting bracket 15.

Referring now to FIGURES 2 and 3, it will be noted that the inner conductors of the co-axial lines 10 and 11 terminate in opposed axially spaced contact ends 16 and 17 respectively. A flexible conducting reed 18 within the body has one end secured as at 19 to the contact 16. The free end of the reed 18 in turn is arranged to engage a flat contacting surface 20 on the other contact 17 when actuated to connect the inner conductors together.

The preferred means for actuating the reed 18 from the open position shown in FIGURE 2 to the closed or bridging condition shown in FIGURE 3 comprises a laterally extending plunger 21 terminating at its upper end in a plate 22 including magnetic material and provided with a conducting surface engaging the top cover plate 23 of the housing 13 when in the position shown in FIGURE 2. The plunger and top end plate 22 are normally held in the position shown by a biasing spring 24. Movement of the plunger is effected by electro-magnetic coils 25 surrounding a magnetic core 26 serving as a guide for the plunger itself. The plate 22 functions as an armature to complete the magnetic circuit when pulled downwardly. As shown in FIGURE 2, the electrical conductors 14 connect to the coils 25 so that the same can be energized to operate the switch from a remote location.

The flexible reed 18 is biased to the position shown in FIGURE 2 so that its free end engages the outer conductor of the co-axial connection 11 as at 27. Thus when the switch is in the "off" position as shown in FIGURE 2, the connection between the inner-conductors is broken and one of the inner-conductors such as 16 is

grounded thereby providing excellent isolation between the connectors 10 and 11.

When it is desired to operate the switch to close the connection between the lines, a signal is passed through the leads 14 to the electro-magnetic coils 25 which pull the plate 22 downwardly to move the plunger 21 against the reed 18. This action will then move the free end of the reed onto the flat contact surface 20 of the contact end of the inner conductor 17 as shown in FIGURE 3. In this position, it will be noted that a straight through connection is effected between the inner conductors whereby discontinuities in the geometry of the co-axial lines are minimized.

When it is desired to open the switch, the signal is removed from the conductors 14 thereby permitting the spring 24 to return the plate 22 and plunger to the position shown in FIGURE 2. The resilient nature of the reed in turn will then move its free end back to the grounded position shown in FIGURE 2.

The preferred embodiment of the switch also includes a stub for effecting a filtering operation when the switch is in its "on" position. This stub comprises a conductor 28 disposed within the plunger 21 and having its lower end arranged to make electrical contact with the reed 18 as at 29. The upper end of the plunger 28 in turn electrically connects to the top plate 22. The length of the conducting portion between the point of contact 29 and plate 22 is made equal to one quarter of the mean operating wave length of the electro-magnetic energy to be passed by the switch. When the switch is in the "off" position as shown in FIGURE 2, the conductor 28 within the plunger 21 has no effect. On the other hand, when the switch is in the "on" position shown in FIGURE 3, the conducting portion 28 within the plunger serves as a quarter wave stub and thus only electro-magnetic energy in which the stub appears as an open circuit will be passed between the co-axial connectors 10 and 11 and all other energy of different frequencies will be filtered by the switch.

Several advantages accrue from the foregoing described construction. As already mentioned, the use of the flexible reed enables a straight through connection to be effected when the switch is in the "on" position so that proper impedance matching and minimum reflections are realized. In addition, the reed itself is of extremely small mass. This feature coupled with the fact that the free end of the reed need only move a very few mils in order to make or break the connection renders the switch extremely reliable even under high g loadings, shocks or other severe environmental conditions. It should be

noted that the desired filtering action is accomplished by the plunger structure itself so that the one moving component of the actuating structure serves a dual purpose.

Modifications that fall clearly within the scope and spirit of this invention will occur to those skilled in the art. The co-axial switch is therefore not to be thought of as limited to the particular embodiment set forth merely for illustrative purposes.

What is claimed is:

10 A switch for high frequency electro-magnetic energy, comprising: a switch body having input and output co-axial connectors in opposite ends, the outer conductors of said connectors being axially aligned and connecting to said body and the inner conductors of said connectors being axially aligned and terminating within said body in 15 opposed spaced contacts; a conducting reed disposed between said connectors and adapted upon movement to electrically connect said contacts; an actuating means extending laterally into said body between said connectors, said actuating means including: a plunger; electro-magnetic coils surrounding said plunger, one end of said plunger engaging said conducting reed; and a plate of magnetic material secured to the other end of said plunger for effecting inward movement thereof upon energization 20 of said coils to move said reed to connect said contacts and effect a straight-through co-axial connection, said plunger including a conducting portion in electrical contact with said reed at one end and said plate at its other end, said plate having a conducting surface which engages said body when said coils are energized and said plate 25 is moved, said conducting portion of said plunger having a length equal to an odd multiple of the quarter wave length of the mean wave length of said electro-magnetic energy, whereby said plunger electrically connects said reed to said body when said straight-through co-axial connection is effected to provide a quarter wave length filtering stub. 30 35 50

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