March 19, 1968 R. E. MOORE ETAL 3,374,449

COAXIAL SWITCH

Filed March 21, 1966 2 Sheets-Sheet 1

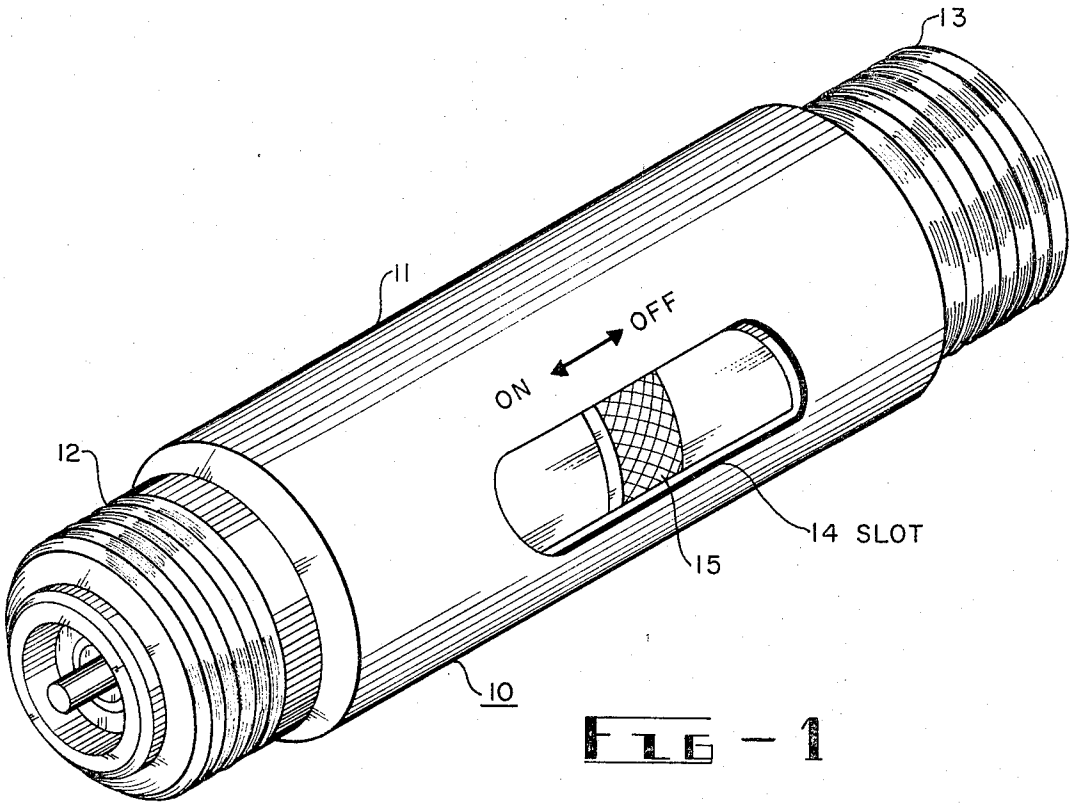

FIG - 1

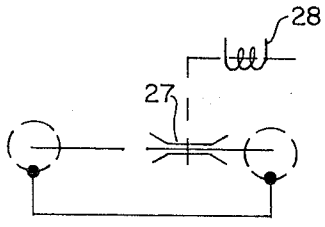

FIG - 4

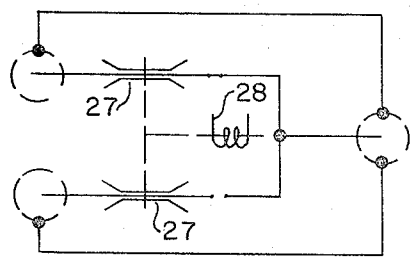

FIG - 5

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March 19, 1968 R. E. MOORE ETAL 3,374,449

COAXIAL SWITCH

Filed March 21, 1966 2 Sheets-Sheet 2

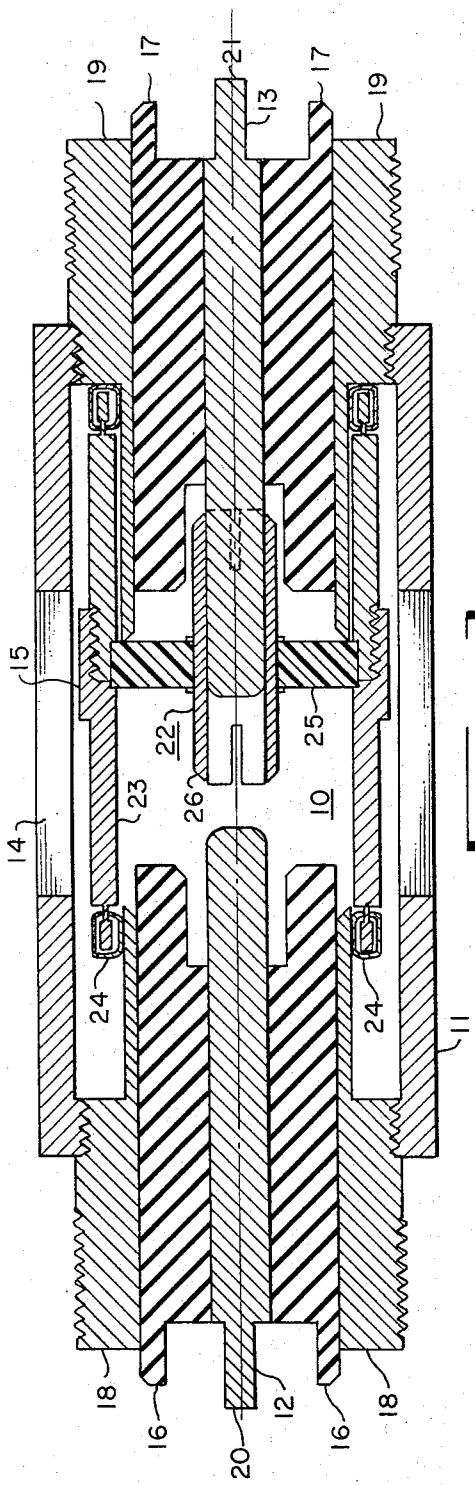

FIG - 2

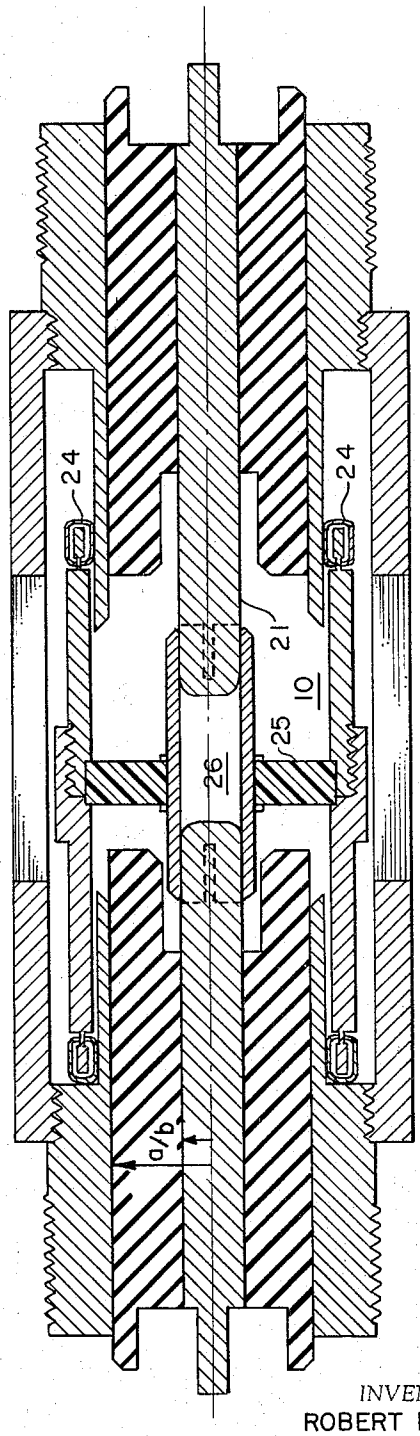

FIG - 1

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COAXIAL SWITCH

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9 Claims. (Cl. 333—97)

This invention relates to switching of shielded cables, such as coaxial transmission lines.

It has been found that existing switching devices used for coaxial transmission lines do not provide efficient high insulation or are constructed in such a manner that disturbances are noted during switching.

The present coaxial switch is of a simple yet highly reliable construction which maintains a constant characteristic impedance between inner and outer conductors and provide high isolation unbalanced signal switching at near unity voltage standing wave ratio (VSWR) and high power loads.

Accordingly, it is an object of the present invention to provide a novel switch for electrically connecting a transmission line while maintaining a constant characteristic (surge) impedance.

Another object of the present invention is to provide a coaxial transmission line switch in which the capacity per unit lengths between inner and outer conductors is maintained constant throughout the switch including an inherent low percentage of reflection and associated energy loss.

Other objects and features of the present invention will appear more fully hereinafter from consideration of the following detailed description in connection with the accompanying drawings which disclose the preferred embodiment of the invention. It is to be expressly understood, however, that the drawings are designed for the purpose of illustration only and are not to be construed as a definition of the limits of the invention, reference for the latter purpose being had to the appended claims.

Referring now to the drawings:

FIGURE 1 is an isometric illustration of the switch;

FIGURE 2 is a longitudinal cross section of the switch as shown in FIGURE 1 in the "off" position;

FIGURE 3 is a longitudinal cross section of the switch as shown in FIGURE 1 in the "on" position;

FIGURE 4 is an electrical diagram wherein the switch is used in a single pole, single throw configuration.

FIGURE 5 is an electrical diagram wherein two switches are used forming a standard coaxial "T" connection to single pole, double throw.

In general the switch comprises the end portions of two coaxial transmission lines having outer conductors joined in a continuous connection through the housing body which mounts the two coaxial end portions together along a common axis and wherein the inner conductors are terminated in spaced relationship. A connector means comprising an outer conductor with sliding spring-loaded contact rings and a hollow inner conductor, mounted therewith through a non-conducting means, is slidably positioned in said housing and limited to reciprocal movement. The connector means will switch the inner conductors in the "on" or "off" position.

Referring now to the drawings wherein similar reference characters denote similar elements throughout the several views:

There is shown in FIGURE 1 the coaxial switch **10**, comprising a housing **11** with a coaxial cable mounting means **12** and **13** on each end of the housing **11**. A slot **14** is provided within the housing **11** for permitting access to a ring-shaped knurled surface **15** for actuating the switch **10** in an "on" or "off" position.

In FIGURE 2 there is shown in cross section the

switch **10** and mounted at each end the two coaxial cable mounting or connection units **12** and **13** to which extended coaxial transmission lines are adapted to be joined. The coaxial cable mounting means **12** and **13** comprises insulator means **16** and **17** separating outer conductors **18** and **19** from the inner conductors **20** and **21** respectively. Inner conductor **21** is slightly larger than the inner conductor **20**. A connecting means **22** comprises an outer cylindrical conductor **23** with spring-loaded ring-shaped sliding contacts **24** at each end. Part of the outer cylindrical conductor **23** is elevated and has a knurled surface **15**, as shown in FIGURE 1, which is visible and easily accessible through slot **14**. The connecting means **22** comprises further an inner circular ring-shaped insulator **25** of polyethylene foam or the like, which holds a hollow conductor **26**. The hollow conductor **26** is slidably positioned about the inner conductor **21** of the coaxial mounting means **13**.

FIGURE 4 illustrates an electrical diagram wherein the coaxial switch **10** is symbolically represented as reference character **27** and wherein an actuator **28**, such as an electromagnet or the like, is shown for remote switching. The circuit shown is a configuration of a single-pole, single-throw type.

FIGURE 5 illustrates an electrical diagram wherein two coaxial switches are used, one in a reversed position from the other for forming a standard coaxial "T" connection for a single-pole, double-throw configuration.

The switch **10** is operated by moving the connecting means **22** which is provided with a knurled surface **15** into the "on" or "off" direction which will in turn connect or disconnect the inner conductor. Because of the manner in which this switch is constructed the continuity of the outer conductors is maintained through the housing material and also through the slidable outer cylindrical conductor **23**. By keeping the outside diameter of the inner conductor in equal ratio with the inner diameter of the outer conductor, constant characteristic impedance is maintained. Therefore, ratio between the outside diameter of the inner conductors **20** and **21** and the inside diameter of the outer conductors **18** and **19** of the switch **10** is maintained constant through said switch at a value which provides a characteristic impedance equal to the coaxial lines (not shown), attached at each side of the switch. This relationship maintains equal capacity per unit length of the coaxial switch and attached lines so that constant surge impedance is maintained throughout the switch **10**, thus reducing energy losses due to mismatch and reflection. The connecting means **22** has an outer cylindrical conductor **23** and hollow inner conductor **26** which when the switch **10** is in the "on" position, are without slots, apertures or openings, thus practically identical to a situation of "no switch" existence. The omission of openings in the conductor sides does not produce interferences or disturbances to the electrical signal.

The ratio between the inner conductor and outer conductor of the switch is equal at all points (see "*a*/*b*," FIGURE 3) thus providing equal capacitance and characteristic impedance except for the small area where the insulation means **25** is positioned. The distance is slightly increased in that area in order to obtain the same characteristic impedance because of the inclusion of the foamed polyethylene or the like dielectric material of insulation means **25**. Therefore, it can be stated that at all points between the inner and outer conductors in the switch in the "on" position, the capacitance and characteristic impedance are equal. Electrically, as shown in FIGURES 1 to 4, the basic unit is a single-pole, single-throw configuration constructed in a most simple manner along a longitudinal axis common with the transmission lines to be switched. For electrical configurations where the feature of a standard coaxial "T" connection is de-

sired, two single-pole switches could be used by reversing one unit. As shown in FIGURE 5 the use of two switches can thus form a single-pole, double-throw device. It should be understood that by using a mechanical yoke and solenoid unit attached to the switches an electrical mechanical switching can be envisioned which may or may not be remotely controlled.

We claim:

1. A switch comprising:
(a) two coaxial transmission lines having outer conductors joined in a continuous connection and having inner conductors terminated in spaced relationship,
(b) a connector means having an outer conductor slidably arranged on said joined outer conductors and a hollow inner conductor,
(c) said hollow inner conductor attached to said slidable outer conductor by a non-conducting means, and
(d) said hollow inner conductor slidable positioned on one of said inner conductors and adapted to contact said other inner conductor by actuating said connector means.

2. A switch as claimed in claim 1 wherein said joined outer conductors are provided with an elongated slot to enable reciprocal actuation of said connector means.

3. A switch as claimed in claim 1 wherein said slidable arranged outer conductor of said connector means is provided with resilient means to maintain electrical contact thereby forming an additional continuous path for said joined outer conductors of said two coaxial transmission lines.

4. A switch as claimed in claim 1 wherein said hollow inner conductor is provided with resilient means for producing an electrical and mechanical contact with each said inner conductors terminated in spaced relationship when said connector means is actuated.

5. In a transmission line switching device comprising:
(a) a housing,
(b) two coaxial transmission line input receptacles being opposedly positioned in said housing along a common axis and having each inner conductor terminated within said housing in spaced relationship from one another and outer conductors mounted in said housing, and
(c) a connection means, for creating a continuous electrical path between said inner conductors and said outer conductors respectively, having an outer conductor slidably engaging with both said outer conductors of said receptacles to form a continuous electrical path and a hollow inner conductor resiliently fitting about one of said inner conductors and positioned for sliding movement along said axis for providing an electrical continuous path by contacting in resilient arrangement with said other inner conductor when said connection means is actuated.

6. A switching device as claimed in claim 5 wherein said housing is of a conductive material and provided with at least one slot for reciprocally actuating said connection means.

7. A coaxial switch comprising:
(a) two coaxial transmission line coupling elements having outer conductors joined in an unbroken connection by means of a housing enveloping said two coaxial transmission line coupling elements, and inner conductors terminating in spaced relationship,
(b) a conductive hollow member being slidably positioned about one of said inner conductors and adapted to contact said other inner connector for forming an unbroken electrical connection between said inner conductors,
(c) a reciprocally movable hollow connector having sliding contacts on each end in contact with said outer conductors,
(d) insulating means mounted between said reciprocally movable hollow member and said conductive hollow members, and
(e) said housing enveloping said two coaxial transmission line coupling elements and being provided with a slot to enable actuation of said reciprocally movable hollow connector whereby said inner conductors are switched in an isolation for maintaining undisturbed signal switching.

8. A coaxial switch comprising:
(a) a conductive housing being a cylindrical hollow shape,
(b) two coaxial transmission line coupling elements connected at each end of said housing,
(c) said coaxial coupling elements having outer conductors attached into said housing, and inner conductors terminating in spaced relationship with one another along a common axis within said housing and insulation means separating said inner conductors from said outer conductors,
(d) a reciprocal movable connecting means having a cylindrical shaped outer connector provided with resilient contact sliprings at each end contacting each of said outer conductor within said housing and an inner hollow connector mounted by an insulation ring within said cylindrical shaped outer connector, and
(e) said hollow connector slidably and guidedly positioned about one of said inner conductors and adapted to move along said common axis to provide electrical contact with said other inner conductor by movable actuation of said connecting means whereby said inner conductors and hollow connector are so located with respect to said outer conductors and said cylindrical shaped outer connector that a constant characteristic impedance exists providing a unity voltage standing wave ratio for signal switching.

9. The coaxial switch as claimed in claim 8 wherein resilient means is provided at the contact end portions between said hollow connector and said inner conductors for keeping a mechanical and electrical contact with said inner conductors.

No references cited.

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