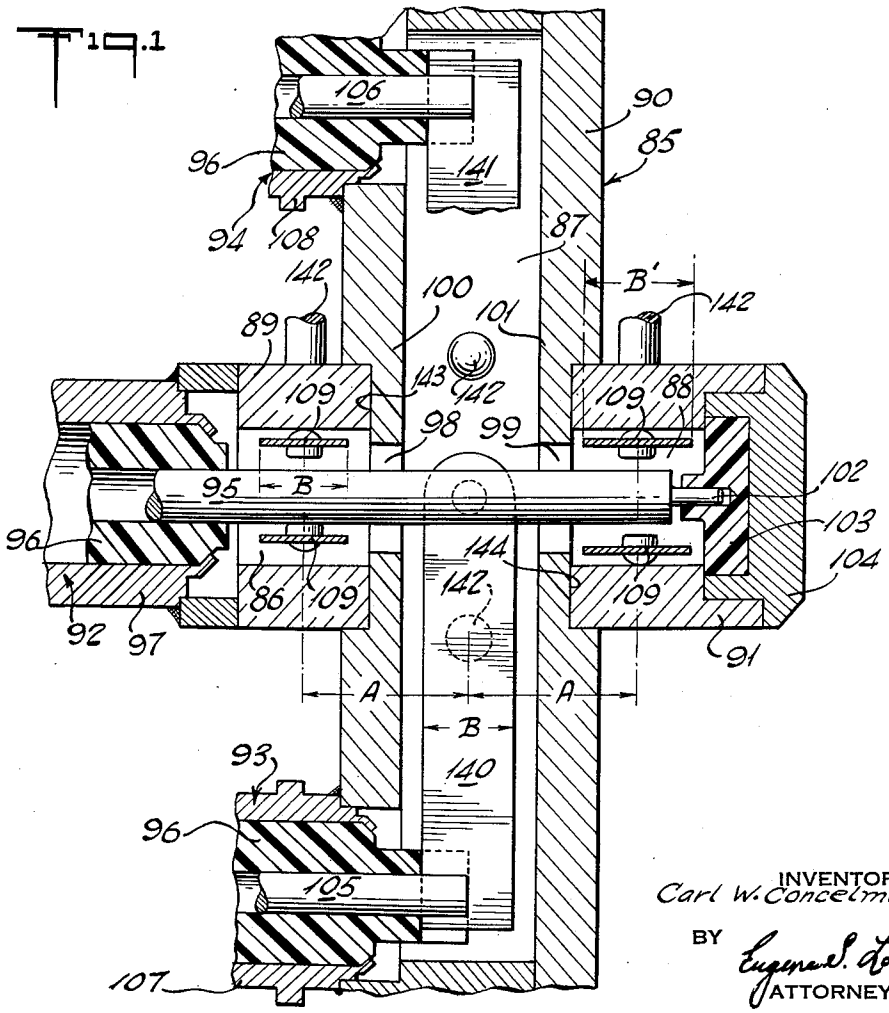
Jan. 9, 1962 C. W. CONCELMAN 3,016,496

MULTI-CHAMBER COAXIAL LINE SWITCH APPARATUS

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Fig. 1



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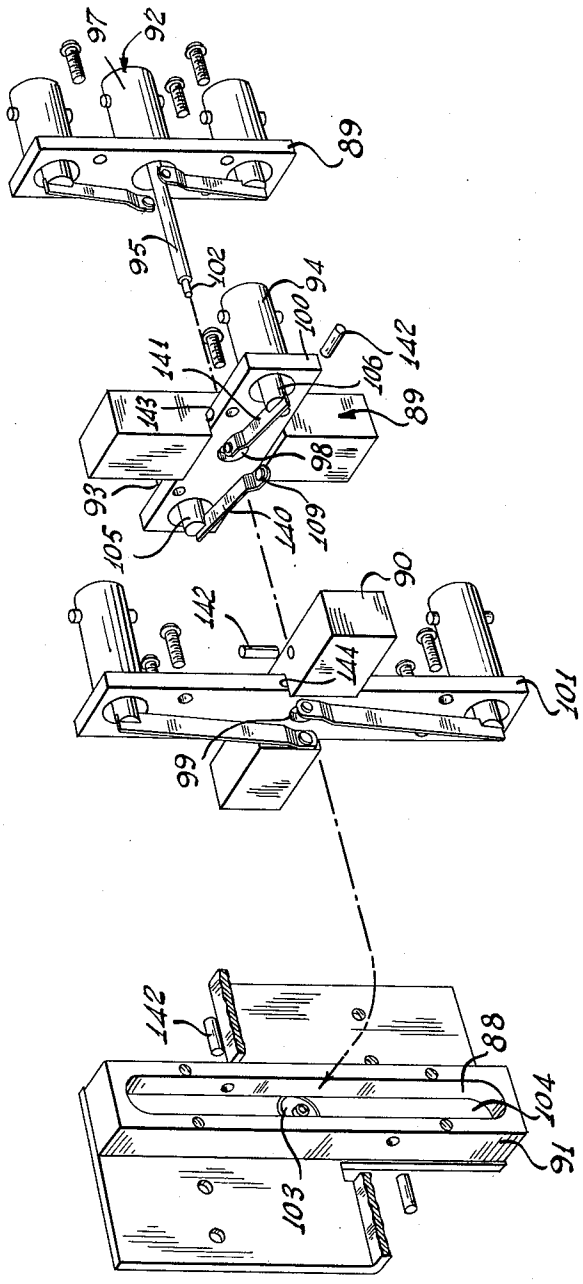


FIG. 2.

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MULTI-CHAMBER COAXIAL LINE SWITCH APPARATUS

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This invention relates to an electrical switch relay and, in particular, to a coaxial switch relay adapted to connect individually and selectively a first high frequency coaxial transmission line to individual ones of a plurality of high frequency coaxial transmission lines.

This application is a continuation-in-part of co-pending application Serial No. 627,049 filed December 7, 1956 and now Patent No. 2,958,052 for "Coaxial Line Switch Apparatus."

The improvements claimed herein are concerned with electrical switches of the type disclosed in U.S. Patent 2,859,311 entitled "Electrical Switch" and issued November 4, 1958. In particular, the invention of the instant application is directed to provide a multi-chamber switch having improved cross-talk characteristics over a wide band of frequency operation. As used herein, cross-talk means picking up a signal in the inactive transmission line, which may be opened, grounded or resistive terminated, as a result of a relatively imperfect isolation of such inactive line from the active circuit of the switch.

It is the main object of the invention to provide multi-chamber electrical switch relay apparatus for interconnecting individually and selectively the first coaxial transmission line to any one of a plurality of coaxial transmission lines and which affords improved broad band operation with better cross-talk characteristics than heretofore achieved.

It is a further object of the instant invention to provide a multi-chamber coaxial switch for connecting a first coaxial transmission line to a plurality of such lines in which the chamber supports are alternately crisscrossed, whereby all the switch connectors are accessible from one side of the structure thereby allowing individual connection to the coaxial lines at said one side of the switch. In addition, the crisscrossed structure incorporates recessed attachment of adjacent chamber supports so that the inner conductor common to the multi-chamber is relatively shorter in longitudinal length to reduce the reactive stub effects created by the conductor by reason of its communicating with all the chambers.

It is a further object of the invention to provide a multi-chamber coaxial switch having economy of design, fabrication and use.

Further objects and advantages will become apparent from the following description of the invention taken in conjunction with the figures, in which:

FIG. 1 is an elevational view in section and partly cutaway of a multi-chamber switch incorporating the improvements of the invention; and

FIG. 2 is an exploded view in perspective of the switch apparatus.

An embodiment of the invention is shown in the figures in which a multi-chamber switch **85** employs three longitudinal interior switch chambers **86, 87, 88**. It will be understood that switch apparatus incorporating the invention may involve two or more chambers stacked in crosscross fashion. A three chamber switch is shown herein for illustrative purposes. Chambers **86, 87, 88** are defined by the opposed interior surfaces of the conducting walls including end walls of the individual switch support bodies **89, 90, 91**. In comparison to the stacked multi-chamber switch of Patent 2,859,311, one advantage of stacking the adjacent switch bodies in crisscross

fashion as contemplated herein permits the coaxial connectors of switch **85** to extend from the same side of the stacked switch for connection with the individual coaxial transmission lines. In addition, and as a further advantage of the instant invention, the length of inner conductor **95**, which is common to all the chambers, is less than the length of the common inner conductor of the equivalent switch made in accordance with the prior art, i.e., a stacked multiple chamber switch wherein the chambers are longitudinally parallel.

The individual chamber supports **89, 90, 91** are substantially identical in structure and operation except for the structural variations described hereinafter to accommodate passage of the longitudinal inner conductor **95** which is an extension of the switch connector **92**. In addition to coaxial connector means **92**, each chamber support **89, 90, 91** is provided with a pair of spaced connectors having individual inner conductors extending into the respective chambers **86, 87, 88** adjacent the end walls thereof. For example, FIG. 1 shows the pair of connectors **93, 94** operatively associated with chamber **87** and the individual inner conductors **105, 106** thereof supported concentrically by dielectric elements **96**. The outer conductors of these connectors and connector **92** are supported by the switch body in accordance with known practice and thus are conductively connected to the chamber walls. The common inner conductor **95** is concentrically supported at its connector end by suitable dielectric material **96** and extends into and through chambers **86, 87, 88** via through bores **98, 99** in the conducting walls **100, 101** of the adjacent chambers. The inner conductor end **102** remote from connector **92** is supported in a dielectric material plug **103** to maintain desired concentric relationship of the inner conductor over its full length with respect to the chambers through which it passes. Plug **103** is supported in conductive wall **104** of chamber **88**. Chambers **86, 88** are longitudinally oriented so that their longitudinal axes are parallel, for example, both are normal to the plane of the paper for FIG. 1. Chamber **87** is interposed the other two chambers and it is longitudinally oriented so that its axis is turned angularly 90° with respect to the parallel axes of chambers **86, 88** as shown in the figures.

A pair of longitudinal deflectable and resilient conductive switch arms are supported in each chamber. Reference members **140, 141** identify the switches operatively contained in chamber **87**. One end of each switch arm is firmly connected to and supported by a respective inner conductor adjacent the end wall of the chamber containing the switch arm. The free end of each switch arm is provided with a contact terminal **109** projecting between one side of common center conductor **95** and a section of the chamber wall confronting said one side of conductor **95**. As known in the art, the free end of each switch arm is adapted to connect conductively with common inner conductor **95** when a deflecting stress is imparted to the arm. This action couples the transmission line connected to connector **92** to the transmission line connected to the connector operatively associated with the temporarily "closed" switch arm, whereby the closed switch arm and the surrounding chamber walls serve as a connecting section of coaxial line for coupling such transmission lines. Upon releasing such deflecting stress, the free end of the switch arm returns to connect conductively with the juxtaposed chamber wall by reason of the return resilient characteristics of the switch arm. The deflecting stress action may be imparted to each arm by switch actuators in accordance with known practices and which include individual dielectric members **142** passing through suitable openings in the chamber walls whereby the inner ends of the dielectric members **142** engage individual ones of the switch arms. The ends of

dielectric members **142** exterior of the chambers are in operative association with respective relay means (not shown) which relays are mounted on the exterior of the switch body for driving the individual members **142** to deflect its corresponding switch arm in accordance with known practices. Accordingly, it is understood that the free end of each switch arm makes connection with inner conductor **95** while its relay is energized. On the other hand, it will be understood that the individual switch arms are normally unstressed, whereby the free ends thereof are conductively in contact with the juxtaposed chamber walls which renders inactive the transmission line circuit connected to the connector operatively associated with such arm. Furthermore, it will be understood that the geometries of the switch arms and the chambers containing same, such as the cross-sectional planes of the chambers normal to longitudinal axes thereof, are selected in accordance with the known practices of the art to provide desired impedance match coaxial sections for connecting the individual ones of the transmission lines connected to the end connectors with the transmission line connected to connector **92**.

In accordance with the practice of the invention, the width "B," the horizontal dimension in FIG. 1, of arms **140, 141** of chambers **86, 87** is made less than the width "B′ " of the arms of the far chamber **88** to offset the reactive capacitive stub effect reflected into chambers **86, 87** by common conductor **95**. For a switch designed to operate over a broad band up to approximately 1500 megacycles and provided with .250 inch square chambers **86, 87, 88**, width "B" for the arms in chambers **86, 87** were chosen .156 inch and the width "B′ " for the arms in chamber **88** were chosen .200 inch.

Although the embodiment illustrates the deflectable end supported type of arm structure, it will be understood that the type of arms illustrated in the embodiments of FIGS. 1, 2 and 3, or the arm structure illustrated in the embodiment of FIG. 4, of Serial No. 627,049 may be used in lieu thereof to obtain the electrical and mechanical advantages of the latter type of structures.

The opposite side walls of center chamber **87** are recessed or undercut at **143, 144** along axes perpendicular to the longitudinal axis of chamber **87**. The support structures **89, 91** of the two outer chambers **86, 88** fit into respective undercuts **143, 144**. This technique allows one to diminish spacings A, A between the center lines of adjacent chambers which would otherwise be spaced further apart. As a result, the over-all longitudinal length of common inner conductor **95** is correspondingly shortened by an amount approximately equal to the aggregate depth of the two undercuts **143, 144**. Shortening conductor **95** reduces the reactive stub effects produced by the common conductor **95** in the circuits of the chambers. Consequently, the crisscross embodiment provides a broader band of acceptable standing wave operation as an advantage in respect to the equivalent prior art embodiment. As a result of the foregoing crisscross chamber structure resulting in a common conductor **95** which is relatively short, this arrangement assures that during operation of the switch, the voltage of signals switched to any one of the six end connectors will be substantially the same if the signals were switched to any other of the six end connectors. In other words, the voltage of the signals switched by switch **85** to any one of the end connectors will not vary by reason of the length of the common inner conductor **95** particularly at the higher frequencies of operation and thus the switch maintains uniformity of the signal along conductor **95** over a relatively wide band of frequency operation. It will be seen from FIG. 2 that the longitudinal length of the third chamber **88** is longer than the length of the other two chambers to provide mechanical clearance for the end connectors communicating with chamber **88** as these connectors project past and straddle the switch bodies of the other chambers.

It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electrical switch for selectively and individually connecting a first high frequency coaxial transmission line to any one of a plurality of such transmission lines comprising, a switch structure having a plurality of switch body supports each provided with an individual longitudinal internal chamber defined by opposed interior conductive walls including end walls, said body supports being alternately crisscrossed thereby angularly displacing the longitudinal axes of adjacent chambers, a pair of coaxial connector means supported by each switch body, each connector of said pair having an individual inner conductor extending into its correlated chamber adjacent an end wall thereof, said connectors being supported from said structure for connection with individual ones of said plurality of transmission lines, an additional coaxial connector supported from one side of said structure by one body support for connection with said first transmission line, adjacent chambers having a contiguous conductive wall provided with a through bore aligned with said additional connector, dielectric means in a chamber conducting wall furthest from said additional connector and being aligned therewith, said additional connector having longitudinal inner conductor extending through said chambers and having its end remote from said additional connector supported by said dielectric means, said inner conductor being common to said chambers, the axis of said common inner conductor being angularly displaced with respect to the individual axes of said chambers, a pair of movable conductive switch arms supported in each chamber between said common inner conductor and a respective one of the inner conductors extending therein adjacent the chamber end walls thereof for making and breaking electrical connection between such respective inner conductors and said common inner conductor, each arm having a free end for conductively connecting alternately with one side of said common inner conductor and the confronting portion of the chamber wall containing said arm, means for selectively actuating said switch arms from one another of two positions wherein movement of each arm to a first position conductively connects its respective inner conductor with said common inner conductor, movement of each arm to its other position conductively connects its respective inner conductor to said chamber wall.

2. Apparatus as defined in claim 1 wherein, the contiguous conductive walls of adjacent chambers are recessed to reduce the spacing which would otherwise exist between said additional connector and said dielectric means so that the longitudinal length of said common inner conductor is shorter than the length of the conductor without recessed contiguous conductive walls, whereby the reactive stub effects produced by said common inner conductor by reason of intercoupling said chambers is reduced.

3. Apparatus as defined in claim 1 wherein, the cross-sectional width dimension of the switch arms suspended in certain of said chambers being slightly less than the cross-sectional width dimension of the switch arms suspended in the chamber furthest from said additional connector in order to compensate for the capacitive reactive stub effect produced by said common conductor.

No references cited.