

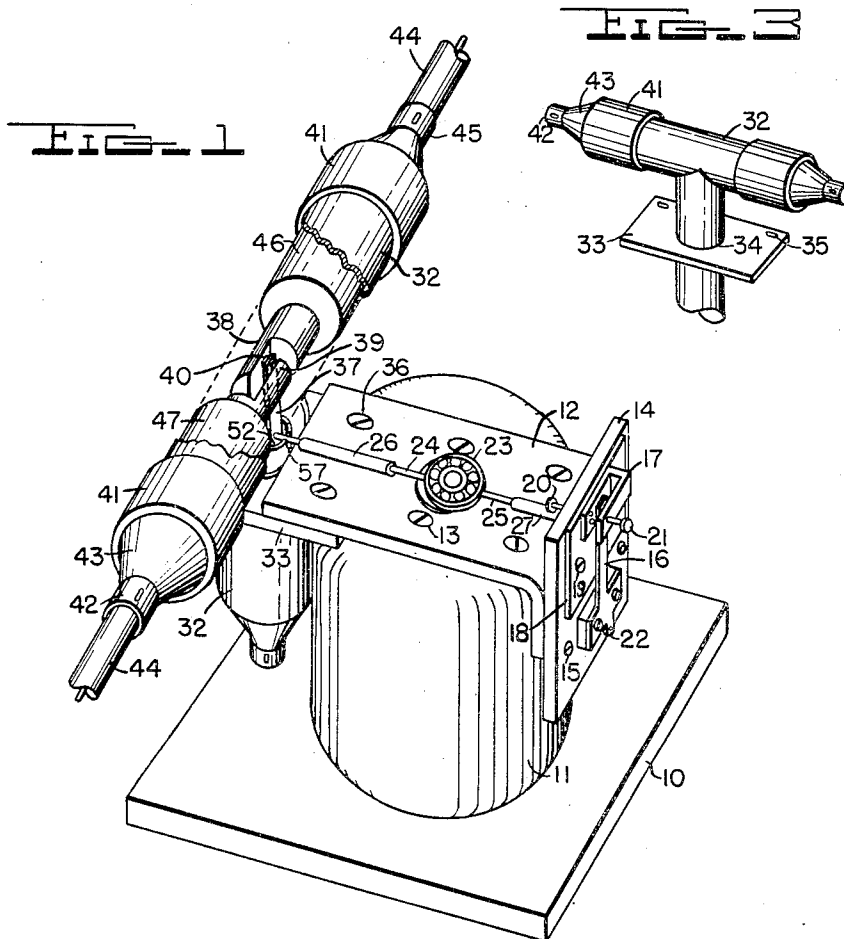
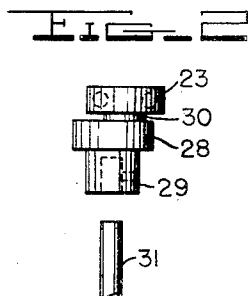
July 17, 1951

C. R. ELLIS ET AL
ELECTRICAL SWITCH

2,560,561

Filed Aug. 9, 1945

2 Sheets-Sheet 1



Inventors

C. RICHARD ELLIS
WILLIAM E. FRYE

By *Ralph L. Chappell*

Attorney

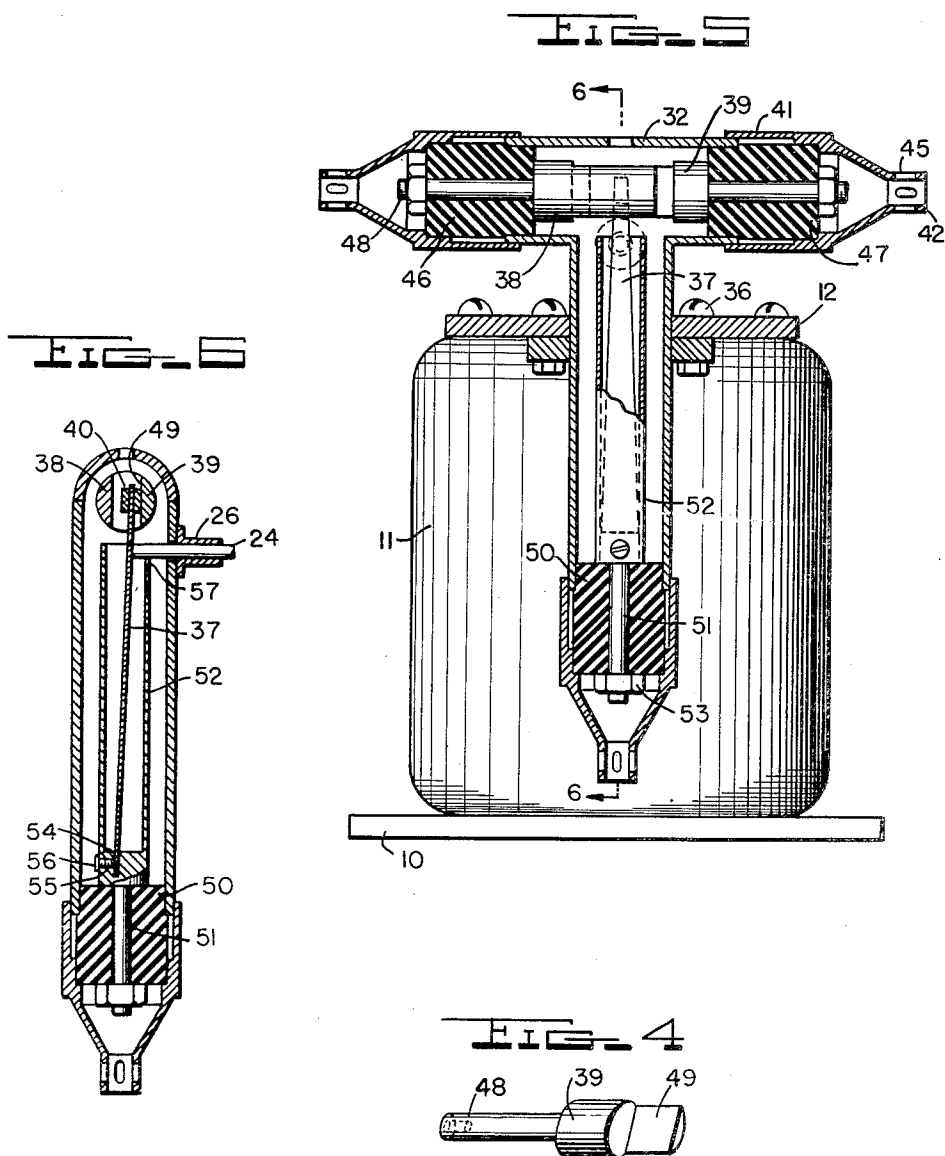
July 17, 1951

C. R. ELLIS ET AL
ELECTRICAL SWITCH

2,560,561

Filed Aug. 9, 1945

2 Sheets-Sheet 2



Inventors

C. RICHARD ELLIS
WILLIAM E. FRYE

334 *Ralph L. Chappell*

Attorney

UNITED STATES PATENT OFFICE

2,560,561

ELECTRICAL SWITCH

C. Richard Ellis, United States Navy, and
William E. Frye, Washington, D. C.

Application August 9, 1945, Serial No. 609,907

4 Claims. (Cl. 200—153)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

1

This invention relates to electrical switches and more particularly to motor driven switches used in high frequency systems.

It is one object of this invention to provide a high speed electrical switch for radio transmission lines employed in high frequency systems.

It is another object of the invention to provide an electrical switch for radio transmission lines which presents a constant impedance despite movement of the movable contact in the switching operation.

With these and other objects in mind the invention may best be understood by reference to the drawings wherein:

Figure 1 illustrates a perspective view of one embodiment of the completed switch,

Figure 2 shows a detailed view of the co-member for actuating the contactor element of the switch,

Figure 3 illustrates perspectively a portion of the switch housing and an associated mounting member,

Figure 4 shows a perspective view of one of the contact members employed in the switch,

Figure 5 is an end view of the switch illustrating the switching mechanism in section with a shield therein partly broken away, and

Figure 6 is a longitudinal sectional view of the switching mechanism taken along line 6—6 of Figure 5.

In the figures of the drawing similar reference characters are employed to indicate similar parts of the invention.

The invention is characterized by a high-speed contact-making switch which passes high-frequency radio signals from a single transmission line to one or more other transmission lines. The switch is built in such a manner that the characteristic impedance of a centrally located movable contactor matches the impedance of either transmission line fed by the switch, thereby maintaining the peak efficiency of the transmission line system.

Referring now more particularly to the drawing, Figure 1 shows an embodiment of this invention which provides connection alternately between one transmission line and a second and third transmission lines. Figure 1 shows a base plate 10 having mounted on its upper surface an electric motor 11. The motor may be of either A. C. or D. C. construction and is secured to the plate endwise in order that its other end, having a rotatable armature shaft extended therefrom, is directed away from the plate.

An L-shaped bracket 12, having its long end

2

portion parallel to the base plate and its bent end resting against the vertical side wall of the motor, is secured to the upper end bell of the motor by screws 13 extending therethrough. A mounting block 14 attached to the short leg of the bracket by screws 15 provides a vertical support for a switch contactor 16 adapted to operate between the legs of a U-shaped contact carrying arm 17. An insulating plate 18 secured to the mounting block by screws 19 electrically isolates the attached U-shaped contact arm from the block. Contact carrying screws 20 and 21 are threaded through suitable apertures in the contact arm whereby they are extended therethrough to provide contacts on both faces of the switch contactor. An apertured lug 22 is provided at the lower end of the contactor for connection with an external circuit while the screw contacts may be connected to leads by soldering or other suitable means.

A cam 23 is fastened to the upper end of the motor shaft (not shown) and is adapted, during its rotation, to laterally reciprocate two shafts 24 and 25 located 180 degrees from each other on opposite sides of the cam's edge portion. Tubular housings 26 and 27 serve as guides for shafts 24 and 25 respectively. Housings 26 and 27 are integrally formed with L-shaped bracket 12.

Referring to Figure 2, a detailed view of the cam is shown wherein an eccentric 28 is machined from a single cylindrical piece of stock to provide extensions 29 and 30 on its opposite faces. Extension 29 is counterbored below its surface, as shown by dotted lines in the figure, to provide a seat for the reception of an end of the motor's armature shaft 31 which is locked thereon by a set screw.

A T-shaped tubular housing 32 comprises a horizontal tubular section of piping integrally joined at its center by another tube extending at right angles from the first pipe to form a T coupling. A mounting means consisting of an apertured metal plate 33 having a large opening 34 centrally disposed thereof is slid over the extended end of the central tube and is sweated thereto at right angles to its length intermediate its end and the junction of the pipes. Other openings 35 formed near the rear corners of the plate provide a means of holding the tube to the supporting bracket 12 by bolts 36.

A cylinder 52 has an aperture 57 at its upper end which is axially aligned with the bore of the housing 26 in order that the end of shaft 24 may extend therethrough to bear against a side of a spring biased terminal contact arm

37. The contact arm consists of a spring strip secured inside and at the base of cylinder 52 and is provided at its upper end with a selector contact in the form of a pair of contacting disks 40 of silver or other high electrically conductive material capable of resisting wear incident to arcing during transfer of energy to either contact. Reciprocating motion of shaft 24 moves the contact arm 37 and with it the selector contact 40 between a pair of spaced selectable contacts 38 and 39. One of the contacts is shown in Figure 4 wherein a circular rod of metal having high electrical conductivity has a reduced terminal engaging portion 48 while its other end presents an offset flat contact face 49 the outer surface of which forms a continuation of the cylindrical surface of the conductor rod. The terminal end 48 is counterbored, as shown by dotted lines in the figures, for the reception of the central conductor of a coaxial cable which may be soldered therein.

In Figure 1, end couplings 41 are internally threaded for engagement with the ends of the contactor housing 32 and each is provided with a reduced end portion 42 connected with the main body of the end coupling through a tapered shoulder 43.

The horizontal branch of the housing has coaxial transmission lines 44 secured to its ends by means of the end coupling while the vertical branch of said housing serves to connect a single transmission line to its extended end. Elongated slots 45 extend through the wall of the coupling ends 42 in order that the outer braid of the coaxial cable may be soldered thereto which provides continuity of the outer conductor from the first transmission line to the two transmission lines 44.

Polystyrene plugs 46 and 47 have central bores extending therethrough for the insertion of the contactors 38 and 39, respectively, and are adapted to be detachably secured within opposite ends of the horizontal tubing 32.

Figure 5 illustrates an end view of the switch mechanism, housing and its mounting block in section, as attached to the motor supported bracket 12. An insulating plug 50 having a central bore therethrough is adapted to receive a reduced end portion 51 of the cylindrical shield 52 which is rigidly tightened thereon by a nut 53. The cylinder 52, shown in the figure as being partly broken away, substantially encloses the terminal contact arm 37 to provide therefor an electrostatic shield which serves as explained below to maintain the impedance of the contactor section of the housing constant. The insulation plug and shield assembly is adapted to be inserted within the vertical extension of housing 32 and to be held therein by threading the end coupling nut thereon.

Reference is now made to Figure 6 which shows a longitudinal section through the switch along line 6-6 of Figure 5. A slot 54 is formed in the inner closed end of the cylinder 52 at an oblique angle to its longitudinal axis and provides a seat for the butt end of spring 37.

A threaded bore 55, extended through the wall of the shield at right angles to its axis, forms a connecting passage to the slot and serves to hold the spring's end against movement therein by threading a set screw 56 therein. The angle of the slot 54 biases the spring against the end of shaft 24 while the top, or contactor portion, of the spring bears against the face 49 of contact 39.

In a specific embodiment of this invention, the additional switch construction at the right end of bracket 12, Figure 1, was used as a means of synchronizing an associated apparatus with the operation of said embodiment. Upon energizing the motor 11, the rotation of its armature shaft will move the ball bearing cam assembly 23 between the shafts 24 and 25 located 180 degrees apart on bracket 12 whereby the shafts will be periodically and alternately pushed from the axis of the motor. Shaft 25 will therefore cause contactor 16 to successively break its inner contact 20, make its outer contact 21, and break it to establish connection again with its inner contact 20 during the revolution of cam 23 from the start of the outward travel of shaft 25.

Shaft 24 will be similarly actuated, but 180 degrees later, whereupon its end in contact with terminal contact member 37 will periodically push the spring away from contact 39 into engagement with the offset face of contact 38.

After the maximum displacement of the shaft 24 by the cam's continued rotation, pressure on the shaft's other end by the biased spring member 37 will cause it to move in the opposite direction whereby contact is again established between contactor 37 and contact 39.

Thus, it is seen that the energy transferred by the first transmission line through its coupling with the vertical section of the switch housing is alternately switched from one contact to the other as the cam turns 360 degrees. This energizes the two transmission lines 44 so that one is energized while the other is deenergized through their connections with the contact terminals.

Inasmuch as the vertical and horizontal sections of the coupling 32 have a characteristic impedance of a coaxial transmission line due to their constructions, a match is made between the sections and the cables. The electrostatic shield 52 which practically encircles the entire length of the spring strip 37 functions to extend the effective cross section of the spring to a cylinder having a fixed length and being maintained a constant distance throughout its length from the inner wall of the housing 32. This avoids the mismatch which would otherwise occur during the to and fro movement of the elastic terminal contact element 37 from the axis of the central section.

It is therefore seen that by new and novel construction of a switch a constant impedance is obtained throughout the coupling unit and that the slight movement of the contact disks between the contacts is insufficient to make an impedance change therein.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A coaxial cable switch comprising an outer tubular housing forming the outer conductor of a coaxial line, a pair of spaced contacts positioned substantially centrally within said housing, a movable contact arm having substantial length axially of said tubular housing carrying a selector contact at one end and movable laterally to move the selector contact into engagement with either one of said spaced contacts, and a second tubular housing for said contact arm electrically connected with the arm and coaxially disposed within said first housing to

5

effectively maintain the arm in the form of a stationary cylinder forming the central conductor of the coaxial line.

2. A coaxial cable switch comprising an outer tubular housing forming the outer conductor of a coaxial line, a stationary contact positioned substantially centrally within said housing a movable contact arm having substantial length axially of said housing carrying a movable contact at one end movable laterally to move the movable contact into and out of engagement with the stationary contact, and a second tubular housing for said contact arm electrically connected with the arm and coaxially disposed within said first housing to effectively maintain the arm in the form of a stationary cylinder forming the central conductor of the coaxial line.

3. A coaxial cable switch comprising a T-shaped tubular housing, a pair of inner coaxial conductors extending inwardly from the ends of the horizontal section and terminating in a pair of spaced selectable contacts situated substantially at the point of intersection of the axes of the horizontal and vertical sections of the housing, said contacts being spaced transversely of both said axes, a contact arm having a lower end mounted within the lower end of the vertical section of the housing and extending substantially centrally of said vertical section into the horizontal section, a movable contact carried by the contact arm between said spaced contacts, means for oscillating said contact arm to effect alternate connection of the movable contact with the spaced contacts, and a second tubular housing surrounding the contact arm to maintain the effective form and dimension of the contact arm equal to that of a fixed cylinder having a constant distance throughout its length from the inner wall of the housing.

4. A coaxial cable switch comprising a T-

6

shaped tubular housing having a pair of circular rod inner coaxial conductors extending inwardly from opposite ends of the horizontal section of the housing and terminating near the point of intersection of the axes of the horizontal and vertical sections of the housing in spaced overlapping reduced end portions having their outer surfaces forming a continuation of the cylindrical surfaces of the circular conductors, said spaced overlapping end portions forming a pair of spaced contact terminals for said pair of coaxial conductors, a contact arm having a lower end mounted within the lower end of the vertical section of the housing and extending substantially centrally of said vertical section into the horizontal section, a movable contact carried by the contact arm between said spaced contacts, means for oscillating said contact arm to effect alternate connection of the movable contact with the spaced contacts, and a second tubular housing surrounding the contact arm to maintain the effective form and dimension of the contact arm equal to that of a fixed cylinder having a constant distance throughout its length from the inner wall of the housing.

C. RICHARD ELLIS.
WILLIAM E. FRYE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,006,959	Mack	July 2, 1935
2,235,010	Chaffee	Mar. 18, 1941

FOREIGN PATENTS

Number	Country	Date
852,646	France	Oct. 30, 1939