

March 21, 1944.

W. KRAM ET AL

2,344,780

SWITCHING MEANS FOR INTERCONNECTING CO-AXIAL CONDUCTORS

Filed May 16, 1942

2 Sheets-Sheet 1

Fig. 1.

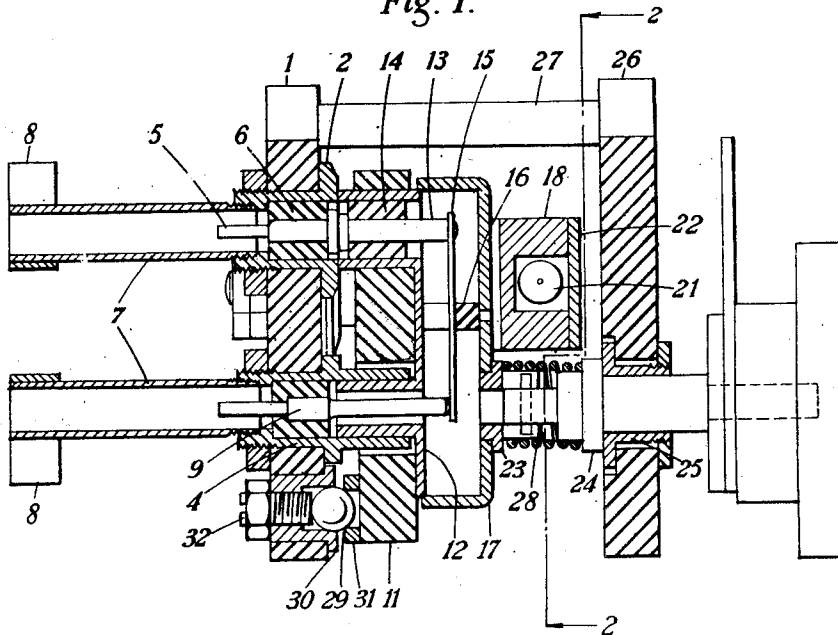
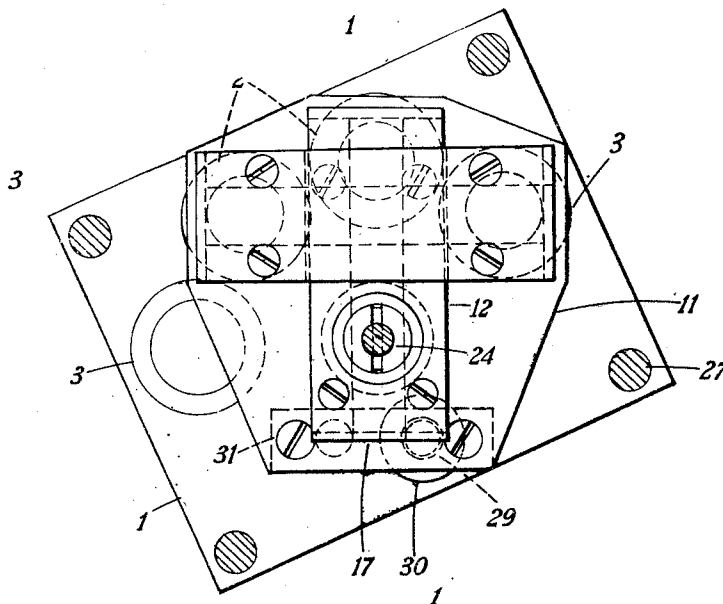


Fig. 2.



INVENTORS  
W. Kram  
F. L. J. Jarvis  
BY *J. P. Mone*  
ATTORNEY

March 21, 1944.

W. KRAM ET AL

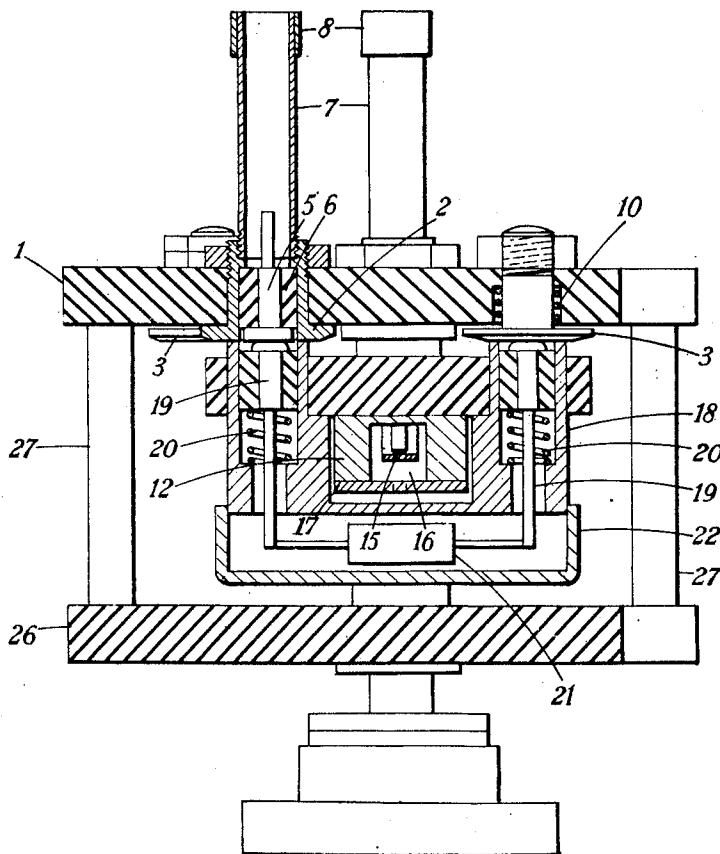
2,344,780

SWITCHING MEANS FOR INTERCONNECTING CO-AXIAL CONDUCTORS

Filed May 16, 1942

2 Sheets-Sheet 2

Fig. 3.



BY

INVENTORS  
W. Kram  
F. L. J. Jarvis  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,344,780

SWITCHING MEANS FOR INTERCONNECT-  
ING COAXIAL CONDUCTORSWalter Kram and Frank Lewis John Jarvis, Lon-  
don, England, assignors to International  
Standard Electric Corporation, New York, N. Y.Application May 16, 1942, Serial No. 443,286  
In Great Britain June 11, 1941

8 Claims. (Cl. 178-44)

This invention relates to the switching of coaxial conductors, e. g. coaxial cords or coaxial cables, and is an improvement in or modification of the invention for which United Kingdom Patent No. 513,287 was granted. For convenience hereinafter the term cable is used generically, the term conductor being reserved for the inner and outer elements of the cable.

Due to the higher frequencies employed in telecommunication the use of coaxial cables has become more frequent in apparatus—notably in testing gear.

One of the problems met with in the use of coaxial cables is the difficulty of quickly switching from one cable to another and still maintaining complete individual screening of the inner conductors. This complete screening of the inner conductors is essential in most circuits owing to the possibility of crosstalk occurring due to the high difference in level in the cables being switched. Another requirement is that as little impedance mismatching as possible be presented to the cables. It is also essential that contact resistance be low, especially the screen contacts, so that a low earth impedance can be maintained.

Advantages of the present invention are: the avoidance of extensions of the inner conductors, in other words the complete screening of the inner conductors; a rigorous wiping action, so that the contacts are maintained in a clean condition; and ready adaptability for switching of one incoming line to a number of outgoing lines. For a specific use to which the invention has been put, namely as a change-over switch of a filter test set, the further advantage is offered that it becomes possible to incorporate the appropriate terminating resistance in a fully screened condition.

The invention consists in a device for connecting together two of a plurality of coaxial cables while maintaining complete screening of the inner conductors from each other and externally.

A typical case in which a switch in accordance with the present invention has been found useful is in a certain H. F. filter test set where the switch in the "measure-test" position had to be capable of switching a coaxial cable to either of two other coaxial cables at will, the unconnected cable being terminated with a 75Ω resistance. The cables being switched might at any time have a difference in level of anything up to 80 db., while it was essential to switch the screens of the cables together with the inner conductors.

An embodiment of the invention as used in

that case has been shown in the accompanying drawings and will now be described, the three figures of the drawings being sections on the respective lines 1—1, 2—2, 3—3.

In the drawings, a mounting plate 1 of insulating material carries four Phosphor-bronze studs 2 and 3 and a Phosphor-bronze bearing piece 4. The studs 2 carry inner nickel silver studs 5 insulated from them by the pieces 6. The inner conductors of the two outgoing coaxial cables, to both of which the incoming cable can be switched, are connected to the studs 5, the screens of the cables being connected via the sleeves 7 to the studs 2. The pieces 8 are for clamping the ends of the sleeves 7 on to the screens of the cables. The incoming cable is connected in a similar manner to the bearing piece 4 and the central stud 3 carried in and insulated from the piece 4. The studs 3 which are also carried by the mounting plate 1 are plain flat top studs spring loaded by the springs 10, restriction of movement being effected by the two locknuts.

The rotor plate 11, of insulating material, carries a brass channel-shaped block 12 which has two tubes turned upon it. One of these tubes is a running fit in the bearing piece 4; the other tube, by turning the rotor plate about its bearing, makes contact with either of the two studs 2. This tube also carries a nickel silver stud 13 which is secured into an insulating plug 14. This plug is a sliding fit in the tube and is urged toward the stud 5 by the flat Phosphor-bronze spring 15, the other end of which bears on the stud 3. The spring is kept centrally in the channel piece 12 by the ebonite spacer 16. It will be seen that the channel piece 12 has a brass covering strip 17 secured to it.

Thus by rotating the rotor plate 11 about the bearing 4 one may make electrical contact between the inner conductor and the screen of the incoming cable and the inner conductor and the screen of either of the two outgoing cables. The inner conductors 5 and 3 of the two cable terminations on the face of the panel 1 and the connection between them over members 13 and 15, are completely screened by reason of the cable-like formation of the connecting member 11, 17 etc.

The rotor plate 11 also has secured to it another brass channel-shaped piece 18 which again has two tubes turned upon it. The ends of these tubes bear against the studs 2 and 3 on the mounting plate 1. Two nickel silver studs 19 secured into insulating plugs which are a sliding fit in the tubes, are urged by the springs 20 to

bear against the studs 3 or 5 (dependent upon the position of the rotor plate). Across the inner ends of the studs 19 is connected a 75  $\Omega$  resistance 21, housed in the brass channel piece 18, to which is secured a brass cover plate 22.

Thus it will be seen that when the incoming cable is connected to one of the outgoing cables the other outgoing cable has its inner conductor connected to its screen through a 75  $\Omega$  resistance, by reason of the fact that the stud 19 which is connected through the 75  $\Omega$  resistance to the inner conductor of the cable, is also connected to the brass channel piece 18 across the flat face of the stud 3. The channel piece 18 being in contact with the stud 2 is thence connected to the screen of the cable through the sleeve 7.

For a convenient means of rotating the switch from one position to the other a knob is provided: this is coupled to the rotor as follows. On the cover plate 17 is mounted a brass bush 23 in which is a hole, a running fit to take the end of the spindle 24. The drive is transmitted from the spindle by a pin working in a slot in the bush 23; the reason for this indirect method of coupling the spindle will be evident later. The spindle runs in a bearing 25 which is supported in the plate 26 which in turn is secured to the mounting plate 1 by the four pillars 27. A spring 28 is fitted to urge the rotor towards the mounting plate 1 so as to maintain good electrical contact between the sets of contact studs on the rotor plate 11 and the mounting plate 1.

A "click" mechanism is provided to locate the switch correctly in the two positions. This consists of a ball 29 which is carried in a cage 30 secured in the mounting plate 1 and which locates in either of two holes in the plate 31 secured to the rotor plate 11. When the ball locates in one of these holes the appropriate contact studs are lined up. Adjustment for the ball is provided by the screw 32.

It will be noted that in turning the switch from one position to the other, the ball 29 forces the rotor away from the mounting plate 1. The spindle 24 will allow this to happen as the driving pin in the end of the spindle will slide in the slot in the bush 23. The advantage of this "lifting-off" is the reduction in friction due to the smaller area then in contact between the studs on the mounting plate 1 and the rotor.

While the embodiment shown is of a form suited to perform a specialised switching operation the straightforward case of a multiple co-axial stud switch is obvious.

It will be seen that by this design complete screening of the inner conductors of the coaxial cables from each other and externally is maintained at all times; that, due to the slight rubbing of the contact studs before "lifting-off" occurs, low resistance contacts are maintained, this low resistance contact being most essential in the screen circuit; and that, owing to the comparatively short path between the incoming and outgoing cables no serious impedance mismatching will occur.

What is claimed is:

1. A switch device for connecting two of a plurality of co-axial cables, comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal elements insulated therefrom, a shiftable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable ter-

minals of two of the cables for closing of the circuits through the inner and outer terminals thereof and supplemental switching means having contact members and a resistance in a series therewith and adapted to engage respectively with the inner and outer terminal elements of a then non-connected cable.

2. A switch device for connecting two of a plurality of co-axial cables, comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal posts insulated therefrom, a rotary switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals of two of the cables for closing the circuits therethrough and supplemental switching means rotatively connected with the rotary switch member and having contact members connected to a resistance in series therewith and adapted to engage respectively with the inner and outer terminal elements of a then non-connected cable and means to effect yielding pressure engagement between the switch contacts and the cable terminal members.

3. A switch device for connecting two of a plurality of co-axial cables, comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal posts insulated therefrom, a rotatable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals of two of the cables for closing of the circuit through the inner and outer terminals thereof and supplemental switching means rotatively connected with the switch member and having contact members and a resistance in a series therewith and adapted to engage respectively with the inner and outer terminal elements of a then non-connected cable, said rotatable switch member and supplemental switching means being supported to permit retractive movement relative to the terminal members and resilient means operative to urge the switch members into pressure contact engagement with the terminals.

4. A switch device for connecting two of a plurality of co-axial cables, comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal posts insulated therefrom, a rotatable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals of two of the cables for closing of the circuit through the inner and outer terminals thereof and supplemental switching means rotatively connected with the switch member and having contact members and a resistance in series therewith and adapted to engage respectively with the inner and outer terminal elements of a then non-connected cable, said rotatable switch member being supported to permit retractive movement relative to the terminal member, resilient means operative to urge the switch members into pressure contact engagement with the terminals and engaging latching means carried by the supporting member and the rotatable switch member adapted yieldably to retain said members in stop position and resiliently to effect lifting release of

the contacts during movement from engaging position.

5. A switch device for connecting two co-axial cables alternatively to a third co-axial cable comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal posts insulated therefrom, the sleeve of one of said terminals being inwardly extended to provide a bearing portion, a rotatable switch member journaled in said bearing portion and having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals, a supplemental switching means carried by the switch member and provided with duplicate concentrically supported contact members and a resistance in series therewith and adapted to engage respectively with the inner and outer terminal elements of the non-connected cable and spring pressed switch studs fitted to the supporting member and positioned for completing the circuit of the supplemental switching means and said rotatable switch member and supplemental switching means being supported to permit retractile movement relative to the terminal member and co-axially supported operating means for the rotatable switch member journaled to permit movement longitudinally of its axis of rotation and having resilient means engaged therewith to urge the switch members into pressure contact engagement with the terminals.

6. A switch device for connecting two of a plurality of co-axial cables comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of

outer terminal sleeves and inner terminal elements insulated therefrom, a rotatable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals of two of the cables for closing of the circuits through the inner and outer terminals thereof.

7. A switch device for connecting two of a plurality of co-axial cables comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal elements insulated therefrom, a rotatable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable terminals of two of the cables for closing of the circuits through the inner and outer terminals thereof and said switch member being provided with screening means for protection of the circuits against induction interference.

8. A switch device for connecting two of a plurality of co-axial cables comprising a supporting member, cable terminal members for the respective cables supported therein and consisting of outer terminal sleeves and inner terminal elements insulated therefrom, a rotatable switch member having connected inner and connected outer contact elements movable therewith to engage the respective inner and outer cable elements of two of the cables for the closing of the circuits thereof and means to effect yielding pressure engagement between the switch contact elements and the cable terminal elements.

WALTER KRAM.

FRANK LEWIS JOHN JARVIS.