Nov. 9, 1943. H. F. MAYER 2,333,659

SHIELDING FOR HIGH FREQUENCY SWITCHES

Filed Oct. 2, 1941

Fig. 1.

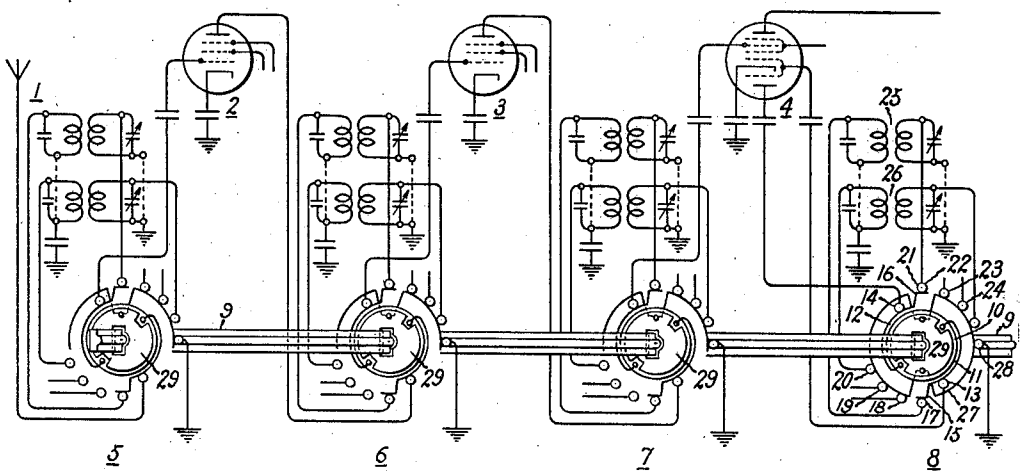


Fig. 2.

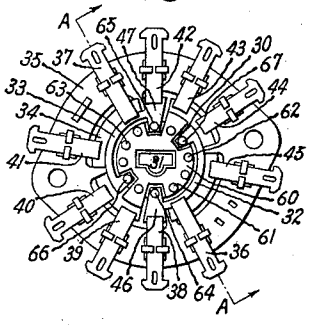


Fig. 3.

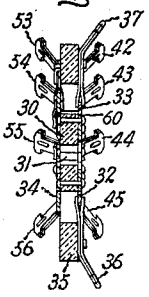


Fig. 4.

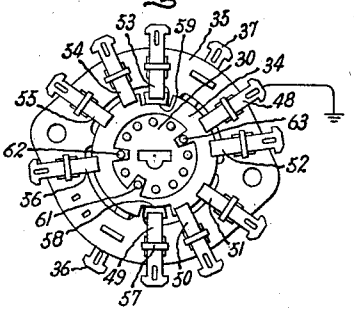


Fig. 5.

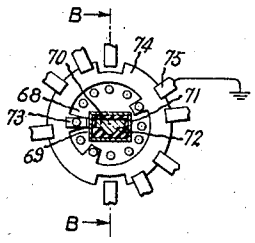
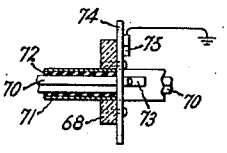


Fig. 6.



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SHIELDING FOR HIGH FREQUENCY SWITCHES

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Application October 2, 1941, Serial No. 413,312

6 Claims. (Cl. 200—6)

My invention relates to switches for controlling high frequency circuits in radio apparatus and the like, particularly to gang switches in such apparatus for selecting frequency bands, and its general object is to provide switches of this character incorporating shielding means which insure more efficient and stable operation of the apparatus.

In multi-band radio apparatus the gang switches commonly employed for the purpose of band changing may comprise for each stage a movable supporting member or rotor member of insulating material having mounted thereon a contact member or members engaging in succession fixed contacts connected to interstage elements or windings corresponding to the several frequency bands to be selected, and a contact member arranged to ground the fixed contacts corresponding to the frequency bands other than the band selected, at any given band position of the rotor. These switch assemblies or switch wafers for the several stages of the apparatus are spaced along a common operating shaft which traverses the insulating movable supporting or rotor members.

In multi-band high frequency radio apparatus it is essential to avoid or to reduce interstage coupling tending to cause undesirable oscillation and radiation, for example the coupling which may be caused by the relatively close proximity of the above mentioned selective switch assemblies or wafers to each other. For the purpose of reducing the latter undesirable coupling it is easily possible to shield the assemblies or wafers from each other practically perfectly. However, there still remains as a coupling means the operating shaft which, because of the severe torsional strains imposed thereon in operation of the numerous closely fitted sliding contacts of the switch assemblies or wafers, is commonly, of necessity a single metal piece.

This conductive shaft element, extending in relatively close proximity to ungrounded contact elements having potentials impressed thereon and comprising the contact members mounted on the several rotors and the fixed contacts in engagement therewith, provides a path of interstage coupling whereby undesired high frequency oscillations may be produced in a stage several inches distant from the stage in which the oscillating voltages originate. In a series of radio frequency amplifiers, the oscillations may be of sufficient magnitude to cause instability of a stage or even to cause the stage to go into oscillation, and in an apparatus of the superheterodyne type oscillating voltages originating in a loacl oscillator may be transmitted along the shaft to the antenna circuit, causing objectionable radiation therefrom.

In all cases with switch assemblies of the type described, the undesired interfering voltages are transmitted to the switch-operating metal shaft largely from the ungrounded rotatable contact members or plates, and the fixed contacts connected therewith, upon which oscillations are impressed and which are mounted respectively on the rotor and on a fixed support, relatively very close to the shaft.

In accordance with my present invention, I have overcome to a marked extent the hereinabove described disadvantage of gang switch arrangements for frequency band selection by providing grounded shielding means interposed between the operating shaft and the switch contact members upon which oscillations are impressed.

The shielding means is preferably constituted by a grounded shield plate mounted on the movable insulating support or rotor of one or more of the switch assemblies and between the latter contact member or members and the metal shaft.

In a modification of my invention the shielding means is constituted by a grounded tubular shield member surrounding a portion of the metal shaft and insulated therefrom.

The novel features which are considered to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing wherein Fig. 1 is a partially diagrammatic representation of a multi-band radio apparatus comprising an embodiment of the switch shielding system in accordance with my invention; Figs. 2, 3 and 4 respectively a front elevation, sectional view on line A—A, and a rear elevation of a usual switch assembly or switch wafer in which a shielding means in accordance with the invention has been embodied; and Figs. 5 and 6 are respectively a rear elevational view and a partially sectional view on line B—B of a switch assembly embodying a modification of the invention.

In Fig. 1 a transformer-coupled multi-band radio apparatus is shown having a usual antenna stage 1, two radio frequency amplifier stages 2 and 3, a converter stage 4 the output of which may be connected to any suitable output circuit (not shown), and a gang switch arrangement for

selecting frequency bands which comprises switch assemblies or switch wafers 5 to 8 (illustrated diagrammatically) and an actuating metal shaft 9.

In switch assembly 8, for example, which is typical and the purpose of which in the system shown in Fig. 1 is to control an anode circuit and a grid circuit in the local oscillator circuit associated with the converter stage 4, shaft 9 traverses an insulating rotor member 10 which supports on one side two contact members designated by the lines 11 and 12 and represented as slidably connected through fixed contacts 13 and 14 to sources of potential which in the present instance are constituted by oscillator elements of the converter 4. The contact members 11 and 12 are adapted to be connected, for the purpose of selecting frequency bands, through portions 15 and 16 of members 11 and 12, and thence through fixed contacts 17 to 20 and 21 to 24, to the high potential terminals of the primary and secondary windings of the coupling transformers, two of which, 25 and 26, are shown in Fig. 1, associated with the local oscillator circuit of converter stage 4.

The rotor member 10 supports on its other side a grounding member, designated by the line 27, adapted to connect to ground through a fixed contact 28 all of the high potential ends of the above mentioned local oscillator transformer windings except those of the transformer illustrated as 25 in Fig. 1, corresponding to the selected frequency band.

The other gang switch assemblies or switch wafers spaced along the operating shaft are similar to switch 8, the switches 5, 6 and 7 being operatively associated respectively with banks of transformers adapted in the selecting of frequency bands to couple antenna stage 1 and the first amplifier 2, the first and second amplifiers 2 and 3, and the second amplifier 3 and the converter 4.

In accordance with my present invention, in order to reduce in amount any undesired coupling which is established between the antenna stage, the radio frequency amplifier stages, and the converter stage through the metal operating shaft 9, a grounded shielding means is provided between the shaft and ungrounded elements of one or more of the switch assemblies 5 to 8, this shielding means being particularly desirable between the shaft and the rotatable ungrounded contact members, such as represented, for example, by 11 and 12 of switch 8. The latter contact members are located close to the shaft and tend strongly to transmit undesired oscillations thereto.

As shown semi-diagrammatically in connection with the switches 5 to 8 the shielding means may preferably take the form of a conductive member or plate 29 mounted on the same side of rotor 10 as the rotatable contact members 11 and 12, and extending closely adjacent to these contact members and to the shaft. The grounding of the shield plate 29 may be conveniently accomplished by connecting the shield to the grounding member 27.

Referring to Figs. 2 to 4, the switch assembly of usual construction illustrated therein embodying the form of my invention indicated diagrammatically in Fig. 1, comprises a circular flat rotor member 30 of insulating material which is provided with a central opening 31 adapted to be traversed by an operating shaft. On one face of the rotor are mounted two contact members or plates 32 and 33 of arcuate shape and on the other side is mounted a single grounding member or plate 34 of circular shape.

On one face of a stationary insulating support 35 surrounding and closely adjacent to the rotor 30 are mounted terminal members 36 and 37 adapted to have potentials impressed thereon and in sliding engagement respectively with the arcuate contact members 32 and 33, and two sets of terminal members 38 to 41 and 42 to 45 adapted to be connected to windings of transformers or the like corresponding to different frequency bands of a given stage and so arranged as to be engaged selectively by the extensions 46 and 47 of the arcuate contact members 32 and 33.

On the other face of the stationary insulating support 35 is mounted a fixed contact member 48, shown in Fig. 4, connected to ground and in constant sliding engagement with the circular grounding member or plate 34. On this other face of the support 35 are also mounted two sets of terminal grounding members 49 to 52 and 53 to 56, preferably opposite to and connected respectively, as by clamping members such as 57 extending through the support 35, to the terminals 38 to 41 and 42 to 45. The grounding members 49 to 52 and 53 to 56 are in sliding engagement with the rotatable grounded plate 34 except at recesses 58 and 59 formed in the outer edge thereof, these recesses being in alignment respectively with the extensions 46 and 47 of the arcuate contact members 32 and 33.

In order to reduce the intensity of oscillations tending to be transmitted to the operating shaft from the switch elements upon which high frequency oscillations are impressed, and particularly from the arcuate contact members 32 and 33 which are of considerable length and which are located relatively close to the shaft, I have provided the shielding plate, 60, between these arcuate contact plates and the shaft opening 31. The shield plate 60 is so formed as substantially to cover the space on the face of insulating rotor 30 not occupied by the contact plates 32 and 33 and with small clearance between the shield's outer edge and the inner edge of the latter contact plates and between the shield's inner edge and the shaft.

The shield plate 60 is connected to the circular grounding plate 34 preferably by wire or rivet members 61 to 63 traversing corresponding holes of a row of holes formed in rotor 30 near the outer edge thereof. Wire or rivet members are also provided connected to the shield plate 60 and traversing all other holes also of the row except those holes utilized in mounting the arcuate contact members 32 and 33 to the rotor. The latter contact members are connected to the rotor preferably by the oppositely spaced pairs of rivets 64, 65 and 66, 67.

It has been found that the numerous conductive wire or rivet members, thus connected to the grounded shield plate 60 and filling a large proportion of the closely spaced holes formed in the edge of the rotor, function effectively as an added shielding means and aid materially in reducing the intensity of undesired oscillations transmitted to the shaft from the switch elements upon which oscillations are impressed.

Referring to Figs. 5 and 6, the switch assembly illustrated therein may be in general essentially similar to that illustrated in Figs. 2 to 4. In the embodiment illustrated in Figs. 5 and 6, however,

the rotor member, 68, is provided with an opening 69, which is of such form and size that it may be traversed by a metal shaft 70, which is enclosed within a tubular shield member 71 and insulated therefrom by insulation material or an insulating member 72. The tubular shield is grounded, preferably by connection, as by a member 73, to the circular grounding plate 74 which is itself grounded through the contact member 75.

The shaft 70, shielded by a separate grounded tubular member at each switch assembly, may traverse several assemblies in succession, similarly to shaft 9 of Fig. 1. The shielding provided by the grounded tubular members therefore reduces the tendency to transmission of undesired oscillations through the metal shaft.

By the use of shielding means in accordance with the present invention the hereinabove described difficulties caused in the operation of apparatus such as multi-band radio receivers by the coupling through the gang-switch metal shaft have been materially reduced. For example, by adding, in such apparatus, a shielding member 60 as described in connection with Figs. 2 to 4 to the local oscillator switch assembly, I have effected a tenfold reduction in the undesired oscillator radiation transmitted through the gang-switch shaft.

My invention has been described herein in particular embodiments for purposes of illustration. It will be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims I intend to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In radio apparatus and the like including a plurality of coaxially spaced switches having a single conductive shaft for operation thereof, means to reduce undesired coupling effects between the circuits connected to said switches due to said shaft including means operatively associated with at least one of said switches to shield said shaft from ungrounded contact portions of said one switch, said shielding means being insulated from both said ungrounded contact portions and said shaft, and means to ground said shielding means independently of said shaft.

2. In radio apparatus and the like including at least two switches having contact supporting stator members and movable insulating supporting members operated by a single shaft of conductive material, each of said movable members having a contact element and a grounding element, said contact element being selectively connected to one of the contacts on said stator member by rotation of said shaft, said rotor members being coaxially spaced on said shaft and said shaft tending undesirably to couple the circuits connected to the contact elements on said switches, and means to reduce undesired currents in said circuits due to the coupling effect of said shaft, said means comprising a conductive shield mounted between said shaft and the contact element of at least one of said switches and connected to the corresponding one of said grounding elements, said shield being insulated from both said shaft and said contact element.

3. A switch including a rotor of insulating material, a shaft of conductive material traversing said rotor, a contact plate adapted to have oscillations impressed thereon and mounted on one side of said rotor, a grounding plate mounted on the other side of said rotor, and a shield plate of conductive material mounted on said rotor between said contact plate and said shaft and connected to said grounding plate, said shield plate being insulated from both said shaft and said contact plate.

4. In radio apparatus and the like including a plurality of switches, each of said switches having a contact supporting stator member and a movable insulating contact-supporting member, a single operating shaft of conductive material traversing said movable members and tending to cause undesired coupling in said apparatus, means to reduce said coupling comprising a plurality of tubular shields, a respective one of said shields encircling said shaft at each of said switches and insulated from said shaft, and means to ground each of said shields.

5. In radio apparatus and the like including a plurality of coaxially spaced switches having a single conductive shaft for operation thereof, each of said switches comprising a stator member having a plurality of contacts carried thereby, a rotor member comprising an insulating disk apertured to accommodate said shaft, said rotor member having a pair of contacts for selectively engaging contacts on said stator member, and means to reduce undesired coupling effects between the circuits connected to the contacts of different ones of said switches and due to said shaft, said means comprising a conductive shield mounted on the insulating disk of at least one of said switches between said pair of contacts and said shaft, and means to ground said shield.

6. In a radio apparatus, the combination of a plurality of coaxially spaced switches having a single conductive shaft for operation thereof, each of said switches comprising a stator member having a plurality of contacts carried thereby, a rotor member comprising a flat insulating disk apertured to accommodate said shaft, said rotor member having mounted on one face thereof a pair of contacts for selectively engaging contacts on said stator member, a flat grounding plate mounted on the opposite face of said disk and engaging the remaining contacts on said stator member, and means to reduce undesired coupling effects between the circuits connected to different ones of said switches and due to said shaft, said means comprising a conductive shield mounted on said one face of said switches between said pair of contacts and said shaft, and means to ground said shield.

HARRY F. MAYER.