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RADIO-FREQUENCY SWITCHING ARRANGEMENT

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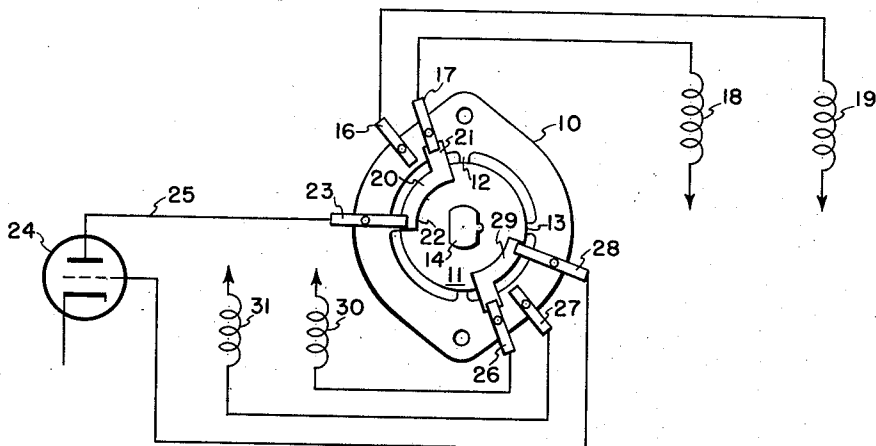


FIG. 1 (PRIOR ART)

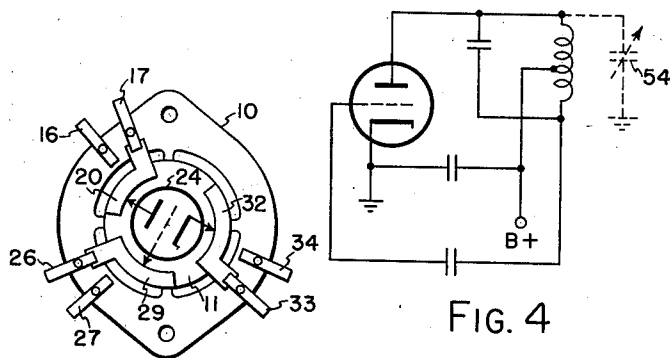


FIG. 2

FIG. 4

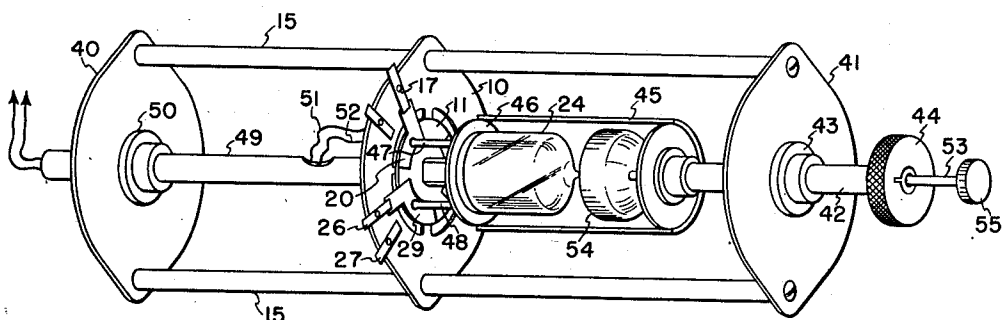


FIG. 3

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RADIO-FREQUENCY SWITCHING
ARRANGEMENT

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This invention relates to the switching of radio frequency circuits and particularly to the switching of such circuits at ultra-high frequencies.

In the usual radio frequency switching arrangement, the plate circuit of a vacuum tube is connected to a fixed switch contact member by means of a bus. In the switching operation it is necessary to move a movable switch contact member into conductive relation with at least two of three or more fixed contact members. The minimum switching operation, therefore, involves the use of two sliding contacts. In circuits in which the grid element must simultaneously be switched, two more sliding contacts are involved, making a minimum total of four sliding contacts for any switching operation.

In the normal low frequency operation of radio frequency circuits, the presence of these sliding contacts is not too important. At the high frequencies, however, the variation in contact resistance with time, due to wear and chemical reduction of the contact surfaces, places limits on the usefulness of the familiar wafer type switch. In addition the length of the connections from the tube elements to the switch contacts limits the upper frequency at which the arrangement may be successfully employed.

It is an object of this invention to provide a radio frequency switching arrangement which may be successfully employed at higher frequencies than prior devices of this nature.

It is another object of this invention to provide a radio frequency switching arrangement in which the number of sliding switch contacts is reduced from that necessary to prior practice.

It is a further object of this invention to provide a radio frequency switching arrangement in which the length of leads from the tube elements to the switch contact members is considerably reduced.

The objects and advantages of the invention are realized by a switching arrangement in which the vacuum tube, whose elements are to be connected to the switch contact members, is mounted axially upon the center shaft of the familiar wafer type switch. The socket for the acquisition of the tube is built as an inherent part for the center switch wafer.

In the drawings:

Fig. 1 is a circuit diagram of a portion of a radio frequency circuit including a plan view of one section of a wafer type switch, constructed in accordance with prior art practice.

Fig. 2 is a plan view of a section of a wafer type switch similar to that of Fig. 1, having schemat-

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ically superimposed a vacuum tube connected to the switch contact members, in accordance with the invention.

Fig. 3 is an elevational view, in perspective, of a wafer type switch assembly illustrating the mounting of a vacuum tube in accordance with the invention.

Fig. 4 is a schematic diagram of an oscillator circuit including a representation of the variable plate to ground capacitor included in Fig. 3.

Prior art practice in the switching of radio frequency circuits is illustrated in Fig. 1 in which there is shown a section of a wafer type switch, the section being composed of an annular outer wafer 10 of non-conductive material, having coaxially mounted thereon a center switch wafer 11 likewise of non-conductive material. The center wafer 11 is provided with a continuous peripheral groove which is not shown, into which extend, from the outer wafer 10, a plurality of projections 12, which secure the two wafers together for relative rotation about a common axis. Formed axially of the center wafer, is a non-circular opening 14, through which a central shaft of the switch assembly is normally extended for the rotation of the center wafer. Such a switch section is normally combined with other sections to form a complete switch assembly as illustrated in Fig. 3, the outer wafers of each section being threaded upon a pair of rods 15 to form the fixed portion of the assembly.

The section shown in Fig. 1 is constructed for the simultaneous switching of the plate and grid circuits of a vacuum tube. For this purpose the outer wafer 10 is provided with a pair of contact members 16 and 17 which are shown as connected, respectively, to a pair of coils 18 and 19, forming portions of resonant circuits tuned to different frequencies. A coacting contact member 20 is carried by the center wafer. This member has a projecting portion 21 which may be brought into contact with either of contact members 16 or 17. The member 20 is provided with an arcuate portion 22, which at all times makes contact with the contact member 23 carried by the outer wafer. The contact member 23 is connected to the anode of a vacuum tube 24 by bus connection 25.

The outer wafer 10 also carries three other contact members 26, 27, and 28. Coacting with a contact member 29, carried by the inner wafer, the contact members 26 and 27 are connected, respectively, to coils 30 and 31, forming portions of resonant circuits of different frequencies and the contact member 28 is connected to the grid

of the tube 24. The projecting portion of the contact member 29 may be brought into contact with either members 26 or 27, while the arcuate portion of the member 29 is in continuous contact with the member 28. It can be seen from this figure, that for any switching operation with the switch arrangement with the type shown in Fig. 1, a minimum of four sliding switch contacts is required.

Fig. 2 shows an arrangement in accordance with the invention in which the vacuum tube 24 is mounted axially of the center wafer 11. The contact members 20 and 29 are shown as in Fig. 1, coacting with the fixed contacts 16, 17 and 26, 27, respectively, in the same manner as in Fig. 1. The anode and the grid of tube 24 are shown as connected directly, by fixed connections, to the members 20 and 29 respectively. The cathode of the tube 24 is likewise shown as connected directly to a contact member 32 of the same type as members 20 and 29. This is desirable at ultra-high frequencies whether the circuit in use requires cathode switching or not, since it eliminates a long cathode lead. The projecting portion of the contact member 32 is shown in coacting relationship with a pair of fixed contacts 33 and 34, carried by the outer wafer, and which are available for cathode switching if the circuit requires it. It can be seen from this figure, that the number of sliding contacts required for the switching of each tube element is reduced to one so that, even with cathode switching, the total number of sliding contacts required is three.

Fig. 3 illustrates the physical mounting arrangement for the tube 24 in a switch assembly. The section upon which the tube is mounted, including the outer wafer 10 and the inner wafer 11, is located centrally between two end sections 40 and 41, the three sections being combined into a unitary assembly by the rods 15. Extending axially through the section 41 is a hollow shaft 42 which is rotatable in a bearing member 43 formed at the center of the section. The outer end of the shaft 42 terminates in a knurled knob 44 by which the shaft may be manually rotated. The inner end of the shaft 42 terminates in a cylindrical element 45, having one side open. The end plate 46 of the cylindrical element 45 which is nearest the center switch section acts as a tube socket for receiving the tube 24 which is shown in place. The end plate 46 may be formed of insulating material and is provided with clips for receiving the base pins of the tube. The proper clips are extended to the contact elements carried by the inner wafer 11 of the center section, one such extension being shown at 47 connecting to contact element 20. A second clip extension 48 is shown connected to the contact element 29. A shaft 49 extends axially of the assembly through a bearing element 50, formed at the center of section 40. The inner end of this shaft section extends through the inner wafer 11 and is fixed to the end plate 46 of the cylindrical element 45. This shaft section is likewise hollow and is shown provided with an opening to receive the heater wires 51 and 52 of the tube 24. The two shaft sections 42 and 49 together with the cylindrical element 45 form a solid center member which is rotated by the knob 44 to move the center wafer 11 in the switching of the tube 24.

Extending through the hollow shaft 42 is a smaller shaft 53 carrying at its inner end a cup-shaped metallic shell 54 dimensioned to enclose the end of tube 24, and terminating at its outer

end in a small knob 55. The metallic shell 54 forms a capacitive element between the anode of the tube 24 and ground, the switch assembly being essentially grounded. The knob 55 provides a means by which this capacity may be varied. This can be accomplished either by pushing the knob in or out or by providing a threaded connection between the shaft 53 and the shaft 42. Such an arrangement is of value in a circuit such as the Hartley oscillator circuit illustrated in Fig. 4 in which the capacity between plate and ground is shown in dotted lines.

What is claimed is:

1. A radio frequency switching arrangement comprising a first switch element carrying contact members, a second switch element carrying at least one contact member, means mounting said second switch element for rotational movement rendering the contact member of said second switch element translatable between contact with alternative ones of said contact members carried by said first switch element, a socket member for an electron discharge tube fixedly secured to said second switch element for movement therewith, said socket member having spaced prong members corresponding to the electrode terminals of said tube, and means conductively connecting one of the prong members of said socket to said contact member carried by said second switch element.

2. A radio frequency switching arrangement comprising a first switch element carrying contact members, a second switch element carrying at least one contact member, means mounting said second switch element for rotational movement with respect to said first switch element, thereby rendering the contact member of said second switch element translatable between contact with alternative ones of said contact members carried by said first switch element, a socket member for an electron discharge tube fixedly secured to said second switch element for movement therewith, said socket member having spaced prong members corresponding to the electrode terminals of said tube, means conductively connecting one of the prong members of said socket to said contact member carried by said second switch element, and means connected to said second switch element for the rotation thereof.

3. A radio frequency switching arrangement comprising a first switch element carrying a plurality of contact members, a second switch element carrying at least one contact member, means mounting said second switch element for rotational movement with respect to said first switch element thereby rendering the contact member of said second switch element translatable between contact with alternative ones of said contact members carried by said first element, a socket member for an electron discharge tube fixedly secured to said second switch element for movement therewith, said socket member having spaced prong members corresponding to the electrode terminals of said tube, means conductively connecting one of the prong members of said socket to said contact member carried by said second switch element, a shaft extending along said axis of rotation of said elements, and means connecting said shaft to said second switch element for the rotation thereof.

4. A radio frequency switching arrangement comprising a first switch element carrying contact members, a second switch element carrying at least one contact member, means mounting said switch elements for relative rotational move-

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ment about a common axis thereby rendering the contact member of said second element translatable between contact with alternative ones of said contact members carried by said first switch element, an electron discharge tube mounted on said second switch element for movement therewith, one of the electrodes of said tube being conductively connected to said contact member carried by said second switch element, a housing extending around said tube and connected to said second switch element for movement therewith, and means connected to said housing and operable to rotate said housing, said tube, and said second switch element to secure translation of the contact member carried by said second member between said alternative ones of said contact members carried by said first switch element.

5. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means for mounting said tube in said switch assembly for rotation with said center wafer, said means comprising a tube socket secured to said center wafer for rotation therewith, a plurality of clips in said socket for receiving the base pins of said tube, means connecting at least one of said clips to one of said contact members carried by said center wafer, and means extending to the exterior of said switch assembly for rotating said center wafer.

6. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means for mounting said tube in said switch assembly for rotation with said center wafer, said means comprising a tube socket secured to said center wafer for rotation therewith, a plurality of clips in said socket for receiving the base pins of said tube, means connecting at least one of said clips to one of said contact members carried by said center wafer, a shaft extending axially of said assembly, said shaft being secured to said center wafer and said tube socket for movement therewith, and means located exteriorly of said assembly, said means being connected to said shaft for the rotation thereof.

7. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means mounting said tube in said switch assembly for rotation with said center wafer, means connect-

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ing at least one of the electrodes of said tube to one of said contact members carried by said center wafer, and means extending exteriorly of said assembly for rotating said center wafer.

8. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means mounting said tube in said switch assembly for rotation with said center wafer, said means comprising a tube socket and a housing secured thereto and extending around said electron discharge tube when the latter is in place on said socket, said socket including means connecting at least one of the electrodes of said tube to one of said contact members carried by said center wafer, and a shaft connected to the end of said housing remote from said socket and extending along the axis of rotation of said center wafer.

9. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means mounting said tube in said switch assembly for rotation with said center wafer, said means comprising a tube socket and a housing secured thereto and extending around said electron discharge tube when the latter is in place on said socket, said socket including means connecting at least one of the electrodes of said tube to one of said contact members carried by said center wafer, a shaft connected to the end of said housing remote from said socket and extending along the axis of rotation of said center wafer, a metallic element located within said housing adjacent the anode of said tube and forming therewith a capacitive structure, and means for varying the relative positions of said metallic element and said anode.

10. In a radio frequency switching arrangement including a wafer type switch assembly for switching the electrodes of an electron discharge tube between various circuit connections, said assembly including a fixed annular wafer carrying contact members constituting said circuit connections and a center wafer supported for coaxial rotation with respect to said annular wafer and carrying contact members movable by said coaxial rotation between said contact members carried by said annular wafer: means mounting said tube in said switch assembly for rotation with said center wafer, said means comprising a tube socket and a housing secured thereto and extending around said electron discharge tube when the latter is in place on said socket, said socket including means connecting at least one of the electrodes of said tube to one of said contact members carried by said center wafer, a hollow shaft connected to the end of said housing remote from said housing and extending along the axis of rotation of said center wafer

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to the exterior of said assembly, a cup-shaped metallic element dimensioned to enclose the upper end of said tube, said metallic element being positioned within said housing and a shaft connected to said metallic element and extending through said hollow shaft to the exterior of said assembly, the last named shaft being provided with means by which the relative positions of said metallic element and said tube may be altered.

11. A wafer-type switch assembly including three wafer-like sections held in spaced relation in mutual parallelism by a pair of rods connected between like points on the peripheries of said sections, the central of said sections comprising an outer annular wafer carrying contact members and an inner wafer supported for coaxial rotation with respect to said annular wafer, said inner wafer carrying at least one contact member translatable by said coaxial rotation between alternative ones of said contact members carried by said annular wafer, means mounting an electron discharge tube upon said inner wafer for rotation therewith, said means comprising a tube socket mounted for rotation with said inner wafer and a tube housing secured to said socket, means conductively connecting one of the electrodes of said tube to said contact member car-

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ried by said inner wafer, a pair of shaft sections, each journaled in a respective one of said sections, one of said shaft sections being rigidly secured to said housing and the other being rigidly secured to said tube socket, said other shaft section passing through and being keyed to said inner wafer, whereby said shaft sections, said tube socket, said inner wafer and said tube housing are rotatable as a unit to switch the contact carried by said inner wafer between alternative ones of the contacts carried by said annular wafer.

12. A wafer-type switch assembly as claimed in claim 11, the said other shaft section being hollow and the heater conductors of said tube being led through the interior thereof to the exterior of said assembly.

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

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