Sept. 26, 1950 W. R. BAKER 2,523,856

RESISTANCE CAPACITANCE NETWORK

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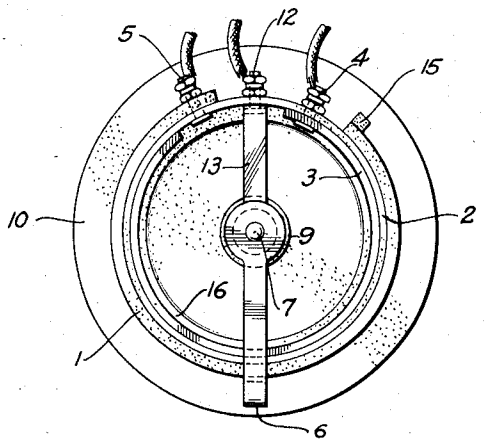


Fig. 1

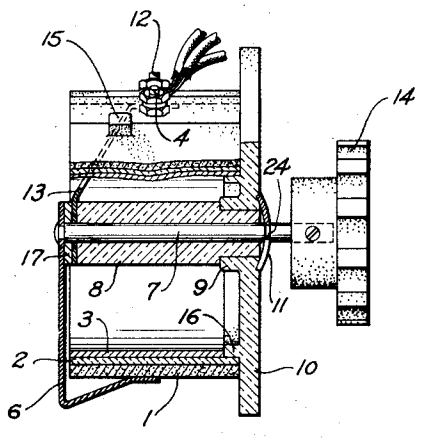


Fig. 2

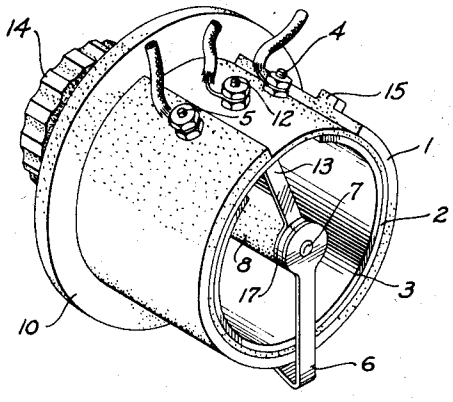


Fig. 3

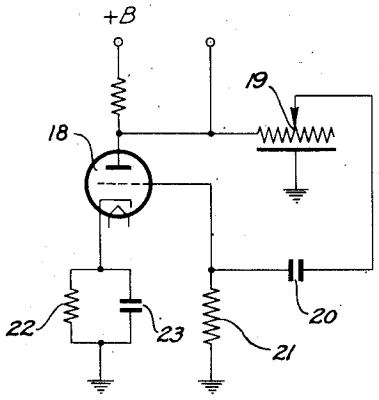


Fig. 4

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RESISTANCE-CAPACITANCE NETWORK

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4 Claims. (Cl. 178—44)

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This invention relates to a variable R. C. filter, and, more particularly, to one having a variable resistance and a constant distributed capacity.

Heretofore, in R. C. oscillators a lumped resistance and capacitance have been used permitting oscillation at only one frequency. This has been unsatisfactory not only because of inflexibility of frequency control, but because conventional capacitors added inherent inductance which is undesirable in the design of high frequency circuits.

It is an object of this invention, therefore, to provide a single unit R. C. filter, the resistance portion of which can be varied. Another object is to provide a single unit, variable R. C. filter which has a capacitance comprising resistive and conductive material separated by dielectric material. A further object of this invention is to provide a single unit R. C. filter having a variable resistance and a substantially constant capacitance distributed along the entire resistance element. A still further object is to provide an inexpensive, easily built, compact, and rugged filter unit. Other objects will appear hereinafter.

A variable noninductive R. C. filter has been provided by this invention having resistance and capacitance merged into a single unit with the capacitance distributed evenly along the resistance so as to permit convenient phase shifting for frequency control in an R. C. oscillator.

The theory and preferred embodiment of the invention are presented in the following detailed description and accompanying drawing wherein:

Figure 1 is a rear elevation view of the filter showing the rotatable arm, the stud connections, and the circular layers of conductor, dielectric, and resistance materials;

Fig. 2 is a side elevation view, partly in section, of the filter disclosing the mechanical linkage between the adjusting knob, the rotatable arm, and the means of fastening the layers to the nonconductive base plate.

Fig. 3 is a perspective view of the R. C. filter showing the resistor arm, the stud connections, and the method of overlapping the various layers.

Fig. 4 discloses one application of the variable R. C. filter in an R. C. type oscillator circuit.

The filter elements of this invention comprise a layer of resistive material separated from a layer of conductive material by a layer of dielectric material. The effective resistance of the resistive layer can be varied by a movable arm. The various layers in combination form a uniformly distributed capacitance.

Referring now to Figs. 1, 2, and 3 of the drawings, a suitable resistance element 1 is formed to conform to the arc of a circle and is mounted on a hollow dielectric cylinder 2. The resistance material may be composed of some pliant metallic substance and be mechanically bent to the form of the dielectric cylinder 2, or, if desired, the resistive element 1 may be composed of carbon or other inflexible substance, in which case it may be formed by casting, machining or molding to the required shape. Several substances that would be suitable for use as the resistive element would be high resistance steel, cast iron, German silver, tungsten, Nichrome, manganin or carbon. The inner surface of the dielectric cylinder 2 is arcuately covered with a layer 3 of highly conductive material such as copper, aluminum or silver. Both the resistive layer 1 and the conductive layer 3 are preferably fastened to the dielectric cylinder 2 by means of a glue or cement type binder. Another method of applying the layers to the dielectric cylinder is to spray the inner and outer layers using hot metallic sprays of suitable resistive and conductive substances. The dielectric cylinder 2 is attached to a nonconductive backing plate 10 by the use of cement along an inner edge of the dielectric cylinder 2 and the outer surface of a flange 16 on the backing plate 10. A stud 5 provides for electrical connection at the end of resistive layer 1. The resistive layer 1 overlaps the conductive layer 3 for a distance sufficient to permit stud 5 to be attached to both the resistive layer 1 and the dielectric layer 2 without touching the conductive layer 3. A stud 4 provides for electrical connection to the conductive layer 3. The conductive layer 3 overlaps the resistive layer 1 on the inner side of the dielectric cylinder 2 by a distance sufficient to permit stud 4 to be attached to both the conductive layer 3 and the dielectric layer 2 without touching resistive layer 1. Studs 4 and 5 also serve to maintain their respective layers in a fixed relationship to the dielectric cylinder 2.

A rotatable arm 6, pivotally mounted at the center of a circle of which the arc of resistive material 1 forms a part, is formed so as to contact the resistive layer 1 at any desired point along its locus. The resilient arm 6 is preferably made of material such as brass, bronze, or a composition thereof which will maintain positive contact with resistive layer 1. The arm 6 is connected electrically and mechanically to a metallic shaft 7 which is guided and held in place by a plastic guide tube 8. The shaft 7 is preferably made of a highly conductive metal such as aluminum, but steel will also serve satisfac-

torily. The guide tube 8 may be composed of Bakelite or some other thermosetting plastic and may be formed as an integral part of the backing plate 10, or, as shown in the embodiment, be pressed into place and cemented to the inner surface of a boss 9 on backing plate 10. A rigid metallic supporting arm 13 serves as a mechanical support for shaft 7 and as a means for providing an electrical connection to rotatable arm 6. Supporting arm 13 is attached to the dielectric cylinder 2 by a stud 12 which also provides for electrical connection to support 13. Mounted on shaft 7 between arm 6 and support 13 is a metallic washer 17 which provides for positive electrical contact between arm 6 and support 13. Shaft 7 is attached to arm 6 by welding or upsetting the end of shaft 7 which contacts arm 6. A spring washer 11 pressed into an indented ring 24 on shaft 7 bears against backing plate 10 and provides the necessary tension to maintain low resistance contact between arm 6, washer 17, and support 13. Rotation of the movable arm 6 is facilitated by means of the knob 14 attached to shaft 7. A projection 15 on the resistive layer 1 serves as a stop for limiting the angular travel of arm 6.

By rotating the movable arm 6, the effective resistance between studs 5 and 12 can be varied. When the arm 6 touches projection 15, the maximum resistance exists between studs 5 and 12. When arm 6 is rotated so that it touches stud 5, all resistance of layer 1 is shorted out and approximately zero resistance exists between studs 5 and 12. The proximity of resistive layer 1 and conductive layer 3 separated by dielectric layer 2 constitutes a uniform capacitance, the terminals of which are studs 5 and 4. This capacitance is constant regardless of the position of the movable arm 6.

Fig. 4 illustrates the use of the variable R. C. filter in an R. C. type oscillator circuit. Oscillation will occur when a 180° phase difference exists between voltages present on the grid and plate of triode 18. As the resistance of the filter unit 19 is changed, the time constant of the filter is altered, thus shifting the frequency for which a 180° phase shift exists. Frequency changes can be uniformly made even at high frequencies due to the noninductive characteristic of the filter. Capacitor 20 serves to prevent D. C. from being applied to the control grid of tube 18. Resistor 21 prevents the accumulation of static charges on the grid by providing a path to ground. Resistor 22 provides grid bias for tube 18, and capacitor 23 is a by-pass for variations in cathode potential, and also serves to maintain a constant bias on the grid.

The many advantages of the unique construction of the preferred form of my invention and its applications in the field of electronics will be apparent from the description and drawing. The arcuate layer-type construction is particularly noteworthy for providing an inherently noninductive filter unit that is easily and economically manufactured. Also, since the filter replaces two or more circuit components an eminently desirable and material simplification of electronc circuits is thereby accomplished.

From the manifold applications, substitutive variations, and other possible departures from the specific arrangements disclosed herein, it will be understood that the invention is not to be limited to said arrangements, but only as may fall within the scope of the annexed claims.

What is claimed is:

1. A low inductance, variable resistance filter unit comprising a nonconductive base plate, an arcuately shaped layer of homogeneous, solid resistive material on the outer surface of a hollow nonconductive cylinder, said cylinder mounted on said plate, an arcuately shaped layer of a highly conductive material on the inner surface of said hollow nonconductive cylinder, and forming with said resistive layer a relatively large, uniformly distributed fixed capacitance, said resistive and conductive layers being of approximately equal length and overlappingly disposed, a first metallic stud connecting said resistive layer and said nonconductive cylinder on the overlapping portion of said resistive layer, a second metallic stud connecting said conductive layer and said nonconductive cylinder on the overlapping portion of said conductive layer, a resilient rotatable conductive arm pivotable axially of said cylinder and arranged to rotate contactually along the outer surface of said resistive layer, a metallic shaft mounted axially of said cylinder and mechanically and electrically connected to said rotatable arm, a metallic support connected between said cylinder and said shaft for mechanically supporting and electrically contacting said metallic shaft, and a third metallic stud connecting said support to said nonconductive cylinder whereby upon rotation of said arm, the effective path for current flow between said first and third studs may be varied thereby to change the resistance of the unit while retaining its low inductance and relatively large, uniformly distributed, fixed capacitance.

2. A variable, low inductance, resistance device comprising a hollow cylinder of dielectric material having a solid homogeneous layer of resistive material on its outer surface, a layer of conductive material on the inner surface of said cylinder and constituting with said resistive layer a uniformly distributed capacitance, a movable conducting member pivotally mounted on an axis of said dielectric cylinder and having one end arranged to move contactually along said resistive layer, and electrical terminals connected respectively to said layers and said member for convenient utilization of said device in an R. C. circuit.

3. A low inductance, variable resistance filter unit comprising a nonconductive base plate, a hollow cylinder of solid dielectric material attached to said base plate, a layer of homogeneous, solid, resistive material adjacent the outer surface of said cylinder and substantially covering the same, a layer of conductive material adjacent the inner surface of said cylinder, said conductive layer substantially coextensive with said resistive layer and forming therewith a uniformly distributed fixed capacitance, a rotatable arm of conducting material mounted axially of said cylinder and arranged to continuously engage said resistive layer, and electrically conductive means connected to said arm, resistive layer and conductive layer whereby said filter unit provides a resistance-capacitance network having a relatively high fixed capacitance and an extremely low stray inductance.

4. A low inductance, variable resistance filter unit comprising a nonconductive base plate having a raised, circular mounting shoulder on one side thereof, an arcuately shaped layer of homogeneous, solid resistive material on the outer surface of a hollow nonconductive cylinder, said cylinder attached to the mounting shoulder of said base plate, an arcuately shaped layer of a

highly conductive material on the inner surface of said hollow nonconductive cylinder and forming with said resistive layer a relatively high, uniformly distributed, fixed capacitance, said resistive and conductive layers being of approximately equal length and overlappingly disposed, a first metallic stud connecting said resistive layer and said nonconductive cylinder on the overlapping portion of said resistive layer, a second metallic stud connecting said conductive layer and said nonconductive cylinder on the overlapping portion of said conductive layer, a resilient rotatable conductive arm pivotable axially of said cylinder and arranged to rotate contactually along the outer surface of said resistive layer, a metallic shaft mounted axially of said cylinder and mechanically and electrically connected to said rotatable arm, a metallic support connected between said cylinder and said shaft for mechanically supporting and electrically contacting said conductive arm, an elongated insulated, tubular hub surrounding said shaft and mounted axially of said nonconductive

cylinder, said hub having an end attached to said plate for guiding and supporting said shaft, a third metallic stud connecting said metallic support to said nonconductive cylinder whereby the resistive portion of said low inductance filter may be varied without affecting the relatively high, uniformly distributed, fixed capacitance.

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