

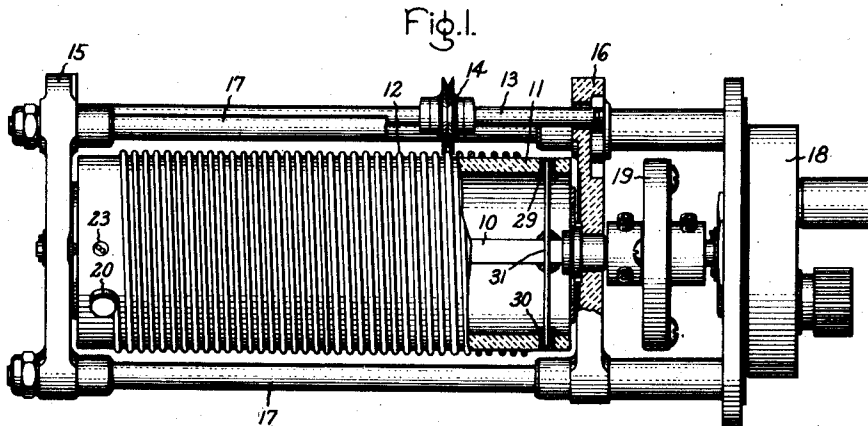
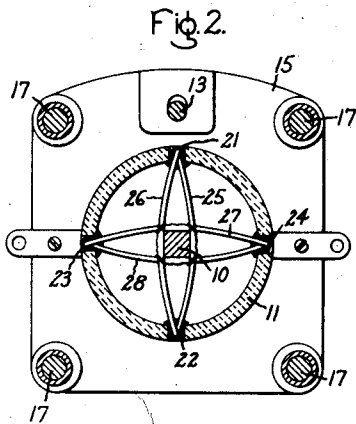
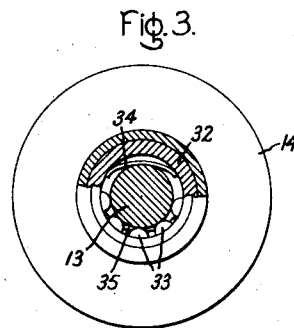
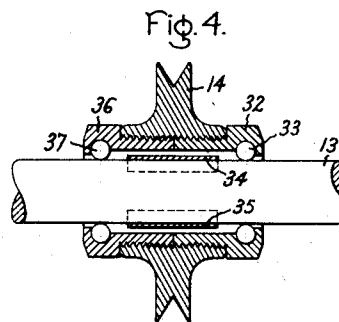
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CIRCUIT CONTROLLING APPARATUS

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CIRCUIT CONTROLLING APPARATUS

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11 Claims. (Cl. 171-242)

This invention relates to circuit controlling apparatus and more particularly to adjustable inductances carrying high frequency currents.

Adjustable inductances are often formed by wire supported on a rotatable frangible cylinder, such as a ceramic coil form supported on a shaft, and cooperating with a contact which follows the turns of wire as the coil is rotated. It is an object of my invention to provide means for mounting such frangible bodies upon a shaft, which means is arranged to reduce to a minimum the breakage of the frangible bodies during their mounting.

The contact which cooperates with such a rotating coil may be a wheel, so placed that the turns of the coil travel thereunder to maintain contact continuously between the wire and the wheel. At either end of the wire coil, fastenings are provided to attach the wire to the ceramic form. When the contact hits such a fastening while the coil is turning, the ceramic form comes to an abrupt stop, which may break the form. It is, therefore, a further object of my invention to provide for mounting a frangible body to rotate with a shaft subject to sudden stops, which mounting means minimizes the danger of breakage of the frangible body upon its abrupt stopping.

It is a still further object of my invention to provide such a rotatable inductance coil having an improved contact wheel cooperating therewith.

The features of my invention which I believe to be novel 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 in which Fig. 1 is a side view, partly in section, of an inductance constructed according to my invention; Fig. 2 is a sectional end view of the same inductance; Fig. 3 is a view, partly in section, of certain parts of the apparatus of Fig. 1; and Fig. 4 is a sectional side view of the parts illustrated by Fig. 3.

In Fig. 1 a shaft 10 carries a ceramic coil form 11 for rotation therewith and a coil 12 of conducting wire wound upon the ceramic form 11. Parallel to the shaft 10 is a conducting shaft 13 upon which a contact wheel 14 is mounted to turn upon the wire forming the coil 12 and to maintain a conductive connection between the coil 12 and the shaft 13. Resilient means, not

shown, are provided at each end of the shaft 13 to maintain it and the wheel 14 pressed against the coil 12.

The ceramic form 11 extends between a pair of insulating end plates 15 and 16, within which the shaft 10 is journaled. The plates 15 and 16 are maintained in fixed relation to each other by rods 17. A handwheel 18 is connected through a flexible coupling 19 to the shaft 10 to provide for manual rotation of the ceramic form 11.

At each end the coil of wire 12 is fastened to the ceramic form 11 by a connection 20, of which only one is shown. An operator can spin the ceramic form with the coil 12 thereon at high speed by the handwheel 18. When the contact wheel 14 reaches either end of its travel along the coil 12, one of the connections 20 comes into sudden contact with the wheel 14 so that the ceramic form 11 is stopped very suddenly.

The ceramic form 11 is supported from the shaft 10 in such a way that sudden stops of this nature are least likely to cause breakage of the ceramic form. The nature of this support may be easily seen in Fig. 2, which shows that the form 11 is supplied with a pair of holes 21 and 22 opposite each other. It is also supplied with a second pair of holes 23 and 24 equally spaced between the first mentioned holes and also opposite each other. Two pieces of stiff spring wire 25 and 26 are passed through the holes 21 and 22, one around each side of the shaft 10. Two other pieces of stiff spring wire 27 and 28 are passed through the holes 23 and 24 and also on opposite sides of the shaft 10.

The wires 25, 26, 27 and 28 are secured where they touch the shaft 10 and adjacent ends of the wires within the holes 21, 22, 23 and 24 are soldered together. Such a supporting structure has two great advantages, namely, during assembly of the ceramic form, the shaft 10 and the support wires, no stress is produced in the ceramic form, and during sudden stops of the ceramic form 11, it is free to move rotationally around the shaft 10 to a slight extent due to the resiliency of the wires 25, 26, 27 and 28, so that breakage of the form 11 due to shocks is minimized.

Fig. 1 shows such a resilient support provided between the ceramic form 11 and the shaft 10 at the right end of the form. This support comprises a resilient wire 31 passing from the hole 29 around one side of the shaft 10 and to the hole 30. A similar hole such as that indicated at 23 is provided at the left end of the form to receive similar spring members.

It has been found that such a rotating inductance coil having a follower contact wheel which rolls on the wire coil may be rendered entirely useless in certain applications because the resistance between its exterior terminals varies between wide limits as the inductance is adjusted. For example, it was found that the resistance between the shaft 13 and the connection 20 changed so much when the handwheel 18 was adjusted that the frequency of an oscillator including the coil 12 in its resonant circuit changed within very wide limits. It has been found that this resistance change occurs almost entirely between the contact wheel 14 and the shaft 13. The resistance change was found to be especially large in wheel structures requiring lubrication. In accordance with my invention a construction for the contact wheel 14 is provided which minimizes any resistance change between it and the shaft 13.

Fig. 3 is an end view of the contact wheel 14, partly in section, showing its manner of support on the shaft 13. A bushing 32 is provided within the wheel 14 to act as a raceway for ball bearings 33 between the bushing 32 and the shaft 13. Two pieces of spring metal 34 and 35 are placed in the space between the bushing 32 and the shaft 13 so as to lie in a distorted shape and bear with substantial force against the bushing 32 while sliding around the shaft 13 when the wheel 14 turns.

In Fig. 4 it may be seen that a second bushing 36 and a second set of ball bearings 37 is provided on that side of the wheel opposite to the bushing 32. The provision of the ball bearings makes unnecessary the use of lubricant, which was found to be highly undesirable.

In order to maintain the resistance between the shaft 13 and the coil 12 most nearly uniform, and at the same time to maintain satisfactory wearing qualities, it is preferred to make the wheel 14 and the shaft 13 of a beryllium-copper alloy. Heat treated beryllium-copper alloy is sufficiently hard so that the ball bearings 33 when unlubricated cannot cut grooves in the shaft 13. Also the wheel 14, when it is struck by one of the connections 20, is not dented.

The ball bearings 33 are provided in order to maintain accurate alignment between the wheel 14 and the conducting shaft 13, so that the pieces 34 and 35 of spring metal may accurately maintain a wiping metal-to-metal contact between the wheel 14 and the conducting shaft 13. It has been found that an adjustable inductance constructed in this manner and having parts of these particular materials has very desirable wear resistance qualities, maintains a low resistance therethrough, and has a sufficiently small change in resistance upon adjustment so that the inductance described in this application may be used in oscillators whose stability in frequency must be high.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since different modifications may be made, and I aim by the appended claims 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. Electric circuit controlling apparatus comprising a rotatable shaft, a frangible cylindrical coil form surrounding said shaft concentrically and having holes therethrough on opposite sides of said shaft, and a pair of resilient wires affixed

to said shaft and extending substantially radially therefrom with their free ends fixedly engaged in said holes whereby said coil form is supported on said shaft and torsional resilience is provided therebetween to minimize breakage of said form.

2. Electric circuit controlling apparatus comprising a rotatable shaft, a frangible cylindrical coil form concentric with said shaft, means for supporting said form on said shaft and to provide torsional resilience therebetween, an inductance coil supported on said form, a conducting shaft parallel to said first shaft and adjacent said coil, and a contact wheel on said conducting shaft conductively engaged with said inductance coil to vary the circuit therethrough, and conducting means between said wheel and said conducting shaft arranged to maintain a wiping metal-to-metal path therebetween.

3. Electric circuit controlling apparatus comprising a rotatable shaft, a cylindrical body mounted on said shaft, an inductance coil supported on said body, a substantially stationary conducting shaft parallel to said first shaft and adjacent said coil, a contact wheel rotatable on said conducting shaft and conductively engaged with said coil to vary the circuit connection therethrough as said coil and wheel are rotated, and resilient conducting means so distorted between said wheel and said conducting shaft as to press apart said wheel and shaft and being slidably arranged between said wheel and shaft to maintain a wiping metal-to-metal path between said wheel and shaft.

4. Electric circuit controlling apparatus comprising a rotatable shaft, a cylindrical body mounted on said shaft, an inductance coil supported on said cylindrical body, a conducting shaft parallel to said first shaft and adjacent said coil, a contact wheel rotatable on said conducting shaft and conductively engaged with said coil to vary the circuit connection therethrough, resilient conducting means between said wheel and said conducting shaft so distorted therebetween as to press apart said wheel and conducting shaft to maintain a wiping metal-to-metal path therebetween, and bearing means to maintain said wheel accurately aligned with said shaft, whereby said wiping metal-to-metal path is unaffected by misalignment of said wheel with said conducting shaft.

5. Electric circuit controlling apparatus comprising a rotatable shaft, a frangible cylindrical coil form concentric with said shaft and having holes at each end thereof on opposite sides of said shaft, said holes being placed at regular intervals around said form, and resilient wires affixed to said shaft and extending substantially radially therefrom with their ends fixedly engaged in said holes to provide torsional resilience between said coil form and said shaft to minimize breakage of said form.

6. Electric circuit controlling apparatus comprising a rotatable shaft, a cylindrical body mounted on said shaft and supporting an inductance coil, a beryllium-copper conducting shaft parallel to said first shaft and adjacent said coil, a contact wheel on said conducting shaft conductively engaged with said coil to vary the circuit connection therethrough as said coil is rotated, conducting means between said wheel and said conducting shaft to maintain a wiping metal-to-metal path therebetween, and ball bearings between said wheel and said conducting shaft to maintain alignment therebetween during rotation without lubrication, whereby mis-

alignment between said wheel and said conducting shaft does not affect said wiping metal-to-metal path.

7. A mounting support for a frangible body, said mounting comprising a shaft, said body being spaced from said shaft and having a recess therein, and a pair of resilient members extending across said shaft, each of said members having a portion fixed to said shaft, the adjacent free ends of said members tending to remain separated and said ends being flexed into seating engagement and affixed to said body within said recess, said body being supported solely on said shaft through said resilient members which provide torsional resilience therebetween.

8. A mounting support for a frangible body, said support comprising a shaft, said body having portions spaced on opposite sides of said shaft and having a recess in each of said portions, and a pair of resilient wires extending across said shaft and having intermediate portions engaged with said shaft on opposite sides thereof, the adjacent free ends of said wires tending to remain separated and said ends being flexed into seating engagement and affixed to said body within said recesses, said body being supported solely on said shaft through said wires whereby torsional resilience is provided between said body and shaft to minimize breakage of said body.

9. A mounting support for a frangible body, said support comprising a shaft, said body having four portions substantially equally spaced around said shaft, each of said portions having a recess therein, a pair of resilient wires extending across said shaft and having intermediate portions engaged with said shaft on opposite sides thereof, and a second pair of wires similarly engaged with

said shaft and extending substantially perpendicularly to said first pair, the adjacent free ends of said wires tending to remain separated, each pair of said ends being flexed into seating engagement and affixed to said body within a corresponding recess, said body being supported solely on said shaft through said wires whereby torsional resilience is provided between said shaft and body to minimize said breakage of said body.

10. Electric circuit controlling apparatus comprising a rotatable shaft, a frangible body spaced from said shaft, said body having recesses therein, and resilient members extending across said shaft, each of said members having a portion fixed to said shaft and a different portion affixed to said frangible body in one of said recesses, said body being supported on said shaft solely through said resilient members whereby torsional resilience is provided between said body and said shaft to minimize breakage of said body.

11. Electric circuit controlling apparatus comprising a rotatable shaft, a frangible body having portions spaced on opposite sides of said shaft, each of said portions having a recess therein, and a pair of resilient members having their intermediate portions engaging opposite sides of said shaft and extending across said shaft, the adjacent free ends of said members tending to remain separated, said ends being flexed into seating engagement within said recesses and being affixed therein to said frangible body, said members providing the sole support for said body on said shaft whereby torsional resilience is provided between said body and said shaft to minimize breakage of said body.

EDWARD A. LEACH.