INDUCTANCE COIL SHORTING SYSTEM

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This invention relates to variable inductance devices and more particularly to inductors varied by shorting together adjacent turns thereof, and to the actuating mechanism.

Prior efforts toward progressive turns-shorting systems by us have been undesirable in that either the system for inserting shorting plungers within the spiral of the inductance has not been able to remove the shorting plungers far enough from the magnetic field of the inductance or if so, has not been capable of this large motion with the high forces necessary at the position of insertion of the shorting plunger. Further difficulties arise in achieving compactness along with the above attributes.

It is therefore an object of this invention to provide a mechanism which moves coil turns-shorting plungers far enough away from the coil for optimum coil quality and yet is capable of high forces for inserting the shorting plungers between turns of the coil.

It is a further object of this invention to provide a mechanism which provides the operating forces necessary in a compact unit which is durable and long lived.

It is a feature of this device that a roller between opposing cams is utilized in linkage positioning the plungers.

Further objects, features, and advantages of the invention will become apparent from the following description and claims when read in conjunction with the drawings, which:

The figure shows a perspective view of the invention with one shorting plug inserted, a second plug approaching the coil, and a third in the fully withdrawn position.

In the figure a spiral of copper ribbon 10 is mounted on a base 13, the insulating plate 12 is mounted on the base 13. The insulating plate may be mounted on stand-offs or directly on the base, as shown. An opening 14 in the base adjacent the coil is made here, to avoid lowering the quality, Q, of the coil in place of mounting the plate on stand-offs. Also mounted on base 13 is a pair of side-plates 16 mounted substantially parallel to each other and adjacent said coil.

Mounted between these two side-plates and substantially parallel to each other are a pair of cam-shafts 17 and 18. Shaft 17 is mounted above shaft 18. Shafts 17 and 18 are mounted for rotation in plates 16. Bushings 19 are shown as illustrative of anti-friction bearings of such nature necessary to carry the loads involved.

Pivot shaft 21 is mounted adjacent shafts 17 and 18, parallel thereto, and on the opposite side thereof relative to the coil. Shaft 21 is mounted fixedly in plates 16.

Complying the rotation of shafts 17 and 18 is a pair of gears 22 and 23. These gears are substantially identical, and are for the purpose of maintaining the rotation of one shaft equal and opposite to the rotation of the other shaft. Chain and sprocket wheel means may be used if the shafts on one side are reversed relative to their present illustrated position to accommodate the rotation of both of the pair of cam-shafts in the same direction.

Mounted on shafts 17 and 18 are a series of cams. Cams 25, 26, and 27 are mounted on shaft 17, and cams 28, 29, and 30 are mounted on shaft 18. Each of these cams is fixed to its respective shaft and is turned thereby. It is to be noted that each cam has two circumferenceal portions of constant radius joined by a beveled portion, e.g., 31 on cam 27. The beveled portion is at a progressively increased distance around the circumference of the cam from the initial position on cam 25. Further, the cams on the lower shaft 18 are complementary to the cams on the upper shaft 17, as will be explained further below.

Mounted on one of the cam-shafts is a knob 32 as exemplary of the input motion for this mechanism. For a remotely controlled device, such as a radio transmitter, a shaft positioning motor system is coupled in the place of knob 32.

Mounted on shaft 21 and carrying pivotally mounted contact plungers 35, 36, and 37 are arms 38, 39, and 40, respectively. Contact plungers 35, 36, and 37 are intended to provide a circuit between adjacent coil turns upon insertion therebetween. Insulation of the arm from the coil may be provided by use of a non-conductor in the mounting or at the pivot, to avoid undesirable currents, unless the entire arm is made of an insulator.

Arms 38, 39, and 40 are mounted for rotation on shaft 21 and may have bearings similar to bushing 19 for anti-friction purposes. Carried on arms 38, 39, and 40, intermediate shaft 21 and shorting plungers 35 through 37, are a series of rollers 42, 43, and 44 having bushings therein for anti-friction purposes. Rollers 42 through 44 are supported on posts fixed to arms 38, 39, and 40, and are of such size that the sum of the radii of the cam, the diameter of a roller, and the larger radius of the cam is equal to a fixed amount which is the center-to-center spacing of cam-shafts 17 and 18. Rollers 42, 43, and 44 are positioned between pivot 21 and the plungers, transversely to the cam-shafts, such that the average of their arc of travel is between the pair of cam-shafts. The cams in the upper shaft are related to the cams in the lower shaft such that the bevel of one recedes as the bevel on the other increases. Thus, the roller is kept positioned exactly and moved as a direct function of rotation of the cam shafts.

In operation, one of the cam-shafts is rotated by an external source of power. Gears 22 and 23 couple the two shafts together so that they rotate in synchronism.

Rotation of the two cam-shafts simultaneously moves the beveled portions at each cam station relative to the roller follower of that station. Arm 38 is shown in the fully-operated position with plunger 35 as fully entered into the coil with a complete contact. Arm 39 is shown with its roller 43 between the bevels of the cams for this station, with the shorting plunger 36 part way advanced toward the inductance coil. Arm 40 is shown in the fully retracted position with the shorting plunger spaced a satisfactory distance away for maintenance of the coil Q.

Further, progressive rotation of cam-shafts 17 and 18 from the illustrated position will move roller follower 43 further toward the base 13, swinging arms 39 as a second class lever further, down to force plunger 36 in between the next two turns of the coil.

As each plunger progressively shortens together adjacent turns of the coil, its inductance is decreased. It is obvious that should the last motion of insertion require even greater force than this illustrated form of the invention yields, the bevel 31 may be shaped slightly at this point of contact to provide greater camming force otherwise yielding a high arm motion on the rest of the bevel for moving the plunger to a desired distance from the coil. With the related bevel surface of the other cam
altered correspondingly, a greater force for removing the plunger will also become available. It should be obvious that the rollers have a slight clearance between the cams to permit relative motion of the surfaces. Where sprocket and chain coupling is used in the place of gears 22 and 23 or some other means of positively relating the two shafts but rotating them in the same sense, the tolerance between cams and a roller may be less in that the roller is rotated therewith.

It is to be understood that other forms of open-turned coils may be adjusted in keeping with the spirit of this invention as, e.g., a helix with the shorting contact plungers inserted radially into the side of the coil.

Although this invention has been described with respect to particular embodiments thereof, it is not to be so limited because changes and modifications may be made therein which are within the full intended scope of the invention as defined by the appended claims.

We claim:

1. A variable inductance comprising an inductance having spaced turns, a plurality of shorting plungers for insertion between turns of said inductance, arm means carrying said plungers, said arm means being pivoted about a shaft, a pair of cam-shafts mounted adjacent said pivot shaft, the cams on one shaft being complementary to the cams on the other shaft, roller means on each arm intermediate said cams, and means coupling said cam-shafts together, whereby rotation of said cam-shafts forces said plurality of plungers in between said turns in a desired order.

2. A variable inductance comprising a flat, spiral inductance coil having spaced turns, a plurality of shorting means for bridging adjacent turns of said spiral, a pair of cam-shafts, each shaft having a plurality of cams, each of the cams on one shaft being complementary to a corresponding cam on the other shaft, a pivot shaft, a plurality of arm means mounted on said pivot shaft, follower means mounted on each arm means, said follower means being mounted substantially between a respective pair of complementary cams and means for rotating said pair of cam-shafts simultaneously, whereby said plurality of shorting means is brought into contact with said coil in succession with continued rotation of said cam-shafts.

3. A variable inductance comprising opposed rotatably supported cam means, said opposed cam means being substantially complementary to define a unique position intermediate therebetween, a plurality of contacting means, means carrying said contacting means, said carrying means being positioned by follower means traveling in said unique position, an inductor, said contacting means being positioned by rotation of said opposed cam means such that said plurality of contacting means is brought into contact with said inductor in a desired order with respect to progressive rotation of said opposed cam means.

References Cited in the file of this patent

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