Aug. 30, 1949. C. F. P. ROSE 2,480,340

VARIABLE INDUCTANCE DEVICE

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FIG.1.

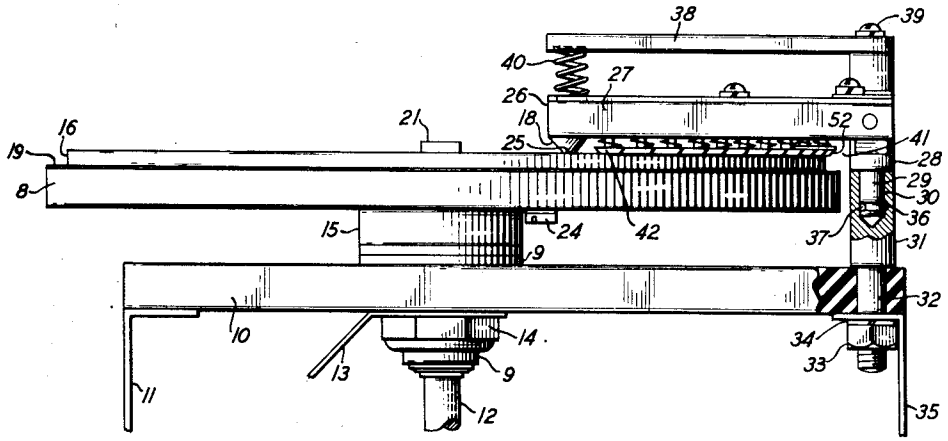

FIG.2.

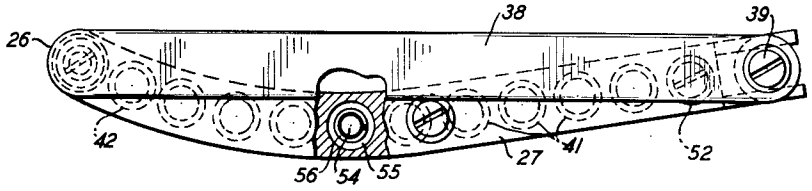

FIG.3.

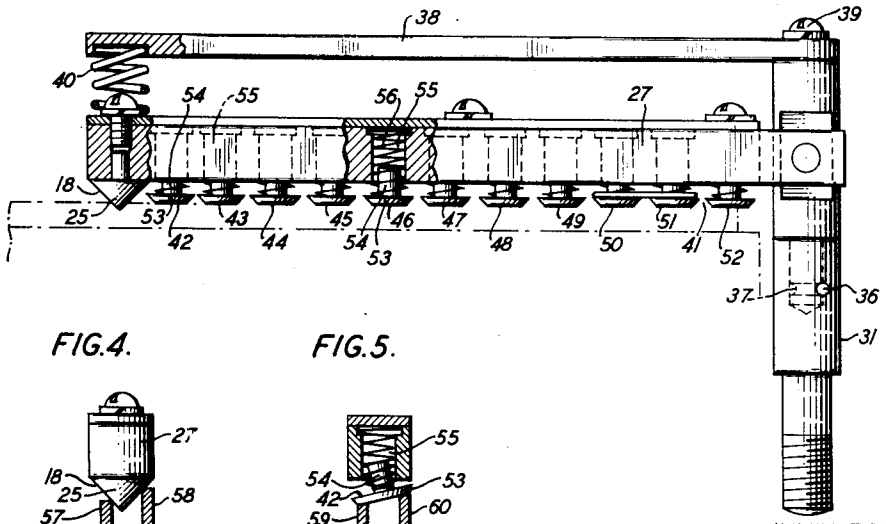

FIG.4.

FIG.5.

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FIG. 6.

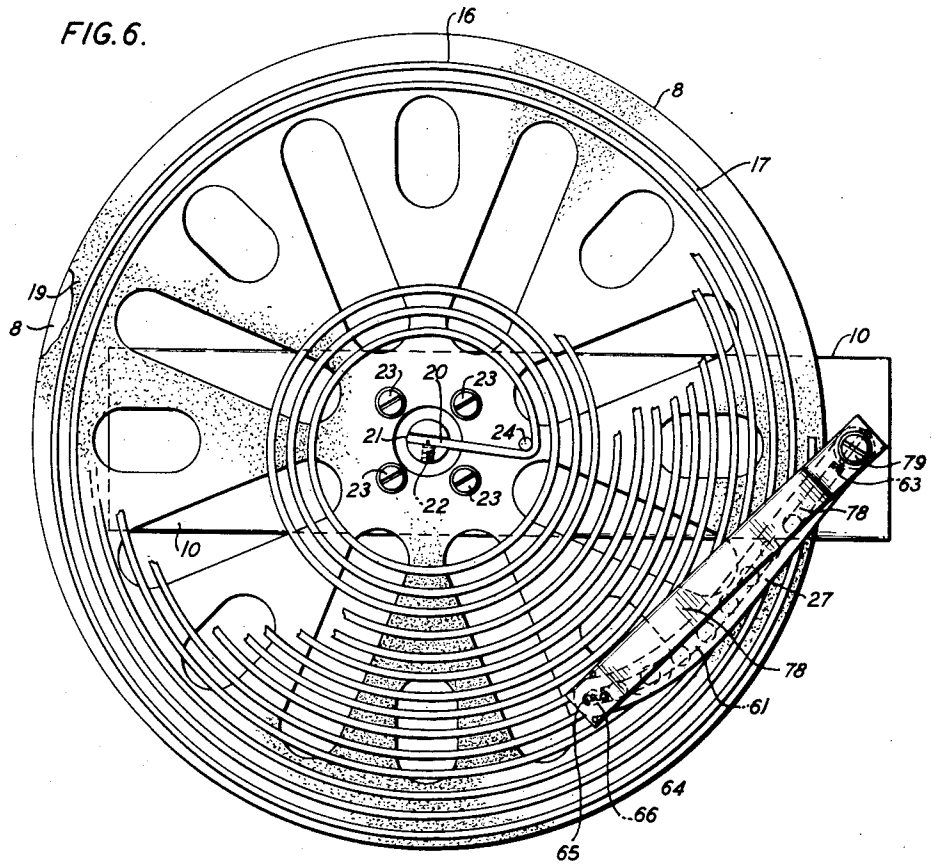
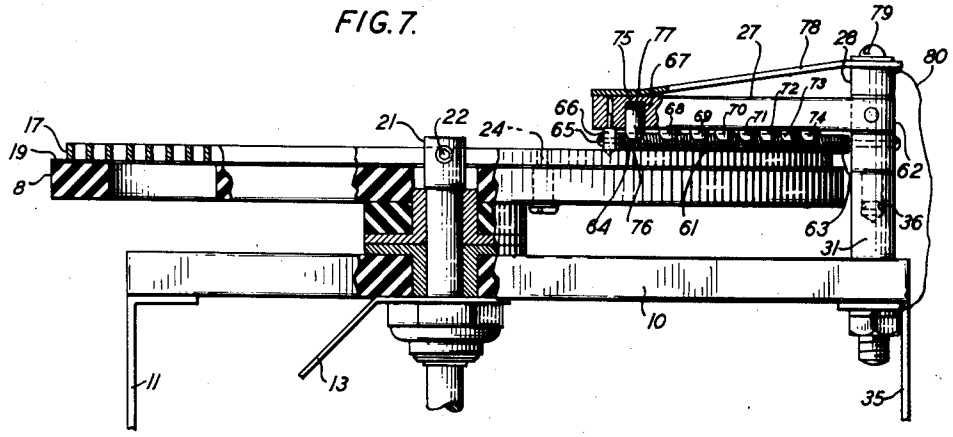


FIG. 7.



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VARIABLE INDUCTANCE DEVICE

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6 Claims. (Cl. 171—242)

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This invention relates to variable electrical control devices and more particularly to variable electrical control devices of the type in which a relatively movable electrical coil and contact are provided.

The invention is applicable to variable inductance and variable resistance devices suitable for use as electrical control means in an electrical system.

An object of the invention is to provide an improved electrical control device operable as a means for controlling electrical inductance in an electrical system.

A feature of the invention resides in an electrical coil of spiral form.

Another feature resides in a contact means to frictionally engage required portions of turns of the spiral coil.

Another feature resides in a secondary contact means to engage and short circuit certain portions of the coil.

In the drawings:

Fig. 1 is a side view, partly in section, of a variable electrical control device embodying the invention;

Fig. 2 is an enlarged plan view, partly in section, of arms and contacts shown in Fig. 1;

Fig. 3 is a side view, partly in section, of certain parts shown in Fig. 2;

Fig. 4 is a view, partly in section, of portions of the coil and its support and a stylus contact in engagement with turns of the coil;

Fig. 5 is a view, in section, of portions of the coil and its support and a secondary contact in engagement with turns of the coil;

Fig. 6 is a plan view of the coil and its support but shows a contact structure and arrangement somewhat different from those shown in the previous figures; and

Fig. 7 is a side view, partly in section, of the device shown in Fig. 6.

In electrical systems in which high frequency currents are employed variable inductance coils are often provided to function as tuning elements in the system. The coil comprises a predetermined length of wire or other conducting material wound in a plurality of turns and a contact member to selectively engage the turns, the coil and the contact being relatively movable as required to bring more or less of the turns of the conductor into the electrical system.

In the present invention, as shown in Fig. 1 a turntable 8 of insulating material is rotatably supported on a bearing assembly 9 mounted on an apertured base 10 of insulating material secured to a support 11, the turntable 8 being secured to a rotatable shaft 12 extending through the bearing assembly 9. The shaft 12 and the bearing assembly 9 may be made of conducting material and be in conductive connection with a terminal 13 held in place on the bearing assembly 9 and the base 10 by means of a holding nut 14. The shaft 12 is mechanically connected to a flanged bushing 15 which is secured to the turntable 8.

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Supported on the turntable 8 is a spiral coil 16 of a type commonly known as a pancake type coil. The spiral coil 16 may be a suitable length of conducting wire coiled to the required form, or, as shown in Fig. 6, may be a conductor 17 of ribbon-like form as shown in Fig. 7 and coiled in the form of a spiral and so that the turns thereof are in spaced relation. The spiral coil 17 is mounted on the upper face of the turntable 8 in a substantially flat condition, lower edges of the turns being secured to the upper surface of the turntable 8 to hold the turns of the coil in required spaced relation and so that two adjacent turns of the coil will cooperatively form, in effect, a track for a stylus-like contact 18 shown in Figs. 1 and 3. Various means may be employed to securely mount the spiral coil 17 on the turntable 8. I have found, however, that a convenient manner of mounting the spiral coil 17 on the turntable 8 is to secure the lower edges of the turns of the coil to the upper surface of the turntable 8 by means of a suitable adhesive such for instance as a thermosetting insulating material 19 as shown in Fig. 7.

An inner end 20 of the spiral coil 17 is extended through a slot in a tubular cap 21 and across an upper end of the shaft 12. The tubular cap 21 is secured to the shaft 12 by means of a set screw 22 which extends transversely through the tubular cap 21, a portion of the shaft 12 and into engagement with the inner end 20 of the coil 17. Mounting screws 23 are provided to secure the turntable 8 to the flanged bushing 15. A snubber pin 24 is secured in the turntable 8 and extended into engagement with the inner end portion 20 of the spiral coil 17 to prevent undue strain on the inner end portion of the coil 17.

The stylus contact 18 is constructed and arranged to ride on and frictionally engage the turns of the spiral coil 17. The lower end 25 of the stylus contact 18 is cone shaped and the point of the stylus contact 18 is arranged to extend into the space between turns of the coil. The stylus contact 18 is supported on the free end 26 of a curved arm 27 supported at one end on a rotat-

able post 28, a reduced lower end portion 29 of which extends longitudinally into a recess 30 formed in the upper end of a pillar 31 rising from and secured to the base 10. A lower portion 32 of the pillar 31 is of reduced diameter and extends through an aperture in the base 10. A nut 33 and lockwasher 34 are provided on the pillar 31 to hold the pillar 31 against withdrawal from the base 10. A terminal 35 is secured to the pillar 31 and is in electrical connection therewith. The reduced lower end portion 29 of the rotatable post 28 is trapped against upward longitudinal withdrawal from the pillar 31 by means of a pin 36 extended transversely in the pillar 31 and into an annular groove 37 formed in the reduced lower end portion 29 of the rotatable post 28. Extending in spaced relation over the curved arm 27 is a bar 38 having one end portion secured to the top of the rotatable post 28 by means of a screw 39. The unsecured end of the bar 38 extends in spaced relation over the free end of the curved arm 27 and a spring 40 is disposed between the free end of the curved arm 27 and the unsecured end portion of the bar 38, the spring 40 and the bar 38 serving in cooperation to press the free end of the curved arm 27 toward the spiral coil 17 to keep the stylus contact 18 in good frictional engagement with the spiral coil 17.

When the turntable 8 is rotated the stylus contact 18 will move over the upper surface of the spiral coil 17 in continuous engagement with the turns in the spiral coil 17, the movement of the stylus contact 18 being imparted by the thrust of the turns in the spiral coil 17 against the conical end portion 25 of the stylus contact 18. If the stylus contact 18 is at the outer end of the spiral coil 17 and in engagement with the outer turn and the next turn inward thereof and the turntable 8 is suitably rotated to a sufficient extent the stylus contact 18 will travel from the outer end of the spiral coil 17 to the inner end of the spiral coil and will traverse all turns of the spiral coil 17 in succession, the stylus contact 18 being in continuous engagement with the spiral coil 17. A sufficient reverse movement of the turntable 8 will drive the stylus contact 18 back to its starting position.

When the terminal 13 is connected to one portion of an electrical system and the terminal 35 is connected to another portion of the electrical system the portions of the spiral coil 17 directly in the circuit will comprise the turns lying between the center of the spiral coil 17 and the innermost point of the spiral coil in instant engagement with the stylus contact 18. To minimize parasitic resonances of other portions of the spiral coil 17 not directly in the circuit a set of contacts designated by the general number 41 is provided. The function of the set of contacts 41 is to short-circuit the turns of the spiral coil 17 not instantly required in the system. The set 41 of contacts will be hereinafter called a set of short-circuiting contacts. In the set 41 of short-circuiting contacts shown in Figs. 1, 2 and 3 there are short-circuiting contacts 42 to 52 inclusive. Each short-circuiting contact comprises a disc portion 53 on the lower end of a stem portion 54 dimensioned to extend into a recess 55 formed in the arm 27. A spring 56 set in each recess 55 and engaging the upper surface of the disc portion 53 of a short-circuiting contact serves to press the disc portion 53 of the short-circuiting contact toward the spiral coil 17. The disc portion 53 of each short-circuiting contact is dimensioned to simultaneously engage and extend slightly more than completely over two adjacent turns in the spiral coil 17. Assuming that the arm 27 has been swung to its fullest inward extent the short-circuiting contact 52 will be resting on the two outermost turns of the spiral coil 17, the short-circuiting contact 51 will be resting on the next two turns inward and each short-circuiting contact of the remainder of the set 41 will likewise rest on succeeding pairs of turns, the short-circuiting contact 42 being in frictional engagement with the two turns of the spiral coil 17 immediately outside the two turns engaged by the stylus contact 18. When the stylus contact 18 is moving inwardly toward the center of the spiral coil 17 the short-circuiting contacts in the set 41 follow to keep the unrequired portion of the spiral coil 17 short-circuited to the arm 27 and hence to the terminal 35 by way of rotatable post 28 and the pillar 31. As the free end 26 of the arm 27 swings to carry the stylus contact 18 toward the outside of the spiral coil 17 the short-circuiting contacts precede the stylus contact 18. When the stylus contact 18 has been moved outward to engage the two outermost turns of the spiral coil 17 the short-circuiting contacts in the set 41 also bear on the two outermost turns of the spiral coil 17, this being due to the curved form of the arm 27 and the curved arrangement of the short-circuiting contacts.

The upper edges of the turns of the spiral coil 17 may at some points extend upwardly to different heights due to manufacturing differences or to slight inaccuracies in securing the turns of the coil to the upper surface of the turntable 8. As shown in Fig. 4 portions of two turns 57 and 58 of the spiral coil 17 extend to different heights from the turntable 8 but since the point of the stylus contact 18 extends into the space between the two turns and the stylus contact 18 is of conical shape the two turns 57 and 58 are both in frictional engagement with the stylus contact 18. In Fig. 5 portions of two turns 59 and 60 of the spiral coil 17 extend to different heights from the turntable 8 but since the short-circuiting contact 42 has free motion to tilt in the recess 55 the disc portion 53 of the short-circuiting contact 42 may take a required slanting position to keep in frictional engagement with the two different height turns of the spiral coil 17.

In Figs. 6 and 7 means somewhat different from the means shown in the other figures for short-circuiting unrequired portions of the spiral coil 17 are shown. In the structures and arrangements shown in Figs. 6 and 7 the turntable 8, the spiral coil 17, the arm 27, rotatable post 28, pillar 31 and terminal 35 may be the same as shown in previous figures of the drawings. In Figs. 6 and 7, however, a helical spring 61 is provided to short-circuit instant unrequired turns of the spiral coil 17. It is advantageous to use the helical spring 61 rather than separate contacts when the spiral coil 17 is made of relatively small gage material and the turns are rather closely spaced. The helical spring 61 will hereinafter be called a short-circuiting spring 61.

The short-circuiting spring 61 is electrically connected at one end to the rotatable post 28 through a bolt 62 which extends through the rotatable post 28 and into a nut 63 secured to one end of the short-circuiting spring 61. The other end of the short-circuiting spring 61 is electrically connected through a nut 64 secured to that end of the short-circuiting spring and a bolt 65 extending through the stylus contact 66 which except for the aperture provided therein to accom-

modate the bolt 65 is like the stylus contact 18 shown in Figs. 1 and 2. The short-circuiting spring 61 is arranged in substantial parallel spaced relation with and under the arm 27 and so that the short-circuiting spring 61 will be in engagement with upper edges of turns in the spiral coil 17. To press the short-circuiting spring 61 against the spiral coil 17 spring pressed plungers 67, 68, 69, 70, 71, 72, 73 and 74 are mounted in the arm 27. Spaced recesses 75 are formed in the under surface of the arm 27 to accommodate the spring pressed plungers 67 to 74 inclusive. Each spring pressed plunger 67 to 74 inclusive comprises a plunger member 76 and a spring 77, part of the plunger member 76 being disposed in a recess 75 and against a spring 77 located between the base of the recess 75 and the plunger member 76. The spring pressed plungers 67 to 74 inclusive bear downwardly against the upper surface of the short-circuiting spring 61 at spaced points and the lower end of each plunger member 76 is diametrically grooved to accommodate the engaged portion of the short-circuiting spring 61, the lower ends of the spring-pressed plungers 67 to 74 inclusive resting like saddles on the short-circuiting spring 61 and holding the short-circuiting spring 61 in a curved form following the curved form of the arm 27.

A leaf type spring 78 secured at one end by means of a screw 79 to the upper end of the rotatable post 28 and extending like a cantilever and sloping downwardly to the free end of the arm 27 provides spring pressure on the free end of the arm 27 to press the stylus contact 66 into good contact with the spiral coil 17. The short-circuiting spring 61 keeps in contact with the turns of the spiral coil 17 not instantly required in the circuit and short-circuits the unrequired turns to the terminal 35. A flexible conductor 80 connected at one end to the leaf spring 78 and at the other end to the terminal 35 provides a good conducting lead between the leaf spring 78 and the terminal 35. The short circuit from the unrequired turns of the spiral coil 17 may, therefore, be by way of the short-circuiting spring 61, nut 64, bolt 65, stylus contact 66, arm 27, leaf spring 78 and flexible conductor 80 to the terminal 35.

What is claimed is:

1. A variable electrical control device comprising a rotatable coil of spiral form, a movable contact driven by means of said coil and operable to select turns of said coil and bring the selected turns into a circuit, a curved movable support for said movable contact and extending over said coil and secondary contact means arranged in curved form and carried by said movable support and into contact with turns of said coil not selected, said secondary contact means being operable to short-circuit the turns of said coil that are not required in the circuit.

2. A variable electrical control device comprising a rotatable conducting coil of spiral form, a movable stylus contact engageable with turns of said conducting coil and movable by means of said coil, curved supporting means for said stylus contact and operable to move over said conducting coil, said stylus contact being operable to control the number of turns in said conducting coil to be instantly used in a circuit and spring pressed short-circuiting contact means arranged in curved form and carried by said curved supporting means and engaging instantly unrequired turns of said conducting coil to short-circuit the instantly unrequired turns of said conducting coil.

3. A variable electrical control device comprising a rotatable conducting coil of spiral form, a movable stylus contact operable to fit between and selectively engage two adjacent turns of said conducting coil, said stylus contact being movable by means of said conducting coil, a curved movable supporting arm for said stylus contact and operable to carry said stylus contact over said conducting coil, said stylus contact being operable to selectively bring required turns of said conducting coil into a circuit and spring pressed short-circuiting contact means arranged in curved form and carried by said movable supporting arm into engagement with instantly unrequired turns of said conducting coil to short-circuit the instantly unrequired turns of said conducting coil.

4. A variable electrical control device comprising a rotatable coil of spiral form, a movable contact engaging and driven by means of said coil and operable to select turns of said coil to bring the selected turns into a circuit, a movable support for said movable contact and operable to travel over said coil and a set of spring-pressed contact members carried by said movable support into contact with the turns of said coil not selected by said movable contact, said set of spring-pressed contacts being of sufficient width to make contact with at least two turns to short-circuit the turns of said coil that are not selected by said movable contact.

5. A variable electrical control device comprising a rotatable coil of spiral form, a movable contact engaging and driven by means of said coil and operable to select turns of said coil to bring the selected turns into a circuit, a curved movable support for said movable contact and operable to travel over said coil and a helical spring contact carried by said curved movable support into engagement with turns of said coil not selected by said movable contact, said helical spring contact extending into contact with and operating to short-circuit the turns of said coil that are not selectively brought into the circuit by said movable contact.

6. A variable electrical control device comprising a turntable, a rotatable coil of spiral form mounted on the turntable, a movable arm extending over said turntable and said coil, said movable arm being curved to follow the curvature of said turntable, a stylus contact supported on said arm and in contact with said coil, said stylus contact being drivable across said coil by means of said coil to selectively bring into a circuit a required number of turns of said coil and movably supported, short-circuiting contact means carried by said arm and arranged in curved form corresponding to the curvature of said arm and operable to engage turns of said coil not brought into the circuit by said stylus contact.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,485,462	Lowenstein	Mar. 4, 1924
1,668,414	Martin	May 1, 1928
1,896,269	Willoughby	Feb. 7, 1933
2,362,470	De Rosa	Nov. 14, 1944