April 18, 1933. J. B. DOW 1,904,208

VARIABLE INDUCTANCE SYSTEM

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FIG. 1

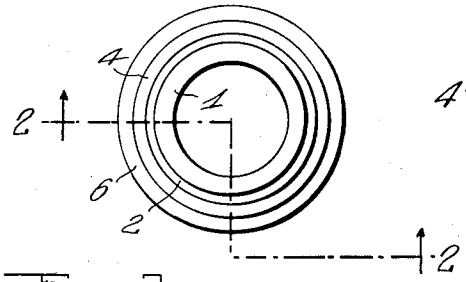


FIG. 3

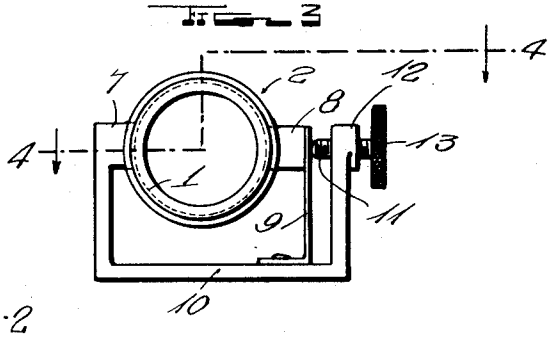


FIG. 2

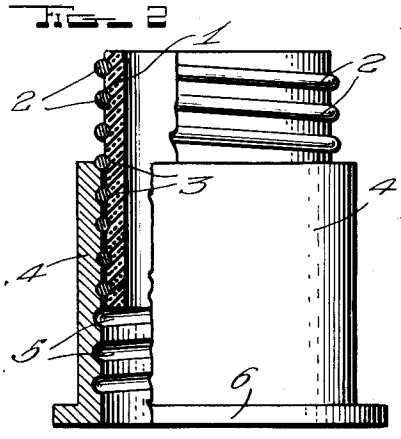


FIG. 4

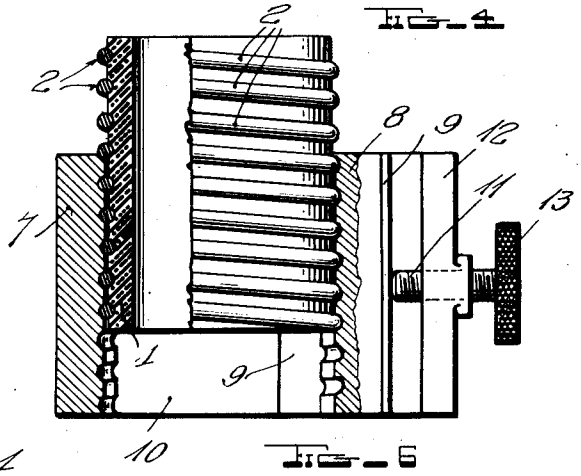


FIG. 5

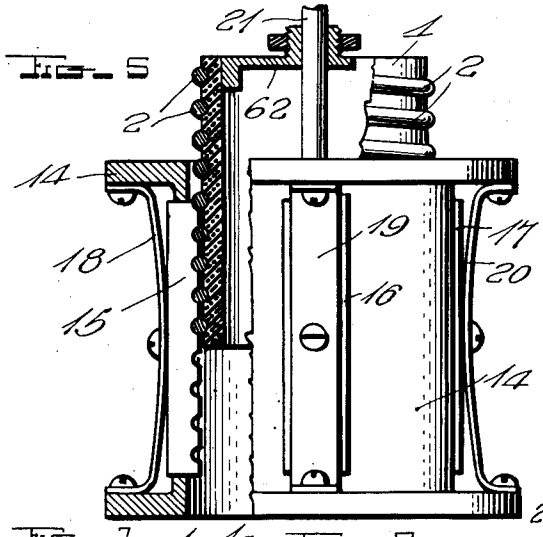


FIG. 6

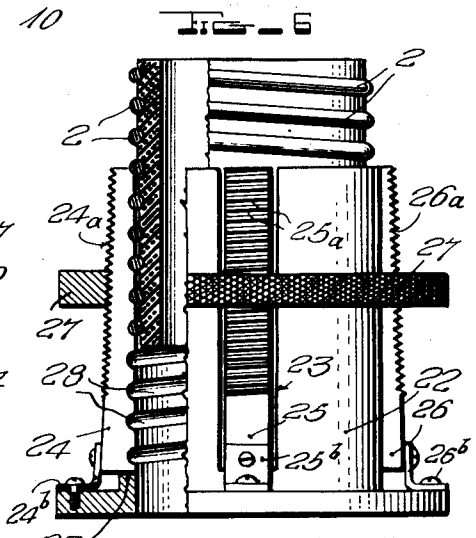


FIG. 7

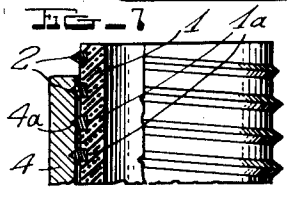
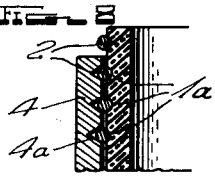


FIG. 8



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VARIABLE INDUCTANCE SYSTEM

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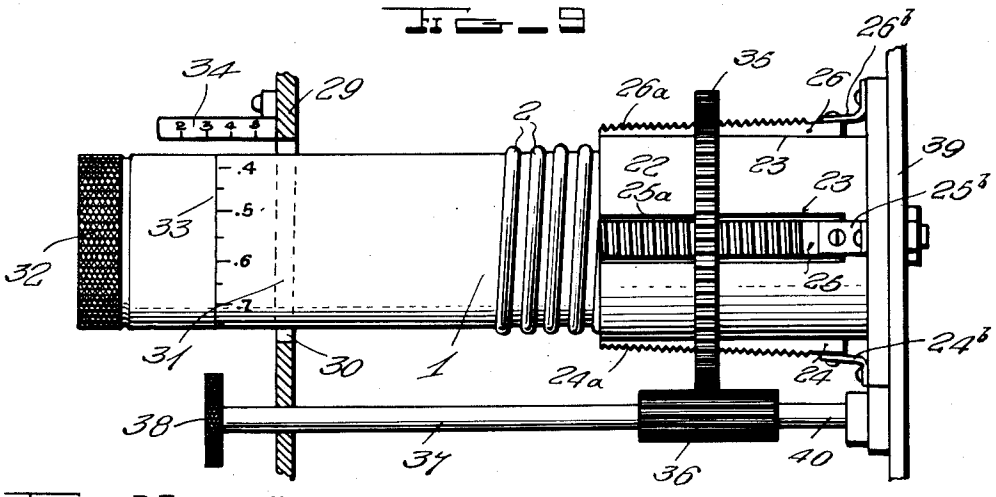


FIG. 9

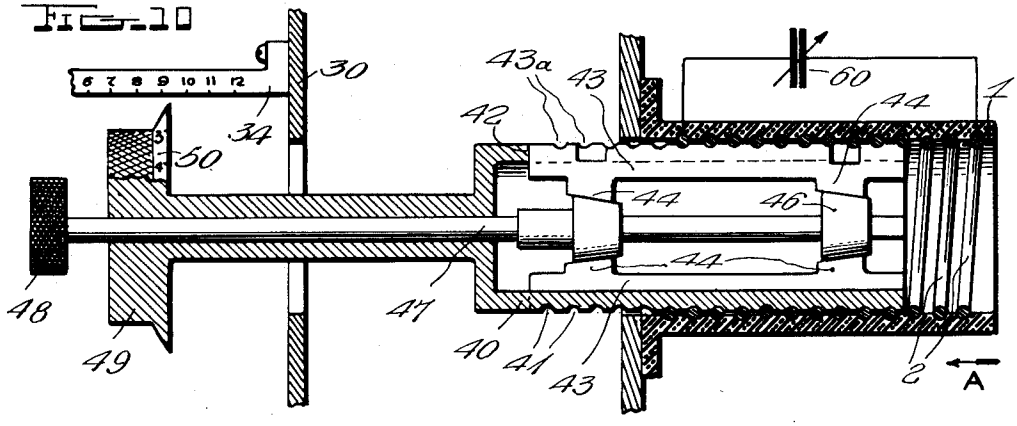


FIG. 10

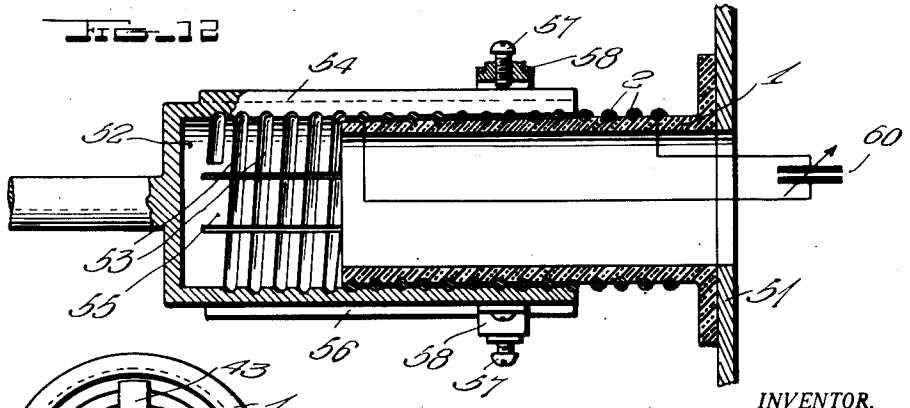


FIG. 12

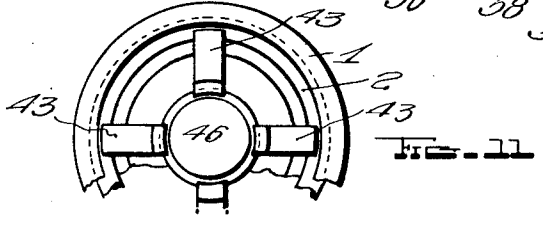


FIG. 11

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VARIABLE INDUCTANCE SYSTEM

Application filed November 14, 1930. Serial No. 495,777.

My invention relates broadly to high frequency signaling systems and more particularly to a method of tuning high frequency signaling circuits and to the construction of an adjustable high frequency inductance.

One of the objects of my invention is to provide a construction of high frequency inductance system in which a high degree of precision may be obtained in adjusting the circuits in which the inductance is included.

Another object of my invention is to provide a method of tuning a high frequency electrical circuit in which the exact amount of inductance required for the adjustment of the circuit to the required period may be selectively obtained.

Still another object of my invention is to provide a construction of high frequency inductance by which the precise length of inductance required for the adjustment of a high frequency electrical circuit may be obtained by shifting the inductance with respect to a contacting member for shunting out the turns of inductance which are not required, while maintaining the required turns of inductance in the high frequency circuit.

A further object of my invention is to provide a construction of high frequency inductance wherein the effective inductance may be determined by movement of the inductance to selected positions within a metallic chamber for short-circuiting undesired turns of the inductance while rendering effective other turns of the inductance.

Other and further objects of my invention reside in a method of selectively varying a high frequency inductance and the construction of a variable high frequency inductance as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, wherein:

Figure 1 is an end view of a variable inductance constructed according to my invention; Fig. 2 is a side elevation of the variable high frequency inductance with parts thereof partially broken away and illustrated in cross-section on line 2—2 of Fig. 1; Fig. 3 is an end view of a modified form of inductance embodying the principles of my invention; Fig. 4 is a plan view of the inductance illustrated in Fig. 3 with parts thereof broken away and illustrated in cross-section on line 4—4 of Fig. 3; Fig. 5 is a side elevation of a further modified form of high frequency inductance embodying the principle of my invention with parts broken away and illustrated in cross-section; Fig. 6 illustrates a high frequency inductance showing means for selectively clamping short-circuiting members along the turns of the inductance when a selected number of turns of the inductance has been effectively included in the high frequency circuit; Fig. 7 shows a modified construction of support for the high frequency inductance illustrating the construction of the turns on the support where the turns serve as screw threads cooperating with screw threads cut in the inductance support; Fig. 8 shows a modified construction of inductance support and screw threads formed by the turns of the inductance; Fig. 9 illustrates a further modified form of variable inductance where the effective value of the inductance may be selectively set by a control which passes through a control panel disposed adjacent the inductance; Fig. 10 illustrates a further modified form of variable inductance system in which the turns of the inductance are shunted out by means adapted to engage the inner faces of the turns of inductance; Fig. 11 is an end view of the inductance looking in the direction of arrow A in Fig. 10; and Fig. 12 shows a still further modification of adjustable inductance embodying the principles of my invention.

My invention provides a suitably supported helical coil where the unused turns are short-circuited by a metallic element or elements containing screw threads corresponding in pitch to the pitch of the helical coil. Suit-

able clamping arrangements are provided to insure the positive short-circuiting action over the unused turns of inductance. My invention is particularly adapted for adjusting the frequency of the circuits of a high frequency radio receiver in which several stages of tuned radio frequency amplification are employed in conjunction with a multiple variable condenser system operating under a single control. Without such variable inductance coils it is extremely difficult to match up the several tuned circuits with sufficient precision to most efficiently employ a single control. Another advantage accrues from the use of such variable inductance coils, viz: In order to cover a frequency range from 1000 to 20,000 kilocycles in ordinary receivers not employing my invention, four plug-in coils are generally required for use in each tuned circuit. Assuming that a tuned detector circuit and three stages of radio frequency amplification are employed, sixteen plug-in coils would be necessary. With my invention only four coils or one per tuned circuit are required.

It is a popular belief that short-circuited turns in a receiver coil seriously affect the receiver efficiency, owing to the I^2R losses which take place in the short-circuited turns. I have found that the effect of the short-circuited turns is to appreciably reduce the total inductance of a coil and to negligibly increase the losses if the short-circuit is well made and if the coil conductor is of ample size and of good conductivity. With a coil wound with good conducting material such as number 18 B and S gauge copper wire and disposed in a regenerative electron tube circuit, provided the L/C ratio of the circuit is not seriously affected by the short-circuited turns, received signals will be just as loud as before and no change in the regeneration control will be required.

The method of precisely fixing the exact inductance required in a tuned circuit in accordance with the principles of my invention may be carried out in a variety of different forms of inductance units. I may utilize the inductance as a screw threaded cylinder and advance or retract the screw threaded cylinder thus formed with respect to interiorly disposed screw threads within a metallic cylinder whereby the turns of the inductance are selectively short-circuited and rendered ineffective. I may provide various forms of side clamping devices for engaging the turns of the inductance. These clamping devices may be remotely controlled for effecting a short-circuit of the turns of the inductance coil in adjusting the frequency of the circuit in which the coil is utilized.

Referring to the drawings in more detail, and in particular to Figs. 1 and 2, reference character 1 designates an insulated cylinder on which the turns 2 of an inductance are wound. The turns 2 are disposed in a spiral groove 3 in cylinder 1 so that the turns are normally spaced one from another at a predetermined pitch. A metallic cylinder 4 is provided with interior screw threads 5 formed therein to receive the turns 2 of the adjustable inductance coil. The turns 2 contact directly with the metallic cylinder 4 enabling the turns within the cylinder to be short-circuited while the turns outside the cylinder are effective. The cylinder 4 is suitably supported by means of a flange 6 by which the cylinder 4 may be maintained in a stationary position while the insulated cylinder 1 is rotated in either a clockwise or counter-clockwise direction for adjusting the effective length of the inductance 2.

In Figs. 3 and 4 I have illustrated a construction of inductance in which the undesired turns of the coil 2 on cylindrical support 1 are short-circuited between two metallic shoes 7 and 8. The portions of the shoes 7 and 8 which make contract with the turns 2 of the inductance are suitably threaded according to the pitch of the helical winding 2. The shoe 8 is mounted upon a vertically extending spring 9 which is supported on base 10 of the inductance mounting. The spring 9 may be adjusted toward or away from the turns of inductance 2 by means of adjustable screw 11 which passes through the vertically extending bracket 12, the screw 11 being adjusted in position by means of knurled knob 13. The inductance support 1 is advanced or retracted between the shoes 7 and 8 to a selected position and then shoe 8 clamped in position against the turns of inductance 2.

Fig. 5 illustrates a further modified form of inductance support in which a frame 14 is provided with a plurality of longitudinally extending slots along the length of the cylindrical portion through which a multiplicity of metallic shoes represented at 15, 16 and 17 project. Each metallic shoe is supported by a resilient strip indicated at 18, 19 and 20, respectively. These metallic shoes each have a surface in which grooves are provided to receive the projecting turns 2 of the inductance carried by cylinder 1. By rotating cylinder 1 the conductor 2 is moved into engagement between the inwardly projecting shoes or is retracted from engagement therewith, allowing the precise length of inductance to be rendered effective.

In the arrangement illustrated in Fig. 6 a cylindrical support 22 is provided with longitudinally extending slots 23 therein through which the shoes 24, 25, 26, etc., project. Flexible members 24*b*, 25*b*, 26*b*, etc., or other suitable arrangements may be employed to hold the shoes 24, 25, 26, etc., in place. Each shoe is provided with grooves adapted to receive the turns of inductance 2 carried by coil support 1 as the coil support 1 is rotated clockwise or counterclockwise with

respect to the cylindrical member 22. The shoes 24, 25, 26, etc., are each screw threaded as indicated at 24*a*, 25*a* and 26*a*, and the screw threads are engaged by ring member 27. The shoes 24, 25, 26, etc., are tapered in such manner that as the ring member 27 is advanced downwardly by rotative movement, the shoes tend to move toward the interior of cylinder 22, thereby clamping the turns of the inductance 2 for shunting out the turns which are not desired. To facilitate the movement of the inductance coil, the interior wall of the cylindrical member 22 is screw threaded as represented at 28.

In Fig. 7 I have shown one form which the inductance element may take, that is a wire element having a rectangular base portion adapted to engage a rectangular groove 1*a* in the coil support 1 and having a V-shaped outer extremity adapted to engage V-shaped threads 4*a* in the metallic cylindrical member 4. As shown in Fig. 8 the turns of inductance 2 may be circular in cross-section and fit within semi-circular recesses 1*a* in the cylinder 1 and engage the V-shaped grooves 4*a* in the metallic cylinder 4. This arrangement provides for a precision movement of the inductance coil.

In order to facilitate the adjustment of the inductance from the front of a panel as indicated at 29 in Fig. 9, I may employ an extension on the cylindrical coil support 1, which extension projects through the aperture 30 in panel 29 as indicated at 31 and terminates in a knurled portion 32 on the end thereof. The extended portion 31 is calibrated as represented at 33 and cooperates with the scale 34 which extends from panel 29 for the purpose of indicating to the operator the amount of the conductor 2 which has been short-circuited and rendered ineffective. The metallic cylinder 22 into which the turns of inductance 2 are screw threaded is similar to the arrangement shown in Fig. 6 wherein the shoes project through slots 23 formed in the cylindrical member 22. The screw threads 24*a*, 25*a* and 26*a* on projecting shoes 24, 25 and 26 are engaged by the ring member 35 which is provided with gear teeth on the exterior periphery thereof with which pinion 36 meshes. A rotatable shaft 37 which carries pinion 36 projects through panel 29 and may be operated by knurled screw 38. The cylindrical member 32 is suitably mounted on vertically extending panel 39 and shaft 37 is journaled with respect to the panel as represented at 40. When the shoes 24, 25, 26, etc., are released from clamped engagement with the turns of the inductance, the knurled head 32 may be revolved to change the effective number of turns of inductance 2 beyond the limits of metallic shoes 24, 25 and 26.

Fig. 10 illustrates a further modified form of inductance system embodying the principles of my invention. In this arrangement the insulated cylinder 1 is internally grooved to receive the turns of inductance 2 with the turns thereof positively spaced one from another. A metallic cylindrical member 40 is grooved on its surface as indicated at 41 in the form of a thread having a pitch corresponding to the pitch of the turns of the inductance 2. The cylindrical member 40 is longitudinally slotted as represented at 42 and through these longitudinal slots there projects the sets of shoes 43, each having a grooved edge indicated at 43*a* cut to the same pitch as the pitch of the turns of inductance 2. The shoes 43 are each provided with cam faces 44 adjacent opposite ends thereof between which the cams 45 and 46 on shaft 47 are located. By withdrawing knob 48 at the front of the panel, cams 45 and 46 are withdrawn relieving the turns of inductance 2 for outward pressure of the shoes 43. The knob 49 may then be turned for advancing or retracting metallic cylinder 40 for rendering a selected number of turns of inductance 2 effective or ineffective. By comparing the scale 50 on knob 49 with scale 34, a position is reached where the desired effective inductance of turns 2 is obtained, after which the shoes 43 may be clamped in position by pushing in knob 48 and the precise value of inductance as thus selected maintained.

In Fig. 12 I have illustrated a construction of adjustable inductance system wherein the inductance coil comprising turns 2 is wound upon the exterior of insulated coil support 1 which is supported from panel 51. A hollow cylinder represented at 52 is interiorly screw-threaded as shown at 53 with threads having a pitch equal to the pitch of the turns of inductance 2. Shoes 54, 55, 56, etc., extend through longitudinal slots in the cylindrical member 52 and are each provided with grooves therein adapted to engage the wire turns on the insulated support 1. Shoes 54, 55, 56, etc., may be formed by suitably slotting the cylindrical member 52 by which construction they form an integral portion of member 52. Spring members 58 which are fitted with adjusting screws 57 may be employed as shown to hold the free ends of the shoes 54, 55, 56, etc., against the turns of inductance 2 with a predetermined pressure.

The inductance system of my invention is highly efficient in its construction and operation and enables precise values of inductance to be obtained in signaling circuits operating at high frequencies. Losses are reduced to a minimum and the actual required value of inductance utilized in the signaling circuits.

Connections are established with one end of the inductance coil by connecting one terminal of any external device to the metallic short-circuiting device which engages selected turns of the inductance. The other terminals of any external device may be connected to active portions of the inductance

coil by flexible leads, contact brushes or, as is illustrated in Fig. 5, by providing in combination with a contact arm and bushing 62, which is permanently connected to one turn of the inductance, a metallic shaft 21 extending axially with the cylindrical inductance coil and to which electrical connection may be made. With the construction shown in Figs. 10 and 12 wherein the inductance coil is stationary, permanent electrical connections may be made to the turns of inductance as I have diagrammatically shown by connections to the variable capacities 60.

While I have described my invention in one of its preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A high frequency inductance system comprising a helical inductance coil, a metallic member, and screw threads formed interiorly of said metallic member and having a pitch corresponding to the pitch of the turns of said inductance coil, said inductance coil being rotatable into position within said metallic member for variably short-circuiting selected turns of said coil.

2. A high frequency inductance system comprising an inductance coil spirally wound upon an insulated support, a metallic member having screw threads formed therein to receive the turns of the coil, and means for clamping said metallic member into engagement with the turns of the coil at a selected position along the coil.

3. A high frequency inductance comprising a winding, an insulated support for said winding, and a metallic member having screw threads formed therein adapted to receive the turns on said insulated support in selected position.

4. An inductance system comprising a cylindrical socket member, an insulated coil support adapted to be moved within said socket, a winding carried by said coil support, and screw threads formed interiorly of said socket and adapted to receive the turns on said coil support for short-circuiting selected turns of said winding while rendering other turns thereof effective.

5. A high frequency inductance system comprising an insulated coil support, a winding carried by said coil support, a metallic member screw threaded to engage the turns of said winding, said metallic member being selectively adjustable along said winding, and means for clamping said metallic member into short-circuiting engagement with selected turns of said winding.

6. A high frequency inductance system comprising an insulated coil support, an inductance coil having its turns spaced apart along said coil support, a metallic member having screw threads thereon adapted to engage the turns of said coil, said metallic member being adjustable along the length of said coil, and means carried by said metallic member for radially clamping parts of said metallic member with respect to the turns of said coil for short-circuiting selected portions of said coil while maintaining other portions thereof effective.

7. A high frequency inductance system comprising a metallic socket having internal screw threads therein, an insulated coil support carrying an inductance coil thereon adapted to be screw threaded into said socket, a panel member extending laterally with respect to said coil support, an actuating knob of said coil support projecting through said panel member, and means projecting through said panel member adjacent said knob for locking the turns of said inductance coil in predetermined short-circuited position within said socket.

8. In combination with a helical coil, a cylindrical socket, one or more metallic contact shoes projecting through and guided by slots in said socket, the contact surfaces or edges of said shoes being threaded in accordance with the pitch of said coil, the pressure of the contact against the coil being regulated by springs adapted to hold the contact shoes in place.

9. In combination with a helical coil, a metallic cylindrical socket, said socket being slotted axially, one or more metallic contact shoes projecting through and being guided by the slots in said socket and adapted to make contact with said coil, the external surface of said shoes being tapered in the direction of the axis of said socket and threaded and a clamping ring surrounding said shoes and being interiorly threaded for engaging the external threads on said shoes.

10. In combination with a helical coil, a metallic cylindrical socket, the inner surface of which is threaded in accordance with the pitch of the coil, said socket being slotted axially, one or more contact shoes extending through the slots in said socket, said contact shoes being fitted with a tapered thread on the outer surfaces, and a clamping ring for compressing the contact shoes against selected turns of the coil.

11. In combination with a helical coil, a metallic cylindrical member, the inner surface of which is threaded in accordance with the pitch of the coil, said cylindrical member being slotted axially, one or more contact shoes extending through the slots in said cylindrical member, said shoes being internally grooved to engage the turns of said coil and having their external surfaces tapered in the direction of the axis of said coil and threaded, a clamping ring surrounding said shoes

and being interiorly threaded for engaging the external threads on said shoes, and means for rotating said clamping ring.

12. In combination with a helical coil, a cylindrical member, the outer surface of which is threaded in accordance with the pitch of the coil, one or more metallic short-circuiting shoes projecting through and guided by slots in said cylindrical member, the contact surfaces or edges of said shoes being threaded in accordance with the pitch of the coil, and a conical wedge or eccentric system adapted to expand the short-circuiting shoes against selected turns of the coil.

13. In combination with a helical coil, a slotted tubular member, at least one metallic shoe extending through the wall of said slotted tubular member, and means for compressing said metallic shoe against said helical coil for selectively short-circuiting any number of turns of the said helical coil.

14. In combination with a helical coil, a slotted tubular member, at least one metallic shoe extending through the wall of said slotted tubular member, said shoe being threaded to conform with the pitch of said helical coil and means for compressing said shoe against said helical coil for selectively short-circuiting turns of said helical coil.

15. In combination with a helical coil, a slotted tubular member having threads thereon conforming to the pitch of said coil, and means for compressing at least one portion of said slotted tubular member against said helical coil for selectively short-circuiting any desired number of turns of said coil.

16. In combination with a helical coil, a slotted member having threads thereon conforming to the pitch of said coil, means for compressing at least one portion of said slotted member against said helical coil for selectively short-circuiting any desired number of turns of said coil, and means for advancing said slotted member along said coil for engaging the desired number of turns.

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