

May 12, 1931.

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1,804,852

CIRCUIT CONTROLLING REACTANCE COIL

Original Filed May 10, 1927 2 Sheets-Sheet 1

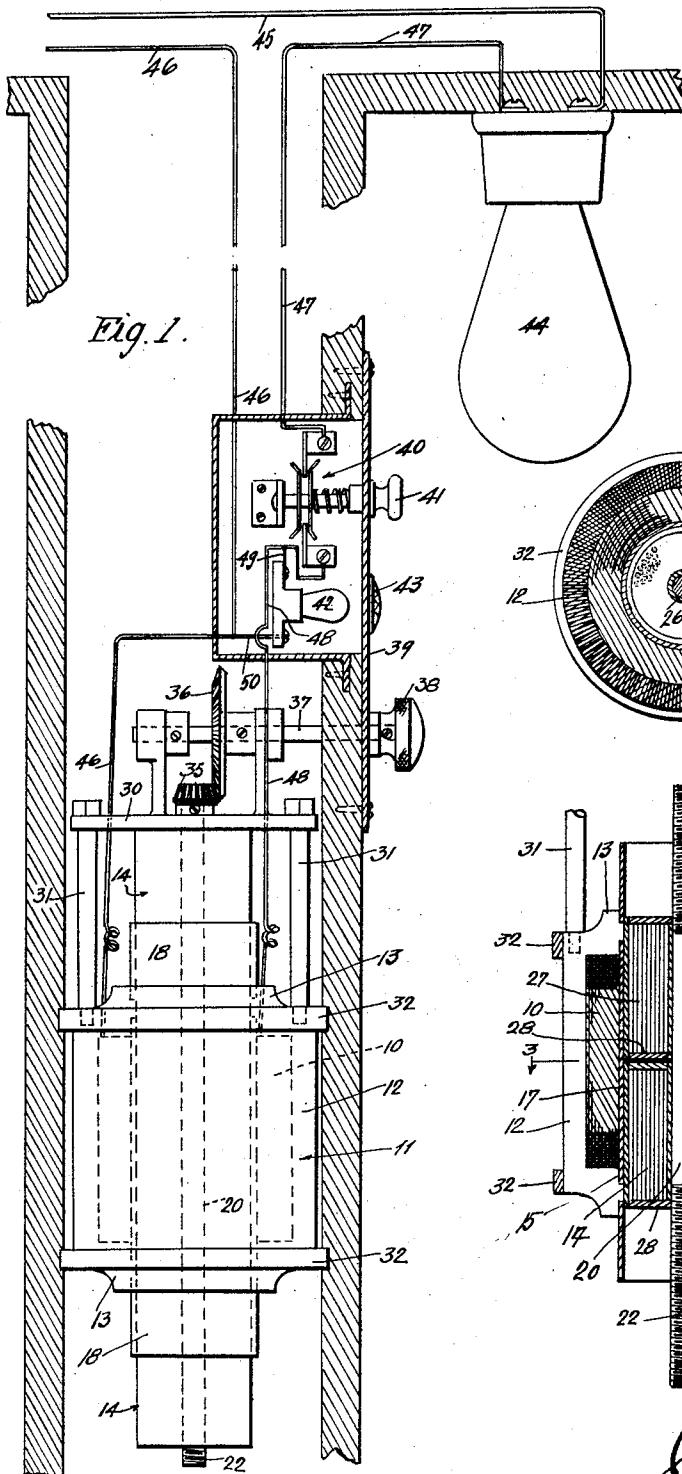


Fig. 1.

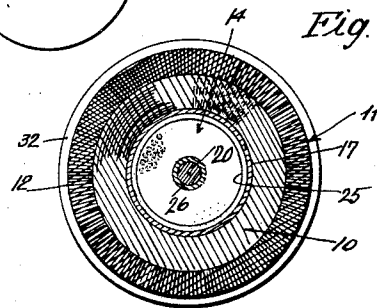


Fig. 3.

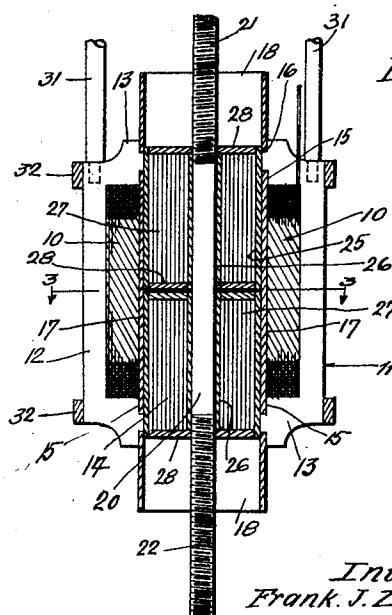


Fig. 2.

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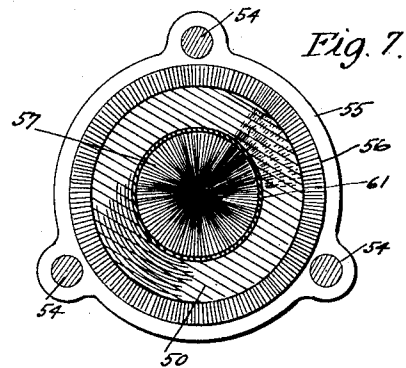
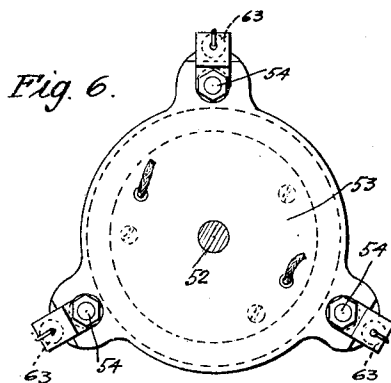
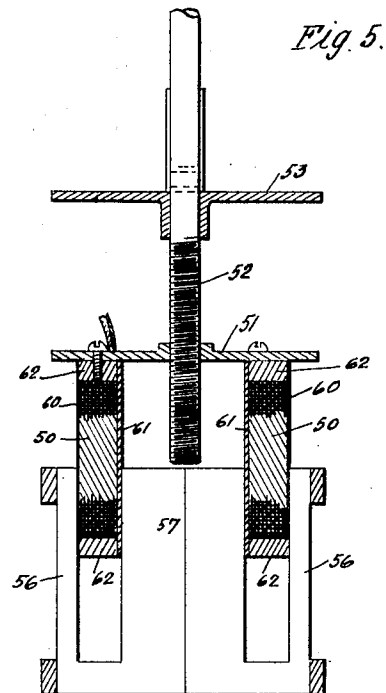
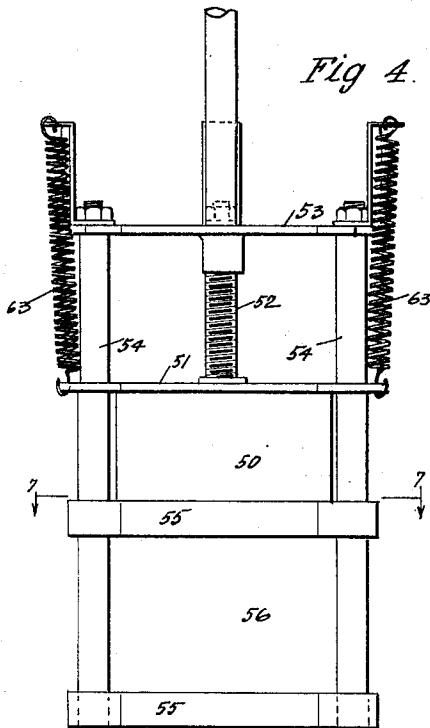
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CIRCUIT CONTROLLING REACTANCE COIL

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UNITED STATES PATENT OFFICE

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CIRCUIT CONTROLLING REACTANCE COIL

Application filed May 10, 1927, Serial No. 190,150. Renewed December 10, 1929.

This invention has to do with the control of electric circuits; and particularly the control of electric circuits for the purpose of varying the voltage without a corresponding loss of energy.

Although the use of reactance or impedance coils has been in the past proposed for varying the voltage of a circuit without the corresponding loss of energy that accompanies the use of resistance, such reactance coils have not been of such a type or characteristic as to make them suitable for use in a great many situations. For instance, it is highly desirable in lighting circuits, among other things, to vary the voltage applied to lights so as to vary the intensity of illumination. In some instances this has been done by interposed variable resistance or by circuitings and switches that will throw the several lights into various series and parallel combinations. But neither of such arrangements is suitable for such use, for instance, as residence lighting; the one resulting in a loss of energy and the other requiring complicated wiring. And such reactance coils of which we are aware are not suitable for such purposes due very largely to the fact of always producing a loud humming or singing noise when in operation. It is an object of this invention to provide an efficient reactance coil and control system which will be highly effective for the purposes set forth, and have none of the objectionable features of previous coils of similar nature. It is also an object to provide a reactance coil of simple and inexpensive design.

How I accomplish this and other objects will be best understood from the following detailed description of specific and illustrative forms that embody the invention, reference for this purpose being had to the accompanying drawings, in which:

Fig. 1 is a more or less diagrammatic view showing an installation of my improved reactance coil and showing the coil itself in elevation;

Fig. 2 is a longitudinal central section of the coil itself;

Fig. 3 is a cross section on line 3—3 of Fig. 2;

Fig. 4 is an elevation of a modified form of coil;

Fig. 5 is a vertical central section of the form shown in Fig. 4;

Fig. 6 is a plan of the form shown in Fig. 4; and

Fig. 7 is a horizontal section on line 7—7 of Fig. 4.

Referring first to Figs. 1, 2 and 3, I shall first explain in detail the structure of the coil itself in its preferred form. The coil winding 10 is located inside an iron sheathing 11 which is preferably made up of laminations which lie in radial planes. This disposition of laminations can best be understood from an inspection of Fig. 3. This magnetic sheathing for the coil comprises in effect a cylindrical outside casing 12, made up of said laminations, and end pieces 13, also made up of the same laminations, and which end pieces overhang the ends of coil 10. Within the coil is a guide tube 17 of some suitable non-magnetic material, this tube guiding the cores 14 and protecting the coil winding against abrasion. The ends of this tube may rest in recesses 15 in end pieces 13, and there may also be guide tubes 18 set in recesses 16 and extending beyond the outer ends of end pieces 13, to guide the cores when they are pulled out of the coil. But the end pieces 13, between the recesses 15 and 16, project inwardly so as to come either into direct contact with, or very close to, the cores 14, as will be seen from an inspection of Fig. 2.

When cores 14 are in the position of Fig. 2 it will be seen that there is an iron magnetic circuit of very low resistance surrounding the coil, increasing the inductance and therefore the reactance of the coil to its maximum. As the cores are withdrawn from the coil the inductance and reactance decreases. By properly proportioning the coil winding, the reactance of the coil when the cores are completely withdrawn may be made to be very small, so that the voltage in the coil circuit is lowered very little. On the other hand, with the cores fully in-

serted, the reactance may be made comparatively large, causing a corresponding drop in voltage. The range of voltage control in a coil of the kind here described is large enough to change an ordinary electric light from full illumination to practically no luminosity at all.

I prefer, in my reactance coil, to use two oppositely moving cores as illustrated, so that the linear movement of the core need be only about one-half the length of the coil. To effect linear movement of the cores I provide a double screw shaft 20 having right and left hand threads 21 and 22 which cooperate with the two cores. The cores are preferably made in laminated form; and an easy method of forming the cores is to construct them of iron wire. Each core may thus be composed of an outer container tube 25 and an inner guide tube 26, the screw shaft 20 extending through the latter. The wire laminations 27 are filled in between the two tubes, and caps 28 are applied at the ends. The screw threads 21 and 22 of shaft 20 are engaged with the two outer end caps 28 of the two cores. Generally speaking, shaft 20 may be operated in any suitable manner and by any suitable means, but in Fig. 1 I have shown simply an effective mounting and operating means for the coil. Above the coil there may be a bearing plate 30 mounted on studs 31 which may be screwed into the upper one of two rings 32 which surround the laminations of the exterior coil sheathing and hold the laminations in proper formation. Screw shaft 20 may have a bearing in the bearing plate 30 and be provided with a bevelled pinion 35 meshing with bevel gear 36 on a knob shaft 37. A knob 38 mounted on shaft 37 outside the wall plate 39 may provide a convenient and easy means of manipulating shaft 20 and therefore of moving the cores. In a typical installation the wall plate 39 may also cover a main circuit switch 40, operated by switch knob or handle 41, and behind the plate may also be located an indicator light 42 behind a colored lens 43. Fig. 1 shows a complete typical installation wherein the reactance coil is controlling a lighting circuit which includes a light 44. Of the wires leading in from the supply circuit one of them 45 may go directly to light 44 and the other 46 may go to one side of the reactance coil. On the other side of the circuit a wire 47 may lead from light 44 to switch 40, and a wire 48 leads from switch 40 to the other side of the reactance coil. Indicator light 42 is connected across between wire 46 and wire 48, by wires 49 and 50; so that the indicator light will, when switch 40 is closed, be subjected to a voltage independent of the adjustment of the reactance coil; while the reactance coil controls the voltage in the circuit that passes through

light 44. The indicator will thus indicate whether or not the switch 40 is on, even though the reactance coil might be so adjusted that light 44 may have no luminosity.

From a consideration of the drawings and of the foregoing description it will be readily understood how the device is operated. In the position of Fig. 2 the lamp 44 or any other device or appliance in the circuit is subjected to practically full voltage; while in the position of Fig. 1 the lamp or other device is subjected to very much reduced voltage. In the position of Fig. 1 it will be noted that the two cores 14 are fully withdrawn from the coil, with their inner ends some little distance from the ends of the coil. Exterior guide tubes 18 are provided to guide the cores when they reach their outermost positions.

A characteristic feature of my reactance coil resides in what I may term its balanced magnetic construction, which avoids the possibility of singing or humming noises being set up by the alternating current. The varying magnetic flux in the field surrounding an alternating current coil ordinarily sets up contractions and expansions which give rise to a humming noise corresponding in pitch to the periodicity of the current. Wherever the iron structure in such a magnetic current is capable of vibration, the humming noise is particularly pronounced. And wherever the iron is not symmetrically disposed about the central axis of the magnetic field, the slightest looseness of the moving part (even that very slight looseness that is necessary for a close moving fit) will allow the moving part to be vibrated back and forth in the unbalanced system and thus create a humming noise. It is a feature of my construction that iron parts are all so symmetrically arranged about the central axis of the magnetic field that a perfect balance of forces is at all times maintained, so that there is no tendency to vibrate the cores. It will be noted that the cores themselves are centralized upon or concentric with the center longitudinal axis of the coil. They fit the guide tubes 17 and 18 with a close sliding fit. Then the iron end pieces 13 and the outer cylindric sheathing 12 are also both concentric with the coil axis and extend completely around it. The result is that the disposition or distribution of the magnetic line or force in and around the coil is perfectly even, the magnetic force in any one radial plane being exactly equal to that in an opposite radical plane. The magnetic forces exerted upon the movable cores are therefore equal and opposite in every direction, with the result that there is no tendency to vibrate the cores laterally. A device constructed as herein specified has been found to be entirely noiseless in operation. Although a balanced magnetic struc-

ture of the type here described may be constructed of solid iron, for instance of castings, the laminated construction has several advantages. In the first place it eliminates hysteresis currents and the attendant heating effects. Also the laminated construction fully assures the full benefits of the balanced features which I here describe. Where the laminations are arranged radially it is readily seen that the paths in all radial planes are of exactly equal magnetic resistance and that the lines of force tend to flow strictly in radial planes and with no deviation therefrom. The radial laminated form therefore assures the certainty of proper operation; whereas a cast iron form, although capable of operating in accordance with my invention, is liable, through the existence of blow holes or non-homogeneity of the cast metal, to cause a symmetric disposition of the lines of force which might result in the objectional humming vibration.

In Figs. 4 to 7 I have shown a somewhat modified form of coil. Here the relative movement between the coil and the iron is caused by the movement of the coil winding itself, the iron being stationary. In these figures I show a coil winding 50 hung from a plate 51 which may be moved vertically by the operation of screw shaft 52, the screw shaft having a bearing in bearing plate 53 mounted on studs 54 which in turn are supported on rings 55, rings 55 being the ones which surround and hold in place the laminations of the iron sheathing and core. The stationary iron parts of the complete coil apparatus comprise an outer ring 56 and an inner core 57, the ring and core being made up of radially placed laminations of the U-shape as illustrated in Fig. 5. These laminations may be placed radially as close together as the thickness of the laminations permits, interspaced laminations which do not reach clear into the center of the core being also used. After as many laminations as possible have been placed, then the whole assembly of laminations may be dipped in wax or some other suitable filling substance, which, upon hardening, will fill the open spaces and bind the laminations into one solid body.

Coil winding 50 may be provided with an outer protecting sheathing 60 and an inner protecting sheathing 61, and these sheathings may be in the form of thin tubes. Between these tubes and at the ends of the coil winding there are preferably two iron rings 62 to complete a magnetic circuit of very low resistance. Springs 63 may be used to balance or partially balance the weight of the coil.

The method of operation of the coil of Figs. 4 to 7 will be readily understood from the foregoing description, the operation and

results being substantially similar to those of the form of Figs. 1 to 3.

I claim:

1. A reactance coil, comprising a coil winding of substantially cylindric form, a cylindric guide tube within the coil, a magnetic sheathing surrounding the coil of substantially cylindric form and symmetrical with relation to the coil axis, magnetic end pieces at the ends of the coil winding, integral with the exterior sheathing and also symmetric with relation to the coil axis, said end pieces having annularly disposed parts which reach inwardly to the inner surface of the guide tube, a pair of magnetic cores fitting within and slidable along the guide tube, said cores making a close sliding fit within the tube and being symmetric with relation to the coil axis, exterior guide tubes of non-magnetic material mounted in and extending from the end pieces, and means to move the two cores equally and oppositely including a screw shaft having right and left hand threaded portions.

2. A reactance coil, comprising a hollow coil winding, a cylindric guide tube within the winding, a magnetic sheathing surrounding the coil and extending inwardly over its ends, a pair of magnetic cores fitting within and slidable along the guide tube, said cores making a close sliding fit within the tube, exterior guide tubes of non-magnetic material forming extensions of the interior guide tube at both ends, and means to move the two cores in a straight line along the longitudinal axis of the guide tubes equally and oppositely in and out of the interior guide tube.

3. A reactance coil, comprising a hollow coil winding, a cylindric guide tube within the winding, a magnetic sheathing surrounding the coil and extending inwardly over its ends, a pair of magnetic cores fitting within and slidable along the guide tube, said cores making a close sliding fit within the tube, exterior guide tubes of non-magnetic material forming extensions of the interior guide tube at both ends, and means to move the two cores in a straight line along the longitudinal axis of the guide tubes equally and oppositely in and out of the interior guide tube, each core being composed of a bundle of magnetic wires and an enclosing non-magnetic sheathing tube.

4. A reactance coil, embodying a hollow coil winding, a cylindric guide tube of non-magnetic material within the winding, a magnetic sheathing surrounding the coil, a pair of relatively movable magnetic cores fitting within and slidable along the guide tube, said cores making a close sliding fit within the tube, and means for oppositely moving said cores in a straight line along the longitudinal axis of said guide tube.

5. A reactance coil, embodying a hollow

coil winding, a cylindric guide tube of non-magnetic material within the winding, a magnetic sheathing surrounding the coil and extending inwardly over its ends, a pair of
5 relatively movable magnetic cores fitting within and slidable along the guide tube, said cores making a close sliding fit within the tube, and means for moving said cores in a straight line along the longitudinal
10 axis of the guide tube equally and oppositely inward and outward of said guide tube.

In witness that I claim the foregoing I have hereunto subscribed my name this 26th
15 day of April, 1927.

FRANK J. ZAMBONI.

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