Sept. 13, 1927. 1,642,488

H. P. CLAUSEN

ELECTRICAL COIL

Filed July 2, 1923 2 Sheets-Sheet 1

Fig. 1

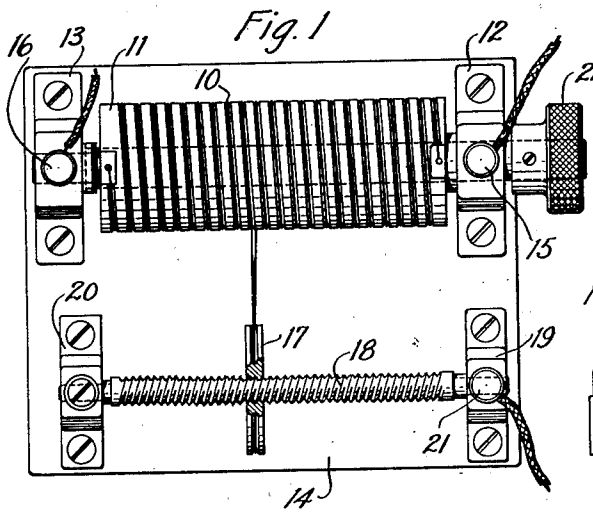

Fig. 2

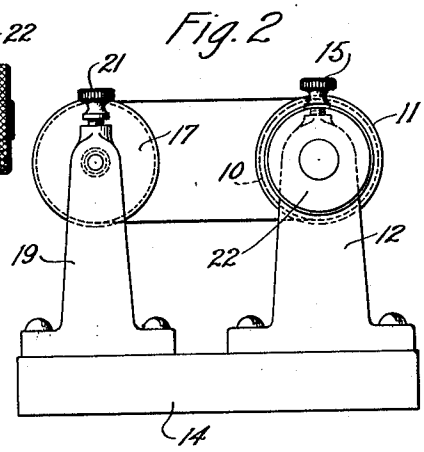

Fig. 3

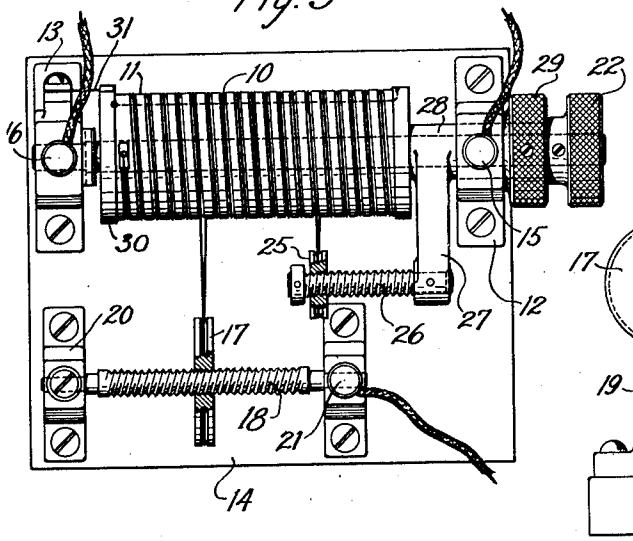

Fig. 4

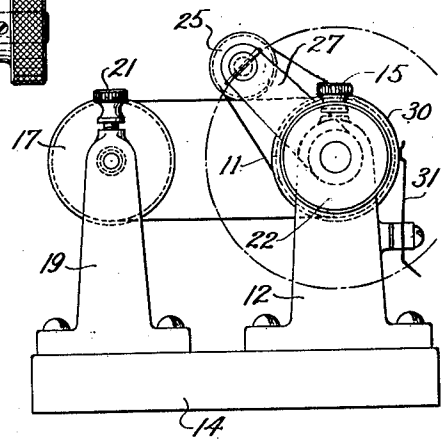

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Fig. 6

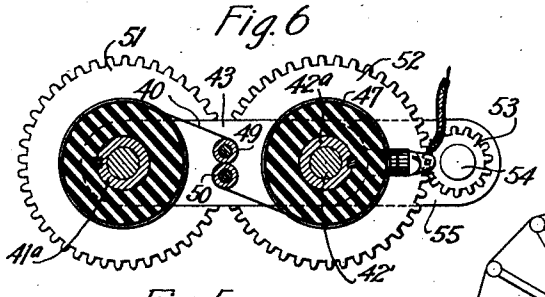


Fig. 7

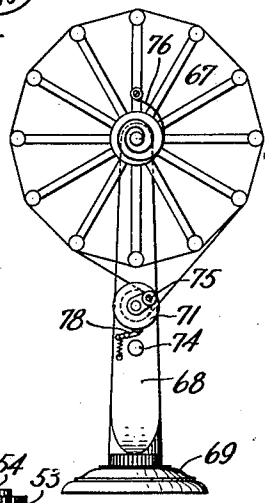


Fig. 8

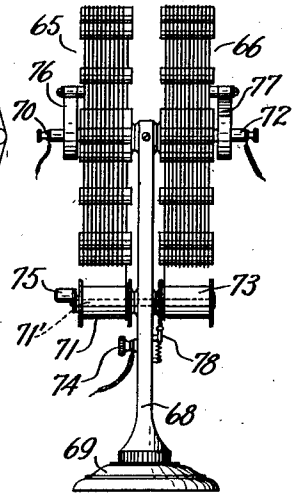


Fig. 5

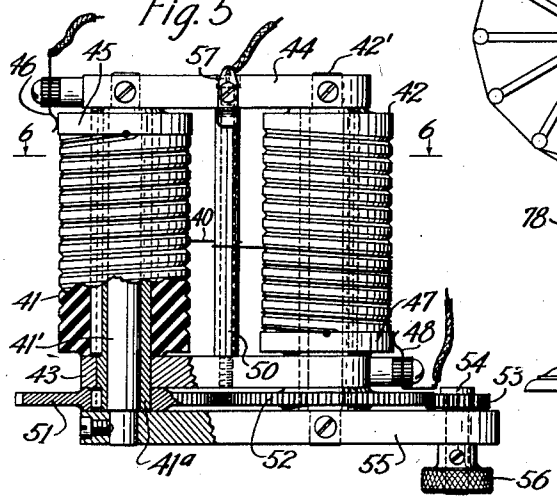
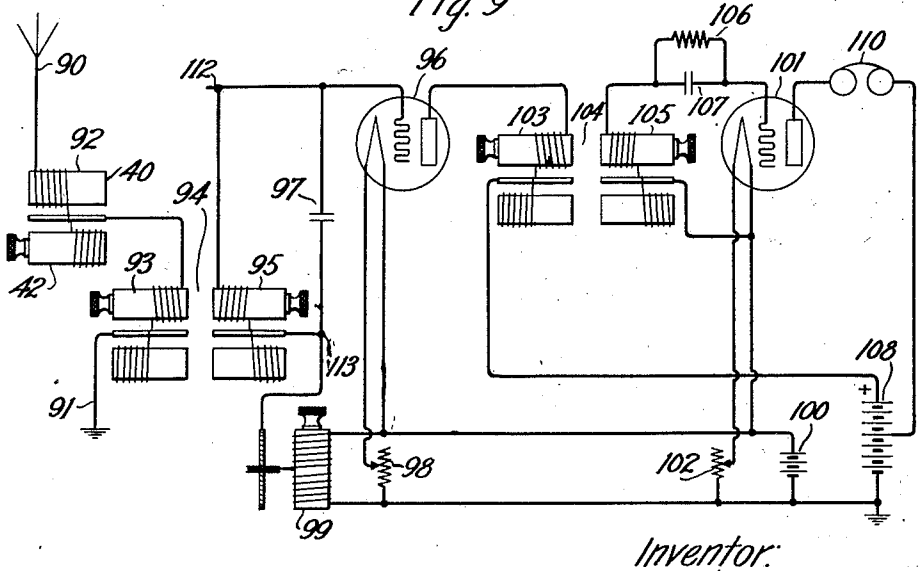


Fig. 9



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Patented Sept. 13, 1927. 1,642,488

UNITED STATES PATENT OFFICE.

HENRY P. CLAUSEN, OF MAMARONECK, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ELECTRICAL COIL.

Application filed July 2, 1923. Serial No. 648,882.

This invention relates to an electrical coil.

It is found that in loop antennæ and in tuning inductances and transformers for receiving or transmitting radio frequency currents, there is a certain optimum number of turns at which energy of a given frequency or wave length will be most efficiently transmitted. Moreover, experiment shows that in loop antennæ having the proper number of turns for a given wave length, the reception factor will be a maximum for this wave length, if there are no dead end turns.

It is an object of this invention, therefore, to provide an electrical coil the effective turns of which are variable and in which end turn effects are nullified.

Another object is to provide an electrical coil having an intermediate tap whereby its effective turns may be varied by infinitesimal amounts.

A further object is to provide a variable coil adapted for use as a loop antenna in which the effective turns may be varied, the effect of end turns nullified, and the unwound portions of the coil may be automatically rewound.

Thus, the electrical coil may comprise a bare conductor arranged to form one or more helical sections. Contact members are provided between sections of such character as to make continuous electrical connection with the bare conductor during the process of adjustment. In order to nullify the effect of dead end turns, conducting cylinders are provided upon which the ineffective turns of the coil are rewound. The same device may serve both as a variable contact member and for annulling end turn effects, or separate devices may be provided to perform these separate functions.

When used as a loop antenna, this electrical coil is preferably provided with means for automatically winding or unwinding the coil sections and for maintaining the coil in its adjusted position.

In the drawings

Figs. 1 and 2 are top plan and end elevation respectively of an inductance coil having a variable intermediate tap.

Figs. 3 and 4 are top plan and end elevations respectively of an inductance coil having a plurality of variable intermediate taps.

Fig. 5 is a top plan of an inductance coil having the winding thereof on two rotatable cylinders.

Fig. 6 is a sectional view on line 6—6 of Fig. 5.

Figs. 7 and 8 are front and side elevations respectively of a loop antenna whose effective turns are variable.

Fig. 9 shows diagrammatically a radio receiving system employing inductance coils of the preceding figures.

The inductance coil of Figs. 1 and 2 has two sections the effective turns of which may be varied with respect to each other.

This inductance coil comprises a bare conductor 10 wound into a helix and supported by a cylinder 11 of insulating material peripherally grooved for the reception of the conductor. The cylinder 11 is rotatably mounted in brackets 12 and 13 projecting from a base 14. The ends of conductor 10 are electrically connected to the supporting brackets 12 and 13 provided with terminals 15 and 16 to which circuit leads may be connected.

The variable intermediate tap is formed by looping the conductor 10 over a peripherally grooved nut 17 carried by and movable along a screw shaft 18 fastened in supporting brackets 19 and 20. The conductor 10 engaging nut 17 is electrically connected to bracket 19 provided with a terminal 21, to which a circuit lead may be connected.

The effective turns of the two sections of the inductance coil may be varied by means of a knurled knob 22 fixed to the end of one of the mounting spindles of cylinder 11. The portion of conductor 10 passing from cylinder 11 over the nut 17 and back to the cylinder is taut, so that whenever the cylinder is rotated the nut is caused to rotate and move along the screw shaft 18.

This coil structure may be employed as a potentiometer.

The inductance coil of Figs. 3 and 4, similar to that shown in Figs. 1 and 2, is provided with a second variable intermediate tap.

This second variable intermediate tap is formed by looping the conductor 10 over a peripherally grooved nut 25 carried by and movable along a screw shaft 26 fixed in an arm 27 of a sleeve 28 surrounding one of the mounting spindles of cylinder 11. The

sleeve 28 has fixed thereto a knurled knob 29 by which it may be rotated. The diameter of traveling nut 25 is one half that of cylinder 11 and the pitch of the threads of screw shaft 26 is one half that of the grooves in cylinder 11, so that the nut 25 will travel in step with the corresponding loop in the conductor 10.

The conductor loop engaging traveling nut 25 is electrically connected to terminal 15. The end of conductor 10 adjacent the supporting bracket 12 is connected to a slip ring 30 which is engaged by a contact brush 31 mounted upon and insulated from the bracket 12. The contact brush 31 may take the form of a flat spring to one end of which a circuit lead may be connected.

By turning knob 22 the cylinder 11 is rotated thereby causing the traveling nuts 17 and 25 to move along their respective screw shafts. Thus the effective turns of the sections of the inductance coil are varied.

By turning knob, the arm 27 and the screw shaft 26 are rotated, so as to vary relatively the effective turns of the middle and the right end sections of the inductance coils.

The inductance coil of Figs. 5 and 6 comprises a bare conductor 40 wound into a helix. The effective turns of the inductance coil are supported by a cylinder 41 of insulating material peripherally grooved for the reception of the conductor. The ineffective turns of the inductance coil are supported by a conducting cylinder 42 peripherally grooved for the reception of turns of the conductor. Thus the cylinder 42 short circuits the ineffective turns.

The two cylinders 41 and 42 are rotatably supported by shafts 41′ and 42′ fixed in end plates 43 and 44 which may be supported by a suitable base (not shown).

One end of conductor 40 is connected to a slip ring 45 fastened to cylinder 41. A contact brush 46 mounted upon and insulated from the end plate 44 engages ring 45. A circuit lead may be connected to the free end of the contact brush.

The other end of conductor 40 is connected to a slip ring 47 on cylinder 42, and a contact brush 48 engages the ring 47. The contact brush 48 is supported by and insulated from the end plate 43.

The conductor 40 in being wound from one cylinder to the other passes between and partially around elongated guiding rollers 49 and 50 supported by rods fastened in the end plates 43 and 44.

The means for varying the effective turns of the inductance coil comprises two meshing gears 51 and 52 respectively mounted upon and rotatable with bearing sleeves 41ª and 42ª of the respective cylinders. The gear 52 meshes with a pinion 53 on a short shaft 54 journalled in a cover plate 55 fastened to the fixed shafts 41′ and 42′. By turning knurled knob 56 secured to shaft 54, the two cylinders are rotated in opposite directions whereby the number of turns on one cylinder is increased while the number on the other is decreased.

If the cylinder 42 be made of insulating instead of conducting material, the inductance coil then becomes one having two sections whose effective turns may be varied relatively. The intermediate top of such a two section inductance coil is formed by the guiding rollers 49 and 50 which may be electrically connected to a terminal 57 mounted upon end plate 44.

The cores of the cylinders shown in any of the Figs. 1 to 6 may if desired be of magnetic material.

Figs. 7 and 8 show a loop antenna formed of two coils 65 and 66 each comprising a plurality of turns of bare conductor. Each coil is wound on a frame 67 rotatably mounted on a shaft fastened in the upper end of a standard 68 rising from a base 69.

One end of coil 65 is connected to a terminal 70 and the other end to a metallic cylinder 71 fixed to a shaft journalled in the standard 68.

The other coil 66 has the ends thereof connected respectively to terminal 72 and metallic cylinder 73. Cylinder 73 is fixed to the shaft upon which cylinder 71 is mounted.

The two cylinders 71 and 73 are electrically connected to a terminal 74.

The shaft 71′ carrying cylinders 71 and 73 has fastened thereto a crank 75 by which the cylinders may be rotated to unwind the conductors from coils 65 and 66 and wind the same onto the respective cylinders.

Spiral springs 76 and 77 associated respectively with the coils 65 and 66 have one end thereof fastened to the shaft supporting the coil frames and the other ends connected to the respective coil frames.

These spiral springs tend normally to wind the conductors onto the respective coil frames and to turn the supporting coil frames in opposite directions.

As the crank 75 is turned to unwind the conductors from the coils, the conductors are unwound against the tension of the spiral springs.

A spring pressed brake 78 mounted on the standard engages the cylinder 73 and prevents the conductors from being unwound from the cylinders by the spiral springs.

When the cylinder 73 is relieved of the pressure of brake 78, the spiral springs 76 and 77 automatically wind the conductors onto the respective coil frames.

By means of the variable intermediate taps hereinbefore described, the inductance of the coil sections may be infinitesimally varied, so that very close adjustment is possible.

Fig. 9 is a radio receiving system utiliz-

ing the variable inductance coils for enabling the various adjustments necessary for reception of any desired signal to be made without the use of variable condensers.

This system comprises an antenna 90 connected to ground at 91 through a loading coil 92 and the primary 93 of transformer 94. The loading coil 92 is preferably similar to the coil illustrated in Figs. 5 and 6 in which the active portion of the coil is wound on insulating cylinder 41 and the dead end turns are short-circuited upon a conducting cylinder 42. Transformer 94 may comprise two coils each like that shown in Figs. 5 and 6 placed with the active portions of their windings in mutual inductive relation and the inactive portions short circuited by the conducting cylinders. Tuning by means of this transformer may be accomplished either by adjusting the number of turns on the primary 93 or by adjusting the number of the turns on the secondary 95 or by both adjustments.

The secondary winding of transformer 94 is connected to the input circuit of a well known form of three-element electron discharge device 96. A fixed condenser 97 is shunted across the secondary winding 95 of the transformer 94 for the purpose of introducing a stabilizing capacity in the circuit. A potentiometer 99, which is preferably similar to the device shown in Fig. 1, has the terminals of its winding connected across the terminals of battery 100 and in parallel with the filament of tube 96. The midpoint of potentiometer 99 is preferably connected to one terminal of the secondary winding of transformer 94. The opposite terminal of this winding is connected to the grid 96. The potentiometer 99 enables the polarizing potential on the grid of tube 96 to be adjusted.

A second three-element vacuum tube 101 has an input circuit connected to its grid and filament comprising the secondary 105 of the transformer 104 similar to transformer 94 and a grid leak resistance 106 in shunt about a blocking condenser 107. The primary winding 103 of transformer 104 is connected in series with a plate current supply battery 108 to the plate and filament of tube 96. The filament of tube 101 is preferably connected in parallel with the filament of tube 96 and is consequently supplied with heating current from battery 100. 110 represents any form of device responsive to signal current, for example, a telephone receiver connected to the plate and filament of tube 101 in series with a portion of the battery 108. Resistances 98 and 102 are placed in the circuit in series with filaments of tubes 96 and 101 respectively for the purpose of enabling the currents by which the filaments are heated to be adjusted.

The form of coil antenna shown in Figs. 7 and 8 may be substituted for the antenna of Fig. 9. This substitution may be effected by connecting the terminals 70 and 72 of the loop of Figs. 7 and 8 to the points 112 and 113 of the circuit in Fig. 9 and by disconnecting transformer 94 therefrom. The antenna 90, coil 92 and transformer 94 are thereby disassociated from the circuit. Tuning with this arrangement may be effected by varying the number of turns on the coils 65 and 66 of the loop antenna. The condenser 97 acts also in this circuit as a stabilizing capacity. The coupling between the amplifier tube 96 and detector tube 101 may be adjusted by varying the turns of transformer 104.

It is to be understood that the specific embodiments of this invention herein shown and described are merely illustrative of the novel principles involved and are in no wise intended to restrict their application. The only limits that are intended to be fixed upon the scope of this invention will appear from the following claims.

What is claimed is:

1. A variable electrical coil comprising a rotatable insulating cylinder having a helically grooved periphery, a winding of bare conductor in the grooves, a circular metallic element carrying at least a portion of one turn of said conductor, means for rotating said cylinder, and means associated with said element for causing it to move with the loop of the conductor and to maintain continuous electrical connection therewith.

2. An inductance coil comprising a rotatable insulating cylinder having a helically grooved surface, a winding of bare conductor in the grooves, means for rotating said cylinder, and means for making an electrical contact at an intermediate point of said winding, said means comprising a conducting lead-screw having a circular metallic nut mounted thereon, a turn of the coil winding being looped over said nut, and the pitch of said screw being proportioned to advance the nut equally with the winding loop as the cylinder is rotated.

In witness whereof, I hereunto subscribe my name this 28th day of June, A. D. 1923.

HENRY P. CLAUSEN.