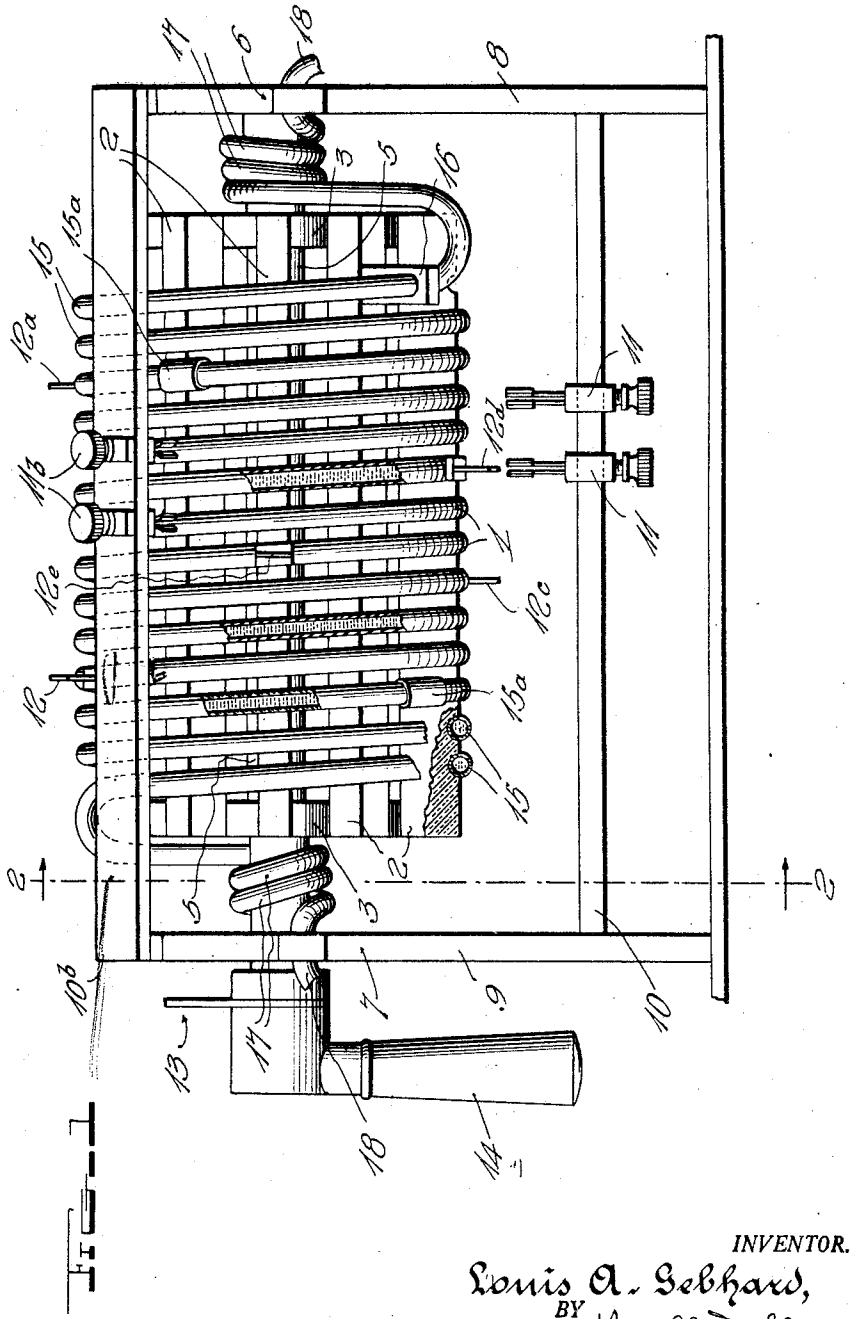
Jan. 12, 1932. L. A. GEBHARD 1,840,391

ADJUSTABLE INDUCTANCE COIL

Filed June 1, 1929 3 Sheets-Sheet 1



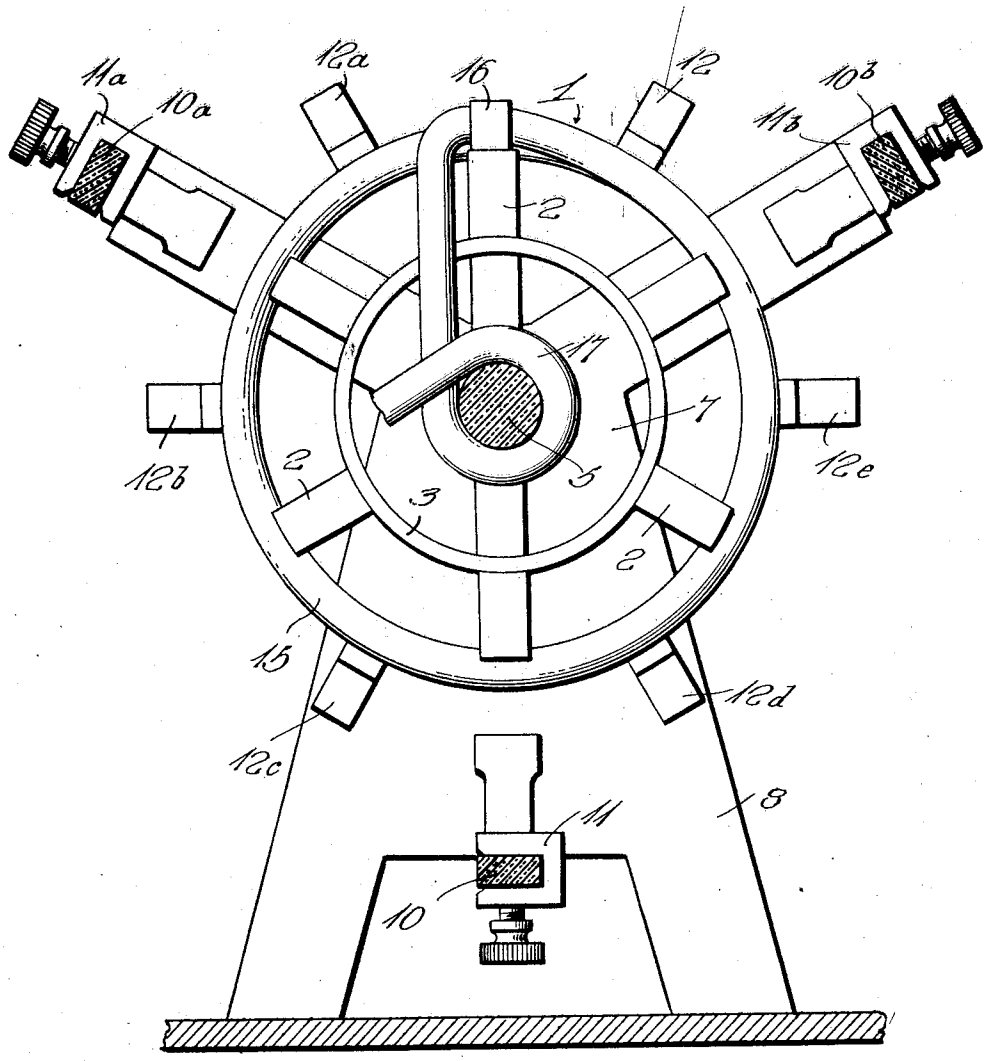
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ADJUSTABLE INDUCTANCE COIL

Filed June 1, 1929 3 Sheets-Sheet 2

Fig. 2



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ADJUSTABLE INDUCTANCE COIL

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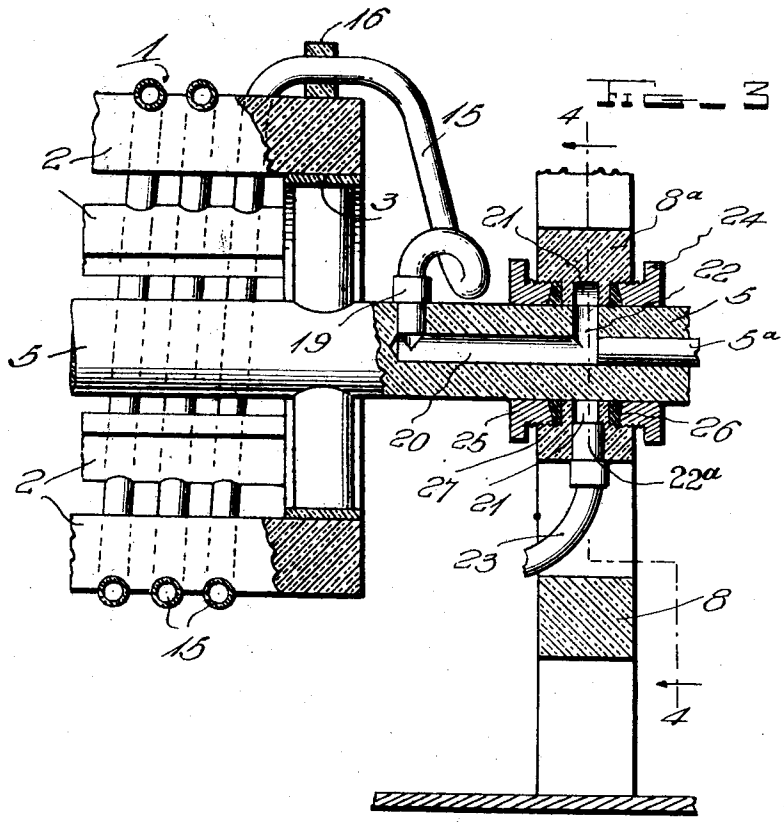


FIG. 3

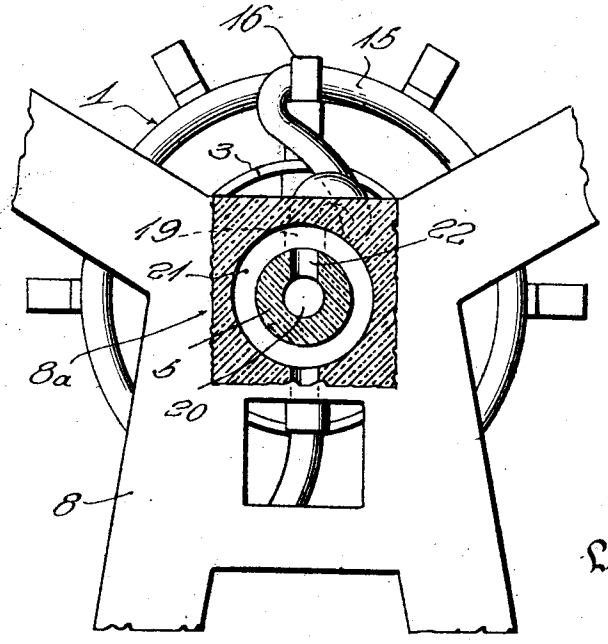


FIG. 4

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UNITED STATES PATENT OFFICE

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ADJUSTABLE INDUCTANCE COIL

Application filed June 1, 1929. Serial No. 367,778.

My invention relates broadly to adjustable inductance coils and more particularly to adjustable inductance coils employed in radio frequency circuits.

One of the objects of my invention is to provide an adjustable inductance coil adapted to be employed in high power, high frequency transmitting systems.

Another object of my invention is to provide an adjustable inductance coil of efficient design as to frequency characteristics and capable of carrying relatively high radio frequency currents.

Other and further objects of my invention reside in certain structural features of an inductance system whereby a small and efficient adjustable inductance coil for high power signal transmitters is made possible.

A better understanding of my invention can be had from the specification following and from the accompanying drawings, wherein:

Figure 1 is a side elevational view of one form of the inductance coil of my invention; Fig. 2 is an end view in section on line 2—2 of Fig. 1 embodying my invention; Fig. 3 is a cross-sectional view taken through a portion of a modified form of the inductance coil of my invention and Fig. 4 is an end view in part section on line 4—4 of the adjustable inductance coil of the form of my invention shown in Fig. 3.

In high frequency transmitting systems designed to operate over a wide band of frequencies it is necessary to provide adjustable or interchangeable capacities to effect a change in frequency characteristics of the system. The change may be effected in many different ways where low currents are involved. However, where large values of current are employed the arrangements suitable for low power are not adaptable. It is also desirable in connection with thermionic tubes to change the connections leading to the inductance coil from the electrodes of the tube. It is also desirable to change the connection to the inductance coil when the energy is to be transferred from one circuit to another.

In Fig. 1 which shows a side elevation of one form of the adjustable inductance coil of my invention, the inductance proper comprises a helically wound length of metallic tubing 1 or the like which constitutes the electrical conductor. The metallic tubing wound in helical manner is referred to herein as inductance 1, the turns of which are suitably spaced by insulating members 2. Members 2 are supported at their ends by annular shaped insulating members 3. Annular shaped insulating members 3 are supported by and spacially positioned co-axially with respect to shaft 5 which extends longitudinally and constitutes the axis of the inductance coil. Shaft 5 turns in bearings 6 and 7 provided in end members 8 and 9, respectively. End members 8 and 9 are of suitable insulating material, the actual form of which is shown in Figs. 2 and 4. Extending longitudinally between end members 8 and 9 I provide supporting rods 10, 10*a* and 10*b* of suitable insulating material or of metal, depending upon the requirements for which the inductance coil is intended. Brushes 11, 11*a* and 11*b* are mounted on rods 10, 10*a* and 10*b* respectively and provided with set screws to permit proper adjustment with respect to contact members 12, 12*a*, 12*b*, 12*c*, 12*d* and 12*e* carried by inductance 1. The contacts carried by inductance 1 and the stationary brushes in contact therewith may be suitably positioned and electrical connection to different turns and different parts of the same turns may be obtained.

The inductance 1 is adapted to revolve on the shaft 5 when the latter is moved by handle 14. Handle 14 may be replaced by any suitable knob which moves with a dial 13 or other suitable calibrated scale or indicating mechanism. Inductance 1 comprising turns of metallic tubing occupies only a certain portion of the length of members 2. The metallic tubular inductance does not extend the entire length of the inductance frame. Instead the turns adjacent each end of the inductance frame consist of insulated tubing shown at 15. The insulating tubing may be rubber hose, hard rubber, phenol composition, glass or suitable silicate composition or any desirable material having high electrical

resistance. Connection may be established by coupling members 15*a*, or if the insulating tubing 15 is of rubber the rubber may be spread over the ends of the metallic tubing. The lengths of the insulating tubing 15 are wound over the spacers 2 and are of sufficient length as determined by the length of the liquid circulation path required to provide adequate insulation. This insulation is necessary where one terminal of a high potential circuit is connected to metallic tubing 1 and the other terminal connected to ground when the source of cooling liquid circulation is also grounded. The resistance through tubing 15 is therefore connected in parallel with the source of high potential, a practice well known to those skilled in the art. For this reason the resistance should be as large as is necessary for the potential employed. The radio frequency energy also should be considered, as very high potentials at the ends of tubing 1 sometimes occur depending upon the type of circuit arrangement connected with the inductance.

Insulating tubing 15 is passed through clips 16 which are carried by members 2. The tubing is then led down around the shaft 5 and a plurality of turns provided around the shaft as shown at 17. The ends 18 of the insulating tubing extend through clips 16 and are connected with the source of cooling fluid. The turns as shown at 17 form a flexible connection for the cooling fluid which permits the turning of shaft 5 without interfering with its movement and still permits the cooling fluid to circulate through inductance 1 without interruption.

Fig. 2 of the drawings shows an end view of the adjustable inductance coil of my invention. Corresponding reference characters are employed in all of the figures of the drawings. The shaft 5 and insulating bars 10, 10*a* and 10*b* are shown in section. The relative position of insulating bars 10, 10*a* and and 10*b* is shown, as are also the structural features of annular member 3, spacing and supporting members 2 and the manner in which insulating tubing 15 is secured by clip 16. It is obvious that when tubing 15 is of non-flexible material that it is necessary to provide a length of tubing having sufficient flexibility for the turns shown at 17. The connection between the rigid and flexible tubular portions may be effected in any suitable manner. Contact members 12, 12*a*, 12*b*, 12*c*, 12*d* and 12*e* are positioned on different portions of the metallic tubing constituting the inductance proper.

Figs. 3 and 4 show sectional and end views respectively of a modification of the adjustable inductance coil of my invention. Where the movement of the coil is relatively large it may be desired to dispense with the flexible connection as shown at 17 in the foregoing figures. This modification is to be preferred where frequent adjustment of the inductance is necessary. The end of insulating tubing 15 is carried through clip 16 and extends to connecting nozzle 19. Nozzle 19 is fitted into passage 20 provided in shaft 5. This passage continues to the center of end member 8 from which it extends at right angles to the shaft as shown at 22. The opening 22 communicates with an annular slot 21 provided in the bearing portion 8*a* of end member 8. A stationary nozzle or coupling unit 22*a* is inserted in bearing portion 8*a* of end member 8 communicating with annular slot 21. The source of cooling fluid is connected with nozzle 22*a* by means of conductor 23. Openings 22 may comprise a plurality of holes drilled perpendicular to shaft 5 thereby providing more than one connecting passage. Passage 20 may be provided by drilling a hole in the center of shaft 5 and afterwards inserting a shaft 5*a* extending to the opening 22. Shaft 5 rests in bushings 24 and 25 which rest in the end member 8. Suitable packing or gaskets 26 and 27 prevent leakage of the cooling fluid between annular slot 21 and the outside of bushings 24, 25. This arrangement may be duplicated at the other end of the inductance coil. By such arrangement it is possible to completely revolve the inductance coil without interrupting the supply of cooling fluid to the coil. The arrangement at one end of the coil may serve as an inlet for the cooling fluid and that at the other for an outlet.

In this modification it is necessary to separate the inductance coil 1 and the coil 15 of insulating tubing to insure proper insulation at the ends of coil 1.

I realize that many modifications of my invention are possible and it is to be understood that the embodiments of my invention illustrated herein are not to be restricted by the foregoing specification or by the accompanying drawings but only 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. An adjustable inductance system comprising in combination a rotatable shaft member, a frame carried by said shaft member, an inductance coil consisting of metallic tubing wound in helical formation and supported by said frame, a stationary framework supporting said shaft, stationary contact members extending from said framework, contact members carried by said inductance coil adapted to be selectively connected with said stationary contact members by the rotation of said shaft means for continuously circulating cooling fluid through said metallic tubing independent of the rotation of said frame, said means in-

cluding a multiplicity of turns of insulated tubing wound upon said frame and connected with the ends of the metallic tubing constituting said inductance coil for supplying cooling fluid thereto.

2. An adjustable inductance system comprising in combination a rotatable shaft member, a frame carried thereby, an inductance coil of metallic tubing wound over said frame coaxially with respect to said shaft member, a stationary framework supporting said shaft member, contact members carried by said inductance coil, stationary contact members carried by said stationary framework, the contact members on said inductance coil being aligned with the stationary contacts on said framework when said shaft is rotated, a plurality of turns of insulated tubing carried by said frame and connected to each end of said metallic tubing, and means for supplying a continuous circulation of cooling fluid though said insulated and metallic tubing.

3. An adjustable inductance system comprising in combination a stationary framework, a rotatable shaft, an insulated framework carried thereby, an inductance coil consisting of helically wound metallic tubing supported coaxially with respect to said insulated framework, stationary contacts positioned on said stationary framework, contacts positioned on said metallic tubing and adapted to be selectively connected with aligned stationary contact members on said stationary framework when said shaft is rotated and composite lengths of rigid and flexible electrical insulating and fluid conducting members connected with said metallic tubing whereby a cooling fluid may be circulated through said metallic tubing irrespective of the rotation of said shaft.

4. An adjustable inductance system comprising in combination a stationary framework, a rotatable shaft carried therein, a frame mounted on said shaft, an inductance coil the turns of which have a common fluid conducting passage positioned upon said frame, contact members carried by said inductance coil, stationary contact members carried by said stationary framework, said coil being positioned coaxially with respect to said shaft whereby the rotation of said shaft selectively effects connection between the contact members carried by said inductance coil and said stationary contact members, a plurality of turns of insulated tubing carried by said frame and connected with each end of said inductance coil, and means for conveying a cooling fluid through the fluid conducting passage through said inductance and insulated tubing whereby the circulation of said fluid is unrestricted by the rotation of said shaft.

5. An adjustable inductance system comprising in combination a stationary framework, a rotatable shaft journaled therein, an insulated frame carried by said shaft, an inductance coil the turns of which have a common fluid conducting passage mounted coaxially with respect to said shaft, upon said frame, stationary contact members carried by said stationary framework, contact members carried by said inductance coil and adapted to be selectively connected with aligned stationary contact members when said shaft is rotated, a plurality of turns of rigid insulated tubing supported on each end of said insulated frame and connected with the ends of the turns of said inductance coil, flexible insulated tubing connected with said rigid insulating tubing, whereby continued circulation of a cooling fluid may be effected independent of the rotation of said shaft.

6. In an adjustable inductance system the combination of a rotatable shaft, an inductance coil positioned coaxially with respect to said shaft, said shaft having a fluid conducting passage disposed coaxially therein, said inductance coils having the ends thereof terminating in fluid passages connecting the fluid conducting passage in said shaft, and fluid conveying means aligned with the fluid conducting passage in said shaft, means supporting said fluid conveying means comprising stationary framework having bearings to which a cooling fluid may be admitted and whereby cooling fluid admitted to said bearings may continuously circulate through said passages irrespective of the rotation of said shaft.

7. An inductance system comprising a pair of supporting members, a rotatable shaft journaled therein, an insulated frame structure carried by said shaft, an inductance constituted by a plurality of turns of electrically conductive tubing wound on said insulated frame, a multiplicity of turns of insulated tubing connected to each end of said conductive tubing and wound upon said frame structure, a plurality of loops of flexible insulated tubing connected with the ends of the aforesaid insulated tubing and flexibly coiled about said rotatable shaft for conveying cooling fluid through said inductance.

8. An inductance system comprising a pair of standards, a rotatable shaft journaled in said standards, an insulated frame carried by said shaft, an inductance constituted by a multiplicity of turns of metallic tubing, a plurality of turns of insulated tubing carried by each end of said frame structure and connected with the ends of said metallic tubing, a plurality of turns of flexible insulated tubing coiled about said rotatable shaft and connected with the ends of the aforesaid insulated tubing for providing a circulatory path for cooling fluid through said inductance, a plurality of contact clips adapted to be adjustably positioned with respect to said standards in alignment with the contact

members on the turns of said inductance whereby rotative movement of said shaft imparts corresponding movement to said frame for shifting the contact members on said inductance into connection with aligned contact clips while said inductance is maintained at uniform temperature by the circulation of cooling fluid therethrough, the electrically connected portion of said inductance being substantially insulated from the source of cooling fluid supply by the insulated turns connecting the ends of said metallic tubing.

9. In a high frequency inductance, a pair of insulated supports, a rotatable shaft, bearings carried by each of said supports for journaling said rotatable shaft, a frame structure carried by said rotatable shaft, a tubular inductance wound upon said frame structure and adjustable to different positions by angular movement of said frame, said bearings each having an annular recess therein, a port extending through each end of said shaft and registering with the recess in the associated bearing, a connection between the ports in said shaft and each end of the tubular inductance carried by said frame and means for circulating cooling fluid through the recesses in said bearings, the ports in said shaft and through said tubular inductance for maintaining said inductance at uniform temperature independent of the adjustment thereof to different angular positions.

LOUIS A. GEBHARD.