Oct. 11, 1932. L. A. GEBHARD 1,882,075

FLUID COOLED INDUCTANCE SYSTEM

Filed Dec. 24, 1930

FIG. 1

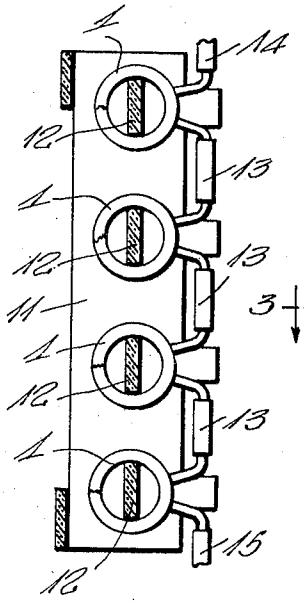


FIG. 2

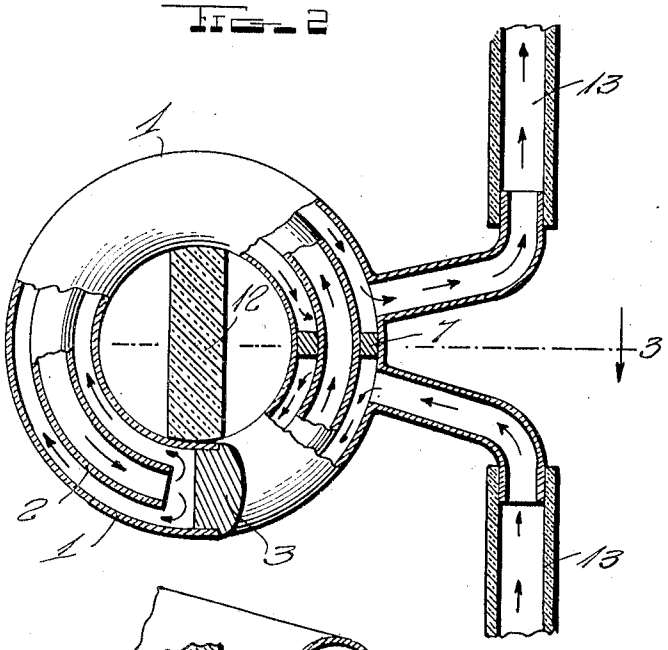


FIG. 3

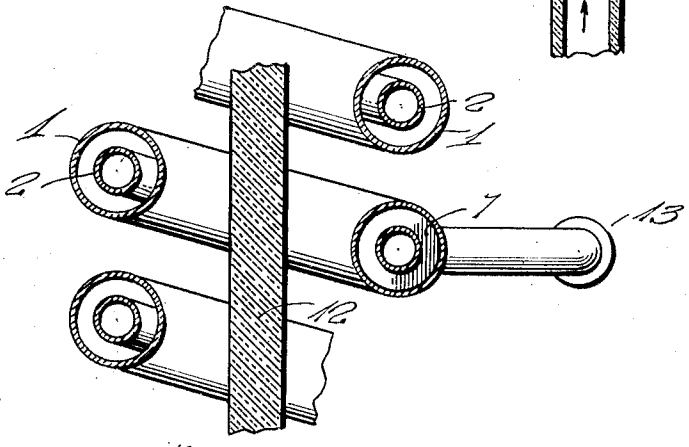


FIG. 4

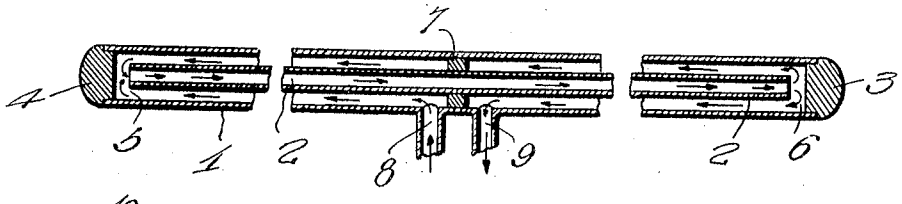
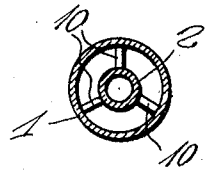


FIG. 5



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UNITED STATES PATENT OFFICE

LOUIS A. GEBHARD, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO WIRED RADIO, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

FLUID COOLED INDUCTANCE SYSTEM

Application filed December 24, 1930. Serial No. 504,628.

My invention relates broadly to high frequency inductance systems and more particularly to a fluid cooled inductance system.

One of the objects of my invention is to provide a construction of high frequency inductance system having means for maintaining the inductance at a uniformly low temperature under conditions of continuous operation.

Another object of my invention is to provide an inductance system for a push pull system of power amplification having means for introducing a cooling fluid into the inductance system at a low potential point in the inductance coil.

Other and further objects of my invention reside in the method of cooling a high frequency inductance and a construction of high frequency inductance as set forth more fully in the specification hereinafter following by reference to the accompanying drawing, in which:

Figure 1 is an end view of a multiplicity of high frequency inductance coils showing the central interconnection of cooling conduits to low potential points therein; Fig. 2 is an enlarged view of the inductance of my invention with a central turn thereof partially broken away and illustrated in cross section showing the passage of cooling fluid into and out of the coil at a low potential point therein; Fig. 3 is a lateral cross sectional view of a fragmentary portion of the coil on line 3—3 of Fig. 2; Fig. 4 shows an expanded view of one of the inductance coils in which the turns have been straightened out to show the fluid cooling circuits; and Fig. 5 shows one manner of supporting the central inner fluid conducting tube within the tube constituting the inductance coil.

In a high power transmitter using a push-pull power amplifier system it is desirable to have the output and input circuit coils fluid cooled so that the conductors making up the coils may be made small. If the transmitter is to operate over a wide frequency range a number of coils must be used which are selectively inserted for the various frequency bands. If these coils are too large, as they would be if they were not fluid cooled, it would be difficult, if not impossible, to arrange them so their leads would be short enough to permit operation in the required frequency ranges. In fluid cooled coils it is desirable to insert the cooling fluid at a low potential point in the coil. If the fluid circuits are connected to the ends of a coil in a push-pull circuit and the cooling fluid passes through the tubes considerable losses will occur at the ends of the coil since these are high potential points. Part of these losses will be in the insulating medium of the insulated tubing, supplying and discharging the fluid and part in the fluid itself since this is both an imperfect conductor and an imperfect insulator.

Fig. 1 shows a number of coils connected together such as described below. Fig. 4 shows an expanded view of these coils in which the turns are straightened out to show the fluid cooling circuits. The coil consists of outer tube 1 which forms the conductor in the circuit. To the ends of tube 1 are fitted plugs 3 and 4 to prevent the cooling fluid from passing out the ends of this tube. Inside of tube 1 is placed another tube 2 which passes from one end of tube 1 to the other end. Spaces 5 and 6 are provided at the end of tube 2 and between it and plugs 3 and 4 to permit the cooling fluid to pass through. In the middle of the coil a plug 7 is placed through which tubing 2 passes. Connections 8 and 9 are made in the walls of tube 1, immediately on both sides of the part 7. The passage of the cooling fluid then is through entrance 8 into the space between tube 1 and tube 2 to the end 3. The fluid then passes into tube 2 and through it to the end of the coil 4, around the end of the tube 2 through the space between tube 2 and tube 1 and discharges through outlet 9. Fig. 2 shows the coil in its normal form with a section cut away near the end 3 to show the passage of the cooling fluid. Fig. 2 also shows a cross section at the center of the coil showing in detail how the part 7 is fitted into place. In the assembly of the coil the part of tube 1 immediately above part 7 may be cut open to allow part 7 to be placed inside. Then tube 2, which has been previously formed, may be

screwed into tube 1. Plug 3 must be left off until this is done. Tube 2 can be passed through 7 and arranged properly in place. 7 may be sweated through the opening in 1 to part 2 and to the inner walls of part 1. The opening in part 1 can then be closed and properly sweated. Plug 3 may then be put in place.

Fig. 3 shows the relative arrangement of the inner and outer tubes for cooling the inductance system. If desired the inner tube 2 may be supported by members 10 inside of the tube 1 as shown in Fig. 5 but this is not essential. A group of these coils may be mounted together as shown in Fig. 1. In this case the coils are supported on rack 11 by insulating members 12. The fluid cooling circuits are connected together by means of insulating tubing 13. Insulating tubes 14 and 15 serve to provide inlet and discharge means. Any desired taps may be placed on the coils for electrical connections.

In the coil above described, the fluid connections are made at a point in the coil which is at low radio frequency potential such as the center of the coil when it is used in a push-pull circuit. This provides a system giving minimum losses in the fluid cooling circuits as well as in the coils themselves.

My invention provides a high degree of efficiency for high frequency transmitters and while I have described my invention in certain 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 coil comprising a tubular member, means closing each end of the tubular member, a partition member disposed intermediate the ends of said tubular member, a port extending through said partition member, an inlet and outlet port on said tubular member on either side of said partition member for introducing a circulating fluid through said member, said member being coiled in the form of an electrical inductance.

2. A high frequency inductance comprising a tubular member, means closing each end of said tubular member, a partition intermediate the ends of said tubular member a tube enclosed by said tubular member and extending through said partition and terminating short of the ends of said tubular member and means for introducing and discharging cooling fluid adjacent the center of said tubular member on either side of said partition for circulation through said tube.

3. A high frequency inductance comprising a conductive tubular member, means closing opposite ends of said tubular member, a partition member disposed centrally of said tubular member, a tube extending through said partition member, and fluid inlet and outlet connections for said tubular member on opposite sides of said partition member and adjacent the center thereof for establishing a circulation of fluid through said tubular member and through the tube extending through said partition member.

4. A high frequency inductance comprising a tubular member, having the turns thereof disposed in the form of a coil, a partition member disposed centrally of said tubular member, a concentric tube extending through said partition member and spaced from the interior walls of said tubular member, means closing opposite ends of said tubular member and fluid inlet and outlet connections on opposite sides of said partition and adjacent the center of said tubular member for circulating cooling fluid through said tubular member and through said concentric tube.

5. A high frequency inductance comprising a pair of nested tubes, means closing opposite ends of the outer tube, a partition member disposed centrally of said tubes and extending between said nested tubes, and fluid inlet and outlet connections for said tubular member adjacent the center thereof and on opposite sides of said partition member.

6. A high frequency inductance comprising a pair of nested tubes, means closing the ends of the outer tube, means disposed centrally of said tubes and closing the annular space between said tube, the inner tube terminating short of the outer tube and fluid inlet and outlet connections for said outer tube disposed on either side of said partition member.

LOUIS A. GEBHARD.