

UNITED STATES PATENT OFFICE

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METHOD OF INSULATING HIGH FREQUENCY TRANSFORMERS

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My invention relates to a method of insulating frequency transformers of the type in which an assemblage of relatively thin laminae of metal is used.

5 In a certain type of high frequency transformers, as described in my pending application Serial No. 3,099, filed January 17, 1925, the medium frequency (7000 to 10000 periods) generated in a high frequency machine is stepped-up to high frequency in a single stage. This particular type of transformer functions in such manner that the alternating current delivered by the machine represents a multiple of the saturation current of the transformer, in consequence of which the curve of E. M. F. is so distorted that at each half period only short impulses of E. M. F. arise which impinge upon a secondary circuit which latter is tuned to the desired natural oscillation. When the damping of this circuit is kept within favorable limits, the oscillation trains following each other give a practically undamped oscillation.

25 In the construction of high frequency transformers it is customary to use thin sheets of metal down to a thickness of 0.3 millimeters and also thin wires. The latter have the drawback that the fitting of the core, particularly when it is to be wound, causes difficulties. As the losses in the metal laminae increase with the frequency, the prior methods of building up a transformer have proved rather unsatisfactory for producing short waves, that is to say high frequencies, for space telegraphy. When in consequence of these losses the transformer heats up, its oil will dissolve the varnish often used for insulation, which causes a complete breakdown of the insulation. Furthermore varnish will prevent the heat from wandering into the cooled transformer parts. With the varnish coating being dissolved the electric currents readily pass from one wire to another and the initial advantages of the use of wire for the most part are lost.

When using plates of the above mentioned thickness it is no longer possible to obtain the effect of the distortion of the curve of E. M. F. for the multiplication of the fre-

quency, as the iron losses are too great and with the small currents necessitated by short waves, a multiple of the saturation current can no longer be had.

According to the present invention sheets of metal of a thickness of 0.02 millimeters and even considerably less are employed in a high frequency transformer which is intended especially for short wave lengths, and which operates by so distorting the curve of energy output of a medium frequency generator that it extends for a prolonged period along the zero line, the energy being transmitted by impulses to a secondary circuit tuned to the desired frequency.

Such relatively extremely thin sheets can be assembled without interposing paper or other solid insulating material between the individual sheets. Upon the structure being placed into the oil bath and currents of radio frequency being impressed across a transformer, the sheets of metal will chatter and the oil will be forced up in between the individual laminae by capillary action effectively insulating them from one another.

My invention, clearly, is applicable only when the sheets are of such thinness that they are readily distorted in their plane and are forced apart by the capillary forces. By using such thin laminae the losses in the metal can appreciably be reduced and still, when the inner part of the transformer heats up, this heat, owing to the fact that no solid insulation is employed, is immediately transferred to the liquid which then flows to the cooled surfaces.

By means of this invention the losses are quite considerably diminished, and in addition it is now possible to produce with such transformers the shortest waves of space telegraphy with the highest output required to make the transformer technically efficient. It may be stated here that it is not always desirable to reduce the thickness of the laminae to the practical minimum, since for every wave length there can be found a certain optimum thickness of sheet. My experiments have shown, for instance, that when using laminae of a nickel alloy, for a wave length of 600 meters a sheet thickness of 0.01 mm., and

for waves of 250 meters a sheet thickness of 0.006 is most favorable.

What I claim is:—

1. In a high frequency transformer, an
5 iron core, individual laminæ for said core of a thickness less than .02 m.m. and capable of distortion, the thickness of said individual laminæ being such that said laminæ are distorted by radio frequency currents and an
10 insulating liquid in the interstices between the individual laminæ forming a correspondingly thin insulating layer of uniform thickness throughout whereby hysteresis and eddy current losses are substantially limited.

15 2. In a high frequency transformer, an iron core, individual laminæ for said core of a thickness less than .02 m.m. and an insulating liquid in the interstices between the individual laminæ forming a correspondingly
20 thin insulating layer of uniform thickness throughout whereby hysteresis and eddy current losses are substantially limited.

3. In the method for constructing a high frequency transformer having an iron core,
25 individual laminæ for said core of a thickness less than .02 m.m. and capable of distortion and an insulating liquid in which said laminæ are immersed, the steps of clamping the laminæ to each other, dipping the whole in
30 a bath of insulating liquid and impressing a radio frequency current across the laminæ to distort the laminæ and permit the insulating liquid to enter into the interstices between the individual laminæ.

35 In testimony whereof I have affixed my signature.

KARL SCHMIDT.

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