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A. NOWAK

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HIGH FREQUENCY VARIABLE INDUCTANCE

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Fig. 1

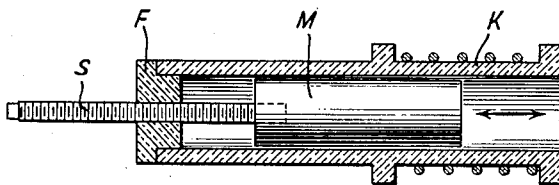


Fig. 2

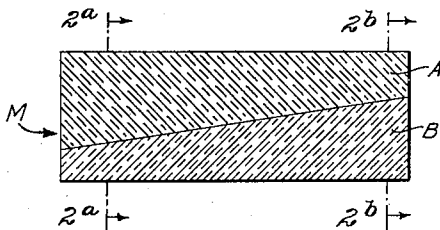


Fig. 2^a

Fig. 2^b

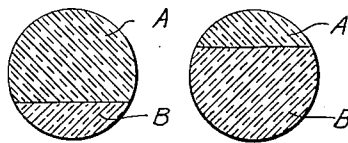
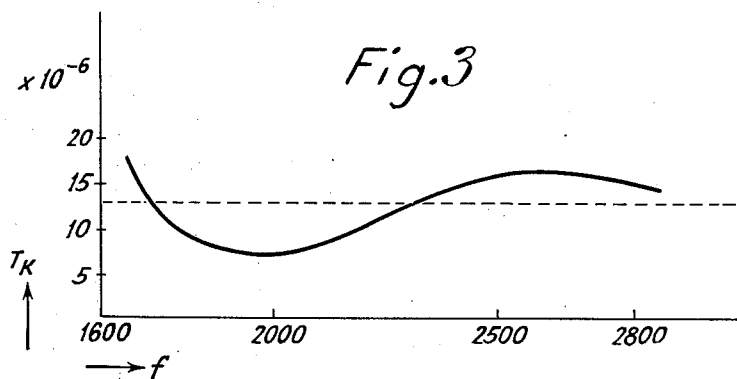


Fig. 3



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HIGH FREQUENCY VARIABLE INDUCTANCE

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4 Claims. (Cl. 171-242)

It is known in the art that the capacity of condensers and the inductance of coils are dependent upon temperature. For a certain frequency the temperature dependency of the inductance of an oscillatory circuit may be compensated, as known in the art, by an equal and opposite temperature-dependent capacity. However, this compensation is more difficult if the oscillatory circuit is tunable over a range of frequencies inasmuch as the temperature dependency is not the same for every position of the rotary condenser or variable inductance. This difficulty could be precluded most readily if the temperature dependency of all parts of the oscillatory circuit could be made equal to zero. However, this is not possible in practice. On the other hand, it is possible to drive a condenser by positively acting means simultaneously with the tuning, for instance, of a variable inductance, the capacity thereof remaining constant while the temperature dependency of the capacity varies. In this manner the temperature dependency of the variable inductance for the different positions could be compensated by means of the said condenser. However, an arrangement of this type would be rather complex and expensive. The invention discloses a simpler method.

According to the invention, which is particularly important and useful in the reception of short waves, the dust-core (also known as an iron or magnetic core) of a radio frequency variable inductance has such a temperature dependency of the permeability that the percentage dependency of the inductance upon temperature variations is practically the same for all positions of the dust-core. It is then possible to compensate the temperature dependency of the inductance by an opposed temperature dependency of the capacity of the oscillatory circuit.

In the accompanying drawing, Fig. 1 illustrates in schematic form a variable or permeability tuned inductance which incorporates certain of the features of the present invention; Fig. 2 is a cross-sectional view of the dust-core shown in Fig. 1, on an enlarged scale; Figs. 2a and 2b are sections respectively along the lines 2a-2a and 2b-2b of Fig. 1; and Fig. 3 is a curve used in describing the invention. In Fig. 1 the coil turns are arranged on the form K. The dust-core M is shiftable inside the form, in the direction of the arrow, by means of screw S. The screw may be rotated in the guide F. It is expedient that form K should consist of ceramic material having a small temperature coefficient and that screw S be of a material having a small

temperature coefficient since for equal percentage material deviations the absolute deviations of the material characteristics are smaller than for lower quality material.

It is not possible in all cases, in applying the invention, to use a single type of dust-core since the temperature dependency of the inductance of the coil is determined not only by the material of the form but also by the dimensions of the coil. What is important in particular is the ratio of the length of the coil to the diameter as well as the pitch of the turns. Even without the dust-core the temperature dependency of the inductance is dependent upon the outer dimensions of the coil. This is due to the fact that an increase in the diameter of the coil as a result of thermal expansion acts in a manner so as to increase the inductance, while an increase in length of the coil acts so as to decrease the inductance.

In a similar manner the action of the dust-core upon the temperature dependency of the coil inductance differs according to the outside dimensions of the coil. By shifting the dust-core inwardly, the coupling relations between the turns of the coil are varied, which, physically speaking, is tantamount to a variation of the coil dimensions. Thus, without the invention, the temperature dependency of the coil without dust-core is simultaneously varied as the dust-core is shifted in. Even if the invention is applied, in general it is not possible to make conditions so that the temperature dependency of the inductance remains the same for every position of the dust-core, but when applying the invention a dust-core of such a type is employed that the variation is as small as possible. Figure 3 shows the dependency of the factor T_k (variation of inductance/degree C.) upon frequency f of a practical embodiment of the permeability tuned inductance, in other words, the dependency upon the position of the dust-core in the coil. When making use of the invention a dust-core of such type is used that the actual curve comes as close as possible to the dash-line curve which represents a mean value. It can be seen that the largest deviation of the factor T_k equals $5 \cdot 10^{-6}$ (contra-distinct to the usual type of dust-core having a T_k equal to about 50 to $200 \cdot 10^{-6}$). The variation of the frequency per degree C. is thus one-half, that is, $2.5 \cdot 10^{-6}$ since for small inductance variations the frequency variation is one-half as large as the inductance variation. For comparison's sake there may be mentioned that the frequency

variation per degree C. for normal quartz is about equal to $1 \cdot 10^{-6}$. A frequency variation of $2.5 \cdot 10^{-6}$ per degree C. results in a frequency variation of $2 \cdot 10^6 \cdot 2.5 \cdot 10^{-6} = 5$ cycles per degree C. for 2000 kc. (150 m.). The practical production of a dust-core according the invention is predicated on the fact that a dust-core with positive and negative temperature dependency of the permeability may be produced. The latter depends upon the type of iron, the insulation material, the mixture ratio, the moulding pressure, the temperature during moulding or pressing as well as the production method. For carrying the invention into practice the dust-core or magnetic core M may comprise two (or more) partial cores, shown at A and B of Fig. 2, which, for instance, are cemented together so that in each cross-section both parts come to act. Care may be taken at the same time by suitable shaping of the partial cores that at different parts of the dust-core the two parts of the cross-section are of different size, as shown in Figs. 2a and 2b, to the end of approaching the horizontal dash-line of Fig. 3, so that, as the dust-core is shifted into the coil, parts or sections with varying characteristics are sequentially introduced. However, the dust-core may also be produced by mixing together different types of dust-core material while taking into account the different influences mentioned above, it being possible also in this case to choose different temperature dependencies of the permeability for different parts of the dust-core.

It is not necessary to measure the temperature dependency of the dust-core permeability since this is not of importance; but what is of import-

ance is that the existing temperature dependency of the inductance varies as little as possible upon introduction of the dust core.

In an experiment and test it was shown that for a greater pitch of the turns the dust-core must have a greater temperature dependency of the permeability. Thus, the most favorable values must be determined by experiment in each case.

What I claim is:

1. In a variable permeability tuning device, in combination, an inductance coil provided with an adjustable magnetic core made up of several longitudinal sections each having a different permeability-temperature coefficient, said sections being so arranged that the percentage variation of inductance with temperature change is substantially the same at all settings of the core with respect to the coil whereby the effect of temperature coefficient can be neutralized by equal and opposite temperature coefficient in a fixed condenser.

2. In a high frequency inductance device, a magnetic elongated core member composed of a plurality of longitudinal sections having different permeability-temperature coefficients.

3. In a high frequency inductance device, an elongated magnetic core having different permeability-temperature coefficients transverse to its length.

4. In a high frequency inductance device, an elongated magnetic core having different permeability-temperature coefficients transverse to its length and like permeability-temperature coefficients along its length.

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