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COIL HAVING A SLIDABLE CORE AND METHOD OF ESTABLISHING THE RATIO BETWEEN THE MAXIMUM AND MINIMUM INDUCTANCE THEREOF

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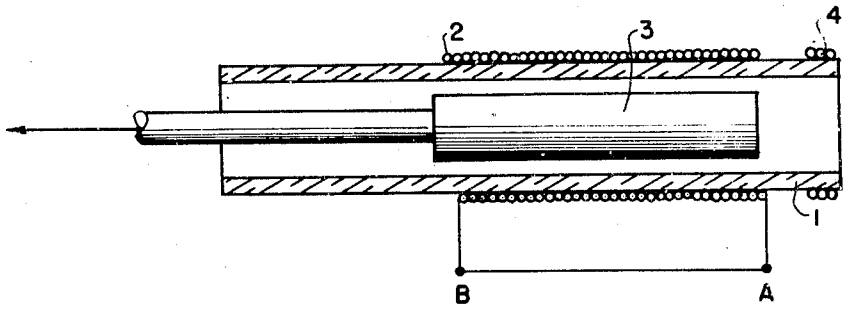


FIG. 1

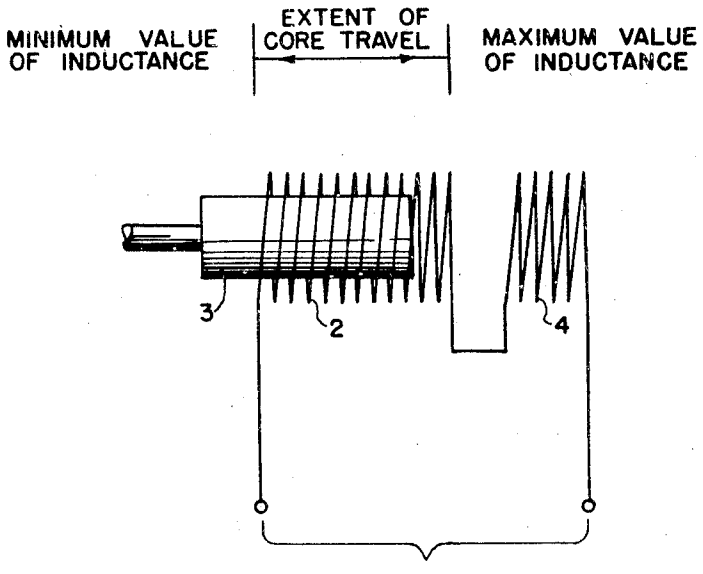


FIG. 2

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COIL HAVING A SLIDABLE CORE AND METHOD OF ESTABLISHING THE RATIO BETWEEN THE MAXIMUM AND MINIMUM INDUCTANCE THEREOF

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3 Claims. (Cl. 171—242)

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By means of modern manufacturing methods, which are used in radio-set works, parts such as coils and condensers jointly constituting the tuning circuits of a radio-receiver can be made with comparatively small tolerances.

Notwithstanding that it is necessary to provide corrections in the eventual adjustment of the set, in order that the position of the pointer with respect to the dial fits in with the wavelength to which the set is tuned. Furthermore readjustment of the circuit constants is necessary in order to ensure a sufficiently exact synchronism of the tuning circuits. For this readjustment use is generally made of so-called trimmer condensers which are usually adjusted in the vicinity of the smallest wavelength of a definite range. Assuming the inductances of all coils and the maximum capacities of all condenser sections to be equal, this adjustment means equalisation of the zero capacities of each circuit so that the range of wavelengths of the circuits will be equal.

However, this is not the case of the trimmer condensers which are used at the same time for compensating divergences from the inductance values of the coils. In fact, this compensation causes the zero capacities in the circuits to differ and since the maximum capacities, due to this readjustment, will percentage-wise alter to a much smaller degree, the ratio between the maximum and the minimum wavelength of the circuits will exhibit divergences.

It is already known in the prior art to realise tuning circuits with so-called slidable core tuning in sets having such a tuning system the tuning circuits being constituted by a fixed condenser and a coil whose inductance can be varied by shifting a core of magnetic material in the space surrounded by the windings. In devices thus realised the problem of adjusting the circuits is somewhat different.

With rotary condensers, which are used in tuning circuits having a stationary coil and a variable condenser, it is customary to provide the terminal plates of the various sections with incisions in order that in this way the capacity variation and consequently the ratio between the maximum and the minimum capacity can be adjusted within fairly exact limits. However, such a simple method of establishing the ratio between the maximum and minimum inductance of coils having a slidable core was not known. Since the slidable cores determine the ratio between the minimum and the maximum inductance one was bound to maintain rather small tolerances in manufacturing and controlling them.

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On the contrary with tuning circuits having a simple construction and consisting of a variable condenser and a stationary coil the inductance of the coil is but slightly variable after it has been mounted in the set. When using tuning circuits having a variable inductance and a fixed condenser the latter may be realised as a semi-variable condenser at a comparatively low cost.

If, consequently there were a simple method of adjusting the ratio between the maximum and the minimum inductance of a coil having a slidable core, without it being necessary exactly to consider the absolute value of this inductance, exact synchronism might be obtained by adjusting the parallel capacity at one value of the wave range.

The invention purports to provide a construction and a method of making a coil having a slidable core in such manner as to permit by means thereof the ratio between the maximum and the minimum inductance to be acted upon and to be given a predetermined value.

According to the invention this is ensured by providing that at the side of the coil remote from the side of entrance of the core a group of turns is located past the end surface of the core in telescoped position to such an extent that the inductance decrease caused by unwinding a turn belonging to this group in completely telescoped position and that created in the extreme outposition of the core are at least substantially equal to each other. Thus it is ensured that the ratio between the maximum and the minimum inductance can be acted upon by unwinding one or more turns.

The coil is preferably constructed in such manner that the unwinding of each of the turns belonging to the said group involves an increase of at least 0.3% of the ratio between the maximum and the minimum inductance of the coil.

In this manner it is achieved that in adjusting the correct inductance variation considerable tolerances can be absorbed and that a practicable variation of the ratio between the maximum and the minimum inductance is brought about per unwound turn.

According to the invention adjustment of the ratio between the maximum and the minimum inductance is preferably effected as follows: The coil is made in such manner that the number of turns remaining beyond the core is so chosen that the ratio between the maximum and the minimum inductance in using each of the slidable cores falling under the tolerance required in manufacture is certainly too small, the ratio between

the maximum and the minimum inductance being given the correct value by unwinding turns which remain beyond the core.

A suitable adjusting method is to measure before establishing the correct ratio

$$\frac{L_{max}}{L_{min}} = a$$

the inductance or a magnitude corresponding thereto in the maximum and in the minimum position, whereupon in the position of the slidable core belonging to the minimum inductance so many turns are unwound that the minimum inductance corresponds to the

$$\frac{1}{a}$$

part of the measured maximum inductance. In this manner it is sufficient, after performing the measurements once to unwind turns, whereupon the coil satisfies required conditions with sufficient accuracy in practically all cases.

The invention will be more fully explained by reference to the drawing representing a coil having a slidable core according to the invention.

In the drawing,

Figure 1 shows a coil having a slidable core in accordance with the invention; and

Figure 2 shows the connection for the coil of Fig. 1.

In Fig. 1, a spool case 1, on which are wound the turns 2, is represented in section. In this coil is movable a core 3 of magnetic material in such manner that in the extreme position of the driving device, consequently in the completely telescoped position, the right-hand end surface extends to the location denoted by A. It appears from the drawing that the turns located at 4 always remain beyond the iron core. If the distance from these turns to the right-hand end surface of the core in the position A is sufficient, the core will not or substantially not act on the part of the inductance resulting from these turns. In Fig. 2, one end of the turns 4 is connected to the adjacent end of the turns 2 thus electrically interconnecting the two portions of the coil designated 2 and 4 respectively.

This means that when some turns are unwound at 4 the inductance of the coil, independently of the position of the iron core, decreases by a definite amount. In this way the ratio between the maximum and the minimum inductance is acted upon, which may be explained by giving the following numerical example.

It is assumed that the iron-core coil must have such properties that the maximum inductance is ten times as high as the minimum inductance. Furthermore it is supposed that the maximum inductance must amount to about 2000 μh. In designing the spool construction according to the invention one has to consider the maximum divergences, which may occur in normal production and which, consequently, the adjusting method according to the invention must be able to make up for. Thus, for instance, the inductance of the coil without iron core may, by means of simple manufacturing methods, be given a value which differs at the utmost by 3% from the nominal value of the inductance, so that a spread of 6% may occur. Furthermore, simple construction methods permit the manufacture of iron cores as a result of which the maximum value of a definite coil amounts to the nominal value of about 3%, so that also in this case a variation of 6% may occur. Since the most unfavourable divergences must be considered and the ratio between maximum and minimum inductance can only be increased by unwinding turns the coil must be designed in such manner that the smallest inductance ratio occurring differs by 12% from the ratio 1:10, i. e. that the minimum ratio amounts to 1:8.8.

In this case the maximum ratio occurring will exactly amount to 1:10 in which case no turn need be unwound.

In the most unfavourable case the coil without iron core has, for instance, an inductance of 200 μh and the maximum inductance amounts to 1760 μh, being 8.8 x 200 μh. In establishing the ratio or the inductance these values are measured and after that, according to the invention, the minimum inductance is reduced to $\frac{1}{10}$ of the maximum value i. e. to 176 μh. Consequently the inductance in the minimum and maximum position is reduced by 24 μh as a result of which the inductance becomes 1736 μh in the maximum position. The ratio between the maximum and the minimum inductance then exhibits a deviation of about 1½% from the desired ratio 1/10, which corresponds to a deviation of about 0.75% from the maximum to the minimum wavelength. This deviation, which is the maximum deviation that can occur with the chosen tolerances, is quite admissible for most set constructions.

If the tolerances in the construction of the coils and cores are smaller a corresponding greater accuracy is obtained upon adjustment.

A great advantage of this adjusting method is that the inductance need be measured only once in the maximum position, followed by a measurement in the minimum position; at the same time the inductance can be reduced to the desired fraction of the maximum inductance. If a coil has been made and adjusted in the manner set out above it is sufficient, in adjusting the circuit to be constituted by means of this coil in the device, to give the capacity of a semi-variable condenser the correct value at a single wave length.

Since the adjustability by means of unwinding turns is reduced as the turns are located more closely to the end surface A of the coil, it is desirable to maintain a definite minimum distance therefor. However, this distance depends on the various dimensions of the coil of the core, but it has been found that if on unwinding a turn the inductance ratio increases by less than 0.3%, the remaining adjustability is generally insufficient. Owing to this it is desirable that also the turn nearest the end surface of the core in the position A, which still enters into account for the adjustment, should give upon unwinding an increase of at least 0.3% in the ratio between the maximum and the minimum inductance of the coil.

What I claim is:

1. A variable inductance system comprising a first coil element, a second coil element having a variable inductance connected in series with said first coil element and coaxial to said first coil element, and a movable magnetic core slidable within said first coil element from a first position corresponding to a minimum inductance value of said first coil element to a second position corresponding to a maximum inductance value of said first coil element, said second coil element being so disposed remote from said minimum inductance position of said core and adjacent said maximum inductance position of said core that variations in the inductance of said

second coil element produce substantially equal incremental variations in the maximum and minimum inductance values of the inductive system.

2. A variable inductance system comprising a first coil element, a second coil element connected in series with said first coil element, said second coil element having a plurality of turns and being coaxial and longitudinally spaced from said first coil element, and a movable magnetic core slidable within said first coil element from a first position corresponding to a minimum inductance value of the first coil element to a second position corresponding to a maximum inductance value of said first coil element, said second coil element being so disposed remote from said minimum inductance position of said core and adjacent said maximum inductance position of said core that the removal of each turn of said second coil successively increases the ratio of maximum to minimum inductance of said inductance system.

3. A variable inductance system comprising a first coil element, a second coil element connected in series with said first coil element, said second coil element having a plurality of turns and being coaxial to and longitudinally spaced from said first coil element and a movable magnetic core slidable within said first coil element from a first position corresponding to a minimum inductance value of said first coil element to a second position corresponding to a maximum inductance value of said first coil element, said second coil element being so disposed remote from said minimum inductance position of said core and adjacent said maximum inductance position of said core that the removal of each turn of said second coil element successively increases the ratio of maximum to minimum inductance of the inductance system by at least about 0.3%.

THEODORUS ANTONIUS SPOOR.

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