

Nov. 18, 1947.

W. C. MOORE

2,430,990

COUPLING TRANSFORMER FOR RADIO-FREQUENCY SELECTORS

Filed July 1, 1944

Fig. 1.

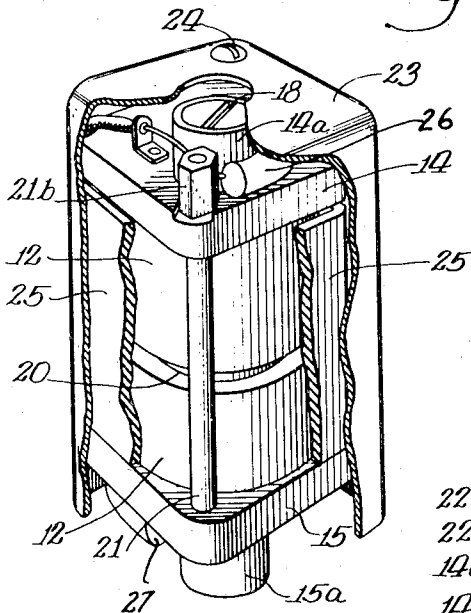


Fig. 2.

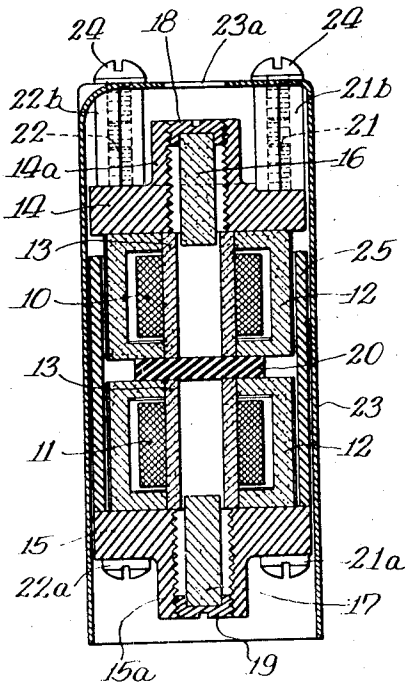
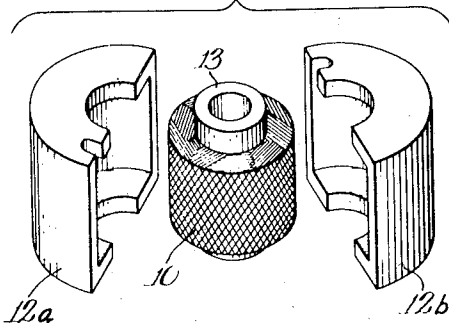


Fig. 3.



Inventor:-
William Cullen Moore,
By Mueller, Dodds & Mason
Attys.

UNITED STATES PATENT OFFICE

2,430,990

COUPLING TRANSFORMER FOR RADIO-FREQUENCY SELECTORS

William Cullen Moore, Chicago, Ill., assignor to
Motorola, Inc., a corporation of Illinois

Application July 1, 1944, Serial No. 543,148

1 Claim. (Cl. 171-119)

1

This invention relates to coupling transformers for radio-frequency selectors and more particularly to such transformers of the type used in double-tuned intermediate-frequency selectors and which permit of independent adjustment of the primary and secondary inductors of the transformer and the coefficient of coupling therebetween.

It is now common practice in double-tuned radio-frequency selectors to utilize fixed sealed capacitors for tuning the selectors because of their stability and to provide a coupling transformer having a powdered iron core adjustably associated with each of the primary and secondary windings for tuning or aligning their respective tuned circuits to the desired frequency. Certain proposed transformers of this type have also included provisions for adjusting the mutual inductance or the coefficient of coupling between the transformer windings but these arrangements have in general been complicated, or have affected the inductances of the primary and secondary windings, and thus the tuning of their associated circuits, or have been subject to both of these disadvantages.

It has also been the practice in construction of transformers of the type described to dispose each of the windings in a magnetic yoke or shell of powdered iron formed of two opposed cup-shaped members so that the resultant yoke was split transversely resulting in a minute air gap around the circumference of the shell. This transverse air gap in the yoke is traversed by the entire flux of the coil and it has been found that the reluctance of the yoke and the Q of the coil are subject to wide variations in manufacture, being particularly sensitive to variations in axial pressure on the opposed cups resulting in variations in the air gap which arise in the course of mounting the transformer structure in the apparatus of which it forms a part.

It is an object of the invention therefore to provide a new and improved coupling transformer for use in a radio-frequency selector by means of which the primary and secondary inductances and the coefficient of coupling therebetween may be substantially independently adjusted.

It is an object of the invention, therefore, to provide a new and improved coupling transformer for radio-frequency selectors in which each of the windings is completely encased in a ferro-

2

magnetic yoke and in which there is no transverse division of the yoke across the flux path of the encased winding.

It is another object of the invention to provide a new and improved coupling transformer for radio-frequency selectors which is of simple construction and by means of which one or more of the disadvantages of the prior art arrangements may be avoided.

In accordance with the invention, in a double-tuned radio-frequency selector comprising primary and secondary tuned circuits, a coupling transformer comprises co-axial primary and secondary windings for connection to the primary and secondary circuits, respectively. A ferro-magnetic core element is adjustably associated with each of the windings to adjust the tuning of its associated circuit, while resilient means are provided for mechanically biasing the windings to relative axial movement in a given sense, for example, toward mutual separation, and there are also provided means for adjustably limiting the movement of the windings relative to each other under the action of the biasing means without affecting the adjustments of the core elements.

In accordance with the invention, in a double-tuned radio-frequency selector comprising primary and secondary tuned circuits, a coupling transformer comprises co-axial primary and secondary windings for connection to the primary and secondary circuits, respectively. The transformer also includes a longitudinally divided ferro-magnetic yoke encasing each of the windings and comprising a pair of integral semi-cylindrical shells and a ferro-magnetic core element adjustably associated with each of the windings.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings while its scope will be pointed out in the appended claim.

Referring now to the drawing:

Fig. 1 is a perspective view, partly broken away, of a coupling transformer embodying the invention;

Fig. 2 is a longitudinal cross-sectional view of the structure of the transformer of Fig. 1; while

Fig. 3 is an exploded perspective view of one of the transformer windings and its associated magnetic yoke.

3

Referring now to the drawings, there is represented a coupling transformer for use in a double-tuned radio-frequency selector comprising primary and secondary tuned circuits. The transformer comprises co-axial primary and secondary windings 10 and 11 for connection to the primary and secondary circuits, respectively. The transformer also includes a ferromagnetic yoke surrounding each of the windings. As illustrated, the yokes of the two windings are identical, each comprising an outer shell 12 of channel-shaped cross section and an inner cylinder 13, so that the windings 10 and 11 are completely enclosed in their magnetic yokes. Preferably each of the shells 12 and cylinders 13 is formed of compressed powdered iron in a binder, as conventionally used in radio-frequency circuits, and is divided longitudinally and comprises a pair of integral semi-cylindrical shells 12a, 12b closely encasing the winding and the inner cylinder 13.

The transformer structure also comprises retaining caps 14, 15 at either end of the winding structures, these caps preferably being formed of molded insulation material such as "Bakelite." A ferromagnetic core element is also adjustably associated with each of the windings 10 and 11, preferably at the ends thereof remote from each other. For example, the caps 14, 15 may be provided with extending necks 14a, 15a, respectively, internally threaded and ferromagnetic core elements 16 and 17 may be cemented, molded as an integral part of, or otherwise mounted in plugs 18 and 19, respectively, of molded insulation material such as "Bakelite" threaded to engage the internally threaded necks 14a and 15a, respectively, of the retaining caps.

The transformer also includes resilient means for mechanically biasing the windings to relative axial movement in a given sense, together with means for adjustably limiting the movement of the windings relative to each other under the action of the biasing means without affecting the adjustments of the core elements. The resilient means may be a spring of glass or other low-conductivity material or, as illustrated, a rubber cushion 20 interposed between the shells 12 of the windings 10 and 11 and held under compression, whereby it biases the windings apart from each other. The limiting means may comprise a plurality of adjustable clamping bolts 21 and 22, or equivalent devices, engaging the retaining caps 14 and 15 to compress the cushion 20 and to form a rigid unitary structure and for adjusting the separation of the windings 10, 11; that is, for limiting their relative movement under the bias of the compressed rubber cushion 20. Preferably the clamping bolts 21 and 22 are provided with heads 21a, 22a engaging one of the retaining caps, for example, the cap 15, and spacer nuts 21b and 22b engaging the other retaining cap 14 and extending therefrom. A shield can 23 for the transformer structure is supported from and secured to the structure by means of machine screws 24 engaging the spacer nuts 21b, 22b. Preferably, a sleeve 25 of insulation material such as fiber or molded "Bakelite" is inserted between the yokes 12 and the shield can 23 to insulate the transformer structure from the shield can. The shield can 23 is provided with an aperture 23a registering with the threaded plug 18 to permit adjustment thereof. In the mounting of the transformer structure a similar aperture will be provided in registry in the plug 19 to permit its ready adjustment. Preferably, the primary windings 10 and 11 are connected

4

to appropriate fixed capacitors 26 and 27, respectively, to form a radio-frequency selector comprising coupled tuned circuits. The capacitors may well be of the fixed sealed mica type which are desirable because of their unusual stability characteristics, or of the cylindrical ceramic type which occupies less space and provides a means of temperature compensation. The capacitors 26 and 27 may be individually mounted on either retaining cap, as illustrated, using the cap as a terminal strip, the windings and their associated capacitors being completely enclosed within the shield can 23.

In the operation of the coupling transformer described, the tuning or alignment of each of the circuits is effected by adjustment of the plug 18 or 19 and its associated ferromagnetic core 16 or 17, as the case may be. Adjustment of either of the cores 16 or 17 is effective to adjust the inductance of its associated winding, and thus the resonant frequency of the circuit of which it forms a part. Due to the fact that the cores 16 and 17 are disposed at the outer ends of the magnetic yokes 12, adjustment of either core affects substantially the inductance of only its associated winding and does not substantially affect the inductance of the other winding or the coefficient of coupling between the two windings. Furthermore, adjustment of the clamping bolts 21 and 22 to vary the spacing of the windings 10 and 11 is effective to vary the mutual inductance, and therefore the coefficient of coupling, between the two windings but does not vary the relative spacing of each of the core elements 16 and 17 and their associated windings 10 and 11, respectively. By splitting the yokes 12 longitudinally, the junction therebetween is parallel to the magnetic flux of the encased winding and the reluctance of the path is therefore substantially independent of the air gap between the sections of the shell. This results in a uniformity of reluctance and of the Q of the associated winding substantially independent of the procedure in mounting of the transformer structure and in the particular transformer construction described independent of the adjustment of the bolts 21 and 22 for adjusting the spacing between the windings to adjust the mutual inductance and coefficient of coupling thereof. At the same time, the adjustments are simple and can be readily made from the exterior of the transformer structure windings. The structure is a rigid unitary one readily adapted to mounting in a wave signal receiver and to adjustment therein.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed as new is:

In a double-tuned radio-frequency selector comprising primary and secondary tuned circuits, a coupling transformer comprising co-axial primary and secondary inductive elements for connection to primary and secondary circuits, respectively, each of said inductive elements including a winding, a longitudinally divided ferromagnetic yoke enclosing said winding including a pair of integral semi-cylindrical shells, and a ferromagnetic core adjustably associated with said winding to adjust the tuning of its associated circuit, resilient means interposed between the yokes of said inductive elements for mechanically biasing said elements to relative axial

movement in a given sense, a plurality of clamping devices acting on said yokes in opposition to said biasing means for adjustably limiting the movement thereof relative to each other under the action of said biasing means, each of said clamping devices consisting of a bolt and a spacer nut, and a shield for said selector secured to said spacer nuts.

WILLIAM CULLEN MOORE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,168,351	LaRue et al. -----	Aug. 8, 1939
2,177,842	Schone et al. -----	Oct. 31, 1939
2,176,064	Cole et al. -----	Oct. 17, 1939
2,035,439	Corssley -----	Mar. 24, 1936
2,130,815	Rlepka -----	Sept. 20, 1938

FOREIGN PATENTS

Number	Country	Date
425,296	Great Britain -----	Mar. 6, 1935