Oct. 9, 1951 L. E. BARTON 2,570,633

INTERMEDIATE FREQUENCY TRANSFORMER

Filed April 1, 1948

Fig. 1

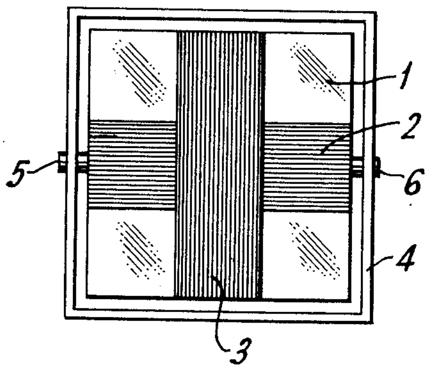


Fig. 2

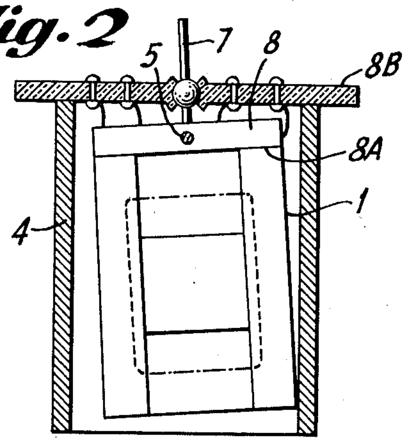


Fig. 3

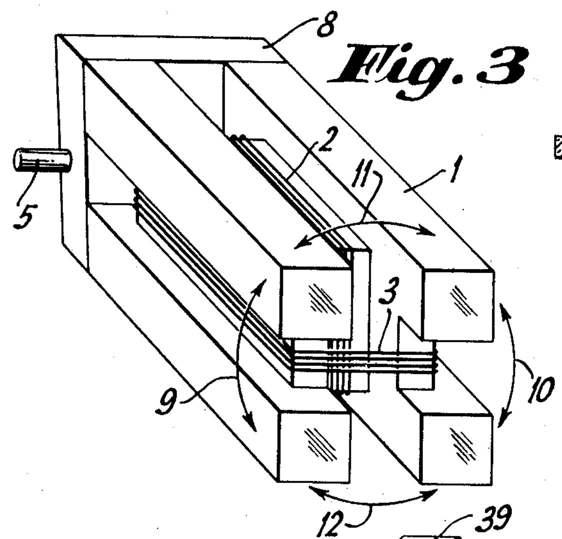


Fig. 4

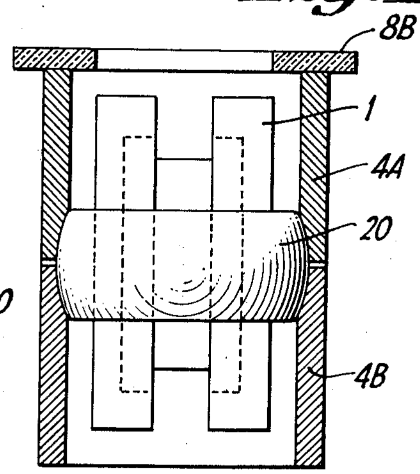


Fig. 5

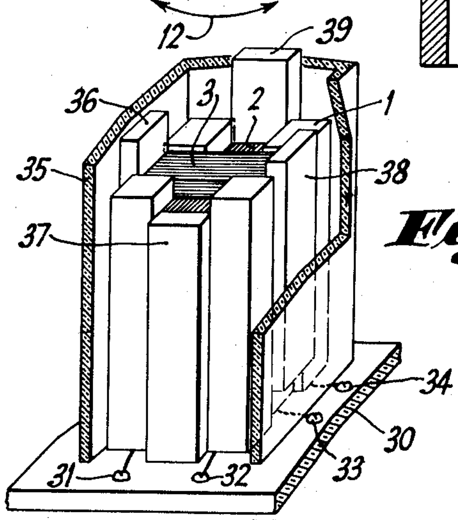
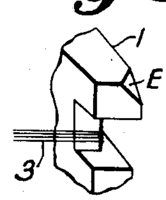


Fig. 3a



INVENTOR
LOY E. BARTON
BY Harry Tunick
ATTORNEY

Patented Oct. 9, 1951

2,570,633

UNITED STATES PATENT OFFICE

2,570,633

INTERMEDIATE FREQUENCY TRANSFORMER

Loy E. Barton, Princeton, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application April 1, 1948, Serial No. 18,353

5 Claims. (Cl. 171—119)

1

This invention relates to new and improved intermediate frequency transformers for use with radio receivers.

An object of this invention is to provide an improved intermediate frequency transformer which will give maximum inductance and improved performance.

Another object of this invention is to provide high frequency transformer components having means for varying the coupling thereof.

Another object of this invention is to provide intermediate frequency transformers having approximately 10% of the volume of similar prior art devices, and with improved Q performance. The transformers of this invention comprise primary and secondary windings on a ferrite core which is variable in its position within a ferrite shell.

Still another object of this invention is to provide a transformer whose fundamental method of circuit tuning is to decrease the magnetic reluctance of the paths of the coil windings.

This invention will best be understood by referring to the accompanying drawings, wherein:

Fig. 1 is a plan view of the intermediate frequency transformer of this invention;

Fig. 2 is a longitudinal cross-section of Fig. 1;

Fig. 3 is a perspective view of the core showing the arrangement of the winding;

Fig. 3*a* is a fragmentary view of the core of Fig. 3 showing a modification in the core shape;

Fig. 4 is a longitudinal cross-section of Fig. 1, showing a modification of the core support; and

Fig. 5 is a perspective view of a core supported on an insulating base.

Referring now to the drawings, a parallelepiped member or block of magnetic material such as ferrite, forms a magnetic core 1, with two continuous intersecting grooves. One groove is cut in two opposed longitudinal faces and each end face. The second groove is located at right angles to the first groove and is of a greater depth where it crosses the first groove. In other words, the grooves form a core having an approximate form of a double H joined together by a central web portion. The grooves of the core are of such depth as to provide a groove of greater depth in the two end faces than the depth in the other two faces, as is indicated by the respective broken and solid lines of Figure 2. A coil winding 2 is placed upon the smaller grooved section of the magnetic core 1. This constitutes the primary winding of the transformer. At right angles to the first winding,

2

a secondary coil winding 3 is positioned on the larger grooved section of the core 1. The slot having a greater depth permits one winding to be spaced from the other. If desired the slots may be of the same depth and the coils spaced where they cross by an insulation sheet. Each coil winding consists of approximately 100 turns of #39 enamel wire, and is shunted with a capacity of approximately 85 micromicrofarads, and is resonant at about 455 kilocycles. Other resonant frequencies may be had, such as 265 kilocycles. The core and the primary and secondary windings are placed within a rectilinear magnetic shell 4 and pivotally secured to the side walls thereof by means of a ball and socket arrangement, or by pivots 5 and 6, which pivots are arranged to rotate in the side walls of shell 4. Coupling variation is made by means of a control rod 7 secured to a bracket 8 of insulation material, located on the upper portion of core 1. The bracket 8 is joined to core 1 at 8A by means of a cement or other suitable means. The flexible connection leads from coils 2 and 3 may be supported and anchored to an extending portion of bracket 8. Or, if desired, the flexible connection leads may be supported by an additional strip 8B cemented to the sides of the shell 4. When the core and windings are inserted within the shell 4 in the position shown by Fig. 2, the Q was found to be about 80 at 455 kilocycles. If the coils and core forms are built accurately, and the coupling is found to be too small for normal use, the casing 4 and the core is adjusted by rod 7 in an unsymmetrical position to give the desired coupling.

Another means for increasing the coupling is to grind off one corner of the core (as indicated at E, Fig. 3*a*), for the desired non-symmetry and coupling. To adjust the inductance of the primary and secondary, the core is tilted as indicated in Fig. 2. Although for simplicity pivots are shown in Figs. 2 and 3, the core is preferably supported in a sort of ball and socket joined at the center (as described in connection with Fig. 4) so that one side of the core decreases the air gap at the top of the shell, and also decreases the air gap on the opposite side of the bottom, which does not change the coupling appreciably. This position increases the inductance more for the coil 2 in the plane of motion than for coil 3. Another motion at right angles to the abovementioned motion similarly tunes the other coil 3.

The position of the core as shown by Fig. 2

indicates the position for maximum inductance for each coil.

When the core is not tilted and is centrally located, the inductance of each coil is at a minimum.

Fig. 4 shows a modified method of supporting the core at the central portion of the shell by dividing the shell **4** into two parts, **4A** and **4B**, the shell being divided at the center in a crosswise direction. The inside ends of the divided shell are ground by any suitable grinding operation to fit a non-magnetic and insulating spherical section **20**. The spherical section **20** is cemented around the core **1** so as to support the core centrally within the two halves of the shell. When the core **1** and the spherical section **20** are in place within the shell halves as shown, the adjacent ends of the two shell halves **4A** and **4B** are cemented together to complete the assembly.

Fig. 5 shows another method of adjusting the two pairs of magnetic reluctance paths, which is to mount or support the core **1** upon a suitable base **30**, preferably of insulating material. The base may also support the leads **31**, **32**, **33** and **34** from the windings **2** and **3**, respectively. Around the core **1** and spaced about 1/32 inch from the sides of the core, there is located a square shell **35**, preferably of insulating material. Four small, flat slabs, **36**, **37**, **38** and **39** of magnetic material of the same ferric composition as the core **1** are provided for adjusting the reluctance paths. These slabs are slipped between the core **1** and the shell **35** on the four sides of the core, and are moved to cover more or less of the air gap on the sides of the core. The shell **35** keeps the tuning slabs in place after adjustment. The coils **2** and **3** are tuned and the coupling adjusted by moving these tuning pieces on the sides of the core.

Any suitable means similar to that of the showing in Fig. 5, for tuning the reluctance paths, may be provided to hold the small tuning slabs on the sides of the core and to permit moving the tuning pieces as mentioned above for tuning and coupling adjustment. In any case (and with the adjustment as described in connection with Fig. 5), the adjusted portions are cemented in place to maintain the adjustment. Later the spring fingers **40** (indicated by the dot and dash lines) may be removed for use on another transformer, as soon as the cement dries.

As mentioned above, the fundamental method of tuning the transformer is to decrease the magnetic reluctance paths **9** and **10** for coil **2**; and paths **11** and **12** for coil **3**. Tilting the core **1** in the shell **4** permits a change of reluctance.

In one transformer constructed according to this invention the overall dimensions were 15/32 square inch by 1/2 inch. Similar transformers may be constructed which will be 3/8 inch square by 7/16 inch overall. It is preferable that the shell be about 1/16 inch wider inside than the overall cross-sectional dimensions of the core and coils to allow for the tuning motion. The shell walls should preferably be 1/32 inch to 3/64 inch thick. A core and shell were constructed of ferrite materials. A preferred composition of ferrite materials comprises .5 Fe_2O_3; .25 MgO; .25 ZnO, in proportions by molecular weight. The ferrite is preferably made from a solid piece, or may be molded in shape with a suitable mold, and retained by suitable binding material. The grooves for the coils are about 3/32 inch wide.

What is claimed is:

1. An inductance device comprising a parallelepiped magnetic core member having four side faces each having a groove therein and a pair of end faces each having two grooves therein intersecting at substantially the center of said end face, one of said grooves at each end face being of greater depth than the other at the intersection of said grooves and each connecting the grooves of oppositely disposed side faces thereby forming two continuous grooves about the periphery of said core member, a first winding in one of said continuous grooves, a second winding in the other of said continuous grooves, and magnetic means disposed in close proximity to each of said side faces of said core member for changing the magnetic reluctance of the flux paths of the core member with respect to said windings.

2. An inductance device comprising a parallelepiped magnetic core member having four side faces and a pair of end faces, each of said side faces having a groove therein disposed in parallel spaced relation to the others of said grooves, each of said end faces having two grooves therein intersecting at substantially the center of said end faces and connecting said grooves of oppositely disposed side faces thereby forming two continuous grooves about the periphery of said core member, a first winding in one of said continuous grooves, a second winding in the other of said continuous grooves, and magnetic means substantially enclosing said sides of said windings for adjusting the magnetic reluctance of the flux paths of the core member with respect to said windings for tuning purposes.

3. An inductance device as defined in claim 2, wherein a hollow magnetic parallelepiped outer shell member is provided for the core member, and wherein the core member is mounted for adjustable movement within and with respect to the shell member.

4. An inductance device comprising a base member, and a parallelepiped magnetic core member supported on said base member and having substantially rectangular side faces and substantially square end faces, each of said side faces having a groove therein disposed parallel to the long axis of said face, each end face having two grooves therein intersecting at substantially the center of said face and connecting said grooves of oppositely disposed side faces thereby forming two continuous grooves about the periphery of said core member, a first winding in one of said continuous grooves and a second winding in the other of said continuous grooves, a plurality of electrical terminals for said windings supported on said base member and insulated therefrom, and magnetic means disposed within said side face grooves for adjusting the magnetic reluctance of flux paths in the sides of said core for tuning said coils.

5. An inductance device comprising a base member and a magnetic core member supported on said base member and having substantially rectangular side faces and substantially square end faces, each of said side faces having a groove therein disposed parallel to the long axis of said face, each end face having two grooves therein intersecting substantially at right angles at substantially the center of said face, one of said grooves at each end face being of greater depth than the other, and connecting said grooves of oppositely disposed side faces thereby forming two continuous grooves about the periphery of

said core member, a first winding in one of said continuous grooves and a second winding in the other of said continuous grooves, a plurality of electrical terminals for said windings supported on said base member, and magnetic means magnetically coupled to each of said side faces whereby certain magnetic flux paths of the core member are adjustable for tuning and coupling purposes.

LOY E. BARTON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
404,630	Kelly	June 4, 1889
1,863,936	Schwager	June 21, 1932
2,031,733	Porter	Feb. 25, 1936
2,143,298	Bouche	Jan. 10, 1939
2,379,417	Conrad	July 3, 1945

FOREIGN PATENTS

Number	Country	Date
228,315	Great Britain	Feb. 5, 1925
460,991	Great Britain	Mar. 11, 1937
94,177	Austria	Sept. 10, 1923

OTHER REFERENCES

Wireless World, Apr. 5, 1935, page 341.