April 25, 1933. F. L. CAPPS 1,905,216

RADIO RECEIVING APPARATUS

Filed July 10, 1928

Fig. 1

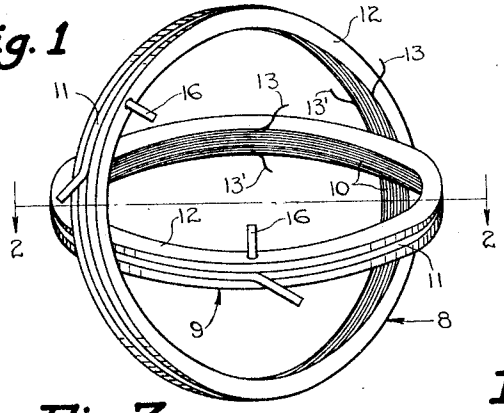


Fig. 2

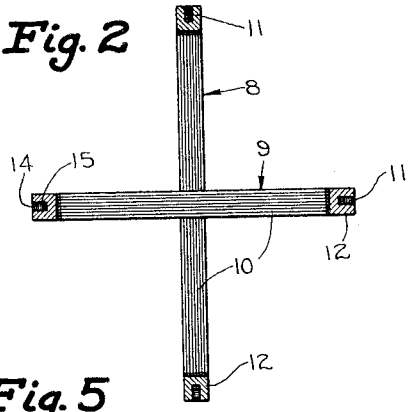


Fig. 7

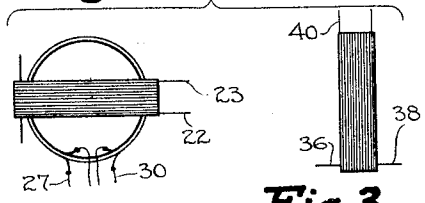


Fig. 5

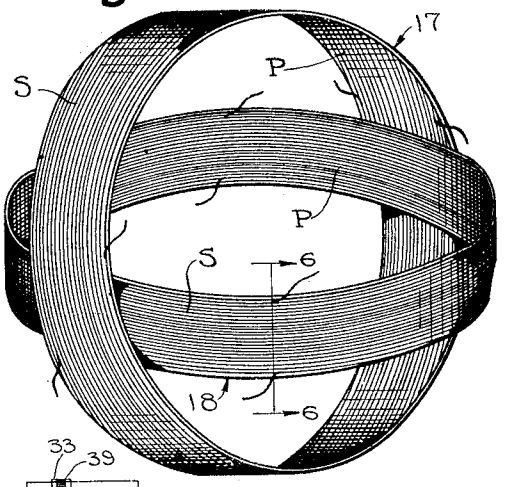


Fig. 6



Fig. 3

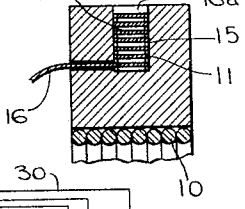
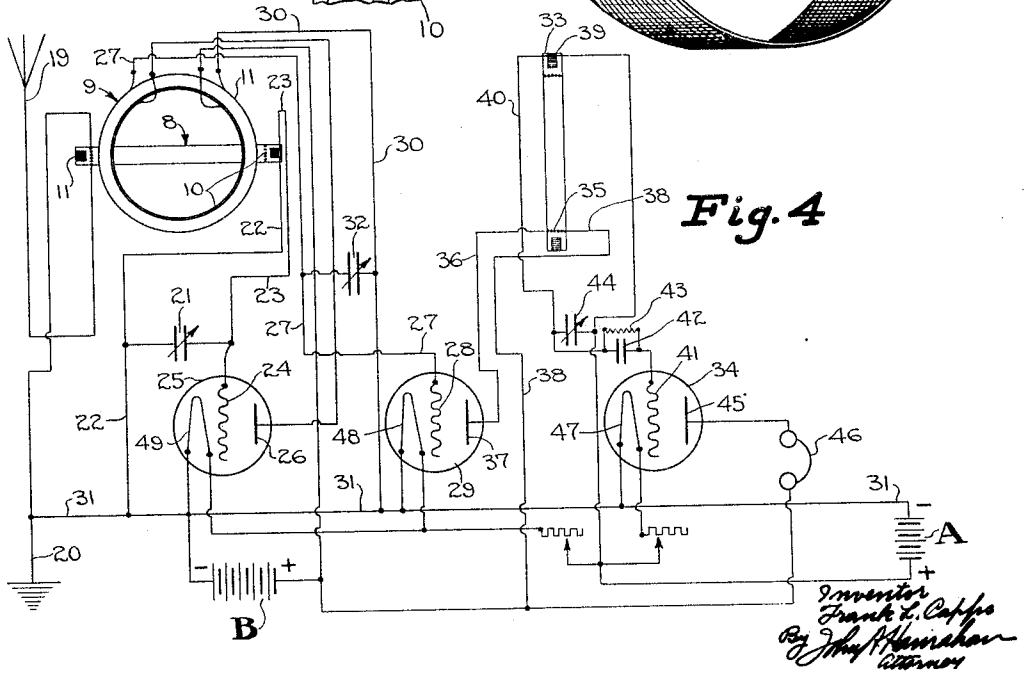


Fig. 4



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Patented Apr. 25, 1933 1,905,216

UNITED STATES PATENT OFFICE

FRANK L. CAPPS, OF MILFORD, CONNECTICUT

RADIO RECEIVING APPARATUS

Application filed July 10, 1928. Serial No. 291,518.

My invention relates to improvements in radio apparatus.

The general object of the invention is to provide a novel construction and arrangement of means whereby the sensitiveness and clarity of radio reception are increased.

Also an object of the invention is to provide a new and novel radio frequency transformer and further to provide a new and novel arrangement of radio frequency transformers with respect to each other such that there will be no mutual inductance between them.

Another object is to provide a radio frequency transformer of such construction as to relieve distortion due to phase displacement and one with which sharp fine tuning may be had.

An additional object of the invention is to provide a novel construction of radio receiving apparatus in which two radio frequency transformers are located one within the other in symmetrical relation to each other and in planes which are substantially at right angles to each other.

A further object of the invention is to provide a construction of radio receiving apparatus in which two radio frequency transformers are located one within the other with their axes substantially at right angles to each other and in which preferably, though not necessarily, a third radio frequency transformer is arranged and supported in position with its axis substantially at right angles to the axes of the first named radio frequency transformers.

Other objects and advantages of the invention will be pointed out in the detailed description thereof which follows or will be apparent from such description.

In order that the invention may be understood more readily and its practical advantages fully appreciated, reference may be had to the accompanying drawing in which one form of convenient embodiments of the invention are shown. However, it will be understood that the invention is susceptible of embodiment in other forms of construction than that shown and that changes in the details of construction may be made within the scope of the claims without departing from the principle of the invention.

In the drawing:—

Fig. 1 is a perspective view of a couple of my improved transformers arranged and secured in accordance with my invention;

Fig. 2 is a view in transverse section taken on line 2—2 of Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view taken at any point through one of my transformers;

Fig. 4 is a view showing schematically a radio receiving apparatus including transformers arranged and related to each other in accordance with the invention;

Fig. 5 is a view similar to Fig. 1 but showing any or an ordinary transformer;

Fig. 6 is a sectional view substantially on the line 6—6 of Fig. 5; and

Fig. 7 is a top plane view of the radio frequency transformers shown in Fig. 5 and in the view, the preferred angular relationship between the transformers, either of the constructions shown in Fig. 1 or Fig. 5, is indicated.

Referring in detail to the drawing and particularly to Figs. 1, 2 and 3, each of the primary and secondary transformers 8 and 9 respectively (which differ only in size or diameter) comprises a primary antenna coil 10 and a secondary coil 11 mounted upon a suitable ring or spool 12 of insulating material; the spool is of ring-like form since it has a relatively large diameter and is relatively small in cross-section, thereby providing for a sufficiently large number of wire windings which are compactly applied, as will now be described.

As designed, the primary coil which is composed of ordinary covered copper wire, may be secured against the inner annular wall of the spool or any convenient means, and has its ends 13 and 13′ extended therefrom for making the necessary connection.

The spool 12, as shown in Figs. 1 and 2 also serves to support the secondary coil and for this purpose is provided in its outer periphery with a central relatively deep annular groove 14 forming substantially parallel side walls or flanges 15 to accommodate the sec-

ondary coil 11 which is formed of flat metal wire, the innermost end 16 of said wire being extended through a hole from the bottom of the groove of the spool out through one side for any desired connection and then wound closely upon the spool within the groove, with a strip of insulating material wound between the respective lines until the desired number of turns are provided. Suitable means may be provided for retaining the secondary windings in position whereupon the outer free end of the wire is carried off to make the necessary connection. Preferably, the wire strip for these coils is slightly narrower than the strip of insulating material, and the winding when complete, may be covered and sealed with a suitable insulating material 16.

It may be noted that by the use of fine ribbon wire wound in the manner described, the several layers of wire are disposed in annular spaced relation to each other in regular succession, as is necessary when dealing with high frequency operations. This construction assists in relieving distortion due to phase displacement. When the secondary winding is of round wire with the coils arranged side by side to form a wide cylinder, there is a disturbance due to the passage of the same impulse through different portions of the coil at different times.

This situation is relieved by utilizing a flat metal wire and using but a comparatively few turns, and forming said turns into a ring. Further, space is conserved. In addition, experience has shown that if the coil is wound on a small diameter, the same fine, sharp tuning does not result. This apparently, is due to the fact that since the length is controlling the layers stack up, and the results are not as satisfactory as when the coil is thin.

In Fig. 4 the receiving system is schematically shown and this system is disclosed as including transformers in accordance with the disclosure in Figs. 1, 2 and 3. However, transformers 17 and 18 such as disclosed in Figs. 5 and 6 and which later will be described, are applicable also, Fig. 7 suggesting this.

The transformers of Figs. 5, 6 and 7 each include a primary P and a secondary S of round wire, and a couple of the transformers are arranged and secured together as shown in Figs. 1 and 2.

Referring to Fig. 4 it will be noted that an elevated conductor system, comprising an antenna 19, the coil 10, and a ground connection 20, is provided. The coil 10 forms the primary of the transformer 8, as before explained, and the secondary 11 of which transformer forms part of a tuned receiving circuit including the variable condenser 21. One end of the secondary coil 11 is connected through a wire 22 to the ground. The opposite end thereof is connected by a line 23 to the grid 24 of a vacuum tube 25.

The second transformer 9 is as previously described, located within the transformer 8. One end of its primary coil 10 is connected to the plate 26 of the tube 25. The opposite end of said coil is connected to the positive side of the battery B. One end of its secondary coil 11 is connected by a line 27 to the grid 28 of a vacuum or electron tube 29. The opposite end thereof is connected through the conducting line 30 to the line 31, one end of which is connected to the ground and the other to the negative side of the battery A. The lines 27 and 30, that is the terminals of the coil 11 of the secondary transformer 9, are connected to a variable condenser 32.

A radio frequency transformer 33, is interposed, between the vacuum or electron tube 29 and an electron detector tube 34. One end or terminal of the primary coil 35 of the transformer 33 is connected by means of a conducting line 36 to the plate 37 of the tube 29. The opposite end or terminal thereof is connected through the conducting line 38 to the positive side of the battery B previously referred to. One end or terminal of the secondary coil 39 of the transformer 9 is connected through a conducting line 40 to the grid 41 of the detector tube 34.

The line 40 is provided with the usual grid condenser 42 and grid leak 43. The terminals of said coil are connected through or by means of variable condenser 44, the plate 45 of the tube 34 as shown in the drawing, is connected through the telephone 46 or other reproducer to the positive side of the battery B; but it will be understood that the output from the detector tube 34 may be into the usual audio frequency amplifiers.

The positive side of the battery A is connected to one end or side of each of the cathode filaments 47, 48 and 49, while the opposite ends or sides thereof are as usual connected to the negative side of said battery by the line 31.

I shall not undertake to describe more fully or in detail the general arrangement of the circuit, because I do not claim any novelty with respect to the circuit but only in connection with, and in respect of the transformers and the relative arrangement thereof with respect to each other.

The transformers 8 and 9, and 17 and 18, and their relationship to each other are shown more in detail in Figs. 1 and 2 and Fig. 5 of the drawing. It will be noted that these transformers which are complete, are arranged one within the other and their arrangement is such that their axes are at right angles with each other. The transformer 9 is associated with and follows or succeeds the first vacuum or electron tube 25, and ordinarily would be shown as located between the amplifying tubes 25 and 29.

In the employment of the transformers embodying my invention they are positioned

one within the other as illustrated and are tested until they are found to give the very best results of which they are capable. This result is found when the transformers are in planes substantially at right angles to each other and usually when they have a common center; that is, when the axes of the two transformers intersect one another, coincident with the geographical center of the respective transformers.

The position having been ascertained at which these transformers give the best results of which they are capable, they are then secured permanently together and are ready for embodiment in a radio receiving set. By positioning the transformers 8 and 9 as described, it will be found that there is no mutual inductive effect; that is, each is neutral with respect to the other.

I prefer also that the third transformer 33 shall be supported and positioned in a plane such that its axes will extend in a direction at right angles to the plane containing the axes of the transformers 8 and 9 or 17 and 18 as the case may be, it being understood that with either construction of transformer, good results are obtained although I prefer the transformers 8 and 9.

If the transformer 33 is located at a distance of about twenty inches or further from the transformers 8 and 9, it is difficult, if not impossible, to note that the adjustment thereof from one plane into another makes any difference in the influence of the same upon the transformers 8 and 9. If, however, the transformer 33 is located nearer than about twenty inches to the transformers 8 and 9, there may be a variation of influence upon adjustment of said transformer 33 or of the transformers 8 and 9 into different planes.

It has been found that by arranging the transformers 8 and 9 in the positions relative to each other as shown and described, the sensitiveness of reception is increased, and clearer and more distinct signals obtained.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A radio receiving apparatus comprising a couple of radio frequency transformers supported with their geometrical centers coincident with each other and said transformers being fixed relatively in non-inductive relation to each other.

2. A radio receiving apparatus comprising radio frequency transformers arranged one within the other and fixed relatively in planes substantially at right angles to each other.

3. A radio receiving apparatus comprising a circuit including amplifying means and radio frequency transformers which transformers are supported one within the other and fixed relatively in planes at right angles to each other.

4. A radio receiving apparatus comprising two stage amplifying means and two relatively immovable radio frequency transformers supported one within the other substantially at right angles to each other.

5. A radio receiving apparatus comprising amplification means including radio frequency transformers supported one within the other and fixed relatively in planes substantially at right angles and in symmetrical relation with respect to each other, and a third radio frequency transformer adapted to cooperate with the first named radio frequency transformers.

6. A radio receiving apparatus comprising amplification means including radio frequency transformers supported one within the other and fixed relatively in planes substantially at right angles and in symmetrical relation with respect to each other, and a third radio frequency transformer supported in a plane substantially at right angles to the planes of the said first named radio frequency transformers.

7. A radio receiving apparatus comprising a two stage amplifying means, two radio frequency transformers supported one within the other in planes substantially at right angles to each other, said transformers being permanently secured together in such positions, and a third radio frequency transformer supported in operative relation to the first named radio frequency transformers.

8. In combination, two transformers supported one within the other in permanent fixed relation with their axes extending substantially at right angles with respect to each other.

9. In combination, two transformers supported one within the other in permanent fixed relation in planes substantially at right angles to each other and with their axes intersecting at a point coincident with the geometrical center of the said transformers.

Signed at Bridgeport, in the county of Fairfield, and State of Connecticut, this 9th day of July, A. D. 1928.

FRANK L. CAPPS.