Oct. 19, 1926. 1,603,313

H. E. BURKET

TRANSFORMER

Filed May 14, 1925 2 Sheets-Sheet 1

Fig. 3

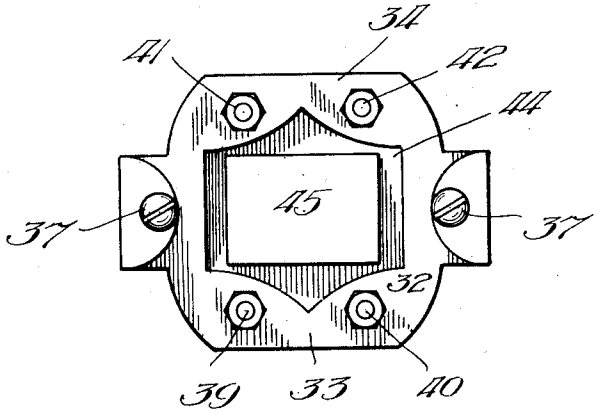


Fig. 1.

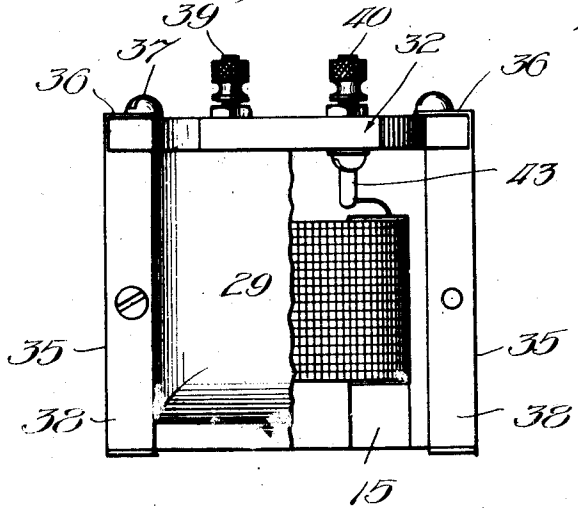
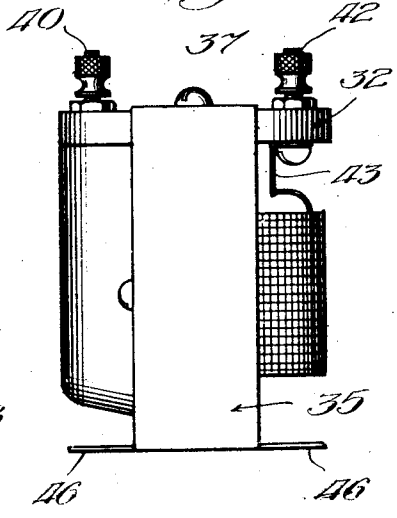


Fig. 2.



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Fig. 6.

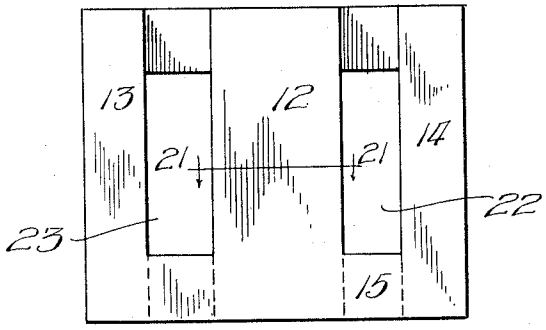


Fig. 7.

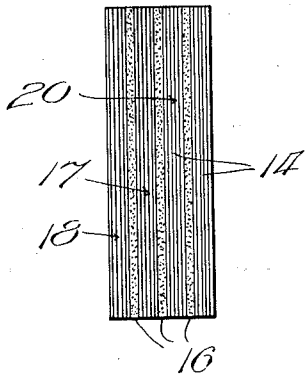


Fig. 8



Fig. 4.

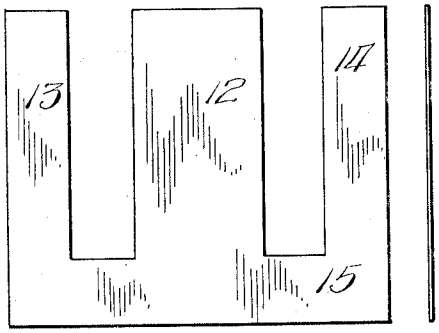


Fig. 5.

Fig. 9

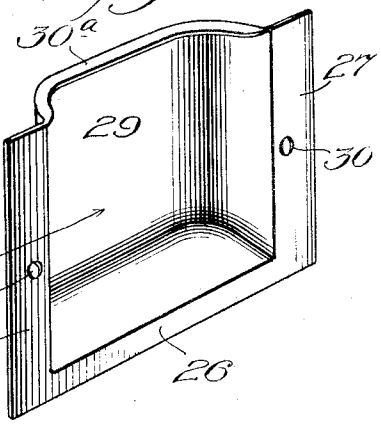
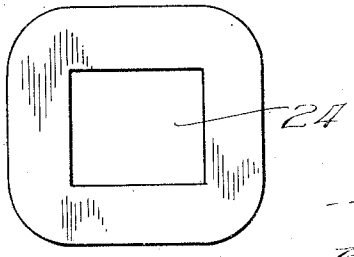


Fig. 10



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Patented Oct. 19, 1926. 1,603,313

UNITED STATES PATENT OFFICE.

HENRY E. BURKET, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-THIRD TO C. C. ASHTON AND ONE-THIRD TO ARTHUR WAGNER, BOTH OF CHICAGO, ILLINOIS.

TRANSFORMER.

Application filed May 14, 1925. Serial No. 30,329.

This invention has to do with improvements in the construction of transformers of relatively small size such as are used for radio work and the like. The construction herein disclosed has been devised with a particular view to meeting certain of the requirements of radio reception, but it will be understood that said features of invention may also be used to advantage in connection with certain other classes of service which will readily suggest themselves to the student.

One of the objects of the invention is to provide a very simple construction of transformer, but one which is so arranged that the reluctance of the magnetic path may be easily adjusted in the original manufacture of the transformer so as to bring the completed transformer to the exact electromagnetic characteristics which are desired. This feature is of particular value in the manufacture of standardized transformers which are made to very close specifications, in which transformers it is essential to adhere rigidly to very close specifications in order to secure satisfactory service in the practical operation of the transformers themselves. This is true, for example, in connection with radio work, and especially in the construction of such circuits as superheterodynes and the like.

Another feature of the invention relates to the provision of a construction of transformer which is so arranged that a very great volume of tone may be secured by the use thereof in radio work, without the objectionable features of squeal and strain which are frequently produced when operating a receiving circuit under relatively heavy load. This result I accomplish by a certain proportioning of the wire of the primary and secondary coils and the iron of the magnetic circuit.

Another feature of the invention relates to the provision of an improved construction of shell and housing for the transformer core and coils so as to effectively protect the same, and at the same time establish a very pleasing appearance and construction. This housing at the same time is so constructed as to shield the coils from outside interference due to radio frequency currents in close proximity, and thus largely eliminate cross interference between the transformer and other portions of the circuit.

In order to secure increased volume of tone without distortion and detrimental noises, I have discovered that it is very desirable to use a magnetic core of relatively large cross section, approximately seven eighths to one square inch in cross sectional area. I have also discovered that it is desirable to use as large a wire as possible for the winding, thus securing the maximum inductance together with the lowest possible ohmic resistance. This is especially true in the primary winding. I have also discovered that while it is impossible to definitely mention any specific ratio of primary to secondary as being the best for all conditions, a ratio of 1.8 secondary turns per primary turn seems to give the best results for ordinary radio frequency service. I, therefore, prefer to use this ratio.

Furthermore, I have discovered that very excellent results may be secured by the use of a primary having approximately 4444 turns and a secondary having approximately 8600 turns, using an iron core of approximately one square inch cross sectional area, as already referred to.

In order to adjust the reluctance of the magnetic circuit, I establish a very slight space or gap therein across which the lines of force must flow, and then provide means for exactly adjusting this clearance in the initial construction of the transformer so as to give the exact characteristics necessary to match the transformer with others. I have discovered that this slight space in the magnetic circuit causes the primary winding to be more heavily loaded, somewhat like an open core transformer; and as this extra impulse is transferred to the succeeding stage greater power is produced, and furthermore the weaker signals are made to function more fully, which otherwise would be distorted. As a result, my improved construction of core gives a more favorable rendition of the monotones, and improves their volume, whereas they would otherwise be

very faint. As a further result a much more even amplification is secured throughout the entire range of frequencies.

The transformers of the present invention may be used for either radio or audio frequency work by proper proportioning of the primary and secondary coils, and the improved core construction will in either case be found to give remarkable improvements in results.

Referring to the drawings:

Figure 1 shows a side view of an assembled transformer embodying the features of the present invention, a portion of the casing being broken away so as to reveal the winding and core;

Fig. 2 is a view at right angles to that of Fig. 1, the right hand casing section being removed;

Fig. 3 is a plan view corresponding to Figs. 1 and 2;

Fig. 4 is a face view of one of the core laminations;

Fig. 5 is an end view corresponding to Fig. 4;

Fig. 6 is a face view of the core with various laminations assembled;

Fig. 7 is an end view corresponding to Fig. 6, and showing the paper insulation by stippling and on greatly enlarged scale of thickness;

Fig. 8 is an edge view corresponding to Figs. 6 and 7;

Fig. 9 is perspective inside face view of one of the cover plates; and

Fig. 10 is an end view of the assembled coil.

Referring first to Figs. 4, 5, 6, 7 and 8, the laminations used are of sheet iron and each provided with a central tongue 12, end tongues 13 and 14, and a cross bar 15. The central tongue 12 is of double width as compared to the end tongues 13 and 14, and the cross bar 15 is of the same width as each of the end bars so as to give a balanced permeability through the magnetic circuit.

In assembling the various laminations together, I prefer to first assemble a series of laminations with their cross bars 15 all at one side and in perfect alignment. This will result in the production of an E shaped section of thickness equal to the assembled sections. I next place a layer or layers of non-magnetic material such as thin paper 16 against the exposed face of the assembled sections and then proceed to place another group of similarly assembled sections against said non-magnetic layer, but with their cross bars 15 reversed in position. Such a second group is indicated at 17 in Fig. 8, the first group being indicated at 18. I then place another layer or layers of non-magnetic material 19 against the exposed face of the group 17, and then another group of laminations 20 against such layer 19, but with the cross bars 15 of the group 20 reversed back into the same position as the cross bars of the group 18. In this way, the completed core consists of alternate layers of laminations and non-magnetic material, the cross bars of the successive lamination layers being placed alternatively at opposite sides of the structure.

From the foregoing it follows that the magnetic flux flowing through its circuit must of necessity jump a gap equal to the thickness of the non-magnetic material, since there is at no point a permanently closed iron circuit. By properly adjusting said thickness in the first instance, this gap may be very accurately set and thus a very perfect tuning of reluctance and transformer characteristics may be brought about. Manifestly, if desired, each group of laminations 17, 18 or 20 may comprise one or more laminations, the essential point being, however, that there is means for determining the exact clearance or separation between consecutive lamination groups for the purpose specified. Furthermore, it is a very simple expedient in the initial assembly of the core to regulate the characteristics of the transformer by simply increasing or decreasing the thickness of the non-magneic layers. This may be done either by the use of sheets of increased or diminished thickness, or by the use of a greater or less number of layers of thin non-magnetic material such as tissue paper. Or the magnetic characteristics may be adjusted by increasing or decreasing the number of laminations in each group of laminations facing in either direction.

I prefer to build up the core to a condition where the cross sectional area of the iron is substantially seven-eighths to one square inch cross sectional area. For example, the iron area on the section 21—21 of Fig. 6 should be substantially the amount mentioned.

The coils are to be wound through the openings 22 and 23 and around the central lugs 12 of the core. Preferably, both coils are wound together in a single structure, as shown in Fig. 10, and then the core is built up with the lugs 12 through the opening 24 of the coil. This can readily be done, and by making the opening 24 of slightly larger size than the final cross sectional area of the central portion of the core, it will be possible to make the adjustments of reluctance with the parts assembled.

I prefer to use substantially a ratio of 1.8 to 1 as between the secondary and primary turns. In the case of an audio frequency transformer, I prefer to use approximately 4444 turns on the primary and 8600 turns on the secondary, and furthermore, I prefer to use No. 32—34 wire, since the same has relatively large cross sectional area for

this class of work. Still larger wire may be used for radio frequency transformers, even as large as No. 20.

After the core and coil have been assembled there may be placed a pair of side cover plates, such as 25 of Fig. 9, at the sides of the structure. Each of these cover plates may be of sheet brass, preferably enameled. It has a flange 26 along its bottom edge and side flanges 27 and 28 at its sides, the same being adapted to set squarely against the bottom and side portions of the assembled electromagnetic circuit. The central portion 29 is bulged out so as to accommodate the projecting portion of the coil, but the top edge 30 of the side plate is flanged backwardly a slight amount. Suitable openings 30 and 31, are provided for through bolts which may be extended through both cover plate and the core.

A top block of fiber or other insulating material such as bakelite 32 is placed on top of the core, said block having the side projecting portions 33 and 34 which reach out into substantial alignment with the side cover plates, already referred to. This top block 34 can be held in place by a pair of end plates, such as 35 (see Fig. 2 in particular), the top of each end plate 35 being flanged over, as shown at 36, so as to rest squarely against the block 32 to which it may be secured by a top screw 37. Each of the end plates 35 is also provided with side flanges 38 which rest against the side flanges 27 and 28 of the cover plate 25, and the same through bolts, already referred to, may be passed through these flanges 38 so as to hold the end plates 35 rigidly in place.

The block 32 may be conveniently provided with the necessary terminal connections 39, 40, 41 and 42 to which the coil terminals are connected from beneath, as shown at 43 in Fig. 1, and the top face of the block 32 may very well be centrally recessed, as shown at 44, to accommodate a suitable name plate or the like, 45. Furthermore, if desired, the end plates 35 may be provided with side pedestals 46, as shown in Fig. 2, so as to establish a base of increased size for the support of the assembled structure.

If desired, an additional or third coil may be used besides the usual primary and secondary, and I contemplate the use of the features of the present invention either with or without such third coil.

While I have herein shown and described only a single embodiment of the features of my present invention, still I do not intend to limit myself to the same, except as I may do so in the claims.

I claim:

1. The method of producing a transformer having the reluctance of its magnetic structure accurately tuned for the purpose specified, which consists in first loosely assembling a series of groups of angle shaped laminations with their cross bars placed alternately at opposite sides of the structure, together with primary and secondary coils interwoven through the structure, and which consists in placing layers of nonmagnetic material between said groups and adjusting the thickness of said layers to establish exactly the desired electromagnetic characteristics of the assembled structure, substantially as described.

2. The method of producing a transformer having the reluctance of its magnetic structure accurately tuned for the purpose specified, which consists in first assembling a series of angle shaped core members with their cross bars placed alternately at opposite sides of the structure, together with interlinked primary and secondary coils, and which consists in accurately adjusting the electromagnetic characteristics of said structure by the use of layers of nonmagnetic material of adjusted thickness between said groups, substantially as described.

3. The method of producing a transformer having the reluctance of its magnetic structure accurately tuned for the purpose specified, which consists in assembling a series of angle shaped core members with their cross bars placed alternately at opposite sides of the structure in bunches, together with interlinked primary and secondary coils, and which consists in accurately tuning the transformer by accurately adjusting its magnetic characteristics by adjustment of the number of core members in the different bunches, substantially as described.

4. The method of producing a transformer having the reluctance of its magnetic structure accurately tuned for the purpose specified, which consists in assembling a core comprising angle shaped members with their cross bars placed at the opposite sides of the structure in bunches and with interlinked primary and secondary coils, and which consists in accurately tuning the transformer by varying the numbers of the E shaped members in the different groups to thereby adjust the magnetic characteristics of the transformer, substantially as described.

5. A transformer for the purpose specified, including in combination a substantially rectangular core formed of laminations with its coils interwoven through the core and projecting beyond both sides of the core, and a shell serving to enclose and protect the core and establish a base therefor, said shell including a sheet metal section formed to establish a horizontal base plate having a width substantially equal to the full width of the transformer, and to also establish vertical end walls each of U-shaped cross-section reaching vertically along the ends of the core and embracing the edge portions of

the sides of the core, dished side sections enclosing the sides of the core and the projecting portions of the coils and cooperating with the vertical end walls aforesaid to establish a complete enclosure for the sides and ends of the core and coils, and a block of insulating material over the top of the core and reaching into alignment with the vertical end walls and the dished side sections to complete the enclosure of the device, said block of material having a recess in its top surface for the accommodation of a name plate or the like, substantially as described.

HENRY E. BURKET.