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J. A. PROCTOR

1,807,135

COUPLING TRANSFORMER

Filed Sept. 12, 1928

Fig. 1.

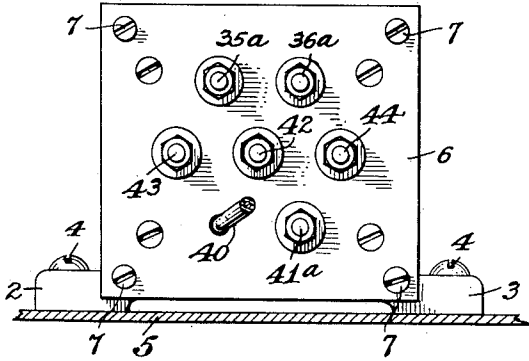


Fig. 4.

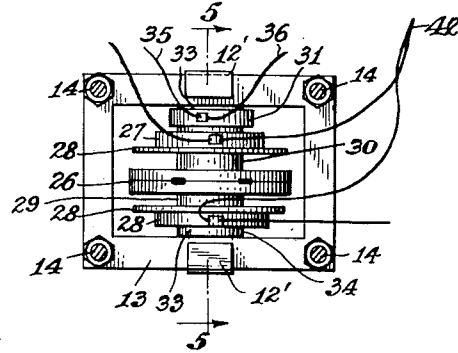


Fig. 2.

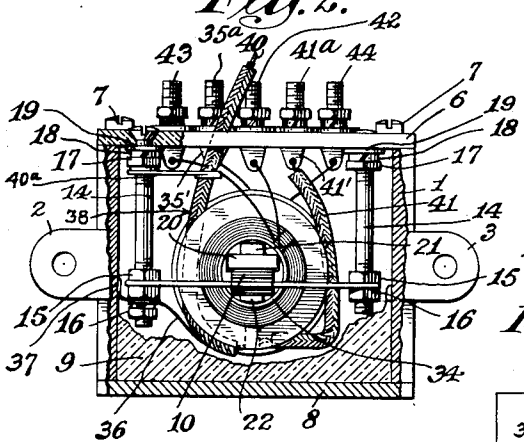


Fig. 5.

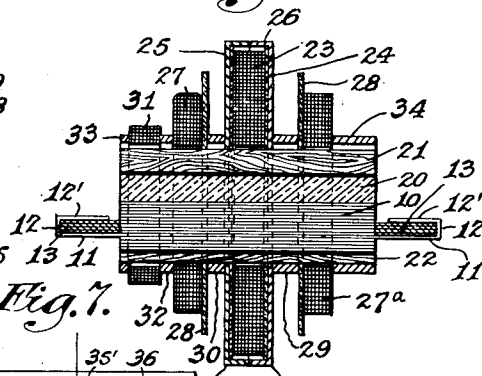


Fig. 3.

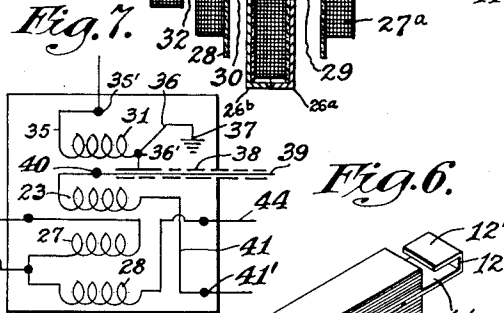
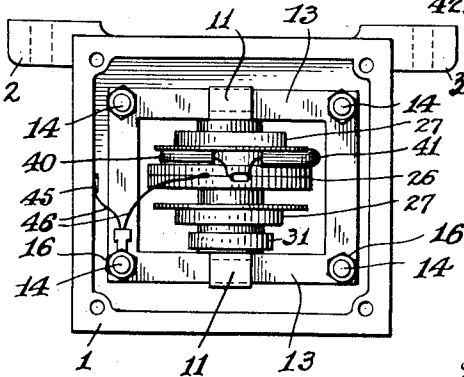
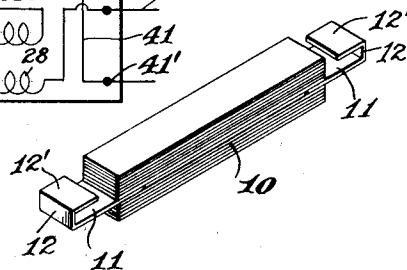


Fig. 6.



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UNITED STATES PATENT OFFICE

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COUPLING TRANSFORMER

Application filed September 12, 1928. Serial No. 305,369.

This invention relates to an improved transformer and more particularly to an improved push-pull radio frequency transformer adapted for coupling the antennae and loop in a radio direction finder circuit.

In the drawings,

Fig. 1 is a top plan view of a transformer secured to the wall of a radio cabinet;

Fig. 2 is an elevation, partly in section, showing the coils of the transformer mounted within its casing;

Fig. 3 is a bottom plan view of the transformer with the bottom cover removed to show the laminae and coils;

Fig. 4 is a top plan view of the transformer frame showing the coils and their leads;

Fig. 5 is a transverse section on lines 5—5 of Fig. 4 showing the details of the coils and the laminae of the core;

Fig. 6 is a perspective view of the core tongue laminae with mounting clips in position, and

Fig. 7 is a wiring diagram of the transformer coils and the leads therefrom.

The completed transformer comprehends a casing, 1, comprising a metallic box member provided with integral mounting lugs, 2, 3, suitably apertured to receive screws, rivets or other securing means, 4, adapted to support the casing on the rear wall, 5, of the catacomb of a radio receiving set of the heterodyne type, or the like, such as is described in my application Serial Number 277,026, filed 11 May, 1928, for radio direction finder.

The top cover 6, of the casing, may be made of any suitable insulating material such as bakelite, and is secured to the casing by suitable securing means such as machine screws, 7. This cover is apertured to receive a plurality of transformer leads which will be described more in detail hereinafter.

The bottom, 8, of the casing, is of any suitable metal and may be formed integral therewith. In this preferred form, the member 8 is made of brass and is secured to the assembly in any suitable manner after the final testing of the unit and the filling of the casing with insulating compound, designated generally by the numeral 9.

The transformer proper comprises an iron core 10, supported on a closed frame, 13, of iron or other metal having the requisite magnetic permeability. The member 10 is built up of a plurality of thin laminae, usually forty in number, the preferred thickness of the individual members being about .0004". The member 13 is preferably composed of four laminae of the same metal. Interposed in the member 10 are a pair of clip members, 11, also of lamina metal, bent over exteriorly of the core proper to form U shaped clip portions 12, which are adapted to support member 10 on the sides of member 13.

The transformer core assembly is supported from the insulating cover 6 by a plurality of headed studs, 14, being held in position by a plurality of lock nuts, 15, 16, threaded on the lower ends of the studs and spaced on opposite sides of the corners of member 13. The studs, 14, are secured to the insulating cover by means of lock nuts 17, acting through spring washers, 18, and bearing washers, 19, which abut against the member 6. The members 14, are inserted through member 6 and held in position thereagainst by the lock nuts and washers just described, after which the nuts, 15, are screwed up a suitable distance and the frame 13, of the transformer placed in position thereon. Nuts, 16, are then screwed in place, holding the transformer assembly in position.

The core, 10, previously noted, together with the coils associated therewith is clipped onto the sides of the member, 13, and held centrally within the frame by means of the clip portions 12 and 12' of the members 11.

The coil assembly proper comprises the laminated core 10, previously described on top of which is placed an insulating block of suitable dimensions, a pair of wooden pegs, 21, 22, being placed above and below this assembly, the whole being secured together in a jig by suitable means during assembly.

Centrally of the core assembly is positioned a secondary coil, 23, this coil being provided on either face with fish paper washers, 24, 25, and the entire structure shielded by suitable material such as the copper foil

shield, 26. This shield is adapted to engage members 21, 22, above referred to, and hold them, together with core 10, and insulating support 20, in cooperative relationship. A pair of primary coils, 27 and 27a mounted on supports, 28, are positioned on the core assembly on opposite sides of the secondary coil and are spaced from the latter by suitable insulating spacers, 29 and 30. An antennæ coil, 31, is mounted on this core and spaced from coil 27 by insulating member 32. This coil is thrown in the circuit in a position of the antenna switch, as described in my application above referred to, and is adapted to indicate the direction of an incoming or received radio signal. This switch and its particular function will be described more in detail in another application about to be filed.

Spacer members 33 and 34, are provided at either end of the coil assembly to conform to the overall length of the intermediate members 21 and 22. When the member 10, with the assembled coils and spacer members is mounted on frame 13, the clip portions 12, as noted above, pass over the outside edges of member 13 and are bent inwardly at 12' to secure the structure thereto. The core members above described are fastened so as to fit snugly in the space comprised between the side arms of member 13, which arms act as retaining members for the spacers, 3, 34.

It will be noted that the coils utilized in the present device are inductively coupled without being concentrically wound. This result is attained by mounting the coils on the laminated core member 10. As above noted, the core and its associated coils are mounted as a unit and inserted in the transformer mounting 13. By this construction, it is possible to wind the several coils separately and encase the secondary coil 23 in its shielded mounting, composed of the two halves 26a, 26b, abutting each other and being suitably secured at their abutting edges by solder or like joining material.

These transformer coils may be made up in any desired quantity, and can be assembled at leisure without involving added trouble for winding the several coils about each other.

The antenna coil 31 is provided with suitable leads 35, 36, which are connected to lugs 35', 36' of terminal members 35a, 36a. The lead 36 is grounded to the casing in any suitable manner, as indicated at 37, Fig. 7. It is likewise grounded to the shielding 38 of the detector tube lead 39 from the secondary coil 23, which shielded lead is designated generally by the numeral 40, the other lead of the secondary coil 41 being also shielded and attached to lug 41' of terminal member 41a. The shield 26 covering the secondary coil 23 is also grounded at 45 through the lead 46.

The primary coils 27, 28 are provided with a common lead 42, and separate leads 43, 44.

The shielded lead 40 is supported interiorly of the casing by the bracket 40a. This construction prevents the cable from being pulled away from its connection to the extremely fine wire of the coil member, when subjected to untoward external stresses. This bracket is anchored to the member 14 in any desired manner adapted to insure the proper mechanical support of the cable.

In the assembly of the device of the present invention, the several coils are loosely mounted on the core member 10, the assembly being then inserted into its intended position in the closed core. The prerequisite tests for the calibration of the device are then carried out, the clip members, being supported on the core frame without being bent therearound. When it is necessary to vary the coupling between the coils, the unit is removed from the core frame and insulating spacers of the proper dimensions are inserted between the coils. The calibrated assembly is then secured to the core frame in the manner described above and the whole suspended from the cover of the casing, 6, the leads from the coils being suitably connected to their respective terminals on the cover, which is thus adapted to serve as a terminal board. When the assembly is complete, and the wiring has been checked, a suitable insulating compound, as above noted, is flowed around the assembly, anchoring the several leads of fine wire when it hardens on cooling.

The cover, 8, previously described, is then put in place and secured by suitable means. This device serves to retain the insulating compound in position in the casing and prevents cold flow, as well as protecting it from mechanical injury.

The completed unit is then mounted on its support, 5, which, as shown, is a wall member of a radio cabinet, although, it will, of course, be understood that any suitable securing means such as a strap may be used to support the unit.

As intimated in my application, S. N. 277,026, above referred to, the coupling coil is so arranged in the circuit on a radio direction finder as to couple together the loop and an antenna by means of the various coils 27, 27a, 23 and 31, for the purpose of giving an indication in the phone of the operator. As discussed in the case above referred to, the antenna coil 31 is so arranged in the circuit that when a button is operated, the incoming signal, which is heard in the operator's phones, has added to it the existing signal of the loop, or the latter is subtracted therefrom, depending on which direction, i. e., from which side of the ship the radio direction finder signal is received. This is effected substantially by virtue of the fact that the coil 31 impinges a distorted signal value on the

transformer, which alters the characteristic of the loop to that of the cardioid characteristic of combined loop and antenna, and the resistance then imparts to the undistorted loop signal the above result for determining the sense of direction indication.

It will now be seen that there has been provided an improved transformer particularly adapted for use as a radio frequency push-pull amplifier which transformer is characterized by having a minimum amount of magnetizable core material of low hysteresis loss, and one which could be readily mounted and dismounted at a minimum of cost.

What is claimed is:

1. A transformer of the character described, including, in combination, a casing, an insulating cover upon the casing, a plurality of terminals on the cover, a transforming unit comprising a closed core member and a demountable core member associated with the closed core member, and a plurality of separately wound and separately removable coils arranged in inductive relationship to each other, and assembled upon said demountable core member, and means passing through the closed core member for securing said unit to said cover.

2. In a radio frequency push-pull transformer of the character described, the combination of a closed core member and a demountable core member, said demountable core member having associated therewith a shielded secondary coil, a plurality of primary coils on either side of the secondary coil, and in electromagnetic inductive relationship thereto, an antenna coil, associated in electromagnetic inductive relationship with one of said primary coils; the several coils being spaced apart by adjustable spacing members and held in cooperative relationship with the demountable core member by a plurality of backing insulating members, as, and for, the purposes described.

3. A transformer including a closed core member, a demountable core member comprising a plurality of laminae arranged in substantially solid rectangular relationship and a pair of opposed clip members included, one at each end of the demountable core member, said clip members being adapted to be deformed to embrace the closed core member and hold the demountable core member in position to form a closed magnetic circuit with the closed core member.

4. A transformer of the class described, comprising a closed core member and a demountable core member associated therewith, said demountable member being provided with deformable clip members projecting beyond its ends and adapted to be deformed over the sides and outer edge of the first named closed core whereby to hold the demountable member in electromagnetic relation therewith.

5. A radio frequency push-pull transformer of the class described including a closed core member and an associated demountable core member centrally disposed in electromagnetic relation to the closed core member, a shielded secondary coil mounted on the demountable core member, a plurality of primary coils associated in electromagnetic relation with the secondary coil, and an antenna coil mounted on the demountable core member and electromagnetically associated with one of the primary coils, said antenna coil being adapted to cause distortion of the electromagnetic currents induced in said secondary coil.

6. A transformer including a closed core member, an open core member connecting opposite sides of the closed core member, coils upon at least one of said members and means for securing said core members together which includes a bent strip secured to one core member and contacting with an edge and outer sides of other core member.

7. A transformer including a closed core member, an open core member connecting opposite sides of the closed core member separately wound coils upon at least one of said members, spacing devices holding the coils in position, and means for securing said core members together, to form a closed magnetic circuit.

8. A transformer including a closed core member, an open core member connecting opposite sides of the closed core member, separately wound coils upon at least one of said members, spacing devices holding the coils in position, and means for securing said core members together, at least one of said coils being shielded in a removable metallic housing.

In testimony whereof I hereunto affix my signature.

JOHN ALBERT PROCTOR.