May 18, 1926. 1,585,158

S. D. LIVINGSTON

RADIOTRANSFORMER

Filed Dec. 21, 1922 2 Sheets-Sheet 1

Fig. 1.

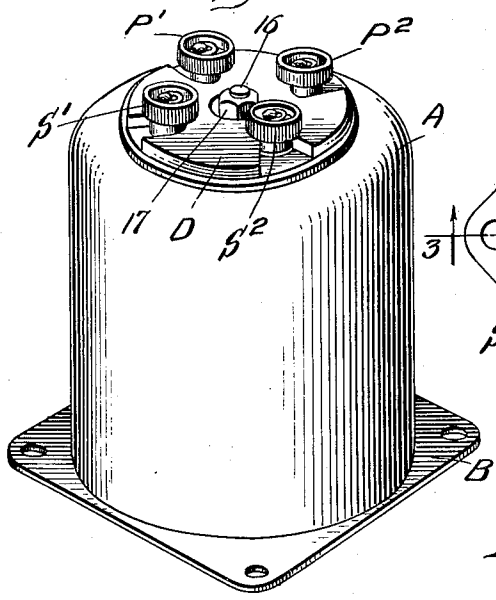



Fig. 2.

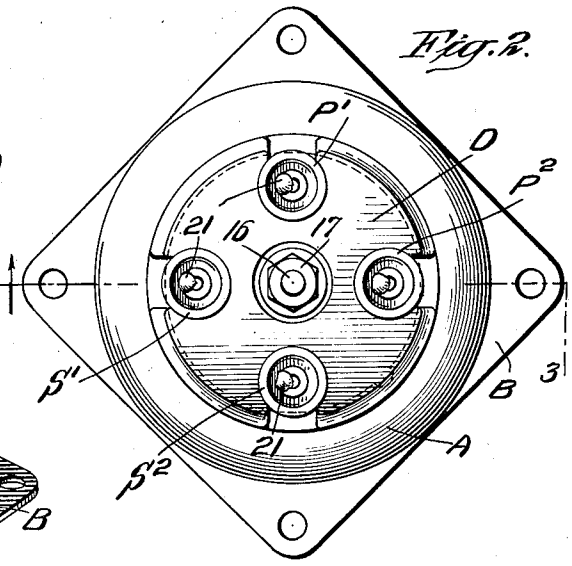



Fig. 4.

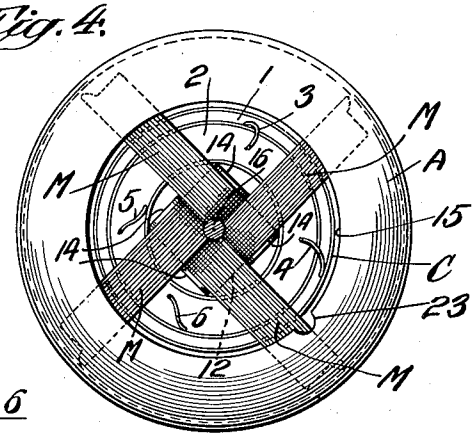



Fig. 3.

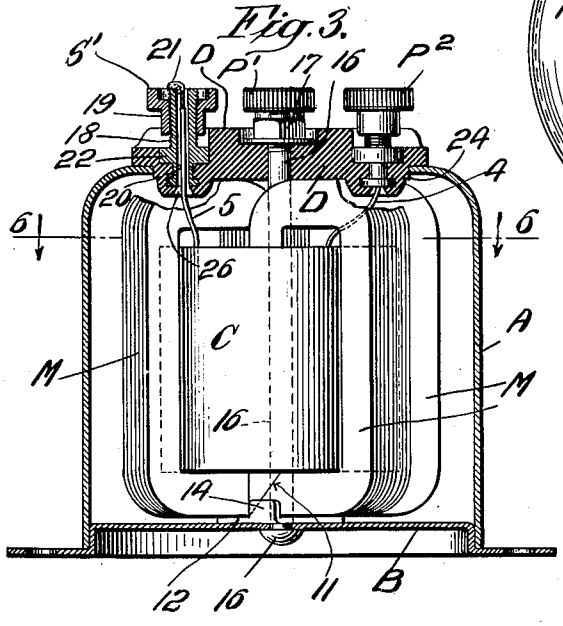
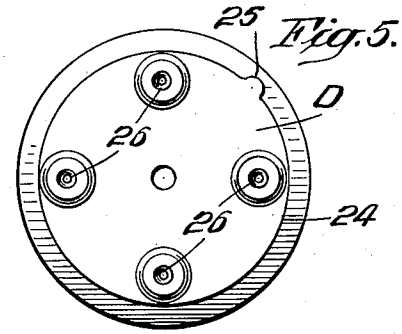



Fig. 5.




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Fig. 6.

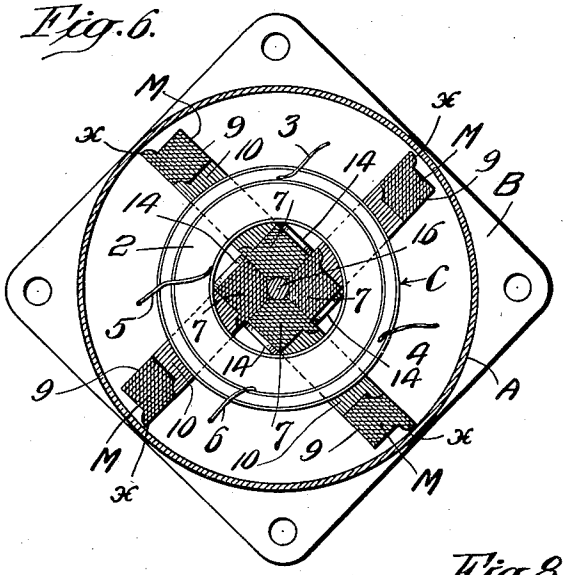



Fig. 7.

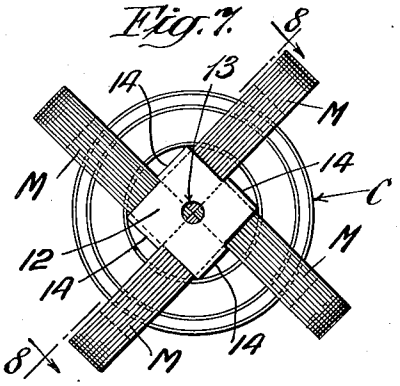



Fig. 8.

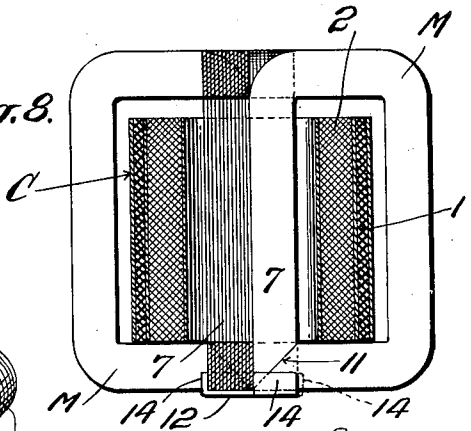



Fig. 9.

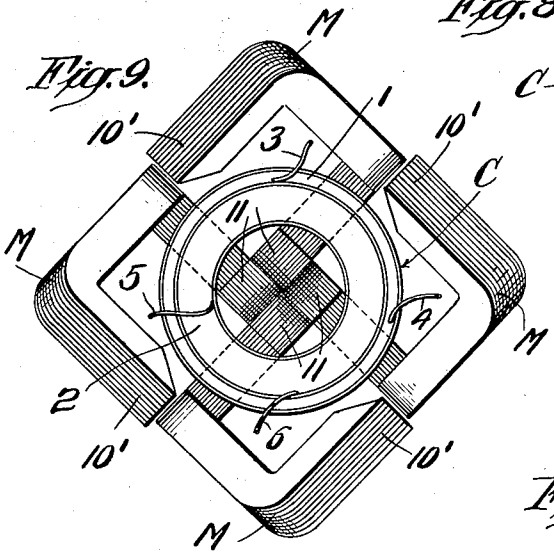
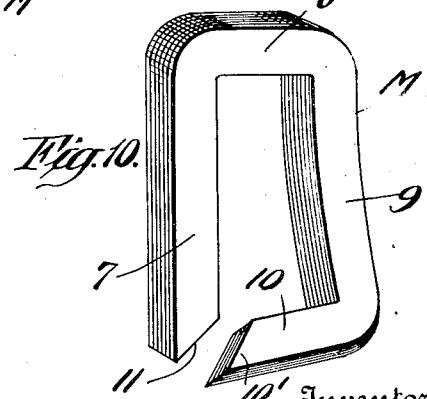



Fig. 10.



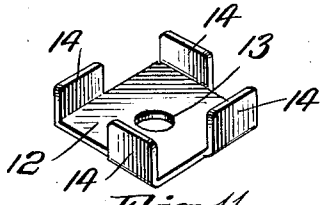




Fig. 11.

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# UNITED STATES PATENT OFFICE.

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## RADIOTRANSFORMER.

Application filed December 21, 1922. Serial No. 608,215.

My invention relates to transformers for use in radio telephony, and its object is to provide a simple, compact and highly efficient transformer especially suitable for audio-frequency amplification and as a wave modulator in radio-receiving systems.

The advantages of my invention will become apparent from a detailed description of a preferred embodiment illustrated in the accompanying drawings, in which

Figure 1 is a perspective view of my new transformer as a finished product, the dimensions being somewhat larger than actual size for the sake of clearness;

Fig. 2 is a top plan view of Fig. 1;

Fig. 3 is a vertical cross-section approximately on line 3—3 of Fig. 2, certain parts being broken away to clarify the view;

Fig. 4 is a top plan view of the transformer with the base and top insulating disk removed;

Fig. 5 is a bottom plan view of the top disk which carries the terminals or binding posts for the transformer coil;

Fig. 6 is a transverse cross-section approximately on line 6—6 of Fig. 3, looking downwardly;

Fig. 7 is a bottom plan view of the coil and core sections, showing how the ends of the core sections are held together by a single clip;

Fig. 8 is a cross-section taken approximately on the broken line 8—8 of Fig. 7;

Fig. 9 is a plan view showing the core section bent laterally to permit insertion of the coil on the core;

Fig. 10 is a perspective view of one of the core sections, showing how it may be bent laterally at one point of separation; and

Fig. 11 is a detached perspective view of the clip for holding the separated ends of the core sections together.

The coil and magnetic core of my new transformer are housed within a casing A mounted on a base B. I prefer to make these parts of sheet metal, which may be steel, brass, aluminum and the like.

The transformer coil C comprises a primary winding 1 and a secondary winding 2, as indicated diagrammatically in Fig. 8. The primary coil consists of relatively few turns of wire and the secondary of relatively many turns, for reasons well understood by those skilled in the art. In this instance, the ratio of secondary to primary turns is nine to one, but this may be varied. The leading-out wires of the primary winding 1 are shown at 3 and 4, and the leading-out wires for the secondary winding are indicated at 5 and 6. The construction of the coil C by a concentric arrangement of the two windings 1 and 2, so that the finished coil is in the form of a hollow cylinder will be clear to the electrical engineer without further detailed explanation.

The transformer coil C is mounted on a magnetic core of novel construction. This core consists of a plurality of flexible laminated sections. In the drawings I have shown four of these sections, each indicated as a whole by M, and arranged radially, or substantially so, with respect to each other. The precise number of core sections may be varied, but I have found in practice that four sections are sufficient and produce a construction which is compact and easily assembled. The magnetic core sections M are substantially in the shape of rectangular loops and are composed of laminæ of suitable magnetic material, such as silicon steel. In other words, each section is composed of a group or bundle of laminæ. The laminæ of each section are separated from each other by thin layers of insulating material. This is perhaps most conveniently accomplished by coating the laminæ with varnish or a like substance. As best shown in Fig. 10, each core section or loop consists of an inner limb 7, a top portion 8, an outer limb 9, and a bottom portion 10. The loop is separated or interrupted at the point or line 11, which is preferably cut in a diagonal direction relative to the laminæ 7. Attention is called to the fact that each loop or section M is interrupted at one place only. This means a low reluctance in the magnetic circuit of the transformer, with a consequent increase in sensitiveness and efficiency. By splitting the laminæ diagonally, as shown in Fig. 10, I increase the area of the air gap and thereby reduce the reluctance of the magnetic circuit below the value it would have with an air gap of decreased area, such as would be formed by cutting the laminæ straight across.

When the core sections M are assembled in radial relation, with the inner limbs 7 arranged together or substantially contiguous, these inner limbs constitute a central core on which the coil C is mounted, as may be seen

from Figs. 6 and 9. In order to mount the coil on the magnetic core, it is only necessary to bend the loops or sections M laterally at the line of separation, as indicated at 10′ in Figs. 9 and 10, whereupon the coil is easily slipped on the central core formed by the inner limbs 7. It will be seen from Fig. 9 that each group or bundle of laminæ is bent open as a unit, so that it requires only the work of a moment or two to bend the four groups open for the insertion of the coil. After the coil is thus in place on the core, the laterally bent portions 10′ of the core sections M are bent back into normal position. The flexibility of the laminæ allows the core sections to be bent laterally into open and closed positions without any difficulty. After the core sections M are closed, the separated ends are held together by a clip 12, the form of which is best shown in Fig. 11. This clip has a central opening 13 and four flanges 14. When the clip 12 is in position on the core sections, the flanges 14 engage the separated ends of the core sections and thus lock them against lateral movement. This is clear from Figs. 6 and 7. Of course, any suitable means may be used for holding the core sections together after the coil is in position on the core.

The outer casing C is provided at the top with an opening 15 adapted to be closed by a disk D of suitable insulating material. A tie rod 16 passes through the base B, through the central core formed by the inner limbs 7 of the core sections M, and through an opening in the disk D. A nut 17 engages the upper end of rod 16 and thus clamps the top disk D and casing A rigidily to the base B. In other words, the tie rod 16 holds the outer parts of the structure together as a unit. If the core sections M are assembled in close fit, as indicated in Fig. 9, the forcing of the rod 16 through the central core will displace some of the laminæ outwardly, as indicated at $x$ in Fig. 6. That, of course, has no effect on the operation of the transformer. I have found, however, that in practice the core sections are assembled with sufficient mechanical clearance between the inner limbs to permit passage of the rod 16 without lateral displacement of the laminæ.

The top disk D carries four terminals or binding posts, which I have designated as a whole by $P^1$ and $P^2$ for the primary winding and by $S^1$ and $S^2$ for the secondary winding. I have assumed that the leading-out wires 3 and 4 of the primary winding are connected to terminals $P^1$ and $P^2$, respectively, and that the leading-cut wires 5 and 6 of the secondary winding are connected to terminals $S^1$ and $S^2$, respectively. As shown in Fig. 3, each terminal or binding post consists of a screw-threaded hollow bushing 18, on which is mounted a clamping nut 19. In Fig. 3, the leading-out wire 5 passes through the opening 20 in bushing 18 and is soldered at 21 to the top of bushing 18. This provides a very simple and easy way of securing the leading-out wires to their respective terminals, and it is to be noted that this connection may be made from the outside. The bushings 18 are preferably embedded in the insulating material of disk D and may be formed with a circular flange or enlargement 22, thus providing ample metallic contact when a wire is clamped between the nut 19 and flange 22. The solder 21 does not interfere with the turning of the clamping nut 19. By use of the hollow binding posts, the leads from the coil can be pulled up tight through the terminals. This obviates the danger of short circuit by loose wires and also avoids blind soldering. Mounting the terminals directly on the insulating disk D dispenses with the necessity of a separate insulating block or plate, such as was required in prior constructions. Since the soldering connections between the coil leads and the terminals on the disk D are readily accessible from the outside of the casing, it is a very simple matter to disconnect the conductors when desired, as prior to removal of the disk D, and this disconnection is without any danger of breaking the conductors at a point inside the casing.

In order to insure proper positioning of the disk D on casing C and also to prevent turning of the disk, I provide a simple locking means for the disk. Referring to Fig. 4, it will be seen that the top edge of the outer casing A is formed with a notch 23. The underside of disk D is formed with a circular flange 24 from which projects a lug 25, as shown in Fig. 5. When disk D is placed on the casing, it is adjusted until the lug 25 snaps into notch 23. Then the nut 17 is screwed down tight and the disk is locked on the casing. As shown in Fig. 5, the underside of disk D is provided with openings 26 in alignment with the openings in the hollow bushings 18 of the terminals. The openings 26 are preferably enlarged at their outer ends, so as to facilitate the insertion of the leading-out wires through the hollow terminals.

It is evident from the foregoing that I have provided a radiotransformer of exceedingly simple and compact construction, which can be assembled at a very low cost. The sectional magnetic core in each loop or section is separated at one point only, and presents the double advantage of permitting easy insertion of the coil on the core and reducing the magnetic leakage and reluctance to a minimun. This enables me to make the outer casing of a strong material like steel, without perceptibly reducing the efficiency of the transformer coil.

The transformer of my invention is specially suitable in vacuum-tube circuits

for amplifying radio telephony. As the use of audio-frequency and modulating transformers is well understood by radio engineers, I need not show or describe any circuit connection for my transformer.

When I apply the terms "top" and "bottom" to the disk D and base B, I use them only in a relative sense, for it is obviously immaterial which end of the transformer is the top and which end is the bottom. In fact, the transformer may be mounted horizontally, and the supporting base may be a plate arranged between the disk D and the casing A, as will be clear without illustration.

Although I have illustrated and described in detail a specific structure, it will be clear that, in the broader aspect of my invention, certain features may be mechanically embodied in other forms than herein set forth, without departing from the invention as defined in the appended claims.

I claim as my invention:

1. In a radiotransformer, a magnetic core consisting of a plurality of spaced flexible sections, each section being composed of a group of magnetic laminæ in the form of substantially rectangular loops, said sections being arranged in approximately radial relation, so that the inner limbs of said groups of laminæ are contiguous to constitute a practically solid central core, each loop being separated at one point only at or near one end of the inner limb thereof, whereby the outer portion of each group of laminæ may be bent laterally to open said group and bent back again into normal position, a coil on said core, said coil being adapted to be inserted on or removed from said core through the opening formed around said core when said groups of laminæ are bent laterally into open position, and a clip provided with flanges for engaging said groups of laminæ at the points of separation and thereby locking the free ends of the laminæ against lateral movement.

2. In a radiotransformer, a substantially cylindrical outer casing provided with an opening at one end, a flange around said opening, a disk having a central portion adapted to fit into said opening to close the same, a peripheral flange on said disk for engaging the flange around said opening, whereby said disk forms a removable part of said outer casing, insulated terminals carried by said disk, a transformer unit within said casing, conductors leading from the transformer coil to said terminals, means for locking said disk against rotation on said casing and insuring its correct position thereon, means for clamping said flanges together to secure said disk to said casing, and means whereby said conductors are secured to said terminals from the outside of the casing after said disk is positioned thereon.

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