Feb. 14, 1933. D. D. ISRAEL 1,897,390

LOUD SPEAKER OPERATION AND CIRCUIT

Filed April 18, 1930

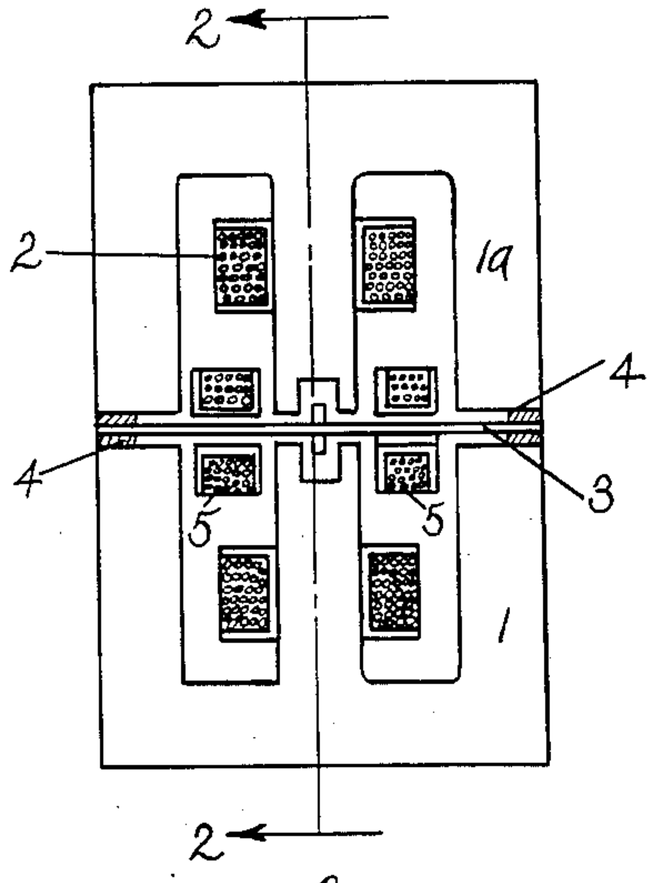

Fig. 1.

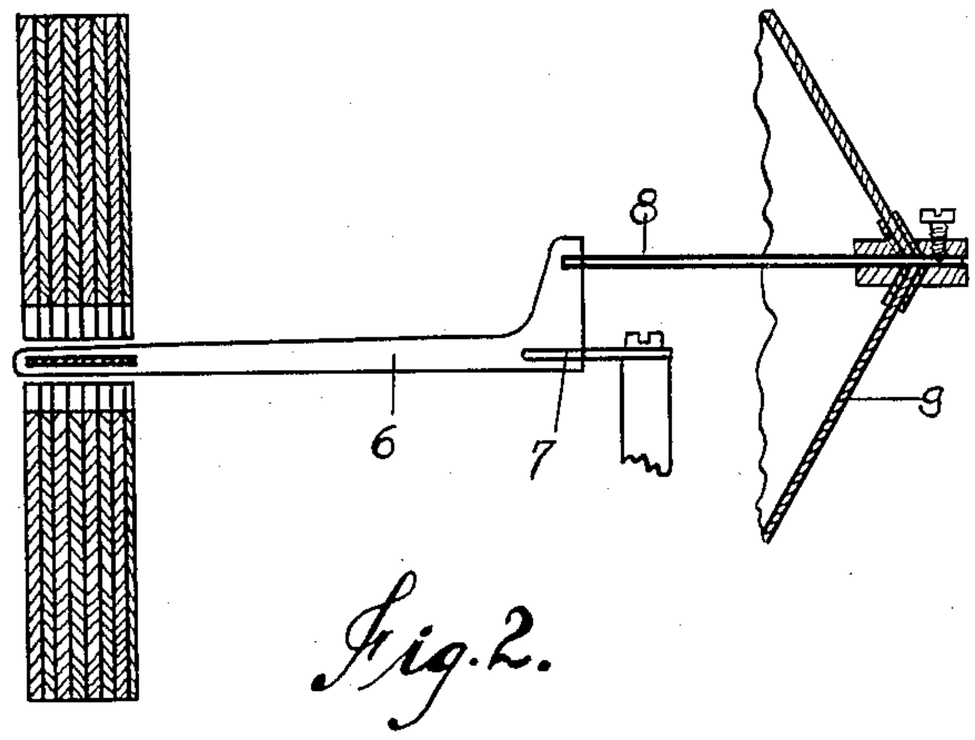

Fig. 2.

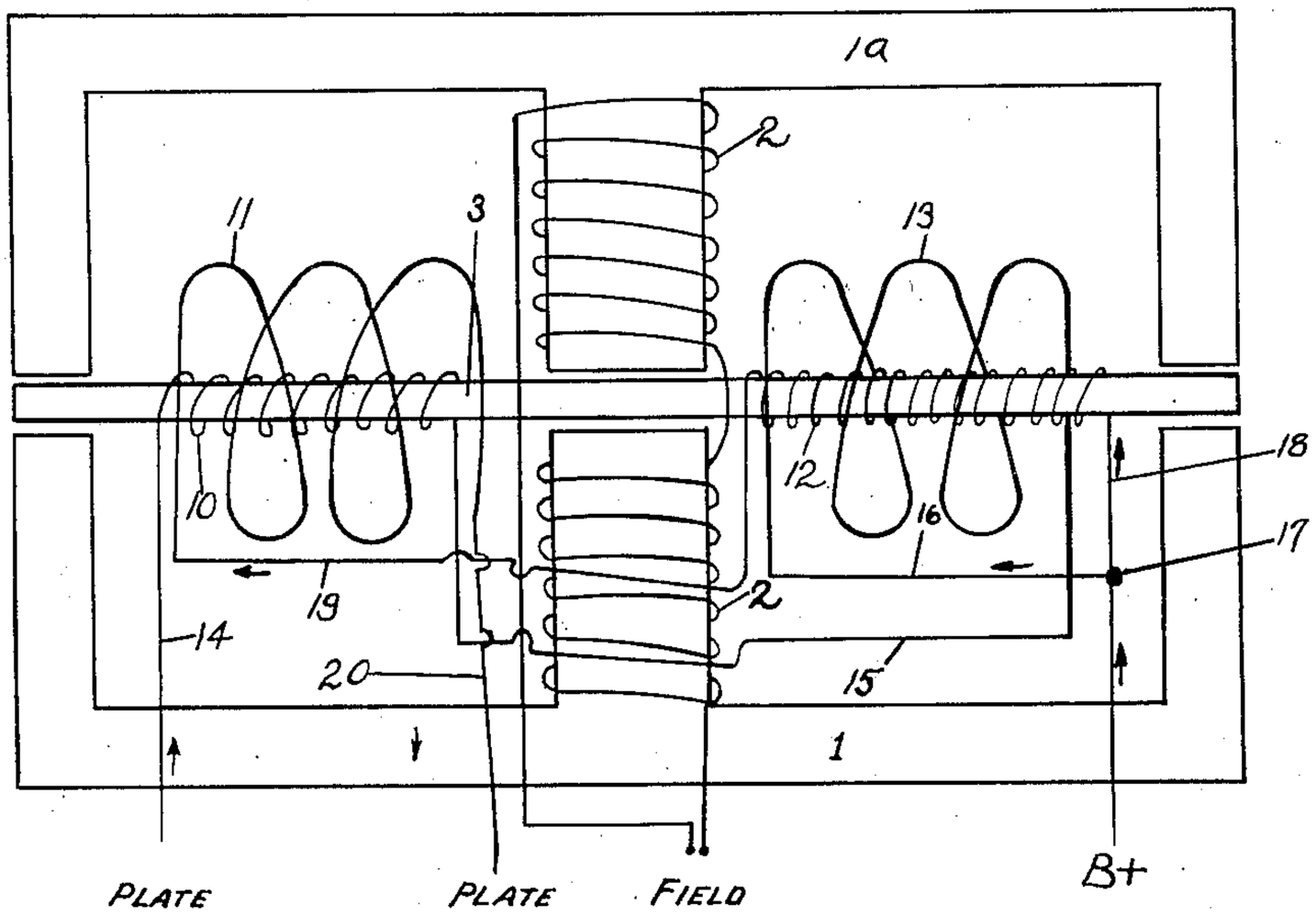

Fig. 3.

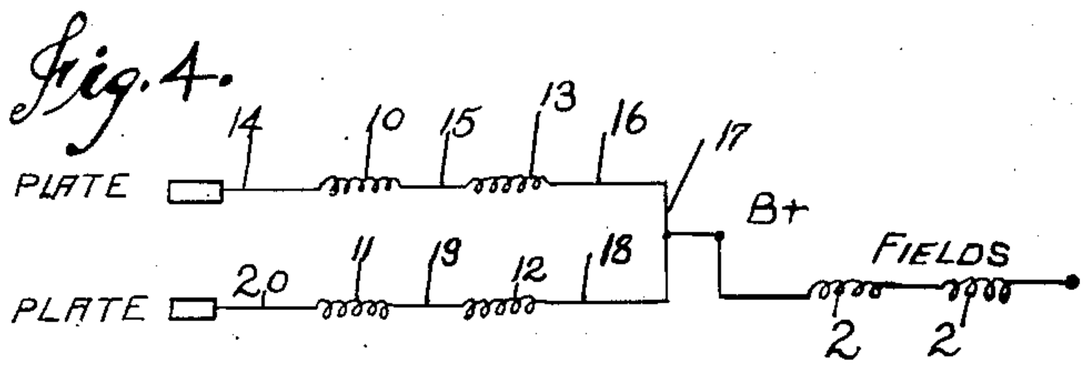

Fig. 4.

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Patented Feb. 14, 1933 1,897,390

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LOUD SPEAKER OPERATION AND CIRCUIT

Application filed April 18, 1930. Serial No. 445,314.

My invention is directed to the operation of loud speakers in connection with radio sets having a final stage of push-pull amplification. In the following specifications, I shall describe my invention in connection with a certain well known type of loud speaker; but it will be understood that my invention is not limited thereto and is applicable to other types of loud speakers as will be obvious to one skilled in the art. The primary object of my invention is to provide for the operation of loud speakers having magnetizable armatures, from a final stage of push-pull amplification in sets which are not equipped with by-passing means for the direct current component of the push-pull stage. In other words, my object is to prevent magnetic saturation of the armature by a direct current component in the armature circuit without at the same time minimizing the effect of the pulsating current in the plate leads of the push-pull amplification circuit. To this end another of my objects is the provision of an armature winding which will of itself neutralize the magnetic effect of direct current in the armature circuit, thereby eliminating the necessity of any output transformer or unit for by-passing direct current components.

These and other objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts and in that circuit of which I shall now describe an embodiment having to do with a commercial type of loud speaker, it being understood that the embodiment described is exemplary and not limiting. Reference is made to the drawing accompanying this specification in which Figure 1 is a diagrammatic representation of a commercial loud speaker motor in elevation, the coils being shown in section.

Figure 2 is a sectional view of the motor along the lines 2—2 of Figure 1.

Figure 3 is a diagrammatic showing of the motor with my windings in place.

Figure 4 is a schematic diagram of my winding.

The commercial loud speaker referred to comprises field cores 1 and 1*a* of generally E-shape and positioned in opposed relationship. A field winding 2 is positioned about each of the central legs of each E and is regularly connected with a source primarily of direct current potential. An armature 3 is positioned between the several pole pieces and is held at each end by non-magnetic washers 4. Armature windings 5 (Figure 1) are located about interspaced portions of the armature between the pole pieces of the field magnets. These windings have normally been connected in opposed relationship so as to divide the armature effectively into two magnetic portions with similar poles meeting at the center thereof, where changes of polarity or variations in magnetic strength will cause the armature to move toward or away from the pole pieces. An operative lever 6 in Figure 2 is connected to the armature centrally and is pivoted upon a piece of resilient metal 7 rigidly held upon the frame of the speaker. The lever arm 6 is in the form of a bell crank, the shorter arm of which is connected by a link 8 to a diaphragm reproducer 9. Hitherto it has been the practice to connect the armature windings 5 to a source of fluctuating alternating current or the plate circuit of the last stage of audio frequency amplification in a radio set.

Hitherto also, if this type of loud speaker or any type having similar armature windings was to be used with a set having a final stage of push-pull audio frequency amplification, it has been necessary in some manner to by-pass the direct current component of the plate circuits so as to avoid an undesirable magnetic saturation of the armature. This has been done by shunting a suitable impedance or transformer across the plate leads and the center tapping of this impedance. With sets not provided with this impedance or some equivalent means, the loud speaker in question could not be used with any degree of satisfaction.

In my invention I connect the field circuit to a suitable source of direct current potential which is ordinarily not separate, but is in the general circuit of the set. I have not illustrated a radio set nor the final stage of

push-pull amplification since it is not necessary to an understanding of my invention to do so. The various connections will be undestood by one skilled in the art or will be explained hereinafter. I do provide however, a novel armature winding and connections therefor such that while the fluctuating current in the plate circuits has the desired effect in reproducing sound, the direct current component in the central tap circuit of the push-pull transformer will be successfully blanked out or neutralized. It will be understood that in the push-pull transformer, the B source is connected with the center tap, whereby as such it neutralizes itself with respect to the core of the transformer by flowing in opposite directions in inductively equivalent windings. Hitherto it has not been possible to do this in loud speakers of this type. Nor is it possible to make a center tap to the interspaced armature windings and gain the effect in this way.

In my invention however, the desired result is accomplished by dividing each interspaced part of the armature windings into two magneto-motively equivalent components and then connecting them in a way hereinafter to be described.

Referring now to Figure 3, it will be seen that on each half of the armature I employ two windings indicated as 10, 11, 12 and 13 respectively. In this embodiment all windings are in the same direction. The windings may be located in any way desired and they may be either one over the other or in portions arranged in some suitable manner longitudinally of the armature. They should however, be magneto-motively equivalent so that if direct current be caused to flow for example in opposite directions in windings 10 and 11, the magnetic effect thereof upon the armature 3 will be completely neutralized.

The current from plate #1 of the push-pull stage is conducted by lead 14 to winding 10 on the left half of the armature in Figure 3. Thence by lead 15 it is conducted to winding 13 on the right half of the armature. It will be noticed however that although windings 10 and 13 are in the same direction as respects the armature, they are so interconnected as to have an opposed magnetic effect. The winding 13 is connected by means of a lead 16 to a common connection 17, the purpose of which will hereinafter be described. Thence by lead 18 it is connected to winding 12 in such a way that the magnetic effect of windings 12 and 13 is a reinforcing effect. Thence by lead 19 the current is conducted to winding 11 in such a way that the magnetic effect of the current in winding 11 is opposed to that in windings 12 and 13 but reinforces that in winding 10. Thence the current travels through lead 20 to plate No. 2 of the final stage of push-pull amplification.

It will be understood that since windings 10 and 11 are in the same direction, and since windings 12 and 13 are in the same direction, and since these several windings are equivalent magneto-motively, 10 and 11 may be interchanged and 12 and 13 may be interchanged, and the connections may be otherwise altered but, the connections are made in such a way that when current flows between plate lead 14 and plate lead 20, it will traverse in series all four windings on each armature half in such a way that while the effect of the windings on one half the armature will oppose the magnetic effect of the windings on the other half of the armature, the magnetic effect of both windings on each half of the armature will reinforce each other.

To the center tap 17 hereinbefore described, I connect the source of B potential. The B plus terminal will thus be connected to the center tap 17 and the direct current therefrom will flow through the several armature windings as will now be described. The current will be divided and one part of it will flow through lead 18 to coil 12 and thence through lead 19 to coil 11. The other component will flow through lead 16 to coil 13 and thence through lead 15 to coil 10. It will be noticed however that with respect to center tap 17 the magnetic effect of coils 12 and 13 is in the opposite direction and the magnetic effect of coils 10 and 11 is also in the opposite direction. Thus the magnetic effect of each coil on each armature section is directly opposite to that of each other coil on each armature section, whereby the magnetic effect of direct current dividing at center tap 17 and proceeding through the different armature windings to plate leads 14 and 20 is completely neutralized. Thus just as the direct current flowing in opposite directions through magneto-motively equivalent windings on the core of the push-pull transformer neutralizes itself, so also this same current proceeding in opposed directions through magneto-motively equivalent windings on each half of the loud speaker armature neutralizes itself there. I have thus succeeded without the use of any choke, transformer or the like in the leads of the last stage of audio push-pull amplification, in effecting a type of armature winding and connections thereto such that the fluctuating current in the plate leads produce a cumulative magnetic effect on the armature, whereas the direct current components between these plate leads and the center tap lead of the push-pull transformer neutralizes itself magnetically in the armature windings.

In order that my windings may be more clearly understood I have shown them schematically in Figure 4, where the same windings and leads are designated by the same numbers as in Figure 3. Modifications may be made in the windings as suggested with-

out departing from the spirit of my invention.

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

1. In a loud speaker motor, an armature, armature windings comprising components, the said components interconnected and connected to the plate leads and the B supply of a push-pull amplification system in such a way that the alternating component of current in the circuit between plate leads flows in series through all components and the direct current between the center tap and the plate leads flows in a divided path through opposed components located upon the same magnetic portion of said armature.

2. In a loud speaker motor, an armature, an armature winding comprising components, the said components connected in series and with the plate leads of a push-pull amplifier, an intermediate tap between components, the said components so arranged that current flowing between said center tap and said plate leads will produce mutually opposed magnetic forces upon the same magnetic portion of said armature.

3. In a loud speaker motor, an armature, an armature winding in component parts located upon the same magnetic portion of said armature, and means for sending alternating current through said component parts in a magnetically reinforcing direction as respects the flux of said armature and for sending direct current through said component parts in a magnetically neutralizing direction.

4. In a loud speaker motor an armature having interspaced windings thereon, each of said windings having component parts, all of said windings connected in series with the plate leads of a push-pull amplification stage and directly opposed pairs of said components connected in opposition with the center tap of said push-pull stage.

5. In a loud speaker motor an armature having interspaced magnetically opposed windings, each of said windings comprising magneto-motively equivalent component parts, all of said component parts connected in a single series circuit with the plate leads of a push-pull audio amplification stage, the component parts of each winding being connected in opposition with a source of direct current potential.

6. In a loud speaker motor interspaced windings each of said windings comprising a pair of magnetically equivalent component windings, all of said components connected in series and with the plate leads of a push-pull amplification stage so that the current therefrom flows through a component of the first winding, both components of the second winding and a component of the first winding in series, and a center connection intermediate the components of the second winding with the B supply of the push-pull amplification system.

7. In a loud speaker motor an armature having a winding in component parts, the direction of winding of said component parts being the same, said component parts being connected in series whereby current flowing in said series circuit through said component parts will have a magnetically cumulative effect upon the same magnetic portion of said armature, and a center tap between said components whereby current flowing into said winding from said center tap will traverse in opposite directions equal components whereby the magnetic effect thereof is neutralized.

8. In a loud speaker motor an armature having interspaced windings, each of said interspaced windings comprising magneto-motively equivalent but separately connected component parts, the winding in all of said parts being in the same direction, all of said parts being connected in series with each other and with the plate leads of a push-pull audio amplification stage forming a circuit in which the current flows through said component parts in sequence to produce a magnetically cumulative effect, and a tap intermediate series of said component parts forming magnetically opposed circuits between said tap and each of said plate leads, said tap being connected to the center tap of said push-pull amplification stage.

9. In a loud speaker motor, an armature having interspaced windings each of said windings comprising two magneto-motively equivalent component parts, all of said component parts being connected in series and with the plate leads of a push-pull audio amplification stage in such a way that current between said plate leads will flow through the first component of the first winding, thence through both components in series of the second winding, thence through the second component of the first winding, all of said components being wound in the same direction and the component parts of the interspaced windings being connected together to form in each winding a cumulative magnetic field but in an opposite direction to the field of the other winding, and a center tap between the components of said second winding, said center tap being connected to the center tap of said amplification stage, whereby current flowing through said center tap will traverse the components of each winding so as to produce magnetic fields opposed in each winding.

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