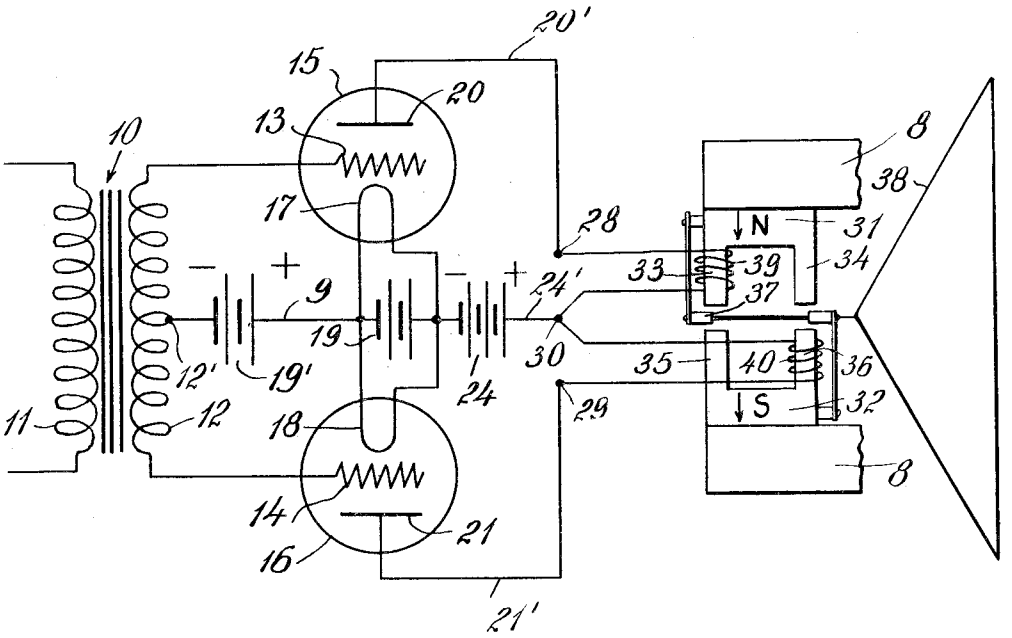
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LOUD SPEAKER AND CIRCUIT THEREFOR

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LOUD-SPEAKER AND CIRCUIT THEREFOR

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This invention relates to radio loudspeakers and to the circuits of which they form a part.

In radio receiving apparatus it is customary to utilize some device to prevent the steady direct current in the amplifier from passing through the loudspeaker windings. Unless the effect of the steady direct current is eliminated it exerts a constant biasing force on the armature of the loudspeaker motor causing an objectionable displacement of it. Perhaps the most commonly used devices for accomplishing this are the so-called output transformer and the output filter. When one of these devices is interposed between the amplifier and the loudspeaker it has the effect of passing the fluctuating speech currents to the loudspeaker motor but it does not pass on to the loudspeaker the steady direct current.

The "push-pull" type of amplifier, now so commonly used, has either a push-pull output transformer or a push-pull output filter, and in either case prevents the steady direct current from reaching the loudspeaker.

One object of this invention is to provide a loudspeaker whose motor is so constructed and so connected with the amplifier that the steady direct current is not prevented from passing to the loudspeaker but is allowed to traverse the loudspeaker windings in such a way that it does no harm, and in some cases may be utilized to advantage.

A further object is to provide a loudspeaker whose construction adapts it for connection in an amplifying circuit to produce the above-mentioned results.

An embodiment of the invention is illustrated in the accompanying drawing which diagrammatically represents the improved loudspeaker connected in circuit with a portion of a push-pull amplifier in a manner that will produce the results contemplated by the invention.

In the drawing the numeral 10 represents an input push-pull transformer having a primary coil 11 connected in circuit with the other instrumentalities of the radio receiver in the customary and well-known way. The secondary 12 of the input transformer is connected at one end with the grid 13 of a three-electrode vacuum tube 15 and at its other end with the grid 14 of a similar vacuum tube 16. An intermediate point 12′ of the transformer secondary winding is connected by means of a conductor 9 to a circuit which includes the two filaments 17 and 18 of the vacuum tubes and a filament battery 19. A grid bias battery 19′ may be inserted in the lead 9. A conductor 20′ extends from the plate 20 of tube 15 to a point 28 and a similar conductor 21′ extends from plate 21 of the tube 16 to a point 29. A "B" battery 24 is connected to the common filament circuit 17—18 and to a conductor 24′ which extends to a point 30.

The arrangement so far described is the well-known push-pull amplifier up to but not including the usual output push-pull transformer. The usual push-pull amplifier has an output push-pull transformer connected at the points 28, 29 and 30 as follows: One end of the primary winding of the transformer is connected at 28 and the other end at 29. A midpoint of the primary winding is connected to the lead 24′ at the point 30. The secondary of the output transformer is connected directly to the loudspeaker motor. In place of an output push-pull transformer an output push-pull filter arrangement is sometimes employed connected at the three points 28, 29 and 30 in a well-known manner. The customary output push-pull transformer, or output push-pull filter arrangement prevents the steady direct current from the "B" battery 24 from reaching the loudspeaker but the fluctuating speech currents are passed on to the loudspeaker in a manner well understood in the art.

According to this invention, the output push-pull transformer, or the output push-pull filter arrangement usually connected at the points 28, 29 and 30, is omitted altogether and the loudspeaker is so constructed that the windings of its motor may be directly connected at the points 28, 29 and 30 in such a way that the steady direct current is allowed to pass through the motor windings but in such a way that it does no harm and in some cases may be utilized to advantage. This is accomplished, in one form of the invention, by utilizing a loudspeaker, constructed and connected in circuit as follows: The loud-

speaker motor has a source of permanent field flux such as a magnet, a portion only of which is represented at 8. The legs of the magnet are attached to two pole pieces 31 and 32, each of which is bifurcated so as to form a pair of poles 33 and 34 on the pole piece 31 and poles 35 and 36 on the pole piece 32. The poles 33 and 34 are of like polarity and the pole pieces 35 and 36 are of like polarity. An armature 37 moves in a path parallel with the polar faces and is connected with a suitable diaphragm such as the cone 38. The arrangement is such that a relative increase of flux at one end of the armature will move it longitudinally in one direction, whereas a relative increase in flux at the other end of the armature will move it longitudinally in the other direction. A coil 39 associated with one of the poles of the pole piece 31 is connected to the points 28 and 30, while a coil 40 on the diagonally opposite pole of pole piece 32 is connected to the points 30 and 29. It will now be seen that due to this arrangement the steady direct current from the battery 24 divides at point 30 and one portion passes through the coil 39 to the point 28 and then through the remainder of the plate circuit of the tube 15. The other portion of the steady direct current passes from the point 30 through the coil 40 to the point 29 and then through the remainder of the plate circuit of the tube 16. Whatever effect on the armature is produced by the steady direct current passing through the coil 39 is offset or counteracted by a similar effect produced by the steady direct current of equal value flowing through the coil 40. In other words these effects add to zero. If the steady direct current tends to increase the flux in the pole 33 it will do likewise and to the same extent in the pole 36 and there will, therefore, be no movement of the armature. If the steady direct current in the coil 39 tends to decrease the flux in the pole 33, the steady direct current in the coil 40 will likewise decrease the flux in the pole 36 to the same extent and there will be no movement of the armature. In either case the steady direct current in the coils 39 and 40 produces like flux changes in their poles. The coils 39 and 40 are preferably so wound that the steady direct current passing through them tends to increase the flux through their respective poles rather than decrease it. The strength of the field is thereby increased because the permanent or steady flux of the field has added to it the flux produced by the steady direct current in the windings 39 and 40.

The fluctuating currents are of unequal value in the windings 39 and 40 and produce unlike flux changes at the poles 33 and 36. That is, as the fluctuating current increases in the coil 39 it decreases in the coil 40, and vice versa, so that the flux changes are unlike in that the flux is increased in one pole while it is decreased in the other. The effects produced by the fluctuating speech currents passing through the windings 39 and 40 therefore do not add to zero, as in the case of the steady direct current, but are effective in causing reciprocation of the armature.

While the drawing shows a coil on one pole only of the pole piece 31 and on one pole only of the pole piece 32, it is apparent that the same results described above may be obtained when all of the poles are provided with coils if the coils are wound in the proper direction and properly connected.

When the windings of a loudspeaker motor are connected in a circuit of the character of the one described in the manner above set forth, the customary push-pull output transformer or push-pull output filter is entirely eliminated thus saving this expense. Moreover, the losses incidental to the use of these instrumentalities are also eliminated.

It will now be seen that the invention eliminates the necessity of using any device for preventing the steady direct current from passing through the windings of the loudspeaker motor. The steady direct current is permitted to pass through these windings without producing any harmful effect and if the coils are wound in the proper direction the steady direct current may even be utilized to build up the steady or permanent flux thereby increasing the strength of the field.

The loudspeaker may have three terminals or binding points corresponding to the points 28, 29 and 30 so that it may be sold as a separate article of manufacture in readiness to be connected to a circuit having the characteristics of the one shown in the drawing.

While the principle of the invention has been illustrated by showing a loudspeaker motor connected with a portion of the usual push-pull amplifier circuit the invention also contemplates any output circuit which will divide or split the steady direct current and distribute it equally to the loudspeaker motor windings and which at the same time will properly produce the fluctuating speech currents in the motor windings. The invention also contemplates the use of loudspeaker motors differing in construction from that illustrated and described so long as the coils are adapted to be properly connected with the amplifier circuit and so long as the general construction of the motor is such as to bring about the effects herein described.

I claim:

1. The combination of a loudspeaker having a motor comprising at least two poles each having a speech coil and an armature between the poles all arranged so that equal currents passing through the coils will produce like flux changes at the poles and result in no movement of the armature and so that unequal currents passing through the coils

will produce unlike flux changes at the poles which result in a movement of the armature, an electric circuit for each of said coils, said circuits having a common path, a source of direct current in said common path whereby steady direct current from said source divides and flows through both of said coils to produce like flux changes at said poles resulting in no movement of the armature, and means in said circuits for producing fluctuating currents of unequal value in the speech coils which result in unlike flux changes at the poles and a consequent movement of the armature.

2. The combination of a loudspeaker having a motor comprising at least two poles each having a speech coil and an armature between the poles all arranged so that equal currents passing through the coils will produce like flux changes at the poles and result in no movement of the armature and so that unequal currents passing through the coils will produce unlike flux changes at the poles which result in a movement of the armature, an electric circuit for each of said coils including a source of direct current such that the steady direct current flowing through both of said coils produces like flux changes at said poles resulting in no movement of the armature, and means in said circuits for producing fluctuating currents of unequal value in the speech coils which result in unlike flux changes at the poles and a consequent movement of the armature.

3. A combination as set forth in claim 2 in which the poles of the motor are associated with a source of permanent flux.

4. A combination as set forth in claim 2 in which the poles of the motor are associated with a source of permanent flux and in which the speech coils are so wound as to cause the steady direct current passing through them to add to and increase the permanent flux.

5. The combination with a push-pull amplifier stage comprising an input push-pull transformer having primary and secondary windings, a pair of vacuum tubes each having a filament, grid and plate, the grids being respectively connected with the ends of the transformer secondary, a filament circuit including the two filaments of the tubes, a connection between the filament circuit and an intermediate point of the transformer secondary, a source of direct current connected to said filament circuit, and leads extending from the plates of said tubes, of a loudspeaker having a motor comprising at least two poles provided with speech coils, an armature arranged between the poles, one of said speech coils being connected to said direct current source and to one of said leads and the other of said speech coils being connected also to said source of direct current and to the other of said leads, said speech coils being wound to produce like flux changes in their poles as a result of the steady direct current from said source which divides and passes through said speech coils in equal amounts.

6. The combination with a thermionic amplifier comprising a pair of vacuum tubes having the grid circuits thereof connected in push-pull relation to an input circuit, of a loud speaker unit including means for producing a permanent magnetic flux adapted to maintain in dynamic equilibrium an armature affixed to an acoustical unit, a pair of signal-current coils for actuating said armature and situated respectively at opposite ends thereof, and means so connecting said coils individually in the anode circuits of said tubes, respectively, that the fluxes due to the space currents flowing therein in each case aid said permanent flux, whereas signal waves repeated by said amplifier tubes produce additive actuating effects upon said armature.

In testimony whereof I affix my signature.

CLAIR L. FARRAND.