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VOICE COIL CONNECTION FOR LOUD-SPEAKERS

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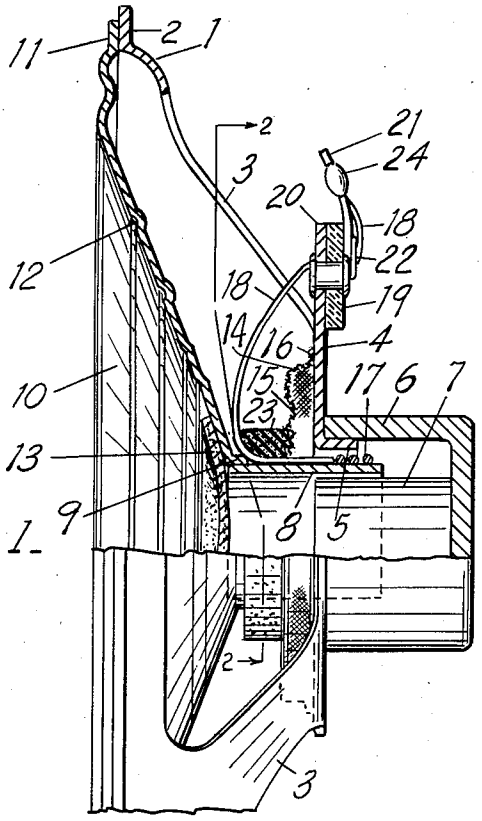

Fig. 1.

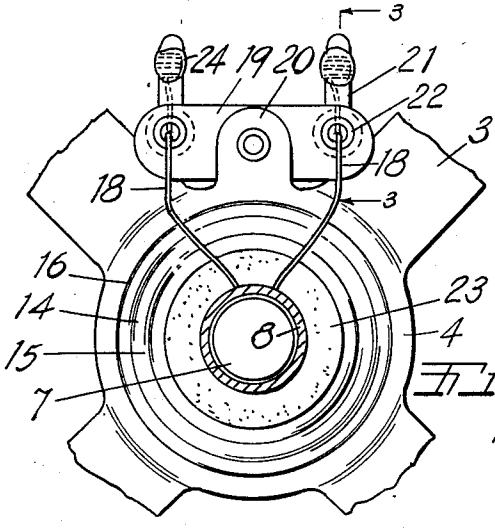

Fig. 2.

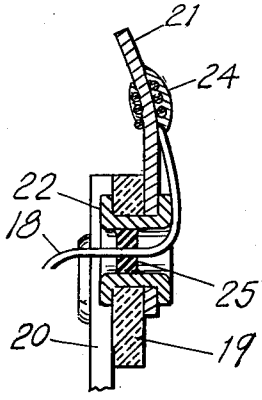

Fig. 3.

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VOICE COIL CONNECTION FOR LOUD-SPEAKERS

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13 Claims. (Cl. 179—115.5)

This invention relates to improvements in voice coil connection for loud-speakers. The principal objects of this invention are:

First, to provide a connection between the voice coil of a loud-speaker and a fixed terminal on the loud-speaker frame which will be simpler and less expensive to install than connections used heretofore.

Second, to provide a connection to the voice coil of a loud-speaker which does not require any attachments to the diaphragm of the loud-speaker.

Third, to provide a voice coil connection which reduces the weight of the movable parts of the loud-speaker to a minimum.

Fourth, to provide a loud-speaker coil connection which does not unbalance or create areas of local flexing in the diaphragm of the loud-speaker.

Fifth, to provide a loud-speaker voice coil connection which permits the diaphragm to vibrate more accurately in response to the forces applied thereto and thus provides higher fidelity of the sound produced by the loud-speaker.

Sixth, to provide means for directly connecting the wire which forms the voice coil of a loud-speaker to a fixed terminal so that the wire will not break due to fatigue under continued operation and vibration of the loud-speaker.

Seventh, to provide a voice coil connection for a loud-speaker which eliminates all possibility of the creation of undesired sound by reason of flexing and vibration of the voice coil leads.

Other objects and advantages of the invention will be apparent from a consideration of the following description and claims. The drawings, of which there is one sheet, illustrate a highly practical form of the voice coil connection applied to a loud-speaker.

Fig. 1 is a fragmentary side elevational view of a loud-speaker partially broken away in axial cross section.

Fig. 2 is a fragmentary cross sectional view taken along the plane of the line 2—2 in Fig. 1.

Fig. 3 is an enlarged fragmentary cross sectional view taken along the plane of the line 3—3 in Fig. 2.

The voice coil connection of the present invention is applicable to most types of permanent magnet loud-speakers and electro-magnet loud-speakers having movable voice coils known in the art today. The particular form of loud-speaker illustrated in the drawings consists of a frame or basket 1 of stamped sheet metal having an annular rim 2 with rearwardly converging and angularly spaced arms 3 joined at the rear of the speaker by a back wall 4. The back wall 4 is centrally apertured and extruded to provide a short cylindrical flange 5 which defines the periphery of a voice coil opening. A generally cylindrical soft iron cup 6 is pressed around the outside of the flange 5 and against the back wall 4 to provide a magnetic return path for the field of the cylindrical permanet magnet 7 that is secured centrally in the bottom of the cup 6.

The forward end of the magnet 7 and the cylindrical

flange 5 define a narrow cylindrical voice coil opening in which the end of the voice coil tube 8 is freely movably received. The voice coil tube 8 is commonly made of paper or other light weight non-conducting material and its forward end is received in and secured to a cylindrical flange 9 formed around the apex of a conical diaphragm 10. The outer periphery of the diaphragm 10 is provided with an annular flange 11 that is secured to and supported by the annular ring 2 of the speaker frame. The conical body of the diaphragm may be provided with one or more annular ribs 12 to vary its vibration characteristics.

A light felt sealing disc 13 closes the forward end of the voice coil tube 8 and a circular spider 14 having a number of annular corrugations 15 has its inner periphery secured around the periphery of the voice coil tube 8 just forwardly of the rear wall 4 of the speaker frame. The outer periphery of the spider 14 is flanged and secured to the back wall 4 as at 16 to center the voice coil in the voice coil opening and to radially stabilize the vibration of the voice coil tube and the diaphragm. Spirally wound around the voice coil tube 8 and located within the cylindrical voice coil opening is the voice coil 17 of very fine insulated copper wire. Voice coils of loud-speakers are wound with wire sizes ranging from No. 32 to 40 Brown and Sharpe gage and commonly from .0086 inch to .0049 inch in wire diameter and the same factors which control the size of the voice coil wire in older speakers control the size of the wire in the present speaker. The voice coil leads 18 consist of integral continuations of the ends of the voice coil wire and are extended forwardly between the surface of the voice coil tube and the inner edge of the spider 14. Between the spider 14 and the apex flange 9 on the diaphragm, the voice coil leads 18 are extended radially outwardly in a broad curve to an insulating terminal strip 19. The strip 19 is fixedly supported on an ear 20 projecting upwardly from the rear wall of the speaker frame and carries a pair of metallic terminals 21 that are secured to the terminal strip by having eyelet portions 22 riveted in holes in the terminal strip.

In order to prevent the continued audio frequency vibration of the voice coil tube from inducing localized flexing and fatigue in the fine wire of the voice coil leads 18 an annular ring 23 of sponge rubber or other soft yieldable material is sleeved around the voice coil tube and the forwardly projecting inner ends of the voice coil leads. The ring 23 is relatively light and vibrates freely with the voice coil tube 8 and at the same time applies a yieldable backing pressure to the voice coil leads where the leads curve away from the voice coil tube. The yieldable compression and expansion of the material in the ring 23 prevents the voice coil leads flexing at any specific point along their length and distributes the flexing loads and movements of the voice coil leads over a substantial length of the inner ends of the leads. Consequently no localized stresses or fatigue points are created in the voice coil leads and they will operate indefinitely without breaking.

The outer ends of the voice coil leads 18 extend through the eyelets 22 and are folded laterally outwardly and electrically and mechanically connected to the terminals 21 by a solder connection 24. In order to prevent the creation of undesired sound by reason of vibration of the voice coil leads against the eyelets 22 a small drop of rubber cement 25 or other yieldable material is positioned around the leads and within the eyelets 22. This yieldable connection also serves to prevent the establishment of a localized flexing point in the outer ends of the leads which might cause the leads to break at that point.

It is pointed out that the voice coil connection thus described leaves the diaphragm 10 entirely free of any attachments or unbalancing weights so that the diaphragm

responds more accurately to the impulses of the voice coil tube. The yieldable ring **23** is relatively light and the thin voice coil leads **18** are substantially lighter than the braided leads now in common use so that the total weight on the voice coil tube **8** is substantially reduced thus reducing the inertia of the vibrating parts of the loud-speaker and increasing the fidelity of the speaker.

While the yieldable ring **23** is extended continuously around the voice coil tube in order to radially balance the tube and for ease in assembly, the greater portion of the periphery of the ring performs no other function and does not coact particularly with the voice coil leads. Those portions of the ring **23** immediately surrounding the voice coil leads **18** cushion and distribute the flexing motion of the leads as pointed out above and this same cushioning and backing function could be performed by local pieces of flexible material mounted directly on the tube **8** or spider **14** and secured thereto to vibrate with the tube provided that the undersurface of the cushioning means were free to deflect radially outwardly from the voice coil tube when contacted by the voice coil leads.

Having thus described the invention, what is claimed as new and is desired to be secured by Letters Patent is:

1. In a loud-speaker having a frame with a magnet structure at one end forming a cylindrical voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a cylindrical voice coil tube secured to the center of said diaphragm and projecting into said opening, an annular flexible spider connected at its periphery to said frame and at its radially inner edge around said tube behind said diaphragm, a voice coil of fine wire wound around said tube within said opening and having its ends extended integrally along the surface of said tube under the inner edge of said spider, an annular ring of soft flexible foam rubber material positioned around said tube and said ends adjacent said spider, an insulating terminal strip fixedly mounted on said frame in rearwardly spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip by eyelets clamped through the strip, said ends being curved in unsupported reaches from said annular ring through said eyelets and electrically and mechanically connected by solder to said terminals, and a small mass of flexible rubber material adhered in said eyelets and around said ends to cushion and dampen the vibration thereof.

2. In a loud-speaker having a frame with a magnet structure at one end forming a voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a voice coil tube secured to the center of said diaphragm and projecting into said opening, an annular flexible spider connected at its periphery to said frame and at its radially inner edge around said tube behind said diaphragm, a voice coil of fine wire wound around said tube within said opening and having its ends extended integrally along the surface of said tube under the inner edge of said spider, an annular ring of soft flexible material positioned around said tube and said ends adjacent said spider, an insulating terminal strip fixedly mounted on said frame in spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip and having eyelets, said ends being curved in unsupported reaches from said annular ring through said eyelets and electrically and mechanically connected to said terminals, and a small mass of flexible material in said eyelets and around said ends to cushion and dampen the vibration thereof.

3. In a loud-speaker having a frame with a magnet structure at one end forming a cylindrical voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a cylindrical voice coil tube secured to the back of said diaphragm and projecting into said opening, an annular flexible spider connected at its periphery to said frame and at its radially inner edge around said tube behind said diaphragm, a voice coil of fine wire of less than .0086 inch in diameter wound around said tube within said opening and having its ends extended integrally along the surface of said tube under the inner edge of said spider, an annular ring of soft flexible foam rubber material positioned around said tube and said ends adjacent the outside of said spider, an insulating terminal strip fixedly mounted on said frame in rearwardly spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip by eyelets clamped through the strip, said ends being curved in unsupported reaches from said annular ring through said eyelets and electrically and mechanically connected by solder to said terminals, and a small mass of flexible rubber material adhered in said eyelets and around said ends to cushion and dampen the vibration of the ends against the terminals.

4. In a loud-speaker having a frame with a magnet structure at one end forming a cylindrical voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a cylindrical voice coil tube secured to the back of said diaphragm and projecting into said opening, an annular flexible spider connected at its periphery to said frame and at its radially inner edge around said tube behind said diaphragm, a voice coil of fine wire of less than .0086 inch in diameter wound around said tube within said opening and having its ends extended integrally along the surface of said tube under the inner edge of said spider, an annular ring of soft flexible material positioned around said tube and said ends adjacent the outside of said spider, an insulating terminal strip fixedly mounted on said frame in spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip, said ends being curved in unsupported reaches from said anuular ring and electrically and mechanically connected to said terminals, and a small mass of flexible rubber material adhered around said ends where the ends converge on the terminals to cushion and dampen the vibration of the ends against the terminals.

5. In a loud-speaker having a frame with a magnet structure at one end forming a voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a voice coil tube secured to said diaphragm and projecting into said opening, an annular flexible spider connected at its periphery to said frame and at its radially inner edge around said tube, a voice coil of fine wire wound around said tube within said opening and having its ends extended integrally along the surface of said tube under the inner edge of said spider, an annular ring of soft flexible material positioned in radially gripping relation around said tube and engaging said ends adjacent said spider, an insulating terminal strip fixedly mounted on said frame in spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip and having eyelets, said ends being curved laterally away from said tube across the end of said ring and extending in unsupported reaches from said annular ring through said eyelets and being electrically and mechanically connected to said terminals, and a small mass of flexible material in said eyelets and around said ends to cushion and dampen the vibration thereof.

6. In a loud-speaker having a frame with a magnet structure at one end forming a voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a voice coil tube secured to said diaphragm and projecting into said opening, a voice coil

of fine wire wound around said tube within said opening and having its ends extended integrally along said tube, an annular ring of soft flexible material positioned in radially gripping relation around said tube and engaging said ends, an insulating terminal strip fixedly mounted on said frame in spaced relation to the point where said ends project from said annular ring, metal connecting terminals secured to said terminal strip and having eyelets, said ends being curved laterally away from said tube across the end of said ring and extending in unsupported reaches from said annular ring through said eyelets and being electrically and mechanically connected to said terminals, and a small mass of flexible material in said eyelets and around said ends to cushion and dampen the vibration thereof.

7. In a loud-speaker having a frame with a magnet structure at one end forming a voice coil opening and a diaphragm supported at its periphery on said frame with its center opposite said voice coil opening, a voice coil mounting comprising a voice coil tube secured to said diaphragm and projecting into said opening, a voice coil of fine wire wound around said tube within said opening and having its ends extended integrally along said tube, an annular ring of soft flexible material positioned in radially gripping relation around said tube and engaging said ends, insulated terminals mounted on said frame in spaced relation to the point where said ends project from said annular ring and having eyelets, said ends being curved laterally away from said tube across the end of said ring and extending in unsupported reaches from said annular ring through said eyelets and being electrically and mechanically connected to said terminals, and a small mass of flexible material in said eyelets and around said ends to cushion and dampen the vibration thereof.

8. In a loud-speaker having a frame with a magnet structure at one end forming a voice coil opening and a diaphragm supported at its periphery on said frame and opposite said voice coil opening, a voice coil mounting comprising a voice coil tube secured to said diaphragm and projecting into said opening, a voice coil of fine wire wound around said tube within said opening and having its ends extended integrally along said tube, an annular ring of soft flexible material positioned in radially gripping relation around said tube and engaging said ends, and insulated terminals fixedly mounted on said frame in spaced relation to the point where said ends project from said annular ring, said ends being curved laterally away from said tube across the end of said ring and extending in unsupported reaches from said annular ring and being electrically and mechanically connected to said terminals.

9. A connection between the vibratorally mounted wire voice coil of a loud-speaker and a fixed terminal comprising an integral end on said coil extending in a curve from the coil and secured to the terminal, and an annular mass of soft springable foam rubber material mounted in fixed relation to said coil to vibrate therewith and overlying and in contact with said end of said wire where the wire diverges from the coil into said curve.

10. A connection between the vibratorally mounted wire voice coil of a loud-speaker and a fixed terminal comprising an integral end on said coil extending in a curve from the coil and secured to the terminal, and a mass of soft springable material mounted in fixed relation to said coil to vibrate therewith and overlying and in contact with said end of said wire where the wire diverges from the coil into said curve.

11. A connection between the vibratorally mounted wire voice coil of a loud-speaker and a fixed terminal comprising an integral end on said coil extending in a curve from the coil and secured to the terminal, and an annular mass of soft springable foam rubber material mounted in fixed relation to said coil to vibrate therewith and overlying and in contact with said end of said wire where the wire diverges from the coil into said curve, said coil and said integral end consisting of fine wire of less than number 32 Brown and Sharpe gage.

12. A connection between the vibratorally mounted wire voice coil of a loud-speaker and a fixed terminal comprising an end on said coil extending in a curve from the coil and secured to the terminal, and an annular mass of soft springable material mounted in fixed relation to said coil to vibrate therewith and overlying and in contact with said end of said wire where the wire diverges from the coil into said curve, said coil and said end consisting of fine wire of less than number 32 Brown and Sharpe gage.

13. A connection between the vibratorally mounted wire voice coil of a loud-speaker and a fixed terminal comprising an end on said coil extending in a curve from the coil and secured to the terminal, and a mass of soft springable material mounted in fixed relation to said coil to vibrate therewith and yieldably supporting the concave side of the curve in said end of said wire where the wire diverges from the coil into said curve, said coil and said end consisting of fine wire.

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