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(54) Loudspeaker.

(57) A magnetic gap-less loudspeaker of a high performance which has a good quality of a voice coil and provides easy wiring between tinsel wires and the voice coil. In the magnetic gap-less loudspeaker, two magnets (M1, M2) magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein a reinforced paper 1B or bobbin material 1A1 is attached to at least a partial area of the outer surface of the voice coil. Conductive areas 1C are provided to the reinforced paper or bobbin material to which areas coil lead wires or tinsel wires are connected.

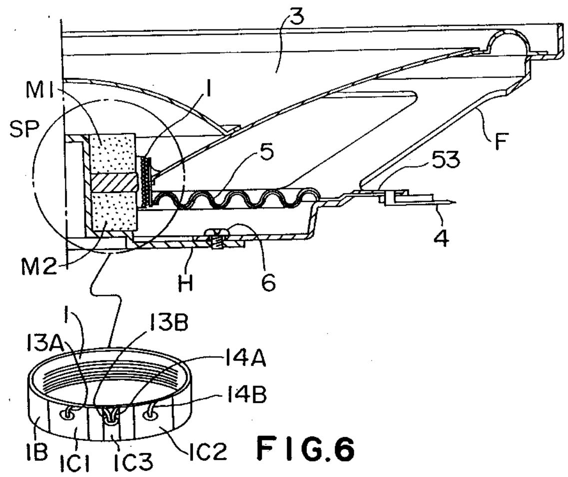

FIG.6

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a loudspeaker, and more particularly to a magnetic gap-less loudspeaker in which two magnets magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets.

Related Background Art

As shown in Fig.1, a conventional loudspeaker has a magnetic circuit constituted by a yoke Y, a magnet M, and a top plate TP. A voice coil 1 is disposed between the york Y and top plate TP or between the outer circumference of a yoke pole YP and the inner circumference of the top plate TP. The voice coil 1 is wound about a tubular bobbin 1A which drives a diaphragm 3 made of cone paper or the like.

It is well known that tinsel cords 2 are connected to coil lead wires 11 and 12 by solder to form wirings through which a voice signal is inputted to the voice coil 1. There are three main wiring types. In the first type, as shown in Fig.1, the coil lead wires 11 and 12 extending from the coil winding start point 13 and end point 14 are cut to have a predetermined length necessary for wiring, and pulled up along the outer wall of the bobbin 1A near to the upper end of the bobbin 1A. The pulled-up lead wires are fixed to the outer wall of the bobbin 1A by a reinforced paper 1B or the like. The end portions of the coil lead wires 11 and 12 extending out of the reinforced paper 1B are subjected to terminal processing, namely the insulating layers of the end portions of the coil lead wires 11 and 12 are removed to expose the inner conductive wires which are coated by solder.

In assembling the voice coil to a loudspeaker, the coil lead wires 11 and 12 are led along the surface of the diaphragm 3 near to holes 31 or eyelets. The end portions 21 of the tinsel wires 2 inserted into the holes 31 are soldered to the coil lead wires 11 and 12 at the solder coated portions thereof. The soldered regions and the coil lead wires on the surface of the diaphragm 3 are fixed by adhesive agent A or the like. The other ends 22 of the tinsel wires 2 are connected to input lug terminals 4.

In the second type shown in Fig.2, similar to the first type, the coil lead wires 11 and 12 extending from the coil winding start point 13 and end point 14 are pulled up along the outer wall of the bobbin 1A near to the central area of the bobbin 1A. The pulled-up lead wires are fixed to the outer wall of the bobbin 1A by a reinforced paper 1B or the like. The end portions of the coil lead wires 11 and 12 extending out of the reinforced paper 1B are subjected to terminal processing. The coil lead wires 11 and 12 are set to predetermined positions on the outer wall of the bobbin 1A, and soldered to one ends 21 of the tinsel wires 2 cut to have a predetermined length. The soldered regions are fixed by adhesive agent A or the like. In assembling the voice coil to a loudspeaker, the other ends 22 of the tinsel wires 2 are connected to the input lug terminals 4.

In the third type loudspeaker wiring which the present inventor has proposed, as shown in Fig.3, conductive areas 1C made of copper foil of the like are provided on the outer wall of a bobbin 1A. The coil winding start point 13 and end point 14, or the coil lead wires 11 and 12, are soldered to the conductive areas 1C. Flat tinsel wires 2H are sewed to a corrugation 51 of a damper 5. In assembling the voice coil 1 and damper 5 to a loudspeaker, the ends 2H1 of the flat tinsel wires 2H on the damper inner circumference 52 are soldered to the conductive areas 1C on the outer wall of the bobbin 1A, and the other ends 2H2 of the flat tinsel wires 2H extending to a tongue 53 at the outer periphery of the damper are soldered to the input lug terminals 4.

A magnetic gap-less loudspeaker has bee proposed wherein two magnets magnetized in the thickness direction are disposed with the same poles being faced each other, and a voice coil is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets. The present inventor has also proposed a loudspeaker shown in Fig.4.

In the loudspeaker shown in Fig.4, two magnets M1 and M2 magnetized in the thickness direction are disposed with the same poles being faced each other, and a center plate SP is sandwiched between the two magnets M1 and M2. The repulsion magnetic fluxes are converged into the center plate SP and radiated outward from the outer circumferential area of the center plate SP. A voice coil 1 is disposed in the magnetic field generated by the radiated repulsion magnetic fluxes. This loudspeaker has no magnetic gap G such as shown in Figs.1 to 3 and is a so-called magnetic gap-less loudspeaker. This loudspeaker can also be called a direct driven type loudspeaker because the neck 32 of the cone diaphragm 3 and a suspension such as the inner periphery 52 of a damper 5 can be directly coupled to the outer surface of the voice coil 1.

With the direct driven type loudspeaker described above, however, connection between coil lead wires and tinsel wires is difficult if the conventional wiring structure is adopted.

Specifically, a conventional voice coil 1 such as shown in Figs.1 to 3 is wound about a bobbin 1A which is made of a rectangular bobbin member mounted on the outer wall of a jig having a predetermined diameter. The structural feature of the direct driven type loudspeaker is that it does not require a coil bobbin 1A because the neck 32 of the cone diaphragm 3 is directly coupled to the outer surface of the voice coil 1, and that even if a bobbin 1A is used, the width of this bobbin 1A is sufficient if it has a minimum width for winding the voice coil 1.

This structural feature enables the vibration transmission path to shorten and enables the voice coil to reduce its weight, thereby realizing a high performance of a loudspeaker. The bobbin 1A has a function of vibration transmission as well as other functions. For example, the coil lead wires 11 and 12 can be fixed to the outer wall of the bobbin 1A so that the winding start point 13 and end point 14 of the coil can be prevented from being peeled off from the outer wall of the bobbin 1A during assembling the voice coil to a loudspeaker or during transportation.

Accordingly, if a bobbin-less structure is used together with a conventional coil structure, the voice coil 1 is likely to be peeled off, lowering the product quality. If a bobbin 1A is used, a bobbin member having an area sufficient for fixing the coil lead wires 11 and 12 is required, having the above-described structural feature.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a direct driven type loudspeaker which has a high performance and a product quality same as a voice coil of a conventional loudspeaker with a magnetic gap and provides easy wiring between tinsel wires and voice coil by the number of processes comparative to the number of processes of a conventional technique.

In order to achieve the above object, according to one aspect of the present invention, there is provided a magnetic gap-less loudspeaker of the type that two magnets magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein a reinforced paper or bobbin material is attached to at least a partial area of the outer surface of the voice coil.

In this case, the voice coil is not required to have a bobbin, and the bobbin material may be formed by injection molding of heat resistant resin, or the voice coil may be subjected to insert molding with the bobbin material.

According to a second aspect of the present invention, there is provided the magnetic gap-less loudspeaker wherein coil lead wires of a coil wire of the voice coil are crawled on the outer surface of the voice coil and covered with a reinforced paper to fix the coil lead wires to the outer surface of the voice coil.

In this case, conductive areas made of copper foil or the like are attached to the bobbin material or reinforced paper, and coil lead wires of the voice coil and input tinsel wires are connected to the conductive areas.

According to a third aspect of the present invention, there is provided the magnetic gap-less loudspeaker wherein at least a pair of conductive areas or more made of rectangular copper foil are attached to the outer surface of the voice coil, and coil lead wires of the voice coil and tinsel wires are connected to the conductive areas.

According to a fourth aspect of the present invention, there is provided the magnetic gap-less loudspeaker wherein coil lead wires are connected to tinsel wires, and the connection areas are fixed by adhesive agent or the like to the outer surface of the voice coil.

According to a fifth aspect of the present invention, there is provided the magnetic gap-less loudspeaker wherein conductive areas made of copper foil or the like are attached to a skirt of the voice coil extending from the lower end of the voice coil to the lower end of a coil bobbin, and the coil lead wires and tinsel wires are connected to the conductive areas.

In assembling a voice coil to a magnetic gap-less loudspeaker, bobbin material is attached to at least a partial area of the outer surface of the voice coil, and support members such as a diaphragm and a suspension for supporting the voice coil are connected to the bobbin material. In this case, the voice coil is not required to have a bobbin, and the bobbin material may be formed through injection molding of heat resistant resin, or the voice coil may be subjected to insert molding with the bobbin material.

For the wiring structure, coil lead wires of a coil wire of the voice coil may be crawled on the outer surface of the voice coil and covered with a reinforced paper to fix the coil lead wires to the outer surface of the voice coil. Conductive areas made of copper foil or the like may be attached to the bobbin material or reinforced paper, and coil lead wires of the voice coil and input tinsel wires are connected to the conductive areas.

Instead of the bobbin material or reinforced paper, at least a pair of conductive areas or more made of rectangular copper foil may be directly attached to the outer surface of the voice coil, and coil lead wires of the voice coil are connected to the conductive areas.

Alternatively, coil lead wires may be connected to tinsel wires, and the connection areas are fixed by adhesive agent or the like to the outer surface of the voice coil. Conductive areas made of copper foil or the like may be attached to a skirt of the voice coil extending from the lower end of the voice coil to the lower end of a coil bobbin, and the coil lead wires and tinsel wires are connected to the conductive areas.

With the voice coil structure constructed as above, the number of voice coil manufacturing steps is generally the same as the number of conventional steps. The quality of the voice coil can be made comparative with conventional coils. The number of wiring processes between tinsel wires and voice coil lead wires is generally the same as the number of conventional steps. Accordingly, the assembly and wiring of a magnetic gap-less loudspeaker become easy, maintaining a high performance of the loudspeaker.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a cross sectional view showing the structure of a conventional loudspeaker.

Fig.2 is a cross sectional view showing the structure of another conventional loudspeaker.

Fig.3 is a cross sectional view showing the structure of another conventional loudspeaker.

Fig.4 is a cross sectional view showing the overall structure of a magnetic gap-less loudspeaker.

Fig.5 is a cross sectional view showing the structure of a voice coil of a loudspeaker according to a first embodiment of the present invention.

Fig.6 is a cross sectional view showing the overall structure of the loudspeaker of the first embodiment.

Fig.7 is a perspective view showing the main part of another structure of the first embodiment.

Fig.8 is a perspective view showing another structure of the voice coil of the first embodiment.

Fig.9 is a cross sectional view showing another structure of the voice coil of the first embodiment.

Fig.10 is a fragmental, perspective view showing the structure of the voice coil shown in Fig.9.

Fig.11 is a diagram showing assembly of the magnetic circuit of the first embodiment.

Fig.12 is a cross sectional view showing the structure of a voice coil of a loudspeaker according to a second embodiment of the present invention.

Fig.13 is a cross sectional view showing the overall structure of the loudspeaker of the second embodiment.

Fig.14 is a cross sectional view showing the overall structure of a loudspeaker according to a third embodiment of the present invention.

Fig.15 is a perspective view showing another structure of the voice coil of the third embodiment.

Fig.16 is a cross sectional view showing another structure of the loudspeaker of the third embodiment.

Fig.17 is a cross sectional view showing the overall structure of a loudspeaker according to a fourth embodiment of the present invention.

Fig.18 is a perspective view showing the main part of the embodiment of Fig.17.

Fig.19 is a cross sectional view showing another structure of the loudspeaker of the fourth embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the loudspeaker according to the present invention will be described with reference to Figs.5 to 19.

In the first embodiment shown in Fig.5, a voice coil 1 has a d.c. resistance of about 5.4 ohms and an inner diameter of 35.5 mm, and is formed by winding an aluminum wire 15 and a conductive wire 16 in parallel. The aluminum wire 15 has a diameter of 0.19 mm. The conductive wire (hereinafter called an iron core wire) 16 has a magnetic material core 16A such as iron and a conductive material surface layer 16B such as copper melted and attached to the surface of the core 16A. The iron core wire 16 has a conductivity of about 60 % of a copper wire because the iron core wire 16A increases the resistance and lowers the conductivity. The wire 16 is formed by wiredrawing to a diameter of 0.19 mm, and is coated with an insulating film over the surface thereof. This voice coil 1 has no bobbin so as to reduce the weight. In order to prevent the winding start points 13 and end points 14 from being peeled off from the surface of the voice coil, about two turns of the coil is wound on the third winding layer near at the winding end points 14. This particular structure for preventing peel-off is omitted in other Figures to simplify the drawings.

As shown in Fig.6, a reinforced paper 1B (in this embodiment, a craft paper having a width of about 11 mm, a length of 50 mm, and a thickness of 0.05 mm) is attached to the outer circumferential surface of the voice coil 1, and a pair of copper foils 1C1 and 1C2 having a width of 9 mm, a length of 11 mm, and a thickness of 0.01 mm is attached to the reinforced paper 1b. Another copper foil 1C3 having a width of 4 mm and a length of 11 mm is attached to the craft paper 1B between the pair of copper foils. The insulating layers near at the coil start and end points 13 and 14 are removed. Thereafter, the winding start point 13A of the aluminum wire 15 is soldered to the copper foil 1C1, the winding start point 13B of the iron core wire 16 is soldered to the copper foil 1C3, the winding end point 14A of the aluminum wire is soldered to the copper foil 1C3, and the winding end point 14B of the iron core wire is soldered to the copper foil 1C2.

In this embodiment, from the viewpoint of coil impedance, two wires are serially connected via the copper foil 1C3. The two wires may be connected in parallel depending on the coil specification without using the center copper foil as shown in Fig.7. Also in this embodiment, although the copper foils 1C are attached to the surface of the craft paper, if for example the insulating strength is not required so much, they may be directly attached to the outer circumferential surface of the coil 1 as shown in Fig.8 because the coil 1 itself has a coated insulating film, or they may be coated with an insulating film such as phenol film on the side to be attached to the coil 1. In order to increase the insulating strength, as the reinforced paper 1B, a material having a higher insulating strength such as an insulating film may also be used.

If there is no limit in the weight of the voice coil 1 and it is important to increase the mechanical strength of it, a bobbin frame 1A1 may be used as shown in Fig.9. This bobbin frame 1A1 may be formed by injection molding of heat resistive resin and attached to the outer circumferential surface of the voice coil 1, or may be formed by insert-molding with the voice coil. The conductive areas 1C such as copper foils are attached to the bobbin frame 1A1. In this case, a step 1A2 for supporting the diaphragm 3 and a step 1A3 for supporting the damper 5 or the like may be formed on the outer wall of the bobbin frame 1A1.

For the connection between coil wires and the conductive areas 1C by using the bobbin frame 1A1, a recess 1A3 is formed in the bobbin frame 1A1 at the position corresponding to the conductive areas as shown in Fig.10. The ends of the coil wires can be therefore led via this recess 1A3 to the conductive areas 1C. Although not shown in Fig.10, instead of the recess 1A3, a hole or the like may be formed in the bobbin frame 1A1. If the mechanical strength is required to be further increased, a conventional bobbin 1A may be used on the inner side of the voice coil 1.

The voice coil 1 is thereafter coupled to a magnetic circuit of the embodiment having the structure shown in Fig.11. Specifically, two magnets M1 and M2 are used which are neodymium magnets of a ring shape having an outer diameter of 34 mm, an inner diameter of 12 mm, and a thickness of 9 mm. The magnets M1 and M2 are magnetized in the width direction. The magnets M1 and M2 and a center plate SP are supported by an aluminum holder H shown in Fig.11. A tubular center guide H1 is formed rising upright from the center of the bottom of the holder H. A step H2 is formed at the lower end of the center guide H1 for the position alignment of the magnets M1 and M2 and center plate SP.

After coating acrylic adhesive agent onto the surface of the step H2, the inner diameter portion M21 of the magnet M2 is fitted around the center guide H1, by directing the N pole upward. This can be done easily because the outer diameter of the center guide H1 has been worked to 11.95 mm. After coating adhesive agent onto the upper surface of the magnet M2, the inner diameter portion SP1 of the center plate SP is forcibly fitted around the center guide H1. The center plate SP is made of an iron ring having an outer diameter of 34.80 mm, an inner diameter of 11.95 mm, and a thickness of 6 mm. The inner and outer circumferential ridges of the center plate SP has been chamfered to C0.4. In this embodiment, although the outer diameter of the center plate is set to the above-described value, this may be changed depending upon a conversion efficiency and clogging phenomenon during coil vibration.

After the center plate Sp is pushed down to the N pole surface of the magnet M2 and adhesive agent is coated onto the upper surface of the center plate SP, the inner diameter portion M11 of the magnet M1 is fitted around the center guide H1 and the magnet M1 is pushed down to the upper surface of the center plate SP, by directing the N pole downward. In this manner, the magnets M1 and M2 are set in position with the same poles N being faced each other, and the center plate SP is sandwiched between the magnets M1 and M2 with the outer circumference SP2 of the center plate SP extending outward by about 0.4 mm from the outer circumferences M12 and M22 of the magnets M1 and M2.

The magnetic circuit is then mounted on the frame F by fixing its holder H to the frame F (refer to Fig.6). The holder H has a flange H3 having a width of about 2 mm and a thickness of 2.5 mm. The flange H3 has four mounts H4 at an interval of 90 degrees. Each mount H4 has a tapped hole H5 having a diameter of 4 mm. After coating rubber based adhesive agent onto the flange H3, the bottom of the frame F is attached thereto and four screws 6 having a diameter of 4 mm are threaded into the tapped holes H5 via mount holes having a diameter of 4.5 mm and formed in the bottom of the frame F at the positions corresponding to the tapped holes H5, to thus fixing the magnetic circuit to the frame F.

As shown in Fig.7, the damper 5 is coupled to the voice coil 1 set near the magnetic circuit. The damper 5 used is a general damper in which thermosetting resin such as phenol is impregnated into cotton fabric or the like, and the cotton fabric is thermally molded to form a corrugation 51 and the like. The corrugation 51 is provided with conductive areas which the present inventor has proposed. Specifically, tinsel wires 2H knitted in a flat shape (hereinafter called flat tinsel wires) are sewed in parallel in the radial direction to the corrugation 51 of the damper 5. The space between the flat tinsel wires 2H corresponds to the space between the conductive areas 1C formed on the outer surface of the voice coil 1.

As shown in Fig.7, the inner circumference 52 of the damper 5 is fitted around the outer surface of the voice coil 1 by aligning the conductive areas 1C on the outer surface of the voice coil 1 with the ends 2H1 of the flat tinsel wires 2H1 at the inner circumference 52. The conductive areas 1C and the ends of the flat tinsel wires 2H1 are then soldered together. Adhesive agent is coated onto the contact area between the outer surface of the voice coil 1 and the inner circumference 52 of the damper 5 to fix the contact area. The adhesive agent is also coated onto the surface of the soldered areas. The neck 32 of the cone diaphragm 3 coated with adhesive agent is fixed to the voice coil 1. In the above manner, a loudspeaker sufficient for practical use is completed.

In the second embodiment shown in Fig.12, a voice coil 1 having a d.c. resistance of about 5.4 ohms is formed by winding only an aluminum wire having a conductive core diameter of 0.19 mm. The coil lead wires 13 and 14 extending from the coil winding start and end points are pulled up along the outer surface of the voice coil 1. The pulled-up lead wires are covered with a reinforced paper 1B to fix it to the voice coil 1. The end portions of the coil lead wires 11 and 12 extending out of the reinforced paper 1B are subjected to terminal processing. Similar to the conventional example, the insulating layers of the coil lead wires are removed and solder is coated on the cores. The magnetic circuit and other components are the same as the first embodiment.

This voice coil 1 is wired in generally the same method as the first embodiment. Specifically, as shown in Fig.13, the inner circumference 52 of the damper 5 is fitted around the outer surface of the voice coil 1. After coating adhesive agent onto the inner circumference 52 and the coil outer surface, they are attached together. Thereafter, the neck 32 of the cone diaphragm 3 is fitted around the outer surface of the voice coil 1 by aligning the coil lead wires 11 and 12 with holes 31 or eyelets formed in the diaphragm 3. The ends of the coil lead wires 11 and 12 are pulled up along the surface of the diaphragm 3 to the holes 31 or eyelets.

The ends 21 of tinsel wires 2 are inserted into the holes 31 or eyelets and soldered to the solder-coated ends of the coil lead wires 11 and 12. The neck 32 is coated with adhesive agent A to attach the diaphragm 3 to the voice coil 1. The soldered area and the area of the coil lead wires 11 and 12 on the surface of the diaphragm 3 are also coated with adhesive agent A to fix them. The other ends 22 of the tinsel wires 2 having a suitable play in wiring are soldered to input lug terminals 4, to thus complete a loudspeaker sufficient for practical use.

In the third embodiment, the voice coil 1 shown in Fig.1 having a d.c. resistance of about 5.4 ohms and formed by winding an aluminum wire and an iron core wire having a conductive core diameter of 0.19 mm with the conductive areas 1C of the first embodiment attached to the surface of the voice coil 1, or the voice coil 1 having a d.c. resistance of about 5.4 ohms and formed by winding only an aluminum wire having a conductive core diameter of 0.19 mm with the conductive areas 1C shown in Fig.14 attached to the surface of the voice coil 1, may be used. In this case, the ends of the tinsel wires may be directly coupled to the conductive areas 1C.

A voice coil 1 not using the conductive areas 1C such as shown in Fig.15 may also be used. In this example, the coil lead wires extending from the coil winding start and end points are pulled up along the surface of the voice coil. The pulled-up areas are covered with a reinforced paper 1B to fix the coil lead wires to the surface of the voice coil. The ends 13 and 14 of the coil lead wires are soldered to the tinsel wires, the soldered areas being fixed by adhesive agent A. The magnetic circuit and other components are the same as the first embodiment. In this embodiment, the pulled-up areas are covered with the reinforced paper 1B. Instead, the pulled-up areas may be fixed by adhesive agent.

In this embodiment, as shown in Fig.14, the inner circumference 52 of the damper 5 is fitted around the outer surface of the voice coil 1. After coating adhesive agent A onto the inner circumference 52 and the coil outer surface, they are attached together. Thereafter, the neck 32 of the cone diaphragm 3 is fitted around the outer surface of the voice coil 1 by aligning the tinsel wires 2 with holes 31 formed in the diaphragm 3 at predetermined positions. The ends of the coil lead wires 11 and 12 are pulled up along the surface of the diaphragm 3 from the neck 32 to the holes 31.

The ends 22 of the tinsel wires 2 are inserted into the holes 31 and to the back side of the diaphragm 3. The ends 22 of the tinsel wires 2 made to have a suitable play in wiring are soldered to input lug terminals 4. The neck 32 is coated with adhesive agent A to attach the diaphragm 3 to the voice coil 1. The area of the tinsel wires on the surface of the diaphragm 3 is coated with adhesive agent A to fix them together, to thus complete a loudspeaker sufficient for practical use.

In this embodiment, the tinsel wires 2 are positioned and wired in the above manner. As shown in Fig.16, if the winding width of the voice coil 1 is large, the tinsel wires 2 may be positioned at intermediate areas between the back wall of the neck 32 and the inner circumference of the damper 52. In this case, wiring similar to the conventional example shown in Fig.2 is possible.

In the fourth embodiment shown in Fig.17, depending upon the specification of a voice coil 1 and the performance of a loudspeaker, a bobbin 1A may be used and the conductive areas 1C may be formed on the so-called skirt of the bobbin 1A from the lowest turn of the voice coil 1 to the bottom of the bobbin 1A.

Also in this case, as shown in Fig.17, the conductive areas 1C are connected to flat tinsel wires 2H at the inner circumference of the damper 5.

The tinsel wires 2 may be connected to the conductive areas 1C in the manner shown in Fig.19. Since the embodiment loudspeaker has no magnetic gap, holes H6 may be formed in the bottom of the holder H as shown in Fig.19 to insert the ends 21 of the tinsel wires 2 into the holes and to lead them to input lug terminals 4 for soldering. In this case, it is not necessary to use expensive flat tinsel wires 2H sewed to the surface of the damper 5, thereby reducing manufacturing cost. It is also unnecessary to lead the coil lead wires along the upper surface of the diaphragm 3 and adhere them to it, reducing the number of manufacturing steps and lowering manufacturing cost.

According to the present invention, coil lead wires are pulled up along the outer surface of the voice coil and fixed to the outer surface by using a reinforced paper, or conductive areas made of copper foil or the like are attached to the outer surface of the voice coil. Accordingly, it is not necessary to use a bobbin, or it is possible to reduce the amount of coil bobbin material considerably if a bobbin is used, thereby providing an easy to assemble, and high performance magnetic gap-less loudspeaker.

The quality of a voice coil is comparative to conventional coils, and the number of wiring steps does not exceed the conventional number of wiring steps while providing very easy wiring processes. It is easy to reinforce a voice coil by attaching conventional bobbin material such as craft paper and resin film to the outer surface of the voice coil. Accordingly, the resonance frequency of the voice coil can be set easily, thus improving the performance and voice quality of the loudspeaker.

In general, a rolling phenomenon of a voice coil can be prevented efficiently by suspending the upper and lower ends of the voice coil. According to the present invention, the lower end portion of a voice coil can be suspended by tinsel wires which are connected to the conductive areas formed on the skirt of the bobbin, and the upper end portion can be suspended by connecting the neck of the cone diaphragm to it. Accordingly, the rolling phenomenon of the voice coil can be efficiently prevented and a simple loudspeaker structure with very simple wiring can be realized.

Claims

1. A magnetic gap-less loudspeaker of the type that two magnets (M1, M2) magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein a reinforced paper (1B) or bobbin material (1A1) is attached to at least a partial area of the outer surface of said voice coil.

2. A magnetic gap-less loudspeaker according to claim 1, wherein said voice coil (1) has no bobbin.

3. A magnetic gap-less loudspeaker according to claim 1, wherein said bobbin material (1A1) is formed through injection molding of heat resistant resin, and said voice coil (1) is insert-molded with said bobbin material or attached to said bobbin material.

4. A magnetic gap-less loudspeaker of the type that two magnets (M1, M2) magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein coil lead wires of a coil wire of said voice coil (1) are crawled on the outer surface of said voice coil and covered with a reinforced paper (1B) to fix said coil lead wires to the outer surface of said voice coil.

5. A magnetic gap-less loudspeaker according to claim 1 or 4 wherein conductive areas (1C) made of copper foil or the like are attached to said bobbin material (1A1) or said reinforced paper (1B).

6. A magnetic gap-less loudspeaker of the type that two magnets (M1, M2) magnetized in the

thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein at least a pair of conductive areas or more made of rectangular copper foil are attached to the outer surface of said voice coil, and coil lead wires (11, 12) of said voice coil are connected to said conductive areas.

7. A magnetic gap-less loudspeaker according to claim 6, wherein input tinsel wires (2) are connected to said conductive areas.

8. A magnetic gap-less loudspeaker of the type that two magnets (M1, M2) magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein coil lead wires (11, 12) are connected to tinsel wires (2), and the connection areas are fixed by adhesive agent or the like to the outer surface of said voice coil.

9. A magnetic gap-less loudspeaker of the type that two magnets (M1, M2) magnetized in the thickness direction are disposed with the same poles being faced each other and a voice coil (1) is disposed in a magnetic field generated by repulsion magnetic fluxes near at the outer circumferential areas of the magnets, wherein conductive areas (1C) made of copper foil or the like are attached to a skirt of said voice coil (1) extending from the lower end of said voice coil to the lower end of a coil bobbin, and input tinsel wires (2) are connected to said conductive areas.

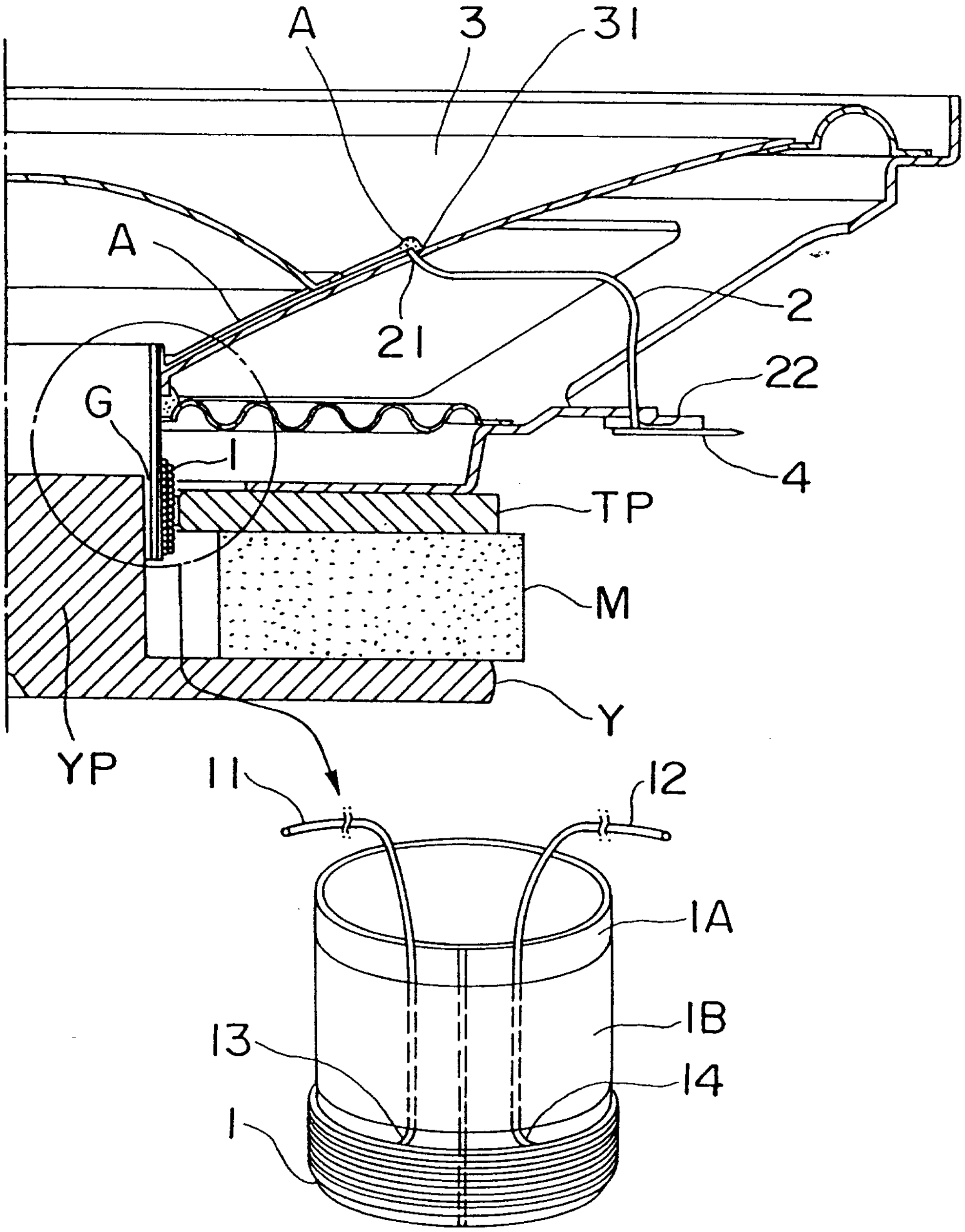
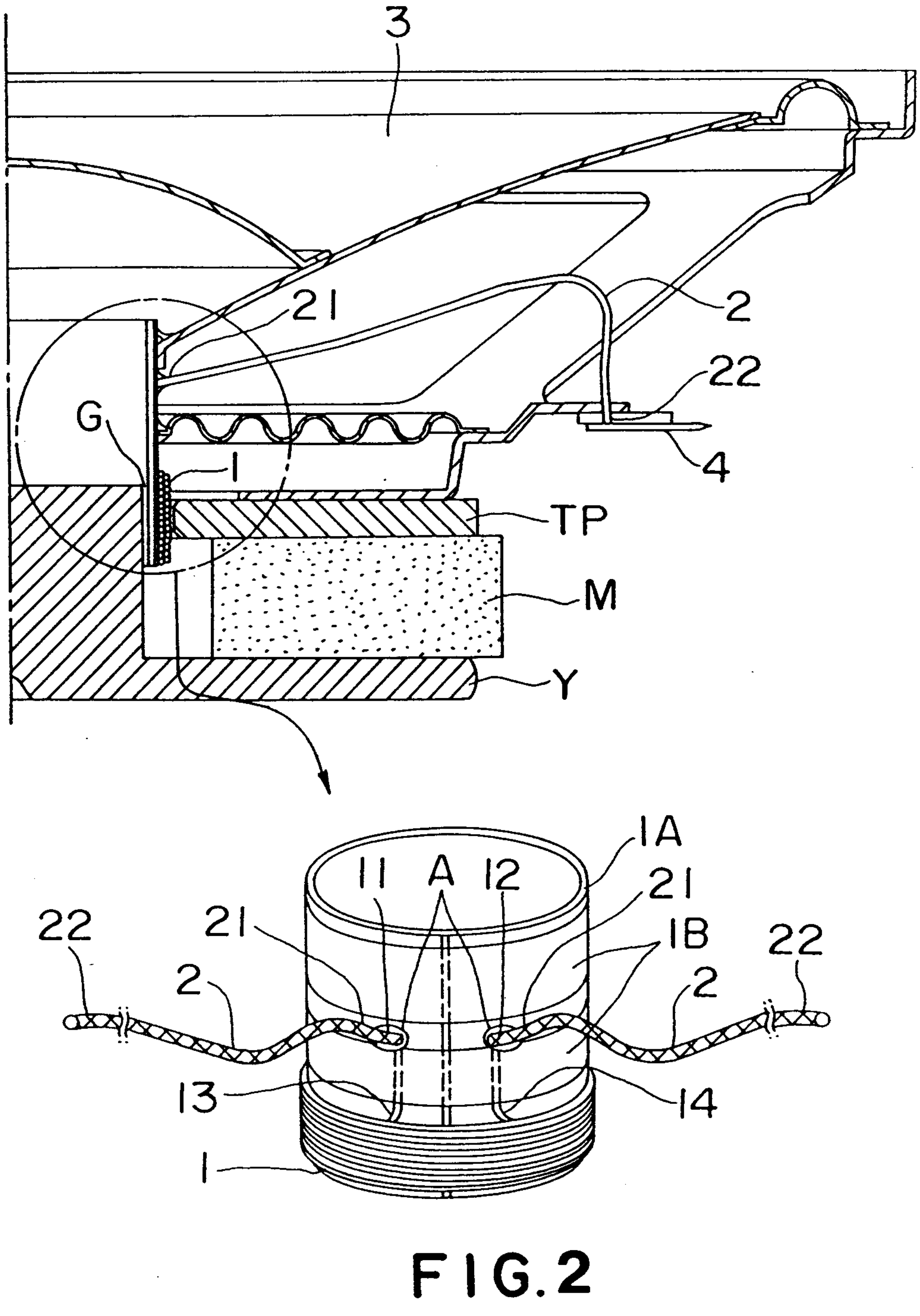


FIG.1



F I G. 2

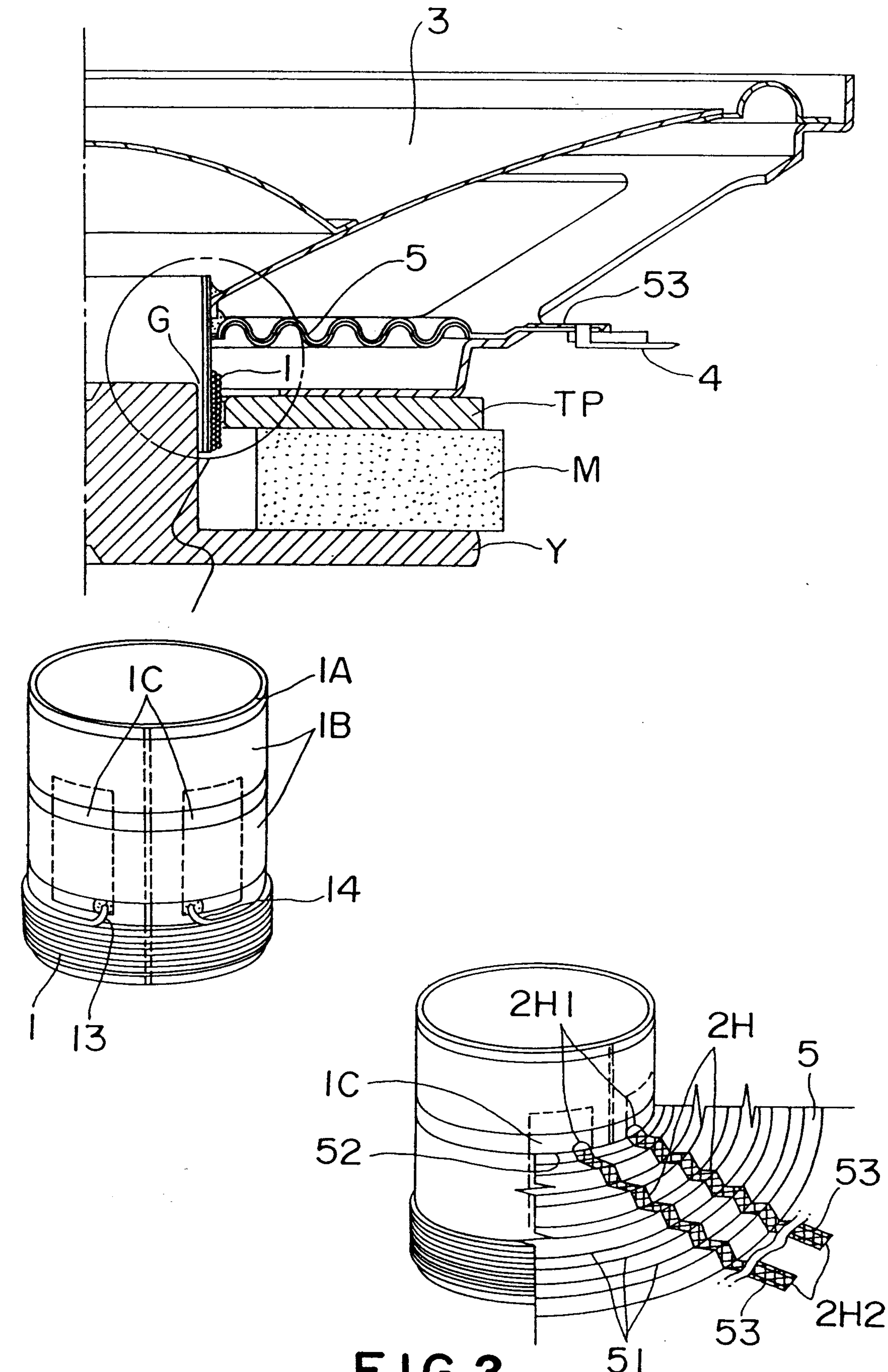
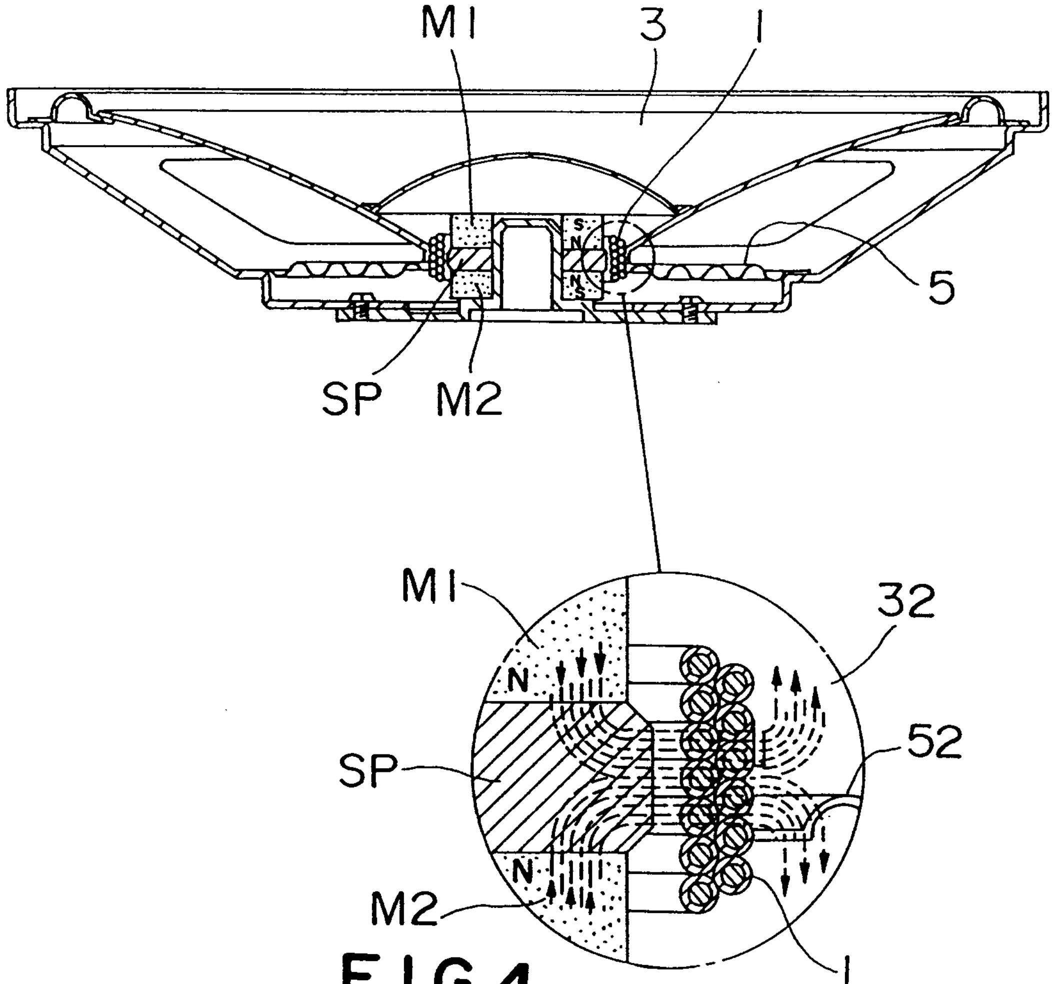
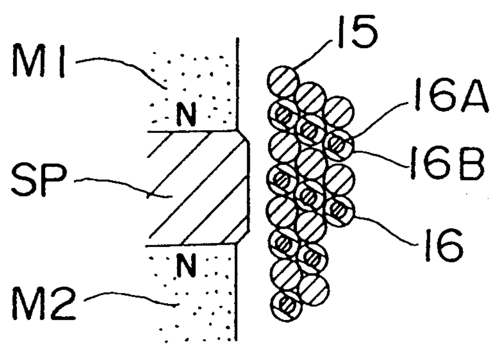


FIG.3



F I G.4



F I G.5

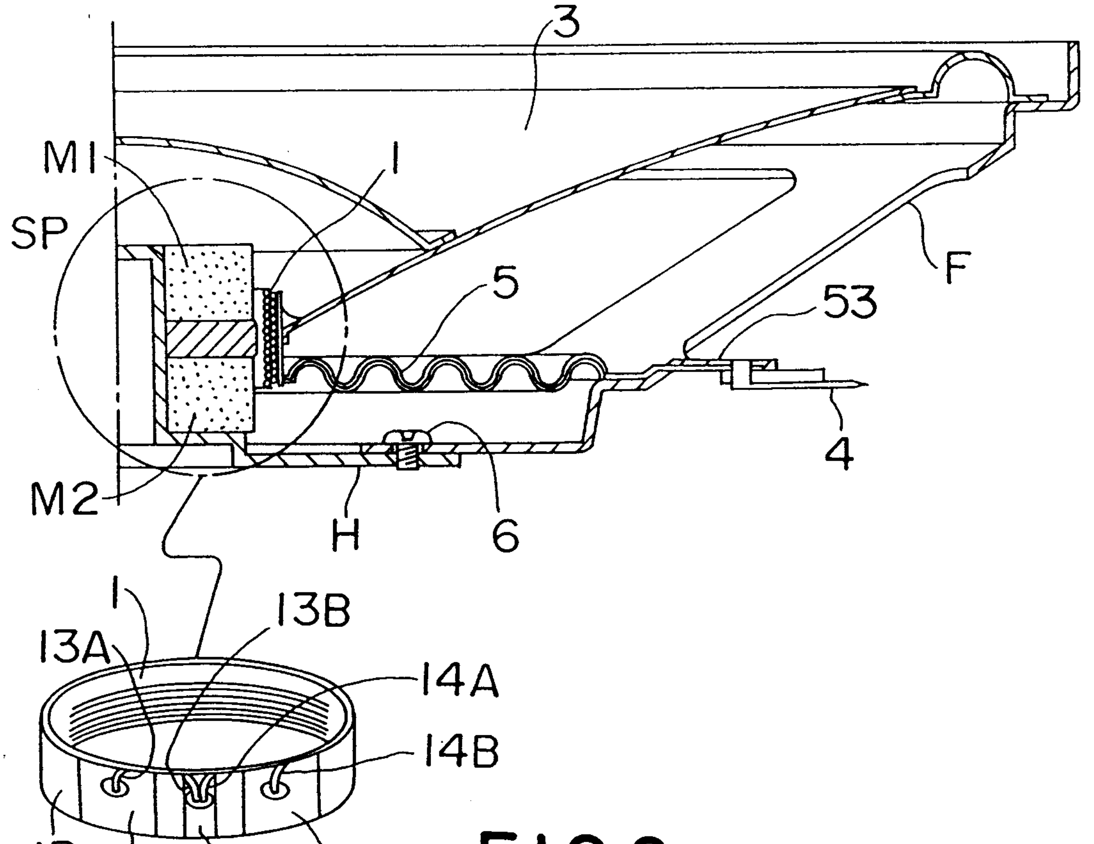


FIG.6

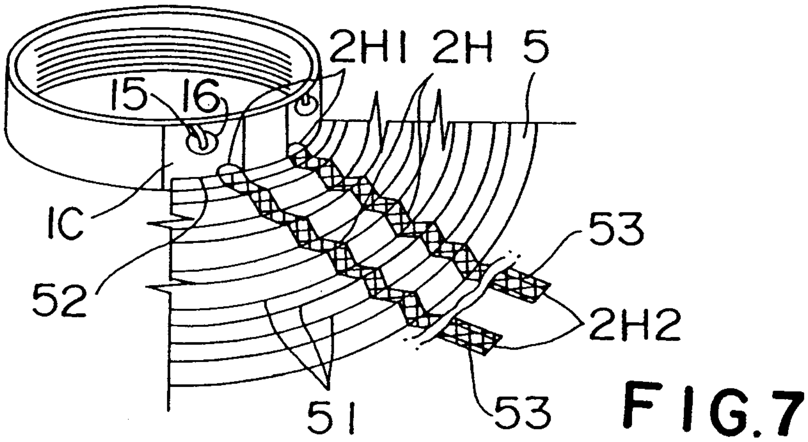


FIG.7

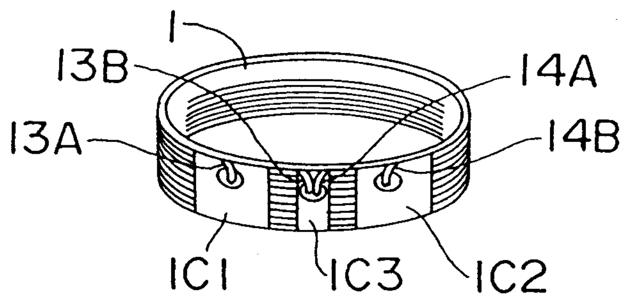


FIG.8

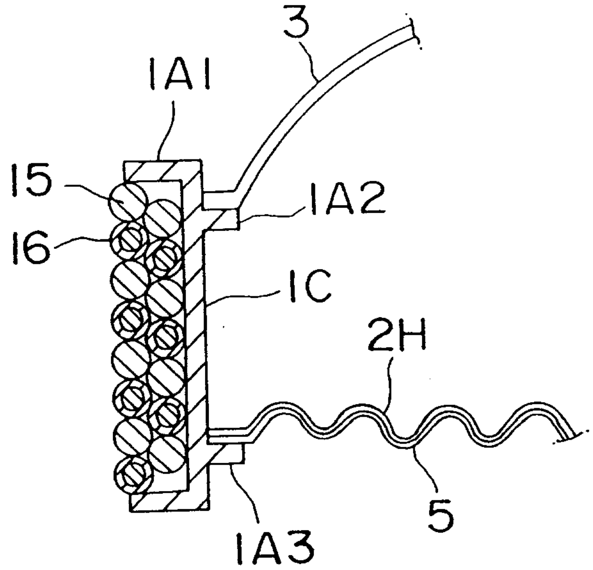


FIG.9

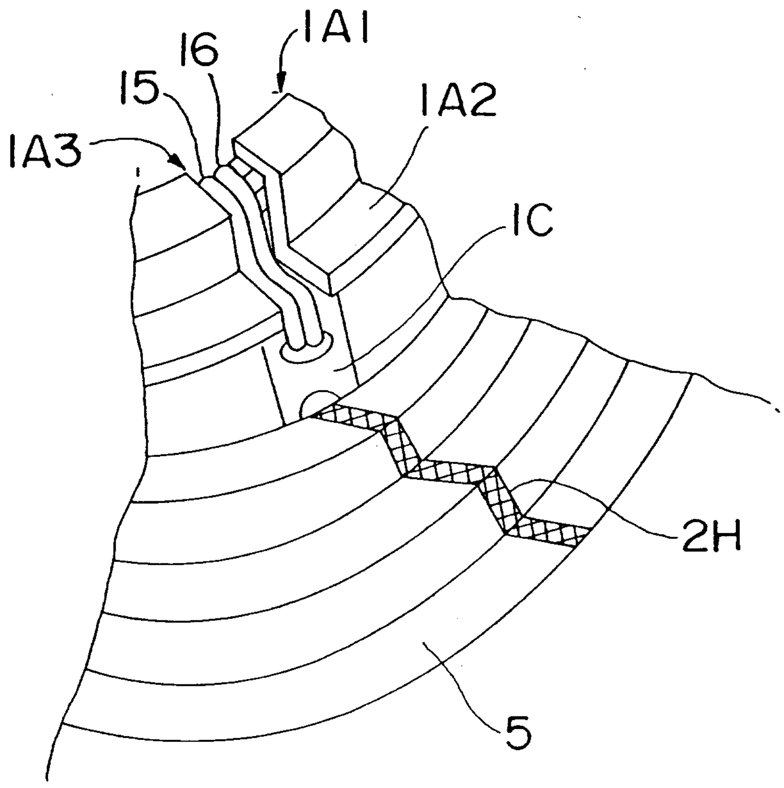
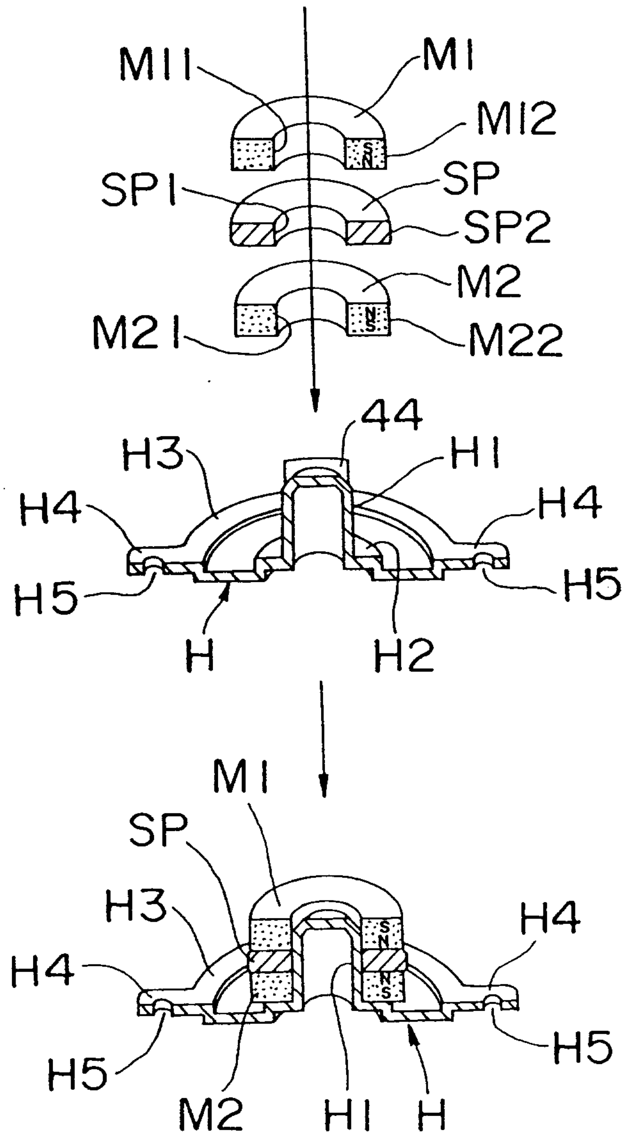


FIG.10


M11
M1
M12
SP1
SP
SP2
M2
M21
M22
44
H3
H1
H4
H4
H5
H5
H
H2
M1
SP
H3
H4
H4
H5
H5
M2
H1
H

F I G.11

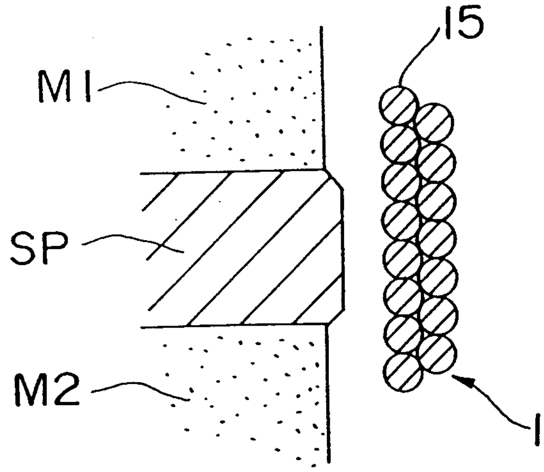


FIG.12

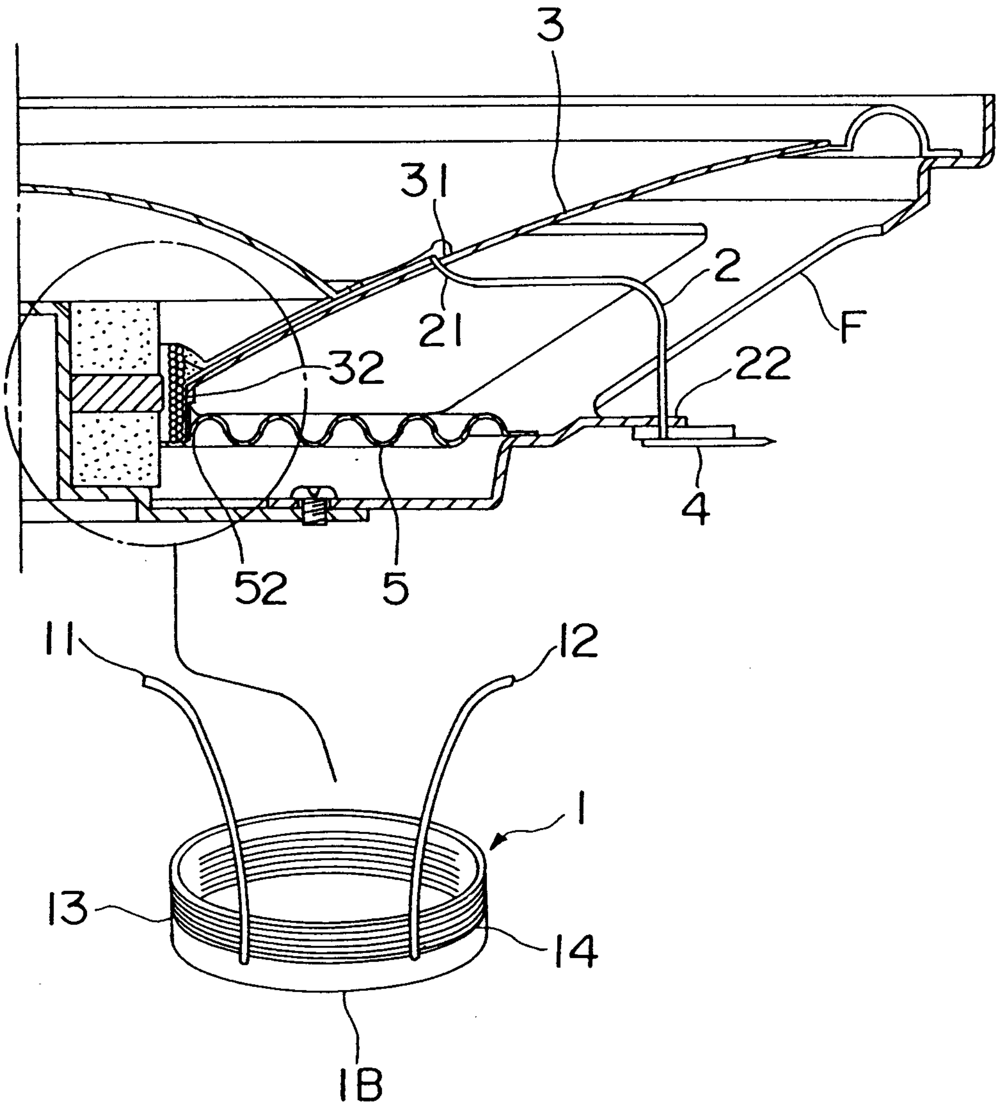


FIG.13

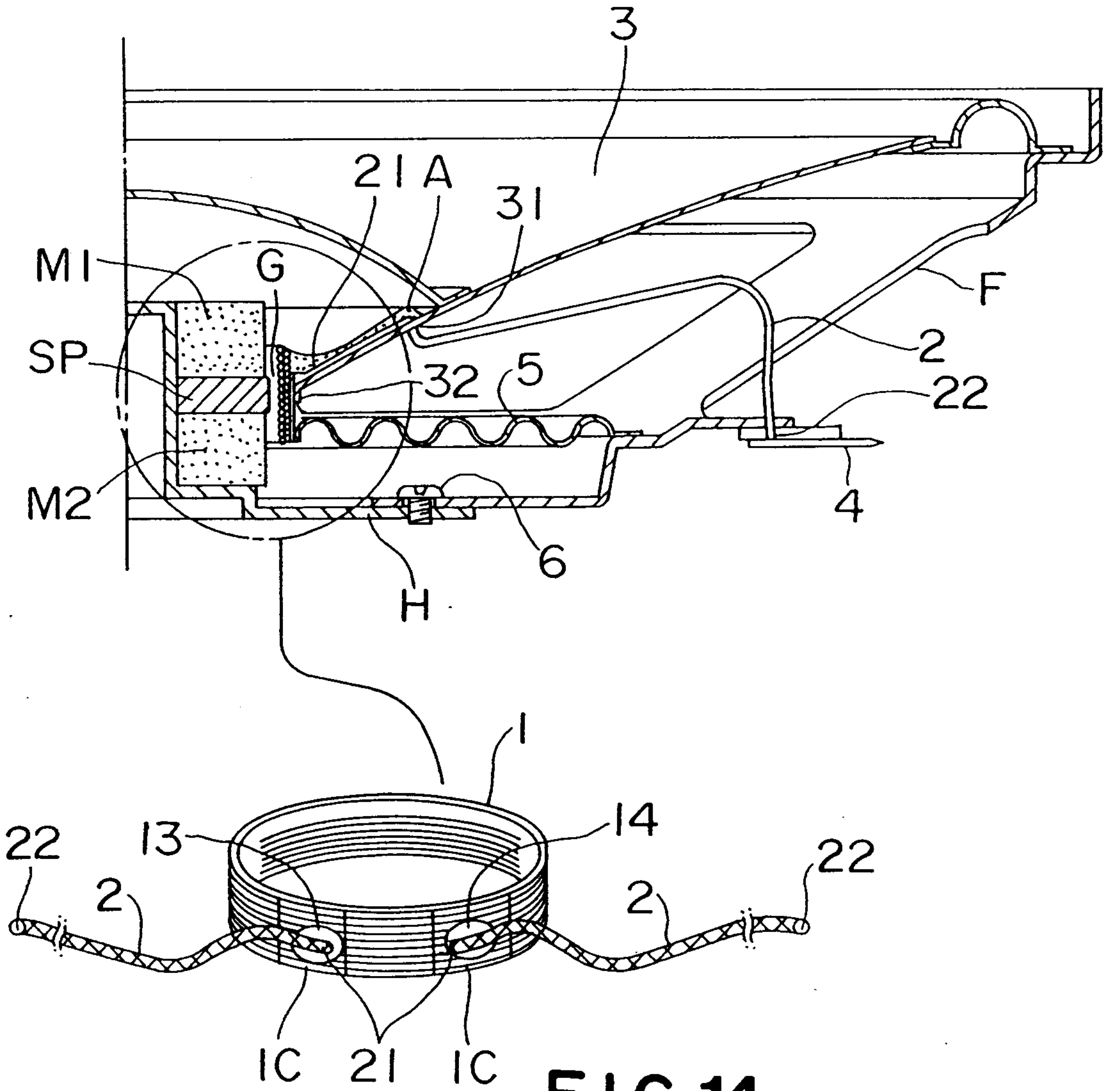


FIG.14

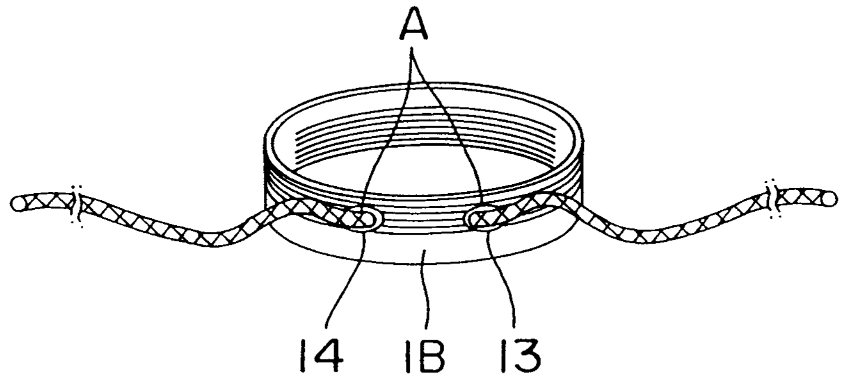


FIG.15

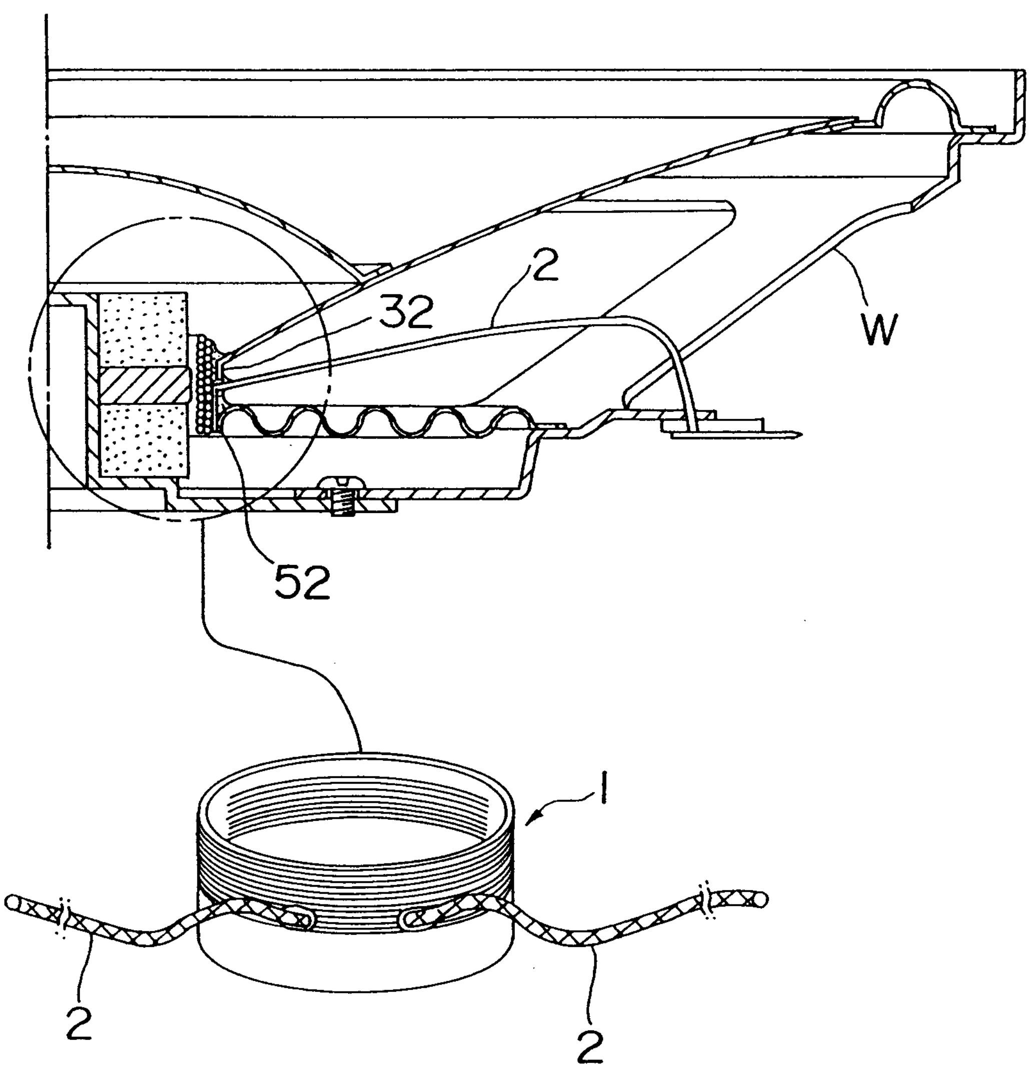
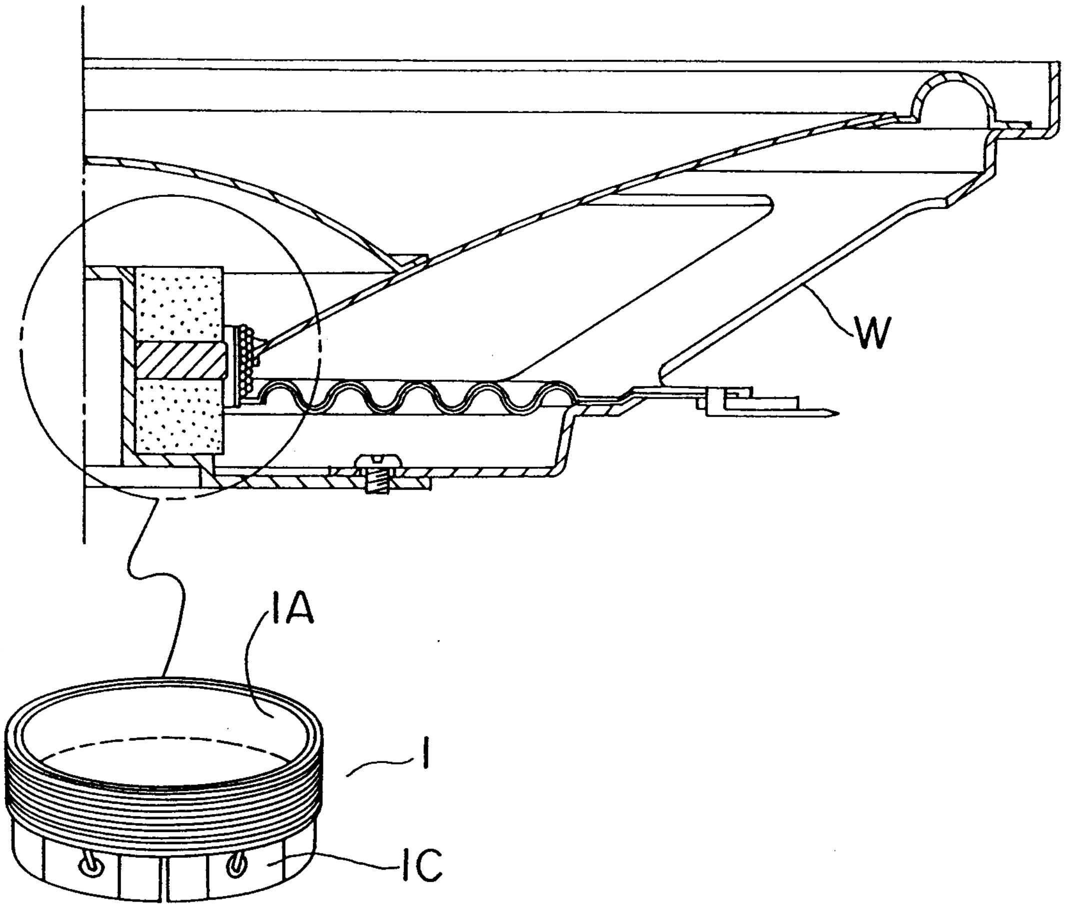
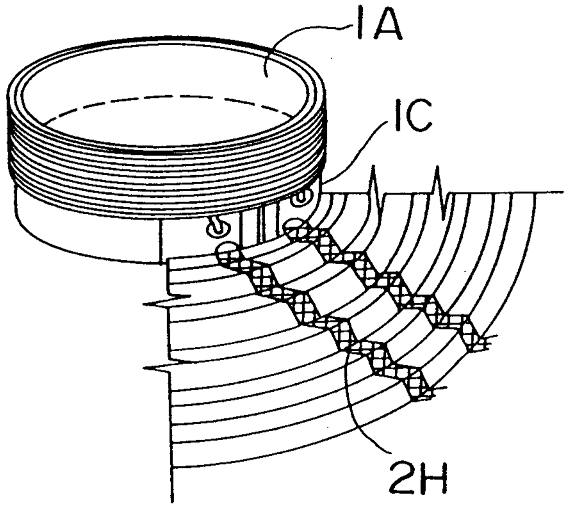


FIG.16



F I G. 17



F I G. 18

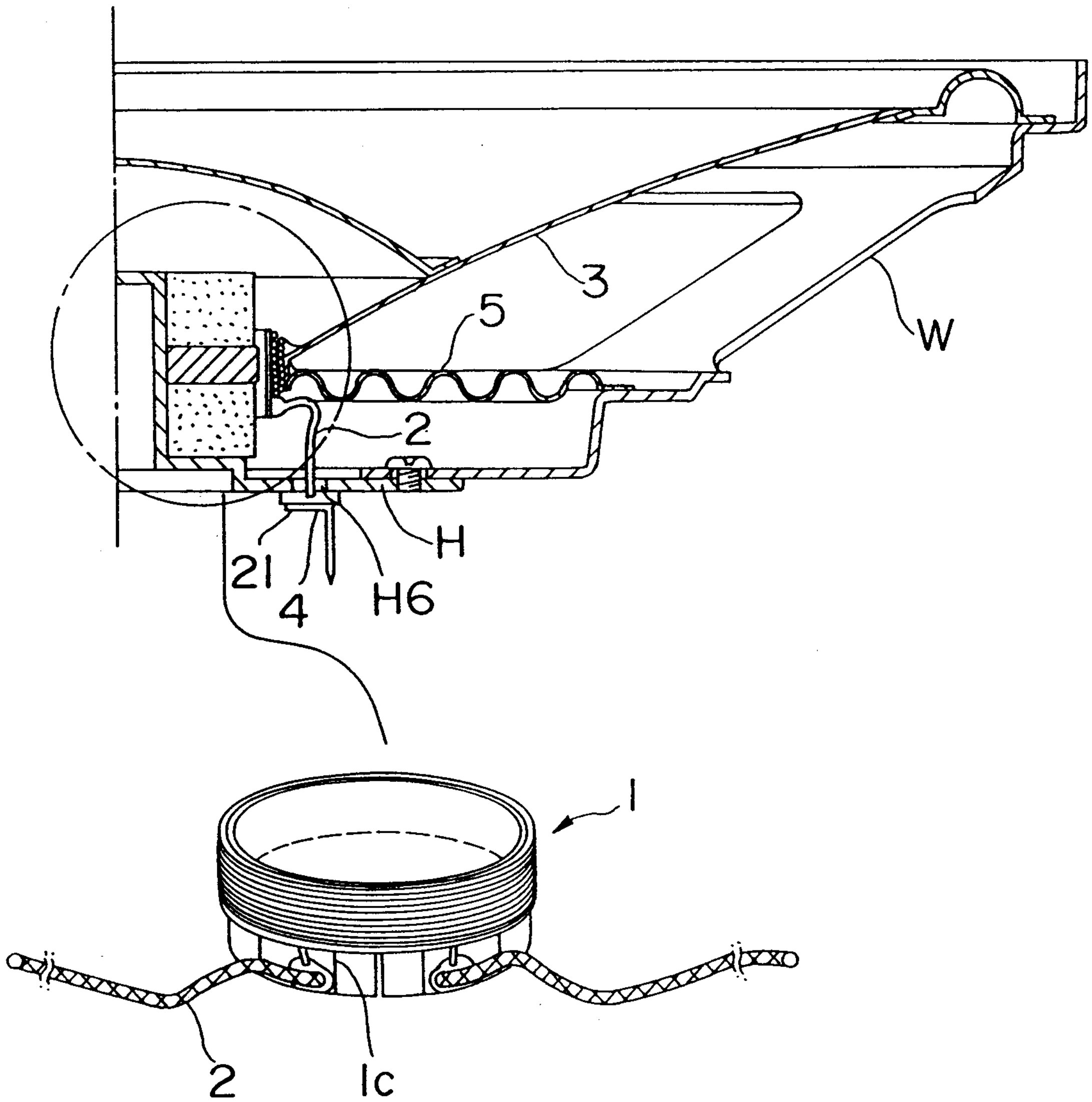


FIG.19