

DESCRIPTION

LOUDSPEAKER SUSPENSION DEVICE AND
FABRICATING METHOD THEREOF

5

BACKGROUND OF THE INVENTIONField of the Invention

The present invention relates to a loudspeaker suspension device and a fabricating method thereof, and more particularly to a loudspeaker suspension device and a fabricating method thereof, capable of providing an improved connection state of signal input ends of voice coil connection conductors.

15 Related Background Art

In order to reduce the number of wiring steps of a loudspeaker, various types of dampers with conductors 2 (hereinafter called "conductive damper 1D) have been proposed heretofore, in which the conductors 2 are provided along corrugations 11c of a suspension 1 generally called spiders or dampers. However, these conductive dampers 1D are not satisfactory in terms of practical use. The inventors have proposed practically usable conductive dampers (hereinafter called "sewn conductive dampers 1Ds) which are already under mass production. This sewn

THIS SHEET HAS BEEN REPLACED

This Sheet Has Been Replaced



conductive damper uses as the conductors 2 conductive wires
(hereinafter called "flat knitted tinsel wires 2h) made of
a desired number of flat knitted conductive wires each
formed by winding a copper foil around fibers. This flat
5 knitted tinsel wire is sewn on a base cloth B made of woven
cloth and constituting a suspension 1. The base cloth B
with the sewn flat knitted tinsel wires is thermally molded
to attache the conductors 2 along corrugations 11c. An
edge (hereinafter called a "conductive edge 1E") utilizing
10 the technology proposed by the inventors has also been
proposed.

A loudspeaker suspension 1 such as a sewn conductive
damper 1Ds and a conductive edge 1E, having conductor 2
along corrugations 11c or roll 11r of the suspension 1, is
15 called a "conductive suspension 1".

The structure of the conductive suspension 1 having
the conductors 2 mounted along the corrugations 11c or roll
11r of a conventional general loudspeaker suspension will
be described by taking as an example the conductive damper
20 1D and the conductive edge 1E. In manufacturing the
conductive damper 1D, for example, in manufacturing the
sewn conductive damper 1Ds proposed by the present
inventors, phenol resin raw liquid generally sold in
markets is diluted with methanol to obtain phenol resin
25 solution having a desired specific gravity. Woven cloth

made of cotton or chemical fibers is dipped in this solution to impregnate or coat it with the phenol resin.

After the methanol solvent is evaporated to remove resin tucking, the woven cloth is cut to have a predetermined width. In this manner, the base cloth B used for damper molding is prepared.

Two flat knitted tinsel wires 2h as the conductors 2 are sewn to the base cloth B with sewing threads 3 called cornex, in parallel along the center line and at a predetermined space relative to the center line, as shown in Fig. 8. After the flat knitted tinsel wires 2h are sewn, the base cloth B is thermally pressed, similar to general dampers, to integrally mold the corrugations 11c concentrically to the center line of the base cloth B, as shown in Fig. 9. Thereafter, unnecessary portions indicated by broken lines in Fig. 10 are trimmed through punching press. In this manner the sewn conductive damper 1D with the flat knitted tinsel wires 2h being mounted along the corrugations 11c can be obtained as shown in Figs. 11A and 11B.

The manufacture of the conductive edge 1E, for example, the sewn conductive edge 1Es (refer to Fig. 3 of an embodiment of the invention) the present inventors have proposed in practical use, is basically the same as the manufacture of the sewn conductive damper 1Ds.

Specifically, a predetermined woven cloth is impregnated with phenol resin or the like having a predetermined concentration and coated with a predetermined damping material such as synthetic rubber to prepare the edge material. This edge material is cut to have a predetermined width to prepare the base cloth B to be used for edge molding. Two flat knitted tinsel wires 2h similar to the above-described wires 2h as the conductors 2 are sewn to the base cloth B with sewing threads 3 called cornex, in parallel along the center line and at a predetermined space relative to the center line.

After the flat knitted tinsel wires 2h are sewn, the base cloth B is thermally pressed, similar to general edge molding, to integrally mold the roll 11r relative to the center line of the base cloth B. Thereafter, unnecessary portions are trimmed. Generally, if the unnecessary portions are cut through punching press, the sewn conductive edge 1Es with the flat knitted tinsel wires 2h being mounted along the roll 11r can be obtained.

The structure of the conductive suspension 1 of a conventional loudspeaker is fabricated in the above method. It is therefore obvious that the conductor 2 made of the flat knitted tinsel wire 2h is disposed on the front surface of the suspension base cloth B made of a woven cloth impregnated or coated with resin. Therefore, exposed

is only one side of the conductor 2, i.e., the flat knitted tinsel wire 2h, and the other side is hidden in contact with the suspension base cloth B.

Next, a means for electrically interconnecting the conductor 2 and an input terminal lug 4 will be described by taking as an example the sewn conductive damper 1Ds. As shown in Figs. 11A and 11B, tongue-shaped projections (hereinafter called tongue portions 13a and 13b) are provided extending outward from an adhesion portion 12 at the circumferential area of the sewn conductive damper where the conductors 2 or sewn flat knitted tinsel wires 2h reach. The ends 2ha and 2hb of the flat knitted tinsel wires 2h extend on the tongue portions 13a and 13b.

In order to perform electrical connection under the conditions that the sewn conductive damper 1Ds is mounted on a speaker frame F, as shown in Fig. 12, the tongue portions 13a and 13b are disposed on input terminals mounted on the speaker frame F. The surfaces of the ends 2ha and 2hb of the flat knitted tinsel wires 2h at the tongue portions 13a and 13b are made in contact with, or pressed against, partial areas of terminal lugs 4a and 4b, and the contact areas or pressed areas of the lugs 4a and 4b are soldered. Therefore, partial areas of the terminal lugs 4a and 4b are made always in contact with the front surfaces of the conductors 2 (flat knitted tinsel wire ends

2ha and 2hb).

Another approach is to separate the ends of conductors 2 or flat knitted tinsel wire ends of the sewn conductive damper 1Ds from the damper base cloth B to expose both the front and back surfaces of the flat knitted tinsel wire ends 2ha and 2hb and jump the ends 2ha and 2hb directly to the input terminal lugs 4. This connection structure of the sewn conductive damper 1Ds has been proposed by the present inventors, as described in Japanese Patent Laid-Open Gazette No. HEI 2-134100 and Utility Model Laid-Open Gazette No. HEI 2-13398.

In this electrical connection process, as shown in Figs. 13A and 13B, the tongue portions 13a and 13b at the damper circumferential area are required to be separated from the flat knitted tinsel wire ends 2ha and 2hb on the tongue portions 13a and 13b, by loosening the sewing thread 3 in the range from the outermost ends of the tongue portions 13a and 13b to the outermost circumference of the adhesive area 12. It is also necessary to peel off the flat knitted tinsel wire ends 2ha and 2hb from the tongue portions 13a and 13b to cut the loosened threads 3. Thereafter, both the front and back surfaces of the flat knitted tinsel wire ends 2ha and 2hb are exposed to separate them from the damper base cloth B (tongue portions 13a and 13b). This process, however, has the problems of

(1) high cost and (2) unstable product quality.

The reason of the high cost (1) is as follows. The process of loosening the sewing threads 3 is very complicated and the number of works increases, resulting in the high cost. The unstable product quality (2) results from a variation in the works of loosening the sewing threads 3. If the thread 3 is loosened too much, it is loosened even near to the ends of the corrugations 11c, and the unfastened portion is formed at the outermost circumference of the corrugations 11c.

In operation of the sewn conductive damper 1Ds having the unfastened portion near at the corrugations 11c, since the corrugations 11s are movable, they vibrate and the flat knitted tinsel wires 2h near at the corrugations contact with the damper base cloth B to generate abnormal sounds called vibratory sounds. If such a state continues for a long time, the copper foils constituting the flat knitted tinsel wires 2h at the unfastened portion are cut, resulting in a fatal defect of no sound from the loudspeaker.

Even if the portion where the sewing thread 3 is loosened does not reach the outermost circumference of the corrugations 11c, the end of the sewing thread 3 may be loosened by vibrations or impacts during the transportation of the damper, and this loosened portion may often reach

the outermost circumference of the corrugations 11c. From the reasons described above, an approach to separating the conductors 2 (flat knitted tinsel wires 2h) of the sewn conductive damper 1Ds from the damper base cloth B (tongue portions 13a and 13b) is not still realized to date.

There are some advantageous cases, however, if the conductors 2 are separated from the damper base cloth B, i.e., if both the front and back sides of the ends 2ha and 2hb of the flat knitted tinsel wires 2h are exposed not to intentionally mount the conductors 2 on the woven cloth (at the tongue portions 13a and 13b or the like) of the base cloth B of the sewn conductive damper 1Ds. For example, such a case occurs if the conductive damper 1D is used with a terminal ring L or the like provided with wiring patterns the present inventors have proposed.

Specifically, in the case of the sewn conductive damper 1Da (Fig. 12) with the conductors reaching the tongue portions 13a and 13b, the woven cloth (at the tongue portions 13a and 13b or the like) of the suspension base cloth B is interposed at a contact surface between the ends 2ha and 2hb of the flat knitted tinsel wires 2h and the wiring conductive patterns (Fig. 14). Therefore, electrical connection by soldering is almost impossible. In order to allow soldering, the present inventors have proposed specific conductive dampers 1D which we call a

woven conductive damper 1Di.

More in detail, a terminal ring L formed through punching press of a printed circuit board or the like made of a resin board attached with copper foils or the like, is
5 integrally formed with three projections L1, L2 and L3 separated by 90 ° about the ring center, as shown in Fig. 14. The projection L1 is formed at the position where terminals are mounted, and the other two projections L2 and L3 are formed at the positions separated by 180 ° about the
10 ring center. A wiring pattern P is also formed on the side where the conductive damper 1D is mounted. Square holes L11 for mounting terminal lugs 4 are formed as shown in Fig. 14 in the tongue-shaped projection L1 on which the input terminals are connected. Caulking portions 41 of the
15 terminal lugs 4 are inserted into the holes L11 and caulked to press a partial area of each terminal lug 4 against the surface of the wiring pattern P to thus complete the ring L with the terminal lugs 4.

In manufacturing the damper, fibers constituting the
20 base cloth B is impregnated with phenol resin having a predetermined concentration and diluted with methanol, and the solvent is evaporated to remove resin tucking. Fibers impregnated with the resin are used as warps and fibers not impregnated with the resin are used as yarns, and one flat
25 knitted tinsel wire 2h is woven on the side of yarns. The

base woven cloth B with the flat knitted tinsel wire 2h disposed on the center line of the damper corrugations 11c is thermally molded to obtain the woven conductive damper 1Di.

5 Since a damper inner diameter portion 13 (Fig. 11) is cut by a trimming process, the flat knitted tinsel wire 2h disposed on the damper center line is cut so that two flat knitted tinsel wires 2h are disposed along the damper center line. At the trimming process, two tongue portions
10 13a and 13b are formed outside of the adhesion portion 12 at the damper circumferential area, as shown in Fig. 14, so that the flat knitted tinsel wire ends 2ha and 2hb reach the tongue portions 13a and 13b. Since the woven conductive damper 1Di has the structure that the flat
15 knitted tinsel wire 2h is woven in the woven cloth, the copper foils of the flat knitted tinsel wire 2h as the conductor 2 are exposed between fibers constituting the woven cloth (between weaving spaces).

As shown in Fig. 14, a predetermined amount of rubber-
20 containing adhesion h is coated on the inner peripheral area of the terminal ring L, and the terminal ring L is dried for a predetermined time to evaporate the solvent of the adhesive h. Cream solder sc (Fig. 15) is coated on a
predetermined area of the pattern P on the projections L2
25 and L3, i.e., on the area where the ends of the flat

knitted tinsel wires 2h of the woven conductive wire 1Di reach. The damper adhesion portion 12 and the outer circumferential portion of the ring L with the terminals are aligned in position, and the damper tongue portions 13a and 13b and the ring projections L2 and L3 are aligned in position. Therefore, the adhesive portion 12 of the woven conductive damper 1Di and the area with the adhesive h are made in contact with each other, and the cream solder sc and the exposed areas of the back surface of the flat knitted tinsel wires reaching the projections of the woven conductive damper 1Di are made in contact with each other.

In this state, thermal press is applied for several seconds at about 250 °C. down to the adhesion portion 12 and tongue portions 13a and 13b of the damper 1Di to thermally reactivate the adhesive h. While the adhesion portion 12 of the woven conductive damper 1Di is attached to the terminal ring L and the cream solder sc is melted, the exposed areas of the back surfaces of the flat knitted tinsel wire ends 2ha and 2hb reaching the tongue portions 13a and 13b of the woven conductive damper 1Di are soldered to the wiring patterns P of the ring L. In this manner, the woven conductive damper 1Di with the ring L and the terminal lugs 4 can be formed (refer to Fig. 15).

During the thermal press, phenol resin or the like will not be attached to the flat knitted tinsel wires 2h as

the conductors 2 of the woven conductive damper 1Di.
Furthermore, the copper foils constituting the flat knitted
tinsel wires 2h are exposed between weaving spaces of the
base woven cloth B and the exposed areas are made in
5 contact with the wiring conductive patterns P of the ring
L. Therefore, it is easy to solder. However, a general
sewn conductive damper 1Ds with the tongue portions 13a and
13b reaching the conductors 2 (flat knitted tinsel wire
ends 2ha and 2hb) is difficult to use with such a structure
10 described above. The types of conductive dampers 1D are
therefore limited and the use range of the ring L with the
wiring conductive patterns P is narrowed.

In order to solve this problem, it is necessary that
copper foils of the conductors 2 or flat knitted tinsel
15 wire ends 2ha and 2hb are intentionally disposed to be
separated from the base woven cloth B of the sewn
conductive damper 1Da. In order to separate the flat
knitted tinsel wire ends 2ha and 2hb reaching the tongue
portions 13a and 13b, as described previously, the sewing
20 threads 3 were loosened to peel off the flat knitted tinsel
wires 2h from the tongue portions 13a and 13b, and the
tongue portions 13a and 13b and the loosened threads 3 were
cut. However, although the problem (1) of the increased
works may be absorbed in the total number of manufacture
25 processes of a loudspeaker, the problem (2) causing a fatal

defect could not be solved.

Specifically, the ends of the sewing thread of the sewn conductive damper 1Ds reaching the outer circumference of the adhesion portion 12 or the outermost end of the tongue portion are subjected to the thermal molding, under the conditions that the ends are in tight contact with the flat knitted tinsel wires 2h and damper base cloth B. Therefore, the ends are maintained in tight contact even after the molding. Furthermore, the sewing threads 3 on the base cloth B are in a semi-adhered state caused by phenol impregnated to the woven cloth. Therefore, the sewing threads 3 reaching the outermost area will not loosened unless a particular force is applied thereto.

However, if the tightly molded sewing threads 3 are once forcibly loosened, the tightly molded state or semi-adhered state of the sewing threads 3 is broken and the ends of the sewing threads 3 are loosened. In such a case, it has been found that if the separated or unfastened portion of the flat knitted tinsel wires 2h reaches near the middle portion of the adhesion portion 12 and if the sewing thread 3 was cut at the outer circumferential area of the adhesion portion 12, because of a variation in the loosening degree of the sewing threads 3, then many of the sewing threads 3 are loosened near to the outermost corrugation 11c by a very small external force,

particularly by a very small external force applied to the flat knitted tinsel wire ends 2ha and 2hb during product transportation.

An example of an advantageous case will be described with reference to Fig. 16, the advantageous case being realized if the exposed areas of the conductors 2 or flat knitted tinsel wire ends 2ha and 2hb or the like of the conductive edge 1E are not mounted on the woven cloth B of the edge. For example, such a case occurs when the flat knitted tinsel wire ends 2ha and 2hb are required to be disposed on the back side of the edge 1E. In such a case, in order to electrically interconnect the flat knitted tinsel wire ends 2ha and 2hb to the input terminal lugs 4, the tongue portions 13a and 13b are provided as in conventional manner to dispose the flat knitted tinsel wire ends 2ha and 2hb on the input terminal lugs 4 for making them in contact with each other. In this state, however, as shown in Fig. 16, the edge base cloth B covers the whole surface of the terminal lugs 4 and the whole surface of the contact area between the flat knitted tinsel wire ends 2ha and 2hb and the terminal lugs 4.

Therefore, although it is easy to make the flat knitted tinsel wire ends 2ha and 2hb in contact with the terminal lugs 4, it is very difficult to maintain a state that the flat knitted tinsel wire ends 2ha and 2hb are

pressed and fixed to the terminal lugs 4. Moreover, since the edge base cloth B having good electrical insulation covers the flat knitted tinsel wire ends 2ha and 2hb as shown in Fig. 16, it is difficult to achieve reliable soldering with the solder s and a soldering work itself is very difficult.

As a countermeasure for this, the flat knitted tinsel wire ends 2ha and 2hb reaching the tongue portions 13a and 13b made of the edge base cloth B may be separated to loosen the sewing threads 3 and peel off the flat knitted tinsel wire ends 2ha and 2hb from the tongue portions 13a and 13b to thereby cut the tongue portions 13a and 13b and not to interpose the base cloth B. Even in this state, similar to the above-described case, the sewing threads 3 are loosened to the roll portion 11r and the unfastened portion is formed to the roll portion 11r.

There is also another electrical connection approach. Specifically, the tongue portions 13a and 13b are provided at the areas where the flat knitted tinsel wire ends 2ha and 2hb outside of the adhesion portion 12 of the edge 1E reach, and the tongue portions 13a and 13b are bent to the front side whereas the back surface side of the flat knitted tinsel wire ends 2ha and 2hb reaching the tongue portions 13a and 13b is turned to the front side to expose it at the front side of the edge base cloth B, as shown in

Figs. 16A and 16B, to thereby press the exposed area against partial areas of the terminal lugs. This approach obviously requires an additional process of bending the tongue portions 13a and 13b, and the terminal lugs 4 are
5 required to have a specific shape as shown.

SUMMARY OF THE INVENTION

It is an object of the present invention to solve the above conventional problems and provide a loudspeaker
10 suspension device and its fabricating method capable of manufacturing the loudspeaker suspension device with low cost.

A loudspeaker suspension device applied with the fabricating method of this invention has a suspension and
15 voice coil connection conductors mounted on a surface of the suspension. The fabricating method of this invention comprising the steps of: (a) mounting the voice coil connection conductors along a surface of a planar base member, the base member including cut portions at positions
20 corresponding to signal input ends of the voice coil connection conductors; (b) pressure molding the base member and the voice coil connection conductors into predetermined shapes; and (c) trimming the base member and the voice coil connection conductors so as to leave the signal input ends
25 of the voice coil connection conductors as projection

portions from the base member.

After the trimming, the signal input ends of the voice coil connection conductors are present as the projection portions outside of the suspension. It is therefore unnecessary to peel off the signal input terminals from the suspension, and it is possible to prevent a loosened state of the voice coil connection conductors and to stop peeling the voice coil connection conductors from the suspension.

According to the fabricating method for a loudspeaker suspension device of this invention, the cut portions are holes formed in the suspension, and a sewing thread for mounting the voice coil connection conductors on the base member is fastened to the voice coil connection conductors including a portion of the voice coil connection conductors corresponding to the holes.

If the signal input ends of the voice coil connection conductors sewn on the base member with the sewing thread is to be peeled off from the base member, it is necessary to pull out the sewing threads from the base member, which may result in a loosened state of the voice coil connection conductors and the voice coil connection conductors peeled off from the suspension. However, in this invention, the unnecessary sewing threads and base member are trimmed and it is not necessary to pull out the sewing threads from the voice coil connection conductors. Therefore, the above

problems can be solved.

According to the fabricating method for a loudspeaker suspension device of this invention, the pressure molding is thermal press, and the signal input ends of the voice
5 coil connection conductors are coated with cream solder and thereafter thermally pressed together with the base member.

The cream solder is melted during the thermal press and attached to the signal input ends. Therefore, a loosened state of the signal input ends can be effectively
10 prevented when the voice coil connection conductors are trimmed.

A loudspeaker suspension device of this invention comprises: (a) a suspension made of a planar base member having cut portions at predetermined positions, the planar
15 base member being pressure molded and trimmed with trimming lines passing the cut portions; and (b) voice coil connection conductors mounted on the suspension with signal input ends of the voice coil connection conductors being positioned at the cut portions, the voice coil connection
20 conductors and the suspension being pressure molded and trimmed along the trimming lines.

The signal input ends of the voice coil connection conductors are positioned at the cut portions of the base member and trimmed together with the base member along the
25 trimming lines. It is therefore unnecessary to peel off

the signal input terminals from the suspension, and it is possible to prevent a loosened state of the voice coil connection conductors and to stop peeling the voice coil connection conductors from the suspension.

5 According to the loudspeaker suspension device of this invention, the suspension includes inner adhesion portions, a roll portion and an outer adhesion portion in the order from the inside to the outside, and the voice coil connection conductors traverse at end portions thereof the
10 roll portion and extend at an intermediate portion thereof the inner adhesion portions.

Such a loudspeaker suspension device is used, for example, with an elongated thin loudspeaker.

 According to the loudspeaker suspension device of this
15 invention, the cut portions are holes formed in said suspension, and a sewing thread for mounting said voice coil connection conductors on the base member is fastened to the voice coil connection conductors including a portion of the voice coil connection conductors corresponding to
20 the holes.

 Although the voice coil connection conductors are sewn on the base member with the sewing threads, the unnecessary signal input ends and the base member are trimmed. Accordingly, it is unnecessary to peel off parts of the
25 voice coil connection conductors from the base member, so

that a work to pull the sewing threads from the base member
can be dispensed with.

BRIEF DESCRIPTION OF THE DRAWINGS

5 Fig. 1 is perspective views of a base cloth of a sewn
conductive edge formed with holes and sewn with flat
knitted tinsel wires with sewing threads, according to the
invention.

10 Fig. 2 is perspective views showing the base cloth of
a conductive edge placed on a lower mold, according to the
invention.

Fig. 3 is perspective views showing the sewn
conductive edge molded and thereafter trimmed, according to
the present invention.

15 Fig. 4 is a perspective view showing the back side of
the sewn conductive edge mounted with a diaphragm and a
partially enlarged perspective view showing the back side
of the flat knitted tinsel wire ends, according to the
present invention.

20 Fig. 5 is perspective views showing the back side of
the sewn conductive edge mounted with the diaphragm and
with voice coils, according to the present invention.

Fig. 6 is perspective views showing the states of
voice coils, a diaphragm with a sewn conductive edge, and
25 input terminal lugs, respectively mounted on a frame, as

viewed from the front side of the loudspeaker.

Fig. 7 is perspective views showing a completed state of a multi-point drive type loudspeaker. mounted with repulsion magnetic circuits after the voice coils, diaphragm with the sewn conductive edge, and input terminal lugs are mounted on the frame, and a partially enlarged view showing the wiring state between flat knitted tinsel wire ends and input terminal lugs.

Fig. 8 is a plan view and a partially enlarged view showing a base cloth of a conventional sewn conductive damper with flat knitted tinsel wires being sewn by sewing threads.

Fig. 9 is a plan view showing a base cloth of a conventional sewn conductive damper with flat knitted tinsel wires being sewn by sewing threads and with corrugations and the like being thermally molded.

Fig. 10 is a plan view showing portions to be trimmed from a base cloth of a conventional sewn conductive damper with flat knitted tinsel wires and with corrugations and the like being thermally molded.

Figs. 11A and 11B are a plan view and a perspective view showing a conventional completed sewn conductive damper.

Fig. 12 is a perspective view showing a conventional sewn conductive damper mounted on a loudspeaker frame and

having input terminal lugs electrically connected.

5 Figs. 13A and 13B are perspective views showing a conventional sewn conductive damper with flat knitted tinsel wires whose sewing threads are loosened so as not to make the damper base cloth intervene the wires.

Fig. 14 is perspective views showing a conventional sewn conductive damper, a terminal ring with wiring patterns, and input terminal lugs, respectively before assembly.

10 Fig. 15 is perspective views showing a conventional sewn conductive damper, a terminal ring with wiring patterns, and input terminal lugs, respectively after assembly.

15 Figs. 16A and 16B are partially enlarged cross sectional views showing a conventional conductive edge with a conductor such as a flat knitted tinsel wire being mounted on the back side of the conductive edge, and showing the positional relation with an input terminal lug.

20

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the invention will be described with reference to Figs. 1 to 7. Like constituent elements to those conventional elements shown in Fig. 8 to Fig. 16B are
25 represented by using identical reference numerals.

Although the embodiment will be described by taking a sewn
conductive edge 1Es, a sewn conductive damper may also be
formed in a similar manner. The diaphragm of the sewn
conductive edge 1Es is an elongated type having a
5 height/width ratio of about 6 : 1, and is used for a multi-
point drive type loudspeaker in which the diaphragm is
driven by three voice coils and three repulsion magnetic
circuits. In this embodiment, the design conditions are
that an edge roll 11r is an up-roll and that edge adhesion
10 portions 14 used for adhering the diaphragm df and the
voice coil wiring portions are not visible from the front
side of the loudspeaker. In order to satisfy these design
conditions, input conductors 2 are disposed on the back
side of the edge roll 11r.

15 Edge woven cloth widely used conventionally was used
for a base cloth B of the edge. As warps and yarns, a
thread made of a single twisted fiber of #30 was used.
Threads were woven at a density of 60 threads/inch for both
the warps and yarns to obtain a cotton cloth having a
20 weight of 100 g to 110 g/m². This cotton cloth was
impregnated with resin solution having a phenol
concentration of 24 %, and coated with solution mixed with
synthetic rubber such as NBR and SBR. This rubber coated
cotton cloth was dried with heated air and thereafter cut
25 with a slitter to have a width of about 80 mm. In this

manner, a rubber coated edge base cloth B with a roll 11r was formed which are presently used widely in this technical field.

Square holes B1 (7mm x 5 mm) such as shown in Fig. 1 were formed in the base cloth B at predetermined positions with a predetermined space therebetween. A desired number of conductive wires generally called tinsel wires made of fibers around which copper foils are wound, were woven flat to form a flat knitted tinsel wire 2h. The flat knitted tinsel wires 2h as conductors 2 were sewn on the base cloth B with threads 3 called cornex #40, in parallel and separately from the center line of the woven cloth B by 13 mm (a pitch of about 26 mm).

The flat knitted tinsel wire 2h was formed in the following manner. A tin-copper alloy wire having a bus bar diameter of 0.1 mm was worked to a foil having a width of 0.32 mm and a thickness of 0.027 mm, and the foil was wound in a single layer at 22 +/- 2 turns/cm around a paraaramid fiber of 200 denier to form a tinsel wire. A bundle of seven tinsel wires was knitted flat at a knitting pitch of 27.45 +/- 0.82 mm/turn to form a flat knitted tinsel wire.

As the flat knitted tinsel wires 2h are sewn in the above manner, parts of the flat knitted tinsel wires 2h traverse the square holes B1 formed in the base cloth B as shown in Fig. 1, partitioning each square hole B1 into two

equal sections. The base cloth B is then placed on a lower mold D for thermal molding, as shown in Fig. 2. Since guide pins D1 are mounted on this mold D at positions corresponding to the partitioned square holes B1, the base cloth B is placed in such a manner that the guide pins D1 are inserted into respective sections of the square holes B1 partitioned by the flat knitted tinsel wires 2h.

The temperature of the mold is set to about 200 °C. An upper mold is lowered to thermally press the base cloth B at a pressure of about 600 Kg (at an axial output) for about 5 seconds to cure the phenol resin or the like impregnated in the base cloth B and form a roll 11r having a predetermined shape at a predetermined area of the base cloth B, as shown in Fig. 3. The molded base cloth B removed from the molds has the flat knitted tinsel wires 2h shaped in conformity with the topology of the roll 11r.

This edge base cloth B with the molded roll 11r and the two flat knitted tinsel wires 2h aligned in position is then subjected to a trimming process to cut unnecessary inner and outer portions indicated by broken lines in Fig. 3 and complete a sewn conductive edge 1Es. In this embodiment, a trimming mold was prepared and the molded base cloth B with the flat knitted tinsel wires 2h was placed on the trimming mold to punch out the unnecessary portions and obtain a desired sewn conductive edge 1Es such

as shown in Figs. 3 and 4.

As shown in Figs. 3 and 4, the end portions of the flat knitted tinsel wires 2h placed over the square holes are cut by the trimming process to have a predetermined size as shown in Figs. 3 and 4. Each of these end portions constitutes a tongue portion outside of the edge adhesion portion 12 without the base cloth B. Namely, this tongue portion exposes both the front and back surfaces of the flat knitted tinsel wires 2h outside of the adhesion portion 12. In addition, as shown in a partially enlarged view of Fig. 4, the sewing threads 3 extend to the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h.

Since the sewing threads 3 extending to the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h were subjected to the thermal press molding, they were molded along the surface of the flat knitted tinsel wires 2h in a fitted manner. Therefore, the sewing threads 3 are in tight contact with the flat knitted tinsel wire ends (extended portions) 2ha and 2hb, so that even if the ends of the sewing threads are loosened, the deeper sides of the threads are prevented from being further loosened and unfastened. Since the sewing threads 3 extended to the flat knitted tinsel wire ends, a conventional phenomenon that the sewing threads 3 are loosened up to the position

of the roll 11r occurred not at all.

In this embodiment, solder was not applied to the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h. However, this soldering process may be performed in the manner proposed by the present inventors. Namely, cream solder is coated on the surfaces of the flat knitted tinsel wires 2h over the square holes. At the same time when the edges are subjected to the thermal mold, the solder coated portions are thermally pressed. Therefore, the cream solder melts and attaches to the conductor surfaces of the flat knitted tinsel wires 2h. In this manner, the soldering process for the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h becomes possible. With this soldering process, an unfastened state at the ends of the flat knitted tinsel wires 2h to be caused by the trimming process of punching out can be prevented more reliably, and soldering with the terminal lugs 4 becomes easier.

The size of the sewn conductive edge 1Es after the trimming process is 202 mm long and 48 mm wide, with the longer and shorter sides being connected by arcs having a radius of 24 mm. An adhesion portion 12 of about 3 mm width for adhering an edge frame is formed at the outermost circumferential area, the roll 11r having a width of 6 mm and a cross section radius of 3 mm is formed inside of the

adhesion portion, and other adhesion portions 14 are formed inside of the roll 11r. The adhesion portions are used for adhering a diaphragm df.

The diaphragm df made of pulp and having an elongated and generally flat shape as shown in Fig. 4 is adhered to the adhesion portion. In this embodiment, as described earlier, the design conditions are that the edge roll 11r is an up-roll and that the edge adhesion portions 14 used for adhering the diaphragm df and the voice coil wiring portions are not visible from the front side of the loudspeaker. Therefore, as shown in Fig. 4, the edge adhesion portions 14 are adhered to the back side of the diaphragm to form the diaphragm df with the sewn conductive edge 1Es.

Since three voice coil mount holes df1 are formed in the diaphragm df with the sewn conductive edge 1Es, as shown in Fig. 5, the outer peripheries of voice coils vc are inserted into the holes df1 to adhere the outer peripheries of the voice coils vc to the diaphragm df. The ends of the voice coils vc are electrically connected to the flat knitted tinsel wires 2h. Since the wiring portions of the voice coils vc are disposed on the back side of the diaphragm, the above design conditions that the wiring portions of the voice coils vc are not visible from the front side of the loudspeaker can be satisfied.

In this embodiment, the sewn conductive edge 1Es and the diaphragm df with the voice coils vc are adhered to a frame F shown in Fig. 6. The frame F is made of ABS resin which contains glass fibers, and has a size of 228 mm long, 5 49.6 mm wide, and 15 mm deep. Three poles F1 having a diameter of 5 mm and a height of 14 mm are integrally formed on the bottom of a frame basket, respectively at the center of the frame F, and at positions separated from the center by 60 mm in the longitudinal direction.

10 On one of flanges F2 provided on the shorter side of the frame F for mounting the frame F, two holes F3 for mounting the input terminal lugs 4 are formed as shown in Fig. 6. This hole F3 is a square hole having a side length of 2.5 mm and passes through the flange F2. A counterbore 15 having a diameter of 8 mm and a depth of 1 mm is formed on the front side of the flange F2, concentrically with the square hole F3. A pitch between the square holes F3 is the same as the pitch (26 mm) between the flat knitted tinsel wires 2h sewn on the sewn conductive edge 1Es.

20 As shown in Fig. 6, adhesive h is coated on the edge adhesion area of the frame F. Although not shown, after a voice coil vc positioning jig is fitted around the poles F1, the inner peripheries of the voice coils vc on the diaphragm df with the sewn conductive edge 1Es are fitted 25 around the outer peripheries of the jig. As shown in Fig.

6, in order to satisfy the above-described design conditions, the diaphragm df is turned upside down to maintain the edge in an up-roll 11r state, the voice coils vc and the wiring portions to the flat knitted tinsel wires 2h are disposed on the back side of the diaphragm so as to make the wiring portions not visible, and the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h are aligned with the holes F3 for mounting the input terminal lugs 4.

10 After the insertion in the above-described state, the adhesion portion 12 at the outer peripheral area of the sewn conductive edge 1Es contacts with the adhesive. By pressing and fixing the adhesive portion, the sewn conductive edge 1Es with the voice coils vc is adhered to the frame F at a predetermined position, while the voice coils are adhered at the predetermined positions of the frame F. Obviously, in this case, although parts of the flat knitted tinsel wires 2h are adhered to the back side of the frame, both the front and back surfaces of the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h are disposed covering halves of the counterbores of the holes F3 for mounting the input terminal lugs 4 and exposing copper foils of the tinsel wires constituting the flat knitted tinsel wires 2h, as shown in Fig. 6.

25 In this state, the input terminal lugs 4 are mounted.

These terminal lugs are those generally used conventionally and are generally called a fastening terminal lug. This terminal lug is made of a 0.5 mm thick brass plate press-worked and nickel plated. As show in Fig. 6, the lug has at a predetermined position a caulking portion 41 of a square tube shape having a side length of 2.5 mm, a height of about 3.5 mm and a side thickness of about 0.5 mm. A lug 4a is a positive terminal and a lug 4b is a negative terminal.

10 A caulking method is quite the same as a conventional method of mounting a terminal lug to a terminal substrate. As shown in Fig. 6, the caulking portion is inserted into the mounting square hole F3 from the back side of the frame flange F2. As shown in a partially enlarged view of Fig.
15 7, each side of the caulking portion 41 is bent outward into four equal pieces, while the corners of the top edge of the caulking 41 extended to the front side of the frame is broken. In this manner, the input terminal lugs 4 are caulked relative to the frame F.

20 In this embodiment, part of the caulking portion 41, i.e., one side of four bent pieces, and the counterbore of the terminal mounting hole F3, squeeze the end (extended portion) 2ha, 2hb of the flat knitted tinsel wire 2h when the lug 4 is mounted on the frame F. In this mount state,
25 the terminal lug 4 is electrically connected to the voice

coil vc. Generally, this squeezed state of the flat knitted tinsel wire ends 2ha and 2hb does not pose a practical problem of electrical conduction quality. However, in this embodiment, the boundary area between the flat knitted tinsel wire ends (extended portions) 2ha and 2hb and the lug caulking portions 41 are soldered as shown in the partially enlarged view of Fig. 7.

Since the whole surface of the conductor (copper foil) of the flat knitted tinsel wire ends (extended portions) 2ha and 2hb is exposed, other electrical connections may be performed. For example, the input terminal lugs 4 are first mounted on the frame F, and then the voice coils vc and the diaphragm df with the sewn conductive edge 2Es are adhered to the frame F. After the diaphragm df is adhered, the flat knitted tinsel wire ends (extended portions) 2ha and 2hb are directly soldered to parts of the four equal pieces of the input terminal lugs 4.

With the above processes, the voice coils vc, diaphragm df, sewn conductive edge 1Es, and input terminal lugs 4 are all adhered to the frame F, and the wiring process is completed. Thereafter, the coil positioning jig is dismantled, and three repulsion magnetic circuits RM are mounted on the poles F1 of the frame F to form a loudspeaker of an elongated-multi-point drive type.

In a loudspeaker having the conductive suspension

structure 1, the ends 2ha and 2hb of the conductor 2 such as the flat knitted tinsel wires 2h can be disposed without the suspension base cloth B. Even if the conductor 2 is disposed on the front or back side of the base cloth B, the ends 2ha and 2hb of the conductor 2 are not affected by the base cloth B and exposed perfectly. Therefore, the input terminal lugs 4 or the like can be electrically connected by the most prevailing soldering method, more easily than conventional. This is effective for simplifying the electrical connection structure and for improving the degree of design freedom considerably.

In manufacturing the conductive suspension 1, the ends 2ha and 2hb of the conductor 2 can be disposed easily without the suspension base cloth B, only by adding a conventional simple punching press process. Furthermore, a method of sewing the flat knitted tinsel wires 2h can be applied, which is most prevailing and low in cost. Therefore, it is possible to provide a loudspeaker conductive suspension of low cost and a considerably improved degree of wiring freedom.

Since the ends 2ha and 2hb of the conductor such as the flat knitted tinsel wires 2h are disposed without the suspension device and the sewing thread 3 extends to the ends (extended portions) 2ha and 2hb of the flat knitted tinsel wires 2h, the above-described phenomenon that the

sewing threads 3 extending to the flat knitted tinsel wire ends 2ha and 2hb are loosened does not occur at all. It is therefore possible to provide a loudspeaker with a conductive suspension of very high quality and a wiring

5 method for such a loudspeaker.



CLAIMS

1. A method of fabricating a loudspeaker suspension device having a suspension (1) and voice coil connection conductors (2h) mounted on a surface of the suspension (1), comprising the steps of:

(a) mounting the voice coil connection conductors (2h) along a surface of a planar base member (B), the base member (B) including cut portions (B1) at positions corresponding to signal input ends (2ha, 2hb) of the voice coil connection conductors (2h);

(b) pressure molding the base member (B) and the voice coil connection conductors (2h) into predetermined shapes; and

(c) trimming the base member (B) and the voice coil connection conductors (2h) so as to leave the signal input ends (2ha, 2hb) of the voice coil connection conductors (2h) as projection portions from the base member (B).

2. A method according to claim 1, wherein the cut portions (B1) are holes (B1) formed in the suspension (1), and a sewing thread (3) for mounting the voice coil connection conductors (2h) on the base member (B) is fastened to the voice coil connection conductors (2h) including a portion of the voice coil connection conductors (2h) corresponding





to the holes (B1).

3. A method according to claim 1 or 2, wherein the pressure molding is thermal press, and the signal input
5 ends (2ha, 2hb) of the voice coil connection conductors (2h) are coated with cream solder and thereafter thermally pressed together with the base member (B).

4. A loudspeaker suspension device comprising:

10 (a) a suspension (1) made of a planar base member (B) having cut portions (B1) at predetermined positions, the planar base member (B) being pressure molded and trimmed with trimming lines passing the cut portions (B1); and

(b) voice coil connection conductors (2h) mounted on
15 said suspension (1) with signal input ends (2ha, 2hb) of the voice coil connection conductors (2h) being positioned at the cut portions (B1), said voice coil connection conductors (2h) and said suspension (1) being pressure molded and trimmed along the trimming lines.

20

5. A loudspeaker suspension device according to claim 4, wherein said suspension (1) includes inner adhesion portions (14), a roll portion (11r) and an outer adhesion portion (12) in the order from an inside to an outside, and
25 said voice coil connection conductors (2h) traverse at end





portions thereof the roll portion (11r) and extend at an intermediate portion thereof the inner adhesion portions (14).

- 5 6. A loudspeaker suspension device according to claim 4 or 5, wherein the cut portions (B1) are holes (B1) formed in said suspension (1), and a sewing thread (3) for mounting said voice coil connection conductors (2h) on the base member (B) is fastened to said voice coil connection
- 10 conductors (2h) including a portion of said voice coil connection conductors (2h) corresponding to the holes (B1).

This Sheet Has Been Replaced



THIS SHEET HAS BEEN
REPLACED