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(54) Deflection coil and fabrication method thereof.

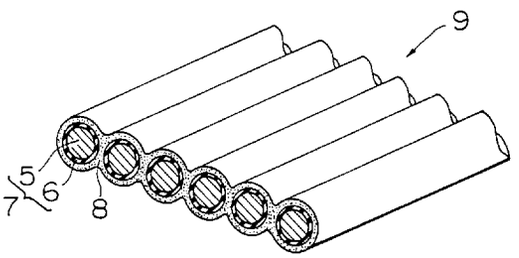
(57) There is provided a deflection coil and a fabrication method thereof wherein conductors of the deflection coil are prevented from being, displaced and biassed and no gap is produced among laminates of the conductors, and the deflection coil is constructed in a short time.

Grooves are formed in a surface of a bobbin, in each of which grooves a band-shaped parallel electric conductor (7) is arranged and laminated, said parallel electric conductor being composed of a plurality of parallel electric conductor wires bonded with each other through a bonding layer.

A thermoplastic resin layer (8) which has a lower softening temperature than an insulating layer and the bobbin is formed on the outermost layer of the parallel conductor insulated through and coated with the insulating layer. The parallel conductors (9) are arranged and laminated in a coil winding groove formed on the bobbin to take a configuration of a saddle type deflection coil, and thereafterthe parallel conductor is supplied with power to thereby heat and soften the thermoplastic resin.

In contrast, a pressurizing tool is inserted into the coil winding groove in the bobbin to pressurize the wound and laminated parallel conductors from the upper portion of the same and hereby bring the laminates of the parallel conductors into close contact for integration thereof.

FIG. 4



EP 0 566 303 A1

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a deflection coil of a deflection yoke mounted on television receivers or display units, and a fabrication method thereof.

2. Description of the Priror Art

With recent development of television recevivers into those of high-vision and with recent appearance of high fine display units, specifications thereof such as color mismatching on a cathode-ray tube screen, i.e., convergence of the same gets increasingly severe, and accompanied therewith further accurate control of a deflection magnetic field becomes earnestly desired.

One type of those deflection yokes for use in television receivers and display units, etc., includes as conventionally known a horizontal deflection coil mounted inside a resin-made bobbin and a vertical deflection coil mounted outside the same. A horizontal defelction coil of a deflection yoke of the type using a bobbin is of a saddle type and a vertical coil is of a saddle type or a troidal type.

A saddle type deflection coil of a deflection yoke is constrcuted as illustrated in FIG. 1 by forming a plurality of grooves 62 in a surface of a bobbin 80 of the deflection yoke and winding one by one electrical conductor wires 60 such as copper wires in the grooves 62 using a winding machine, each electrical conductor 60 having an insulating layer 60b coated on the surface of a conductor wire 60a. Such prior art saddle type deflection coil, however, suffers from difficulties: Owing to force directed in the direction of F in Fig. 1 and exerted on the electrical conductor wire 60, the electrical conductor wire 60 to be wound in the groove 62 is, displaced and biassed in the direction of the force F, and the order of the winding of the electrical conductor wire 60 is replaced and hence such winding as designated by a design becomes impossible. Further, a displaced state of each of the windings of the mass-produced deflection coils causes variations thereof for each article, which makes it impossible to accurately control a deflection magnetic field. Further, variations of mass-produced articles result in the lowering of the yield, and hence the prior art winding method is disadvantageous in view of the cost. Even in the just-mentioned prior art method, the electrical conductor wire 60 is reduced in its displacement and biassed winding as the width of the coil winding groove is narrowed to satisfy an original design, but followed by another problem of coil performance being deteriorated because of a ratio L/R between inductance L and resistance R being reduced.

SUMMARY OF THE INVENTION

The present invention is to solve the difficulties with the prior art, and has an object to provide a deflection coil and a fabrication method thereof wherein electric conductor wires are prevented from being displaced and biassed in the groove while being wound.

It is another object of the present invention to provide a method of fabricating a deflection coil with no gap produced among laminated electrical conductor wires.

It is further object of the present invention to provide a deflection coil which can be formed in a short time.

To achieve the above object, a deflection coil according to the present invention is adapted such that there is employed a band-shaped parallel conductor which is formed with a plurality of parallel bonded electrical conductors each having the same cross sectional configuration and being insulated from each other. The parallel conductor wire is wound in each groove formed in a bobbin surface. The parallel conductors wound in each groove are laminated into a plurality of layers and those laminated parallel conductors are integrally united through insulating resin previously applied on a parallel conductor surface and softened by heating. Those parallel conductors may be wound in lamination and integrally united as the deflection coil.

A fabrication method of a deflection coil according to the present invention comprises steps of: forming a band-shaped parallel electrical conductor by parallely arranging and bonding a plurality of electrical conductor wires each of the same cross sectional configuration; winding and laminating said parallel electrical conductor in a groove formed in a bobbin or a metal mold; and thereafter integrally uniting resulting laminates of said parallel electrical conductor through injected insulating resin injected into the groove or through resin applied on a parallel electrical conductor surface which resin is softened by heating.

Further, a fabrication method of a deflection coil according to the present invention comprises steps of: forming a saddle type deflection coil by winding and laminating the parallel electrical conductors in the bobbin groove; supplying said wound and laminated parallel electrical conductors with power to hereby soften said thermoplastic resin layer while integrally closely uniting said laminates of the parallel electrical conductors by inserting a pressurizing tool into the wound and laminated parallel electrical conductors from the upper portion of the same.

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which prefered embodiments of the present invention are shown by way of illustrative examples.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view illustrating electric conductor wires wound in a groove associated with a- prior art deflection coil;

FIG. 2 is a perspective view illustrating a deflection coil according to the present invention mounted on a bobbin;

FIG. 3 is a perspective view illustrating the deflection coil according to the present invention;

FIG. 4 is a perspective view illustrating a band-shaped parallel electric conductor used for a deflection coil according to the present invention;

FIG. 5 is a perspective view illustrating a half of the deflection coil mounted on a deflection coil according to the present invention;

FIG. 6 is a sectional view illustrating electric conductor wires wound in a groove of the deflection coil according to the present invention;

FIG. 7 is a connection diagram exemplarily illustrating coil connection;

FIG. 8 is a perspective view illustrating a metal mold for fabricating the deflection coil;

FIG. 9 is a sectional view illustrating the electric conductor wires wound in a groove of the deflection coil according to the prior art;

FIG. 10 is a sectional view illustrating the electric conductor wires wound in the groove of the deflection coil being pressurized through a pressurizing tool;

FIG. 11 is a perspective view illustrating another embodiment of the parallel electric conductor;

FIG. 12 is a sectional view illustrating still another embodiment of the parallel electric conductor; and

FIG. 13 is a sectional view illustrating still another embodiment of the parallel electric conductor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In what follows, preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Referring to FIG. 2, there is illustrated a horizontal deflection coil 2 which is of a horn-shape as a whole and includes conductor wires wound into a predetermined configuration inside a resin-made bobbin, and which constitutes a deflection yoke in cooperation with a vertical deflection coil and a core, etc not shown. The horizontal deflection coil 2 is formed with two deflection coils one of which is illustrated on a bobbin 4a in FIG. 5. As shown in Fig. 5, a deflection coil 4 conprises parallel conductors 9 wound in a plurality of grooves 31 formed on the inside surface of the bobbin 4a.

In the following, there will be described the deflection coil 4 by reference to Figs. 2 and 5. The deflection coil 4 includes the bobbin 4a and a parallel electric conductor 9 wound in first through seventh grooves 31 to 37 formed on the inside surface of the bobbin 4a. These grooves 31 to 37 are disposed symmetrically in each of the two deflection coils. The fifth groove 35 and the seventh groove 37 for example have a common base end (neck part) A and tip ends (head parts) being branched, with the groove width of each of the fifth and seventh grooves 35, 37 on the tip end being the same as that on the base end A.

The parallel electric conductor 9 is constructed into a band-shaped one as illustrated in FIG. 4 by forming a bonding layer 8 on the outside of each electric cnductor wire 7. The electric conductor wire 7 is formed with a conductor wire 5 of copper for example and an insulating layer 6 coated on the outer periphery of the conductor wire 5. A parallely a plurality of the electric conductor wires 7 are arranged parallely and bonded with bonding layers 8. The conductor wire 5 of each electric conductor wire 7 is made equal in its sectional configuration along its longitudinal locations, i.e., being formed into the same sectional configuration along the length thereof.

Further, the parallel electric conductor 9, in the present embodiment, possesses its width equal to or slightly smaller than the groove width W of the bobbin 4a illustrated in FIG. 6 on which bobbin 4a the parallel electric conductor 9 is wound. An example of the groove width of the bobbin 4a is 3 mm, and therefore the parallel conductor 9 has a width of 3 mm or a width about 0.1 mm smaller than the former.

The deflection coil 4 is constructed by winding and laminating a plurality of times the parallel electric conductor 9 in the grooves 31 to 37 of the corresponding bobbin 4a with use of a winding machine and the like as illustrated in FIG. 6.

The parallel electric conductor 9, in the present embodiment, is comprised of the six electric conductor wires 7 as illustrated in FIG. 4. The parallel electric conductr 9 is wound by 5 turns in a first groove 31, and wound by 4 turns in a second groove 32, and finally wound 2 turns in a n-th groove, as illustrated in FIG. 7. The six electric conductor wires 7 in each groove are divided into 3 blocks one block with two electric conductor wires, and the electric conductor wires 7 of each block are interconnected parallely with each other and the respective blocks of the respectve grooves are interconnted in series to each other, as illustated in FIG. 7. Further, output terminals of the blocks of the first groove 31 and input terminals of the blocks of the second grooves 32 are interconnected with each other.

In such a manner, the output terminals of the blocks of each groove and the input terminals of the blocks of the next groove are interconnected in series to each other for wiring of the deflection coil 4.

It is noted herein that the deflection coil 4 in the present embodiment may be constructed not only as

the horizontal deflection coil 2 but also as a saddle type vertical deflection coil. On the outside of the saddle type horizontal deflection coil 2 constructed as just-mentioned above, a saddle type vertical deflection coil is disposed, on the outside of which vertical deflection coil a core not shown is further disposed, to assemble a deflection yoke.

According to the present embodiment, the deflection coil 4 is yielded by joining a pluality of the parallel electric conductor wires 7 with each other into the band-shaped parallel conductor 9 and winding the parallel conductor 9 in the corresponding grooves in the bobbin. The electric conductor wires 7 of each parallel conductor 9 are prevented from being replaced in the order and displaced. In addition, since the parallel conductor 9 possesses its width equal to or slightly smaller than the groove width, it is satisfactorily wound without suffering from any backlash to prevent the electric conductor wires 7 from being wound, displaced and biased and thus eliminate the variations of a mangnetic filed distribution for high accuracy of formation of the deflection coil.

Further, since the deflection coil is formed by winding the parallel conductor 9, wiring time is sharply shortened compared with the prior art method where the electric cnductor wires 7 are wound one by one.

Since the parallel conductor 9 is wound without suffering from any backlash in the groove, the parallel conductor 9 is prevented from being displaced even under exertion of any vibration to stabilize the characteristics thereof againts mechanical vibration and the like. Further, the electric conductor wires of the parallel conductor 9 wound in each groove are divided into blocks, one block for the two electric conductor wires, the two electric conductor wires 7 of each block being interconnected parallely, so that interline voltage between adjacent electric conductor wires 7 in each groove is reduced compared with a case where the six electric conductor wires 7 in each groove are interconnected in series to each other. Hereby, the interline distributed capacitance between the adjacent electric conductor wires 7 is reduced and hence the self resonance frequency of the coil is also reduced to effectually prevent any ringing (streaking on a screen) from being produced. Further, since the electric conductor wires 7 of each block are parallely interconnected with each other, current capacity is increased and is made adjustable depending upon the number of the electric conductor wires 7 interconnected parallely. The deflection coil may be fabricated using a metal mold 24 illustrated in FIG. 8. The metal mold 24 includes a plurality of grooves 31 to 37 formed thereon, matched with the configuration of a deflection coil to be fabricated, and pins 25 and flanges both formed thereon. A deflection coil of a predetermined configuration is formed by winding the parallel conductor 9 along the groove 31 and the pins 25 and the like. The deflection coil is eliminated by pulling out the pins 25 and the flange 23 from the metal mold 24. FIG. 3 illustrates the deflection coil 14 so removed. The deflection coil 14 fabricated as such is assembled on the bobbin to construct the horizontal deflection yoke 2.

Another embodiment will further be described wherein a plurality of the laminates of the parallel electric conductor 9 may be fixed to each other by injecting a bonding agent into the groove 31 for example in the bobbin 4a in the case where the parallel electric conductor 9 is wound a plurality of times in the bobbin 4a or injecting a bonding agent into the groove in the metal mold 24 in the case where the parallel conductor 9 is wound a plurality of times in the metal mold 24. Thereupon, the parallel electric conductor 9 may be fixed integrally to the groove 31 for example in the case of the use of the bobbin 4a while the laminates of the parallel conductor 9 are fixed to each other not to the groove 31 for example in the case of the use of the metal mold 24.

Such use of the bonding agent 2 to integrate the respective laminates of the parallel electric conductor 9 further improves stability of the coil against any mechanical vibration and the like and strengthens the mechanical strength of the coil as well as it prevents each parallel electric conductor from being displaced to ensure further stabilization in view of coil characteristics.

Although in the above embodiments a conductor wire of each electric conductor wire 7 was configured into a circular sectional shape, the shape may include other sectional shape such as a square or the shape of bifilar winding, and the number of the electric conductor wires 7 of the parallel electric conductor wire 9 may be set arbitrarily responsibly to the specifications of the coil.

Further, although in the foregoing embodiments the laminates of the parallel conductor 9 were integrated with the bonding agent, any resin which can be softened by heating may be injected and heated, and further such resin (including resin bonded by heating such as a hot melt) softened by heating may previously be applied in the surface of the parallel electric conductor 9 and heated by proper heating means such as heating by power supply to integrate the laminates through softening of the resin softened by heating or fusion of the same.

Further another embodiment will be described with reference to Figs. 11 to 13.

Referring now to Fig. 11 the parallel conductor wire 9 comprises the electric conductor wires 7 each of which is yielded by coating the surface of the conductor wire 5 such as copper or aluminum with an insulating layer 6 formerd with urethane resin and formal resin for example and further coating on the surface of the insulating layer 6 as the outermost layer of the electric conductor wire 7 a thermoplastic resin layer 29 which possesses lower softening tempera-

ture than that of the insulating layer 6 and the bobbin 4a and is not softened by heat produced by coil driving. More specifically, it is formed by arranging a plurality of electric conductor wires 7 and bonding them substantially in the same width of that of the grooves 31 for example of the bobbin 4a.

FIG. 10 is an enlarged view illustating the groove 31 of the bobbin 4a illustrated in FIG. 5, wherein the bobbin 4a where the parallel electric conductor 9 is wound and laminated into a saddle type coil configuration is placed on a base jig 27. The parallel electric conductor 9 is supplied with power and hence heated to melt and fuse the thermoplastic resin layer 29. Prior to the power supply heating or simultaneously with the power supply heating or in a proper timing during the power supply heating the pressurizing tool 28 is inserted into the groove 31 and pressurized from the upper portion thereof whereby the laminates of the parallel electric conductor 9 is pressurized between the base jig 27 and the pressurizing tool 28 owing to the base jig 27 serving as a stopper and brought into close contact and united integrally through quick solidificaton of the thermoplastic resin layer 29.

Hereby, even if there is a tendency of the parallel electric conductor 9 being likely to be bent or is any gap 30 produced any gap 30 between the adjacent laminates of the parallel electric conductor 9 as illustrated in FIG. 9, the gap 30 which might otherwise be caused by the tendency of the parallel electric conductor 9 being likely to be bent is corrected and eliminated by the pressurization, and the laminates of the parallel electric conductor 9 are brought into close contact with each other to ensure a high dimensional accuracy deflection coil 4. The pressurizing force may be as low as possible provided it can correct the gap 30 between the adjacent laminates of the parallel conductor 9 and the pressurizing jig 28 is needed as a matter of course to be fabricated so as not to deform the bobbin 4a.

Further, although in the foregoing embodiments the description has been made exemplarily using the bobbin 4a, a metal mold 24 is useable as a still further embodiment.

According to the present embodiment, a parallel electric conductor 9, with the thermoplastic resin 29 possessing a softening temperature lower than those of the bobbin 4a and the insulating layer 6 formed on the outermost layer of the parallel electric conductor 9, is wound and laminated in the groove 31 for example, and thereafter supplied with electric power and hence heated while the groove 31 for example in the bobbin 4a is pressurized from the upper side thereof. There is accordingly eliminated any gap 30 which might otherwise be produced between the adjacent laminates of the parallel electric conductor 9 and between the parallel electric conductor 9 and the bottom 41 of the groove 31 for example in the bobbin 4a to ensure a high dimensional accuracy deflection coil 4 and hence control a deflecting magnetic field precisely.

Additionally, since the parallel electric conductor 9 of the same width as that of the groove 31 for example in the bobbin 4a is wound and laminated in the groove 31 for example, the conductor wires 5 are prevented from being wound, displaced and biassed or from being replaced in the order of the winding for accurate winding as designated by a design.

Further, since the bobbin 4a and the parallel electric conductor 9 are brought into close contact and integrated with each other with the thermoplastic resin 29, a resulting deflection coil is made stable against any vibration and so on.

Still further, since the thermoplastic resin 29 brings the laminates of the parallel electric conductor 9 into close contact with each other in a very short time, working efficiency is sharply improved.

It should herein be noticed that the present invention may be modified into varieties of modes. For example, although in the foregoing examples the thermoplastic resin is melted and thereafter the pressurzing tool 28 is employed for the pressurization, the laminates of the parallel electrode conductor 9 may be pressurized by the pressurizing tool 28 and thereafter fixed to each other by injecting the resin or the bonding agent into the groove.

Further, although in the foregoing embodiments the parallel electric conductor 9 is coated with the thermoplastic resin 29 on the outside of the insulating layer 6, conductor wires 5, each of which is coated an insulating layer 6, may be arranged as illustrated in FIG.11 and the thermoplastic resin 29 may be disposed as a bonding agent underneath thereof. Further, a resin- sheet 42 illustrated in FIG. 12 may be used as in place of the theremoplastic resin 29.

Further, the thermoplastic resin 29 may be formed on the outermost layer of the parallel electric conductor 9, where the conductor wires 5 are parallely arranged as illustrated in FIG. 12 and bonded integrally by a bonding layer 8. The thermoplastic layer 29 may be formed on the outermost layer of the parallel electric conductor 9 where the bonding layer 8 is uniformly applied over the entire outer periphery surface of the conductor wire 5 for bonding as illustrated in FIG. 13. Further, the conductor wire 5, on each of which the insulating layer 6 is formed, may be bonded through the thermoplastic bonding layer 29 by arranging the conductor wires 5 parallely and closely but without being bonded and covering the entire of the conductor wires with the thermoplastic bonding layer 29.

Additionally, although in the foregoing embodiments the bobbin 4a was supported using the base jig 27, use may be made of another means such as a chuck pawl or the like instead of the base jig 27 for supporting the bobbin 4a.

Claims

1. A deflection coil comprising a band-shaped parallel electric conductor, said electric conductor being formed with a plurality of parallel bonded electric conductor wires insulated from each other.

2. A deflection coil according to claim 1 wherein said parallel electric conductors are laminated one on another and resulting laminates of the parallel electric conductor are fixed to each other through a bonding agent.

3. A deflection coil according to claim 1 wherein said parallel electric conductors are arranged in grooves formed in a surface of a bobbin.

4. A delection coil according to claim 3 wherein said parallel electric conductors are laminated one on another and are fixed to each other through a bonding agent;

5. A method of fabricating a deflection coil comprising steps of:

forming a band-shaped parallel electric conductor into a predetermined configuration, said parallel electric conductor being comprised of a plurality of parallel electric conductor wires insulated from each other;

applying a bonding agent onto the parallel electric ady wewere rconductor to the parallel conductor; and

fixing the parallel electric conductor wires to each other by said bonding agent.

6. A. method of fabricating a deflection coil according to claim 5 wherein said bonding agent is a thermoplastic resin which is applied on said parallel electric conductors, heated and melted to fix said parallel electric conductors to each other.

7. A method of fabricating a deflection coil comprising steps of:

superimposing band-shaped parallel electric conductors in a groove formed on a surface of a bobbin, said band-shaped parallel electric conductor being comprised of a plurality of parallel bonded electric conductor wires insulated from each other; and

injecting a bonding agent into said groove to fix said parallel electric conductors in said groove.

8. A method of fabricating a deflection coil according to claim 7 wherein said bonding agent is thermoplastic resin which is applied onto said parallel electric conductors formed in a predetermined configuration, heated and melted to fix said parallel electric conductor to each other.

9. A method of fabricating a deflection coil according to claim 8 wherein the thermoplastic resin is previously applied on the outermost layer of the parallel electric conductors.

10. A method of fabricating a deflection coil according to claim 9 wherein said resin is melted in the groove of the bobbin, and the parallel electric conductor wires arranged in the groove are pressed externally through a press die and are hereby brought into close contact with each other.

11. A method of fabricating a deflection coil according to claim 9 wherein said thermoplastic resin is heated by supplying a current in the coil.

12. A method of fabricating a deflection coil according to claim 10 wherein said thermoplastic resin is heated by supplying a current in the coil.

13. A method of fabricating a deflection coil comprising steps of:

superimposing in a groove formed in a metal mold a band-shaped multicore parallel conductor, said multicore parallel conductor being comprised of a plurality of bonded parallel electric conductor wires insulated from each other;

injecting a bonding agent into said groove to fix the multicore parallel conductors to each other;

and thereafter take out the multicore parallel conductor from the metal mold.

14. A method of fabricating a deflection coil according to claim 13 wherein said bonding agent is thermoplastic resin which is applied onto said multicore paralell conductor formed into a predetermined configuration, heated and melted to fix said multicore parallel conductor.

15. A method of fabricating a deflection coil according to claim 14 wherein said thermoplastic resin is previously applied on the outermost layer of the multicore parallel conductors.

16. A method of fabricating a deflection coil according to claim 15 wherein said resin is melted in the groove in the metal mold and the multicore parallel conductors arranged in said groove are pressed externally into close contact with each other.

17. A method of fabricating a deflection coil according to claim 15 wherein said thermoplastic resin

is heated by supplying a current in the coil.

18. A method of fabricating a deflection coil according to claim 16 wherein said thermoplastic resin is heated by supplying a current in the coil.

FIG. 1
PRIOR ART

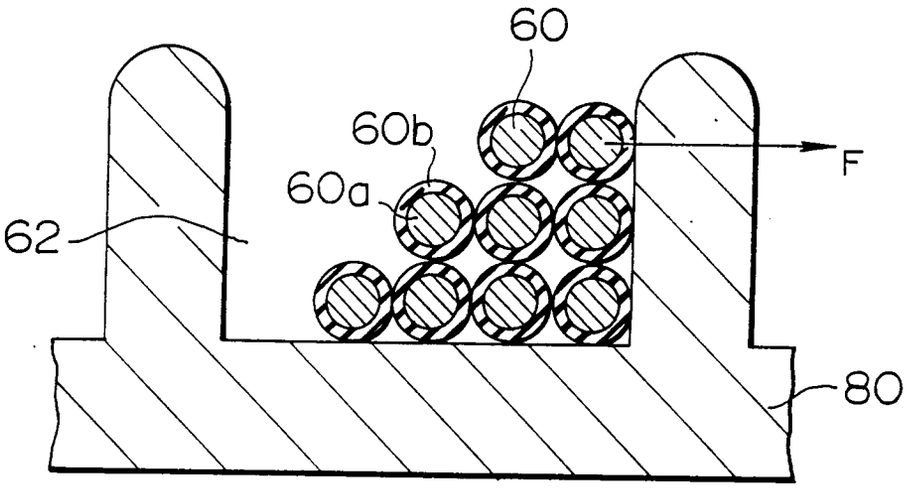


FIG. 2

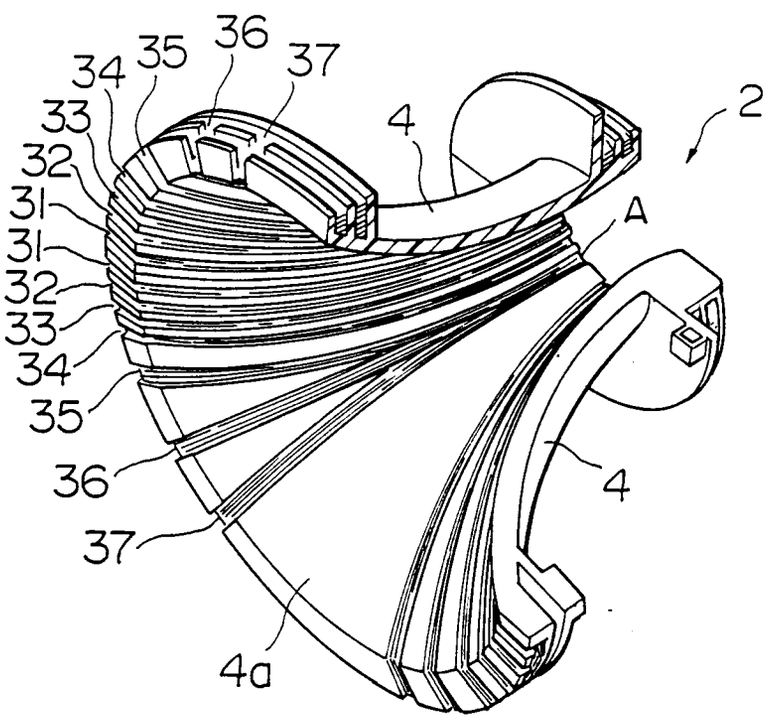


FIG. 3

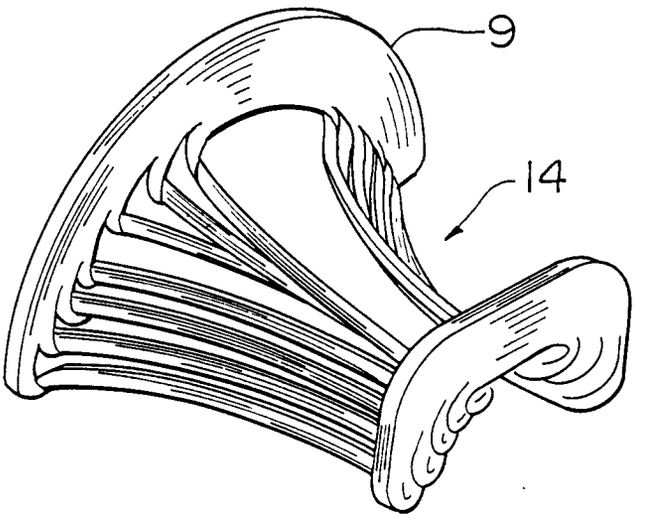


FIG. 4

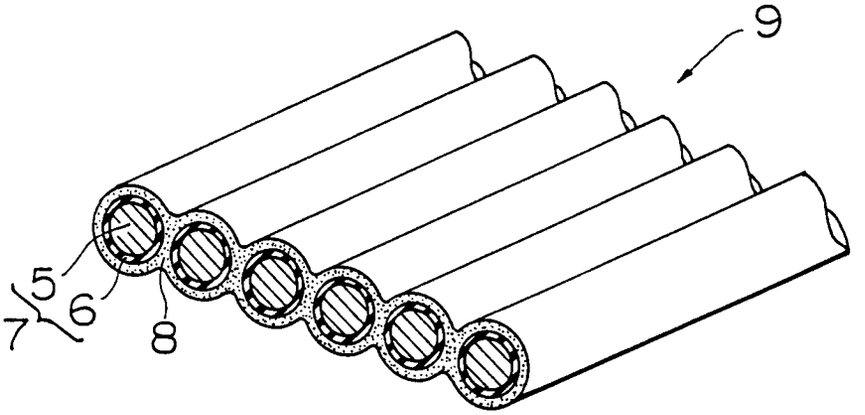


FIG. 5

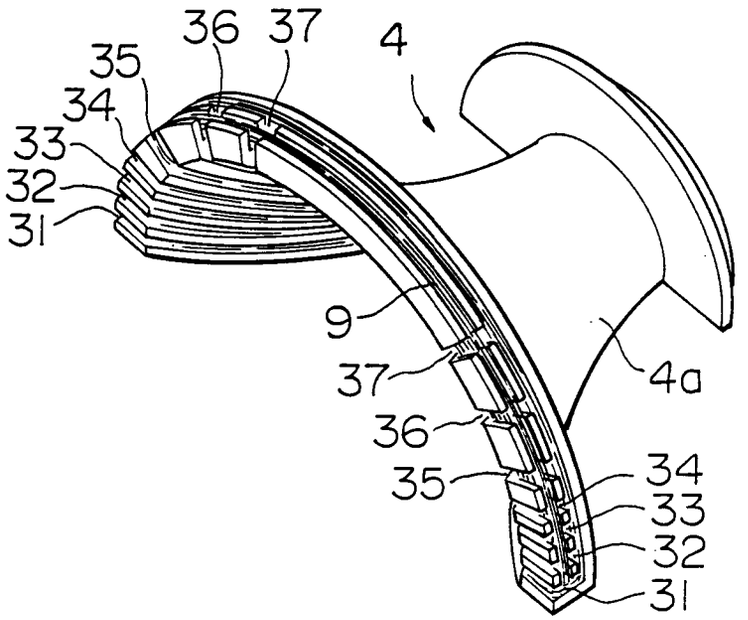


FIG. 6

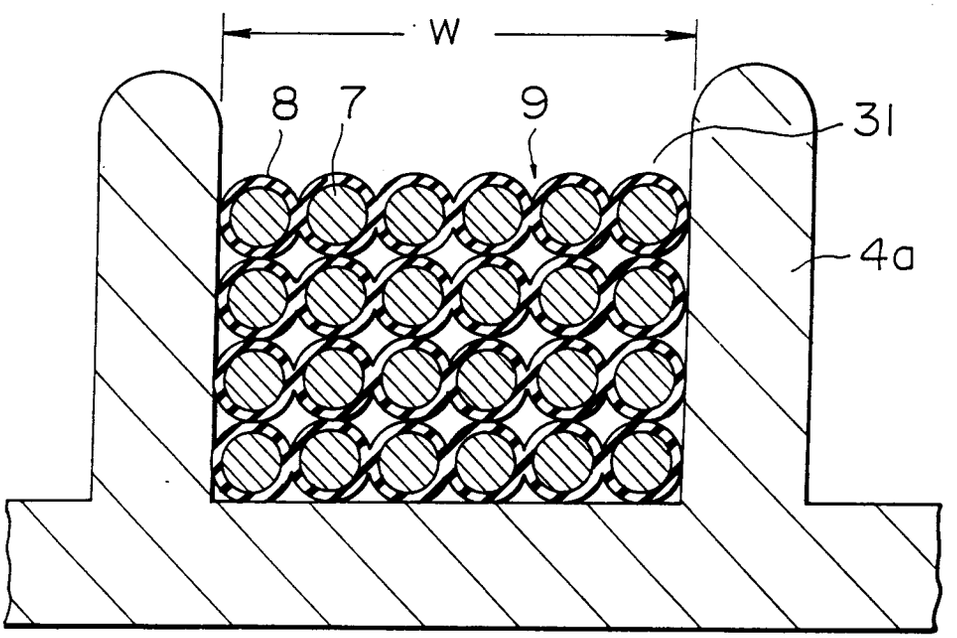


FIG. 7

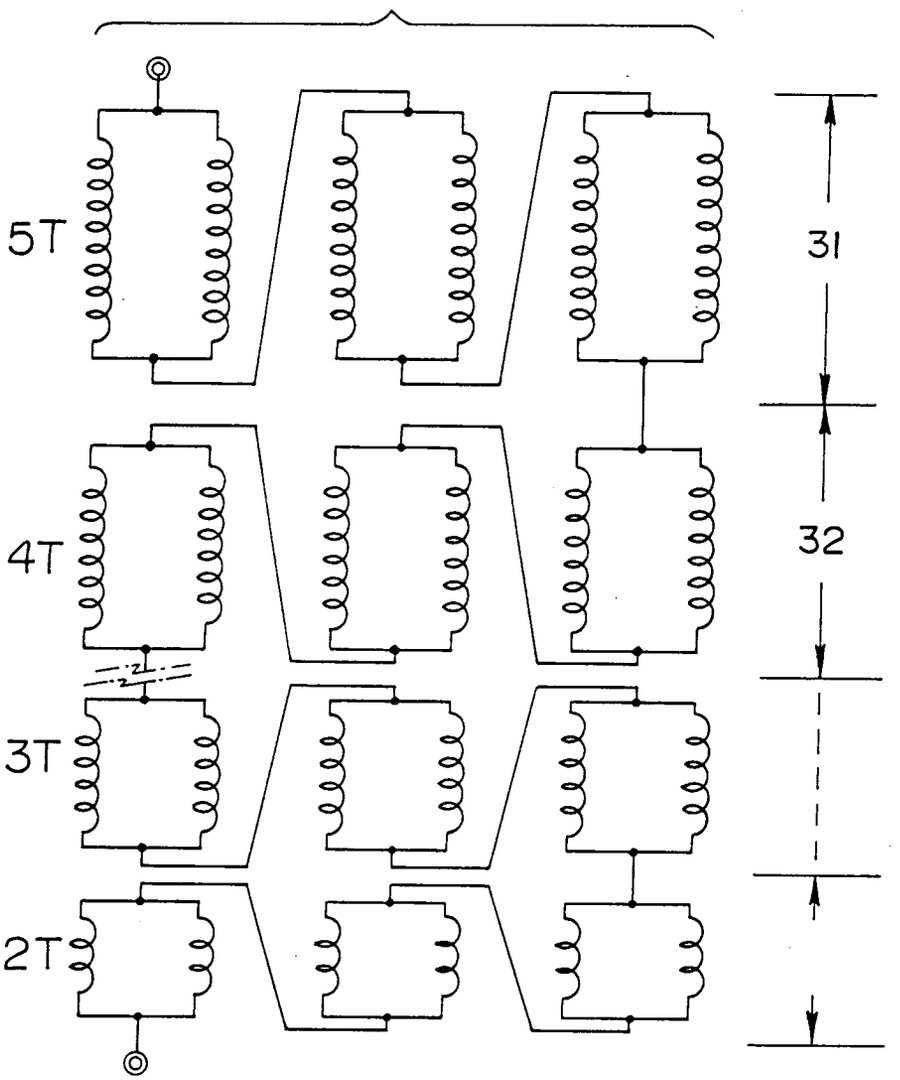


FIG. 8

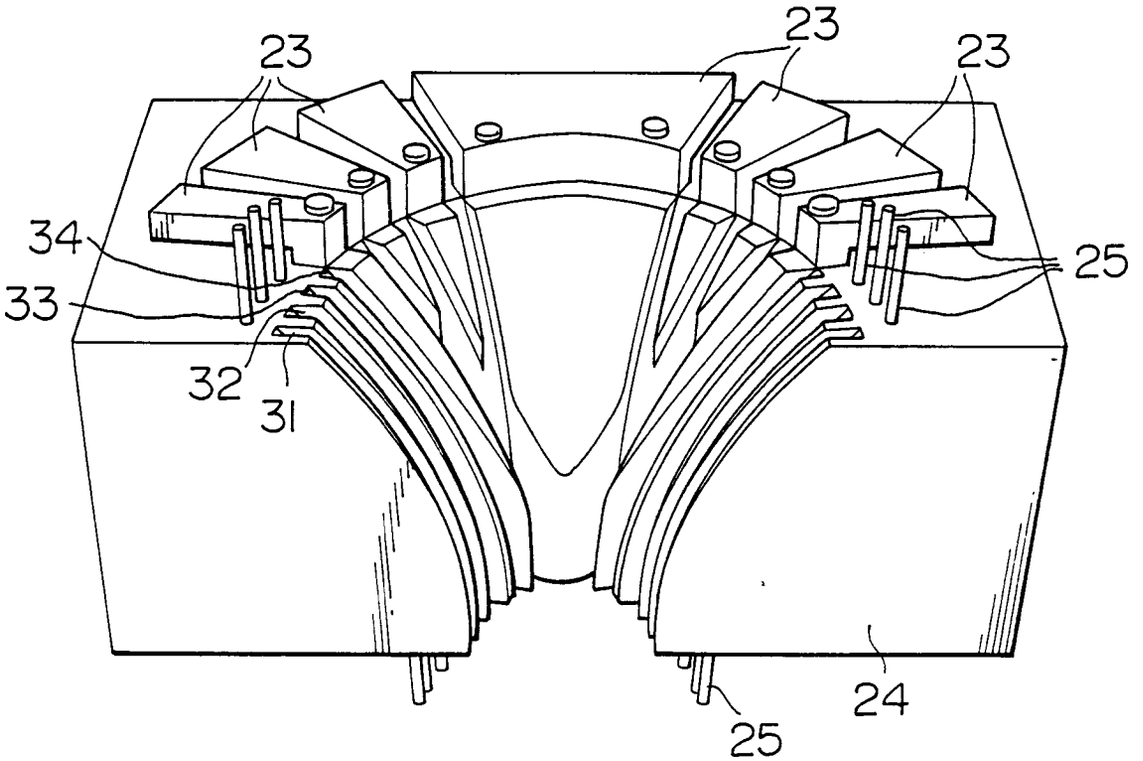


FIG. 9

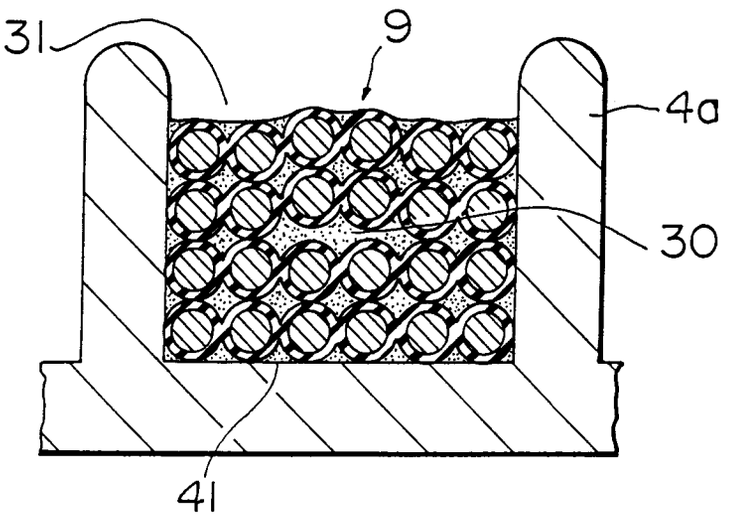


FIG. 10

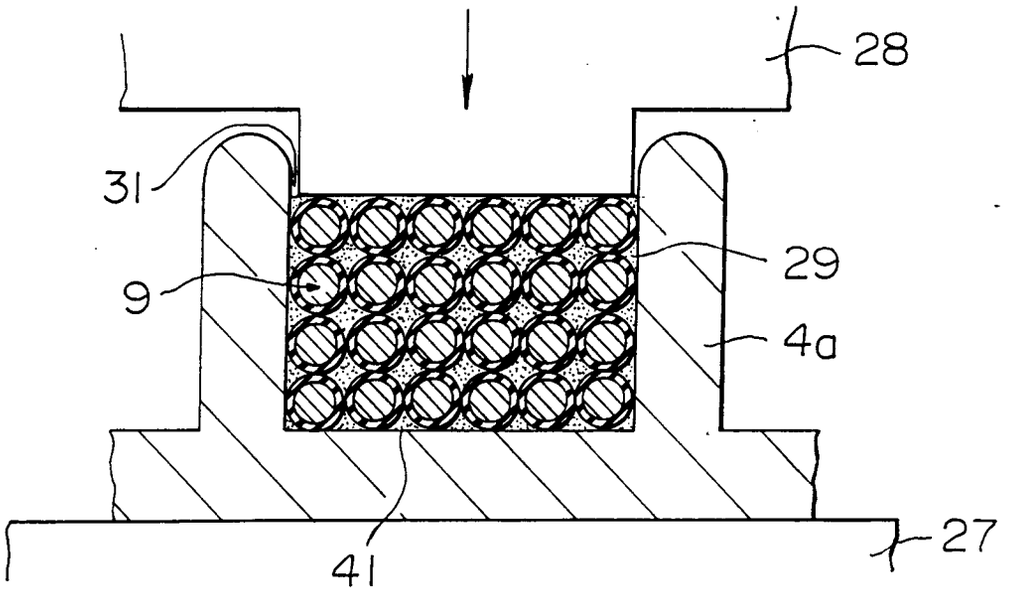


FIG. 11

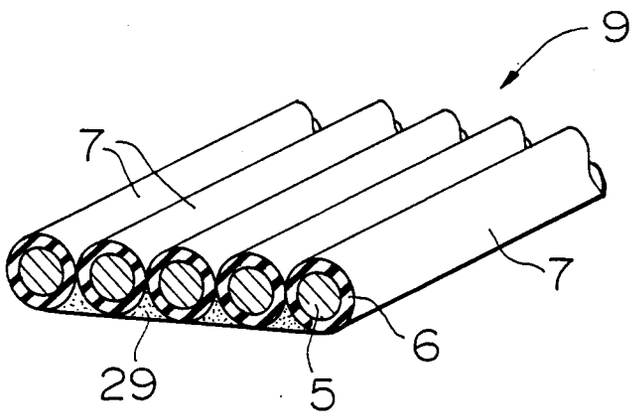


FIG. 12

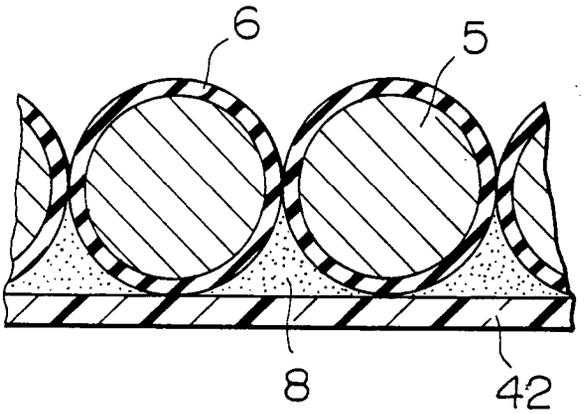
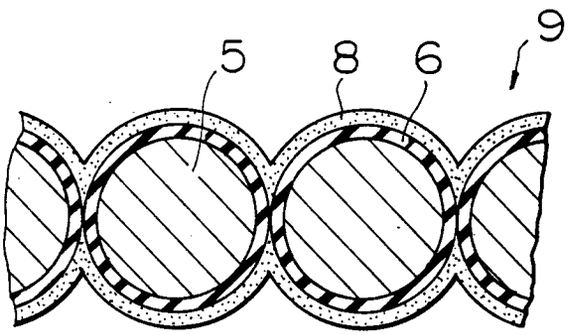


FIG. 13



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 2676

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-C-2 744 048 (LICENTIA PATENT-VERWALTUNGS-GMBH) * column 1, line 62 - column 2, line 2 * * column 2, line 9 - line 27 * * column 2, line 58 - column 4, line 19 * * figures *	1-5	H01J9/236 H01J29/76 H01F41/04
Y	---	6	
Y	US-A-4 473 716 (JESSEMAN) * column 1, line 64 - column 2, line 27 * * column 5, line 5 - line 35 * * figures 3,10 *	6	
A	---	7	
	EP-A-0 198 535 (NV. PHILIPS' GLOEILAMPENFABRIEKEN) * abstract; figures 1,3 * * page 2, line 37 - page 3, line 5 * * page 3, line 26 - line 29 * * page 4, line 13 - line 19 * * page 7, line 19 - line 35 *		
A	---	7	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
	PATENT ABSTRACTS OF JAPAN vol. 8, no. 239 (E-276)(1676) 2 November 1984 & JP-A-59 119 640 (TOUSHIBA AUDIO BIDEO ENG. K.K.) 10 July 1984 * abstract *		H01J H01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 JULY 1993	COLVIN G.G.

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