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**AT BE CH DE DK ES FR GB GR IT LI LU MC
NL PT SE**(71) Applicant: **You, Chin-San**
No. 3, Lane 1029,
Feng-Shyn Road
Feng Yuan City, Taichung Hsien(TW)(72) Inventor: **You, Chin-San**
No. 3, Lane 1029,
Feng-Shyn Road
Feng Yuan City, Taichung Hsien(TW)(74) Representative: **Jones, Michael Raymond et al**
HASELTINE LAKE & CO.
Hazlitt House
28 Southampton Buildings
Chancery Lane
London WC2A 1AT (GB)(54) **Method of making a game racket frame.**

(57) There is disclosed a method of making a game racket frame which comprises the use of a tubular body of aluminium alloy consistent with a shape of a racket frame (10). An annular recess (20) is provided respectively at the mid-point of the left-hand half of the head frame (121) and at the mid-point of the right-hand half of the head frame. The annular recess (20) is coated with adhesive resin. The tubular body is placed in a moulding tool (30) comprising a mould cavity (34) having an annular ring which is located at a position corresponding to the annular recess (20) of the tubular body and which has a shape corresponding to that of the annular recess (20) of the tubular body and a size slightly larger than that of the annular recess (20) of the tubular body. Molten plastics material is injected into the mould cavity (34) under pressure and heat. Upon completion of the curing of the plastic material, the racket frame is removed from the moulding tool. The racket frame so made is provided with weight-balancing pieces (16, 18) fastened securely to the head frame (12) of the racket (10).

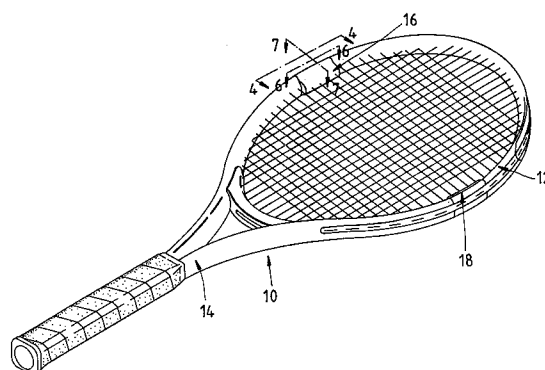


FIG.1

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This invention relates to a method of making a game racket frame, and more particularly to a method of making a racket frame made of an aluminium alloy and provided with a weight-balancing system.

According to the prior art, a racket frame, especially a tennis racket frame, is generally provided with weight-balancing pieces fastened respectively to the mid-point of the left-hand half of the head frame and to the mid-point of the right-hand half of the head frame, so as to enhance the inertia of the racket and to prevent the racket from twisting upon hitting a ball. However, it is often difficult to have such weight-balancing pieces fastened securely to a head frame of an aluminium alloy.

According to one aspect of the present invention, there is provided a method of making a game racket frame, comprising the steps of:

- (a) using a tubular body of an aluminium alloy to constitute a major component of a racket frame having a head frame and a shaft extending outwardly from an open end of the head frame;
- (b) punching an annular recess of a predetermined length located at each of an approximate mid-point of the left-hand half of the head frame and an approximate mid-point of the right-hand half of the head frame;
- (c) coating each annular recess with an adhesive resin;
- (d) placing the head frame in a moulding tool having a cavity provided with a widened portion facing an inner side of the annular recess and with a shape and size slightly larger than the annular recess;
- (e) injecting a molten plastics material into the cavity of the moulding tool under pressure at a predetermined temperature; and
- (f) upon completion of the curing of the plastics material, removing the racket frame from the moulding tool.

The present invention makes it possible to provide a method of making a game racket frame made of aluminium alloy, provided with weight-balancing pieces, which are securely fastened to the head frame.

Preferably each annular recess has two first step portions located respectively at both ends thereof and has a second step portion located between the two first step portions.

Preferably each annular recess is provided with a plurality of cavities.

Preferably a surface region at a junction between the head frame and the annular recess is provided with a plurality of serrated grooves before the racket frame is placed in the moulding tool.

Preferably the cavity of the moulding tool has a wall provided with a bridging layer made of a carbon fibre fabric preimpregnated with a ther-

mosetting resin and located at a position corresponding to the annular recess.

Preferably each annular recess is provided with a plurality of ducts at the time when the annular recess is punched.

Another aspect of the present invention provides a game racket frame having a head frame and a shaft and formed of an aluminium alloy, which has an annular recess at each of an approximate mid-point of the left-hand half of the head frame and an approximate mid-point of the right-hand half of the head frame, the annular recesses each being surrounded by a cured plastics material which serves as a weight.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 shows a perspective view of a racket frame of aluminium alloy of a first preferred embodiment of the present invention;

Figure 2 shows a three-dimensional view of a punched annular recess of a head frame embodied in the present invention;

Figure 3 shows a three-dimensional moulding tool for making the first preferred embodiment of the present invention;

Figure 4 shows a sectional view of a portion taken along the line 4-4 as shown in Figure 1;

Figure 5 shows a sectional view of a portion of a second preferred embodiment of the present invention;

Figure 6 shows a sectional view of a portion taken along the line 6-6 as shown in Figure 1;

Figure 7 shows a sectional view of a portion taken along the line 7-7 as shown in Figure 1;

Figure 8 shows a sectional view of a portion of a racket frame of aluminium alloy of a further embodiment of the present invention;

Figure 9 shows a three-dimensional view of a racket frame of aluminium alloy of another embodiment of the present invention;

Figure 10 shows a sectional view of a portion taken along the line 10-10 as shown in Figure 9;

Figure 11 shows a three-dimensional schematic view of a manufacturing process in accordance with a preferred embodiment of the present invention; and

Figure 12 shows a sectional view of a racket frame of aluminium alloy of the last-mentioned embodiment of the present invention.

Referring to Figures 1-4, a racket 10 made of an aluminium alloy tubular body embodied in the present invention is shown to comprise a head frame 12 and a shaft 14. A punched annular recess 20 of a predetermined length is provided at the mid-point of the left-hand half of the head frame 12 and a similar recess 22 (not shown) at the mid-

point of the right-hand half of the head frame 12. The annular recesses 20 and 22 are coated with epoxy resin. A moulding tool 30 comprises a male mould 31 and a female mould 32 which between them define a mould cavity 34, which has a size larger than the head frame 12 and also has a widened portion 36 facing the inner side of the annular recess 20 or 22. With the moulding tool 30 surrounding the racket head frame 12 in the regions of the annular recesses 20 and 22, a plastics material mixed with an epoxy resin is injected into each mould cavity 34. Upon the completion of the curing of the injected plastics material, the racket frame 10 is removed from the moulding tool 30. The racket frame 10 so made is provided with the head frame 12 having weight-balancing pieces 16 and 18, which are located respectively at the mid-point of the left-hand of the head frame 12 and at the mid-point of the right-hand half of the head frame 12.

The weight-balancing pieces 16 and 18 are securely fastened to the head frame 12 by virtue of the facts that they are held securely to the annular recesses 20 and 22 and that they are securely adhered to the surfaces of the annular recesses 20 and 22 by means of a mixture containing the plastic material and the epoxy resin. The weights of the weight-balancing pieces 16 and 18 can be adjusted in accordance with the sizes of the annular recesses 20 and 22 and of the mould cavity 34, and with the density of the injected plastic material.

In a variant shown in Figures 5 and 6, the annular recesses equivalent to the recesses 20 and 22 of Figure 2 are provided respectively with first step portions 201 and 221 and with second step portions 202 and 222 located in an intermediate region of the first step portions 201 and 221. A bridging layer 38 made from carbon fibre fabric preimpregnated in epoxy resin is attached to the mould cavity wall located in a position corresponding to the first step portions 201 and 221. Thereafter, the annular recesses 20 and 22 are each placed in the mould cavity 34, into which a molten plastics material is injected, so that the gap between the cured bridging layer 38 and the wall of the mould cavity 34 is filled in by the injected plastics material. As a result, the weight-balancing pieces 16 and 18 are securely and intimately adhered to the annular recesses 20 and 22.

In order to ensure further that the cured plastics material in the annular recesses 20 and 22 is securely anchored, the annular recesses 20 and 22 are further provided with a plurality of cavities 24 or ducts 26, into which the injected plastics material flows and anchors, as shown in Figures 7 and 8.

In order to prevent the junction area between the weight-balancing pieces 16 and 18 and the

annular recesses 20 and 22 from cracking, a plurality of serrated grooves 28 of the various lengths are constructed at the junction surface between the head frame 12 and the annular recesses 20 and 22, so as to allow the injected plastics material to flow and anchor therein. In view of the fact that the serrated grooves 28 are of different lengths, an uneven junction line is formed in the junction between the weight-balancing pieces 16 and 18 and the head frame 12, as shown in Figures 9 and 10. Such structures as described above serve to avert the cracking of the junction area between the weight-balancing pieces 16 and 18 and the annular recesses 20 and 22.

Furthermore, serrated grooves 28 of an equal length may be disposed in or adjacent the annular recesses 20 and 22, which are provided respectively with the first and the second step portions 201, 221, 202 and 222. A bridging layer 40, which is made of carbon fibre fabric preimpregnated in epoxy resin, is attached to the wall of mould cavity 34 opposite to each of serrated grooves 28 and each of the first step portions 201 and 221. Such a bridging layer 40 is embedded in the serrated groove 28 upon completion of the curing process thereof. As a result, the junction area between the weight-balancing pieces 16 and 18 and the head frame 12 is further reinforced.

Claims

1. A method of making a game racket frame, comprising the steps of:
 - (a) using a tubular body of an aluminium alloy to constitute a major component of a racket frame having a head frame and a shaft extending outwardly from an open end of said head frame;
 - (b) punching an annular recess of a predetermined length located at each of an approximate mid-point of the left-hand half of the head frame and an approximate mid-point of the right-hand half of the head frame;
 - (c) coating each annular recess with an adhesive resin;
 - (d) placing the head frame in a moulding tool having a cavity provided with a widened portion facing an inner side of the annular recess and with a shape and size slightly larger than the annular recess;
 - (e) injecting a molten plastics material into the cavity of the moulding tool under pressure at a predetermined temperature; and
 - (f) upon completion of the curing of the plastics material, removing the racket frame from the moulding tool.

2. A method according to claim 1, wherein each annular recess has two first step portions located respectively at both ends thereof and has a second step portion located between the two first step portions. 5
3. A method according to claim 1 or 2, wherein each annular recess is provided with a plurality of cavities. 10
4. A method according to claim 1, 2 or 3, wherein a surface region at a junction between the head frame and the annular recess is provided with a plurality of serrated grooves before the racket frame is placed in the moulding tool. 15
5. A method according to any preceding claim, wherein the cavity of the moulding tool has a wall provided with a bridging layer made of a carbon fibre fabric preimpregnated with a thermosetting resin and located at a position corresponding to the annular recess. 20
6. A method according to any preceding claim, wherein each annular recess is provided with a plurality of ducts at the time when the annular recess is punched. 25
7. A game racket frame having a head frame and a shaft and formed of an aluminium alloy, which has an annular recess at each of an approximate mid-point of the left-hand half of the head frame and an approximate mid-point of the right-hand half of the head frame, the annular recesses each being surrounded by a cured plastics material which serves as a weight. 30 35

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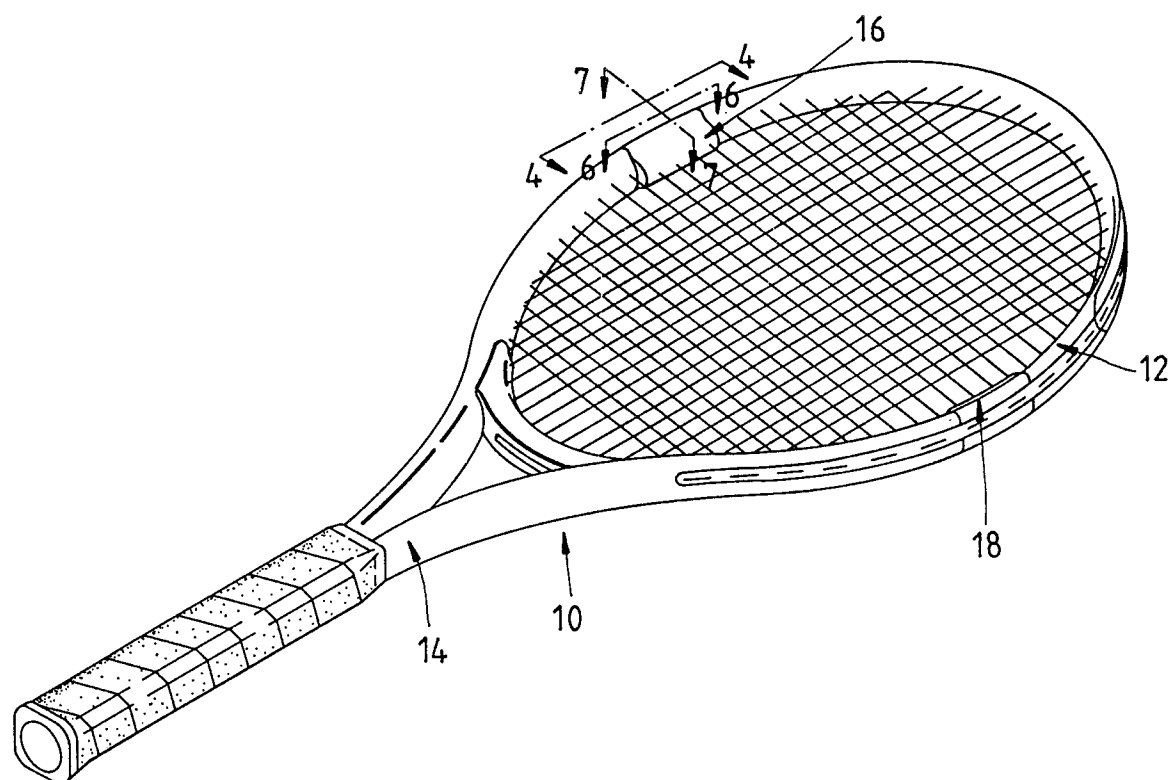


FIG. 1

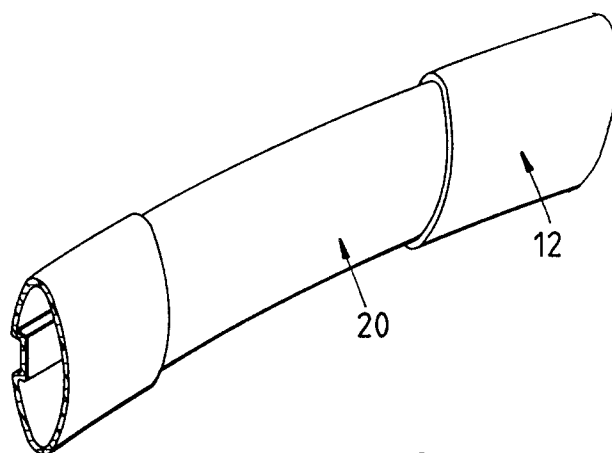


FIG. 2

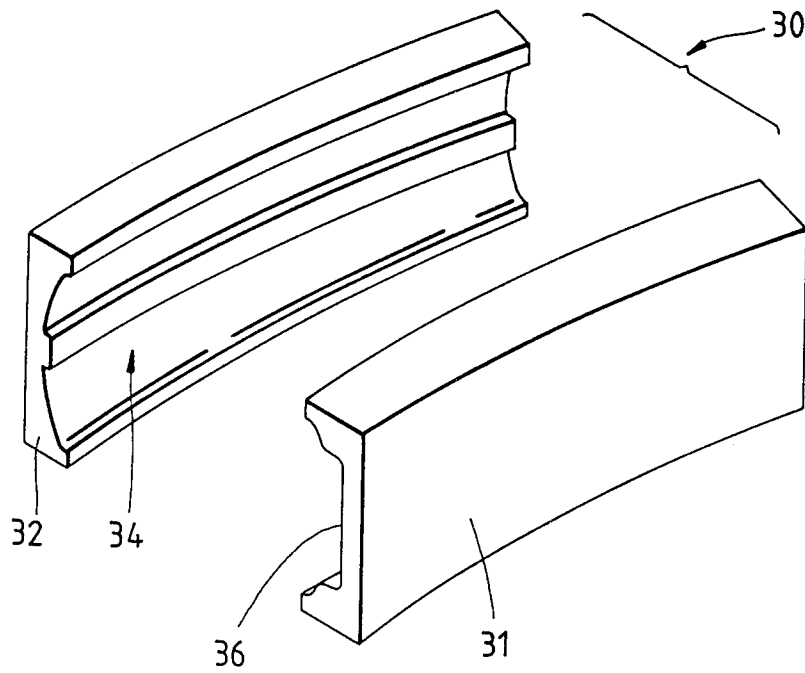


FIG. 3

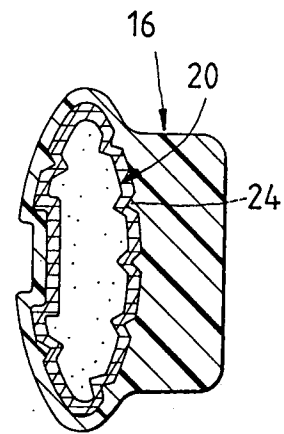


FIG. 7

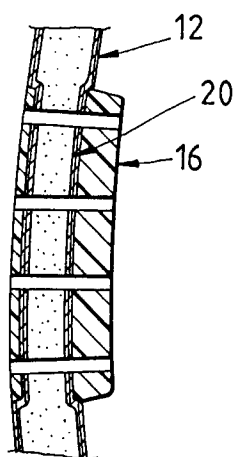


FIG. 4

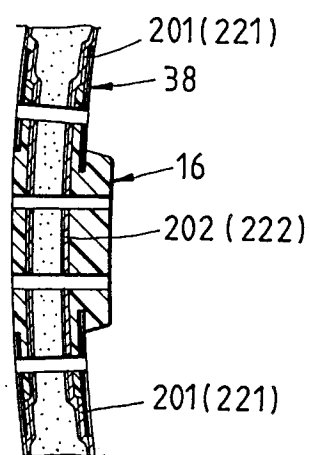


FIG. 5

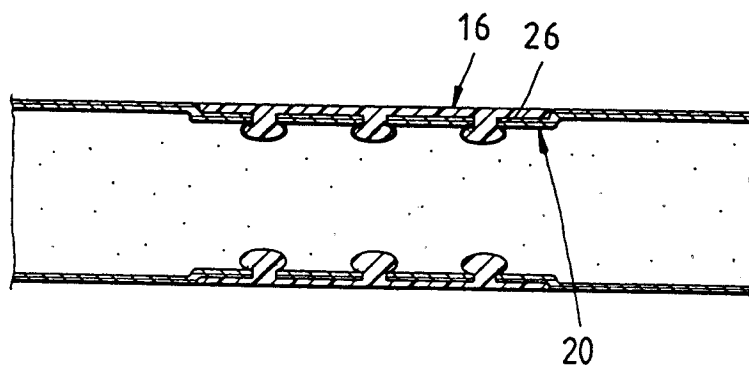


FIG. 8

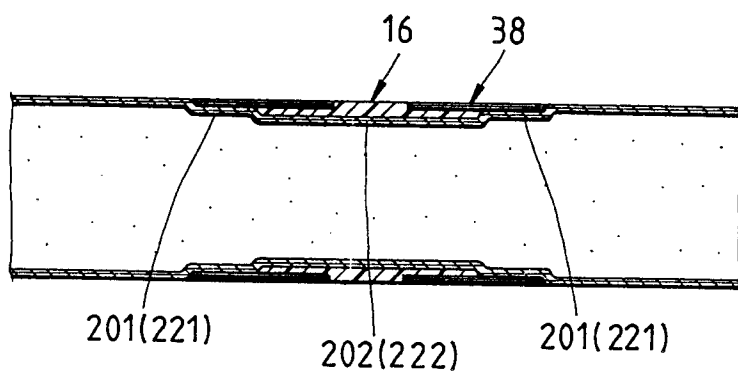


FIG. 6

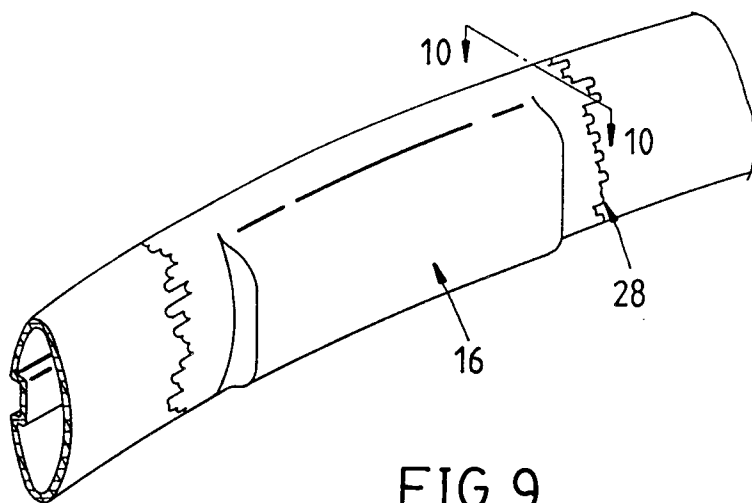


FIG. 9

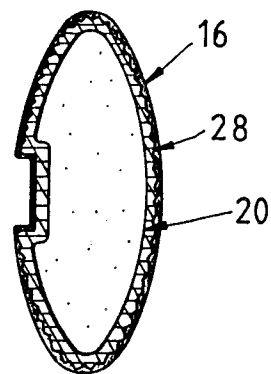


FIG. 10

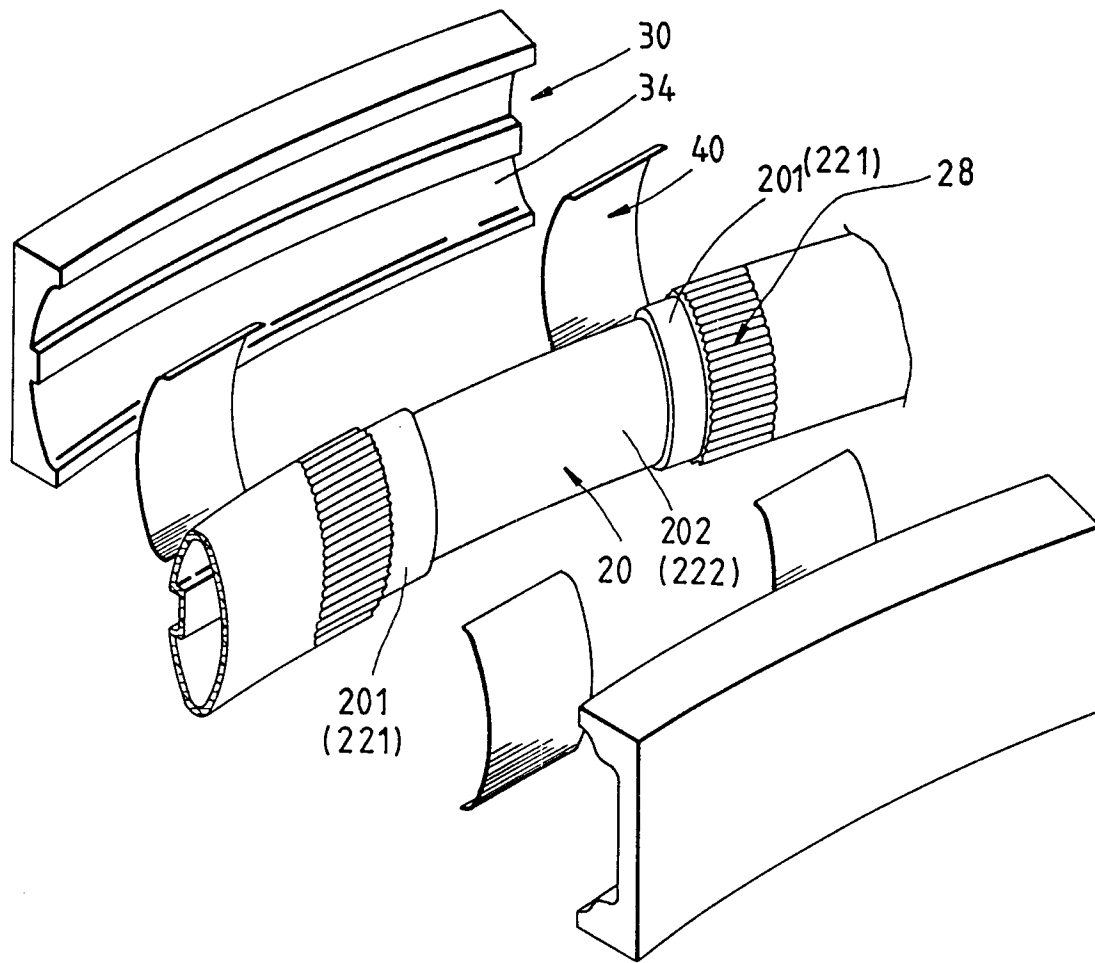


FIG.11

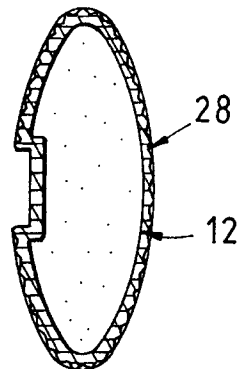


FIG.12



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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 6692

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)
A	FR-E-91 118 (D ZEPPELLINI) * page 2, column 2, line 3 - line 55 * * figures 4-7 * ---	1,7	A63B49/12 A63B49/04
A	US-A-5 054 780 (D CHEN) * the whole document * -----	1,7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A63B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 MARCH 1993	Examiner VEREECKE A.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			