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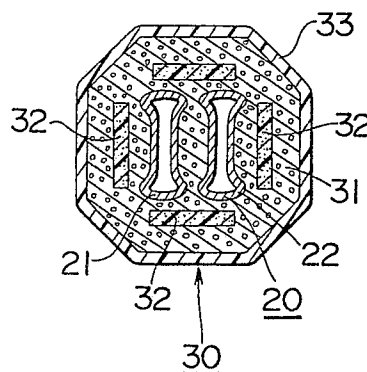
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㉚ **Sports implement for hitting balls or the like.**

㉛ A sports implement for hitting balls or the like, such as a tennis racket, comprises a ball hitting portion connected to a handle (30). The handle comprises a shaft (20) enclosed within a first layer (31) of foamed synthetic resin, a second layer (33) of e.g. leather arranged outwardly of the first layer, and a buffer portion (32) consisting of a plurality of elongate buffer members of gel material extending parallel to the shaft (20) and embedded in the first layer.

**FIG. 2**



## Description

### Sports implement for hitting balls or the like

The present invention relates to a sports implement for hitting balls or the like, such as a tennis racket, golf club or baseball bat.

Conventional sports implements of this kind have a ball hitting part provided with a ball hitting surface for hitting a spherical object such as a tennis ball and a handle for swinging the implement, the handle and the ball hitting part being integrally connected by some form of hard bar-shaped framework.

In the case of a tennis racket, the head of the racket for hitting a ball is provided by a stringed frame, the frame being integral with a shaft which has at its end remote from the head a handle provided with a grip. In the case of a golf club, a club head is normally integrally provided on the end of a shaft which also has a handle at its end remote from the head. In the case of a baseball bat, a ball hitting surface is provided by substantially the entire outer surface of its upper body, whilst the lower half of the bat is provided with a suitable handle.

In such conventional ball hitting sports implements, an impact force produced at the ball hitting surface when a ball is hit is directly conducted to a palm or palms of a player and the player receives a shock to his hand(s) and arm(s) since the ball hitting part and the handle are directly connected by a substantially rigid shaft.

When the ball hitting part makes inaccurate contact with a ball, i.e. offset from the centre of percussion, a shock wave resonates to act strongly on the palm and thence the wrist of a player. This gives rise to various problems for beginners who frequently suffer from sports injuries to their wrists, elbows (e.g. tennis elbow), shoulders, etc. and even skilled or well trained players suffer from similar sports injuries due to training for long periods of time, since impact forces arising from hitting a ball reach the player's wrist through the shaft of the implement and are not significantly attenuated.

According to the invention there is provided a sports implement for hitting balls or the like, comprising a ball hitting portion and a handle, wherein the handle comprises a shaft of a substantially hard material enclosed within a first layer of foamed synthetic resin, a second layer arranged outwardly of the first layer, and a buffer portion of gel material located between the shaft and the second layer and embedded in the first layer.

With such a sports implement, an impact force produced at the ball hitting portion when a ball, shuttlecock or the like is hit is conducted from the handle to a player's hand; however, the construction of the handle results in significant attenuation of any shock waves. The shock wave buffering function of the buffer portion depends on an inelastic or slightly elastic physical deforming property of gel material and a diffusion property of gel material similar to liquid. In other words, if a shock wave is applied, gel material absorbs and attenuates shock energy by inter-molecule frictional resistance due to physical deformation of gel material which is caused by the

impact force. In this case, since a repulsive elasticity which takes place along with physical deformation of gel material is extremely small or negligible the concurrent buffer function is not adversely affected. Thus the emergence of new shock waves due to repulsive elasticity can be prevented and, since gel material has the property of being able to diffuse quickly and conduct shock waves by virtue of its propagation characteristic similar to liquid, shock waves are finely divided and propagated into the adjacent layer of foamed synthetic resin.

Accordingly, shock waves dispersed from the shaft are effectively absorbed and reduced in the other parts of the handle.

The buffer portion preferably comprises a plurality of elongate buffer members extending parallel to the shaft. For example, four buffer members may be provided. In a preferred arrangement, the buffer members are substantially strip-shaped and each such strip is arranged with one of its major surfaces facing the shaft.

The buffer portion may be disposed in contact with the shaft. Alternatively the buffer portion may be disposed at a spacing from the shaft, in which case the space between the buffer portion and the shaft will preferably be filled by the foamed synthetic resin making up part of the first layer. Furthermore, the buffer portion may be disposed in contact with the second layer.

The shaft may comprise a pair of parallel members or a single member, and the or each member may be in the form of a tube. Such a tube may be hollow or may contain foamed synthetic resin.

Since there may be a tendency for the gel material to escape from the buffer portion, a sealing cover is preferably provided to enclose the gel material to prevent leakage thereof.

The synthetic resin is preferably of low foaming property. The second layer is preferably an external or outer layer made e.g. of leather.

Certain preferred embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig. 1 is a partly cutaway plan view showing a tennis racket as an embodiment of a sports implement in accordance with the present invention;

Fig. 2 is a cross sectional view along line II-II of Fig. 1; and

Figs. 3 and 4 are cross-sectional views similar to that of Fig. 2 but each showing another embodiment of the invention.

Referring to Fig. 1, the ball hitting part or head of the tennis racket comprises a generally oval portion of a frame 10 which is netted with gut or nylon string 11 to form a ball hitting surface 11. The frame is made of a substantially hard material in the form of a hollow bar of substantially drum-shaped cross-section, the frame having a forked stem part 20 which is integral with the head portion.

A laterally extending frame member 12 is provided

at a position near the junction between the stem part 20 and the head portion of the frame 10 to form the lower edge of the ball hitting surface 11 and the ends of strings of the netting are fastened to this lateral frame member 12.

The stem part 20 has an end portion (the lower part in Fig. 1) which forms part of a handle 30, which comprises, as shown in Fig. 2, a first or base layer 31 made of foamed synthetic resin formed to surround the periphery of the stem part 20, a buffer portion 32 made of gel material which is provided separately from the stem part 20 in the base layer 31, and a second or external covering layer 33 which covers the external surface of the base layer 31. The covering layer may be in the form of artificial or natural leather wound round the base layer 31 and the handle 30 is approximately 10-20 cm in length.

The buffer portion 32 made of gel material is embedded in the base layer 31 made of foamed synthetic resin, preferably synthetic resin of low foaming property. For its stability of material, silicone gel is well suited as gel material for this buffer portion 32; particularly, silicone gel with a penetration value of approximately 50 - 200 measured according to JIS (Japanese Industrial Standard) K-2530-1976 (50 g load), and compound silicone gel made up by mixing fine hollow particles in the above-mentioned silicone gel as base material are best suited. These silicone gel materials excel in their buffering and vibration absorbing abilities.

Suitable gel materials include, for example, Toray Silicone CF5027 (trade mark) manufactured by Toray Silicone Kabushiki Kaisha and KE-1051 (product name) manufactured by Shinetsu Kagaku Kogyo Kabushiki Kaisha, and fine hollow particles to be mixed in this silicone gel material include Fillite (registered trade mark) manufactured by Nippon Fillite Kabushiki Kaisha and Expancel (registered trade mark) sold by Nippon Fillite Kabushiki Kaisha. The silicone gel mixed with fine particles is disclosed in the specification of the Japanese Patent Application SHO 60-297677. The type and quantity of fine hollow particles to be mixed in the gel material can be selected as required; for example, using said Fillite as much as approximately 35 weight % is mixed.

As shown in Fig. 2, the buffer portion 32 comprises four buffer members arranged to extend longitudinally of the stem part 20 to cover four sides of two parallel shafts 21 and 22 which form the stem part 20. In this embodiment, each buffer member is formed as an elongate strip having flat faces and embedded in the base layer 31.

The base layer 31 has a substantially octagonal section and covers the buffer members of the buffer portion 32 so that the buffer members are slightly spaced from the stem part 20. This design causes shock waves from the stem part 20 to reach the buffer member through an inner portion of the base layer 31. This arrangement also ensures close adhesion between the base layer 31 and the stem part 20.

In the embodiment of Fig. 3, the buffer members forming the buffer portion 32 are directly attached to the stem part 20, whilst in the embodiment of Fig. 4,

the buffer members are interpositioned between the base layer 31 and the covering layer 33. In this latter embodiment, the handle 30 is preferably made with the buffer members slightly proud of the base layer 31, so that the covering layer 33 is displaced outwardly by the buffer members. For such a construction, it is better to form concavities in the base layer 31 so that the buffer members forming the buffer portion 32 may be respectively fitted into these concavities.

The stem part 20 and head portion of the frame 10 are preferably adapted to absorb shock waves by themselves. For the above purpose, the stem part 20 in the embodiments shown in Figs. 3 and 4 has a core 23 containing high-foamed synthetic resin and is made of fibre-reinforced plastic material. Such a stem part 20 of the frame can be obtained by winding the core 23 made of foamed synthetic resin such as, for example, polyurethane with a preparation made of fibre-reinforced plastic material, moulding it and hardening it through heating and application of pressure.

In a manufacturing process where silicone gel material is used as the buffer portion 32, an oil component tends to exude from the buffer portion and the quality of the connection with adjacent parts of the handle may deteriorate. It is therefore preferable to seal the gel material in a converging material 321 such as, for example, 0.1 mm thick urethane film or 0.3 mm thick polyvinyl film as shown in Fig. 4.

The handle 30 may be formed in a preferred manner by reactive injection moulding means by which the end part of the stem part 20 and gel material are inserted in advance in the mould and a foaming synthetic resin is injected into the mould. For example, when using polyurethane as the foaming synthetic resin, a liquefied moulding material can be prepared by adding additive components such as hardening catalyst, foaming agent, and foam adjusting agent to main components such as diisocyanate and polyol. This may be hardened after being injected into the mould in which the end portion the stem part 20 and strip- or plate-shaped gel material for forming buffer members of the buffer portion 32 are set in advance. Thus the buffer members can be firmly retained in the handle 30 by virtue of an internal pressure produced from foaming in the base layer 31.

When employing such a foaming method, it is preferable to ensure a good connection between the base layer 31 and the stem part 20 by depressing and concaving under pressure the end portion of the stem part 20 of the frame.

In the embodiment shown in Fig. 1, gel material is used without covering it with a film or the like. The gel material is prepared by adding Expancel as much as 3 weight % to Toray Silicone Gel CF5027 as described above and gelling the prepared gel material. Four buffer members of the buffer portion 32 are made with gel material in the form of a 1 mm thick chewing gum of 15 mm x 110 mm.

In each illustrated embodiment, four buffer members make up the buffer portion 32. The number of buffer members need not always be 4 and can be

2, 6 or 8. The provision of the buffer portion 32 as separate members disposed within the base layer 31 limits their deviation and deformation due to torsional force in a certain specified range and ensures an appropriate feeling of the grip.

This intensifies the connection between the stem part 20 of the frame and the base layer 31 and is advantageous in preventing the handle 30 from falling off.

If a ball is struck by the ball hitting sports implement, the impact of hitting of the ball with the ball hitting portion is conducted as shock vibration to a palm or palms of the player. This shock oscillation passes through the handle 30 shortly before being conducted to the player's palm and accordingly the vibration transmitted to the buffer portion 32 made of gel material is received as a shock wave by the palm.

In this case, the gel material which forms the buffer portion 32 provides inelastic deformation and does not provide repulsive elasticity and quickly propagates vibration to a wide area. Accordingly, the vibration is absorbed and attenuated by a whole area of gel material and a shock much smaller than in a conventional implement is conducted to the palm and diminished within a short period of time.

In comparing a tennis racket of a preferred embodiment and the conventional tennis racket, it was observed that the impact force conducted to the player's palm and the vibration diminishing time was greatly improved, and in particular that the vibration diminishing time was reduced by 30 to 50%.

The term "inelastic deformation" for the purposes of this specification is intended to mean that the gel material used does not provide such strong elastic deformation as e.g. rubber or a spring, but the term is not intended to mean that the gel material does not show elastic deformation at all.

Similarly, the statement that no repulsive elasticity is gained is intended to mean that the gel material used does not provide such strong repulsive elasticity as e.g. rubber or a spring but is not intended to mean that the repulsive elasticity is absolutely zero.

As a secondary effect, if silicone gel is used as the gel material for the buffer portion 32, the centre of gravity of the tennis racket can be appropriately shifted towards the handle 30 since silicone gel with specific gravity of 0.6 - 1 is relatively denser than a foamed frame member used in a conventional tennis racket.

Though the foregoing description refers to a tennis racket, the ball hitting sports implement in accordance with the present invention can also be embodied as a golf club, metallic bat for use in baseball, or a badminton racket.

In addition to the use of gel material described above it is possible to use gel material which is provided with a non-adhesive skin layer at its surface by increasing the bridging effect of the surface after gelling as disclosed in the Japanese Patent Gazettes (laid-open) SHO 61-51035 and SHO 62-13839. It is also possible to use gel material which is sealed in an external covering member made of urethane film

or in a tubular film as disclosed in the Japanese Patent Gazette (laid-open) SHO 61-21436, or which is gelled in the shape of a ball as disclosed in the Japanese Utility Model Gazette (laid-open) SHO 61-89534. Further, gel material which is regenerated by the manufacturing method disclosed in the Japanese Patent Gazette (laid-open) SHO 62-132849 and moulded products using this regenerated gel material can be selectively used.

For the rigid or hard framework such as the stem part 20 which extends from the handle 30 to the ball hitting part and is used as the core of the handle, various materials can be used as alternatives to the stainless steel shaft used in the described embodiments. Almost all types of materials used conventionally for the shafts of sports implements may be used, such as: single timber, laminated timber, and timber reinforced by layers of glass fibre or the like; metals which are cut, ground, punched or drawn or made by other suitable forming processes from aluminium and other metal alloys; composite members having a core, made of wood, laminated wood, or foamed synthetic resin of polystyrene or polyurethane, and wound or covered with fibre-reinforced plastic with glass fibre or the like, or metal such as aluminium, and being processed by bending and heating under pressure for hardening, or these members which can be made by injection moulding, transfer moulding or compression moulding thermoplastic or thermosetting resin.

Polyurethane is particularly well suited as foamed synthetic resin which forms the base layer 31. However, the material for this base layer is not limited to polyurethane, and almost all kinds of synthetic resin which can be used for plastic moulding such as epoxy resin, unsaturated polyester resin, polyamide, polystyrene, ABS, polypropylene, etc. can be used. These materials can be selected as material for the handle 30 in view of strength, durability, etc.

As described above, the ball hitting sports implement incorporating a buffer portion 32 made of gel material which is connected to a base layer 31 made of foamed synthetic resin in the handle of the implement can disperse the impact produced when hitting a ball into the buffer portion 32 and the base layer 31 to absorb such impact and substantially reduce the vibration from the impact which would otherwise adversely affect the player's palm or palms.

It is to be clearly understood that there are no particular features of the foregoing specification, or of any claims appended hereto, which are at present regarded as being essential to the performance of the present invention, and that any one or more of such features or combinations thereof may therefore be included in, added to, omitted from or deleted from any of such claims if and when amended during the prosecution of this application or in the filing or prosecution of any divisional application based thereon. Furthermore the manner in which any of such features of the specification or claims are described or defined may be amended, broadened or otherwise modified in any manner which falls within the knowledge of a person skilled in the

relevant art, for example so as to encompass, either implicitly or explicitly, equivalents or generalisations thereof.

## Claims

1. A sports implement for hitting balls or the like, comprising a ball hitting portion and a handle (30), wherein the handle comprises a shaft (20) of a substantially hard material enclosed within a first layer (31) of foamed synthetic resin, a second layer (33) arranged outwardly of the first layer, and a buffer portion (32) of gel material located between the shaft (20) and the second layer (33) and embedded in the first layer (31).

2. A sports implement as claimed in claim 1, wherein the buffer portion (32) comprises a plurality of elongate buffer members extending parallel to the shaft (20).

3. A sports implement as claimed in claim 2, wherein the buffer members are substantially

strip-shaped and each such strip is arranged with one of its major surfaces facing the shaft (20).

4. A sports implement as claimed in claim 1, 2 or 3, wherein the buffer portion (32) is disposed in contact with the shaft (20).

5. A sports implement as claimed in claim 1, 2 or 3, wherein the buffer portion (32) is disposed at a spacing from the shaft (20).

6. A sports implement as claimed in claim 5, wherein the buffer portion (32) is disposed in contact with the second layer (33).

7. A sports implement as claimed in any preceding claim, wherein the buffer portion (32) includes a sealing cover (321) enclosing the gel material to prevent leakage thereof.

8. A sports implement as claimed in any preceding claim, wherein the gel material is a silicone gel.

9. A sports implement as claimed in any preceding claim, wherein the shaft (20) is a tubular member having therein foamed synthetic resin (23).

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FIG. 1

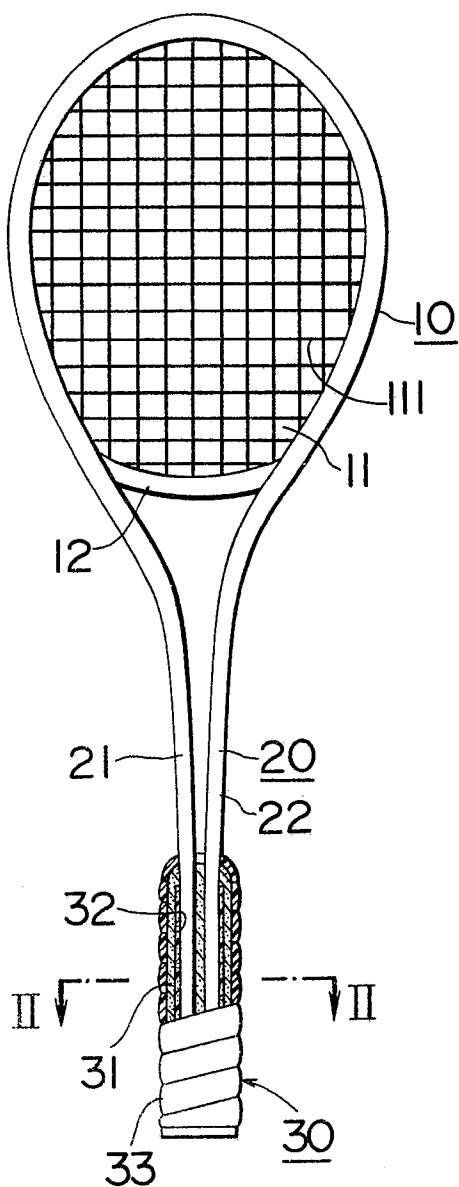


FIG. 2

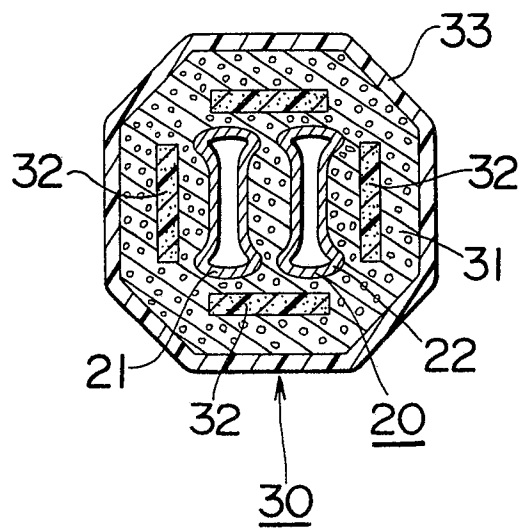


FIG. 3

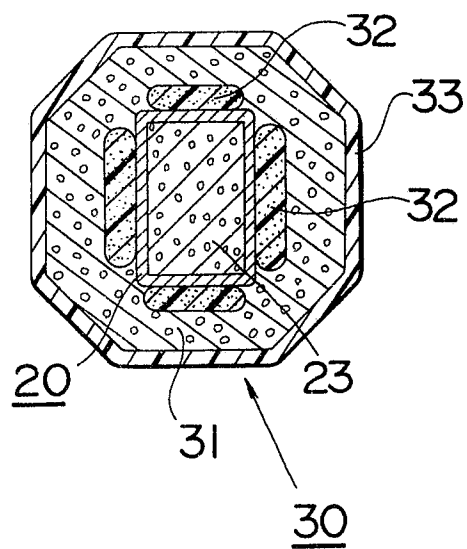
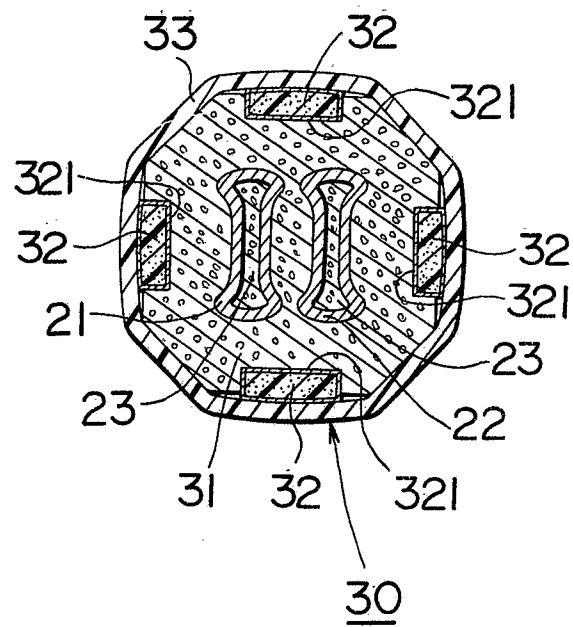


FIG. 4





DOCUMENTS CONSIDERED TO BE RELEVANT			EP 88307716.6
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US - A - 4 660 832 (SHOMO) * Abstract; fig. 1,2; column 3, lines 4-51 * --	1,2,3,4	A 63 B 49/08
A	DE - A - 2 106 800 (SCHNELL) * Fig. 1,2,3,4,9,10; claims 2,9; page 2, lines 8-12 * --	1,4,6,7,9	
A	DE - A1 - 3 332 643 (PUMA SPORT-SCHUHFABRIKEN RUDOLF DASSLER KG) * Fig. 1; page 8, line 33 - page 9, line 33; claims 9,11 * --	1,4,6	
A	US - A - 4 105 205 (THEODORES) * Abstract; column 4, lines 13,14 * --	1,8	
P,A	WO - A1 - 87/05 524 (WHITEFORD) * Abstract; claim 17 * ----	1,2,3,4	
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 11-11-1988	Examiner BRÄUER
<b>CATEGORY OF CITED DOCUMENTS</b> 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			