(12) UK Patent Application (19) GB (11) 2 416 130 (13) A

(43) Date of A Publication 18.01.2006

(21) Application No: 0415816.8

(22) Date of Filing: 15.07.2004

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(51) INT CL:
E01C 13/00 (2006.01)

(52) UK CL (Edition X):
A6D DTN
C1H H620 H710 H711 H787

(56) Documents Cited:
DE 003109392 A **JP 630300119 A**
JP 600136850 A **JP 100183818 A**
US 5678363 A **US 5308397 A**

(58) Field of Search:
UK CL (Edition W) **A6D, C1H**
INT CL[7] **A63B, C04B, E01C**
Other: **Online:WPI,EPODOC,JAPIO**

(54) Abstract Title: **Construction Material**

(57) A construction material comprises a matrix of a concrete material (12) filled with pieces of rubber (11) reinforced with absorbent fibres (15. The invention also provides a method of manufacturing the construction material, a surfacing structure (1) , notably a tennis court, which incorporates the construction material, and a method of manufacturing the surfacing structure (1). Preferably the pieces of fibre-reinforced rubber are chopped-up or shredded car tyres having cloth like fibres.

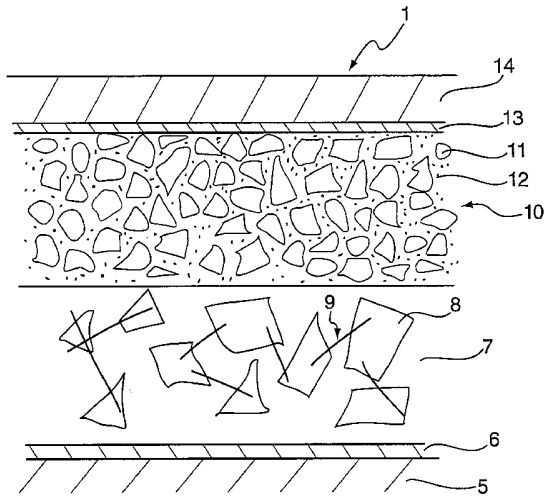

FIG. 2

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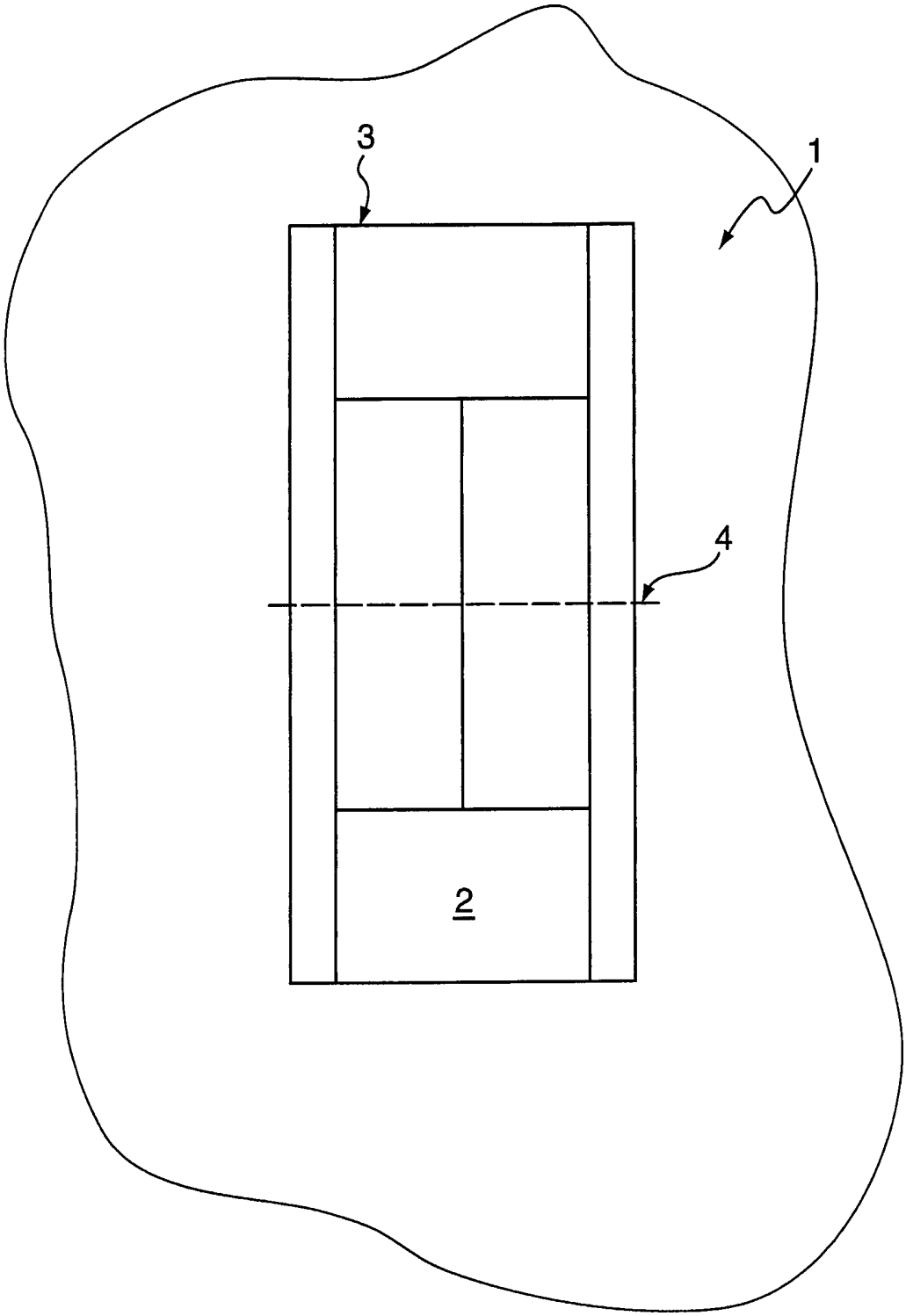


FIG. 1

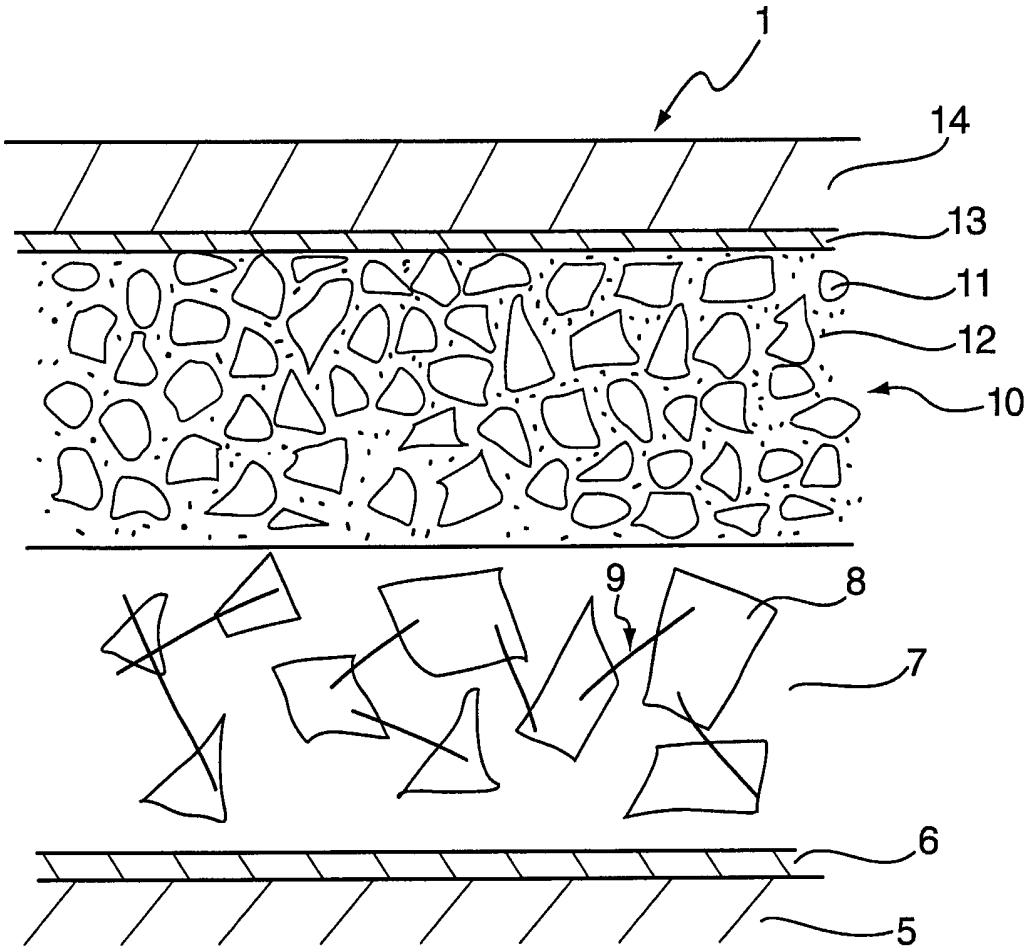


FIG. 2

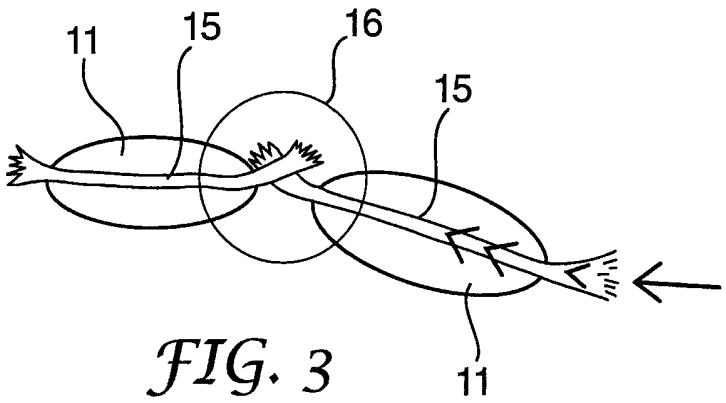


FIG. 3

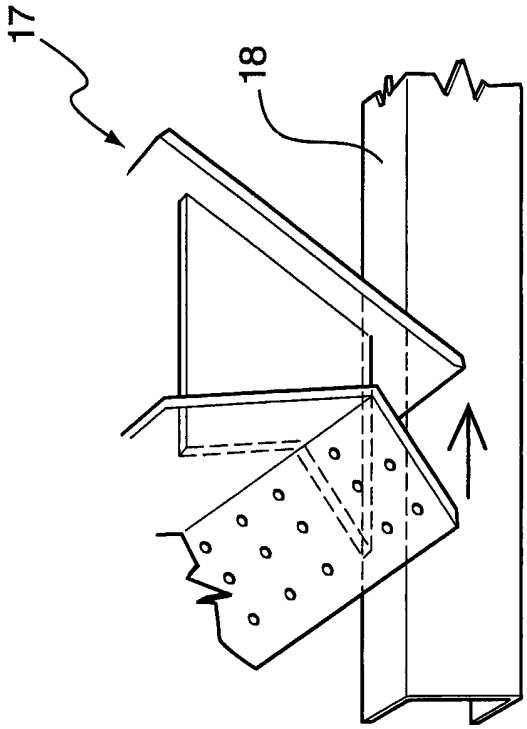


FIG. 5

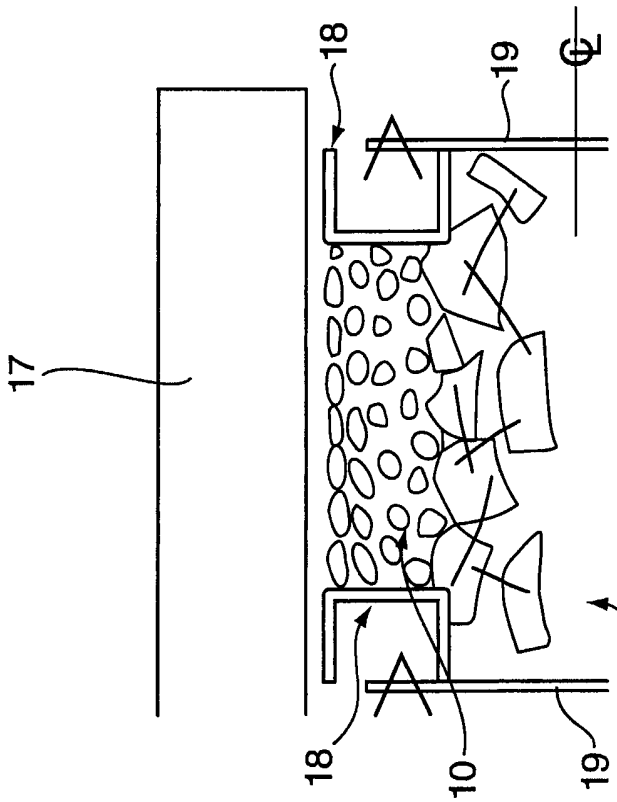


FIG. 4

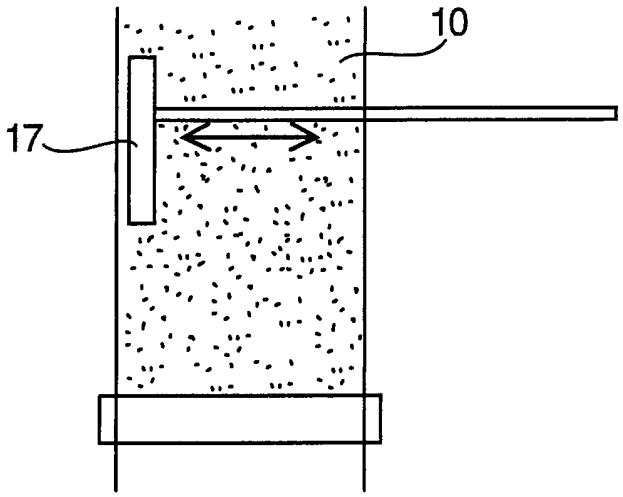


FIG. 6

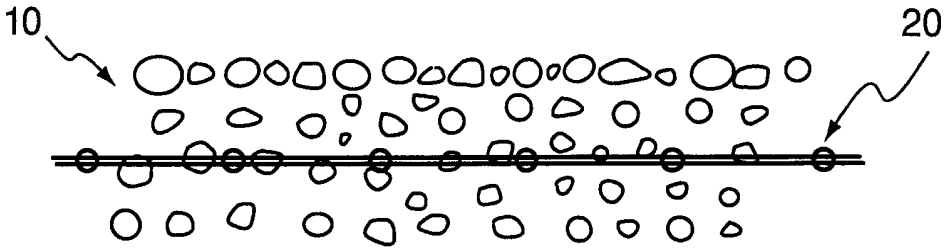


FIG. 7

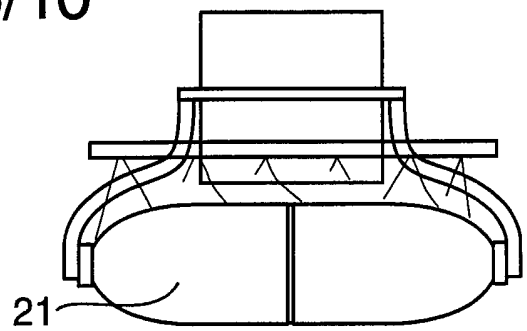


FIG. 8

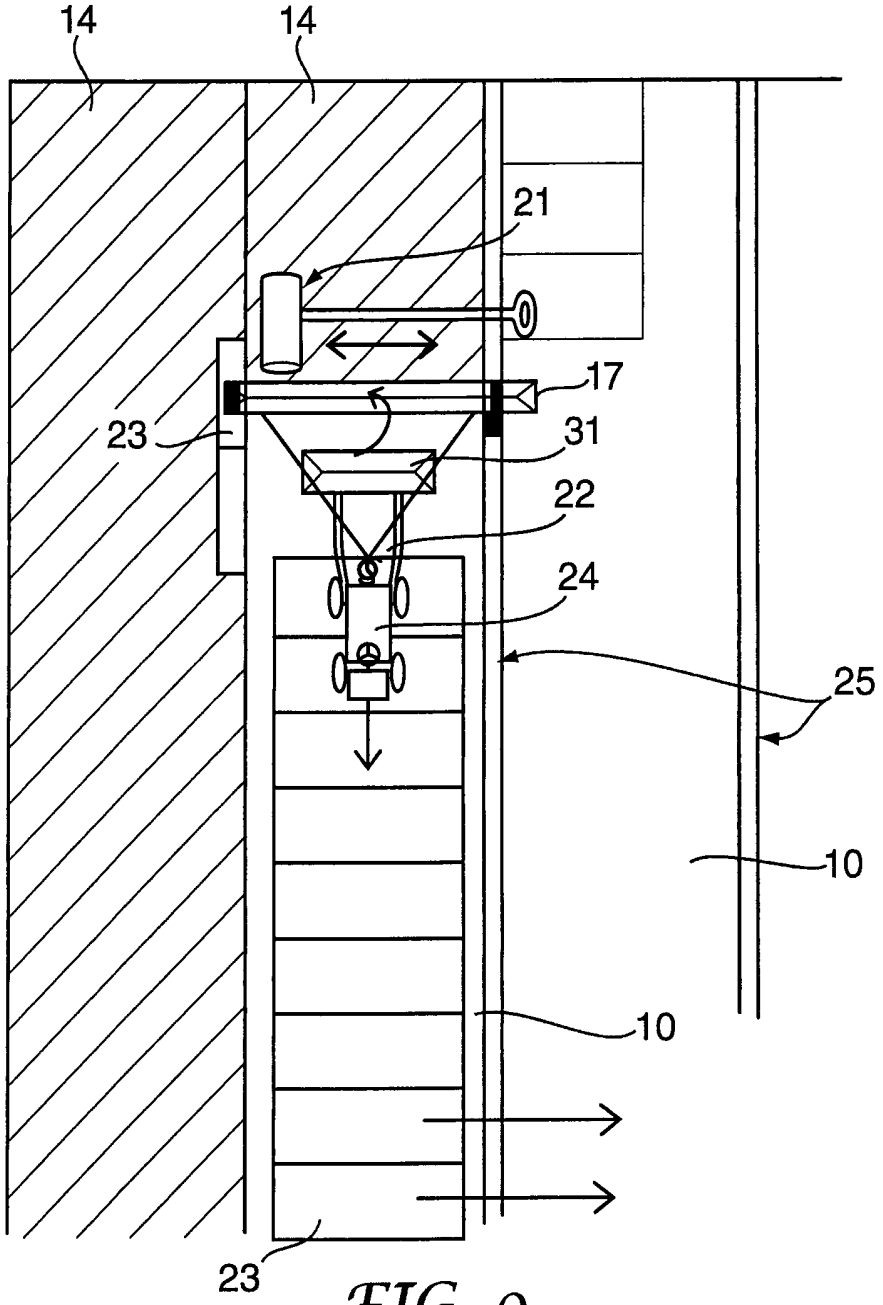


FIG. 9

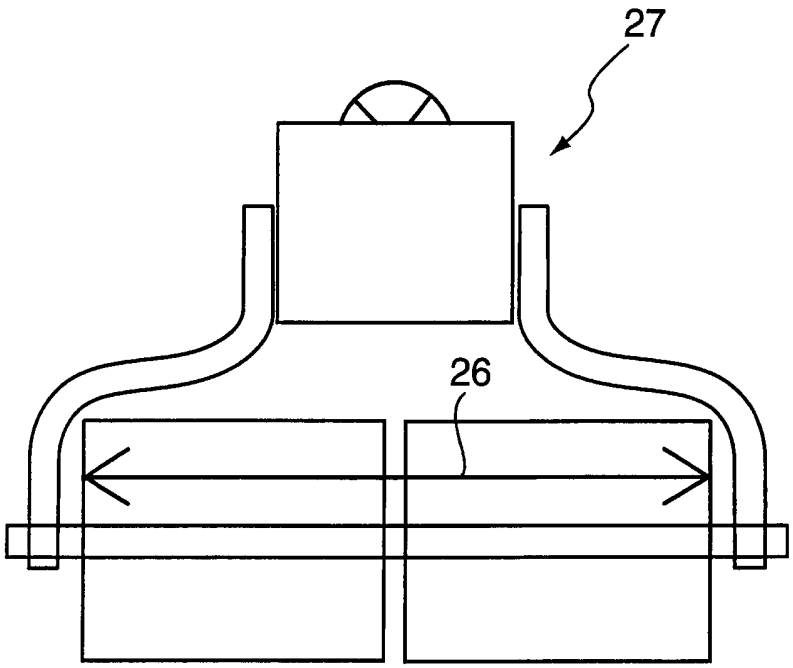
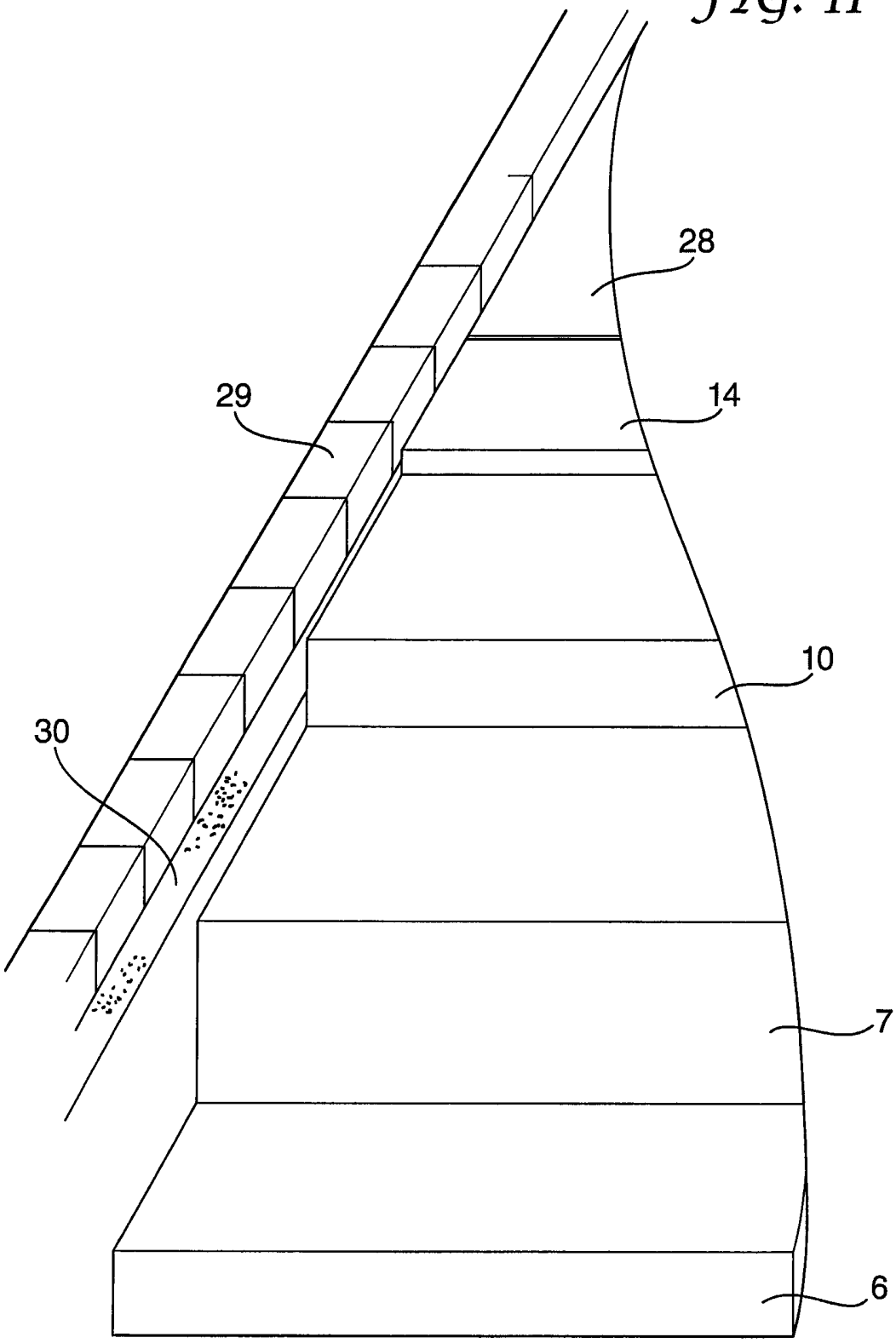


FIG. 10

FIG. 11



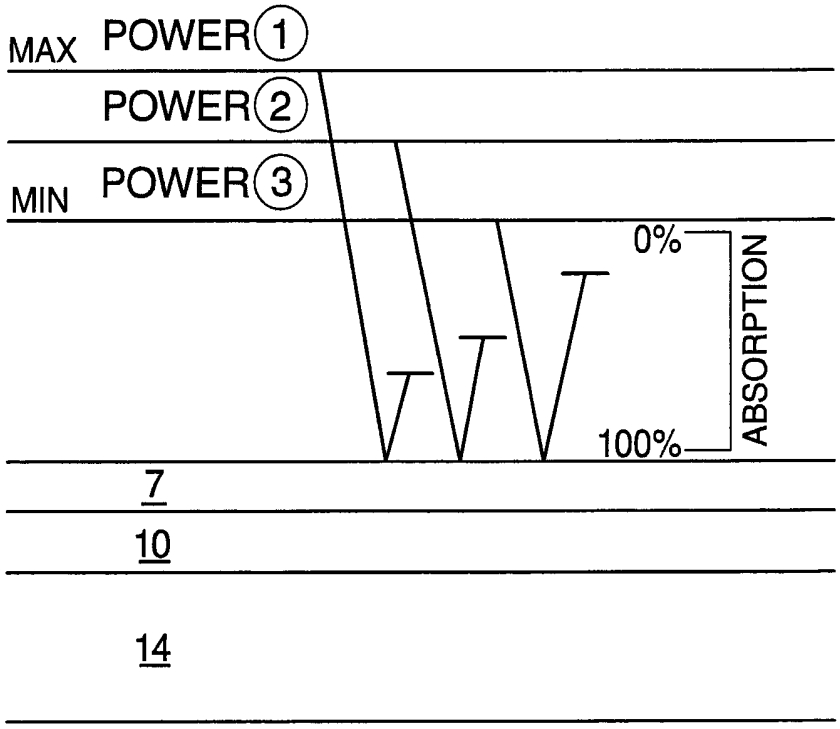

MAX
POWER (1)
POWER (2)
MIN
POWER (3)
0%
100%
ABSORPTION
7
10
14

FIG. 12

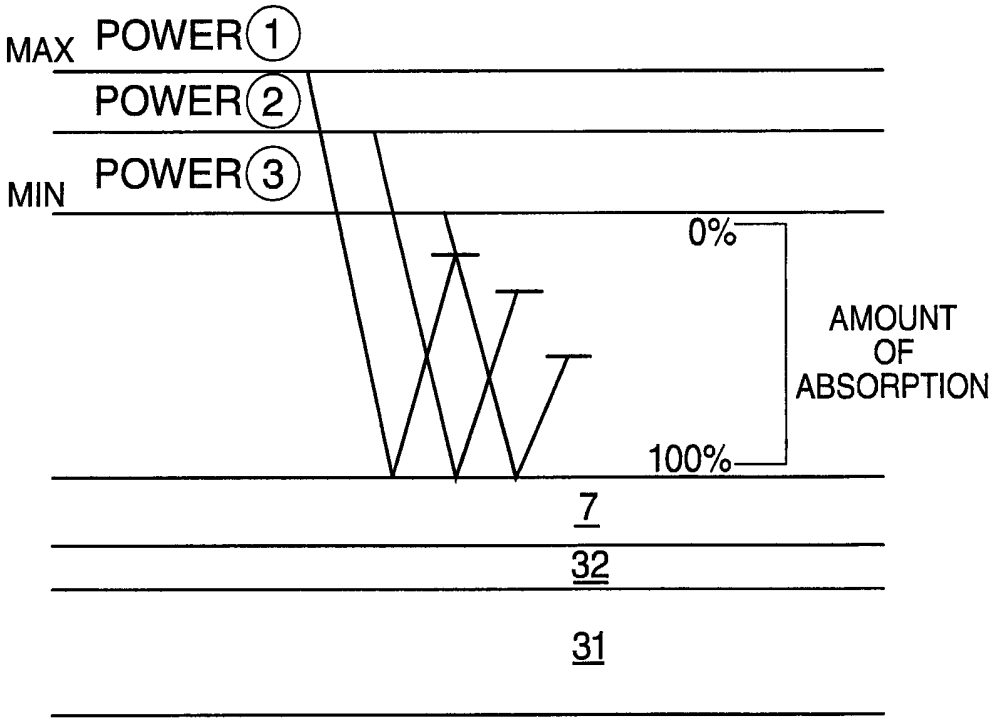

MAX
POWER (1)
POWER (2)
MIN
POWER (3)
0%
100%
AMOUNT
OF
ABSORPTION
7
32
31

FIG. 13

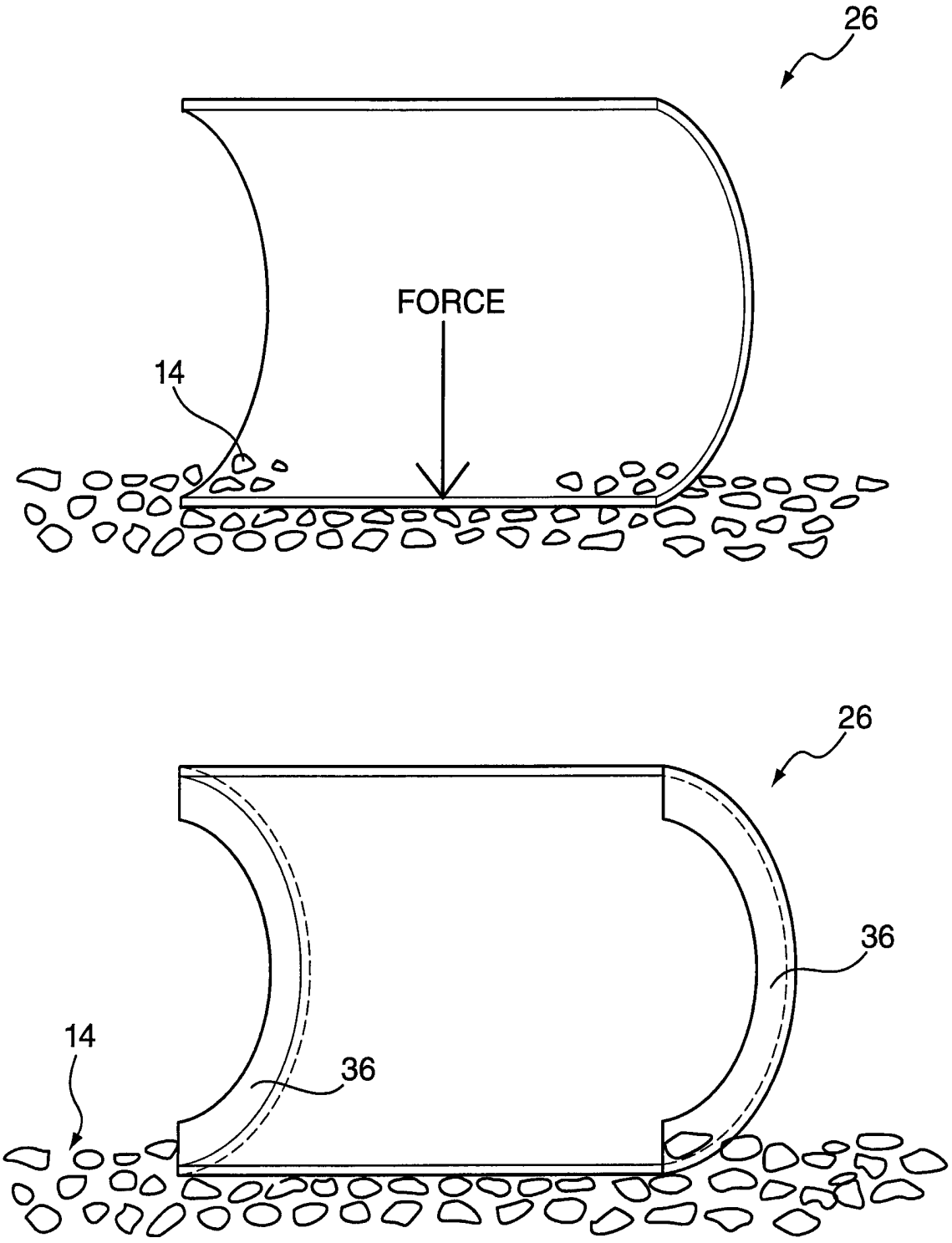
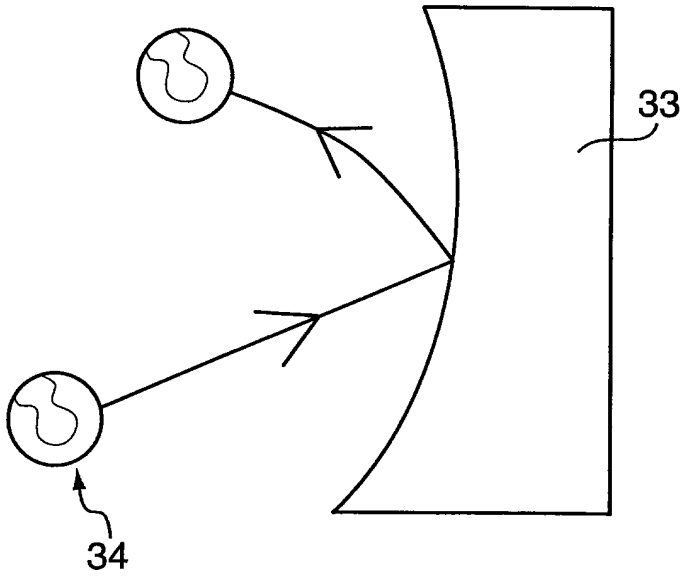


FIG. 14



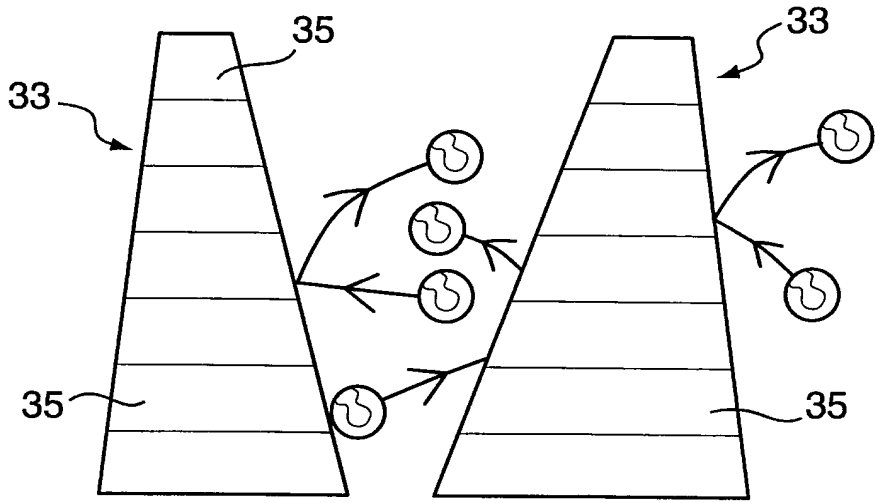


FIG. 15

CONSTRUCTION MATERIAL

FIELD OF THE INVENTION

The present invention relates to a construction material and method of manufacturing the material. Other aspects of the invention provide structures incorporating the material, notably a surfacing structure and a method of manufacturing the structure. The surfacing structure is particularly useful as a playing area for sports such as tennis but is not limited to this use.

BACKGROUND TO THE INVENTION

Tennis is a popular sport and is of importance to government strategies to improve national fitness levels. For the amateur game the standard court surface consists of asphalt laid over a hard core foundation with a painted top surface to allow court markings to stand out clearly. Such surfaces suffer inherent disadvantages relating to their inflexible structure, giving rise to problems of knee stress, leg muscle fatigue and lower back jarring for players playing for a long time. Attempts have been made to address these issues, particularly in the USA, using surface mounted shock absorbency. This technology has achieved only limited success in the UK for three principal reasons. First is that such a soft surface does not allow for true bounce from the tennis ball. Second, for any painting on the surface to withstand the continual flexing it has to be of such a consistency as to render it impervious and unable to absorb rainwater. While this might not be an issue in the southern United States, it is an important issue in the British

climate. The third issue is that of cost; a court built using the technology costs around 75% more than a normal tarmacadam surface.

Other types of tennis court systems have their own benefits but also drawbacks. Grass is a traditional playing surface but it requires high maintenance and is generally unsuitable for anything but a professional organisation. Artificial grass is lower maintenance but it is expensive and not LTA approved. Clay is commonly used as a hard court surface for professional tournaments. It requires sophisticated drainage systems with consequent high installation costs. A clay court tends to cause similar physiological problems for players as a standard tarmacadam surface. A cushion acrylic surface is known, which supposedly slightly reduces problems of knee stress, leg muscle fatigue and lower back jarring. However a cushion acrylic court is expensive to install and causes uncontrollable bounce. It is non-porous and not suitable for outside use in the UK. It is endorsed by the LTA for indoor use only.

Various proposals have been made over the last 70 years or so to produce an improved playing surface. GB 399147 proposes making a resilient and springy playing surface using compound substances consisting of a mixture of bitumen, stearine-pitch and shredded, ground or otherwise granulated india rubber. Spanish patent document ES 2 014 191 describes a similar structure covered with thin, flexible layers and finished off with varnishes and paints. GB 2 226 764 proposes a safety surface material comprising a base layer comprising rubber chips bound with a bitumen material and a flexible wear layer provided on the base layer. DE 3 109 392 describes a floor

covering containing a mixture of specified amounts of mineral construction materials, an elastic aggregate, a polyol and a polymeric adhesive. EP 0 258 871 proposes a sports track consisting of a bottom layer applied to a hard base, and a covering layer on top. The covering layer is separated from the bottom layer by a holding layer and an elastic layer. None of these proposals has been widely adopted so that the surfaces set forth in the preceding paragraphs account for the great majority of outdoor tennis courts in use today.

It is an object of the present invention to provide a surfacing structure which reduces at least some of the above-mentioned problems.

It is another object of the invention to provide a construction material suitable for use in the surfacing structure and other structures.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a construction material comprising a matrix of a concrete material filled with pieces of rubber reinforced with absorbent fibres.

The construction material may be manufactured in situ where needed, or it may be pre-cast. The material may be formed as individual bricks, blocks or tiles and assembled to form a building structure such as a floor or wall, optionally with the use of linking means such as mortar, glue, metal wires, dowels or pins. The pre-cast building units may be made interlocking and will be well understood by those skilled in

the art of brick and tile making. In a particularly preferred application, the construction material is used in the manufacture of a surfacing structure suitable for use as a sports playing area or a walkway.

Accordingly, a second aspect of the present invention provides a surfacing structure suitable for use as a sports playing area or a walkway and comprising a subsurface on which is laid a lower layer of concrete filled with pieces of rubber reinforced with absorbent fibres and a surface layer above the lower layer for walking on or playing a game or sport on.

For convenience, the lower layer of concrete filled with pieces of fibre-reinforced rubber will be referred to hereinafter as a rubber concrete layer, and the corresponding construction material will be referred to as rubber concrete. By forming a rubber concrete layer of suitable thickness and proportion of rubber, a surfacing structure having a level of energy absorption and bounce appropriate to many different outdoor sports, play or other activities may be formed. The rubber concrete may be filled only with the fibre-reinforced rubber or may optionally include other fillers such as sand, aggregate or limestone, or liquid additives, to fine-tune or optimise the mechanical properties of the layer. Preferred liquid additives are a water-based acrylic resin, a polyurethane, or a mixture thereof.

In addition to its non-softening property, rubber concrete has the significant characteristic of 'memory'. Thus, an impact on the rubber concrete puts the rubber under stress, and its natural resilience urges it to return to its original

shape prior to the impact. This property is manifest in the rubber concrete layer, which demonstrates good impact resilience.

The ideal thickness for the rubber concrete layer will depend on its composition and the composition of other layers making up the surfacing structure, and on the function for which the surfacing structure is intended to be used. A preferred thickness is in the range 50 - 150 mm, notably 75 - 125 mm, particularly 85 - 115 mm. If desired, the rubber concrete layer may be formed from a plurality of separate layers, formed on top of each other, optionally with other layers separating them, to fine-tune or optimise the mechanical properties of the layer.

The preferred sizes of the pieces of rubber will depend to some extent on the intended use of the surfacing structure. A preferred size range is 10 - 30 mm, notably 15 - 25 mm. The fibre-reinforced rubber preferably comprises from 60 - 90% of the rubber concrete by volume. A particularly preferred range is from 70 - 85%, notably about 80%.

The rubber concrete layer is suitable for covering by any desired surface layer without the need for an intermediate capping layer, such as is typically required on top of conventional foundation layers for tennis courts. The rubber concrete layer effectively functions as both a foundation and a capping layer. The rubber concrete layer is highly water-permeable and drains quickly. In a preferred embodiment the surface layer is also water permeable so that surface water can drain quickly away through the entire area of the structure. This quick drainage and the non-absorbent "warm"

materials make the surfacing structure very resilient to frosts and freezing conditions.

A major advantage of the rubber concrete compared to prior art surfacing materials is that it is non-softening, substantially retaining its hardness regardless of variations in temperature and humidity.

A particularly preferred surface layer is all-weather porous macadam. Other surface layer materials include without limitation: asphalt, porous or non-porous acrylic materials, artificial turf, grass, rubber, American cement, ceramic, and granular materials. Depending on its nature, the surface layer may be applied as a coating, in sheet form, or as interlocking or non-interlocking tiles. The thickness of the surface layer may be selected to produce a desired surface hardness and wear. A preferred thickness for macadam is in the range 20 - 60 mm, notably 30 - 50 mm.

The surfacing structure may be formed without the use of heavy plant and equipment. Because of this, soft or unstable land will not require thousands of tonnes of rock to stabilise it.

If desired, other layers may optionally be included between the rubber concrete layer and the surface layer, and/or underneath the rubber concrete layer. In a preferred embodiment a porous membrane is disposed between the rubber concrete layer and the surface layer, for example a geotextile mat such as 1000 gauge Terram™ fibreglass (around 1 mm thick). By providing the membrane between the layers, the macadam top layer may be removed when worn, together with

the membrane, and replaced without the need to remove or replace the underlying rubber concrete layer, thus retaining the original shock absorbency. Other types of layer, known *per se*, such as cushioning layers, may be employed if desired.

We have found that shredded or chopped-up car tyres provide a suitable source of fibre-reinforced rubber pieces for making the rubber concrete. Clean rubber, or chopped-up lorry tyres reinforced with a metal fabric, will not bond properly with the cement and are not suitable for use in the rubber concrete layer. Chopped-up car tyres reinforced with cloth-like fibres work well in the invention.

In a preferred embodiment, the surfacing structure further comprises a base layer underneath the rubber concrete layer. The base layer may comprise pieces of one or more types of rubber material to further increase the absorbency and resilience of the surfacing structure. The base layer may be formed from clean rubber or from shredded car or lorry tyres. In a particularly preferred embodiment, the base layer comprises pieces of shredded lorry tyres which may have metal reinforcement. The rubber pieces in the base layer do not need to be bonded together, so shredded lorry tyres with metal reinforcement are preferred for the purposes of recycling in an environmentally acceptable manner and to provide additional long term absorbency and increased drainage. Without wishing to be bound by theory, we believe that the increased absorbancy is created by the larger voids or "air gaps" and the ability of the rubber and wire to "flex" around these voids. Smaller dense rubber bases would eventually become more solid or harder. A preferred depth

for the base layer is 0 - 200 mm, notably 100 - 150 mm. A preferred size range for the rubber pieces in the base layer is 10 - 90 mm, notably 25 - 75 mm.

The present invention provides a playing or other surface which may be hard and have true bounce, depending on the nature of the top surface layer, but which will also absorb impact well. It may be likened to a placemat laid upon a dish of jelly. If the mat is tapped the surface is hard, but the shock is transferred to and absorbed by the jelly. Whereas the weight of a human body will activate the absorption, a ball such as a tennis ball substantially will not.

The rubber concrete structure will reduce wear to surfaces that are constantly on the move because of expansion and contraction, such as interlocking tiles, artificial turf, and carpeting.

The chopped up car or lorry tyres may also find application as a drainage/absorption layer on sports pitches such as football pitches, notably in areas where jumping and colliding tend to occur, such as a football (soccer) goal area. A preferred thickness for the layer is 100 - 300 mm. It is preferably laid on an existing drainage system, then covered with a conventional sports pitch construction, optionally with one or more (notably two or three) membrane layers inbetween. Terram fibreglass geotextile layers are preferred.

Other aspects and benefits of the invention will appear in the following specification, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described, by way of example, with reference to the following drawings, in which:

Figure 1 is a plan view of an athletic playing area according to an aspect of the present invention in the form of a tennis court;

Figure 2 is a sectional view through a surfacing structure in accordance with one embodiment of the present invention;

Figure 3 is a schematic depiction through part of the rubber concrete layer of the surfacing structure of Figure 2;

Figure 4 is a part sectional view through a part-formed surfacing structure in accordance with another embodiment of the invention;

Figure 5 is a simplified side view of elements of Figure 4;

Figure 6 is a plan view of a stage in the formation of a surfacing structure in accordance with an embodiment of the invention;

Figure 7 is a sectional view through a layer of a surfacing structure in accordance with a further embodiment of the invention;

Figure 8 is a simplified front view of a crossroll sealer for use in manufacturing a surfacing structure in accordance with an embodiment of the invention;

Figure 9 illustrates stages in the formation of a surfacing structure in accordance with an embodiment of the invention;

Figure 10 is a simplified front view of a rolling machine for use in manufacturing a surfacing structure in accordance with an embodiment of the invention;

Figure 11 is a part-sectional view through a preferred embodiment of a surfacing structure in accordance with the invention;

Figures 12 and 13 are schematic diagrams comparing absorption properties of a surfacing structure in accordance with an aspect of the present invention with a prior art surfacing structure;

Figure 14 shows part sectional views of a conventional roller wheel and a novel roller wheel for use in rolling asphalt and rubber in the manufacture of a surfacing structure; and

Figure 15 shows walls made from rubber concrete blocks in accordance with yet another aspect of the invention.

DETAILED DESCRIPTION

In the following description all percentages and parts are by volume unless otherwise specified. Figure 1 illustrates a tennis court formed from a surfacing structure 1. The tennis court has a hard playing surface 2 which is marked with lines 3 that define the various parts of the court in a well-known manner. A net will be disposed along a centre-line 4.

Figure 2 shows a sectional view through the surfacing structure 1. The surfacing structure 1 comprises a ground subsurface 5 which is generally flat and firm. The subsurface 5 will typically be formed by excavation using conventional techniques. It may optionally be levelled with a filler such as sand, limestone, aggregate or the like. In this example, an optional lower membrane 6 of Terram™ fibreglass about 1 mm thick is laid on the subsurface to help provide a uniform base. An optional base layer 7 is provided on the lower membrane 6. In this example, the base layer 7 is about 150 mm deep and comprises pieces of rubber 8 reinforced with metal wires 9, obtained by chopping up lorry tyres. The sizes of the rubber pieces 8 range from about 25 - 75 mm. The base layer 7 may be laid by a tracked excavating machine to avoid too much human contact with the ripped wires 9, optionally with compacting by a purpose designed roller (Figure 14) and/or the back of the excavator's bucket. The voids provided by the rubber pieces 8 and the metal wires 9 will provide enhanced and long term absorbency and rapid drainage. Because of the resilience of the base layer 7 it is not essential that the subsurface be very flat or very firm; the structure will be tolerant of reasonable subsurface variations.

On top of the base layer 7 is laid a rubber concrete layer 10, comprising a matrix of set cement 12 filled with pieces of fibre-reinforced rubber 11. The sizes of the rubber pieces 11 range in this example from about 10 - 25 mm. The rubber pieces 11 occupy about 80% by volume of the rubber concrete layer 10, giving the layer 10 flexibility and excellent drainage properties. The rubber pieces 11 comprise chopped ("crumbled") car tyres which have cloth-like fibres or cords 15 running through them. The fibres 15 have a fluffy appearance and are highly absorbent. Without wishing to be bound by theory, we believe that the fibres 15 act as wicks, drawing in a suspension of cement in water (and optional additives), and helping to interlock adjacent rubber pieces when cured, as illustrated in the circled region 16 of Figure 3. The rubber concrete layer 10 is preferably formed *in situ* and we have found that the correct order of mixing is important to achieve an optimal result. Firstly, the water and cement are mixed with stirring to form a slurry, and then the rubber pieces 11 are added and stirring is continued until the rubber pieces are thoroughly dispersed in the cement slurry. The slurry mixture is then laid on the base layer 7. In the present example the rubber concrete was made by mixing together 20 parts of cement with 15 parts of water to form a slurry, followed by the addition of 80 parts of chopped up car tyres. The cement used was Rugby ordinary Portland cement. It will be appreciated that the layers of Figure 2 are somewhat simplified. Because of the fluid nature of the rubber/cement slurry, some of the slurry will at least partially fill or key into voids at the top of the base layer 7. The cement may optionally be mixed with chemical additives or fillers such as sand, limestone, or

other mineral materials before or after the slurry is formed, to modify its mechanical properties for any desired application to which the surfacing structure is to be put.

The optimal cure time for the rubber concrete layer 10 will depend on the weather. Preferably the cure time will be at least a week, often longer, unless special rapid setting agents are employed.

Any desired surface layer may be laid on top of the rubber concrete layer 10. In the present example an optional upper membrane layer 13 is provided, comprising an approximately 1 mm deep layer of Terram™ 1000-gauge fibreglass. A surface layer 14 is laid on top of the upper membrane layer 13, in this example about 30 mm of asphalt. The surface layer 14 is porous so that the surfacing structure 1 can readily drain away surface water over its entire area.

Referring now to Figures 4 and 5, a preferred embodiment is illustrated in which the rubber concrete layer 10 is applied *via* temporary roadforms 18 that have contact with the ground so that levels are not compromised by the inherent instability of the base layer 7. The roadforms 18 act as temporary construction aids and are releasably fixed in the ground by means of pins 19. A screed or float 17 may be moved over the rubber concrete layer 10 to set the surface level. The final finishing may be achieved by the use of weighted conventional floats 17, as illustrated in Figure 6.

If desired, a reinforcing member, for example an A143 mesh 20, may be incorporated into the rubber concrete layer 10 to spread applied load further. Applications where spreading of

point loading may be desirable include under basketball or soccer goals, service areas, benches and tables, service vehicles etc. Subject to fire restraints, the surfacing structure may be used beneath squash court floors and indoor sports floors.

Our early tests show that the rubber concrete layer expands and contracts within its own structural volume, which should eliminate the need for expansion joints and avoid reflective cracking to the surface layer. The rubber concrete layer 10 is non-softening and can be covered without damage with a protective covering such as polyethylene immediately after floating to reduce moisture loss and protect from rain.

The extremely low density of the rubber concrete layer 10 will mean that an on-site batching plant of unusual proportions will be desirable. It is envisaged that an outsize mixing drum (in relation to the engine and frame) may be used because of the lightness of the rubber materials. A method of laying the asphalt is described below with reference to Figures 8-10.

The ability of the asphalt to form a strong bond between individual solid particles is dependent on the contractor's ability to 'seal' the texture. We have found that sealing is optimised if the temperature of the asphalt arriving on site is in the range about 170° to about 175°C. This temperature range provides substantially constant drag and allows sealing using lighter than standard compaction equipment. Referring to Figure 9, the surface in this example is laid in six bays of approximately 4 metres using runners 25 (in this example, steel runners) as guides, fixed with a releasable adhesive.

Boards 23 about 18 mm thick are laid width-ways on the rubber concrete layer 10 to spread the load of the dumpers or loaders 24. The boards 23 are moved along a bay and from one bay to another as progress requires. The loaders 24 will fill a hopper 31 and then be connected to a hopper on the screed 17 to provide drive while screed operatives guide and monitor operation of the screed. The screed 17 is connected to the loader 24 by wires at a spring-loaded pulley point 22 on the loader 24. Sealing and compaction are achieved using light crossrolling machinery and a specially designed heat-sealing motorised roller 21 (Figure 8) using rejected pressure cylinders to provide the finish. The special rolling machine 27 shown in Figure 10 is lighter than conventional rolling machines, having a weight in the range 1 - 1.5 tonnes compared to a conventional rolling machine weighing from 1.5 - 3 tonnes. The roller itself has a greater working area than a conventional roller, with a working diameter 26 in the range 1.2 - 1.5 metres compared to 800 mm to 1.2 metres for a conventional roller. This combination of lightness and greater working area helps protect the rubber concrete layer from damage during laying of the asphalt or other surface layer 14.

Referring now to Figure 14, a problem with a conventional roller wheel 26 (upper drawing) is that it can sink into the rubber concrete layer, part of which may spring inside the wheel 26. Asphalt 14 may also enter the wheel, so that the roller tends to plough up the surfacing structure and fold the asphalt layer 14. This problem can be reduced or eliminated by the use of a novel roller wheel (Figure 14, lower drawing) in which an annular plate member 36 is provided at each open end of the roller 26. The plate 36

helps to prevent ingress of materials in the roller 26, thus avoiding ploughing or folding of the asphalt. The novel roller is particularly for use in the present invention, but it will be understood that it is also of use in rolling conventional asphalt or other surfacing materials in other applications.

Referring now to Figure 11, a particularly preferred embodiment of surfacing structure is shown. In this embodiment a drainage layer 6 is provided on an excavated subsurface 5 to suit particular site requirements. A base layer 7 of 100 - 200 mm depth is provided on the drainage layer 6. The base layer 7 comprises pieces of chopped up lorry tyres. A rubber concrete layer 10 is applied directly on top of the base layer 7, whether formed in situ or in tile form. A 30 mm layer of flexible macadam 14, or any other desired sports surface, is applied on the rubber concrete layer 10, and on top of this is an optional colouring layer 28, in this example an acrylic-based colour. The surfacing structure is laid against side haunching 30 which is topped by edging bricks 29. It may be used as a walkway or as a sports surface.

Applications for which the invention may be used include, without limitation: tennis courts, netball courts, basketball courts, American football fields, soccer fields, hockey pitches, athletic tracks, jogging tracks, children's play areas, horse- or dog-racing tracks, or horse dressage rinks. For children's play areas the surfacing structure may be used as a shock absorber under a covering such as tree bark, artificial turf, sand, or finely chopped clean rubber. The technology is particularly useful where children are liable

to fall from a height, such as around swings and slides, or around a garden trampoline. A preferred surface layer formulation for children's play areas comprises pieces of clean, chopped rubber, for example 6 mm pieces, embedded in a hardened resin. The resin typically is mixed with a hardener and with the rubber pieces and then applied to the rubber concrete while fluid. Curing takes a few hours - typically 4-5 hours, leaving a resilient, highly shock-absorbing surface. Suitable rubber pieces may comprise chopped up tyres with the fabric reinforcement removed.

It is believed that the present invention provides a preferable power to response ratio compared to traditional prior art surfacing materials. Without wishing to be bound by theory, a qualitative attempt to illustrate the expected differences is shown in Figures 12 and 13. Here, Max. Power represents an athlete landing badly from a height and/or at speed; Min. Power (3) represents light play without aggression. In the surfacing structure according to the invention (Figure 12) higher powers are absorbed more strongly, while lower powers are absorbed less strongly. In the prior art surfacing structure of Figure 13, the reverse applies. Here, the surfacing structure comprises a traditional foundation 31 and a traditional base course 32. Because the novel surfacing structure absorbs larger forces more effectively, the danger of injury to an athlete is reduced.

Although it is preferred to apply the rubber concrete layer *in situ* it would also be possible to construct tiles, blocks or bricks from the material for assembly on site or in a household environment. In a preferred embodiment tiles or

bricks would be interconnectable by means of a spigot and socket system, optionally bonded with an adhesive, preferably a waterproof adhesive such as an epoxy resin. A benefit of this method is that slabs or blocks, typically about 1 metre square, can be constructed and cured indoors, followed by laying the rubber concrete layer outdoors. Because the rubber concrete is pre-cured, it can be laid regardless of the weather. In a preferred embodiment, each block has a spigot on two adjacent edges and a complementary recess on two other adjacent edges so that the entire layer can be made interlocking by inserting and gluing spigots in recesses with the blocks butted up against each other.

Referring now to Figure 15, the rubber concrete is used to construct rebound walls 33 for sport. In this example, a tennis ball 34 is illustrated rebounding from the walls 33. The walls 33 may be made in situ, or preformed from blocks 35. The walls 33 may be rendered with a special crack-resistant coating and coloured. Suitable crack-resistant coatings will be well known to those skilled in the coating art. Other applications include insulated damp-proof layers, sound proofing for stores, sheds and garages, patio slabs (safety slabs), and ornamental walls.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment, may also be provided separately, or in any suitable combination.

CLAIMS

1. A construction material comprising a matrix of a concrete material filled with pieces of rubber reinforced with absorbent fibres.

2. A construction material according to claim 1, wherein the pieces of fibre-reinforced rubber are chopped-up or shredded car tyres having cloth-like fibres.

3. A construction material according to claim 1 or claim 2, wherein the pieces of fibre-reinforced rubber have sizes in the range 10-30 mm.

4. A construction material according to any preceding claim, wherein the fibre-reinforced rubber comprises from 60-90% by volume of the lower layer.

5. A construction material according to claim 4, wherein the fibre-reinforced rubber comprises about 80% by volume of the lower layer.

6. A method of making a construction material comprising a matrix of a concrete material filled with pieces of rubber reinforced with absorbent fibres, the method comprising the steps of mixing water and cement to form a slurry and then subsequently mixing in pieces of said fibre-reinforced rubber to the slurry, laying the resulting mixture on a surface and curing the mixture.

7. A method according to claim 6, wherein said surface is an inner surface of a mould for making a brick, block or

tile.

8. A structure constructed at least partly from a construction material as specified in claim 1.

9. A structure according to claim 8, comprising a wall or a surface for walking on or for playing a game or sport on.

10. A surfacing structure suitable for use as a sports playing area or a walkway and comprising a subsurface on which is laid a lower layer of concrete filled with pieces of rubber reinforced with absorbent fibres and a surface layer above the lower layer for walking on or playing a game or sport on.

11. A surfacing structure according to claim 10, wherein the pieces of fibre-reinforced rubber are chopped-up or shredded car tyres having cloth-like fibres.

12. A surfacing structure according to claim 10 or claim 11, wherein the pieces of fibre-reinforced rubber have sizes in the range 10-30 mm.

13. A surfacing structure according to any of claims 10-12, wherein the fibre-reinforced rubber comprises from 60-90% by volume of the lower layer.

14. A surfacing structure according to claim 13, wherein the fibre-reinforced rubber comprises about 80% by volume of the lower layer.

15. A surfacing structure according to any of claims 10-14,

wherein the surface layer is water-permeable.

16. A surfacing structure according to any of claims 10-15, wherein the surface layer is a material selected from asphalt, macadam, and artificial turf.

17. A surfacing structure according to any of claims 10-16, further comprising a base layer disposed between the lower layer and the subsurface, the base layer comprising pieces of rubber material.

18. A surfacing structure according to claim 17, wherein the base layer comprises pieces of chopped up or shredded lorry tyres.

19. A surfacing structure according to claim 17 or claim 18, wherein the pieces of rubber in the base layer have sizes in the range 10-90 mm.

20. A surfacing structure according to any of claims 10-19, further comprising a porous membrane disposed between the lower layer and the surface layer.

21. A surfacing structure according to claim 20, wherein the membrane is formed from a fibreglass material.

22. A tennis court comprising a ground subsurface on which is laid a lower layer of concrete filled with pieces of rubber reinforced with absorbent fibres and a surface layer above the lower layer; the surface layer having markings thereon denoting tennis playing areas.

23. A tennis court according to claim 22, wherein the pieces of fibre-reinforced rubber are chopped-up or shredded car tyres having cloth-like fibres.

24. A tennis court according to claim 22 or claim 23, further comprising a base layer disposed between the lower layer and the subsurface, the base layer comprising pieces of rubber material.

25. A method of manufacturing a surfacing structure suitable for use as a sports playing area or a walkway, the method comprising:

a) excavating ground to a predetermined depth to create a levelled subsurface where the surfacing structure is to be formed;

b) laying on said subsurface a slurry of cement, water, and pieces of rubber reinforced with absorbent fibres;

c) allowing said slurry to cure to form a lower layer of concrete filled with pieces of fibre-reinforced rubber; and

d) applying on said lower layer a surface layer of a material suitable for walking on or playing a game or sport on.

26. A method according to claim 25, wherein said material of said surface layer comprises asphalt or macadam.

27. A method according to claim 25, wherein said slurry is formed by first mixing together cement and water and subsequently mixing in said pieces of fibre-reinforced rubber.

28. A method according to claim 25, further comprising the step of laying a base layer of rubber pieces on said subsurface prior to laying said slurry.

29. A method of manufacturing a surfacing structure suitable for use as a sports playing area or a walkway, the method comprising:

a) excavating ground to a predetermined depth to create a levelled subsurface where the surfacing structure is to be formed;

b) laying on said subsurface a plurality of blocks of a construction material comprising a matrix of concrete filled with pieces of rubber reinforced with absorbent fibres so that the blocks butt together to form a lower layer;

c) applying on said lower layer a surface layer of a material suitable for walking on or playing a game or sport on.

30. A method according to claim 29, wherein said material of said surface layer comprises asphalt or macadam.

31. A method according to claim 29 or claim 30, further comprising the step of laying a base layer of rubber pieces on said subsurface prior to laying said blocks.

32. A method according to any of claims 29-31, wherein each of said blocks is provided with at least one recess and at least one spigot, the method further including the step of applying an adhesive material to a spigot or recess of at least some of the blocks and forming the lower layer by

locating each spigot in a recess of an adjacent block so as to interlock the blocks.

33. A method of manufacturing a surfacing structure substantially as herein described with reference to the drawings.

34. A surfacing structure substantially as herein described with reference to the drawings.

Application No: GB0415816.8
Examiner: Mr Mark Sexton
Claims searched: 1-34
Date of search: 11 October 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	all	US 5678363 A (OGORCHOCK et al.) - see whole document, note particularly column 2 lines 7 & 8
X	all	US 5308397 A (WHATCOTT) - see whole document
X	all	DE 3109392 A (NEUBAUER) - see whole document, note WPI Abstract accession number 82-90517E/43
X	all	JP 10183818 A (MITANI SEKISAN KK) - see whole document, see WPI abstract accession number 98-440902/38
X	all	JP 63300119 A (SATO KOGYO) - see whole document, note english abstract
X	all	JP 60136850 A (UBE INDUSTRIES) - see whole document, note particularly WPI abstract accession number 94-197695/24

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{W} :

A6D; C1H

Worldwide search of patent documents classified in the following areas of the IPC[07]

A63B; C04B; E01C

The following online and other databases have been used in the preparation of this search report

Online:WPI,EPODOC,JAPIO