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(56) Documents Cited
GB 2186521 A GB 2055682 A US 4666648 A
US 4369025 A

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(54) Concrete roofing tiles

(57) Concrete roofing tiles which imitate the appearance of natural slate or stone are made by a process in which a base concrete mix layer and a second concrete mix layer are applied in succession to form two layers of concrete and then a third concrete mix having a different colour to that of the second concrete mix is discharged onto the second layer in a non-uniform manner from a location which is spaced from and above the second layer. The resulting product is then compacted to consolidate the layers to produce a tile having an upper surface in which the two concrete colours are irregularly interdispersed. The manner in which the third concrete mix falls or is propelled onto the second layer can be further randomised by means of rotatable rollers having an irregular arrangement of transfer pockets, reciprocating apertured plates and/or deflecting means. The resulting tiles each have a virtually unique upper surface appearance making it easy to achieve a completely natural effect when laying the tiles on a roof.

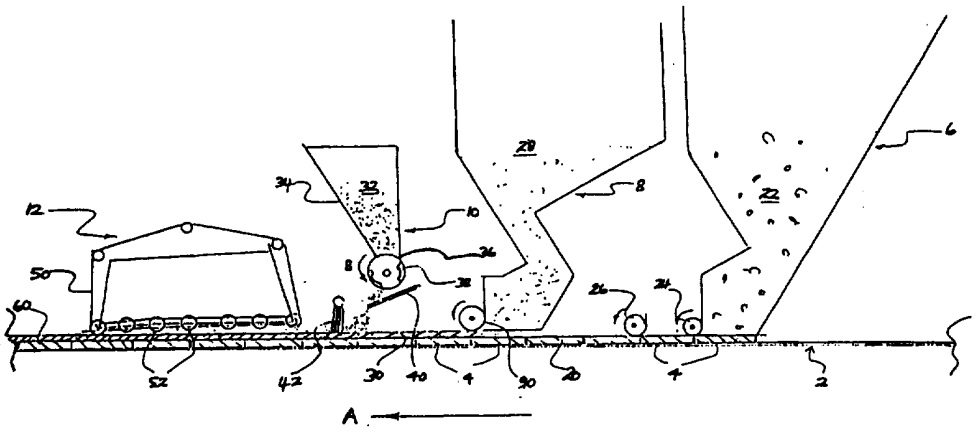

FIG. 1

GB 2 310 161 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

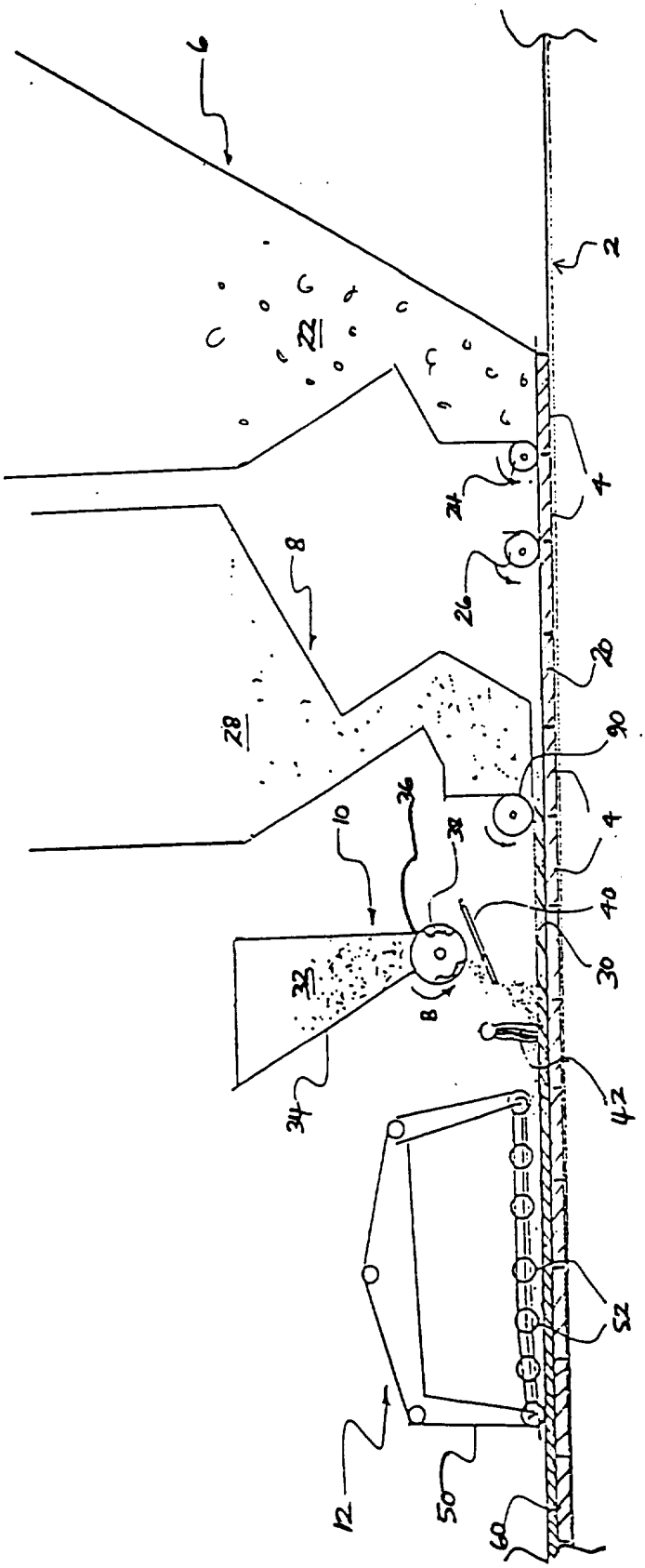

FIG. 1

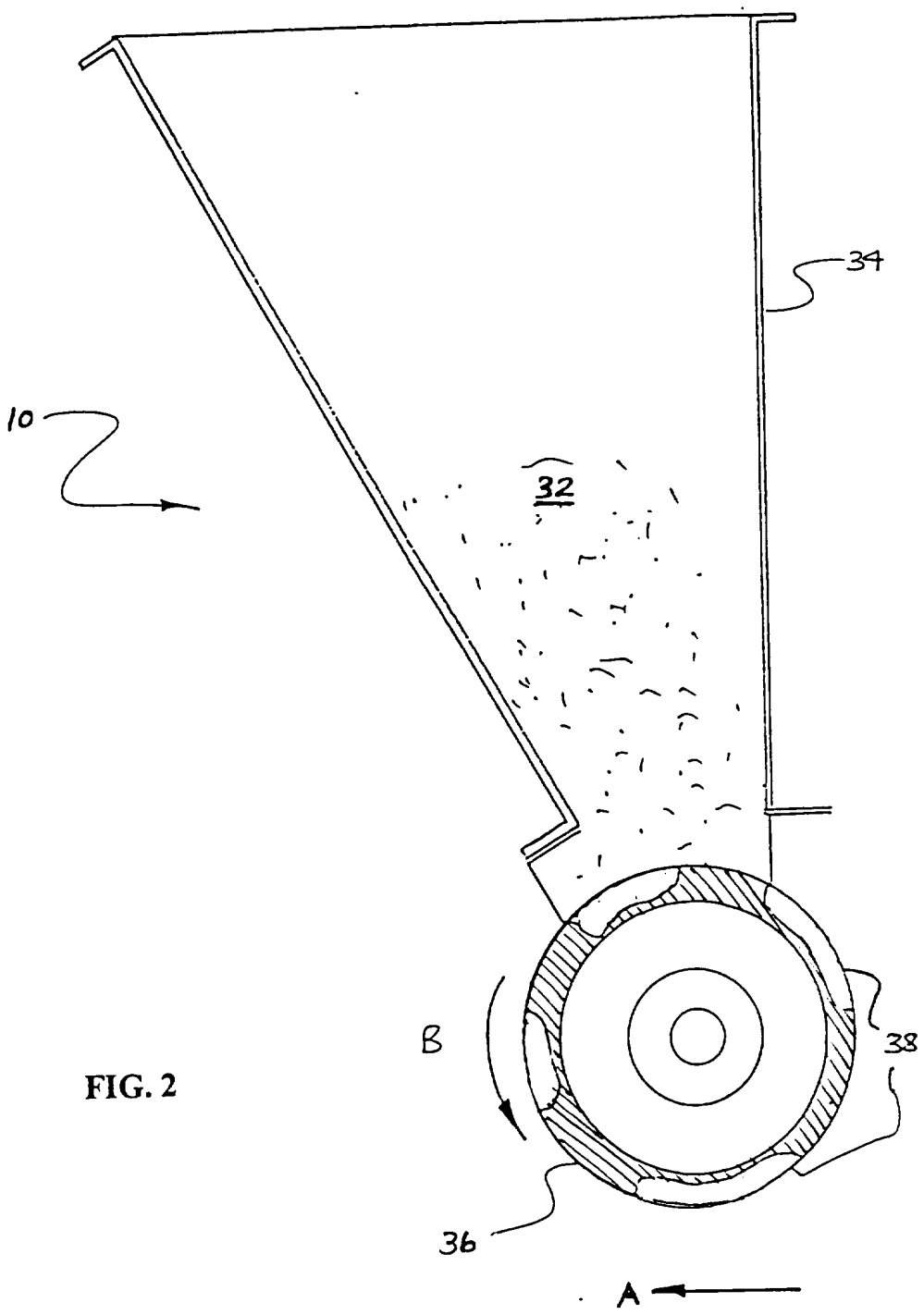

FIG. 2

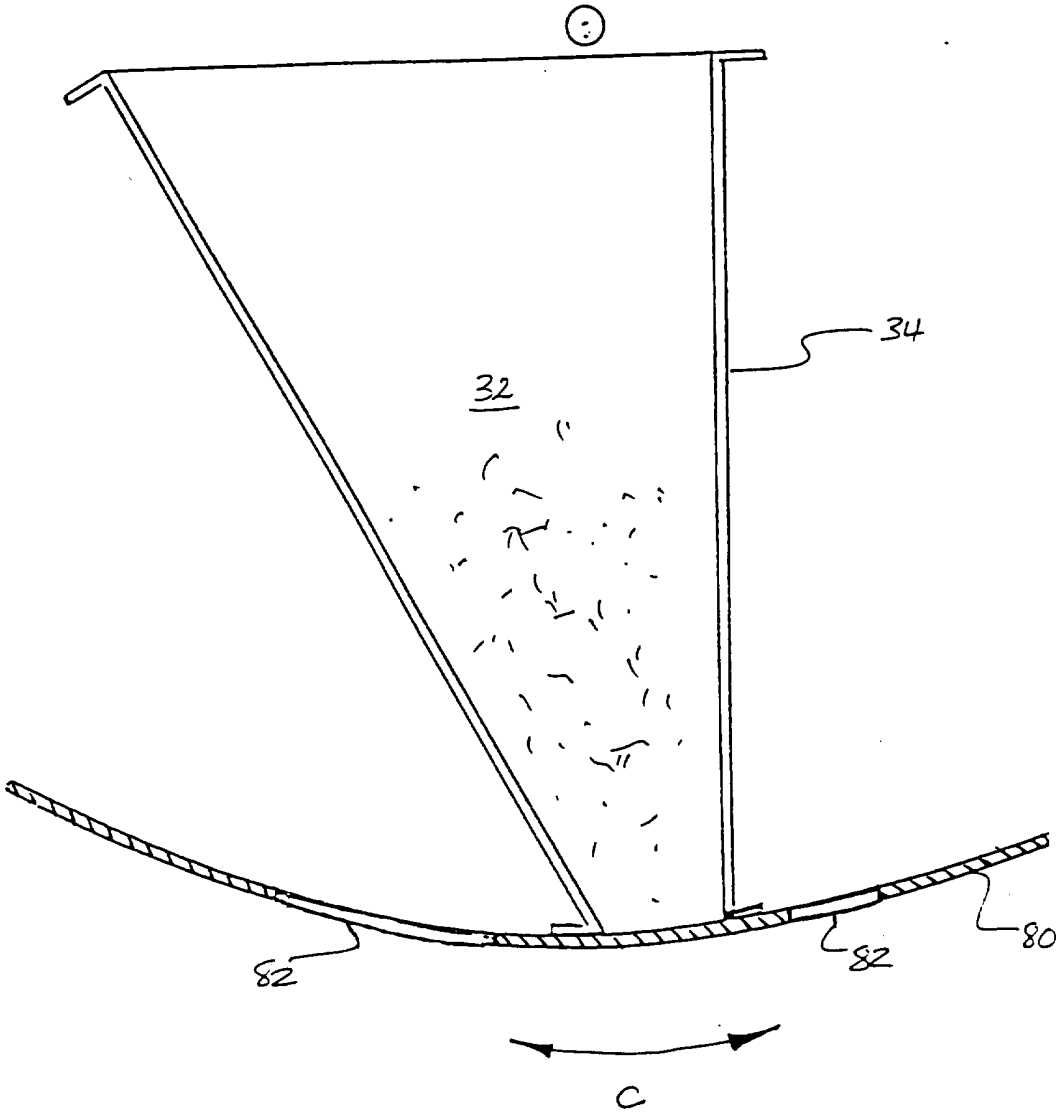

FIG. 3

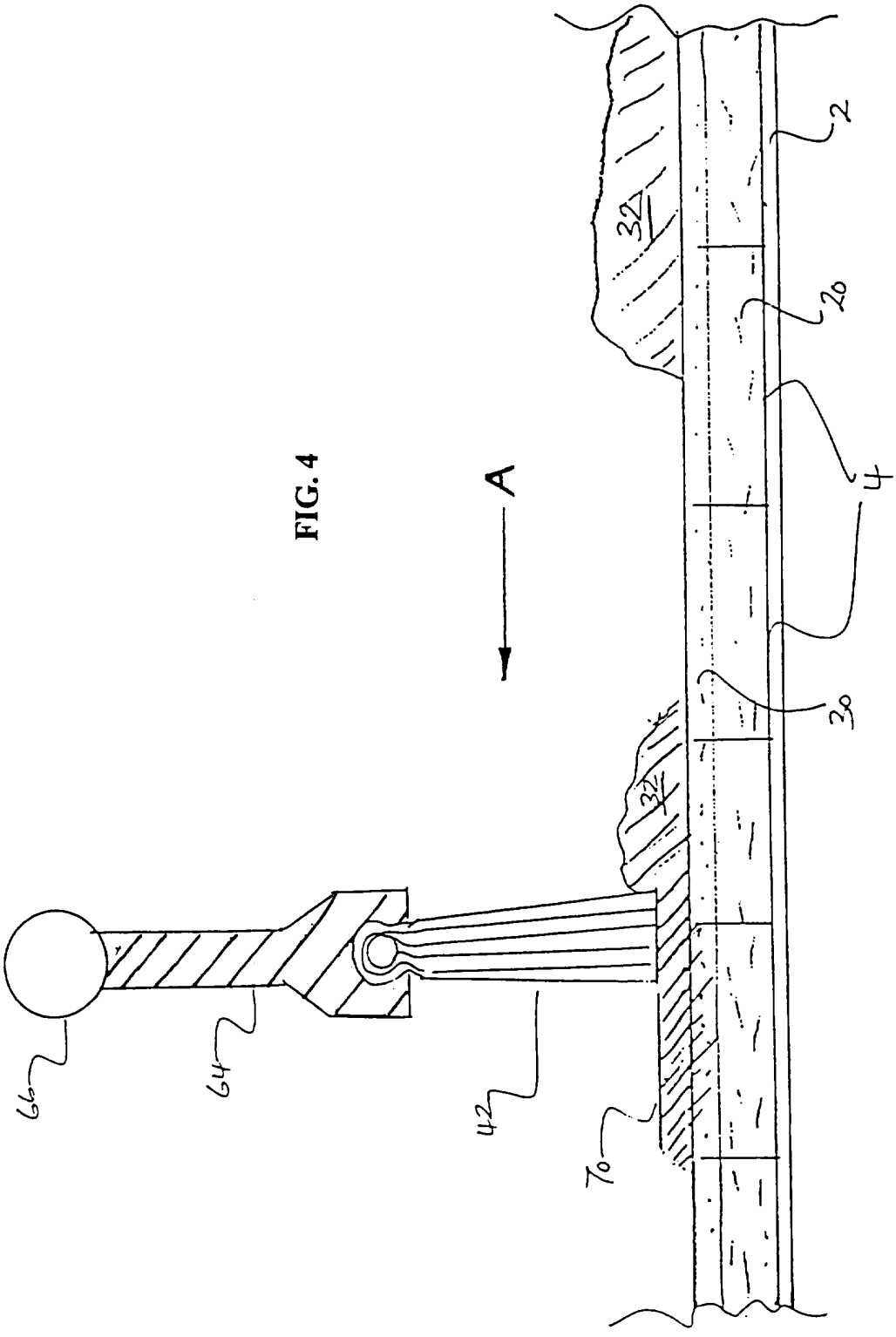

FIG. 4

FIG. 5

FIG. 6

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CONCRETE ROOFING TILES

The present invention relates to concrete roofing tiles, more particularly but not exclusively to roofing tiles which are known in the industry as "slates", and to a method of making a series of roofing tiles each tile having colour variation on its upper surface.

Roofing tiles of a cementitious material, hereinafter generically referred to as "concrete" roofing tiles, and in particular concrete roofing tiles in the form of concrete slates intended to imitate the appearance of natural slateor stone, have been manufactured for more than fifty years using a process which allows the compaction of two dissimilar layers of concrete into a single product. The advantage of such a process is that the lower layer can utilise a coarse aggregate which enhances the strength characteristic of the product and there is no need to use pigmentation in this layer since it is not visible in use. The upper layer generally utilises a finer aggregate to give a smoother upper surface and usually incorporates pigment to give the desired colour finish.

The equipment used to produce such concrete slates comprises a continuous conveyor which is propelled by means of an electric motor connected to a driveshaft. The conveyor is provided with cross members which act as dividers for the individual tiles to be manufactured. Pallets comprising metal sheet are placed between the dividers and are propelled under a hopper containing the concrete mixture which is to form the lower layer. The depth of the lower layer is controlled by means of a roller set at a predetermined height above the pallets and rotating in a direction which is opposite to that of the flow of pallets. The pallets containing the lower layer of concrete then pass under a second hopper containing the concrete mixture which is to form the upper layer. Generally, the outlet of the second hopper is positioned such that the upper layer is laid or rolled onto the lower layer. Again, the depth of the upper layer is controlled by means of a levelling roller set at a predetermined height above the pallets and rotating in a direction which is opposite to that of the flow of pallets. The pallets containing both concrete layers then pass under compacting means. The compacting means comprises a continuous belt, typically of rubber, moving in the direction of the pallets. Within the

continuous belt is housed a series of weighted reciprocating rollers which apply pressure through the belt on to the concrete below causing the concrete mixtures to densify by compaction and the upper and lower layers to consolidate into a single product. The belt is preferably provided with scraping means to remove any concrete which adheres to the belt after it has passed over the concrete. Following compaction, the tiles are removed from the conveyor with their pallets and are stacked and allowed to cure. Once cured, the tiles are removed from the pallets ready for despatch.

The above process produces tiles having substantially uniform upper surfaces in terms of their colour. However, tiles made from natural slate or stone rarely have such a uniform upper surface appearance, especially weathered slate or stone tiles, which tend to have a blotchy or irregular upper surface appearance. Usually colour and/or tone variations are present on each individual natural slate or stone tile and it is extremely rare for any two or more tiles to share the same pattern of colour and/or tone variations. Attempts have been made in the past to more closely imitate natural slate or stone by providing the upper surface of each tile with colour and/or tone variations.

Extruded concrete tiles comprising more than one upper surface colour are known, but so far none as yet are able to provide a wholly convincing substitute for natural slates or stones. For example, the extrusion onto a first pigmented layer of a further layer containing a different pigment or concentration of pigment from that of the first layer has resulted in a tile having a streaky appearance which is not a normal characteristic of slates or stones. Moreover, most known prior art methods inevitably result in some repetition of the upper surface features.

It is therefore an object of the present invention to provide a concrete roofing tile wherein the upper surface in use of the tile comprises at least two colours irregularly dispersed.

It is a further object of the present invention to provide a method for the manufacture of a concrete roofing tile whereby the upper surface in use of the tile comprises at least

two colours irregularly dispersed.

It is a further object of the invention to provide a method for manufacturing a series of roofing tiles whereby the upper surface in use of each tile comprises at least two colours irregularly dispersed and the appearance of each tile is unique amongst the tiles of the series.

Accordingly, from one aspect, the invention resides in a method of manufacturing a concrete roofing tile, including forming a base layer comprising a first concrete mix, applying to said base layer an upper layer comprising a second concrete mix, discharging from a feeder unit at a location spaced from and above the upper layer a non-uniform supply of a third concrete mix having a different colour to that of the second concrete mix and compacting the resulting product thereby to consolidate the layers and produce a tile having an upper surface comprising at least two colours irregularly dispersed.

Expressed in a different way, the invention resides in a method of manufacturing a roof tile, such as a concrete slate, in which a base concrete mix layer and a second concrete mix layer are applied in succession to form two layers of concrete, characterised in that a third concrete mix having a different colour to that of the second concrete mix is discharged onto the second layer in a non-uniform manner from a location which is spaced from and above the second layer and compacting the resulting product to consolidate the layers and produce a tile having an upper surface comprising at least two colours irregularly interdispersed.

The term "different colour" is intended to embrace variations in tone of the same colour so, for example, the third concrete mix may be provided with a greater or lesser pigment concentration than that of the second concrete mix. Alternatively, the second concrete mix may be devoid of pigment or may comprise pigment of a completely different colour to that of the third concrete mix.

From a commercial aspect, the invention resides in a method of producing a series of

roofing tiles including feeding a first concrete mix to a series of tile pallets to form a base layer, feeding a second concrete mix to form an upper layer on the base layer, discharging from a feeder unit at a location spaced from and above the upper layer a non-uniform supply of a third concrete mix having a different colour to that of the second concrete mix and compacting the resulting product thereby to consolidate the base and upper layers and produce a series of tiles each having an upper surface comprising at least two colours irregularly dispersed and having an appearance which is unique amongst the tiles of the series.

The method of the invention may be performed by means of apparatus comprising a first concrete delivery unit for delivering a base layer of a first concrete mix onto a series of tile pallets carried on a conveyor, a second concrete delivery unit for delivering an upper layer of a second concrete mix onto the base layer and a compaction unit for compacting and consolidating the base and upper layers, wherein a feeder unit adapted to discharge a non-uniform supply of a third concrete mix to the upper layer is interposed between the second concrete delivery unit and the compaction unit at a location spaced from and above the upper layer.

For convenience, the base layer is formed in accordance with the prior art process as hereinbefore described, namely by feeding the first concrete mix from a hopper to a series of pallets passing under the hopper by means of a conveyor and controlling the depth of the base layer using a roller set at a predetermined height above the pallets and rotating in a direction which is opposite to that of the flow of the pallets.

Similarly, the upper layer is formed by feeding the second concrete mix from a second hopper and again controlling the depth of the upper layer according to the predetermined height above the pallets of a further roller which also rotates in an opposite direction to that of the pallet flow.

It will be appreciated that other ways of forming the base and upper layers in accordance with the invention are also envisaged and are within the purview of the person skilled

in the art.

Where the method of the present invention does diverge from the prior art is in the provision of a feeder unit which discharges a third concrete mix to the upper layer prior to the final compaction stage which consolidates the base and upper layers. The feeder unit essentially acts as a colour dosing unit, providing a contrasting colour to that of the second concrete mix.

Of course, when it is desired to provide an upper surface displaying more than two colours, then multiple feeder units discharging additional coloured concrete mixes can be added after formation of the upper layer and before the final compaction stage. Preferably any such multiple feeder units are arranged in succession in the direction of flow of the pallets. Alternatively, the third concrete mix may comprise an unevenly blended mix of two or more colours which is fed to the upper layer from a single feeder unit.

It is a requirement that the feeder unit for discharging the third concrete mix, which differs in colour from that of the second concrete mix, be located at a position superior to and spaced from the upper layer. Moreover, it is a further requirement that the feeder unit discharges the third concrete mix in a non-uniform or irregular manner to the upper layer. By this means, subsequent compaction of the resulting concrete product produces a tile which has an irregular appearance in terms of its colour distribution. It will be appreciated that the method of the invention enables the production of a series of tiles each having a unique upper surface appearance, in other words, it is virtually impossible to produce two or more identical tiles.

The method of the present invention has therefore enabled the mass production of imitation concrete slates or stones each slate of which has a unique appearance. Thus, whereas the use of previously mass produced concrete slates or stones have relied upon the skill of the tiler in selecting the tiles when laying to achieve a completely random and natural effect (a skill which incidentally is fast dying out because of economic

constraints in the building industry), there is no such requirement in laying tiles of the present invention since no two tiles are the same.

Typically, the irregularity in colour of the upper surfaces of the tiles formed in accordance with the invention creates a blotchy or patchy appearance, the different colours of the second and third concrete mixes being randomly diffused. Such a blotchy/patchy mix of colours is characteristic of natural slate or stone, either before or after weathering.

In order to provide optimum results in terms of consolidation of the layers and colour dispersion of the upper surface, it is particularly important that the second concrete mix has a lower water content relative to the first concrete mix. Preferably, the upper layer is formed of a semi-dry mix of concrete. By such means, water in the base layer seeps or diffuses into the upper layer during compaction and subsequent curing thereby enhancing the "bonding" between the layers. Any tendency towards de-lamination of the layers is therefore suppressed.

It will be understood that the characteristic appearance of the tiles according to the invention results from the manner in which the third concrete mix is introduced. In this regard, and as already mentioned, it is essential that the third mix be discharged from a feeder unit located at a position which is not only above, but is also spaced from, the upper layer formed by the second concrete mix. It is also important that the feeder unit allows the third mix to fall or be propelled onto the second mix in an irregular or non-uniform manner.

Various methods may be adopted for achieving a non-uniform supply of the mix to the upper layer, for example, by charging one or more recesses with the mix and subsequently discharging the or each recess. Advantageously, the or each recess is discharged by means of rotation whereby the charged mix falls from or is propelled out of the recesses during rotation.

To further enhance the irregularity of colour achieved in the upper surface, the method of the invention additionally includes variable speed delivery or discharge of the third concrete mix. For example, this may be achieved by variable speed rotation of the or each recess. The trajectory of the mix as it is discharged from the or each recess will vary according to the rotational speed. At low speeds, the mix may fall by gravity alone, whereas at higher speeds the mix will be propelled towards the upper layer. Moreover, as the rotational speed increases, the amount of mix charged to the recesses is likely to be less than the maximum load which can be accommodated. Accordingly, the quantity of third concrete mix available for deposition on the upper layer can also be altered by varying the rotational speed.

Apparatus for performing such a method may comprise a hopper or other reservoir in communication with a roller provided with an irregular arrangement of one or more recesses or transfer pockets. The roller is preferably positioned beneath the hopper but essentially above and spaced from the pallets into which the base and upper layer have already been formed. In this way, as the roller rotates, the or each recess or pocket is charged from above with the third concrete mix and, as the roller continues its cycle, the charged recesses or pockets gradually empty as they arrive at a position where the gravitational and/or centrifugal force overcomes any tendency for the mix to adhere to the recesses of the roller. Hence the mix falls or is projected from the or each recess towards the upper layer below.

By means of the roller with its array of one or more recesses, discrete but irregular slugs of the third concrete mix are caused to fall or are propelled from the feeder unit towards the upper layer and are dispersed on or among the material comprising the second concrete mix in an irregular fashion. In the subsequent consolidation stage arising from compaction, not only is the already irregular dispersion of colours on the upper tile surface enhanced or exaggerated, but the irregularity in appearance is stabilised in readiness for curing.

Advantageously, as with the rollers normally provided upstream for levelling the base

and upper layers after they are formed in the pallets, the recessed transfer roller also rotates in a direction which is opposite to the flow of the pallets. Such an arrangement causes the third concrete mix to fall or be projected from the transfer roller towards the pallets below after the pallets have passed below the roller.

The recessed roller is preferably provided with variable speed means for varying the rotational speed. As described above, when the rotational speed of the roller increases, the recesses or pockets are less likely to pick up their maximum load from the hopper above and the quantity of third concrete mix available for deposition on the upper layer therefore depends to a certain extent upon the rotational speed of the roller. The trajectory of the mix as it leaves the roller will also vary according to its rotational speed.

An alternative method for discharging the third or subsequent concrete mix from the feeder unit is by feeding of the mix through at least one aperture. Preferably, the mix is fed through a reciprocating aperture to achieve an enhanced measure of irregularity. Moreover, the irregularity may be further enhanced by varying the the speed of reciprocation to affect the rate of discharge of the mix through the or each aperture.

To perform the method described above, the third concrete mix may be allowed to fall from its respective hopper or reservoir through an apertured or ported transfer plate or belt means positioned underneath the hopper but spaced from and above the upper layer formed on the pallets below. To achieve a non-uniform flow of mix through the transfer plate or belt, the apertures have irregular dimensions and the plate or belt is moveable relative to the outlet of the hopper to vary the number and/or extent of the apertures under the outlet at any one time.

As with the recessed roller described above, the speed of movement of the apertured transfer plate or belt may be varied thereby providing a means for increasing or reducing the quantity of mix falling through the apertures during each pass under the hopper outlet. Such a variable speed mechanism further increases the irregularity in upper

surface appearance.

Ideally, the apertured transfer plate is capable of reciprocal motion, preferably parallel with the direction of flow of the pallets. While such a plate may be substantially planar, in a preferred embodiment the plate has a radius of curvature such that the plate reciprocates along an arcuate path and the mix emerges from a convex, lower face of the plate.

Advantageously, the blotchy or patchy appearance of the upper surface is further enhanced by deflecting or otherwise interrupting the flow of third concrete mix after it emerges from the feeder unit, more especially by deflecting the flow as it emerges from the unit. By deflecting the flow, additional random scattering of the mix is caused as it falls or is projected from the feeder unit.

Deflection of the third concrete mix as it is discharged from the feeder unit may be achieved by providing deflecting means, such as a deflector plate, and more especially an inclined deflector plate, interposed between the transfer roller, plate or belt and the upper layer comprising the second concrete mix. In this way, further random diffusion of the already irregular supply of third concrete mix is achieved.

Deflection of the third concrete mix may also be accompanied by vibration to further break up or randomise the fall of the third concrete mix onto the upper layer. The deflecting means may therefore be additionally provided with vibrating means.

The dispersion of the third concrete mix onto the upper layer to provide an irregular colouration in the upper surface of the tiles may also be achieved by spreading the mix on the surface of the upper layer after it has discharged from the feeder unit. Spreading by brushing or combing the surface is a preferred option.

Moreover, spreading of the mix under a reciprocating motion transverse to the direction of flow of the pallets, especially reciprocating in a transverse direction between an angle

of 20 to 90 degrees to the direction of flow, is particularly suitable. Of course, the angle of the direction of reciprocation may also be variable to further randomise the operation.

In a preferred apparatus, the spreading means advantageously comprises a multi-pronged member, such as a brush, comb or the like mounted on reciprocating means.

While charging of recesses, feeding through apertures, deflecting and spreading have been described as alternative methods for producing an irregular surface appearance in the upper surface of the tile, it should be understood that any combination of these methods may be used.

In a particularly preferred embodiment, the desired appearance of the tile is achieved by charging at least one rotating recess of a feeder unit with the third concrete mix, discharging the mix from the at least one recess and interrupting the flow of the mix towards the upper surface below by deflecting the mix after it is discharged. Varying the speed of rotation and simultaneously vibrating the mix as it is deflected provide optimum benefits.

In terms of a preferred apparatus, the third concrete mix is charged to a recessed roller rotating at variable speed and discharged therefrom onto an inclined vibrating deflector plate positioned under the roller from where the mix is deflected onto the upper layer on the pallets passing below. Prior to final compaction, the pallets are subsequently conveyed beneath a transversely reciprocating brush to spread the mix and further interdisperse the second and third concrete mixes now forming the upper surface of the products.

Although not limited in size, the tiles produced according to the invention are typically derived from a base layer having a thickness in the region of 12mm after intermediate rolling and an upper layer comprising second and third concrete mixes in the order of 2 to 3 mm after final compaction.

It will be understood that the present invention further includes a concrete roofing tile having an upper surface of a blotchy or patchy appearance whenever made by any of the methods described hereinabove.

From another aspect, the invention resides in a roofing tile including a base layer and an upper layer, wherein the upper layer comprises an uneven blend of at least two concrete mixes of different colours such that the upper surface of the tile has a blotchy or patchy appearance.

The invention also resides in a roof comprising a plurality of roofing tiles having the aforementioned characteristics, namely an upper surface comprising an uneven blend of at least two concrete mixes of different colours such that the upper surface has a blotchy or patchy appearance, and in a roof comprising a plurality of roofing tiles having an upper surface with a blotchy or patchy appearance made according to any of the methods described hereinabove.

The invention will now be illustrated, by way of example, with reference to the following drawings and photographs in which:-

Figure 1 shows apparatus for manufacturing roofing tiles;

Figure 2 shows a cross-section of a feeder unit;

Figure 3 shows a cross-section of a reciprocating spreading means;

Figure 4 shows an alternative feeder unit to that of Figure 3;

Figure 5 is a photograph showing the appearance of the upper surface of a typical tile formed in accordance with the invention; and

Figure 6 is a side view of the tile of Figure 5.

Turning to Figure 1, conveyor 2 travelling in the direction of arrow A carries a series of tile pallets 4 which pass successively under first hopper 6, second hopper 8 and feeder unit 10 and finally under compaction unit 12.

The first hopper 6 delivers a base layer 20 of a first wet concrete mix 22 containing coarse aggregate onto the pallets 4. The pallets 4 now carrying base layer 20 are then conveyed under rollers 24 and 26 to level the layer 20. After levelling, the pallets 4 are conveyed under second hopper 8 containing a second, less coarse and relatively dry concrete mix 28. The second concrete mix 28 emerges from hopper 8 and is laid upon the base layer 20 to form an upper layer 30 which is levelled by passing under roller 90.

The pallets 4 now carrying base layer 20 and upper layer 30 are conveyed further downstream and pass under feeder unit 10 which includes a third hopper 34 provided at its base with transfer roller 36. As the roller 36 rotates, the third hopper 34 containing a third concrete mix 32 which is a different colour to that of the second concrete mix 28 delivers the mix 32 to recesses 38 provided at irregular intervals on the roller surface.

The roller 36 is positioned above and spaced from the upper layer 30 carried on the pallets 4 below such that upon rotation of roller 36 in the direction of the arrow B, the mix 32 is discharged from the recesses 38 towards the pallets beneath. The volume, trajactory and level of dispersion of the falling mix is partially determined by the speed at which the roller 36 is rotated. The roller 36 is usually operated at variable speed so that the fall of particles is further randomised.

A further component of is inclined deflector plate 40 which is positioned to interrupt and deflect the flow of mix 32 from roller 36. The deflector plate 40 is vibrated causing additional randomisation of the particles of mix 32 as they are shaken off the plate 40 and allowed to drop towards the upper layer 30.

After dropping on to upper layer 30, the third concrete mix 32 at least partially diffuses

in an irregular manner into the surface of upper layer 30.

Spreading means in the form of brush 42 which reciprocates in a direction transverse to the direction of travel of the conveyor 2 is positioned yet further downstream of the feeder unit 10. As the brush 42 comes into contact with the upper layer 30 now incorporating an irregular dispersion of mix 28,32 further dispersion results.

After emerging from under the reciprocating brush 42, the pallets are conveyed to compaction unit 12 which comprises a continuous rubber belt 50 in which is housed a series of weighted reciprocating rollers 52 which exert a pressure on the belt 50 and hence onto the filled pallets 4 below.

The pressure caused by the rollers 52 acting on the belt 50 causes compaction of all constituents to consolidate the base and upper layers 20, 30 formed on the pallets and thereby stabilise the irregular dispersion between second and third concrete mixes 28, 32 in the upper layer and hence determine the final appearance of the formed tiles 60 carried on the pallets.

Figure 2 shows an enlarged cross-sectional view of part of feeder unit 10, in particular hopper 34 for housing third concrete mix 32 and transfer roller 36. As will be seen, roller 36 is provided on its rolling surface with a plurality of recesses 38, each being differently and irregularly configured in terms of both circumference and depth.

In operation, as transfer roller 36 is rotated in the direction of arrow B, third concrete mix 32 is charged to the recesses 38 as they pass beneath the base of the hopper 34, at least partially filling the recesses 38. Upon further rotation of the roller 36, the at least partially filled recesses empty or partially release their load under the combined influence of gravity and the centrifugal force caused by the rotation.

Figure 3 shows an enlarged cross-sectional view of the apparatus in the region of reciprocating brush 42. In particular, the figure shows discrete irregular "blobs" of third

concrete mix 32 previously dropped from a distance above onto the upper layer 30 formed of second concrete mix 28. The brush 42 is carried on carriage member 64 which in turn depends from reciprocating member 66. Reciprocating member 66 moves in a direction substantially transverse to the direction of travel of the pallets 4 on the conveyor and shown by arrow A. In addition to causing concrete mix 32 to at least partially diffuse into the upper layer 30, the brush 42 also assists in levelling the upper surface 70 of the formed product prior to final compaction.

Instead of transfer roller 36 located at the base of third hopper 34, a sliding transfer plate 80 having a plurality of differently shaped apertures 82 can be provided as shown in Figure 4. The transfer plate 80 is attached to drive means (not shown) to move the plate 80 through an arcuate path as shown by arrow C. Different apertures 82 are sequentially passed below the outlet of hopper 34 allowing irregular amounts of concrete mix 32 to drop through the apertures 82 towards the upper layer carried on the pallets 4 below. The drive means may drive the plate 80 at variable speeds to affect the flow of concrete through the apertures. Deflector plate 40 and/or brush 42 may or may not be provided in addition to plate 80.

Figure 5 is derived from a photograph taken of the upper surface of a roofing tile formed in accordance with the process and apparatus of the invention. While the appearance of the upper surface is "typical" in terms of the blotchy or irregular colour dispersion between the second and third concrete mixes, its appearance is unique amongst those that have been produced.

Figure 6 is a side view of the tile of Figure 5 and shows a relatively thick base layer 20 of concrete formed from a first concrete mix and a relatively thin upper layer 30 comprising a non-uniform dispersion of second and third concrete mixes.

While particular embodiments have been described, it should be appreciated that various modifications may be made without departing from the scope of the invention. For example, the deflector could be replaced by a spinnable element whereby the third

concrete mix is spun off the element in an irregular manner towards the upper layer below or alternatively by a paddle wheel arrangement comprising a series of plates mounted in a circumferential array. A non-uniform appearance on the upper surface may also be achieved by discharging the third concrete mix from the feeder unit electrostatically, for example, by electrostatically charging the pallets carried on the conveyor.

CLAIMS

1. A method of manufacturing a concrete roofing tile including forming a base layer comprising a first concrete mix, applying to said base layer an upper layer comprising a second concrete mix, discharging from a feeder unit at a location spaced from and above the upper layer a non-uniform supply of a third concrete mix having a different colour to that of the second concrete mix and compacting the resulting product thereby to consolidate the layers and produce a tile having an upper surface comprising at least two colours irregularly dispersed.

2. A method according to claim 1, wherein the third concrete mix is discharged from said feeder unit at a variable rate.

3. A method according to claim 1 or claim 2, wherein said feeder unit comprises one or more transfer pockets and said third concrete mix is charged to said one or more transfer pockets and subsequently discharged therefrom.

4. A method according to claim 3, wherein the or each transfer pocket is provided on a rotatable roller such that said third concrete mix is charged to and discharged from the or each pocket upon rotation of the roller.

5. A method according to claim 4, wherein the third concrete mix is charged to and discharged from a plurality of transfer pockets irregularly arranged on said roller.

6. A method according to any of claims 3 to 5, wherein said roller is rotated at variable speed.

7. A method according to any preceding claim, wherein the third concrete mix is discharged from the feeder unit through one or more apertures.

8. A method according to claim 7, wherein the third concrete mix is discharged through a reciprocating transfer plate or belt provided with one or more apertures.

9. A method according to claim 8, wherein the speed of reciprocation of the transfer plate or belt is varied thereby to affect the rate of discharge of the third concrete mix through the or each aperture.

10. A method according to claim 8 or claim 9, wherein the transfer plate reciprocates along an arcuate path and the third concrete mix is discharged through the or each aperture in the convex, lower face of the plate.

11. A method according to any preceding claim, further including deflecting the third concrete mix after discharge from the feeder unit.

12. A method according to claim 11, wherein the third concrete mix is vibrated at the same time as it is deflected.

13. A method according to any preceding claim, further including spreading the third concrete mix on the surface of the upper layer after discharging from the feeder unit.

14. A method according to claim 13, wherein spreading of the third concrete mix is accompanied by a reciprocating motion.

15. A method of making a series of roofing tiles including feeding a first concrete mix to a series of tile pallets to form a base layer, feeding a second concrete mix to form an upper layer on the base layer, discharging from a feeder unit at a location spaced from and above the upper layer a non-uniform supply of a third concrete mix having a different colour to that of the second concrete mix and compacting the resulting product thereby to consolidate the base and upper layers and produce a series of tiles each having an upper surface comprising at least two colours irregularly dispersed and having an appearance which is unique amongst the tiles of the series.

16. A concrete roofing tile having an upper surface comprising at least two colours irregularly interspersed when made by a method according to any preceding claim.

17. A concrete roofing tile including a base layer and an upper layer, wherein the upper layer comprises an uneven blend of at least two concrete mixes of different colours such that the upper surface has a blotchy or patchy appearance.

18. A roof comprising a plurality of roofing tiles as claimed in claim 16 or claim 17.

19. Apparatus for the manufacture of concrete roofing tiles comprising a first delivery unit for delivering a base layer of a first concrete mix onto a series of tile pallets carried on a conveyor, a second concrete delivery unit for delivering an upper layer of a second concrete mix onto the base layer and a compaction unit for compacting and consolidating the base and upper layers, wherein a feeder unit adapted to discharge a non-uniform supply of a third concrete mix to the upper layer is interposed between the second concrete delivery unit and the compaction unit at a location spaced from and above the upper layer.

20. Apparatus according to claim 19, wherein said feeder unit comprises a concrete reservoir in communication with a rotatable transfer roller provided on its outer surface with one or more transfer pockets into which the third concrete mix is charged prior to discharging therefrom.

21. Apparatus according to claim 20, wherein said roller is rotatable at variable speed.

22. Apparatus according to any of claims 19 to 21, wherein the feeder unit comprises a concrete reservoir in communication with an apertured transfer plate or belt positioned thereunder and through which the third concrete mix is discharged to the upper layer.

23. Apparatus according to claim 22, wherein said transfer plate or belt is provided with a plurality of apertures having irregular dimensions and the transfer plate or belt is moveable relative to the reservoir to vary the number and/or extent of the apertures in communication therewith at any one time.

24. Apparatus according to claim 22 or claim 23, wherein the transfer plate or belt is

provided with a variable speed mechanism.

25. Apparatus according to claim 23 or 24, wherein the transfer plate has a radius of curvature and the plate reciprocates along an arcuate path such that the third concrete mix is discharged through the apertures from a convex, lower face of the plate.

26. Apparatus according to any of claims 19 to 25, further comprising a deflector plate interposed between the feeder unit and the upper layer to deflect or interrupt the flow of concrete after discharge from the feeder unit.

27. Apparatus according to claim 26, wherein said deflector plate is provided with vibration means.

28. Apparatus according to any of claims 19 to 27, further comprising spreading means for spreading the third concrete mix on the upper surface after discharge from the feeder unit.

29. Apparatus according to claim 28, wherein the spreading means is provided with reciprocal motion means for reciprocating in a transverse direction between an angle of about 20 to 90 degrees to the direction of flow of the pallets.

30. Apparatus according to claim 29, wherein the reciprocal motion means includes means for varying the angle of reciprocation.

31. A method of manufacturing a concrete roofing tile, or a series of concrete roofing tiles, substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

32. A concrete roofing tile substantially as hereinbefore described with reference to Figures 5 and 6 of the accompanying drawings.

33. Apparatus for the manufacture of concrete roofing tiles substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

The Patent Office

21

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Claims searched: 1-33 **Date of search:** 19 June 1997

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): B28B(1/16, 1/29, 5/00, 5/02, 5/04, 13/02, 19/00)

Other: Online:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2186521A	Anchor Building Products Limited	
A	GB2055682A	Tarmac Industrial Holdings Limited	
A	US4666648A	Marley Tile AG	
A	US4369025A	EPSI Brevets et Participations S.A.	

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