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(71) Applicant: **Travancore Mats & Matting Co.**
Cherthala 688-524, Kerala (IN)

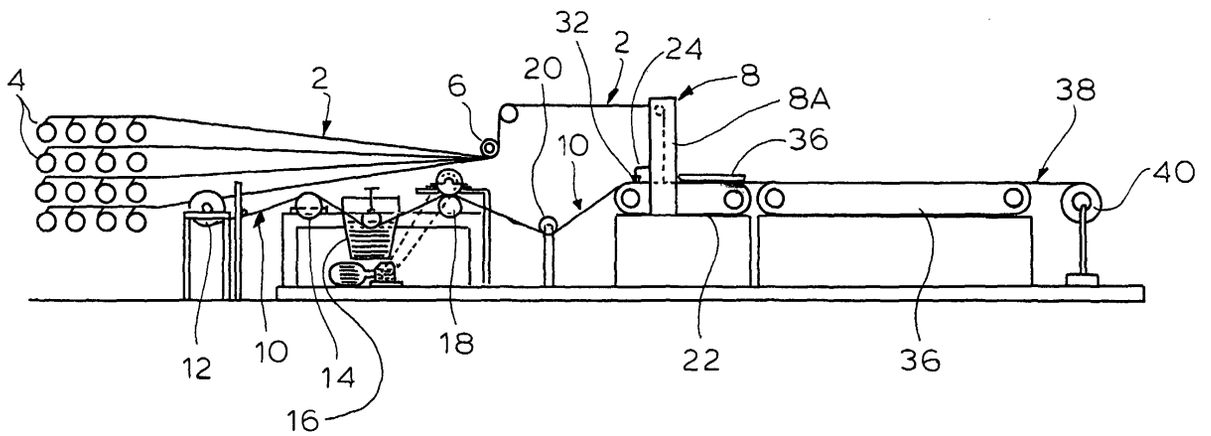
(72) Inventor: **Santhosh, Velayudhan**
Cherthala 688-524, Kerala (IN)

(74) Representative: **Bluff, John William et al**
Lloyd Wise, Tregear & Co.,
Commonwealth House,
1-19 New Oxford Street
London WC1A 1LW (GB)

(54) Brush-type mat and its manufacture

(57) A brush- type mat (38) is formed of a supporting base layer constituted at least in part by a cured biodegradable plastic reinforced by a mesh fabric (10), into which layer a plurality of closely spaced lengths or tufts of fibrous materials (2) are embedded so as to extend up therefrom, the mat being produced by providing an uncured layer of that plastic material (24) at an assembly station into which mesh fabric (10), preferably pre-coated (16) with the plastic, is embedded in the plastic layer, and where thereafter the lower ends of the tufts of fibrous material are inserted lengthwise (8), the plastic thereafter being cured (36).

FIG. 1



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Description

[0001] This invention relates to the formation of a brush-type mat with lengths of fibrous materials embedded and extending up from a base layer of plastic, in which that base layer is essentially formed of a biodegradable plastic, the mat having superior physical and chemical characteristics.

BACKGROUND OF THE INVENTION

[0002] Brush-type mats are well known, and are often used as doormats. They consist of a base layer of plastic into which are embedded the ends of tufts of fibrous material, portions of these tufts extending up from the base layer. Since such mats are generally used in applications where they are subjected to extremely rigorous conditions, they therefore must be capable of withstanding these conditions. Accordingly, in the past the base layer has usually been constituted of a cured plastic having appropriate physical and chemical characteristics, usually polyvinyl chloride or comparable material, into which the lengths of the fabric material forming the tufted portion of the mat are embedded. Those plastic materials, while generally satisfactory in terms of use, have a significant drawback which has recently become relatively critical, to wit, they are not biodegradable. Since mats of the type under discussion have only a finite life and will be discarded at some time, the non-biodegradability of the plastics used in them has become a serious drawback, particularly in view of the increased consciousness on the part of the public of the need for biodegradability. Non-biodegradable curable plastics are, of course, known, but their use in mats of the type under discussion has been contra-indicated because they have not in the past produced mats of adequate physical characteristics, in particular being deficient in the strength with which the tufted lengths of fibrous materials are reliably retained within the plastic layer and the resistance of the mats to tearing or the like.

SUMMARY OF THE INVENTION

[0003] In accordance with the present invention, the layer which forms the base of the mat is constituted by a layer of biodegradable plastic material such as rubber, preferably to a large degree natural rubber, which is reinforced by a mesh cloth embedded therein prior to the insertion of the lengths of fibrous material thereinto, that mesh cloth preferably being coated with the plastic, as by being dipped thereinto, before reaching and becoming embedded in that plastic layer. The thus assembled combination of plastic backing layer, mesh cloth and upstanding lengths of fibrous material is then subjected to plastic curing in order to produce the desired mat material. The lengths of fibrous material preferably are formed of coir yarn, as has long been the case. The mesh cloth is preferably formed of jute or cotton. As a result a brush mat is produced which is not only biodegradable but also has improved physical characteristics when compared with the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] A preferred embodiment of the present invention is illustrated in the following drawings in which

Fig. 1 is a schematic representation of the equipment used to form the mats of the present invention;
Figs. 2 and 3 illustrate the left and right hand portions respectively of the apparatus of Fig. 1, but on an enlarged scale; and
Fig. 4 is a schematic representation of that portion of the apparatus of Fig. 1 which pours plastic to produce the plastic layer at the assembly station.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0005] As is shown in the drawings, which disclose a preferred embodiment of the apparatus to produce the mat of the present invention, the fibrous material generally designated 2 which will form the tufts of the mat are preferably constituted by coir yarn, the fibers being extracted from the husks of coconuts, cleaned and then spun by hand or machine to form yarn. That yarn is provided in a plurality of rolls 4. Many lengths of yarn 2 are unwound from the equally numerous rolls 4 and fed over roller 6 to an assembly station 8 of known construction and operation, the continuous yarn lengths 2 at this assembly station 8 being cut into short lengths which eventually become the tufts of the mat.

[0006] A mesh cloth, generally designated 10, is provided on a roller 12. That cloth is in mesh form so as to facilitate its incorporation into the end product and to better receive the inserted fibrous tufts. It has a width generally the same as the width of the mat to be produced. It passes from the roller 12 over a roller 14, into a bath 16 of appropriate uncured and soft plastic material and then through rollers 18 which serve to feed the cloth 10 under roller 20 and to the leading end of a driven Teflon conveyor belt 22 forming a part of the assembly station 8.

[0007] Also a part of the assembly station 8 is the plastic feeding mechanism, generally designated 24, schematically shown in Fig. 4. It comprises a head 26 slidable back and forth on rod 28 and driven back and forth by rotated screw 30. The head 26 has a nozzle 32 directed downwardly towards the upper reach of the Teflon belt 22 and is connected by conduit 34 and pump (not shown) to a suitable source of uncured plastic. The head 26, when moved back and forth over the Teflon belt 22 while uncured plastic is being pumped out therefrom, forms on the Teflon belt 22 a layer of uncured plastic material having an appreciable thickness such as 4-8 mm, depending on the desired pulling strength and pile height of the end product, into which layer the mesh cloth 10 is embedded. As can best be seen from Figs. 1 and 3, this occurs in advance of the vertical portion 8A of the assembly station 8 which is adapted to receive the fibrous material 2 and cut that fibrous material, as it is fed therethrough into short lengths the size of which is determined by the desired thickness of the mat to be produced. Those short lengths of fibrous material are, at the assembly station 8, oriented vertically and pushed down so that their lower ends become embedded in the plastic layer formed by the head 26 into which the mesh fabric 10 is embedded. Preferably, and as shown in the drawings, the mesh cloth 10 is applied to the Teflon belt 22 before it reaches the plastic feeding mechanism 24, so that the plastic is poured evenly onto the mesh cloth 10 to form the plastic base layer with the mesh cloth 10 embedded therein. The thickness of that plastic layer is maintained relatively constant by means of a doctor blade included in the assembly station 8.

[0008] In this way, a continuous embryonic mat is produced consisting of a continuous layer of uncured plastic stabilized and strengthened by the mesh fabric 10 with a substantially continuous series of tufts of fibrous material extending up therefrom. That embryonic mat is then subjected to a treatment such as a heating treatment in order to cure the plastic and thus produce the finished product. As here disclosed, that cure is accomplished in two stages. The Teflon belt 22 extends for an appreciable distance from the vertical portion 8A of the assembly station 8, is provided with an internal heat source (not shown) and may be provided with a cover 36 to define at least a preliminary heat treatment or vulcanizing chamber through which the continuous embryonic mat, when it leaves the assembly station, slowly passes. That may, for example, involve travel of 10 meters at a temperature of about 160° C. This will usually not completely cure the resin but will sufficiently cure it so that it will readily release from the Teflon belt 22.

[0009] This semi-cured matting is fed onto a second conveyor belt 36 which may be formed of stainless steel. It too is provided with heating means (not shown), and as the mat moves along with the belt 36 its curing is completed. The belt 36 may be approximately 30 meters in length, the temperature to which the matting is subjected may be about 160° C. and the matting may move along with the belt 36 for approximately 45 minutes. The finally cured matting thus produced, generally designated 38, is wound up on a reel 40, ready for cutting and shearing, as is conventional.

[0010] The plastic material in the bath 16 and the plastic material fed onto the Teflon belt 22 and the mesh cloth 10 are preferably the same. As indicated above, it is important that the composition of the plastic material be biodegradable. A preferred biodegradable material is rubber latex and in particular, but not exclusively, natural rubber latex, combined with the usual and known compounding agents such as accelerators, vulcanizing agents, activators, and coloring agents. One particular formulation which has produced good results is as follows, the wet weights being set forth in the proportions to produce 100 kilograms of material:

		Wet Wt.
1.	Styrene Butadiene Rubber latex (SBR) (50% dry rubber compound)	10.00 kg
2.	Natural rubber latex (50% dry rubber compound)	40.00 kg
3.	Emulsion MC 140 strength 35% (polyvinyl acetate emulsion)	10.00 kg
4.	10% solution of decomposed tamarind see (seed of tamarindus indica) (a natural starch based resin) (Stabilizer)	20.00 kg
5.	Fungicide (Phenolic based anti fungal)	0.50 kg
6.	Sulphur (Vulcanizing agent) (Rubber grade 50% dispersion)	2.00 kg
7.	ZDC (Zinc Diethyl Dithiocarbonate) (50% dispersion) (Accelerator to increase speed of vulcanization)	2.00 kg
8.	Zinc Oxide (40% dispersion) (Activator)	0.80 kg
9.	Saturated ammonium chloride solution 30% (Accelerator)	0.20 kg
10.	Ammoniated water (5%)	14.00 kg.
11.	Pigment as required for color	

[0011] An alternative and particularly preferred formulation is as follows:

		Wet Wt.
1.	SBR or Styrene Butadiene Rubber latex (50% dry rubber) plus or minus 10%	3.00 kg

(continued)

		Wet Wt.
2.	Natural rubber latex (53% dry rubber content)	60.00 kg
3.	Emulsion MC140 strength 35% (poly Vinyl acetate emulsion)(VA)	20.00 kg
4.	10% Ammoniated oleate (stabilizer) or an alternate stabilizer	4.00 kg
5.	Fungicide (Phenolic based anti fungal)	0.06 kg
6.	Sulphur (Vulcanizing agent) (Rubber grade 50% dispersion)	2.00 kg
7.	ZDC (Zinc Diethyl Dithiocarbonate) (50% dispersion) (Accelerator to increase speed of vulcanization)	2.00 kg
8.	Zinc Oxide (40% dispersion) (Activator)	0.80 kg
9.	Saturated ammonium chloride solution 30%	0.20 kg
10.	Ammoniated water (5%)	10.00 kg
11.	Pigment as required for color	

[0012] The proportions of all of the elements may be varied, and in particular the proportions of the first four elements may be varied by plus or minus 10%. Other biodegradable plastics may be substituted, in particular in place of the polyvinyl acetate. The disclosed specific formulation is primarily natural rubber to which a minor amount of synthetic rubber has been added to improve the physical characteristics of the end product, which is also the case with respect to the polyvinyl acetate and stabilizer, but those elements and may be omitted or provided in somewhat different proportions, and other biodegradable plastics may be substituted for them.

[0013] In a preferred procedure the sulphur, ZDC and zinc oxide are ball milled and set aside. The polyvinyl acetate emulsion is mixed with the ammoniate water, after which the stabilizer, fungicide and pigment are added and mixing continues. After those materials are thoroughly mixed the rubber latex and the previously mixed sulphur, ZDC and zinc oxide are added, mixing continues, and finally the other compounds are mixed into the overall composition, after which that composition is ready for feeding through the feeding mechanism 24.

[0014] The thus constituted mats, after curing the plastic, are particularly well suited for strenuous use, for example, as a door mat, because the tough fibrous tufts which extend up from the plastic base are retained in that base with a reliability (pulling strength) exceeding that characteristic of prior art mats using a conventional polyvinyl chloride plastic, while the plastic backing itself exhibits improved stability and tearing strength when compared with the prior art. This is due to a large degree to the reinforcement of that plastic layer by the cloth 10, the mesh nature of which not only facilitates its embedment in the plastic layer but also facilitates lengthwise insertion of ends of the tufting material 2 into the plastic layer for retention therein. In addition, and most significantly, the mats of the present invention are biodegradable.

[0015] The embodiments here disclosed have been chosen to illustrate the advantages of the present invention, but it will be understood that they are exemplary only, and that variations may be made therein in accordance with the skill of the art, all within the scope of the invention as described in the following claims.

Claims

1. The method of making a brush-type mat in which lengths of fibrous material extend upwardly from a base layer of plastic into which said lengths are partially embedded, said method comprising conveying substantially continuous lengths of said fibrous material to a cutting station where the material is cut into short lengths, conveying said short lengths to an assembly station, providing at said assembly station a layer comprising plastic and a mesh fabric embedded therein, said plastic being uncured and sufficiently fluid so that said short lengths can be inserted thereinto, at said assembly station partially inserting said short lengths into said layer so that said short lengths extend therefrom, and conveying the thus assembled plastic, mesh fabric and upstanding lengths to a curing station where said plastic is cured.

2. The method of Claim 1, in which said plastic is biodegradable.

3. The method of Claim 1, in which said plastic is predominantly biodegradable natural rubber latex.

4. The method of Claim 1, in which said uncured plastic comprises a mixture of styrene-butadiene rubber latex, natural rubber latex and stabilizer.

5. The method of any of Claims 1, 3 or 4, in which said mesh fabric is formed of a substance from the group consisting of jute and cotton.

6. The method of any of Claims 1, 3 or 4, forming said layer by coating said mesh fabric with said plastic before said mesh fabric reaches said assembly station, and thereafter embedding said mesh fabric in a layer of said plastic formed at said assembly station.

7. The method of Claim 1, in which said plastic layer comprises styrene butadiene 3-10 parts, natural rubber 40-60 parts, and polyvinyl acetate 10-2 parts, all parts by weight.

8. The method of making a brush-type mat in which lengths of fibrous material extend upwardly from a base layer of plastic into which said lengths are inserted, which method comprises:

(a) conveying substantially continuous lengths of said fibrous material to a cutting station where the material is cut into short lengths and conveying said lengths to an assembly station;
(b) forming a layer of uncured plastic at said assembly station;
(c) conveying a mesh fabric to said assembly station and there embedding said mesh fabric into said plastic layer;
(d) at said assembly station partially inserting said short lengths into said plastic layer so that said short lengths extend therefrom; and
(e) conveying the assembly of plastic layer, mesh fabric and upstanding lengths to a curing station where said plastic is cured.

9. In the method of Claim 8, coating said mesh fabric with said plastic while it is being conveyed to said assembly station.

10. A brush-type mat comprising a supporting base layer comprising a cured biodegradable plastic layer and a substantially co-extensive layer of mesh fabric embedded therein and, extending upwardly from said base layer, a plurality of closely spaced lengths of fibrous material the lower ends of which are embedded and retained within said plastic layer.

11. The mat of Claim 10, in which said mesh fabric is formed of a material from the group consisting of jute and cotton.

12. The mat of either of Claims 10 or 11, in which said plastic predominantly comprises natural rubber.

13. The mat of either of Claims 10 or 11, in which said plastic comprises a mixture of styrene-butadiene rubber, natural rubber and stabilizer.

14. The mat of Claim 10, in which said plastic layer comprises styrene butadiene 3-10 parts, natural rubber 40-60 parts, and polyvinyl acetate 10-2 parts, all parts by weight.

FIG. 1

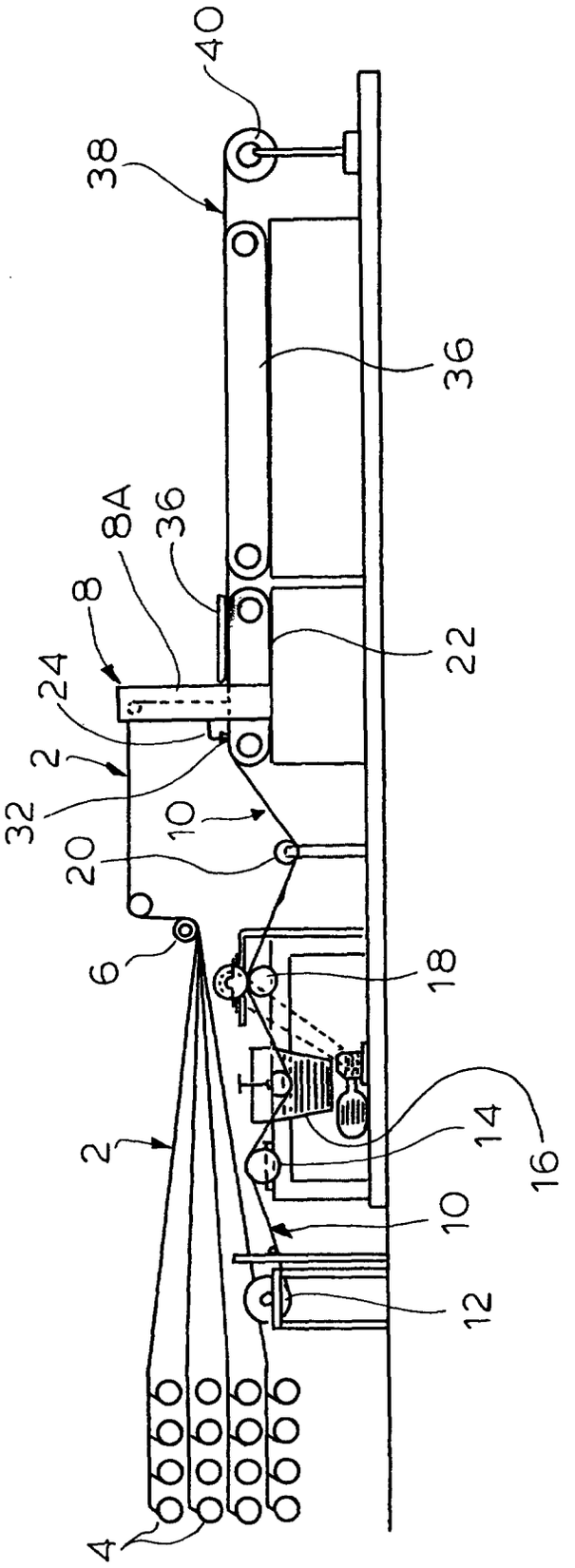

FIG. 2

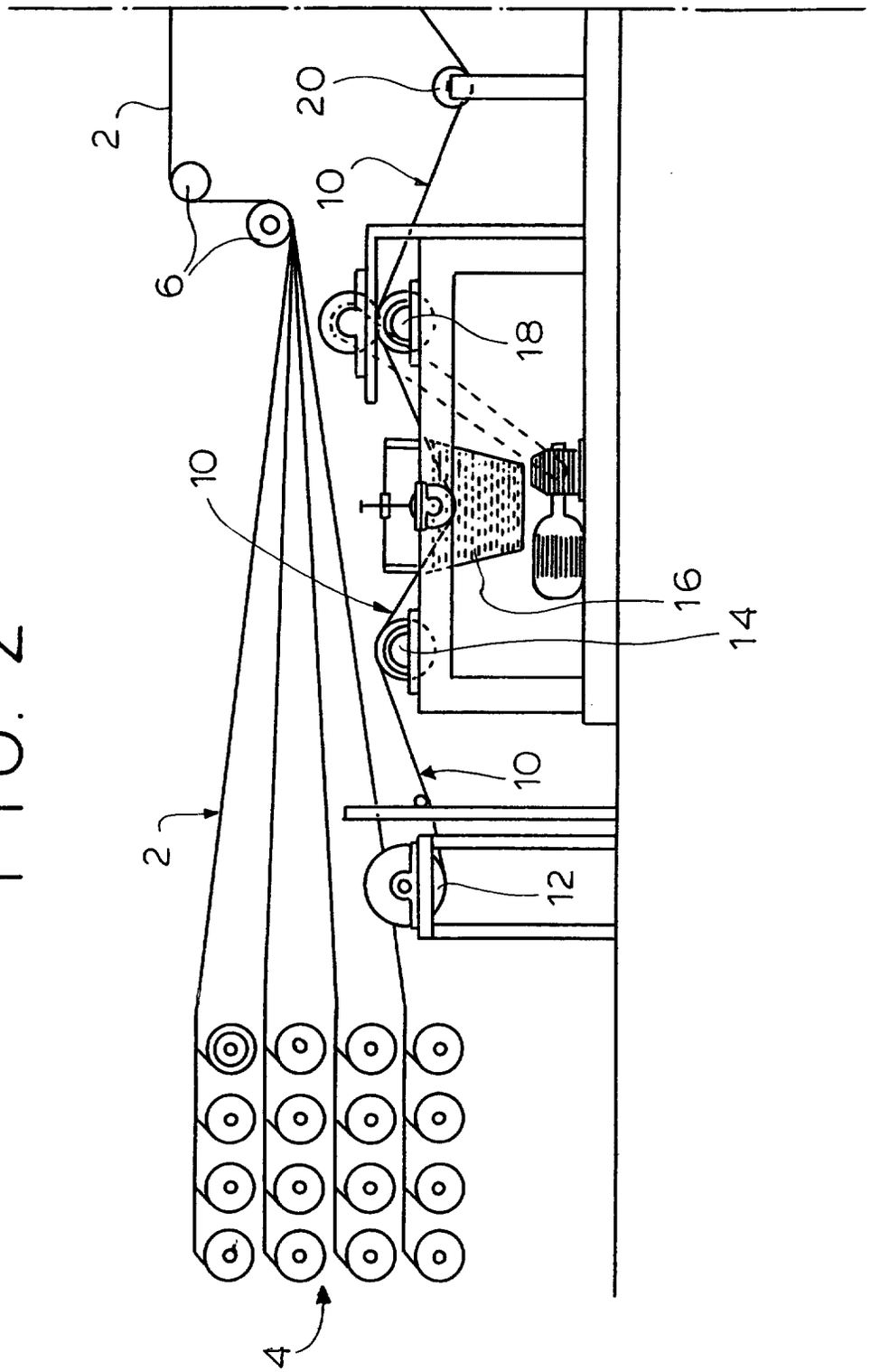

FIG. 3

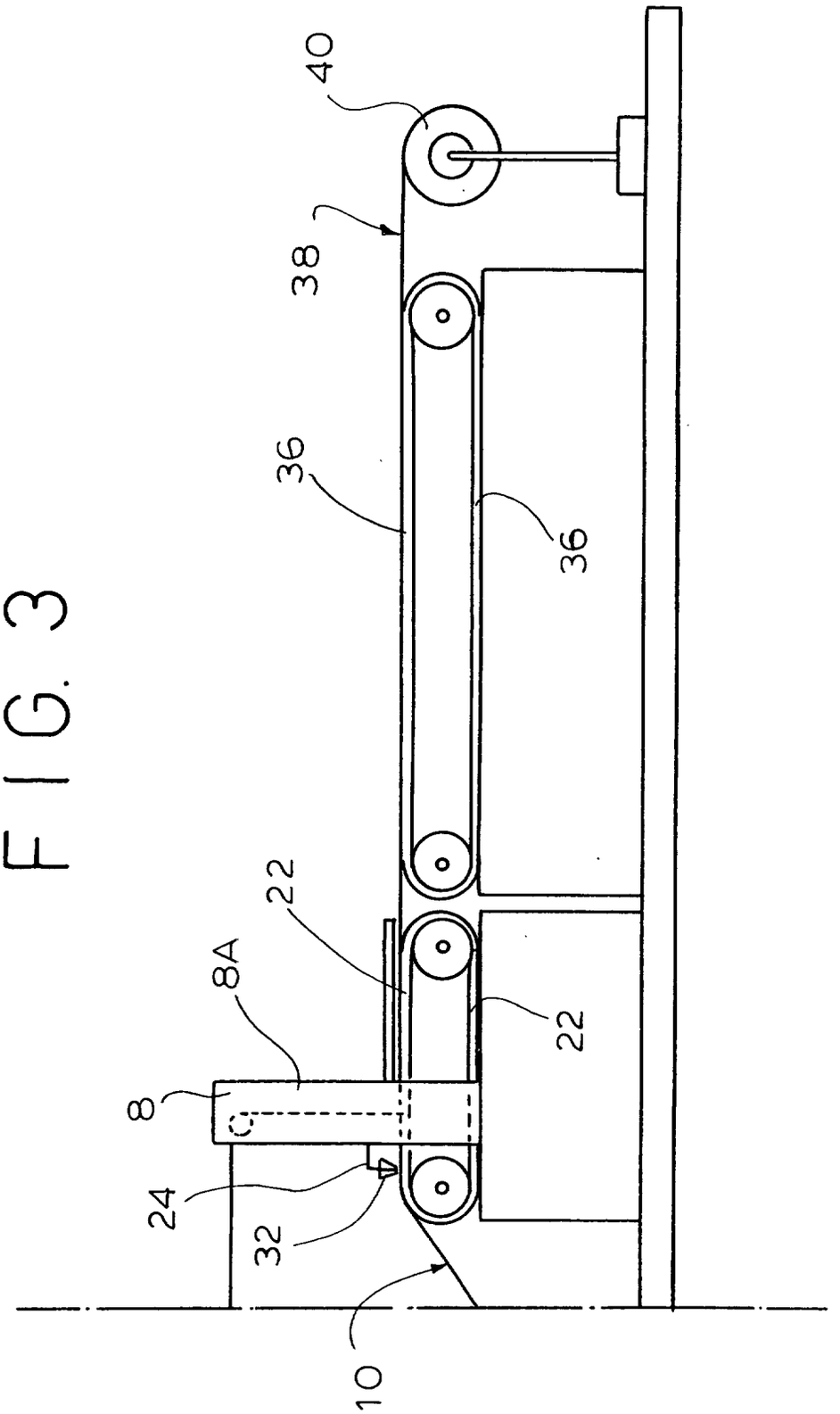

FIG. 4