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(54) Title: A COIR MAT, A METHOD FOR MAKING THE COIR AND AN APPARATUS FOR MAKING THE COIR MAT

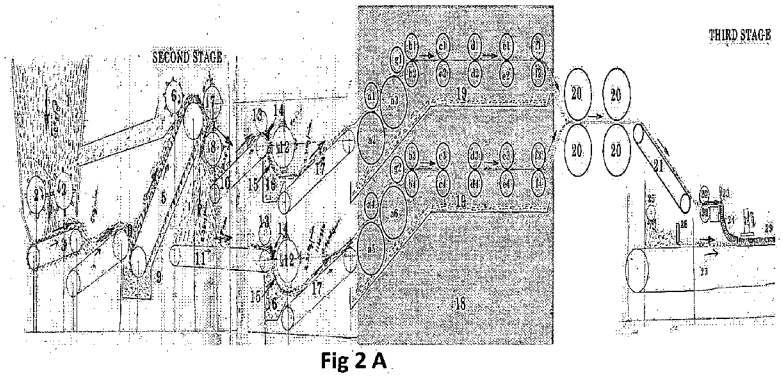



Fig 2 A

(57) Abstract: The invention relates to a coir mat, a method for making the coir and an apparatus for making the coir mat. The coir mat comprising a plastic polymer or rubber polymer base layer and a well parallelized coir web fibrous material. Bottom side of the coir fibrous material is embedded and retained partially within the base layer and top side of the coir fibrous material extending above the base layer. The apparatus for making a coir mat comprising of a willowing assembly, a web preparation assembly and a fiber impregnation assembly for conveying the coir fiber, preparing well parallelized calendared coir web and impregnation cut web onto the plastic polymer or rubber polymer liquid layer base.

# TITLE: A COIR MAT, A METHOD FOR MAKING THE COIR AND AN APPARATUS FOR MAKING THE COIR MAT

## FIELD OF INVENTION:

The Field of invention is to prepare a fiber mat, an apparatus for making the fiber mat and a process for making the mat from coir * fibers.

* Coir = 100% Coir Fibers; or a Blend of Coir Fibers with other Natural Fibers (like Jute, Sisal, Hemp, Abaca, etc) or with a blend of coir and Synthetic fibers (for special effects/appearance)

## PRIOR ART:

The prior art teach the preparation of cut fiber tufts which are vertically positioned and embedded in tufts onto a plastic polymer or rubber polymer base. Some of the prior arts are given below:

The prior art US *20020119716 relates to a*n improved mat is formed of a supporting base layer constituted at least in part by a cured biodegradable plastic reinforced by a mesh fabric, into which layer a plurality of closely spaced lengths or tufts of fibrous materials are embedded so as to extend up there from, the mat being produced by providing an uncured layer of that plastic material at an assembly station into which mesh fabric, preferably pre-coated with the plastic, is embedded in the plastic layer, and where thereafter the lower ends of the tufts of fibrous material are inserted lengthwise, the plastic thereafter being cured.

The prior art US6,093,469 discloses an entrance mat has a polypropylene greige fiber pad with a trimmed outer peripheral edge and a backing of non-skid plastic material. The backing has longitudinal treads having high friction and tacky properties which prevent creep and folding of the pad on a floor. An edge has a non-skid web secured with an adhesive to the backing and a lip extended over the adhesively secured to the trimmed outer peripheral edge. As per FIG. 3, pad 11 has a flat greige base 13 and upright loop plastic fibers 14. The base 13 and fibers 14 are greige with fibers mechanically interlocked by needle punching and heat bonding. Fibers 14 are

wear resistant plastic stands, such as Nylon and polypropylene materials, which do not absorb water. For example, base 13 and fibers 14 are non-woven polypropylene with an 18, 60, 100 denier blend and a fiber weight of 55 oz. per square yard. Other fibrous materials can be used to make pad 11.

The prior art US*20030138595* relates to mats and in particular, but not exclusively, to washable dust control mats, in which a rubber backing sheet is cured and heat-bonded under pressure to the back of a fabric layer. It also relates to a process for manufacturing mats. The mat has a fabric layer (2) including a substrate (8) a tufted pile (6), and a rubber backing (4). The fabric layer (2) includes tufts of a blended yarn (12) that includes moisture absorbing fiber and a fiber having anti-microbial properties, and optionally a low melting point fiber that is at least partially fused to the other fibers in the blended yarn. The tufted pile (6) may also optionally include tufts of twisted synthetic yarn (10).

The prior art US 1913560 relates to a tufting machine The prior art was providing a mechanism capable of forming successive loops upon one side of a piece of fabric and thereafter holding each loop out of the path of movement of a 10 needle involved in the formation thereof, during the operation of a loop severing mechanism and while the aforesaid needle is withdrawn from the fabric and thereafter inserted therein for the formation of a succeeding 15 loop; to provide an inexpensive and reliable mechanism capable of performing such loop forming, holding and cutting operations at comparatively high operating speeds; and generally to provide an improved and simplified tuft forming mechanism which can be readily applied to an available and standard form of sewing machine.

The prior art US 6,774,067 discloses a drip mat is an absorbent mat that is placed on a bar counter to absorb drips and spilled drinks. Which is not limited to drip mats but also includes other types of mat such as floor mats, in particular printed floor mats carrying advertisements or other promotional matter. It is known to provide a drip mat having a fabric layer of tufted cut pile polyester and a rubber backing layer that is vulcanized to the back of the fabric layer. The fabric layer absorbs liquid and the rubber backing layer prevents this liquid from running through onto the surface of the bar. The drip mats are washable by immersion and agitation in water or other cleaning fluid, followed by spin extraction and tumble drying.

The prior art US4,849,271 discloses a Process for producing mats for cleaning purposes and mat for cleaning purposes. Mats for covering surfaces or for cleaning purposes, particularly doormats, which comprise a basic material, mainly of plastic with a fibrous layer and a support layer fixing the latter and fibers with a bristle-like structure applied to the basic material. The basic material is zonally melted by heating the fibers and optionally the support layer and compressed onto or into the support layer 50 as to form depressions in fibrous layer. The bristles are inserted substantially in parallel to each other in the in depressions and are joined to the compressed basic material by melting their ends or by a homogeneous weld.

The prior art US 4820566 discloses a tufted carpet mat which is particularly suited for pedestrian traffic. The mat of the invention may be advantageously used at the entryway of a building to wipe wet and/or dirty shoe soles. Tufted carpet comprising a backing having thereon tufts of fine denier fibers and tufts of stiff, crimped, coarse denier fibers, said tufts of crimped, coarse denier fibers providing a very open structure in said carpet which is capable of easily receiving said obscuring dirt once it enters therein.

None of the above patents teach or disclose use of coir fiber web for making a mat.

**OBJECT OF THE INVENTION:**

The object of the invention is to achieve a 'machine-made' coir mat with coir fiber webs.

Another object of the invention is to achieve a coir mat eliminating the insertion of upstanding lengths of cut coir spun YARN tufts into base.

Another object of the invention is to achieve a process of preparing coir web which can be embedded in plastic polymer or rubber polymer base for making a mat.

Another object of the invention is to achieve an apparatus which will prepare the coir web and prepare the coir mat with the prepared coir web.

**Description of the invention with part numbers and with respect to the drawing:**

| S.no | PART NAME | PART NO |
|---|---|---|

| | | |
|---|---|---|
| 1. | Hopper spray nozzles in willowing assembly | A |
| 2. | First Conveyor in willowing assembly | B |
| 3. | Fibre beaters in willowing assembly | C |
| 4. | Blades in willowing assembly | D |
| 5. | Grid bars in willowing assembly | E |
| 6. | Trash box in willowing assembly | F |
| 7. | Second Conveyor in willowing assembly | G |
| 8. | Hopper in web preparation assembly | 1 |
| 9. | Wooden-Bladed Beater in web preparation assembly | 2 |
| 10. | Wooden Lattice Conveyor in web preparation assembly | 3 |
| 11. | Conveyor in web preparation assembly | 4 |
| 12. | Spiked Lattice Conveyor in web preparation assembly | 5 |
| 13. | Evener Roller in web preparation assembly | 6 |
| 14. | Rubber Bladed Beater #1: in web preparation assembly | 7 |
| 15. | Rubber Bladed Beater #2: in web preparation assembly | 8 |
| 16. | Dust Collection Chamber in web preparation assembly | 9 |
| 17. | Conveyor #1: in web preparation assembly | 10 |
| 18. | Conveyor #2 in web preparation assembly | 11 |
| 19. | Stripping Opening Beater in web preparation assembly | 12 |
| 20. | Knurled Feed Roller in web preparation assembly | 13 |
| 21. | Nose Bar in web preparation assembly | 14 |
| 22. | Grid Bar in web preparation assembly | 15 |
| 23. | Dust Collector in web preparation assembly | 16 |
| 24. | Conveyor Belts 1&2 in web preparation assembly | 17 |
| 25. | Rubbing and Drafting Zone in web preparation assembly | 18 |

| | | |
|---|---|---|
| 26. | The first set of rollers of serial no. 18 | a1/a2 & a3/a4 |
| | | a1(a2+a3) & a4(a5+a6) |
| 27. | The second set of rollers of serial no. 18 | b1/b2 & b3/b4 |
| | | b1(b2+g1) & b3(b4+g2) |
| 28. | The third set of rollers of serial no. 18 | c1/c2 & c3/c4 |
| 29. | The fourth set of rollers of serial no. 18 | d1/d2 & d3/d4 |
| 30. | The fifth set of rollers of serial no. 18 | e1/e2 & e3/e4 |
| 31. | The sixth set of rollers of serial no. 18 | f1/f2 & f3/f4 |
| 32. | Collection Trays beneath the rollers under serial no. 12 | 19 |
| 33. | Heated Calenders (2 sets) in web preparation assembly | 20 |
| 34. | Conveyor transporting the web fibers towards impregnation assembly | 21 |
| 35. | Gauge roller in impregnation assembly | 22 |
| 36. | Cutting blades in impregnation assembly | 23 |
| 37. | J-box staking in impregnation assembly | 24 |
| 38. | Rubber or plastic dispenser in impregnation assembly | 25 |
| 39. | Doctor blade in impregnation assembly | 26 |
| 40. | Teflon conveyer in impregnation assembly | 27 |
| 41. | Push mechanism in impregnation assembly | 28 |
| 42. | Curing zone | 29 |

Fig 1 illustrates the first step of cleaning process of the coir fiber (part nos. A to G).

Fig 2 and 2A illustrates the coir fiber web manufacturing process (part nos. 1 to 21), (a1-f4) and (a1-g2).

Fig 3 illustrates the coir fiber web cutting & impregnation process, using J-box stacking apparatus (part nos. 22 to 29).

Fig 4 (a , b) wherein fig. 4(a) illustrates the typical impregnation of cut spun coir yarn onto a base as practiced in prior art in comparison with fig. 4(b) illustrating the invention.

**DESCRIPTION OF THE INVENTION:**

The fiber mat as per the invention is prepared using a coir fibrous web cut & embedded onto a plastic polymer or rubber polymer base such that the bottom side of which is embedded and retained partially within the said plastic polymer or rubber polymer base and with the top side extending above the base plastic polymer or rubber polymer layer thereby forming a useful mat. The mat of this nature is novel and not found in prior art. There is no teaching on this principle in any prior art.

The method of making the coir fiber mat as per invention is to prepare a fiber web from fiber coir and thereafter cut and embed this prepared fiber web onto a plastic polymer or rubber polymer base. By this method, the mat will NOT have length of coir spun yarn tufts extend vertically upwardly from a base layer of plastic polymer or rubber polymer base, which said lengths are partially embedded as is done typically in prior art.

The apparatus in operation as per the method disclosed in the invention is such that the fibrous material is fed by way of conveyors and is treated by spiked lattice in such a way that the material is broken up and separated largely opened and cleaned-up into undivided individual fibers. Thereafter the fibers are brushed, combed, cleaned and evened. Then these evened fibers are passed through drafting and rubbing rollers, to intermingle the fibers give a cohesion to these parallelized fiber web, as they join together while moving in the rollers, and the rollers also exert compression whereby further cohesion of fibers is achieved to form a well parallelized fiber web.

The process and method of preparing the fiber mat has three stages. The first stage is the willowing stage, the next is the fiber web preparation stage and third is the embedding of the web onto the base.

A\ method of making a coir mat in which horizontal length of well parallelized fibrous web material is prepared and disposed on a base layer of plastic polymer or rubber polymer into which said web material is partially embedded, the said method comprising conveying substantially continuous lengths of said fibrous material from a willowing assembly to a web-preparation assembly where the fibrous material is stripped, brushed, combed, straightened, evened, rubbed and drafted forming well parallelized coir web length, conveying said cut web coir lengths to an impregnation assembly in which web is cut to have desired pile height, providing at the said impregnation assembly a plastic polymer or rubber polymer layer comprising (uncured and sufficiently fluid) plastic polymer or rubber polymer layer of plastic polymer or rubber polymer solution so that the said cut web lengths can be positioned and pasted there onto, such that bottom portion of the web is partially embedded there onto plastic polymer or rubber polymer base with top portion of the fiber web extending there from the plastic polymer or rubber polymer layer, and conveying the thus assembled coir web mat lengths for curing, the said method characterized in forming coir web from coir fibers by reducing attenuating/parallelizing the fiber web density stepwise in a plurality of rubbing cum drafting rollers and thereafter embedding the formed coir web onto a plastic polymer or rubber polymer base.

Accordingly the invention shall have three portions in the apparatus. The first stage is the willowing assembly. The second stage is the web preparation assembly. The third stage is the web impregnation assembly. Each of the assembly is described in detail assembly-wise.

**First stage willowing assembly:**

This is a process done initially to the Coir Fibers, which enables in opening up of the coir fibers from the bale pressed form, and to clean the fibers from very short fibers and coir pith. Also, in this process the coir fibers get wetted, by spraying with water. The cleaned (willowed) fibers have a moisture regain content of 15-20%. This moisture level has better influence on the processing quality. The wetting process swell up the fibers. The normal swelling achieved is around 10%.

The main parts involved in this process are as follows:

A. Spray Nozzles: the opened bales of coir fibers are spread onto a Conveyor (B), which has the Spray Nozzles (A) positioned above the conveyor. This is to wet the coir fibers and increase the moisture level from about 10% to 20%.

B. Conveyors: there are two wooden lattice type conveyors, (B & G), which transport the fibers.

C. Beaters: there are several Beaters (C) which are placed in an upwards angle. These spiked Beaters have a diameter of about 25 cms and rotate at an RPM of about 600 rpm.

D. Blades: there are Blades (D) which are placed above each beater at a specified angle and height. The purpose of these Blades are to prevent excessive rotation of the fibers on the Beaters, which will lead to rupture of the coir fibers. So these Blades enable in stripping away the fibers from the Beater.

E. Grid Bar: grid bars (whose gap can be adjusted) are placed beneath the beaters, and these grid bars enable is removal of the coir pith and the short fibers into the Trash Box (F) below.

F. Trash Box: the trash box is used to collect the pith and short fibers that pass through the Grid Bar assembly.

The process involved is as follows:

The coir fibers that are obtained from the pressed bundles, are placed on to the Conveyor A, wherein it is sprayed with water to attain a moisture content of around 20%.

The moistened fibers then pass through sets of Spiked Beaters of about 25 cms diameter which rotate at a speed of 600 rpm. This process strips combs & opens the fibers and separates the long fibers from the short fibers and the coir pith.

The Blades placed above the Beaters prevent excess fibers getting entangled in the beater and also from the fibers getting ruptured. Also the Blades are involved in the stripping away of the fibers from the beaters.

The Grid Bars placed underneath the Beaters help in removal of these short fibers and pith, which fall through, and is collected in the trash box below.

In the process, the coir fibers of about 90 kgs/m3 density is opened up, moistened and fluffed up to about 60 kgs/m3.

The moisture content of the coir fiber is enhanced from about 10% to about 20%. The yield of fibers after this process is about 80%, though this is dependent on the requirement of the final quality , and of the cleanliness of fibers.

The willowing assembly as illustrated in figure 1 comprises of a coil-fiber / coir fiber hopper feeding mechanism which feeds the coir fibers with a blade roller onto a first conveyor means (B). A plurality of nozzles (A) sprays water onto conveyor means (B). A plurality of upwardly inclined spiked lattice beaters (C) receives the moving coir fibers from the first conveyor means (B). A plurality of blades (D) is disposed above the beaters (C) for stripping the fibers and preventing excessive rotation of moving fibers on the beaters (C). A plurality of grid base (E) is disposed beneath the said beaters (C) for removal of coir pith and short fibers as trash. A trash box (F) is provided for collecting the trash. A second conveyor means (G) receives the moving coir fibers from spiked lattice beaters (C) at its one end and delivers clean moistened coir fibers at its other end.

**Second Stage of coir fiber WEB preparation assembly.** In this assembly the coir fibers are converted into coir fiber web.

The main parts involved in this CRITICAL second part of the assembly are:

Hopper (1): this is the storage area, wherein the cleaned & moistened coir fibers are loaded. The capacity of this Hopper feeder is about 500 kilos. The density of the coir fibers is about 60 kilos per m3, same as the density coming out of the Willowing machine.

Wooden-Bladed Beater (2,2): these are a pair of variable speed beater rollers, which assist in a controlled release of the fibers from the Hopper onto the Wooden Lattice Conveyor. The flow, in our case, is maintained at about generally 5 kilos per minute or a little above.

Wooden Lattice Conveyor (3): this lattice conveyor transports the fibers that come out of the Wooden Bladed Beater, onto the second conveyor. The purpose of the Lattice Conveyor is to ensure that the higher quantity of about 5 kilos per minute flows smoothly onto the next

conveyor. This conveyor is generally and preferably is kept at an angle of about 10 degrees upwards.

Conveyor (4): this is the second conveyor, which is also kept at an angle of about 10 degrees.

Spiked Lattice Conveyor (5): this spiked lattice conveyor, kept at an angle of about 60 degrees, transport the coir fibers upward onto the Rubber Bladed Beaters. It is kept at this angle to induce even feeding of the fibers, and this conveyor moves at a speed of about 15 meters per minute, in our case.

Evener Roller (6): the Evener roller kept at the top of the spiked lattice conveyor has a diameter of about 20 cms and it rotates at an rpm of about 200 rpm. Its function is to remove the excess fibers beyond 5 kgs or a predetermined value back into the Hopper.

This ensures that the fibers fed are kept at a consistent +/- around 5 kgs/minute quantity. The gap between spiked lattice conveyor (5) and evener roller (6) can be adjusted to control the feed of fibers.

Rubber Bladed Beater #1 (7): this is a 20 cm diameter beater with flexible rubber blades, rotating at about 300 rpm. 80-90% of the fibers are stripped off the Spiked Inclined Lattice by this Beater.

Rubber Bladed Beater #2 (7): this is also a similar beater to Beater#1, but the rubber blades are less flexible compared to the beater #1. The remaining 10-20% of the fibers is stripped away using this second beater.

Dust Collection Chamber (9): this is used to collect the dust and short fibers that are not collected and stripped by the two rubber bladed beaters.

Conveyor #1 (10): this conveyor is kept above the conveyor #2, and is kept at an approx angle of 40 degrees; and is of much shorter conveyor length (compared to the conveyor #2), and carries about 2.35 kilos per minute of fibers.

Conveyor #2 (11): this conveyor is much longer in length and is kept beneath the first conveyor, and is almost parallel to the floor. This conveyor also carries almost 2.35 kilos per minute of fibers, in our case.

By adjusting the length of the conveyors (10, 11), we can ensure that both these conveyors first and second carry almost equal quantities of fibers, i.e. about 2.35 kilos per minute.

Stripping Opening spike Beater (12): this is a 40 cm diameter beater, which brushes opens and comb the layer of fibers onto a conveyor that feeds to the Rubbing & Drafting Zone Rollers. After the brushing of the fibers with this Spiked Stripping Opening Beater, the fibers become quite parallel, similar to brushing combing of hair.

Knurled Feed Roller (13): this roller holds the fiber sheets for the stripper beater to brush comb the fibers straight.

Nose Bar (14): this triangular wedge assists in better brushing combing of the fibers by the stripping opening & combing beater (12)
Grid Bar (15): this filter removes the short fibers and also the remaining pith from the fibers.

Dust Collector (16): the remaining filtered short fibers and pith is collected into the dust collector.

Conveyor Belts 1&2 (17,17): these two conveyor belts kept at about 40 degrees, feeds the sheet of fibers into the drafting cum rubbing zone sets of rollers. These conveyors transport about 2.31 kilos per minute per conveyor, which works out to about 1160 grams per square meter. These conveyors move at a speed of about 0.96 meters per minute, in our case.

Rubbing and Drafting Zone Rollers (18, a1-a4 to f1 to f4) and (18,a1-a6 to f1 to f4):
Straightening of the fiber web, and cohesion of fibers in the web is made possible in this zone.
- The first and few more of the rollers are kept at an angle of about of 40 degrees. However, at least the first one shall be kept at an angle of 40 degrees. It is also preferred to keep first and the second at an angular position.

The balance set of rollers are almost parallel to the floor. The purpose is to improve the quality of web and to minimize disturbance of web flow.

- Each roller in this Drafting and Rubbing Zone is about 15 cms diameter.
- The gap between the sets of rollers are maintained at about 20 cms (except for the sets of rollers that follow the last set of angular set rollers).

This gap need to be adjusted to the raw material quality. For example if the average length of fiber is about 15 cms, then the gap has to be about 25% higher at about 20 cms.

a. The first set of rollers, namely, a1/a2 & a3/a4, are rubbing-cum-drafting rollers. They rotate (& has traverse movements). The rotation speed of these first set of rollers is 2.04 meter per minute, and the input feed rate of he fiber web is 1160 gsm.

b. The second set of rollers, namely, b1/b2 & b3/b4, are drafting rollers. These sets of rollers rotate at a higher speed of 2.25 meters per minute, resulting in a draft of 1.1 between the rollers (a) and rollers (b). Therefore the fibred web density reduces from 1160 grams per square meter (gsm) to 1054 gsm fiber web.

c. The third set of rollers, namely, c1/c2 & c3/c4, are again rubbing cum drafting rollers. These sets of rollers rotate (& has traverse movements) move at a higher speed of 2.70metres per minute, resulting in a further draft of 1.2. Therefore the fiber web density reduces further from 1054 gsm fiber web to 880 gsm fiber web density.

d. The fourth set of rollers, namely, d1/d2 & d3/d4, are drafting rollers. These sets of rollers rotate at a speed of 3.51 meters per minute, resulting in a draft of 1.3, therefore the fiber web density reduces from 880 gsm to 676 gsm fiber web.

e. The fifth set of rollers, namely, e1/e2 & e3/e4, are drafting cum rubbing rollers. These sets of rollers rotate (& have transverse movements) at a speed of 4.57 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 676 gsm to 520 gsm fiber web density.

f. The sixth set of rollers, namely, f1/f2 & f3/f4, are drafting rollers. These sets of rollers rotate at a higher speed of 5.94 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 520 gsm to 400 gsm fiber web.

(Here again we can have this process Zone in three different ways:

(i) combined rubbing cum drafting movements on each sets of rollers.

(ii) sets of rubbing rollers before(or after) the sets of drafting sets of rollers. &

(iii) alternating the rubbing and drafting sets of rollers, one after the other.)

There are six pairs sets of rollers as per one of the embodiments to get a final web thickness of 400 gsm to achieve a final web quality of 800 gsm web. The 800 gsm quality is equivalent to the thickness of the Coir spun Yarn, that is currently used for making the coir door mats.

As per another embodiments illustrated in fig. 2A, the arrangement of rollers is slightly different from the arrangements illustrated in fig. 2.

The first (and perhaps a few more of the sets of rollers) are called Breaker Draft Zone Rollers. In this Breaker Draft Zone Rollers, each set comprises of Three rollers, One draft roller on Top, and Two draft rollers beneath the top roller forming a triangle of rollers. The Top Roller is about 15 cm diameter and the Bottom Rollers are about 30 cms diameter. At least, the first set of Breaker Draft Zone Rollers shall be kept at an angle of 40 degrees. It is also preferred to keep first and the second at an angular position.

The purpose of have this Three Roller Breaker Draft Zone Rollers are many fold;

1. To avoid or minimize Slippage in the Draft.
2. To ensure better guidance and more even draft, since the web is thicker in the initial zone, and also since the web is less cohesive in the initial zone.

- The balance subsequent set of rollers are almost parallel to the floor, and they are called Finisher Draft Rollers. In the Finisher Draft Roller Zone, we employ one over one roller arrangement; each roller in this Drafting and Rubbing Zone is about 15 cms.

The purpose of the Finisher Draft Zone Rollers is to improve further the quality of web, to minimize disturbance of web flow, and to ensure an even and fine draft.

- The gap between the sets of rollers are maintained at about 20 cms (i.e. + 20% longer than the mean fiber length).

This gap need to be adjusted to the raw material quality. For example if the average length of fiber is about 15 cms, then the gap has to be about 20% higher at about 18-20 cms.

a. The first set of Breaker Draft Rollers, namely, a1/(a2+a3) & a4/(a5+a6), are drafting rollers. The rotation surface speed of these first set of rollers is 2.04 meter per minute, and the input feed rate of he fiber web is 1160 gsm.

b. The second set of Finisher Draft Rollers, namely, b1/b2 & b3/b4, are rubbing cum drafting rollers. There is a set of third rollers g1 and g2 associated with the above rollers to form a set of three rollers as illustrated in fig. 2A. These sets of rollers rotate (& have traverse movements) at a higher surface speed of 2.25 meters per minute, resulting in a draft of 1.1 between the rollers (a) and rollers (b). Therefore the fiber web density reduces from 1160 grams per square meter (gsm) to 1054 gsm fiber web.

c. The third set of Finisher Draft Rollers, namely, c1/c2 & c3/c4, are again drafting rollers. These sets of rollers rotate and move at a higher surface speed of 2.70metres per minute, resulting in a further draft of 1.2. Therefore the fiber web density reduces further from 1054 gsm fiber web to 880 gsm fiber web density.

d. The fourth set of Finisher Draft Rollers, namely, d1/d2 & d3/d4, are rubbing cum drafting rollers. These sets of rollers rotate (& have traverse movements) at a surface speed of 3.51 meters per minute, resulting in a draft of 1.3, therefore the fiber web density reduces from 880 gsm to 676 gsm fiber web.

e. The fifth set of Finisher Draft Rollers, namely, e1/e2 & e3/e4, are drafting rollers. These sets of rollers rotate at a surface speed of 4.57 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 676 gsm to 520 gsm fiber web density.

f. The sixth set of Finisher Draft Rollers, namely, f1/f2 & f3/f4 are rubbing cum drafting rollers. These sets of rollers rotate (& have traverse movements) at a higher surface speed of 5.94 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 520 gsm to 400 gsm fiber web.

(Here again we can have this process Zone in three different ways:

(i) combined rubbing cum drafting movements on each sets of rollers.

(ii) sets of rubbing rollers before(or after) the sets of drafting sets of rollers. &

(iii) alternating the rubbing and drafting sets of rollers, one after the other.)

There are six sets of rollers as per one of the embodiments to get a final web thickness of 400 gsm, to achieve a final combined top & bottom web quality of 800 gsm web. The 800 gsm

quality is equivalent to the thickness of the Coir spun Yarn(traditionally known as Vaikom quality coir yarn of about 6.5 kilotex), that is currently used for making the coir door mats.

Collection Trays (19): these trays collect the fibers that fall off the drafting and rubbing zone rollers. The fibers collected here are taken off and returned back into the Hopper (1).

Heated Calenders (2 sets) (20,20) : The drafted and straightened Fibre Web, having cohesive bonding, and having a density of 400 gsm is about 4 mm thick. The TWO 400 gsm webs pass through the two sets of 30 cms diameter Heated Calenders(heated and kept at about 100 degrees centigrade). The rotation speed of these heated Calender Rollers is kept at 2.97 meters per minute. The resultant web coming out of the Calender Rollers has better evenness and cohesion because of calendaring, and the resultant thickness reduces to about 6 mm. The density of the fiber web is about 140 kgs per m3. (This density is equivalent to the present quality of coir yarn used for tufting.)

Conveyor (21): a conveyor transports the Calendered Web Fibers onto the Gauge Rollers.

The quantity of fibers (i.e. GSM or grams per square meter of fibers) in the web can be adjusted by adjusting the speed (& gap) of the wooden bladed beaters (2). Also the web fiber quantity can be adjusted by adjusting the gap and speed of the evener roller (6).

FIBRE WEB PREPARATION STAGE – II as illustrated in figure 2.

The fiber web preparation assembly comprises of a coir-fiber hopper (1) which feeds the coir fiber from willowing assembly with a pair of variable speed beater rollers (2) onto a first inclined (10° upwards) wooden lattice conveyor (3), a second inclined (10° upwards) wooden lattice conveyor (4) for receiving the moving coir fiber from the conveyor (3), onto an inclined upwardly (60° upwards) spiked lattice conveyor (5) for receiving the moving coir fiber from conveyor (4), an evener roller (6) disposed at the top end of spiked lattice conveyor (5) for removing the excess fibers and dropping the same back into the hopper, a first set of rubber bladed beaters (7) disposed at the top end of the spiked lattice conveyor (5) for partially stripping off the fibers, a second set of rubber bladed beater (8) also disposed at the top end of the spiked lattice conveyor (5) but adjacent and after the rubber bladed beater (7) for completely stripping off the partially stripped fibers, a dust collection chamber (9) arranged

Beneath the conveyor (5) for collecting the dust and short fibers, a inclined (40°) first conveyor (10) for receiving a portion of the moving coir fiber at its one end from conveyor (5), a second flat conveyor (11) also for receiving a portion of the moving coir fiber at its one end from conveyor (5), a strip an opening beaters (12,12) disposed at the second end of each of the conveyor (10) and conveyor (11) for brushing opening and combing the moving fiber on the corresponding conveyor, a pair of knurled feed roller (13,13) disposed adjacent to strip opening beater (12,12) for holding the moving coir fiber while strip opening beater brushes opens and combs the moving fibers, a triangular wedge nose bar (14,14) for supporting the strip opening beater (12,12) to brush comb the fibers, a pair of grid bar (15,15) disposed beneath conveyors (10,11) for removing short fibers and pith as trash, a pair of dust collectors (16,16) disposed beneath grid bars (15,15) for collecting the trash, a pair of inclined (40°) conveyor belts (17,17) for receiving the coir fiber from conveyors (10,11), a plurality of rubbing and drafting zone rollers (a1-a4 to f1-f4 / a1-a6 to f1-f4) for receiving the coir fibers from conveyor belts (17,17) in rubbing and drafting zone (18) and straightening and cohesion of fibers in the web to provide a web output, a collection tray (19) for collecting the trash fibers falling away from rubbing and drafting zone rollers, a set of heated calendar rollers (20,20,20,20) for calendering the prepared coir fiber web moving out from the rubbing and drafting zone rollers (a1-a4 to f1-f4 / a1-a6 to f1-f4), and a conveyor (21) to carry the calendared web fibers into gauge rollers (22).

It is possible to make the web preparation process separately, not synchronizing with the existing gauge impregnation machine. In this method, the prepared web is fed later directly into the gauge impregnation machine, as a continuous web roll.

It is also possible to get further cohesion by applying an adhesive material onto the fibrous web, after the drafting rollers using any known conventional adhesive means.

The rubbing and drafting rollers are six sets in numbers as illustrated in fig. 2. It comprises of:

- a first set of rollers (a1,a2,a3,a4) arranged inclined at 40° degrees adapted to rotate at first speed and has traverse movements thereby acting as rubbing-cum-drafting rollers,
- a second set of rollers (b1,b2,b3,b4) arranged preferably inclined at 40° degrees adapted to rotate at second speed which is higher than first speed of first set of rollers, thereby resulting in a draft between first set of rollers and second set of rollers,

- a third set of rollers (c1, c2, c3, c4) arranged flat adapted to rotate at third speed which is higher than second speed of second set of rollers and has traverse movements thereby acting as rubbing-cum-drafting rollers,
- a fourth set of roller (d1,d2,d3,d4) arranged flat adapted to rotate at fourth speed which is higher than third speed of third set of rollers, thereby resulting in a draft between third set of roller and fourth set of roller,
- a fifth set of rollers (e1,e2,e3,e4) arranged flat adapted to rotate at fifth speed which is higher than fourth speed of fourth set of rollers and has traverse movements thereby acting as rubbing-cum-drafting roller, and
- a sixth set of rollers (f1,f2,f3,f4) arranged flat adapted to rotate at sixth speed which is higher than fifth speed of fifth set of rollers thereby resulting in a draft between fifth set of rollers and sixth set of rollers.

With the above arrangement, there is a sequential process of rubbing and drafting thereby obtaining a quality cohesion of clean fibers thereby achieving a good quality fiber web.
Alternately, as per another embodiments illustrated in fig. 2A, the arrangement of rollers is slightly different from the arrangements illustrated in fig. 2.

The first (and perhaps a few more of the sets of rollers) are called Breaker Draft Zone Rollers. In this Breaker Draft Zone Rollers, each set comprises of Three rollers.
- The balance subsequent set of rollers are almost Parallel to the floor, and they are called Finisher Draft Rollers. In the Finisher Draft Roller Zone, we employ one over one roller arrangement.

a. The first set of Breaker Draft Rollers, namely, a1/(a2+a3) & a4/(a5+a6), are drafting rollers. The rotation surface speed of these first set of rollers is 2.04 meter per minute, and the input feed rate of the fiber web is 1160 gsm.
b. The second set of Finisher Draft Rollers, namely, b1/b2 & b3/b4, are rubbing cum drafting rollers. There is a set of third rollers g1 and g2 associated with the above rollers to form a set of three rollers as illustrated in fig. 2A. These sets of rollers rotate (& have traverse movements) at a higher surface speed of 2.25 meters per minute, resulting in a draft of 1.1 between the rollers (a) and rollers (b). Therefore the fiber web density reduces from 1160 grams per square meter (gsm) to 1054 gsm fiber web.

c. The third set of Finisher Draft Rollers, namely, c1/c2 & c3/c4, are again drafting rollers. These sets of rollers rotate and move at a higher surface speed of 2.70metres per minute, resulting in a further draft of 1.2. Therefore the fiber web density reduces further from 1054 gsm fiber web to 880 gsm fiber web density.

d. The fourth set of Finisher Draft Rollers, namely, d1/d2 & d3/d4, are rubbing cum drafting rollers. These sets of rollers rotate (& have traverse movements) at a surface speed of 3.51 meters per minute, resulting in a draft of 1.3, therefore the fiber web density reduces from 880 gsm to 676 gsm fiber web.

e. The fifth set of Finisher Draft Rollers, namely, e1/e2 & e3/e4, are drafting rollers. These sets of rollers rotate at a surface speed of 4.57 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 676 gsm to 520 gsm fiber web density.

f. The sixth set of Finisher Draft Rollers, namely, f1/f2 & f3/f4 are rubbing cum drafting rollers. These sets of rollers rotate (& have traverse movements) at a higher surface speed of 5.94 meters per minute, resulting in a draft of 1.3; therefore the fiber web density reduces from 520 gsm to 400 gsm fiber web.

With BOTH the above arrangements, there is a sequential process of rubbing and drafting thereby obtaining a quality cohesion of clean fibers thereby achieving a good quality fiber web.

**The third stage is the Fiber Impregnation assembly**

In this stage, the fiber web is impregnated and affixed onto a plastic polymer or rubber polymer base. It has the following parts :

Gauge Rollers (22): a pair of about 90 mm diameter of rollers accurately grip and transport the fiber web onto the cutting blades. The movement of these rollers is synchronized with the speed of cutting blades. Also, the rotation movement of the Rollers depends on the Pile height requirement. For example, if we require a coir pile height of 17 mm, then the rollers move by 17 mm for each stroke of the cutting blade. This can be adjusted, for adjusting the pile height required.

Cutting Blades (23): there are a pair of cutting blades, which works on vertical cylindrical cam movement. The lower blade is stationary and the upper blade moves up and down for the cutting motion. (There are vertical type cutting blades, and in some machines, the cutting blades are horizontal type. However, the effect on the pile formation is the same.) The fibers,

that are accurately cut using the cutting blades, stacks into a J-Box that is adjacent to below the Cutting Blades. The J-Box helps transfer the cut length web fibers from 180 degrees to 90 degrees, over the passage of the J-Box.

J-Box Stacking (24): this is a J shaped stacking tray, wherein the horizontally cut web fibers are stacked one on top of the other, and transported down the J-shaped tray, into a Vertical position.

Plastic polymer or rubber polymer dispenser (25): pvc Plastic polymer or rubber latex polymer, that are premixed, is Dispensed using the suitable pourer onto the Teflon Belt.

Doctor Blade (26): this doctor blade ensures that consistent thickness of rubber polymer or plastic polymer is spread onto the Teflon belt.

Teflon Conveyor (27): this conveyor is a continuous loop endless belt, which transports the impregnated tufted mat through the Vulcanising /Polymerizing / Curing chamber.

Punch Mechanism (28): a reciprocating punch gently pushes the vertically placed fibers from the J-box into the rubber polymer or plastic polymer solution.

Polymerizing / Curing Zone (29): this is a long zone (can be either open curing or closed chamber for polymerizing / curing/vulcanising). Here the temperature is kept around 160 degrees (depending on the compound), to cure/vulcanise /polymerize the mat. The time taken for this process depends on the temperature and speed of the conveyor, and also the type of polymer compound.

FIBRE IMPREGNATION PROCESS STAGE – III as illustrated in figure 3

- a pair of gauge rollers (22,22) to receive the calendared well parallelized web fiber from conveyor (21),
- a pair of cutting blades (23) adapted with (vertical or horizontal) cam motion includes a stationery lower blade and a moveable upper blade to cut the calendared web fiber to a required coir pith height,
- a J-Box stacking tray (24) for receiving the cut fiber webs and holding the same transferring the cut web from 180 degrees to 90 degrees vertically,

- a Teflon conveyor (27) with a continuous loop endless belt for receiving the cut web fibers from the tray (24),
- a rubber polymer or plastic polymer dispenser (25) for dispensing rubber polymer or plastic polymer onto the Teflon conveyor (27),
- a doctor blade (26) adapted to spread the rubber polymer or plastic polymer dispensed by dispenser(25) evenly on the Teflon conveyor (27),
- a punch mechanism for pushing the vertically placed fiber web from J-Box (24) into a PVC onto a rubber polymer of plastic polymer solution, and
- a heater means for maintaining the cut fiber web at 160° in a curing/polymerizing zone.

As such the apparatus essentially includes a fiber impregnation assembly as a last portion of the apparatus, the said assembly comprising of a pair of gauge rollers (22,22) to receive the calendared web fiber from conveyor (21), cutting blades (23) for cutting the calendared web fiber to desired coir pith pile height, a tray (24) for receiving the web horizontally and delivering the cut web vertically, a conveyor (27) conveying base uncured plastic polymer or rubber polymer liquid solution layer sheet for receiving the cut web from the tray, there onto for impregnation of cut web onto the plastic polymer or rubber polymer liquid solution layer base and a heater means for curing the impregnated cut fiber webs with plastic or rubber base. As such the invention has successfully achieved a novel coir mat, which mat is comprising a plastic polymer or rubber polymer base layer and a calendared well parallelized coir web fibrous material, the bottom side of which is embedded and retained partially within the said plastic polymer or rubber polymer layer, with the top side extending above the base plastic polymer or rubber polymer layer thereby forming a fibrous mat.

The invention has sufficiently disclosed the method of preparing web and embedding the web on the base also and further the apparatus necessary to follow the method is also disclosed.

There is been serious attempt to disclose in detail the product, process and the apparatus in the specification. However it is to be understood that the present invention can be attempted with various modification, changes and adaptations and the same are intended to be comprehended within the meaning and scope of the invention.

CLAIMS:

1. A coir mat comprising a plastic polymer or rubber polymer base layer and a well parallelized coir web fibrous material, the bottom side of which is embedded and retained partially within the said plastic polymer or rubber polymer layer, with the top side extending above the base plastic polymer or rubber polymer layer, thereby forming a fibrous mat.

2. A method of making a coir mat in which horizontal length of fibrous web material is prepared and disposed on a base layer of plastic polymer or rubber polymer into which said web material is partially embedded, the said method comprising conveying substantially continuous lengths of said fibrous material from a willowing assembly to a web-preparation assembly where the fibrous material is stripped, brushed, opened, combed, straightened, evened, rubbed and drafted forming coir web length, conveying said cut web coir lengths to an impregnation assembly in which web is cut to have desired pile height, providing at the said impregnation assembly a plastic polymer or rubber polymer layer comprising (uncured and sufficiently fluid) plastic polymer or rubber polymer layer of PVC Plastic polymer or Rubber polymer solution so that the said cut web lengths can be positioned and pasted there onto, such that bottom portion of the web is partially embedded there onto plastic polymer or rubber polymer base with top portion of the fiber web extending there from the plastic polymer or rubber polymer layer, and conveying the thus assembled coir web mat lengths for polymerizing/curing, the said method characterized in forming coir web from coir fibers by reducing the fiber web density stepwise in a plurality of rubbing cum drafting rollers and thereafter embedding the formed well parallelized coir web onto a plastic polymer or rubber polymer base.

3. An apparatus for making a coir mat with moistened coir fibers having density of 60kg/$m^3$ obtained from pressed bundles placed onto a conveyor (A) and sprayed with water to attain a moisture content of around 20%, with the said apparatus comprising of :

   i) a willowing assembly comprising of a plurality of spiked lattice beaters (C) in-between two conveyors means (B,G) disposed on either side of the beaters (C)

wherein the spiked lattice beaters are arranged sequentially and both are upwardly inclined with respect to conveyor (B), the said assembly conveying the coir fiber received from a hopper feeding assembly at conveyor (B) towards the conveyor (G), through the lattice beaters (C), where at conveyor (G) the said cleaned coir fiber has a density of 60 kg/$m^3$.

ii) a web preparation assembly comprising of a pair of upwardly inclined conveyors (3,4) for receiving coir fibbers from a coir fiber hopper (1) which feeds fibers from the willowing assembly through a pair of variable speed beaters (2), an inclined spiked lattice conveyor (5), an evener roller (6) above conveyor (5), a rubber bladed beaters (7,8) at conveyor (5) top end, an inclined conveyor (10), a flat conveyor (11), stripped opening beaters (12,12) at the top end of conveyors (10,11) correspondingly , a pair of inclined conveyor belts (17,17), a plurality of rubbing-and-drafting rollers and drafting rollers (18,a1-g2), a plurality of heated calendar rollers (20,20,20,20) and a conveyor (21) all arranged in sequence as passage for the coir fibers received from the willowing assembly, thereby delivering well parallelized calendared coir web at the end of conveyor (21), and

iii) a fiber impregnation assembly comprising of a pair of gauge rollers (22,22) to receive the well parallelized and calendared web fiber from conveyor (21), cutting blades (23) for cutting the well parallelized and calendared web fiber to desired coir pith pile height, a tray (24) for receiving the web horizontally and delivering the cut web vertically, a conveyor (27) conveying base uncured plastic polymer or rubber polymer liquid solution layer sheet for receiving the cut web from the tray, there onto for impregnation of cut web onto the plastic polymer or rubber polymer liquid layer base and a heater means for polymerizing/curing the impregnated cut fiber webs with plastic polymer or rubber polymer base.

4. The apparatus as claimed in claim 3 wherein willowing assembly further comprises of a plurality of blades (D) is disposed angularly above the beaters (C) for stripping opening the fibers.
5. The apparatus as claimed in claim 3 wherein willowing further comprises of a grid base (E) is disposed beneath the said beaters (C) for collecting the undesired coir pith and short fibers as trash.

6. The apparatus as claimed in claim 3 wherein willowing further comprises of a trash box (F) is disposed beneath grid base (E) for collecting the trash.
7. The apparatus as claimed in claim 3 wherein the said web preparation assembly further comprising of evener roller (6) for removing excess fibers and a rubber bladed beaters (7,8) arranged at the top end of the lattice conveyor (5).
8. The apparatus as claimed in claim 3 wherein the said web preparation assembly further comprising of strip opening beaters (12,12) supported with nose bar (14,14) and knurled feed rollers (13,13) for brushing combing the moving coir fiber.
9. The apparatus as claimed in claim 3 wherein the said web preparation assembly further comprising of grid base (15, 15) disposed beneath the conveyors (10,11).
10. The apparatus as claimed in claim 3 wherein the said web preparation assembly further comprising of dust collection chambers (16,16) beneath the grid base (15,15).
11. The apparatus as claimed in claim 3 wherein the said web preparation assembly further has a dust collection chamber (9) beneath the conveyor (5).
12. The apparatus as claimed in claim 3 wherein the said web preparation assembly further has a collection tray (19) disposed beneath the rollers (18) to collect the fibers that fall off from drafting and rubbing rollers (18).
13. The apparatus as claimed in claim 3 wherein the said web preparation assembly further has drafting rollers (18) preceding the rolling cum drafting rollers in the arrangement.
14. The apparatus as claimed in claim 3 wherein the said web preparation assembly further rubbing cum drafting roller (18) preceding the drafting rollers in the arrangement.
15. The apparatus as claimed in claim 3 wherein the said web preparation assembly further the rubbing cum drafting rollers (18) and drafting rollers may be alternative in the arrangement.
16. The apparatus as claimed in claim 3 wherein the said web preparation assembly further rubbing cum drafting rollers (18) are adapted to have rotary motion and traverse motion.
17. The apparatus as claimed in claim 3 wherein the said web preparation assembly further the drafting rollers (18) are adapted to have only rotary motion.
18. The apparatus as claimed in claim 3 wherein the said web preparation assembly further includes adhesive means for applying adhesive material onto the fibers moving of rollers (18)

19. The apparatus as claimed in claim 3 wherein the said impregnation assembly further comprising of a punch means (28) to apply a push force to push the vertically placed coir web tray (24) towards the conveyor (27).
20. The apparatus as claimed in claim 3 wherein the said impregnation assembly further comprising of the said tray (24) is a J shaped stacking tray adapted to receive the horizontal cut web and transport the same through the tray to deliver the cut web vertically to the conveyor (27).
21. The apparatus as claimed in claim 3 wherein the said impregnation assembly further comprising of cutting blades (23) a pair of blades with a stationery lower blade and a moveable upper blade, the said cutting blades operable with a cam means for cutting the moving web to have a uniform pile formation.
22. The apparatus as claimed in claim 3 wherein the said impregnation assembly further comprising of doctor blade (26) to control the liquid plastic polymer or rubber polymer layer thickness on the conveyor (27).

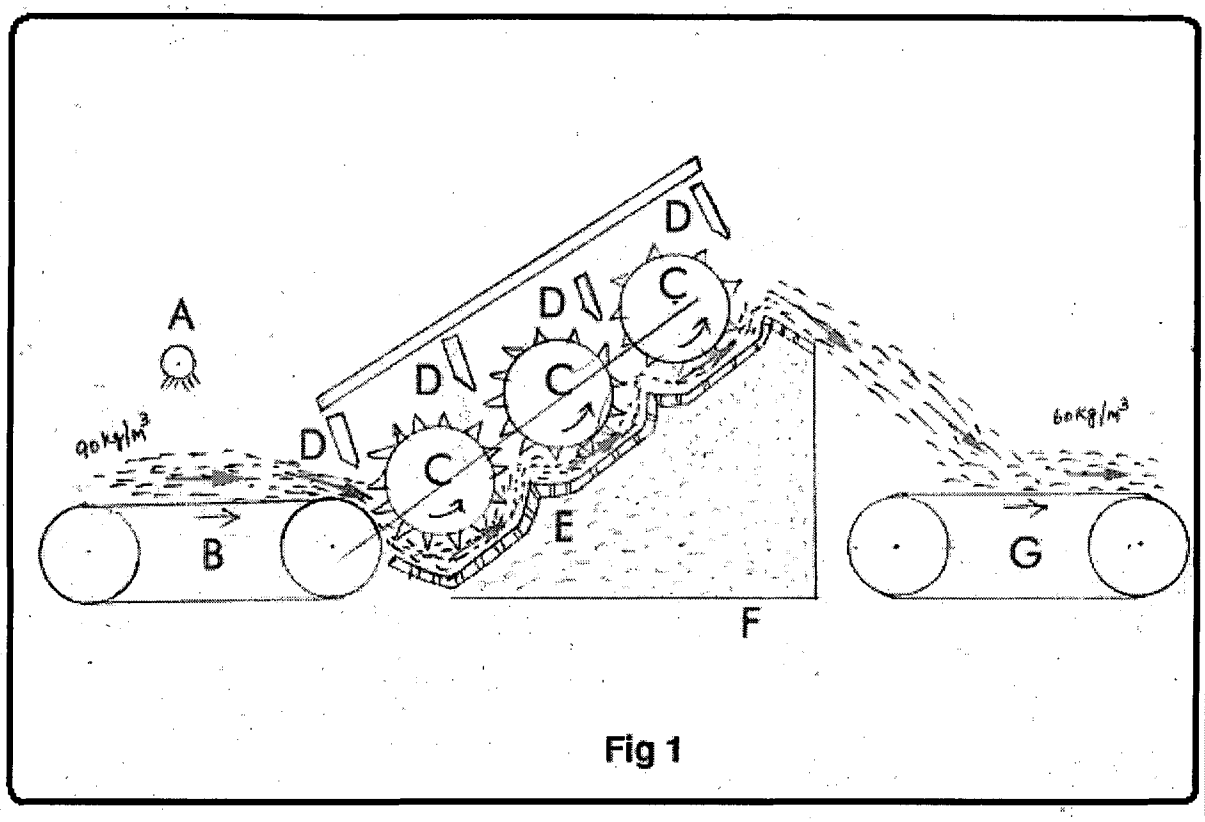



Fig 1

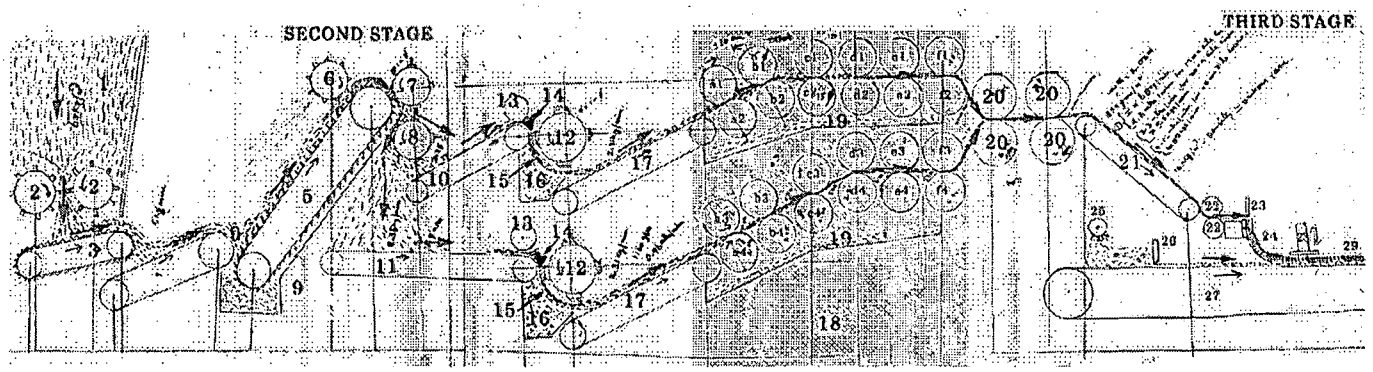



Fig 2

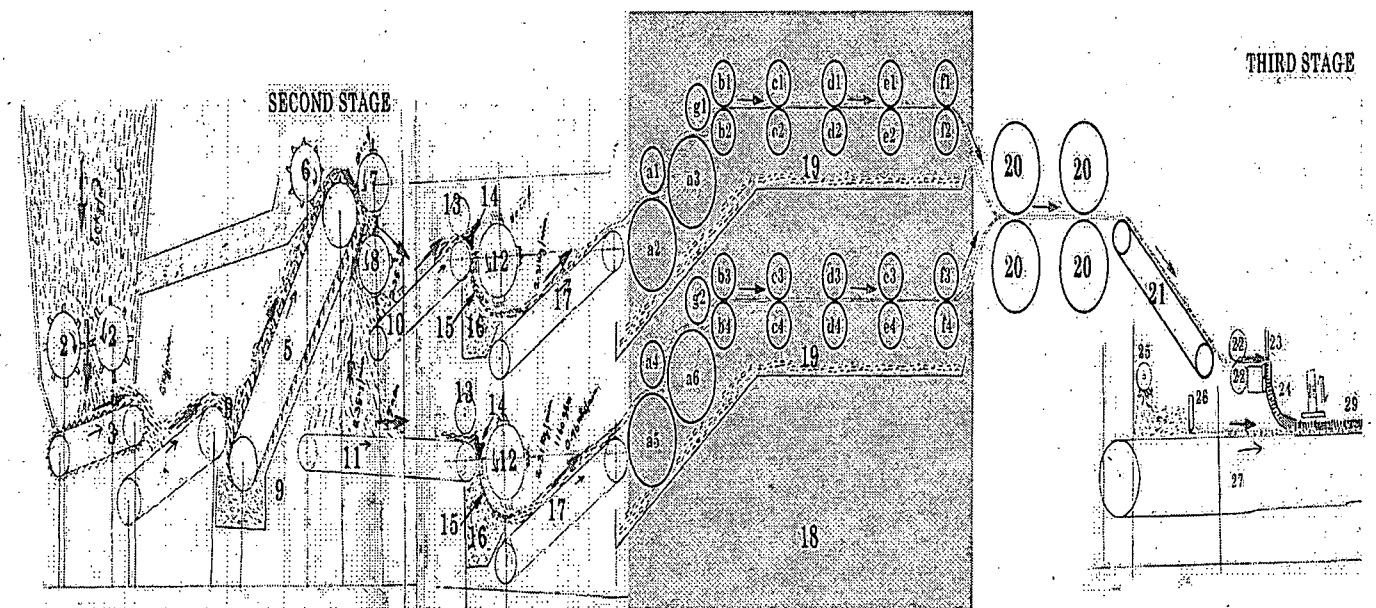



Fig 2 A

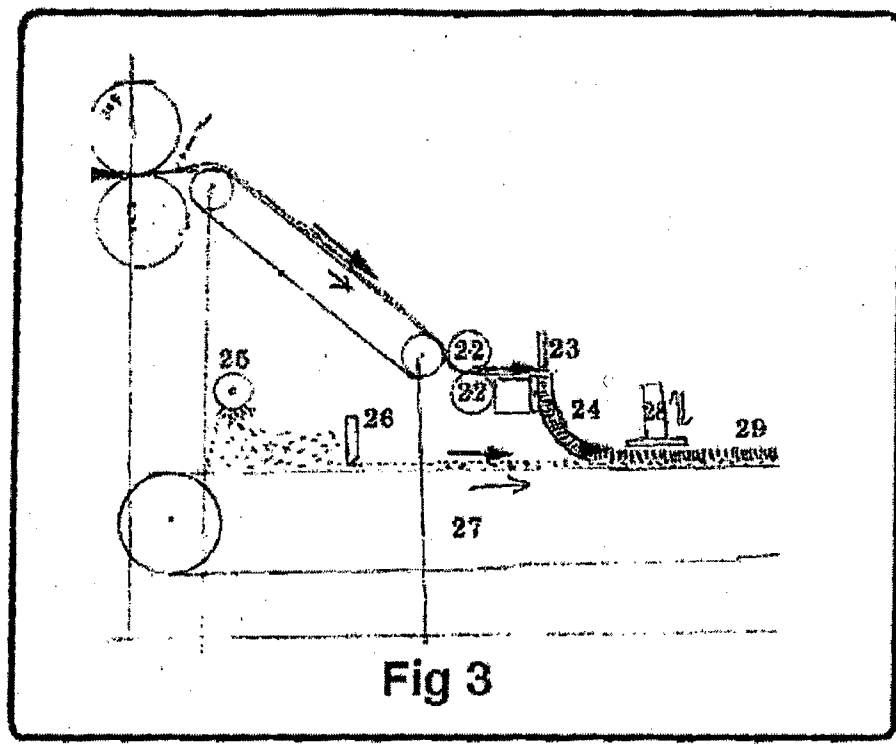



Fig 3

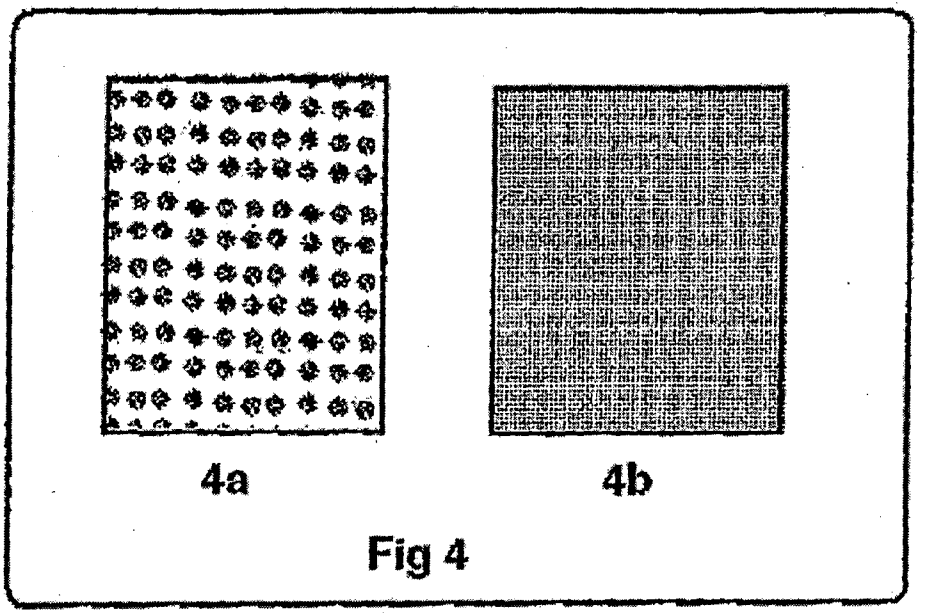



Fig 4

# INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2012/000326

A. CLASSIFICATION OF SUBJECT MATTER
INV. D04H1/4266 D04H11/00 A47L23/26
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D04H A47L B27N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | FR 2 218 071 A1 (BERTIN & CIE [FR])<br>13 September 1974 (1974-09-13)<br>page 2, line 25 - page 4, line 5 | 1 |
| X | WO 2005/055770 A1 (ARUN PRASAD [IN])<br>23 June 2005 (2005-06-23)<br>page 4, line 8 | 1-22 |
| X | AT 195 746 B (ANGLEITNER OTTO DR)<br>25 February 1958 (1958-02-25)<br>the whole document | 1-22 |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 22 March 2013 | 02/04/2013 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Van Beurden-Hopkins |

1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IN2012/000326

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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