

Nov. 24, 1964

E. A. N. JOHNSON

3,158,668

METHOD AND APPARATUS FOR MAT FORMING

Filed Dec. 19, 1960

3 Sheets-Sheet 1

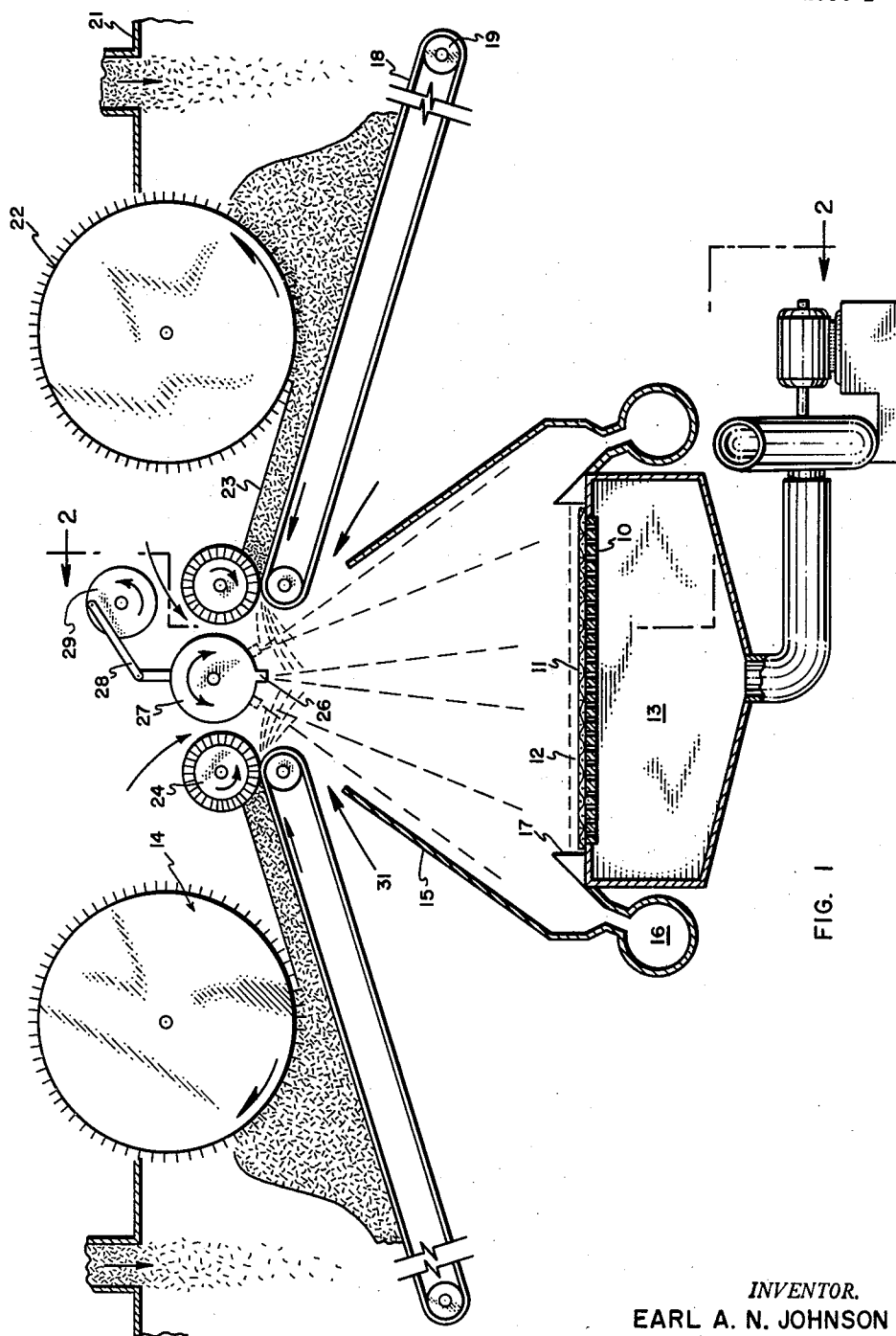


FIG. 1

INVENTOR.
EARL A. N. JOHNSON
BY *Robert R. Finch*
Attorney

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E. A. N. JOHNSON

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3 Sheets-Sheet 2

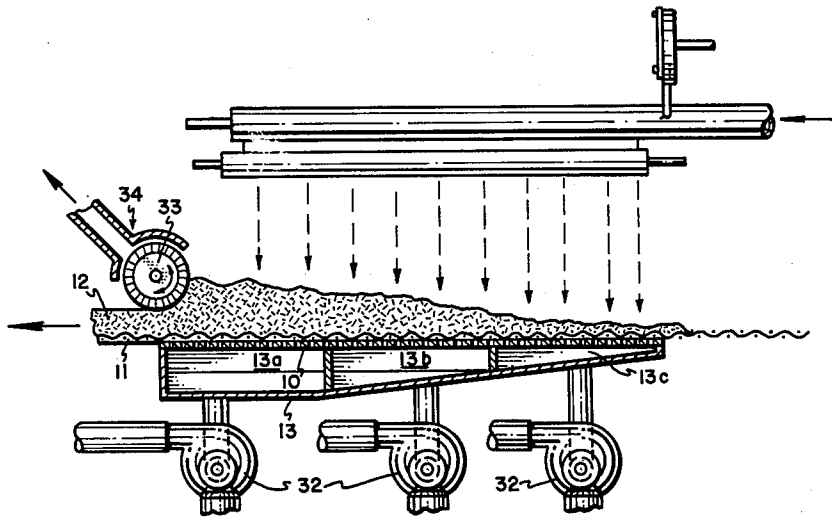


FIG. 2

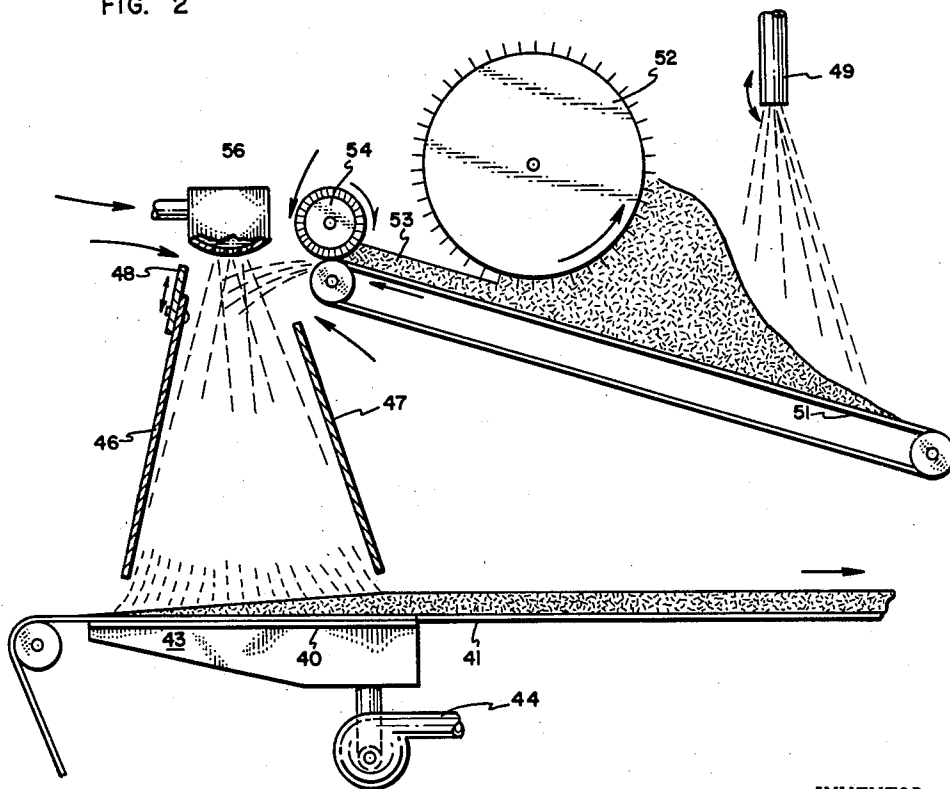


FIG. 3

INVENTOR.
EARL A. N. JOHNSON
BY *Robert R. Simule*
Attorney

Nov. 24, 1964

E. A. N. JOHNSON

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3 Sheets-Sheet 3

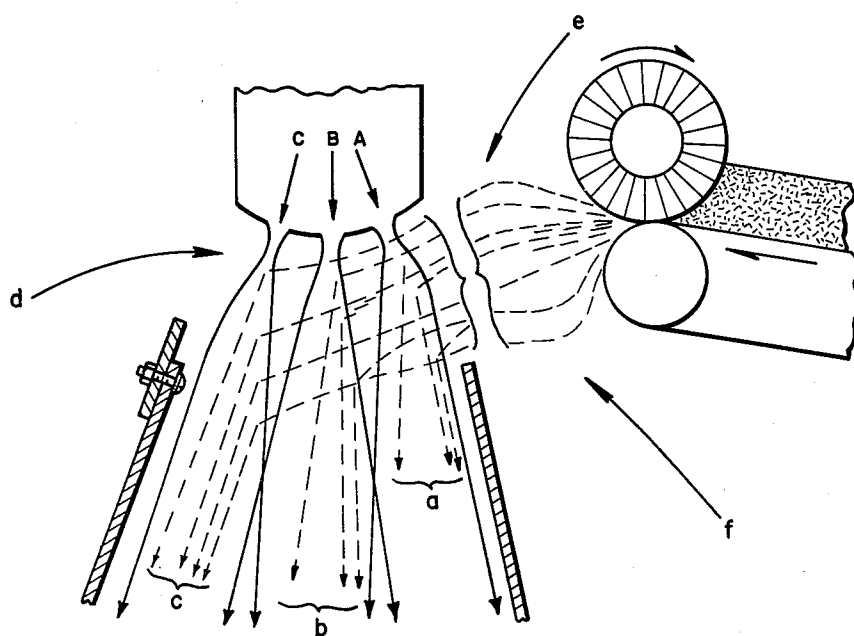


FIG. 4

INVENTOR.

EARL A. N. JOHNSON

BY

Robert A. Finch
Attorney

1

3,158,668

METHOD AND APPARATUS FOR MAT FORMING

Earl A. N. Johnson, 1044 Sprague St., P.O. Box 100,
Edmonds, Wash.

Filed Dec. 19, 1960, Ser. No. 76,961

6 Claims. (Cl. 264-116)

This invention relates to mat or web forming ways and means for laying up a web of lignocellulosic fibers, such as wood, straw, sugarcane and the like, with or without admixture with a suitable binder, to form a directly useable mat or one adapted for subsequent processing, as by hot pressing, into special building boards.

As is well known, uniformity of the final board depends upon the formation of a preliminary mat of uniform density and thickness in which fibrous material is present in the form of individual fibers rather than fiber bundles or clumps.

Mat forming devices heretofore employed have taken a variety of forms, but commonly utilize purely mechanical fiber distributors, such as pick rolls, to throw fibers into a traveling belt to thereby form a mat that is subsequently levelled by various mechanical devices. Such prior devices and systems employing such devices, have enjoyed some commercial success, but are still not all that is to be desired because the resulting mat contains many fiber clumps and lacks the all-important uniformity of density and fiber distribution. As a result, the final product is not uniform as to the important factors of strength, density, thermal or moisture expansion, appearance, etc., necessary in a commercially useful board.

It is the primary object of this invention to provide ways and means capable of forming a mat consisting of individual fibers and substantially free of fiber clumps. An important related object is the provision of ways and means for breaking up fiber bundles and depositing them as a mat before any regrouping of fibers into bundles can occur.

Another important object is the provision of ways and means enabling controlled deposition of fibers to form a mat of substantially uniform density.

A further object is the provision of a method and means particularly adapted to dry felters, to carry out such method whereby the rate of feed to the final fiber distribution station is maintained substantially uniform despite fluctuations in the actual supply of fibers to the system.

As this specification proceeds other related objects will appear to those skilled in the art to which the invention pertains.

In order that the invention may be more readily understood and carried into effect, reference is made by way of example to the accompanying drawings which form a part of this specification, it being understood that the described embodiments are not to be taken as limiting the invention, the scope of which is defined by the appended claims and equivalents thereof rather than by the description preceding them.

In the drawings:

FIG. 1 is a partial end view, somewhat diagrammatic, showing an embodiment of the invention.

FIG. 2 is a diagrammatic side view taken generally in the plane of line 2-2 of FIG. 1, certain elements being omitted for purposes of clarity.

FIG. 3 is a side view, more or less diagrammatic, of a separate embodiment of the invention.

FIG. 4 is an end view illustrating certain details, especially positioning of distribution air jets employed in the embodiment illustrated in FIG. 3.

Referring to FIGS. 1 and 2, there is provided a suitably mounted fixed perforated support plate 10 over which travels a foraminous screen 11 adapted to support a mat 12 formed by fibers. A vacuum box 13 is provided under

2

the feed section of the machine in which fiber is discharged on the travelling screen.

The feed section is open at the top and confined at its sides by upwardly extending inclined baffles 15 which, as hereinafter described in more detail, serve to confine fibers and also aid in fiber distribution. At the base of each baffle, and at least coextensive with the length of the feed section, there is provided a separate exhaust manifold 16, connected to a suitable exhaust fan not shown, which serves to remove excess fibers not deposited on the traveling screen. Inboard of each exhaust manifold and adjacent the sides of the traveling screen, there are provided side dams 17 which together serve to dimension the mat and between which the screen travels. Excess feed material spills over these dams to be carried away by the exhaust system, preferably to be returned to process.

The screen is mounted in any suitable manner to travel continuously through the feed section.

In the illustrated embodiment there is shown a feed arrangement on both sides of the machine. This is important because it insures a more uniform feed supply.

The feed supply system of the invention comprises an endless belt 18 mounted to travel on suitable rollers 19 one of which is driven in suitable manner by means not shown and the other of which can be mounted as an idler roll. Feed, usually a mixture of fibers and binder, is supplied to a rear portion of the belt through a suitable supply port 21. Such port should be designed to provide uniform distribution of fibers over the width of the belt. This may be accomplished by any of several schemes, such as an oscillating pipe (Cf. Ref. 49 FIG. 3), which is advantageously an oscillating tailpipe on a dust cyclone which deposits separated fibers onto the belt. Feed, which may originate from any suitable source is deposited on the belt and carried toward the open top defined by the side baffles 15. During such travel, the material passes under a reverse turning pick roll 22 or equivalent structure which scalps the thus formed feed pile to a preliminary mat 23 of uniform thickness, the excess material being thrown to the rear of the belt where it is retained as a constant supply feed source from which the feed belt is fed. This is an important feature as it enables accommodation of varying rates in the primary feed as initially supplied through port 21.

The preliminary mat 23 travels on belt 18 past the pick roll into a nip formed between a revolving brush or pick roll 24 mounted adjacent the inboard end of the belt and closely spaced thereabove.

As the preliminary mat passes under the brush roll it is disintegrated into fiber clumps as well as into individual fibers which are thrown into the path of a series of high velocity air streams directed downwardly through the open top of the feed section toward the screen 11 from spaced apart nozzles 26 provided in an oscillating elongated plenum space of manifold 27 mounted above and in a plane substantially parallel to the direction of travel of the perforated screen 11. Such manifold is suitably journaled at its opposite ends to permit oscillation while enabling passage of high pressure air. Oscillation may be accomplished by any suitable means such as levers 28 and drive wheel 29. A continuous elongated air passage may be substituted for the spaced apart nozzles 26.

Oscillation of the manifold and nozzles effects a constant air stream sweeping action which in turn effects uniform distribution of fibers on the travelling screen.

Pile-up or accumulation of fibers adjacent the sides of the screen, such as would normally occur during the null period in the oscillation cycle, is prevented by dams 17 and exhaust manifold 16. In this connection, the oscillation arc should be adjusted so that the swing ends when

3

the center line of the base of the cone formed by the normally expanding air jets strikes the dams 17.

The downward velocity of the air jets disintegrates any fiber clumps that might be discharged by the brush roll. The high air velocity drives fibers onto the screen with such speed that there is insufficient time for reformation of large clumps. A constant vacuum maintained in vacuum box 13 insures deposition and adherence of fibers on the screen.

It is noted that the baffles 15 are arranged to have their top edges spaced from the feed belt but adjacent to the in-board end thereof. This forms a passage 31 through which outside air is drawn into the fiber distributing area where it performs an extremely important function in fiber mixing and in fiber dispersion. Thus, it is an important feature of the invention that the arrangement utilizes the negative forces existing at the contracted portions (vena contracta) of the jets to pull a strong air stream through the passage 31 which sweeps fibers into the main jet streams. This also adds additional fiber carrying capacity to the downflowing stream.

It is extremely important that the downward air velocity, and sub-mat vacuum if employed, be co-ordinated with belt speed and/or mat thickness as to insure that surface particles are not swept away by air not accommodated by the vacuum.

In general, air velocity and volume and vacuum box operation should be such that the average air velocity at the mat surface is about 400 to 600 f.p.m. while velocity through the mat itself is on the order of 300 f.p.m. This will give proper deposition of fiber and insure retention of deposited fibers on the screen.

In connection with air issuing from the nozzles 26, the velocity should be sufficient to disintegrate clumps and drive separated fibers onto the screen or mat surface. For a loosely packed feed mix (less than 1.5 lbs. solids/cu. ft. of bulk) and relatively dry (less than 50% moisture by weight) the issuing air jet velocity should be at least 7,500 f.p.m. For more tightly packed or wetter material, the minimum air velocity required may exceed 25,000 f.p.m.

Referring especially to FIG. 2, it will be seen that the mat builds up progressively as the screen travels through the feed section. In order to prevent excessive packing of the mat in formation, an occurrence that would contribute to excessive pressure drop across the screen as well as non-uniformity of mat density, the vacuum box 13 is divided into sections as indicated at 13^a, 13^b, and 13^c. Each section is provided with a suitable exhaust fan 32 thereby enabling independent regulation of the sections so defined.

As a formed mat passes the feed section, it moves under a shaving or pick roll 33 set a predetermined distance above the screen and which serves to level the mat to a uniform depth, excess fiber being returned to process by an exhaust system 34.

FIGS. 3 and 4 illustrate an embodiment of the invention employing a fixed manifold positioned transversely to the direction of screen travel and having nozzles so arranged and sized as to obtain the necessary air velocity and distribution for fiber clump disintegration and fiber distribution.

FIG. 3 illustrates a basic structure comprising a perforated support plate 40 over which travels a permeable screen 41 adopted to receive and support a mat being formed. Under the mat forming section is positioned a vacuum box 43 connected to a suitable vacuum pump 44. Front and rear baffles 46 and 47 define the mat forming section. The front baffle 46 is provided with a movable auxiliary plate 48 at its upper edge to enable adjustment of the height of such baffle for reasons to be hereinafter explained.

FIG. 4 illustrates diagrammatically the expected distribution (shown by the broken arrows) of outside air drawn in through open areas *e* and *f* by the air jets issu-

4

ing through orifices A, B and C as they normally expand to the widths nominally indicated at *a*, *b*, and *c*. For clarity, distribution of air drawn through opening *d* is omitted.

That feed supply section illustrated is similar to that described in connection with FIGS. 1 and 2 and comprises an initial feed port 49 desirably mounted to oscillate for distribution of feed onto an endless belt 51 which carries the feed under a reverse rotating pick roll 52 whence a preliminary loosely formed mat 53 results. The mat passes into the nip between brush roll 54 and the belt whence the preliminary mat is disintegrated to discharge as loose fibers and fiber clumps into the path of high velocity air streams issuing from a fixed manifold 56. As in the embodiment of FIG. 1, the downward air blast, in cooperation with the vacuum in box 43, distributes the fibers and clumps, deposits them on the traveling screen and holds the resulting mat in place.

Although the embodiment shown employs vacuum beneath the final screen, this is not necessary in all cases. The important requirement is that of sweeping fibers onto the screen and this may be accomplished without vacuum so long as a pressure drop exists across the screen to enable air flow therethrough.

As used in this specification the term fibers or individual fibers include small fiber clumps or bundles.

I claim:

1. The method of forming a compacted mat from finely-divided fibers comprising the steps of forming from such fibers a non-compacted first mat of substantially uniform depth, continuously disintegrating successive portions of said mat into substantially individual fibers and reforming such fibers into a relatively compacted mat by continuously entraining them in a downwardly directed high velocity fluid jet emitted from an orifice at an initial velocity of at least about 7500 f.p.m. and having a reduced pressure zone at its vena contracta by introducing such fibers into air flowing toward said reduced pressure zone of said high velocity jet thence passing said fluid jet through a horizontal fluid-pervious surface adapted to retain the fibers on its surface.

2. Mat forming apparatus comprising in combination; first mat forming means adapted to form from fibers a first mat of substantially uniform thickness, mat disintegrating means enabling disintegration of a mat into individual fibers, conveyor means enabling feeding of a mat to said disintegrating means, and means including said disintegrating means for discharging individual fibers from said conveyor means; second mat forming means adapted to reform said individual fibers into a second mat, said second mat forming means comprising a substantially horizontal fluid-pervious screen adapted to support fibers, an open top fiber receiving chamber above said screen, said chamber being formed between spaced apart upwardly extending inclined walls converging toward the top and terminating at an elevation above said screen, conducting means for conducting pressured fluid toward said open top, at least one orifice in communication with said conducting means and adapted to emit therefrom a high velocity fluid jet having a vena contracta zone of reduced pressure, said orifice being positioned at an elevation above said open top and being directed downwardly through said open top toward said screen, and means mounting said second mat forming means with said open top of said fiber receiving chamber in the path of individual fibers discharged from said first mat forming means.

3. Mat forming apparatus comprising in combination, first mat forming means including a conveyor, means for depositing fibers on the upper surface of said conveyor, means for forming a mat of uniform thickness on the surface of said conveyor from fibers deposited thereon, and discharge means for disintegrating a mat formed on said conveyor and discharging the same therefrom as individual fibers; second mat forming means including a

5

substantially horizontal fluid pervious screen adapted to support fibers deposited thereon, said screen being located at an elevation below said discharge means from said conveyor, an open top fiber receiving chamber above said screen, said chamber being formed from spaced apart upwardly extending inclined walls converging toward the top and terminating at an elevation below said discharge means of said conveyor and adjacent thereto whereby said open top is in position to receive fibers from said discharge means; conducting means for conducting pressurized fluid toward said second mat forming means, a plurality of orifices in said conducting means each adapted to emit therefrom a high velocity fluid jet, said orifices being positioned at an elevation above said open top of said fiber receiving chamber and directed downwardly through said open top toward said screen whereby to entrain individual fibers received in said open top from said discharge means of said first mat forming means.

4. Apparatus according to preceding claim 3 in which said screen is formed as an endless belt and there is provided means for moving said belt horizontally through said fiber receiving chamber and a vacuum box below said fiber receiving chamber in communication with said chamber through said screen as the latter passes through said chamber.

6

5. Apparatus according to preceding claim 3 with the addition of an exhaust manifold adjacent both sides of the bottom of said chamber on opposite sides of said screen, said walls being joined to said manifolds and said manifolds being in communication with the interior of said chamber along both sides of said screen.

6. Apparatus according to preceding claim 3 in which said conducting means includes an elongated plenum chamber mounted above said open top of said fiber receiving chamber parallel to said screen, and said orifices are formed in the wall of said plenum chamber.

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