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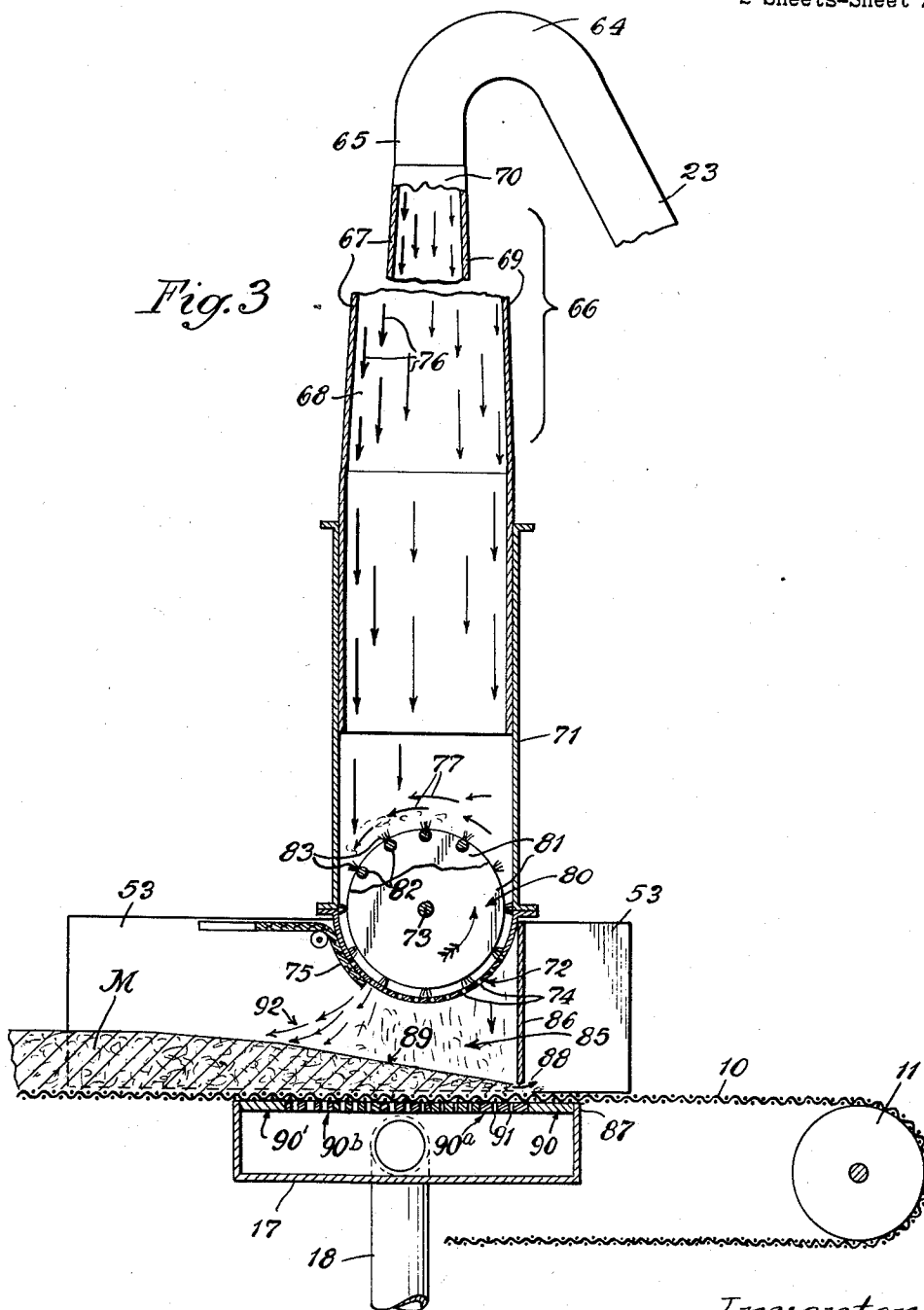
C. C. HERITAGE

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SUCTION FILTER APPARATUS AND METHOD

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SUCTION FELTER APPARATUS AND METHOD

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20 Claims. (Cl. 19—156)

The present invention relates generally to the production of air-laid felts and apparatus therefor, and in particular to pneumatic apparatus having independently controlled air-pressure and air-suction systems interconnected through the atmosphere at a region wherein the felt is formed.

The present invention is a continuation-in-part of my copending application Serial No. 182,965, filed September 2, 1950.

Among conventional ways to form air-laid fiber felts are deposition by gravity from dispersion in air, and deposition by filtration from a moving suspension in air. In deposition by gravity, fibers land on fibers with such a low impact that they form a mass more like a pile of fibers than a felt of fibers. When the impact at deposition is increased, each fiber tends to penetrate deeper into the mass of fibers on which it lands, and also to compress the mat being formed to a density in equilibrium with the forces predetermining the value of the impact. Impact is commonly made relatively high by filtering a stream of air in which the fibers are suspended, using the felt already deposited as the exposed part of the filter. In forming a continuous mat by filtration on a moving mechanical filter, the exposed surface of the filter varies from that of the mechanical filter itself at one extreme to that of the deposited mat at the other extreme. This variation commonly involves difficulties with respect to uniformity from face to face.

The density and uniformity of formation in a mat as felted are important with respect to the density and uniformity of structure when that mat is compressed to a uniform thickness. In making dense hot-pressed board from such mats, final uniformity of density is very important, and deviations are manifest in the appearance and character of the board. The lower the density of the initial mat or felt, the less a given differential in its thickness is reflected in variation of board properties. It is desirable to make the initial mat as uniform as possible in all of its characteristics, and then to compress either to handleability or to a useful article of commerce. However, to do so involves difficulties.

In air-laid felts, the strength depends upon the interlocking of fibers. In compressing an initially deposited mat in horizontal position, vertical fibers therein tend to move toward the horizontal position. To the extent that the initial density is greater, such vertical fibers, herein called "nailers," on compression hold or catch more of the remaining fibers both under them and over them for added strength. To the extent that the initial density is less, the nailers on compression tend to lie in layers with other fibers, yielding a compressed mat exhibiting cleavage on the order of a laminated structure.

However, there are limitations, and the initial mat must not be so dense as to bar entry of the nailers. Adequate velocity of depositing fibers is needed to effect penetration as nailers, and this may be effected and controlled by pneumatic conveyance of the fibers into the deposition

area. The present apparatus is especially suitable for producing such nailer-strengthened mats. As the moisture content of the fibers increases, the fibers deposit with greater impact under a given set of conditions.

It is a general object of the invention to provide discharging apparatus for air-suspended fibers.

It is a general object of the present invention to provide an air-laying felter in which fibers are felted to a mat of substantially uniform density and thickness, in a region exposed to the atmosphere on a continuously moving conveyer, and at a relatively rapid rate.

It is a particular object to provide a depositing region exposed to the atmosphere in which an air stream carrying fibers to the region is controlled, and in which a second air stream feed from the felted fibers is independently controlled and in which the second air stream within the said depositing region may be advantageously locally controlled.

It is another object of the invention to control the character of either one or both of the exposed faces of the felt by the relationship between the two controlled air streams, and by other means.

It is a particular object of the invention to form a thick mat and by suitable control to effect nailer-forming impact on deposition, and additionally to provide substantially the same kind of formation at the first-formed layer, the last-formed layer, and the intermediate layers.

Various other and ancillary objects and advantages of the invention will become apparent from the following description and explanation of the invention, as described with reference to the accompanying drawings in which:

Fig. 1 is a diagrammatic representation of the felter and various parts functioning therewith.

Fig. 2 is a plan view of a portion of the apparatus shown in Fig. 1 to illustrate particularly the alinement of certain parts.

Fig. 3 is a detailed view in vertical cross-section showing the principal features of the felter.

The drawings show a preferred embodiment of the invention, but it is to be understood that component parts within the scope of the appended claims may be used in other combinations.

The illustrated apparatus provides a moving foraminous conveyer on which the felt is formed substantially at atmospheric pressure in a region over a suction box. A perforated dispersing head contains a stock of agitated fiber at superatmospheric pressure, which stock is continuously replenished and drawn upon. A constant stream of air passes through the head and in so doing sweeps individual fibers from the head and into the depositing region. The said stream of air is preferably the means for bringing in fibers to replenish the stock of fiber, and in such case the velocity of the entering fibers is reduced by the provision of an expansion housing. A suitable agitator is provided in the head to keep the stock fluffy and uniformly available for the desired uniformity of outfeed. Conditions at the dispersing head crosswise of the moving conveyer must be uniform, but may vary longitudinally in the direction parallel to the said movement. A semicylindrical dispersing head with its axis crosswise of the moving conveyer is ideal to meet these conditions. To maintain some degree of order in the agitation, a constant speed mechanism is used for agitation, and where this is a coaxial rotor it preferably revolves in such a direction that it maintains a constant uniformity of turbulence axially within the head. This relationship is hereinafter described.

The air-pressure in the head causes a leaving current of air to carry individual fibers speedily away from the head into a depositing region where the felt is formed. This region is exposed to the atmosphere, thus eliminat-

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ing need for a closed housing which is required if the felt is formed at other than atmospheric pressure. The depositing region is defined by passing a continuously moving filter, such as a wire screen, over an area maintained at subatmospheric pressure, and placing the dispersing head in spaced proximity to the suction area and substantially entirely within its sphere of influence in operation as described.

The pressure in the head and the suction below the screen are so related that a continuous and constant stream of air carrying fibers passes through the atmosphere to the depositing region and is there filtered to form the felt. By providing two independently controllable pneumatic systems interconnected through the atmosphere at the depositing region, many factors in mat formation may be controlled, when the area of the suction box is so located as to comprehend the stream from the dispersing head.

When each system carries the same amount of air, there is theoretically a perfect balance. But the suction system may be adjusted to carry more or less air than the pressure system, with special advantages in each case. Because the moving forming mat adds increasing resistance to air flow from one end of the depositing region to the opposite end, there may be imposed a compensating and variable mechanical resistance, thereby tending locally to equalize the flow of air carrying the fibers to the screen. As described hereinafter, this may be effected by placing under the screen at the opening of the suction box, numerous plates, variously perforated, or even imperforate where it is desired that an edge of the depositing region be moved inwardly from the edge of the suction box.

These objectives are all readily effected by the apparatus shown in the drawings. In Fig. 1 there is provided an endless wire screen 10 between end rolls 11 and 12, at least one of which is rotated at a constant but controllable speed. A master control means 13 is indicated, having relation to other parts, and having its relation to the moving screen represented by the dotted line 14 to roll 11. A constant voltage power source coupled with proper motors may serve as the master control means 13. The screen 10 preferably moves in a horizontal plane and traverses a depositing region 16 over a suction box 17 located below the upper stretch of the screen 10. The suction box is connected by conduit 18 to the intake of a suitable blower 19. The blower 19 is arranged to operate at a regulatable constant speed by means 20 having a relation to other parts through the control means 13.

Over the depositing region there is a fiber disperser generally designated 22, with air therein maintained at super-atmospheric pressure by a suitable means such as a connection through a conduit 23 to the pressure side of a suitable blower 24, of which the inlet is connected by conduit 25 to a region at atmospheric pressure, and preferably to fiber-receiving hopper 26. Blower 24 is operated at a constant but controllable speed by means indicated at 27 having relation to other parts through connection to control means 13.

From the foregoing it may be appreciated that the blower 19 may carry more air than blower 24 in a manner to draw to the screen 10 all the fiber and air from the disperser 22, and in addition an envelope of air from the atmosphere. However, departures from this condition through refinements in construction and operation are applicable to the achievement of various objectives.

Before describing such departures and refinements, other parts of the general assembly are described. The fiber-receiving hopper 26 is shown as receiving a continuous charge of fibers 30 to be dispersed for felting. The fibers 30 are continuously fed into the hopper at a constant rate by suitable control means. To illustrate a suitable control the fibers 30 are shown as being discharged from a moving endless belt 31 running on two rolls 32

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and 33, and receiving fibers in a stream 34. When the axis of roll 33 is fixed and roll 32 floats in a balanced condition, as against tension spring 35, the assembly may be used as a volume or weight regulator of stream 30.

Such devices are well known. The one herein described operates by the weight of fibers 36 carried on upper stretch of belt 31, causing the roll 32 to move and adjust its vertical position. The movement is used to vary the rate of supply of fibers in stream 34 by known means (not shown).

Sometimes, more than one material is fed into the hopper 26 for incorporation into the felt. It may be a second kind of fiber, or it may be a binder in solid form such as a powdered thermosetting resin. When it is such a resin, other features of the apparatus become important. Numeral 40 represents a supply of such resin at a constant rate from a controlling belt 41, which may be part of a regulator such as that supplying fiber 30.

Many materials felted by suction provide a fraction of "fines" that escape the felting process and pass through the filter. The quantity of the escaping fraction is often appreciable and is often of significant importance particularly in the case where a powdered ingredient is present, such as a resin binder. Although it is important for economic reasons to recover such escaping fines, it is also important to do so for other reasons. Where two materials, such as fiber 30 and resin 40 are supplied at fixed rates, they exist and mix at fixed proportions prior to felting, and are naturally proportioned according to the proportion desired in the felt. When this proportion is disturbed by a disproportionate escape of fines, the effect may be corrected in a continuous operation by returning all the fines to the felter.

For such purposes, numerous expedients are possible. For example, the exhaust of suction-side blower 19 is connected by conduit 43 to a solids-separator, such as separating cyclone 44, which is shown as returning a constant stream of the recovered fines 45 to the hopper 26. Because the fines 45 have been previously and initially weighed in, they pass directly into the hopper 26. The cyclone 44 is shown as discharging air to the atmosphere at its vent 46. Where a thermal or other economy factor is involved, a part at least of the air lost at exhaust 46 may be reused in feeding air into conduit 25, by known means not indicated. These economies are described in my earlier application Serial No. 182,965, filed September 2, 1950, of which the present application is a continuation-in-part.

Fig. 2 is a plan view of the felter, to which attention is directed for features directly connected with the disperser shown in detail in Fig. 3. Where fiber is introduced into the dispersing head by entrainment in the air supplied thereto, certain conditions must be avoided and others observed, to maintain uniformity of fiber distribution in the dispersing head crosswise of the moving conveyor. To these ends the conduit 23 and the periphery of the blower 24 are aligned with the direction of movement of the felting screen 10, as on dotted line 50, which is an axis of symmetry for the disperser and for depositing region 16. Fig. 2 shows initially a formed mat M leaving the depositing region. It has vertical lateral edges 51 and 52 by reason of its formation against two parallel vertical side plates 53 and 54, later described. The initially formed mat M may be insufficiently felted; to be handled apart from its original horizontal support. Therefore, it may be compressed to greater density in one or more stages of compression, of which one stage is indicated by a pair of rolls 55 and 56, forming pressed mat P to facilitate removal from the screen 10. The compression may widen the mat as shown by new edges 57 and 58, unless opposing baffle plates are used. If necessary, such extended edges may be trimmed forming new vertical edges 58 and 59 and waste 60.

The described alinement of conduit 23 and its blower 24 is a matter of great importance. Centrifugal action

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in blower 24 loads the air stream in conduit 23 more at the region 61 than opposite it at region 62. Equalization of distribution tends to occur to the extent that conduit 23 is straight and long. Inclined conduit 23 is topped by a gooseneck 64 turning the passageway to a vertical leg 65 having an opening from which an enclosed horn-like housing 66 flares vertically downwardly and symmetrically with respect to line 50 (Fig. 2). The curve at gooseneck 64 again introduces a centrifugal force which throws a heavier concentration of fibers and the heavier components thereof more toward the front wall 67 of housing 66 than rearwardly of it.

The housing 66 is an expansion conduit for the fiber-air suspension conveyed in conduit 23. It serves to reduce the velocity so that the impact of conveyed fibers on being arrested in the housing minimizes felting in the housing. It also serves to equalize the air stream over the area discharging to the atmosphere. Since the latter discharging area requires straight sides parallel to the axis line 50, and substantial identity of crosswise conditions between such sides and along every intervening parallel line, the discharging area must be rectangular in its horizontal projection. Accordingly, the housing 66 flares generally downwardly through increasing rectangular crosssections. For simplicity and economy, this is preferably done by a pyramidal type of structure.

As illustrated and as used in one studied embodiment of the invention, the housing 66 flares with a rectangular cross-section from a top opening of about 9 x 18 inches to a bottom opening of about 24 x 54 inches in a vertical drop of about 17 feet. These dimensions are merely illustrative. Its walls are designated clockwise in Fig. 2 as 67, 68, 69 and 70. For uniformity crosswise of the housing, the periphery of blower 24, and all of conduit 23 including its gooseneck 64 lie in a vertical plane which bisects every horizontal cross-section of the housing about midway longitudinally of the conveyor.

The bottom opening of the housing 66 may have a terminal dispersing head or it may be extended by a suitable tubular means, such as a prismatic box-like section 71 with four vertical side walls, for any suitable or desired distance, for example about 5 feet. The rectangular bottom opening of the housing 66 as extended by section 71 is closed by a perforated head, preferably a semi-cylindrical dispersing head 72 with its horizontal axis 73 at right angles to axis line 50. The box 71 is shown as telescopic in two sections to permit adjusting the vertical height of the dispersing head 72 above the screen 10.

An arc of about 100° of the periphery is perforated substantially symmetrically of line 50 with holes 74 of size to effect substantial individualization of the fibers constituting the charge 30 fed to blower 24. In the case of wood fibers 30 previously liberated substantially as individualized ultimate fibers of the wood, the holes may be $\frac{5}{16}$ inch in diameter and countersunk deeply from the exterior side. The countersinking minimizes the extent of cylindrical wall in the hole and thus minimizes the tendency of the holes to plug and to deliver slugs felted within the hole. The more numerous the holes, the greater the capacity of the system. A wide variety of hole sizes, shapes and arrangements is permitted. In one form the holes have been alined along geometrical elements of the head 72 on half-inch centers, staggered in adjacent rows, and said rows spaced on 0.4375 inch centers. A flexible adjustable gate 75, like the closure of a roll-top desk, is positioned to vary the effective arc of perforations.

In Fig. 3 the arrows 76 in housing 66 indicate the downward course of fibers and air and a heavier concentration of fibers along the front wall 67. Numeral 77 indicates arrows representing an agitated stock of fibers in section 71 and dispersing head 72. Fibers 77 are maintained in agitation by suitable means. This is designed to minimize the formation of obstructive fiber clots. Preferably, it is a squirrel-cage type of rotor generally desig-

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nated 80, co-axial with head 72, having end disks 81 and spaced bars lying in a cylindrical arrangement, such as the elemental bars 82, preferably carrying bristles 83 to brush fibers through the perforations. The agitator must be designed to avoid lateral urging of fiber stock, in order to maintain crosswise uniformity. For example, spiral bars, like those on a lawn mower cutter, would move the stock along its axis. The rotor turns at a high speed, as in a range from 175 to 600 r.p.m. Its direction is such as to cause the fibers which move with it to mesh with the heavier feed of fibers down the front wall 67 of the housing 66. Thus, where the conduit 23 approaches from the right in Fig. 3, the agitator operates best when turning counter-clockwise in Fig. 3.

The air rushing through the holes 74 carries fibers with it as indicated by numeral 85. The path of fibers 85 is predetermined largely by a suction area under screen 10 and by positioning baffles, such as the side plates 53 and 54 or others. For example, there is shown a rear vertical baffle 86 extending nearly to the screen 10, but forward of the rear edge 87 of the suction box 17. To the extent desired, suction may extend rearwardly from baffle 86. The lower edge of baffle 86 may be so high and the suction at said edge be so reduced that a stream of the lighter-weight or fine fibers designated 88 may float out and deposit first on the screen 10 to predetermine the texture of that face. The mat M begins to form substantially at the junction of baffle 86 and screen 10, where suction functions at the line of baffle 86, building up on an incline to the final thickness of mat M. The density and thickness of the initial mat may be varied over wide ranges by control of the materials and operating conditions. For example, where wood fiber with a few percent of added resin binder is to be formed into hot-pressed board at a density of 64 pounds per cu. ft., and in thicknesses of $\frac{1}{4}$ inch, the initial mat may have a density in the range from 2 to 6 pounds per cu. ft. of oven dry fiber at corresponding thicknesses in the range from 8 to 2.7 inches. These results may be achieved with a pressure in the head of 0.1 to 1.0 inch of water, and a suction in the box 17 of about 2 to 30 inches of water, under the following described conditions of graded partial obstruction of the area of suction. For the dispersing head having the dimensions previously given above, the volume of delivery air may vary roughly in the range from 1000 to 5000 cu. ft. per minute.

A planar incline for the forming top surface of the mat signifies even distribution of fibers over the depositing area, and hence substantially uniform impact on deposition. Were the suction box 17 open directly to the screen, the greater volume of air, and hence concentration of fiber, would obtain at near the baffle 86, and the resulting mat would so resist the suction as to maintain this inequality of distribution. Accordingly, the suction is controlled and distributed to secure a planar incline to the forming top face of the mat.

The preferred means to distribute the suction is to employ an open construction for the suction box 17 and to provide for it changeable plates together forming a functioning cover for the open top in the manner set forth in Roberts U.S. Patent No. 2,912,723. Numerous plates of which the length of each runs crosswise of and under the screen 10, provide a suction platform over which the screen 10 runs. Perforations made in the plates determine the effective boundaries of the deposition region 16. Uniformity requires the perforations to be uniform crosswise of the screen, and build-up of the mat calls for variation lengthwise of the screen. The perforations in their effective area increase forwardly of the machine, and are arranged with respect to particular conditions and materials, having as an objective the creation of the inclined plane 89 for the growing face of mat M.

As shown, rear plate 90 is a blank or closure plate, cutting off suction to the rear of baffle 86, except for some perforations 91 in the forwardly adjacent plate 90a.

The most forward plate 90' is shown also as a blank. To its rear the adjacent plate 90^b is more perforate than the rearmost perforate plate 90^a to compensate for the resistance of the thicker mat formed above it. The region between plates 90^a and 90^b has plates with perforated area increasing from that in plate 90^a to that in plate 90^b.

As shown in Fig. 2 the side plates 53 and 54 lie vertically alongside the ends of the semi-cylindrical head 72, and the suction plates have their perforations extending to but not beyond the said side plates. Side plates 53 and 54 preferably have lengths at least comprehending the region between the forward and rearward edges of suction box 17. Side plate extension along the entire length of the uncompressed web is undesired because of possible drag and dislocation of fibers at the lateral edges.

In practice, when the suction system is operated at greater capacity for air than the fiber-feeding system, an envelope of air from the atmosphere is drawn in, to house all the moving fiber, provided the plates are suitably perforated at the forward and rearward edges. This is very desirable where the fiber may contain dust, or an expensive or a dangerous ingredient, desirably not wasted into the atmosphere.

However, as shown, the relative capacities of the two blowers, or the arrangement of the suction plates, may be so chosen that at the forward end over mat M there is a forward winnowing of air from the head to carry lightweight fine fibers for final deposition, as indicated at 92. The air so permitted to move forward may drop its fines by gravity and diffuse into the atmosphere, or it may respond to a slight suction in the mat M resulting from suitably limited perforations in the forward plates.

The apparatus may be operated over a wide range of conditions for its numerous variables in order to achieve different predetermined effects. The superatmospheric pressure in the head is preferably much less in degree than the subatmospheric pressure in the suction box, largely because of the resistance to air passage imposed by the mat being formed. Suitable operating ranges are from 0.1 to 1.0 inch of water as positive pressure in the head and from 1 to 30 inches of water negative pressure in the suction box.

In one particular study of such variables, the following spans within greater ranges have been covered:

Conveyor speed.....	2.5 to 10.5 feet per minute.
Fiber feed.....	1275 to 2540 pounds per hour.
Fiber deposited.....	.76 to 2.04 pounds per sq. ft.
Fiber moisture.....	10 to 26.8 percent by weight.

Delivery air:

Static pressure in head	0.25 to .63 inch of water.
Volume.....	2460 to 3570 cu. ft. per minute.

Suction air:

Negative pressure in box	4.18 to 7.38 inches of water.
Volume.....	2550 to 3940 cu. ft. per minute.

Volume ratio of suction: Air to delivery air	0.88 to 1.22.
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All of the above are directed to conditions for producing pressed boards of 1/8 inch thickness at 64 pounds per cu. ft.

The invention is not limited to the entire assembly as illustrated. The dispersing head is disclosed as vertical because of its use to deposit fibers on a horizontal conveyor. The multiplicity of jets of air carrying fiber, as discharged from the head may be moved in directions other than vertical, for example by turning the assembly of expansion chamber and head to a horizontal position, and using the same as a disperser for other uses of the fiber, or for other means of felting.

From the foregoing it will be appreciated that the apparatus is capable of modification for many kinds of fibers,

and for operation in many combinations of variable factors, to produce a wide variety of felts.

I claim:

1. Apparatus for felting comprising a movable endless screen on which continuously to form a fiber felt at a stationary deposition area thereof exposed to the atmosphere, means providing suction under said screen and thereby defining said deposition area, a blower having its inlet connected to said suction means and its outlet arranged to discharge into a region at atmospheric pressure, an expansion housing flaring laterally in all directions toward said deposition area, a perforated head for passing substantially individualized fibers closing said housing and located in spaced proximity to said deposition area, means to maintain agitation of fibrous material in the vicinity of the perforations of said head, a second blower having its inlet connected to draw air from a region at atmospheric pressure and its outlet connected to the small end of said flaring housing whereby to create superatmospheric pressure in said head, means continuously to feed fibers for entry into said head for dispersion therefrom, means to move said screen, and means to increase the degree of suction in said deposition area in the direction of movement of said screen.

2. Apparatus for felting comprising a movable endless screen on which continuously to form a fiber felt at a stationary deposition area thereof exposed to the atmosphere, means providing suction under said screen and thereby defining said deposition area, a blower having its inlet connected to said suction means and its outlet arranged to discharge into a region at atmospheric pressure, an expansion housing flaring laterally in all directions toward said deposition area, a perforated head for passing substantially individualized fibers closing said housing and located in spaced proximity to said deposition area, means to maintain agitation of fibrous material in the vicinity of the perforations of said head, a second blower having its inlet connected to draw air from a region at atmospheric pressure and its outlet connected to the small end of said flaring housing whereby to create superatmospheric pressure in said head, means continuously to feed fibers for entry into said head for dispersion therefrom, means to move said screen, and variably perforated means under said screen to regulate the degree of suction locally in said deposition area to increase it in the direction of movement of said screen.

3. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a semi-cylindrical head closing the lower end of said conduit and exposed externally to the atmosphere, a portion of said head between two geometrical elements thereof being perforated for the dispersal of and passage of said material there-through, a rotor in said head provided with fiber-agitating members and arranged in rotation to distribute said material for dispersal through said perforated portion, a movable endless foraminous felting conveyer spaced below said head and arranged to travel horizontally under said head in a forward direction transversely of the axis of the head, independent means to exert suction on the under side of said conveyer over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, spaced vertical side plates closing the lateral space between said conveyer and said head for defining the width of a web to be felted therebetween, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration in elemental directions along the head and felt on the conveyer and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

4. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a semi-cylindrical head closing the lower end of said conduit and exposed externally to the atmosphere, a portion of said head between two geometrical elements thereof being perforated for the dispersal of and passage of said material therethrough, a rotor in said head provided with fiber-agitating members and arranged in rotation to distribute said material for dispersal through said perforated portion, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of the axis of the head, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration in elemental directions along the head and felt on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

5. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a semi-cylindrical head closing the lower end of said conduit and exposed externally to the atmosphere, a portion of said head between two geometrical elements thereof being perforated for the dispersal of and passage of said material therethrough, a rotor in said head provided with fiber-agitating members and arranged in rotation to distribute said material for dispersal through said perforated portion, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of the axis of the head, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, spaced vertical side plates closing the lateral space between said head for defining the width of a web to be felted therebetween, and means to regulate the degree of suction locally so as to increase it in the direction of movement of the conveyor, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration and formation in elemental directions along the head and felt with controlled impact on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

6. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a semi-cylindrical head closing the lower end of said conduit and exposed externally to the atmosphere, a portion of said head between two geometrical elements thereof being perforated for the dispersal of and passage of said material therethrough, a rotor in said head provided with fiber-agitating members and arranged in rotation to distribute said material for dispersal through said perforated portion, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of the axis of the head, independent

means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, and means to regulate the degree of suction locally so as to increase it in the direction of movement of the conveyor, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration and formation in elemental directions along the head and felt with controlled impact on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

7. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a perforated rectangular head closing the lower end of said conduit and exposed externally to the atmosphere, the perforations being arranged for dispersal of substantially individualized fibers therethrough uniformly in one of its two rectangular dimensions, agitating means in said head to distribute said material for dispersal through said perforated head, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of said one dimension, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, spaced vertical side plates closing the lateral space between said conveyor and said head for defining the width of a web to be felted therebetween, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration along said one dimension of the head and felt on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

8. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a perforated rectangular head closing the lower end of said conduit and exposed externally to the atmosphere, the perforations being arranged for dispersal of substantially individualized fibers therethrough uniformly in one of its two rectangular dimensions, agitating means in said head to distribute said material for dispersal through said perforated head, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of said one dimension, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration along said one dimension of the head and felt on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

9. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a perforated rectangular head closing the lower end of said conduit and exposed ex-

ternally to the atmosphere, the perforations being arranged for dispersal of substantially individualized fibers therethrough uniformly in one of its two rectangular dimensions, agitating means in said head to distribute said material for dispersal through said perforated head, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of said one dimension, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, spaced vertical side plates closing the lateral space between said conveyor and said head for defining the width of a web to be felted therebetween, and means to regulate the degree of suction locally so as to increase it in the direction of movement of the conveyor, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration and along said one dimension of the head and felt with controlled impact on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

10. Apparatus for felting comprising a rectangular expansion conduit flaring downwardly in both cross-sectional dimensions, means to feed into the top of said conduit at superatmospheric pressure a suspension in air of material including feltable fibers, a perforated rectangular head closing the lower end of said conduit and exposed externally to the atmosphere, the perforations being arranged for dispersal of substantially individualized fibers therethrough uniformly in one of its two rectangular dimensions, agitating means in said head to distribute said material for dispersal through said perforated head, a movable endless foraminous felting conveyor spaced below said head and arranged continuously to travel horizontally under said head in a forward direction transversely of said one dimension, independent means to exert suction on the underside of said conveyor over an area including the projected area of said perforated portion of the head and extending both rearwardly and forwardly of said area, and means to regulate the degree of suction locally so as to increase it in the direction of movement of the conveyor, the capacity for suction being such as to take in substantially more than the amount of air fed to said head, whereby in operation fibers are discharged from the head substantially uniformly in concentration and along said one dimension of the head and felt with controlled impact on the conveyor and on the felt being formed thereon and are thereon firmly held by the passing air stream against movement from the line of deposition thereon.

11. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyor exposed to atmospheric pressure, a substantially horizontal open-topped suction box over which the upper stretch of said conveyor is positioned to move, covering means partially closing the open top of said suction box, said means being variably perforated to vary the capacity locally under said conveyor, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said upper stretch in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a semi-

cylindrical head rounding downwardly as a bottom closure of said housing, said head having its axis perpendicular to said plane and being located in spaced proximity to and above said conveyor over said suction box, parallel vertical side plates extending from said head substantially to said conveyor over the effective side edges of the suction box, an arcuate portion of said bottom head having fiber-dispersing perforations uniformly in the axial direction extending to said side plates, the horizontal projection of the perforated area of said head on said conveyor being comprehended within the area of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyor when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

12. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyor exposed to atmospheric pressure, a substantially horizontal open-topped suction box over which the upper stretch of said conveyor is positioned to move, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said upper stretch in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a semi-cylindrical head rounding downwardly as a bottom closure of said housing, said head having its axis perpendicular to said plane and being located in spaced proximity to and above said conveyor over said suction box, parallel vertical side plates extending from said head substantially to said conveyor over the effective side edges of the suction box, an arcuate portion of said bottom head having fiber-dispersing perforations uniformly in the axial direction extending to said side plates, the horizontal projection of the perforated area of said head on said conveyor being comprehended within the area of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyor when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

13. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyor exposed to atmospheric pressure, a stationary open-topped suction box positioned to act on the underside of said conveyor, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said conveyor in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a semi-cylindrical head rounding downwardly as a bottom closure of said housing, said

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head having its axis perpendicular to said plane and being located in spaced proximity to and above said conveyer over said suction box, parallel vertical side plates extending from said head substantially to said conveyer over the effective side edges of the suction box, an arcuate portion of said bottom head having fiber-dispersing perforations uniformly in the axial direction extending to said plates, the horizontal projection of the perforated area of said head on said conveyer being comprehended within the horizontal projection of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyer when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

14. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyer exposed to atmospheric pressure, a substantially horizontal open-topped suction box over which the upper stretch of said conveyer is positioned to move, covering means partially closing the open top of said suction box, said means being variably perforated to vary the capacity locally under said conveyer, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said upper stretch in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a semi-cylindrical head rounding downwardly as a bottom closure of said housing, said head having its axis perpendicular to said plane and being located in spaced proximity to and above said conveyer over said suction box, an arcuate portion of said bottom head having fiber-dispersing perforations uniformly in the axial direction, the horizontal projection of the perforated area of said head on said conveyer being comprehended within the area of the opening of the suction box, and fiber agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyer when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

15. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyer exposed to atmospheric pressure, a substantially horizontal open-topped suction box over which the upper stretch of said conveyer is positioned to move, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said upper stretch in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a semi-cylindrical head rounding downwardly as a bottom closure of said housing, said head having its axis perpendicular to said plane and being located in spaced proximity to and above said conveyer over said suction

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box, an arcuate portion of said bottom head having fiber-dispersing perforations uniformly in the axial direction, the horizontal projection of the perforated area of said head on said conveyer being comprehended within the area of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyer when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

16. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyer exposed to atmospheric pressure, a substantially horizontal open-topped suction box over which the upper stretch of said conveyer is positioned to move, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said upper stretch in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a perforated head closing the lower end of said housing located in spaced proximity to and above said conveyer over said suction box, at least an arcuate portion of said head having fiber-delivering perforations arranged uniformly in the direction perpendicular to said plane, the horizontal projection of the perforated area of said head on said conveyer being comprehended within the area of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyer when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

17. Apparatus for felting comprising in combination a continuously movable endless foraminous conveyer exposed to atmospheric pressure, a stationary open-topped suction box positioned to act on the underside of said conveyer, a blower having its intake connected to said suction box and its exhaust connected to a region at atmospheric pressure, a second blower having its intake connected to a region at atmospheric pressure, a conduit connected to the outlet of said second blower and arranged at its terminal end to discharge substantially vertically downwardly, said conduit lying in a vertical plane located so as substantially to bisect the depositing region of said conveyer in the direction of its movement, a generally downwardly directed rectangular expansion housing flaring downwardly in both cross-sectional dimensions connected to and extending from said conduit, said housing having horizontal rectangular cross-sections symmetrically bisected by said plane, a perforated head closing the lower end of said housing located in spaced proximity to and above said conveyer over said suction box, at least a portion of said head having fiber-dispersing perforations arranged uniformly in the direction perpendicular to said plane, the horizontal projection of the perforated area of said head on said conveyer being comprehended within the horizontal projection of the opening of the suction box, and fiber-agitating means in the head, said head being exposed to the atmosphere whereby independent operation of the two blowers provides a stream of air and suspended fibers crossing the space between said head and said suction box for felting fibers on said conveyer

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when feeding fibers to the intake of said second blower in quantity to maintain a supply for agitation in said head.

18. Apparatus for dispersing fibers for felting comprising a conduit for carrying a stream of air having entrained fibers therein, an elongated expansion chamber flaring in all its cross-sectional dimensions connected at its small end to and extending said conduit, said chamber flaring symmetrically with respect to a fixed plane from its small end to a rectangular opening bisected by said plane, means having a semi-cylindrical shell of a coinciding rectangular opening as its diametrical plane closing the open-end of said chamber and extending outwardly therefrom with the axis of the cylinder perpendicular to said fixed plane, an arcuate portion of said shell between two geometrical elements thereof being perforated symmetrically with respect to said fixed plane for the dispersion of fibers therethrough, and a coaxial squirrel-cage rotor within said shell having elemental bars thereon in close proximity to the interior of said shell.

19. A continuous felting process comprising essentially continuously suspending fibers at a substantially constant rate in a constant moving stream of air in a directing conduit, discharging said stream from said conduit vertically downward in a linear direction and expanding said stream horizontally in all directions within confining walls to lower the velocity, imposing in the path of said expanded stream a perforated obstacle having less open area than the cross-section of the expanded stream, which obstacle passes the air and opposes free passage of the fibers, forming and maintaining over said obstacle a gravitated supply of fibers at an increased concentration, mechanically agitating said supply at a level below the top of said supply and simultaneously mechanically sweeping individualized fibers through the perforations of said obstacle in the air passing through said perforations, whereby to form a multiplicity of jets of air containing individ-

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ualized fibers, and directing said jets toward a continuously moving filtering and conveying means having capacity in operation to pass substantially all the air from said jets while depositing and conveying away the fiber contents of the jets as a felt.

20. In a felting process, the steps of continuously feeding an expanding stream of air and feltable fibers suspended therein in a downward direction and thereby forming and maintaining by gravity a supply of loose feltable fibers over and on a wall having fiber-passing foramens and in a region of air at superatmospheric pressure, mechanically agitating said supply at a level below the top of said supply and simultaneously mechanically sweeping individualized fibers into said foramens and discharging fibers through said foramens by the passage of air through said foramens from the region of said supply, and maintaining lower pressure on the opposite side of said wall, whereby air flows through said supply and through said foramens in said wall and carries fibers therewith.

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