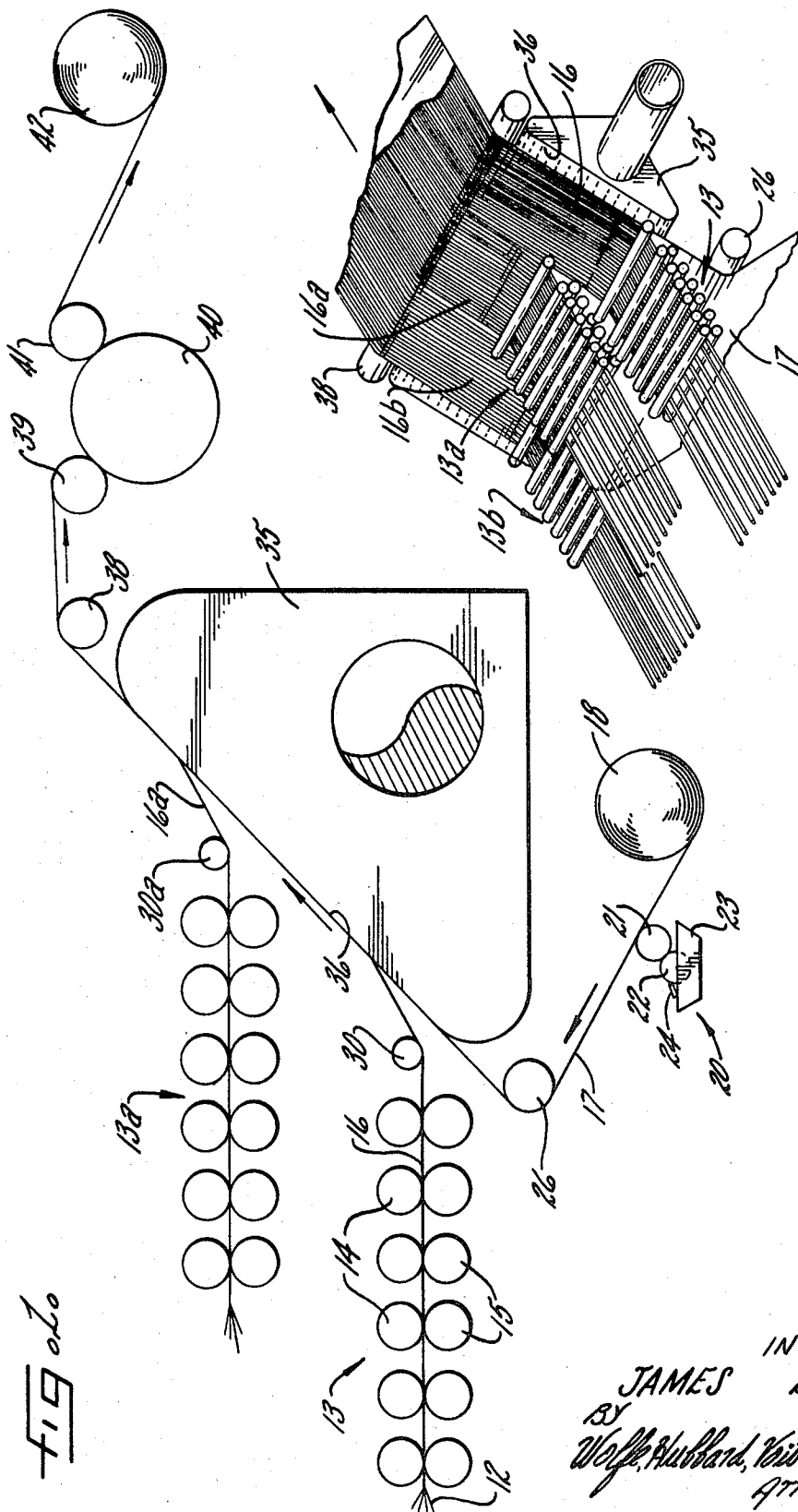


May 11, 1971

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APPARATUS FOR DRAFTING AND DEPOSITING MULTIPLE  
FIBER WEBS ON A CARRIER SHEET  
Filed June 23, 1969

3,578,533



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## APPARATUS FOR DRAFTING AND DEPOSITING MULTIPLE FIBER WEBS ON A CARRIER SHEET

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Filed June 23, 1969, Ser. No. 835,630

Int. Cl. D04h 3/00; B65h 5/04

U.S. Cl. 156—436

5 Claims

### ABSTRACT OF THE DISCLOSURE

An apparatus for forming a non-woven material including a web of highly-drafted fibers and a layer of cellulosic wadding is disclosed. The wadding sheet is printed with a spaced pattern of adhesive and moved along a path disposed to intersect the discharge path of the drawn web. A vacuum is drawn through the wadding sheet opposite the point of fiber impingement to pull the highly-drafted fibers against the sheet and partially embed the fibers in the adhesive. The wadding sheet may be substantially wider than the web of highly-drafted fibers and multiple draw frames are provided with adjacent ones of the draw frames disposed in laterally offset and vertically staggered relation such that adjacent webs are successively deposited on the sheet in substantially abutting side-by-side relation.

### BACKGROUND OF THE INVENTION

It has previously been proposed, for example in Sokolowski Pat. No. 3,327,708 to form a laminated non-woven fabric including a web of highly-drafted fibers adhesively bonded to a carrier sheet of cellulosic wadding by guiding an adhesively printed carrier sheet around a roller closely adjacent the draw frame and moving the sheet away from the draw frame substantially coplanar with its discharge path but at a slightly higher speed in order to maintain the web of highly-drafted fibers under constant tension as it is discharged from the draw frame and deposited on the carrier sheet.

While the drafting and alignment of fibers is readily controllable to provide a highly uniform sheet when making webs of narrow width, mechanical problems multiply disproportionately as widths are increased, largely because dynamic forces generated in wider drafting rolls of relatively small diameter cause the rolls to oscillate, flex, or whip at the high speeds required for economical production.

In the drafting equipment normally used in the process, pairs of aligned top and bottom fluted drafting rolls are arranged to provide light pressure nips through which juxtaposed slivers of staple length synthetic fibers are drawn. These pairs of rolls are geared to rotate at progressively faster speeds so that as the slivers pass from nip to nip, the individual fibers are drafted and stretched out to substantially their full length while being simultaneously aligned in side-by-side parallel arrangement to form a very thin, tenuous web. The drafting rolls are necessarily quite small in diameter because of the short length of the staple synthetic fibers customarily used. In the common staple grades available for synthetic fibers, lengths generally average about  $2\frac{1}{4}$  inches, with a range of about 1–2 inch to about three inches. To handle such fibers satisfactorily, the diameter of the rolls should be between 2 inches and  $2\frac{1}{4}$  inches whereby the span between nips of paired rolls can be about  $2\frac{1}{2}$  inches. Smaller diameters may cause undesirable wrapping and fiber build-up on the roll, while larger diameters do not draft the fibers uniformly because the span between successive nips is excessive with respect to fiber length.

The operation of small diameter rolls are no problem

in narrow draw frames. It has been found however, that as the width of the draw frame is increased in an attempt to provide wider webs more suitable for commercial application, the necessary limitation on diameter of the drafting rolls imposed by the described fiber length limitation, places a corresponding limitation on the length of a roll which can be used. The longer rolls with this imposed diameter limitation are relatively more flexible and as a result the pressure exerted in the nip of a pair of drafting rolls varies transversely from end to end. This lack of uniformity in pressure prevents accurate fiber control in drafting, and as a result creates variances in the thickness, density, and alignment of the issuing fiber web.

Accordingly it is an object of this invention to provide a method and apparatus for producing extra wide non-woven webs from juxtaposed arrays of highly-drafted and aligned fibers.

Another object is to provide an arrangement whereby light-weight webs of highly-drafted and aligned staple length synthetic fibers are kept under tension while being aligned in side-by-side arrangement and embedded in the adhesive of a suitable carrier sheet.

Still another object is to provide an improved arrangement in which light-weight webs of highly-drafted and aligned fibers are preliminarily embedded in the adhesive of a suitable carrier sheet under the influence of a vacuum.

### SUMMARY OF THE INVENTION

The invention comprises an arrangement utilizing at least two separate draw frames to process juxtaposed slivers of staple length synthetic fibers into thin webs of highly-drafted and aligned fibers, and subsequently depositing these webs on an adhesively coated surface of a moving carrier sheet in a manner to preserve the drafted and aligned nature of the fibers. The carrier sheet is inclined upwardly from the horizontal and the sheet is arranged to pass over a vacuum box. A first draw frame is arranged to deposit its web under tension on the upwardly-inclined sheet opposite the vacuum box and the second draw frame is disposed above the first draw frame in laterally offset and vertically staggered relation so that the first and second webs are successively deposited on the carrier sheet in substantially abutting side-by-side relation. The vacuum assists in embedding the fibers in their aligned and highly-drafted condition in the adhesive on the carrier sheet until they are bonded by known means into a composite web.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic side elevation of one arrangement of an apparatus for carrying out the invention; and,

FIG. 2 is a diagrammatic perspective view of this embodiment of the invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the invention, as shown in FIG. 1, multiple slivers 12 of staple length textile fibers are drawn in juxtaposed relationship into a draw frame 13 comprising a series of paired rolls 14 and 15. The rolls of each pair are driven by appropriate gearing, well known in the art, at a peripheral speed slightly faster than the speed of the preceding roll pair to drawn out and align the individual fibers into substantially parallelized arrangement with the fibers extended to their full length. The drawn fibers are discharged from the draw frame 13 in the form of a flat, tenuous web 16.

As the web 16 is discharged from the draw frame 13 it is of such filmy and gossamer-like character that it must be quickly deposited on a supporting carrier sheet 17 in order to maintain the substantially parallelized and

fully extended condition of the fibers. In the particular embodiment here shown and described, the carrier sheet 17 comprises a continuous sheet of light-weight cellulose wadding which eventually becomes an integral part of the finished product. The wadding sheet 17 preferably has been stretched and iron to facial tissue softness by known means to provide a like softness and hand to the finished product. However, for certain products such stretching and ironing may not be necessary or even desirable.

The wadding sheet 17 is drawn from a supply roll 18 and over the surface of an adhesive printer indicated generally at 20. The adhesive printer includes an offset print roll 21 maintained in light pressure engagement with the wadding sheet 17. In this case, the surface of the offset roll 21 is provided with a spaced pattern of adhesive from an intaglio pattern on the surface of a print roll 22 which picks up adhesive from a dip pan 23. Excess adhesive is scraped off the print roll 22 by a doctor blade 24. The adhesive is preferably a low viscosity thermoplastic adhesive which remains substantially on the surface of the wadding sheet 17 in the form of a layer of the spaced pattern selected. The printed sheet 17, bearing adhesive on its surface, is then drawn around guide roll 26 and moves upwardly along a path which intersects the discharge path of the web 16 from the draw frame 13.

The fiber web 16 passes partially around a guide bar 30 disposed between the draw frame 13 and the upwardly inclined sheet 17. From the guide bar 30, the web 16 is deposited directly upon the adhesively printed surface of the wadding sheet 17. As the web 16 is deposited on the shaft 17 it is important to maintain the fibers under tension at all times after drafting. The tension maintains frictional engagement between adjacent fibers so that the fibers are retained in their highly-drafted and aligned form, whereby they remain substantially fully extended and parallel to each other.

In order to insure that tension is maintained in the drafted fiber web 16 during the transfer to the sheet 17, the sheet must, of course, travel at a speed slightly faster than the discharge speed of the web 16 from the draw frame 13. Also the guide bar 30 acts to hold the fibers in the web continuously under tension.

To facilitate the preliminary embedment of the fibers in the adhesive printed on the wadding sheet 17, suction is drawn on the side of the sheet 17 opposite the adhesive. In the illustrated apparatus, the suction is drawn from a suction box 35 which is provided with a perforated surface 36 inclined upwardly and forwardly with respect to the discharge path of the web 16 from the draw frame 13 at an acute angle. It will further be noted that due to the relative movement of the wadding sheet 17 and fiber web 16 the effective angle of disposition of the web on the sheet is quite small. While the angular disposition of the web 16 to the sheet 17 is shown as 15° in the drawings, it will be understood that this angularity may be varied to suit the best running conditions of the apparatus.

From the suction box 35, the combined fiber web 16 and wadding sheet 17 are carried around guide rolls 38 and 39 and into prolonged contact with a heated drum 40. The heat fuses and cures the adhesive to a substantially non-tacky condition while the fibers are in firm contact with the drum surface. To provide this curing effect, travel around a substantial portion of drum 40 as in the manner shown is desirable. The laminated web with the fibers partially embedded in the adhesive then passes under a pressure roll, or calender roll 41, which presses the fiber layer more firmly into the adhesive to assure permanent attachment. The laminated web is subsequently wound up in a take-up roll 42.

As previously noted the width of the highly-drafted fiber web 16 is limited due to mechanical considerations in the draw frame 13. The wadding sheet 17, however, may be substantially wider than the web of highly-drafted fibers.

Accordingly, in keeping with the present invention, a second draw frame 13a is provided in laterally offset and vertically staggered relation relative to the first draw frame 13 such that a second web 16a of highly-drafted fibers is successively deposited on the carrier sheet 17 in substantially abutting side-by-side relation with the first web 16. The operation of the second draw frame 13a is similar to that of the first draw frame. After discharge from the draw frame 13a, the highly-drafted fiber web 16a passes under depression rod 30a and is deposited on the upwardly inclined surface of the carrier sheet 17 opposite the vacuum box. As shown in FIG. 2, the second draw frame 13a, in addition to being located above first draw frame 13, is laterally offset so that the near edge of web 16a meets the far edge of the web 16 after being deposited on the sheet 17.

In addition to draw frames 13 and 13a, a third draw frame 13b, is shown in FIG. 2. Draw frame 13b has the usual upper and lower drafting rolls and a depression bar 30b. Web 16b leaving draw frame 13b is kept under tension and angularly disposed with respect to sheet 17 in the same manner as web 16a. As shown, the third draw frame 13b is offset to the far side of the first frame 13 so that the near edge of web 16b meets the far edge of web 16a. This arrangement is used when webs wider than can be produced with two draw frames are required. The resulting product comprises a single wide web made up of separately deposited webs 16, 16a and 16b reading from right to left. It will readily be seen that additional draw frames may be added alternately at the bottom and top so that a still wider web of almost indefinite width may be fabricated.

In adjusting the apparatus care should be taken to see that the depression rod 30a cooperating with the upper draw frame 13a is disposed sufficiently high above the previously deposited drawn web 16 so that it does not touch the previously deposited web or interfere with its fiber alignment. The speed of the carrier sheet 17 should be regulated so that it exerts enough tension on the drafted webs to maintain smooth alignment of the fibers. If the speed is excessive, the fiber-to-fiber tenacity will be destroyed and the fibers will pull apart in uncontrolled, non-uniform sections.

In the foregoing description the adhesively printed carrier sheet 17 becomes part of the final laminated web. However, this may not always be necessary or desirable. Thus, the sheet 17 could be replaced with a release coated carrier belt. When such a belt is treated with a release agent and used merely as a carrier for the adhesive, the bonded fiber web is subsequently stripped from the belt and the finished web comprises only the adhesive binder and fibers. It is to be understood, of course, that prior to passing around roll the belt has printed on its release coated surface a pattern of adhesive to which the fibers of the webs 16, 16a and 16b adhere as they are deposited.

While various well-known adhesives may be employed in the process, advantages reside in the use of plastisols, which, as is well known, comprise colloidal dispersions of synthetic resins in a suitable organic ester plasticizer, and which, under the influence of heat, provide good binding power while remaining soft and flexible. While many adhesives of this type are known, those found particularly useful for incorporation in the product of this invention include vinyl chloride polymers, and copolymers of vinyl chloride with other vinyl resins, plasticized by organic phthalates, sebacates, adipates, or phosphates. These provide a fast curing plastisol adhesive characterized by relatively low viscosity, low migration tendencies, and minimum volatility. Such adhesives remain soft and flexible after curing, can be reactivated by the application of heat and pressure, such as by hot-calendering for the aforesaid lamination purposes, and insure that the resultant product retains a desirable softness and proper hand and feel.

Although plastisols are preferred, polyvinyl resins per se, plasticized or unplasticized may also be used. Other

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flexible adhesives, which may be employed, although generally less desirable, include materials such as acrylic resins like the alkyl acrylates and butadiene resins such as buna-S and buna-N.

It is preferred that the adhesive pattern be substantially open with large adhesive free areas; and, if flexibility is desired, that the total area occupied by the adhesive comprise not more than 25% of the total area of the original fiber-wadding laminate. Thus, the preferred adhesive pattern may comprise a spaced brick or an open diamond arrangement. However, other well-known patterns may also be employed, such as spaced continuous parallel lines, spaced circles, dots, V's, herringbones, etc. No matter what adhesive arrangement is chosen, care should be taken to assure that the adhesive-free area between adjoining adhesive patterns be less in the longitudinal direction of the fibers than the average length of the individual fibers, in order that the integrity of the web is maintained.

The fibers used in the process may comprise most of the staple length fibers employed in textiles. These include both natural and synthetic fibers such as cotton, viscose or acetate rayon, nylon, polyesters, acrylonitriles, polyolefins, and the like. When synthetic fibers are used, a denier range of 0.5 to 3 is preferred. However, coarser denier may be used. It is also preferred that the fibers be of staple length, or in the range of 1/2 to about 3 inches or longer, with the majority of fibers being at least one inch in length. For most purposes, the drafted web should be as light weight as possible commensurate with handleability on the drawing frame.

It will be apparent to those skilled in the art that many variations from the examples given may be employed without departing from the spirit of this invention. For example, the weight and fiber type of the starting slivers may be varied to provide a drawn web of varying characteristics throughout its width. Similarly, various mixtures of thermoplastic and non-thermoplastic fibers may be used. Other suitable changes, modifications, and variations may also be made without departing from the scope of the invention.

I claim as my invention:

1. An apparatus for forming a non-woven material including a web of highly-drafted fibers comprising, in combination:

a first draw frame having a series of progressively more rapidly rotating drafting roll pairs for drafting multiple slivers of fibers into a light-weight fiber web;

a carrier sheet and means for printing adhesive on the surface of the sheet, said carrier sheet being substantially wider than said web of highly-drafted fibers;

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a second draw frame for forming another light-weight fiber web;

means for moving said sheet at a speed greater than the discharge speed of said webs from said draw frames and along an upwardly inclined path disposed to intersect the discharge paths of said webs from said draw frames;

said first and second draw frames disposed in laterally offset and vertically staggered relation such that said first and second webs are successively deposited on said carrier sheet in substantially abutting side-by-side relation; and,

means located adjacent said upwardly inclined sheet path for drawing a vacuum through said sheet on the side thereof opposite said draw frames to pull said webs of highly-drafted fibers against said sheet and partially embed the fibers thereof in said adhesive.

2. An apparatus as defined in claim 1 including one or more additional draw frames for forming additional tenuous webs of highly-drafted fibers, adjacent ones of said draw frames disposed in laterally offset and vertically staggered relation such that said webs are successively deposited on said carrier sheet in substantially abutting side-by-side relation.

3. An apparatus as defined in claim 2 including an odd number of draw frames with all of the odd numbered draw frames located on one vertical level and all of the even numbered draw frames located on a different vertical level.

4. An apparatus as defined in claim 2 including an even number of draw frames with all of the even numbered draw frames located on one vertical level and all of the odd numbered draw frames located on a different vertical level.

5. An apparatus as defined in claim 1 wherein said carrier sheet comprises at least one ply of cellulosic wadding on which said adhesive is printed and said apparatus includes heated calender means for further embedding the fibers of said highly-drafted web in said adhesive and for curing said adhesive.

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