April 27, 1954 C. H. PLUMMER ET AL 2,676,364

METHOD AND APPARATUS FOR MAKING FABRICS

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Fig. 1.

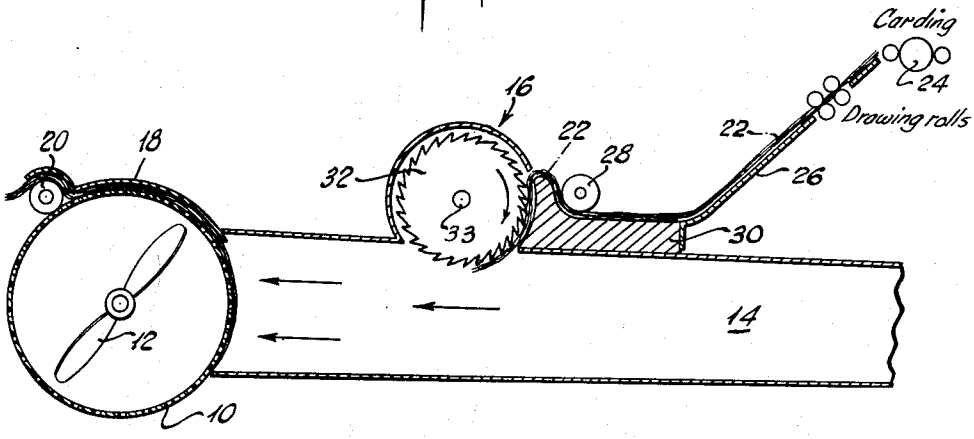
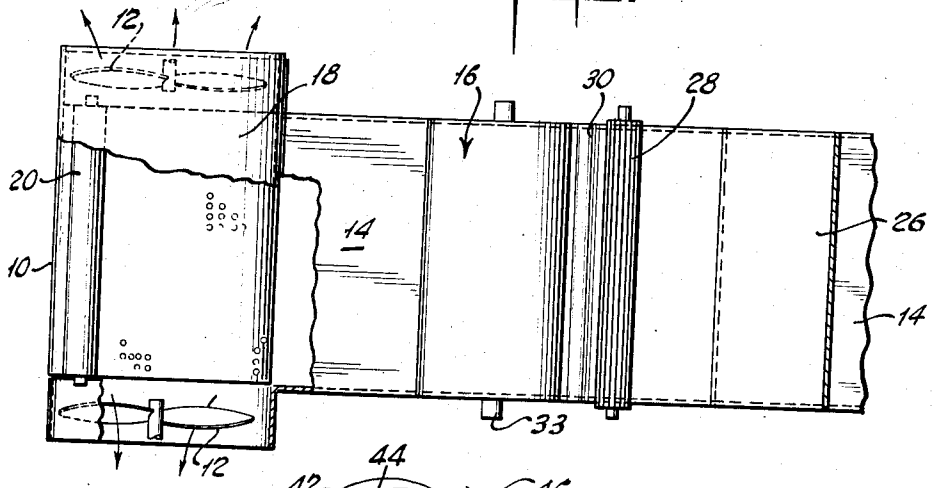


Fig. 2.



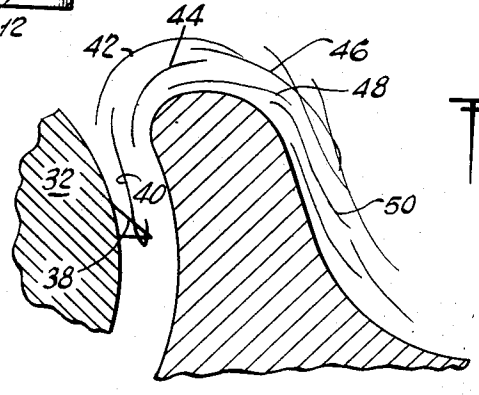


Fig. 3.

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METHOD AND APPARATUS FOR MAKING FABRICS

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7 Claims. (Cl. 19—156)

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This invention relates to apparatus and methods for making non-woven fabric or cloth from various fibers.

Many people have long tried to make cloth without either spinning or weaving the fibers. This has usually been attempted by laying down a thin layer of fibers (cotton or rayon staple for example) and binding or cementing the fibers together to form a sheet. The fibers have usually been laid down by carding, which aligns the majority of the fibers lengthwise of the cloth, leaving few fibers in the cross direction, and so forms a fabric having inadequate cross strength. It has also been proposed to suspend fibers in an air stream, then filter the fibers out on a screen to form a layer in which the fibers are arranged at random and thus to provide, after binding, a fabric which is more or less isotropic which means, as used here, having the same properties in all directions in the plane of the sheet. Such an isotropic fabric theoretically has equal tensile strength or breaking strength lengthwise and crosswise. While this theoretical method of manufacture has been proposed, and while as heretofore proposed it might be used to make thick bats or laps, no one previous to this invention, as far as is known, has devised a method or apparatus which successfully produces uniform thin fabrics, nor has anyone made practical isotropic fabrics at commercially practical costs or rates of production.

The inherent difficulties of making such fabrics are especially marked in attempting to make uniform fabrics from the textile fibers, by which we mean fibers long enough to be spun and woven into cloth. And with the textile fibers the difficulty increases as the fiber length increases, so that with long fibers, such as ⅝ inch and longer, it has been commercially impossible to make a uniform fabric. Further, the difficulty increases as the thickness of the attempted fabric decreases. For many purposes, especially in thin fabrics, it is desirable to use long fibers because they increase the strength of the fabric.

One of the objects of the invention is to provide improved methods and improved apparatus for making a highly uniform substantially isotropic web from a wide variety of fibers and in a wide range of thickness. It is especially an object of the invention to make very thin webs, for example of the order of 100 grains per square yard, and to make such webs of long staple fibers, ¾ inch and longer, in order to provide adequate strength and durability and desirable hand. Another object is to provide a simple and inexpensive machine which can be operated at high rates of production and produce such webs inexpensively.

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Other objects and advantages of the invention will be evident in the following description and in the accompanying drawings. In the drawings:

Fig. 1 is a diagrammatic vertical section of one form of apparatus for carrying out the invention;

Fig. 2 is a diagrammatic plan of the apparatus shown in Fig. 1, part being removed; and

Fig. 3 is an enlarged diagrammatic vertical section of a portion of the fiber feeding and separating mechanism of Fig. 1, illustrating the fiber separating operation.

In forming a fabric in accordance with our invention it is important to separate the fibers completely from one another and to free them into the air stream as individual fibers, in order to avoid depositing clumps of fibers in the fabric which would provide lumps and thick spots. Also it is important to separate the fibers from each other without breaking appreciable numbers of them, in order to produce a fabric composed essentially of long fibers. Our invention accomplishes both of these objectives to a high degree by a simple process and by inexpensive apparatus.

One suitable form of apparatus may include a rotating pervious drum or screen **10** through which air may be drawn at a constant rate by one or more blowers **12**. Air is supplied to the screen by any suitable conduit **14** into which fibers are fed.

Fibers, supplied by the fiber feeding device denoted generally by **16**, arrange themselves in random directions in the air stream as they are carried between the fiber feeding device and the screen **10**. The screen filters out the fibers to form a layer **18** which may be removed from the screen by any suitable device, such as the doffing roll **20**. The layer or web can then be processed in any suitable manner to form the desired fabric which will then contain fibers arranged in all directions in the plane of the web, and overlapping to form an isotropic sheet.

In practicing our invention we first form a feed lap **22** in which the fibers are, as far as is practicable, aligned in the direction of the length of the web and have a minimum of crosswise entanglement. This may be done in various ways. For example, one or more fiber aligning devices **24**; which conveniently may be cards, may deliver a card web or a pile of superposed card webs to a conveyor chute **26** which leads to

the fiber feeding device. Alternatively, especially where a thick lap is wanted, the lap may consist of a number of card slivers placed side by side. A card aligns most of the fibers in one direction and produces a web (which may be formed into a sliver) in which the fibers are what we term predominantly aligned. More fibers can be aligned by subsequent drawing operations, and a lap, formed either as card web or as slivers can have substantially all its fibers aligned in the direction of the length of the web, substantially no crosswise entanglement. Alignment and low crosswise entanglement is important in subsequent separation of the fibers without breakage and in feeding them uniformly in the air stream.

The predominantly or completely aligned lap 22 is fed by any suitable known feed roll 28 and nose plate 30 to a combing cylinder 32 which may conveniently be the conventional lickerin cylinder of a card, driven by any suitable means herein diagrammatically represented by shaft 33. This consists essentially of a cylinder which has projected a large number of teeth closely spaced and distributed more or less uniformly over the surface. This is usually formed by winding a saw-toothed strip, called a lickerin wire, continuously in a spiral groove covering the surface of the roll.

The combing roll is driven in any suitable manner and at any suitable constant speed which will remove fibers individually from the feed lap. The feed roll advances the fibers endwise into the path of the teeth. The teeth rake or comb the fibers out of the web 22 and feed them into the air stream. This may be accomplished by rotating the cylinder at such speed (for example 1200 to 5000 R. P. M. for an eight inch diameter) that the fibers are doffed by centrifugal force as soon as they are free of the beard formed by the advancing web 22 and are free of the nose plate.

Feeding the fibers endwise and substantially free of entanglement to the combing roll has the advantage that the individual fibers are combed out of the feed lap without breaking them, and without dragging other fibers with them in groups or clumps. This promotes an extraordinarily high degree of fiber separation, and preserves the long fibers. In previous attempts to feed fibers from unorganized masses such as picker laps, the fibers have been so entangled that they were broken, or removed in clumps, or both. Clumps destroy the uniformity of the fabric being made, and breaking of the fibers into short lengths produces a weak fabric. Likewise the feeding of aligned fibers increases the uniformity of deposition of fibers in the air stream and therefore it increases the uniformity of the final fabric.

Fig. 3 shows what we believe to be the action of the combing device. Individual fibers 40 to 50 are held together in alignment by the pressure of the feed roll 28 against the plate 30 and by friction between individual fibers. As the fibers advance toward the lickerin, an individual tooth 36 hooks an individual fiber 40 and pulls it from the group of fibers. But while the fiber 40 is being pulled by the tooth, it is held back and straightened out by the friction of its neighboring fibers such as 42 and 44. This results in separating the single fiber 40 from its fellows and ultimately freeing this single fiber into the air stream. An instant later the fiber 44 is advanced into the path of another tooth and this separates the fiber 44 in like manner and deposits it in the air stream. This process is multiplied over the entire length of the cylinder and repeated indefinitely.

It will be understood that the lickerin usually rotates at high speed, which is constant for any particular lap or kind of fibers. The fans draw air predominantly in the direction of the axis of the conduit (disregarding local eddies and turbulence) at a constant rate and preferably at high speed through the conduit and through the screen. Preferably the air speed at the lickerin is equal to or greater than the lineal speed of the lickerin teeth to assist in doffing the fibers. Where the speed of the air and teeth are equal the teeth can throw off the fibers, in effect into still air, there being no air drag to bend the fibers back across the teeth, which would increase the friction between the fiber and the tooth as the fiber tends to slide off the tooth under the action of the centrifugal force. This is particularly important if all the teeth are not perfectly smooth and polished.

With some forms of teeth it is preferable to have the air velocity much higher than the peripheral speed of the combing roll, in order that the air may positively remove the fibers from the teeth by blowing them ahead of the teeth before the fibers can be carried around the roll out of the air stream. This prevents clogging of the combing roll with fibers.

It is important to have the teeth perfectly clean of fibers after they have passed through the air conduit and are approaching the nose plate. Otherwise fibers would accumulate on the teeth and as the teeth became clogged they would comb less and less fibers into the air stream, which would result in immediate thin spots in the fabric, followed by thick spots or clumps as accumulated fibers are periodically discharged from the lickerin cylinder. The feed roll 28 is rotated at a very slow speed which may be of the order of 25 to 150 R. P. M. for a 2½ inch diameter roll. This rate is constant for any given condition of operation, but is changed to determine the rate of fiber feed which determines the thickness of the final fabric.

We claim as our invention:

1. The method of making a substantially isotropic web of textile fibers arranged at random which comprises forming a layer of fibers predominantly aligned in one direction, progressively removing individual fibers from the aligned layer, freeing the fibers in an air stream, moving the air and the fibers predominantly in one direction, stopping movement of the fibers while continuing the movement of the air in its predominant direction to place the fibers at random in a layer transverse to the predominant movement of the air, and continuously removing the random layer from the air stream.

2. The method of making a substantially isotropic web of relatively long textile fibers arranged at random which comprises forming a layer of fibers predominantly aligned in one direction, progressively removing individual fibers substantially intact from the aligned layer, freeing the fibers in an air stream, moving the air and the fibers predominantly in one direction, stopping movement of the fibers while continuing the movement of the air in its predominant direction to place the fibers at random in a layer transverse to the predominant movement of the air and continuously removing the random layer from the air stream.

3. The method of making a substantially iso-

tropic web of relatively long textile fibers arranged at random which comprises forming a layer of fibers predominantly aligned in one direction, continuously moving the layer in the direction of predominant fiber alignment, progressively removing individual fibers substantially intact from the aligned layer, freeing the fibers in an air stream, moving the air and the fibers predominantly in one direction, stopping movement of the fibers while continuing the movement of the air in its predominant direction to place the fibers at random in a layer transverse to the predominant movement of the air and continuously removing the random layer from the air stream.

4. The method of making a substantially isotropic web of textile fibers arranged at random which comprises forming a layer of fibers predominantly aligned in one direction, progressively removing individual fibers from the aligned layer, freeing the fibers in an air stream, moving the air and the fibers predominantly in one direction, stopping movement of the fibers while continuing the movement of the air in its predominant direction to place the fibers at random in a layer transverse to the predominant movement of the air and continuously removing the random layer from the air stream in a direction transverse to the predominant direction of movement of the air.

5. Apparatus for making webs comprising in combination means for forming a continuous layer of fibers predominantly aligned in one direction, means for continuously advancing the layer in the direction of predominant fiber alignment, a conduit, means for flowing air through the conduit, means for progressively separating individual fibers from the advancing edge of the layer and for depositing the fibers in the air stream, and means for separating the fibers from the air stream,

6. Apparatus for making webs comprising in

combination means for forming a continuous layer of fibers predominantly aligned in one direction, means for continuously advancing the layer in the direction of predominant fiber alignment, a conduit, rotary means for progressively separating individual fibers from the advancing edge of the layer and for depositing the fibers in the conduit, means for rotating the separating means at a peripheral speed sufficient to doff the fibers by centrifugal force, means for flowing air through the conduit at a speed not less than the peripheral speed of the separating means and means for separating the fibers from the air stream.

7. The method of forming a substantially isotropic web of relatively long textile fibers which comprises arranging the fibers in alignment in a layer, progressively pulling individual fibers from an edge of the layer by drawing the fibers in the direction of alignment while yieldingly opposing movement of the fibers in response to such drawing, depositing the fibers in an air stream and filtering the fibers out of the air stream in a layer.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,401,439	Pettit	Dec. 27, 1921
1,461,562	Rooney	July 10, 1923
1,574,344	Garner	Feb. 23, 1926
1,827,183	Bennett	Oct. 13, 1931
2,014,844	Holt	Sept. 17, 1935
2,420,033	Fairbairn	May 6, 1947
2,451,915	Buresh	Oct. 19, 1948
2,477,675	Wilson et al.	Aug. 2, 1949

FOREIGN PATENTS

Number	Country	Date
9,891	Great Britain	of 1843
372,624	Germany	Mar. 31, 1923