Sept. 26, 1961 R. D. HEFFELFINGER 3,001,242

FIBROUS WEB MANUFACTURE

Filed May 3, 1956

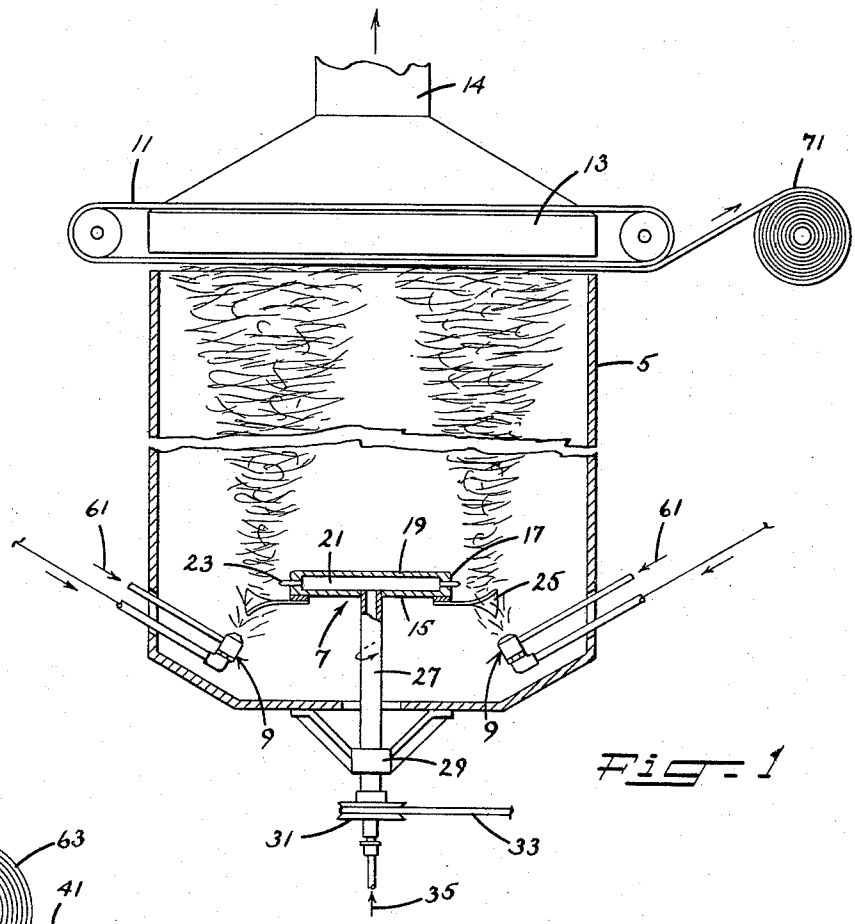


Fig. 1

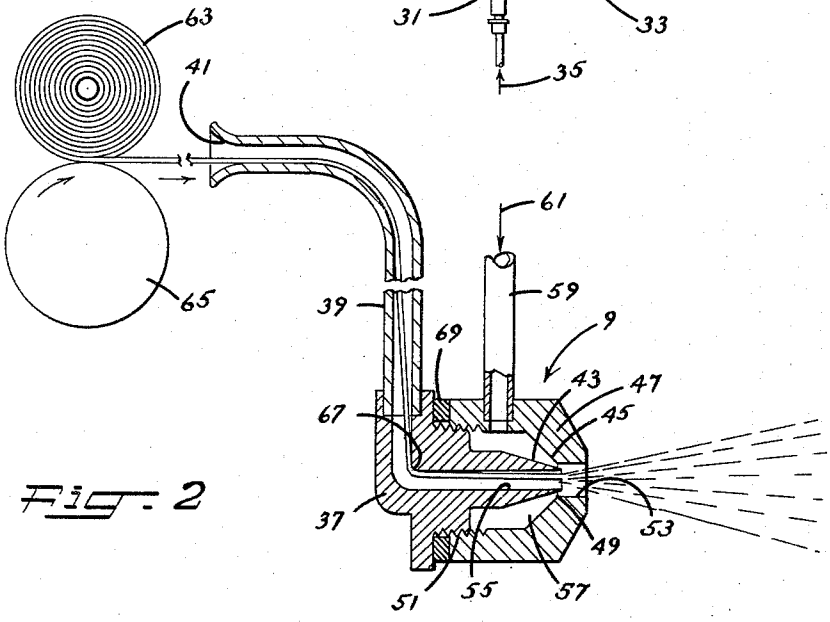


Fig. 2

United States Patent Office 3,001,242 Patented Sept. 26, 1961

3,001,242

FIBROUS WEB MANUFACTURE

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Filed May 3, 1956, Ser. No. 582,557
1 Claim. (Cl. 19—146)

The invention relates to the production of fibrous webs, and particularly to a method for manufacturing webs having intermingled preformed fibers and fibers formed in situ of flowable organic plastic compositions.

In a pending application, Method for Producing Filters, of Derek E. Till and Worth Wade, Serial No. 501,933, filed April 18, 1955, there is described a method of forming filters by combining preformed fibers, such as textile fibers, with other fibers formed in situ. The textile or preformed fibers are introduced as a loose mass by a blower, or are cut from a continuous tow or strand and dispersed into an air stream which separates and delivers the same into the desired area. The fibers formed in situ are obtained by feeding a plastic fiber-forming material through a spraying unit which is positioned within a high velocity air stream. As more fully described in said above mentioned application, the fibers from both sources are deposited in a random arrangement and in an intermingled relationship to provide a fibrous filter, the filtration properties may be varied by controlling the degree fiber intermingling or overlapping.

In the above mentioned procedure, advantages result by exercising greater control over the preformed materials so as to deliver the same as a uniform dispersion or airborne cloud of individual fibers which could be uniformly mixed with the fibers formed in situ. Accordingly, it is an object of this invention to provide a generally new or improved and more satisfactory fiber delivery method.

Another object is the provision of a method for producing fibrous webs from fibers formed in situ, and preformed fibers which are plucked or pulled out from a continuous strand and delivered into a desired area as a cloud or uniformly dispersed mass by a gas stream.

Still another object is the provision of a method for continuously delivering and vibrating a textile strand to loosen and pluck the individual fibers from the strand and disperse the same as a uniform cloud.

These and other objects and advantages of the invention will be apparent from the following description and accompanying drawing in which:

FIGURE 1 is a diagrammatic elevation, partly in section, illustrating one form of apparatus utilizing the teachings of the present invention for producing continuous fibrous webs; and

FIGURE 2 is a vertical section, on an enlarged scale, of the aspirator device shown in FIGURE 1.

In general, the invention relates to the production of fibrous webs by combining in random and intermingled relationship fibers formed in situ and preformed fibers pulled or plucked from a continuous yarn bundle or strand and delivered uniformly as a cloud. The in situ fibers are formed by any suitable method and apparatus and preferably in accordance with the teachings set forth in the above noted pending application, while the preformed fibers are loosened and separated from the continuous strand and uniformly dispersed by an aspirator which subjects the strand to a turbulent and vibrating high velocity gas stream.

With reference to the drawing, the apparatus employed in the practice of the method of the present invention includes a chamber or tower 5 having a fiber forming means 7 and a plurality of aspirator units 9 at one end and, at its opposite end, an endless screen 11 upon which the dispersed fibers are collected in random and intermingled relationship as hereinafter explained. A suction chest or box 13, connected through a duct 14 to a suitable exhaust source (not shown), facilitates the removal of the gas or air from the chamber 5 and assists in depositing the fibers upon the screen 11 in their random and intermingled arrangement.

The fiber forming means 7 includes a circular disc 15 having an upwardly-extending, integral rim or flange 17. A cover plate 19 is secured to the flange 17 to provide a closed chamber 21 into which a flowable organic plastic composition is fed. A plurality of spaced, radially extending spray nozzles 23 are mounted on the periphery of the rim 17 and communicate with the chamber 21. An impeller comprising a plurality of gas-moving vanes 25 is secured to the lower side of the disc 15. A tubular shaft 27 is connected to the disc 15 and is supported by bearing 29 for rotary movement applied thereto by any suitable source, such as by a belt and pulley shown at 31 and 33, respectively. In addition to rotating the disc 15 within the chamber 5, the shaft 27 communicates with the chamber 21 and provides a passage through which the fiber-forming liquid is delivered from a suitable source (not shown), as indicated by an arrow 35 in FIGURE 1.

The means for delivering the preformed fibers into the chamber 5 comprises a plurality of aspirator units 9, preferably located to the rear or below and slightly outwardly of the periphery of the impeller 25, as shown in FIGURE 1. While two aspirator units 9 have been illustrated, it is of course obvious that the number can be varied as desired. Each of the aspirator units, as best seen in FIGURE 2, includes an angulated suction tube 37 which is releasably connected, at one end, to a strand or bundle delivery or feed duct 39 having an enlarged or bell-shaped entrance 41. The opposite end of the suction tube 37 is inclined or tapered at 43 and cooperates with an inclined or tapered surface 45 of the housing 47 to form an annular convergent or restricted orifice or nozzle 49. The housing 47 is secured to the suction tube 37, preferably by means of cooperating threads, shown at 51, which permit relative movement between these parts and thus enable the size of the nozzle 49 to be varied. A central annular opening 53 passes through the housing 47 and is in alignment with a central passage 55 of the suction tube 37. This housing opening 53 constitutes a discharge tube within which the strand is subjected to a turbulent high velocity gas stream to effect fiber loosening and separation as more fully explained hereinafter. If desired, the nozzle 49 and discharge tube 53 may be rifled or baffles may be placed in the nozzle to obtain added gas turbulence or to cause the gas to travel a spiral path. The annular area between the suction tube 37 and housing 47 serves as an air or gas chamber 57 into which compressed gas is delivered from a suitable source (not shown) by a conduit 59, as shown by arrows 61.

The compressed gas, issuing through the nozzle 49, undergoes a rapid expansion upon entry into the discharge tube 53 and is moving at a high velocity. As a result, a vacuum is induced at the discharge end of the suction tube 37, which in turn produces an inrushing flow of gas or air through the entrance 41 of the duct 39. The combined action of the induced vacuum and the inrushing gas is relied upon for supporting and conveying the strand within and through the duct 39 and suction tube 37, and in effect the aspirator unit is considered to be self-lacing. In view of the low mechanical strength of the yarn bundle or strand, the force of the inrushing gas and vacuum is not relied upon for feeding the strand to the duct 39, and instead the yarn is mechanically unrolled from its supply 63 by surface driving means 65, which may be of any suitable and conventional construction.

In addition to effecting strand delivery through the duct

39 and tube 37, the expanding high velocity gas in the discharge tube 53 impinges against the fibers and creates a turbulent gas flow which tends to vibrate and loosen the fibers in the yarn bundle. To enable these loosened fibers to be removed from the yarn bundle or strand and be dispersed into the chamber 5 as a uniform cloud, the strand is subjected to a retarding or frictional force within the suction tube 37 so that the high velocity expanding gas leaving the discharge tube 53 reacts against the individual fibers at the leading end of the strand and pulls or plucks the same therefrom. As shown in FIGURE 2, this frictional force is created as the strand moves against the edge 67 when its direction of travel is altered as a result of the relatively sharp bend of the suction tube itself. The bend of the suction tube should be as sharp as practical, with a right angle bend, as shown in FIGURE 2, being satisfactory to properly regulate the pulling or plucking of the fibers from the yarn bundle.

In addition to the above described structural aspects of the suction tube 37, the central passage 55 is preferably of uniform cross-section, with particular care being exercised to avoid an enlarged or bell-mouthed opening in the area of the bend or edge 67 which would permit an expansion of the inrushing air. Further, the length of suction tube 37 between its bend and its discharge end should be slightly less than the staple length employed in the yarn bundle. With this construction, the high velocity gas stream in the area of the nozzle 49 and discharge opening 53 at all times reacts against the ends of those fibers which have moved beyond the suction tube bend and thus are not subjected to any retarding or frictional forces and can be more easily pulled or plucked from the yarn bundle. The releasable connections of the suction tube 37 and housing 47 enable the suction tube to be easily replaced as the yarn bundle staple length is varied.

In preparing for operation, the housing 47 of each aspirator unit is first adjusted relative to the end of the suction tube 37 to provide the desired restricted orifice 49. For ease of adjustment, a spacer 69 of selected thickness is merely placed between the angulated portion of the suction tube 37 and the terminal portion of the housing 47 (see FIGURE 2) so as to obstruct advancing movement of the housing once the desired nozzle opening 49 has been attained. The apparatus is then assembled as shown in FIGURE 1, with the strand supply packages being located as close as possible to entrance 41 of the feed ducts 39.

In operation, a rotary movement is imparted to the shaft 27 and the flowable spinning liquid is supplied, under pressure, to the chamber 21 and extruded through the spray nozzles 23 by both the supply pressure and the centrifugal force created by the rotating disc. As the fiber-forming liquid leaves the nozzles, it is subjected to both the static extrusion pressure exerted in a radial direction and a tangential force. The directions of these forces, which are at right angles to each other, are continuously changing with the rotation of the disc. These forces are believed to effect at least a portion of the attenuation of the plastic stream. The outermost end of the plastic or fiber is in the air and the extruded plastic which is just emerging from the extrusion orifice is moving in a circular path with the extrusion orifice. The friction between the end of the fiber and the air is believed to cause a drag which may account for a part of the attenuation of the plastic stream. The air flow created by the impeller also subjects the fiber to a force which is at an angle to the plane of the extrusion and the tangential forces. As the free end of the fiber is blown upwardly, a further drag is probably created with respect to the movement of the nozzle. The combined forces and the frictional drag cause the attenuation and stretching of the fiber and the breaking of the attenuated plastic to form discontinuous fibers. During this period, the major portion of the solvent becomes volatilized to establish the size of the fibers.

Concomitantly with the above described spinning of the fibers in situ, a yarn bundle or strand is being delivered into each of the aspirator units 9 where they are subjected to the vibratory forces of the high velocity gas issuing from the nozzle 49. As heretofore described, the fibers are pulled or plucked from the yarn bundle by the expanding gas and carried upwardly toward the endless screen 11 where they are collected in a random and intermingled relationship with the fibers formed by the spin disc. The collected fibers thus form a continuous fibrous web having a uniform intermixture of preformed fibers and fibers formed in situ, and is collected in a suitable manner as shown at 71.

To insure that the aspirator units function satisfactorily in providing a uniform dispersion of preformed fibers, proper staple selection and fiber lubricant, and careful processing of the fiber bundle are required to avoid crimp in the fibers, surface friction, and tangling of the fibers within the aspirators. A minimum twist, commensurate with good processing, should be imparted to the fiber bundle.

During operation, the aspirator units require little supervision once the air pressure has been regulated and the rate of fiber feed has been adjusted, with some care being exercised in the last noted adjustment to avoid overfilling of the aspirator which results in interrupted operation. In the event the fiber bundle should break, it is only necessary to place its free end adjacent to the entrance 41, with the inrushing gas and suction forces, heretofore explained, effecting the aspirator lacing. Should the aspirator become clogged, blocking the end of the discharge tube 53 causes the high velocity air to blow back through the suction and delivery tubes to clear the same.

The preformed fibers forming the yarn bundle or strand are preferably natural or synthetic textile fibers such as for example cotton, wool, silk, rayon, acetate, nylon, Dacron, acrylic fibers and the like. While the yarn bundle or strand has been described as having a slight twist, it is here emphasized that the bundle or strand is actually a continuous loose and soft assemblage of substantially parallel fibers which have been twisted to a minimum degree necessary to maintain bundle continuity. In effect, the degree of twist utilized adds little or negligible strength to the bundle.

It is seen from the above description that the objects of the invention are well fulfilled by the method described. The description is intended to be illustrative only and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claim.

I claim:

A process for providing a uniform dispersion of individual fibers from a continuous yarn bundle formed of preformed fibers extending generally longitudinally of the bundle including the steps of advancing the leading end of a yarn bundle into a turbulent fluid stream to loosen the fibers thereof and passing the yarn bundle through an angular path to retard its rate of advancement at a location spaced from its leading end to permit the turbulent stream to pluck the loosened fibers from the yarn bundle and disperse the same as a mass of individual fibers.

References Cited in the file of this patent

UNITED STATES PATENTS

240,660	Chichester	Apr. 26, 1881
1,929,344	Benoit	Oct. 3, 1933
2,199,309	Freudenberg	Apr. 30, 1940
2,287,815	Modigliani	June 30, 1942

(Other references on following page)

5

UNITED STATES PATENTS

2,315,083	Chesler	Mar. 30, 1943
2,328,714	Drill et al.	Sept. 7, 1943
2,336,743	Manning	Dec. 14, 1943
2,357,392	Francis	Sept. 5, 1944
2,571,025	Fletcher	Oct. 9, 1951

6

2,578,101	Stalego	Dec. 11, 1951
2,618,816	Joa	Nov. 25, 1952
2,662,250	Schweizer	Dec. 15, 1953
2,850,421	Thompson	Sept. 2, 1958

FOREIGN PATENTS

137,945	Australia	July 31, 1947