

July 26, 1966

R. E. HAWKINS ET AL

3,262,181

METHOD FOR OPENING FIBROUS TOW

Filed Nov. 22, 1963

3 Sheets-Sheet 1

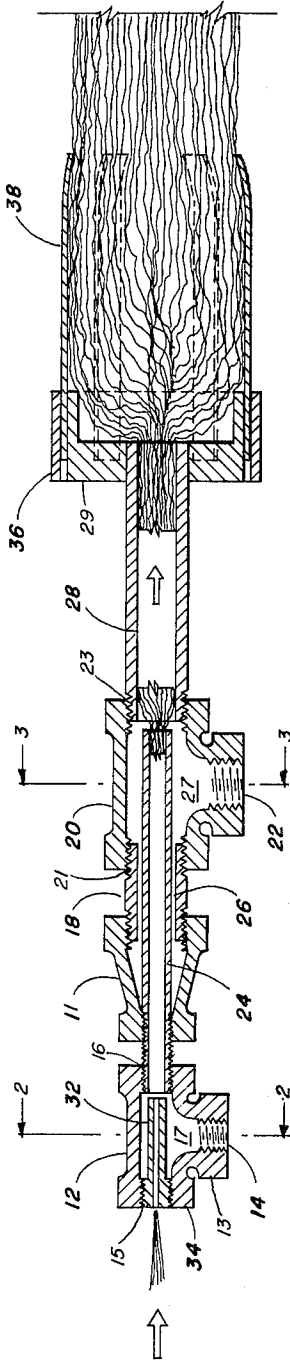


FIG. 1.

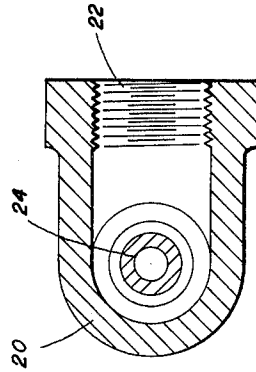


FIG. 3.

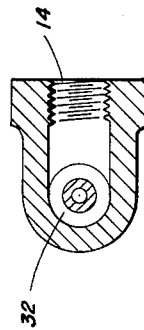


FIG. 2.

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3 Sheets-Sheet 2

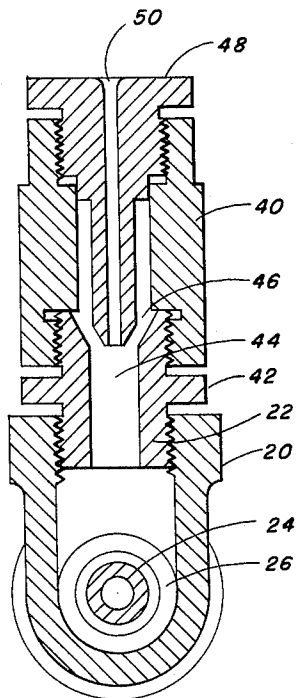


FIG. 4.

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3 Sheets-Sheet 3

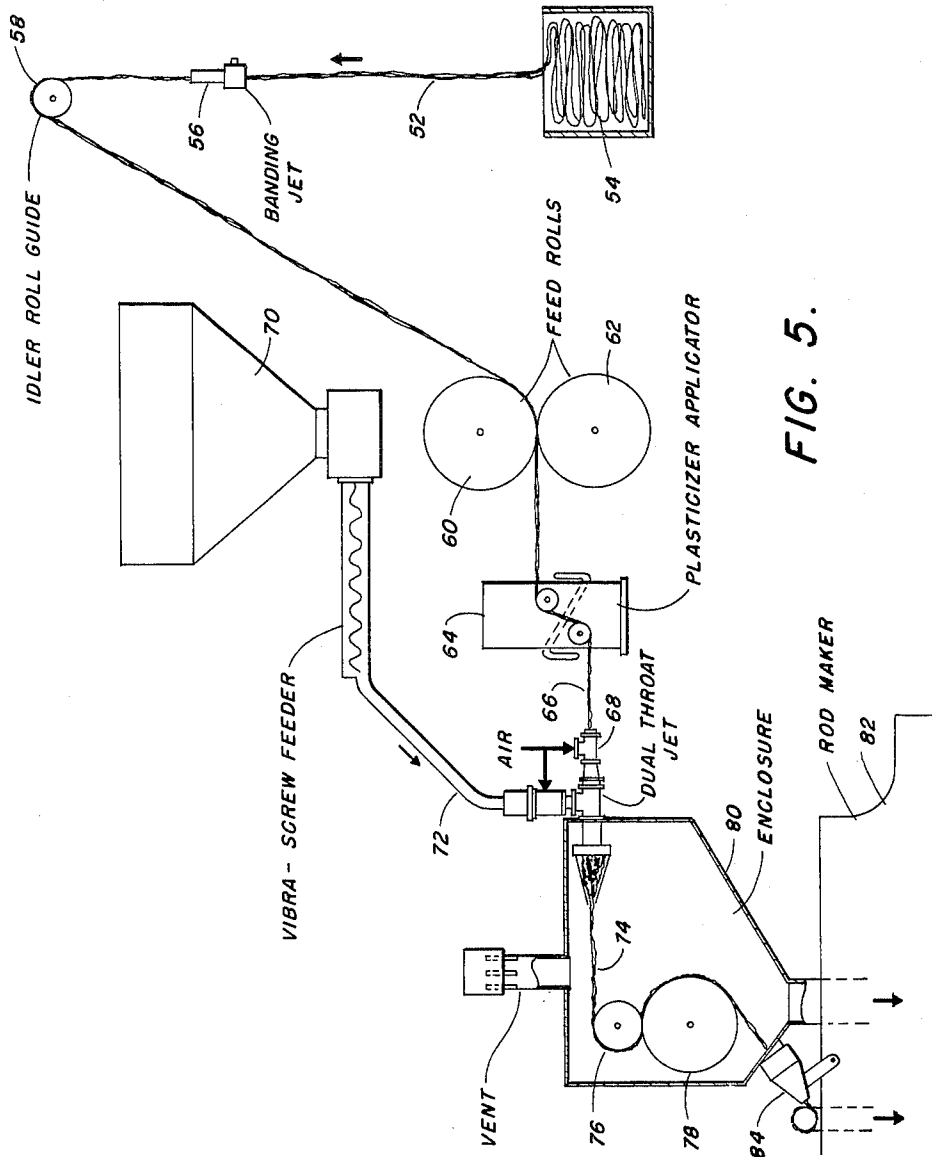


FIG. 5.

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3,262,181

**METHOD FOR OPENING FIBROUS TOW**

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7 Claims. (Cl. 28—72)

This invention relates to the treatment of continuous filament tow. More particularly it concerns an improved apparatus and process for opening or blooming tow and for applying particulate additives in dry or slurry form to tow.

Our coworkers in U.S. Patent Nos. 2,881,769; 2,881,770; 2,940,456; 2,956,329; 3,008,473 and 3,043,736 have disclosed the production of improved tobacco smoke filament filters by the incorporation therein of various particulate additives by spraying onto the tow prior to compacting the tow into the rod-shaped filter elements. Our coworkers Aspy and Pannill on the other hand have disclosed in Serial No. 287,227, filed June 12, 1963, a simplified T-joint jet for blooming or opening tow suitable for forming into filter elements and the like. While in the tobacco smoke filter industry incorporation of the additives of Touey by spraying or a like method has been highly successful and blooming of the tow by the jet of Aspy and Pannill is already being accepted as a highly successful method of opening the tow preparatory to compacting into filter elements, there has until now been developed no simple one-step method which blooms the tow while simultaneously applying the appropriate substance thereto in a one-step operation. Therefore development of a single step method and apparatus for applying additives to fibrous tow while at the same time opening or blooming the tow in such a manner to prepare it for further processing into rod-shaped filter elements or the like represents a highly desirable result. After extended investigation we have found that by modifying a blooming or entangling jet such as the above mentioned jet of Aspy and Pannill it is possible to apply additives to the tow uniformly while at the same time blooming the tow to the desired degree.

One object of this invention is to provide improvements in the method and apparatus for processing continuous filament tow. Another object is to provide a method and apparatus of improved economy whereby in a single step operation, fibrous tow may be opened or bloomed while a tow-improving additive is applied thereto. Still another object is to provide a simplified process and apparatus for blooming and applying additives to a tow in a single step and adapting it for further processing into filter elements or the like. Other objects will appear hereinafter.

In accordance with the present invention apparatus is provided comprising a dual throat jet consisting of a pair of aspirator members suitably connected in fluid communication in series. The tow to be treated is introduced into the center tube of the first aspirator and is drawn by air under pressure introduced into the side of the aspirator through the first aspirator into the relatively larger center tube of the second aspirator where it likewise encounters air under pressure entering the side of the second aspirator and is thus drawn forward and out of the second aspirator into a tow blooming device in fluid communication therewith. The tow blooming device comprises a conduit connecting the outlet of the second aspirator with a tow expansion or blooming chamber constituted by a plurality of flexible metal fingers. Preferably this connecting conduit is larger in diameter than the center conduit of the adjacent aspirator.

Our novel jet utilizes two streams of motivating gas introduced in series thereby requiring less energy to open

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the tow. The first stream of gas motivates the tow permitting the energy of the second stream to be utilized almost exclusively to open the tow.

According to our invention, additive may be applied to the tow by incorporating it in either or both of the gas streams entering the respective aspirators, the second or downstream entrance being preferred. The stream or streams of gas pull the additive along by aspiration and disperse it throughout the bloomed tow. The additive may be a dry, flowable material or it may be a dispersion of a solid in a carrier liquid. Representative of additives which may be applied according to our invention are activated carbon, starch, starch derivatives, silica gel, titanium dioxide, phthalocyanine blue, magnesium carbonate, calcium carbonate, polyalkylene glycols and glycol esters, carboxylic acid esters, various health-approved coloring and flavoring agents and the like.

For assistance in a better understanding of the invention, reference is made to the attached drawings forming a part of the instant application in which:

FIG. 1 is a transverse sectional view through the dual-throat jet used in accordance with the present invention. In this figure the tow is shown diagrammatically entering the jet in a confined path and leaving the jet in bloomed form.

FIG. 2 is a cross section taken at line X—X of FIG. 1.

FIG. 3 is a cross section taken at line Y—Y of FIG. 1.

FIG. 4 is a cross section of the second gas inlet with an auxiliary jet (also in cross section) attached thereto for incorporation of an additive.

FIG. 5 is a simplified view in elevation of the dual-throat jet of our invention assembled with other apparatus elements suited to prepare a tow for transverse compaction and the formation of unitary filter rod elements.

Referring to FIG. 1 there is shown the dual throat jet of the present invention comprising an aspirator 12 in fluid communication with an aspirator 20 which in turn is connected in fluid communication with a tow blooming device 36 having restraining fingers 38.

Aspirator 12 comprises a T-body 13 having threaded openings 14, 15 and 16 and chamber 17. A conduit 32 through which the tow enters aspirator 12 is positioned in chamber 17 by engagement of its threaded end with threaded opening 15. Gas under pressure is introduced into aspirator 12 through opening 14 from a source not shown.

Aspirator 20 similarly comprises a T-body 20 having threaded openings 21, 22 and 23 and chamber 27 therein. A conduit 24 through which tow enters aspirator 20 is positioned in chamber 27 and connects aspirator 12 with aspirator 20, being threadedly mounted in opening 16 of aspirator 12. Conduit 24 is also mechanically supported between aspirator 12 and aspirator 20 by members 11 and 18. Gas under pressure is introduced into aspirator 20 through opening 22 from a source not shown.

Tow blooming device 36 comprises a conduit 28 threadedly engaged with aspirator 20 at opening 23 and a base member 29 which supports the plurality of tow restraining fingers 38.

As is evident from FIG. 1, the continuous filament tow to be treated is introduced into the first aspirator 12 through conduit 32. As it leaves this conduit and enters chamber 17 it encounters the gas under pressure which is flowing into chamber 17 from the source connected to opening 14 and out of the chamber through conduit 24. Because conduit 24 is of larger diameter than conduit 32, the tow tends to bloom as it enters chamber 17 and continues to expand radially somewhat as it travels in conduit 24.

At the exit end of conduit 24 surrounded by air space 26 the tow enters chamber 27 of aspirator 20. Here

it is acted on by the gas under pressure flowing into chamber 27 through opening 22. The tow therefore further is subjected to a blooming action and this continues as it passes into and through conduit 28 which is in turn of larger diameter than conduit 24.

The final blooming of the tow occurs as the tow is drawn out of conduit 28 and into blooming device 36. Here the gas under pressure is permitted to expand substantially without restraint and the tow moves away from the axis of the conduit 28 and is retained by flexible fingers 38. From this point the treated and bloomed tow is processed as will be further explained in connection with FIG. 5.

Referring now to FIG. 4, an auxiliary jet is shown inserted in inlet 22 of T-body 20. The auxiliary jet consists of a body 42 with a central bore 44 and gas entrance 46. Nozzle 48 extends into bore 44 and is secured therein by means of sleeve 40. The additive, delivered by a screw feeder or like mechanism, is aspirated through bore 50 of nozzle 48, dispersed, and injected into T-body 20 by a gas stream connected to entrance 46.

With reference to FIG. 5, tow 52 from source 54 such as a tow bale is passed first through banding jet 56 and then over idler roll guide 58 before being conducted between the nip formed by feed rolls 60 and 62 and across plasticizer applicator 64, at which point a suitable plasticizer may be applied. Next the tow at this point 66 is passed through dual throat jet 68, into which a particulate additive from feeder 70 is aspirated via line 72. The treated tow 74 passes around rolls 76 and 78 in vented enclosure 80 and on into rod maker 82 via stuffing jet 84, which may be of a structure such as that of the jet of U.S. Patent 3,050,430 to our co-worker Gallagher.

A further understanding of the apparatus parts disclosed in the several figures and hereinabove described and their operation in accordance with this invention will be had from the following examples, which are intended to be illustrative only.

#### Example I

This example illustrates the improved efficiency in air consumption and pressure brought about by use of the dual-throat jet of the instant invention. Dimensions in this and the other examples refer to representative pipe size of the two concentric throats of the jet end. A ½" x 1" dual-throat jet was used to bloom 5 D/F 200,000 total denier tow. Blooming was accomplished with 90 s.c.f.m. air supplied at 9-10 p.s.i.g. This compared to a usage of about 160 s.c.f.m. at 18 p.s.i.g. when two single-throat jets were used to bloom the same tow.

#### Example II

A ¼" x ¾" jet was used to bloom 3.3 D/F 46,000 total denier Y-section cellulose acetate tow. Blooming was accomplished with 5 p.s.i.g. air as compared to 18-22 p.s.i.g. air used by a single-throat jet such as that of Caines, Dyer and Pannil Serial No. 226,432.

#### Example III

This example illustrates the simultaneous blooming and application of a dry, particulate additive to tow with a ½" x 1" dual-throat jet. Using 5 D/F 45,000 total denier tow and the apparatus shown in FIG. 5, air at a pressure of 9 p.s.i.g. was introduced at the first fluid entrance. Activated carbon, 35 x 150 mesh, was metered to an injector jet where air at 15 p.s.i.g. injected it into the second fluid entrance. The activated carbon was distributed uniformly throughout the bloomed tow.

#### Example IV

The apparatus was operated as in Example III except that free-flowing calcium carbonate having a 5-15 micron particle size was applied to the tow.

#### Example V

The apparatus differed from that shown in FIG. 5 as follows. The plasticizer applicator and dust enclosure were removed. The powder feeder was replaced by a pump capable of handling a viscous slurry. The slurry consisted of rice starch suspended in a fluid composed of glycerol triacetate, propylene glycol, water and a dispersing agent. The processed tow contained 20 p.p.h. rice starch, 10 p.p.h. glycerol triacetate, and 10 p.p.h. propylene glycol, the water having been essentially evaporated by the blooming air. The resultant filter elements were firm and removed 1.4 times as much tars from the smoke of cigarette as did a 5 D/F filter tip of equal pressure drop without the additive.

It is thought apparent from the preceding description and examples that we have provided a novel dual-throat jet method and apparatus for simultaneously blooming and applying additive to continuous multifilament tow.

The invention has been described in considerable detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove, and as defined in the appended claims.

We claim:

1. A process for opening a tow made up of crimped continuous filaments which comprises introducing the crimped tow into a treating zone in a substantially unidirectional path, directing thereagainst in substantially the same direction as the movement of said tow a first stream of motivating gas, downstream from said introduction of said first motivating gas directing a separate stream of motivating gas against said tow also substantially in the direction of movement of said tow, said separate stream being directed in a path concentric to the axial path of said first stream to a point at which said streams merge in a single, confined, generally cylindrical course, thereby blooming the previously crimped filaments of said tow and adapting same for compacting into a unitary rod-like structure.

2. A process for opening a tow made up of crimped continuous filaments which comprises introducing tow into a center tube of a first aspirator, drawing the tow by gas introduced into the side of said first aspirator through said first aspirator into a relatively larger center tube of a second aspirator wherein the tow is again drawn by gas introduced into the side of said second aspirator, thereby drawing said tow forward and out of said second aspirator into a tow blooming zone in fluid communication therewith, said zone being larger in diameter than the center tube of said second aspirator and connecting an outlet of said second aspirator with a tow expansion chamber wherein said tow is confined by a plurality of flexible fingers.

3. A process for opening a tow made up of crimped continuous filaments which comprises motivating the tow through a first throat of a dual-throat jet by air introduced from the side, blooming the tow as it enters said first throat and expands radially while travelling into a second throat, motivating the tow through said second throat of said dual-throat jet, further blooming the tow in said second throat by continued radial expansion while treating it by further air introduced from the side, and still further blooming the tow by expanding the air substantially without restraint as the tow moves out of said second throat into a zone of greater volume.

4. The process of claim 3 wherein the tow is retained by flexible fingers in the zone of greater volume.

5. The process of claim 3 wherein additive is applied to the tow by incorporating it in the air under pressure introduced to the first throat.

6. The process of claim 3 wherein additive is applied to the tow by incorporating it in the air under pressure introduced to the second throat.

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7. The process of claim 3 wherein additive is applied to the tow by incorporating it in the air under pressure introduced to the first and second throats.

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