

Aug. 21, 1962

P. GALLAGHER

3,050,430

JET AND METHOD OF FILTER MANUFACTURE

Filed Nov. 12, 1959

2 Sheets-Sheet 1

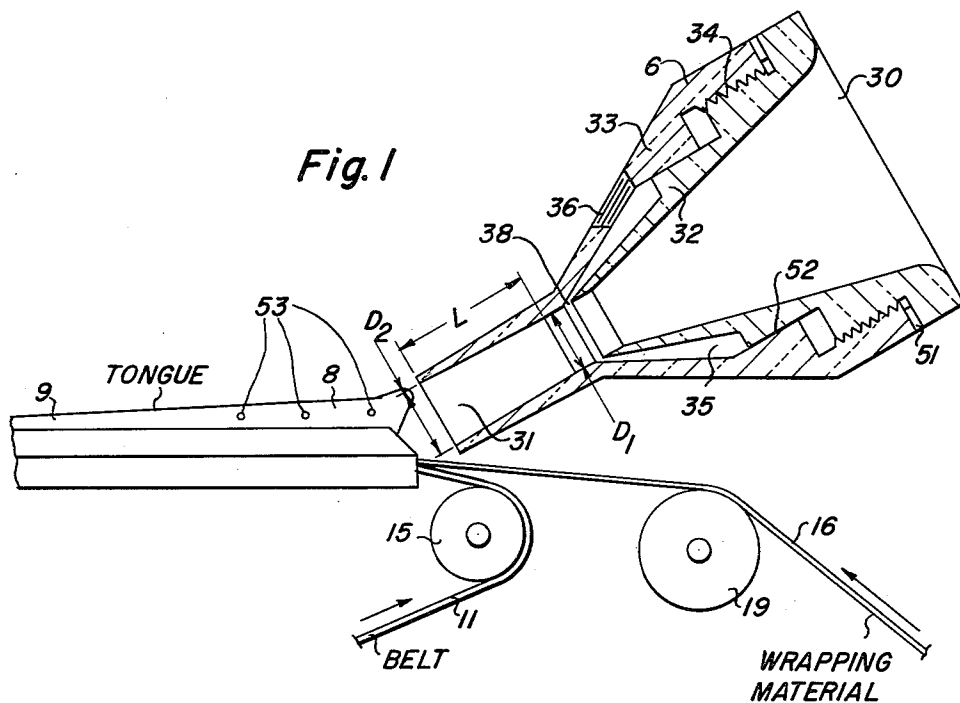


Fig. 2

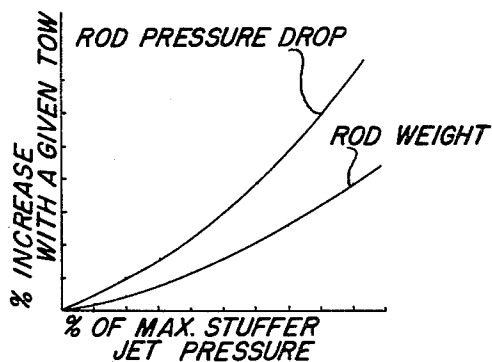
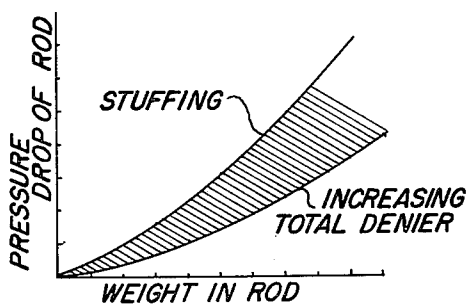


Fig. 3



PAUL GALLAGHER
INVENTOR.

BY *R. Frank Smith*
Harold N. Powell
ATTORNEYS

Aug. 21, 1962

P. GALLAGHER

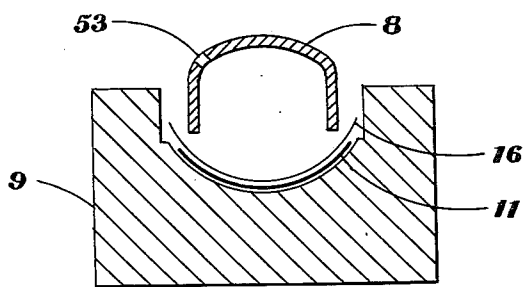
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Fig. 4



Paul Gallagher

INVENTOR.

BY *R. Frank Smith*
Harold W. Powell

ATTORNEYS

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3,050,430

JET AND METHOD OF FILTER MANUFACTURE**Paul Gallagher, Kingsport, Tenn., assignor to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey**

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10 Claims. (Cl. 156-166)

This invention relates to an improved method and apparatus for forming crimped continuous filament tow into tobacco smoke filters. More particularly, this invention relates to an improved jet for motivating and forming a lower denier per filament, more highly crimped tow than has heretofore been used into filter rods for cigarette tips.

As is known in the industry, a substantial amount of filter production is carried out generally in accordance with the apparatus of the kind shown in Crawford and Stevens U.S. Patent 2,794,480 and by the method disclosed therein. In prior type of operation the filaments to be made into filter elements, after the filaments have been opened up, after treating with plasticizer and fluffing, are then mechanically pulled or drawn into the garniture for compacting and forming the preliminarily processed crimped filaments into the filter element. Such prior art mechanical type treatment tends to pull out the crimps and otherwise is not as efficient as the present invention.

In companion Wexler U.S. application Serial No. 761,602, a co-worker has shown an improved method and jet whereby the spread-out band of filaments may be pushed by gas through filter forming and wrapping means.

After extended investigation I have found certain improvements in the Wexler method and apparatus for compacting and forming filaments into filter elements.

This invention has for one object to provide a process of condensing a bundle of continuous filaments to a smaller diameter under little or no tension whereby a substantial percentage of each filament is positioned more nearly crosswise to the longitudinal axis of the filament bundle. Still another object is to provide a process of condensing a bundle of filaments to a smaller diameter whereby there is obtained a firmer and more fully packed filter element than obtainable by prior methods. Still a further object is to provide a process of condensing a bundle of filaments by means of the aspirating action of air or the like gas in a manner whereby the filaments are pushed rather than pulled into the compacting mechanism. Still another object is to provide a process of making filter rods particularly adapted for the attachment to cigarettes, which process is relatively simple and more efficient than prior art processes. Another object is to provide an apparatus for making filter elements from continuous filaments, which apparatus contains an air jet in special combination with forming means. Still another object is to provide a specially shaped jet particularly adapted for handling a bundle of continuous crimped filaments whereby the filaments may be motivated but still maintained in a relatively relaxed or untensioned state. Other objects will appear hereinafter.

In the broader aspects of my invention I have found that if a band of opened-up continuous crimped filaments is pushed rather than pulled or drawn into the compacting and forming means that substantially better results may be obtained. Expressed in another way, I have found that if the filaments being made into the filter element are maintained in a somewhat relaxed or untensioned state that a relatively large percentage of each filament may be positioned somewhat crosswise or perpendicular to the longitudinal axis of the filament bundle. Such crosswise positioning of a portion of the filaments results in a more efficient or higher removal filter for a given pressure drop or draw through the filter. Thus, by the present invention filters can be produced having a

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higher removal at the same pressure drop or equal removal with a lower pressure drop than filters produced by prior art procedures. Furthermore, by the present invention where the filaments are motivated by air or the like gas in a manner which pushes the filaments into the compacting and forming means, even though finer more highly crimped filaments are used such filaments are not broken and an improved filter is obtained.

This may be accomplished in the present invention by employing a certain apparatus construction which includes therein a specially shaped jet positioned in a certain relationship in the apparatus with respect to the compacting and forming means. The preferred jet of the present invention is, as just mentioned, of a special construction which facilitates pushing the crimped continuous filament into the forming means in an improved manner.

For a further understanding of my invention reference is made to the attached drawing forming a part of the present application.

In the drawing:

FIG. 1 is a semidiagrammatic side elevation view of the forming garniture in combination therewith my novel improved aspirating jet.

FIGS. 2 and 3 are graphs for showing the improvement in filter product which may be obtained using the improved jet of the instant invention.

FIG. 4 is a transverse cross section through parts 8 and 9 of FIG. 1.

Reference is made now to FIGS. 1 and 4 wherein the improved jet 6, the tongue 8 and the forming member 9 are shown in longitudinal and cross sections. Certain of these parts, as well as certain other parts, may be the same as those in Wexler referred to above. However, the jet is different as will be apparent as the description proceeds. It will be further noted that the wrapping material 16, the endless belt 11, as well as rollers 15 and 19 may be as shown in Wexler.

Jet 6 preferably is of cone-shaped construction. That is, the jet overall can be considered somewhat as a truncated cone shape thereby having a considerably greater cross-section on the entrance end 30 than on the exit end 31. The jet is made up of the inner member 32 and the outer member 33. These parts are suitably threaded at 34 or otherwise fabricated so that they may be assembled together and provide the chamber 35 which encircles the entire inner member. An opening into this chamber is provided at 36 for the introduction of air or other gas. The inner walls of this chamber are shaped so as to provide an outlet orifice 38 around the periphery of the inner member. In other words, this outlet orifice permits the air or the like motivating gas to escape out through the exit end 31 of the jet. The size of this outlet orifice may be determined by the thickness of the gasket 51.

It will be observed that the jet 6 is suitably positioned at an angle so as to permit the ready movement of the web of wrapping material 16 thereunder as well as the movement of the endless belt 11.

The portion of jet 6 labeled "L" is an improvement over the Wexler jet. "L" is a diverging or venturi nozzle, with D_2 larger than D_1 , made as part of the jet. This nozzle takes advantage of the venturi orifice principle by which a greater flow of air is obtained compared to a jet with a sharp edge orifice. As referred to above, the aspirating effect of the jet, as well as the amount of compressed gas used, is controlled by the thickness of the gasket (which regulates the opening of the orifice) and the pressure of the compressed air. As may be noted from the drawing of FIG. 1, the inner nozzle is centered at the orifice by two mating diameters 52 midway on the inner and outer nozzles.

The best operation of this improved jet depends on dissipating the volume of air emerging from the jet so

the filaments of the filter tow are not blown onto the portion of the wrapping paper that seals the filter. This may be accomplished by drilling $\frac{1}{16}$ " diameter holes 53 in the tongue of the filter forming apparatus on centers not greater than $\frac{3}{16}$ ". It is advisable to drill more holes on the front side of the tongue since the sealing edge of the wrapping paper passes along the front edge of the tongue. The stuffer jet should extend under the tongue far enough to insure no filaments blowing out from under the tongue. It may be desirable to machine an elliptical recess in the top of the tongue for the jet, or it is possible for the tongue to be an integral part of the jet. The jet should be located at an angle to the horizontal as shown in the drawing such that it will be as horizontal as possible without interfering with the movement of the paper or put undue drag on the tow as the tow enters the jet from the feed roll.

In regard to the size of the jet this will be governed to some extent by the size and number of the crimped filaments being supplied thereto. In the present construction where cigarette filters are being made, a jet of about two inches diameter at the entrance end and $\frac{3}{4}$ to $\frac{3}{8}$ inch diameter at the discharge end is quite satisfactory. That is, such a jet will handle 5,000-30,000 filaments of a size to make a tow of 20,000 to 80,000 total denier.

While the air or other gas can be directly introduced into the jet through inlet 36, if desired, suitable control valves can be incorporated with the jet to provide the desired control over the volume and/or pressure of the fluid going into the jet. Rods of different levels of weight and/or pressure drop can be made by changing the rate at which the tow is fed to the jet. By varying the air pressure supplied to the jet, different rates of tow feed can be accommodated by the jet.

The operation of the above described apparatus is thought apparent to a substantial extent from an inspection of the drawings and consideration of the preceding description. The operation is relatively simple and efficient but a brief general description will now be set forth.

A band of several thousand continuous crimped filaments is fed into inlet 30 of the jet. It is relatively easy to feed the filaments to the jet since the gas supplied to the jet causes it to be substantially self-threading. By supplying a suitable amount of air to the jet at 36 the band of crimped filaments is pushed through the jet and under tongue 8 into the forming means 9 where the filaments are compacted and formed into a cylindrical shaped filter element. At the same time this is being accomplished the wrapping material 16 is being continuously supplied and the endless belt 11 conveys the wrapped filter rod out of forming means 9 to the subsequent steps such as cutting the rod into suitable lengths.

A still further understanding of my invention will be had from a consideration of the following examples which illustrate the advantages of the venturi stuffer jet and modified tongue of the present invention in comparison with the subject matter of the aforementioned companion application of Wexler.

Example I

Rods were made from 5 D/F—70,000 T.D. tension bloomed tow using both types of apparatus. Both rods were 24.8 mm. circumference by 90 mm. long. The following data was obtained.

Apparatus	Air consumption, s.c.f.m.	Weight of one rod, gms.	Rod pressure drop, in. of H ₂ O
Wexler.....	6.6	0.836	8.6
Improved.....	7.0	0.883	10.0

Example II

Another pair of rods were made from 2.1 D/F—46,000 T.D. air fluffed tow. All conditions were identical except for the stuffer jet and tongue.

Apparatus	Air consumption, s.c.f.m.	Weight of one rod, gms.	Rod pressure drop, in. of H ₂ O
Wexler.....	5.2	0.686	12.0
Improved.....	5.2	0.720	13.4

From the above and other data it may be seen that the instant invention has several advantages over the aforementioned Wexler subject matter.

(1) The modified apparatus of the present invention is capable of attaining the same rod pressures as the Wexler jet with 40 to 50% less compressed air. Likewise, a higher rod pressure is possible with the same air usage. This is a less expensive method due to lower air consumption and also the same rod pressures are possible with lower pressure air indicating a less expensive source of compressed air.

(2) The modified apparatus of the present invention is easier to operate than the Wexler jet because it does use less air to obtain equivalent or better results. One of the limitations of the stuffer jet is the degree to which filaments are blown out of the tongue and garniture at the exit of the jet. It is, therefore, apparent that the jet can be operated with less trouble or to higher limits if less air and lower velocities are encountered at the exit of the jet.

(3) The maximum rod pressure is increased with the modified apparatus. The relative increase is independent of rod circumference.

(4) A particularly beneficial use of the modified apparatus of the present invention is with the finer D/F tows, either air bloomed or a combination of air and tension bloomed. However, the apparatus of the present invention may be used to advantage on the larger D/F tows that are tension bloomed. Therefore, it is possible to use the modified apparatus to advantage on all tows from less than 1 D/F to 16 D/F.

(5) Since the removal of a filter is a function of the pressure drop of the filter, it is evident that filters with a higher removal are possible using the present invention.

While in the above examples there were used relatively moderate air pressures from about 3 to 8 p.s.i.g. for higher speed operation it may be desirable to increase the air pressure up to 30 p.s.i.g. It will be observed as indicated above that the instant invention not only operates satisfactorily on finer filaments than heretofore have been commonly used in filter manufacture such as filaments having a denier per filament of about 2, but the present invention will also operate satisfactorily on filaments having a denier of 5 or higher and being present in a total denier of 80,000 or more. Likewise, the present invention works satisfactorily on filaments which are crimped with various degrees of crimp from, for example, 6 crimps per inch up to crimps of the order of 40 crimps per inch. Therefore, the present invention will function satisfactorily not only on filaments heretofore used in the manufacture of filters but will operate successfully on very fine, highly crimped filaments.

The present invention possesses merit and utility in that it is possible to increase the weight and pressure drop of the filter by using this venturi type jet to limits not attainable formerly. An example of this is that of a 24.8 mm. x 90 mm. rod of 5D/F x 70,000 tow being increased from 7.5" to 11.5" pressure drop. This is an increase of 53.4% in pressure drop for the corresponding increase in weight of 11.7%. It is possible to increase the pressure drop of the finer D/F tows to beyond presently used limits in commercial filters. Thus virtually any filter rod pressure drop desirable is easily attained by the use of this im-

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proved stuffer jet in combination with the modified tongue which will relieve air from the garniture or rod forming apparatus.

The foregoing may be further appreciated by referring to FIGS. 2 and 3 of the attached drawing. FIG. 2 assumes any one given tow item and shows that pressure drop increases at a greater rate than rod weight with given increments in stuffer jet pressure. FIG. 3 demonstrates that pressure drop obtained by increasing the rod weight by stuffing rises at a faster rate than the pressure drop obtained by increasing the rod weight through using higher total denier tow. The shaded area represents the type improvement obtained through the use of the present invention. These and other related improvements are summarized as follows:

(1) Improved tow utilization in terms of pressure drop per unit rod weight.

(2) Improved hardness at same pressure drop by using lower total denier and stuffing up to desired pressure drop, rather than obtaining desired pressure drop with total denier increase.

(3) Improved versatility in that rods may be made at more than one pressure drop level, yet only one tow item need be kept in inventory.

The invention has been described in detail with particular reference to 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.

I claim:

1. An apparatus for manufacturing filters out of continuous crimped filaments comprising a truncated cone-shaped jet with a large and a small end, said small end being in the form of a venturi leading into tongue compacting means, means for conducting gas through said jet, means for moving compacted filaments through said tongue compacting means, and means for feeding wrapping material in close association with said tongue compacting means.

2. An apparatus in accordance with claim 1 wherein the venturi is positioned at an angle to the tongue compacting means.

3. An apparatus in accordance with claim 1 wherein the large end of the jet is at least 2 inches in diameter and the portion of the venturi adjacent to the tongue compacting means is larger than the opposite end of the venturi.

4. An apparatus for manufacturing filters out of continuous crimped filaments comprising a jet in combination with compacting means, said jet being of a truncated cone shape with a large end and a small end having a venturi member adjacent said compacting means, an endless belt leading through said compacting means, means for feeding

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wrapping material into said compacting means, said compacting means having at the entrance end thereof a tapered portion perforated with a plurality of holes whereby aspirating gas emerging from said jet is dissipated, thereby preventing said continuous crimped filaments from being blown onto the sealing portion of said wrapping material and causing a loose seal.

5. A method of making filter elements from crimped continuous filaments which comprises passing a band of several thousand filaments into a truncated cone-shaped jet, supplying a gas to said jet whereby said filaments are motivated through said jet and upon exiting therefrom are pushed through a venturi nozzle into tongue compacting means, thereby being formed into filter elements, permitting some of said gas to escape through peripheral holes in said tongue compacting means, thereby dissipating the gas emerging from said jet and preventing the filaments from being blown onto the sealing portion of a wrapping web supplied to said tongue compacting means whereby the formed filter elements are wrapped, sealing the wrapping web around the filter elements and cutting the filter elements to length.

6. The method in accordance with claim 5 wherein the filaments are cellulose acetate filaments of a denier per filament of less than 16.

7. A method in accordance with claim 5 wherein the filaments are cellulose acetate filaments of a denier per filament of less than 3.

8. In a process of manufacturing filter elements from cellulose acetate filaments wherein the filaments are conducted into compacting means which shape the filaments into filter elements, the improvement which comprises passing the filaments through an air jet having a venturi section immediately adjacent said compacting means whereby the filaments are motivated into said compacting means.

9. The improvement in accordance with claim 8 wherein the air pressure to supply the jet for motivating the filaments is from 2 to 30 p.s.i.g.

10. In the process of manufacturing filter elements from a band of several thousand continuous crimped filaments, the steps which comprise spreading out the crimped filaments and then conducting the spread-out filaments through an air jet ending in a venturi section into a compacting zone and applying air pressure thereto sufficient to motivate and push the filaments through said venturi section into said compacting zone.

References Cited in the file of this patent

UNITED STATES PATENTS

2,794,239	Crawford et al. _____	June 4, 1957
2,884,756	Head _____	May 5, 1959