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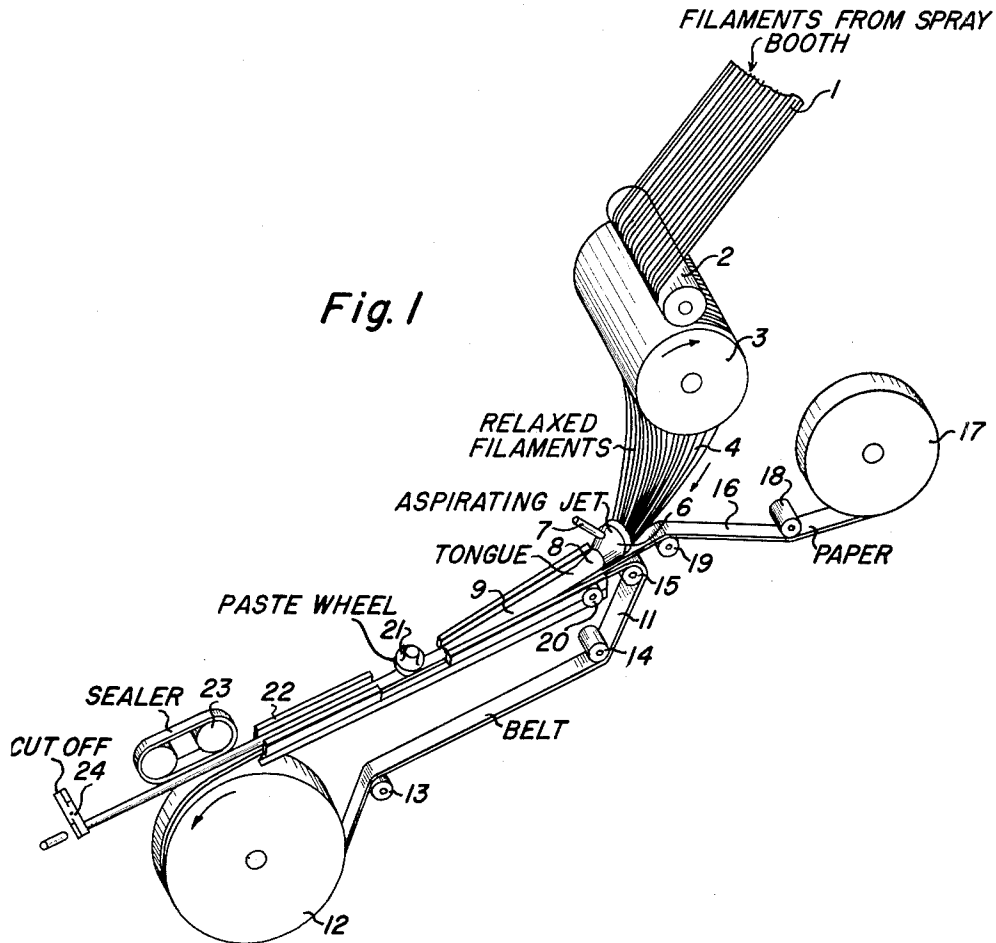
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METHOD AND APPARATUS FOR FORMING TOBACCO SMOKE FILTERS

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2 Sheets-Sheet 1



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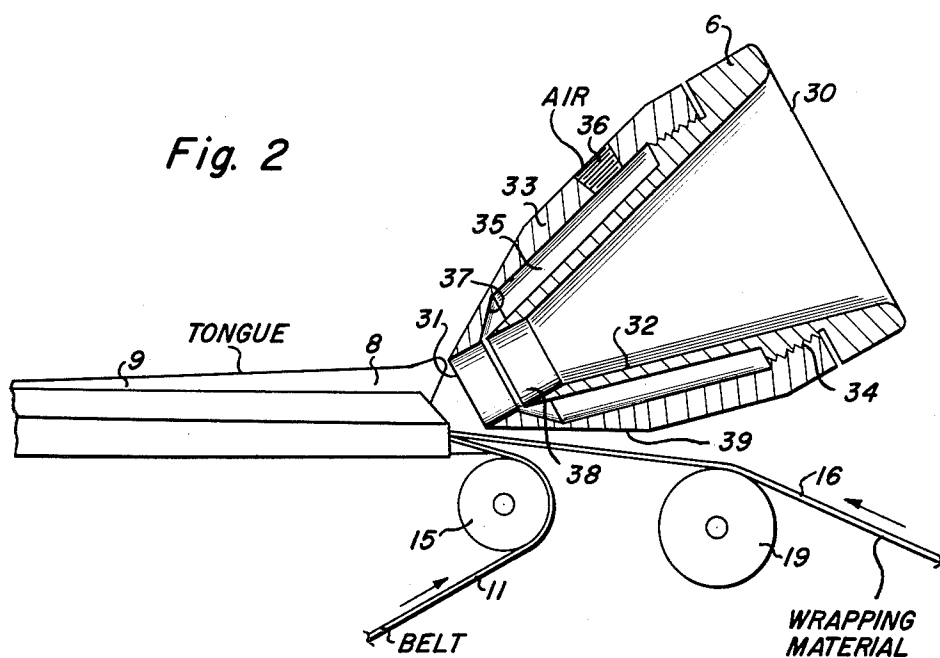
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METHOD AND APPARATUS FOR FORMING
TOBACCO SMOKE FILTERS

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This invention relates to an improved method and apparatus of forming crimped continuous filament tow into tobacco smoke filters. More particularly, this invention relates to a method and apparatus for 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 No. 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 preliminary 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.

After extended investigation I have found an improved method and apparatus for compacting and forming filaments, even finer and more highly crimped 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 an 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 special cone-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 the bundle of 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 higher removal at the same pressure drop or equal removal with a lower pressure drop than filters produced by prior art pro-

cedures. 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.

As just mentioned I accomplish the present invention by employing a certain apparatus construction which includes therein a cone-shaped aspirating 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 of a special construction which facilitates pushing the crimped continuous filaments into the forming means in a manner whereby the filaments are in a relatively relaxed or untensioned condition.

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 apparatus for filter element manufacture comprising a machine having in combination therewith my novel aspirating jet.

FIG. 2 is also a semidiagrammatic side elevation view somewhat on an enlarged scale for clarity showing the aspirating jet in section and particularly showing the positioning thereof with respect to associated parts.

FIG. 1 will now be described in detail. In this description the figure will be considered from right to left. Namely, it will be assumed that a suitable bundle of crimped continuous filaments has been obtained and is being fed through the apparatus of FIG. 1 for forming a filter element. In other words, the description will be of a path through the apparatus for forming the spread-out continuous filaments into a compacted filter element.

Therefore, 1 designates the crimped continuous filament tow in a spread-out condition to be made into a filter element. This band of filaments will comprise several thousand individual continuous crimped filaments which have previously been treated in certain desired manners. That is, these filaments may be fluffed, opened up by rolls, sprayed with plasticizer and the like. Further details concerning such treatment may be had from a review of the aforementioned Patent 2,794,480. These filaments 1 pass over and around rolls 2 and 3 for motivating the filaments from the previous treatments such as fluffing, plasticizing, etc. to the treatment by the present invention. These several thousand filaments then arrive at a position designated 4 where the filaments are about to be compacted and formed into a rod-like shape as a filter element.

There is positioned reasonably adjacent position 4 the cone-shaped aspirating jet 6 of the present invention. Since the construction of this jet is covered in detail in connection with FIG. 2 it will merely be mentioned at this point that the jet is provided with a conduit 7 for supplying air or the like fluid pressure thereto.

This device 6 of the present invention is also positioned in close proximity so as to feed under and into the tongue 8 of the forming member designated overall as 9. This forming member in the present instance for making cigarette filters is generally cylindrical in shape. In other words the forming member is generally of a configuration similar to the configuration of the filter which it is desired to produce. Therefore, since in the present instance it is desired to produce a cylindrical filter element generally conforming to the cylindrical shape of a cigarette, the forming member is, on the upper surfaces thereof, cylindrical and tapered toward the exit end. However, the bottom portion of forming member 9 may be opened to some extent or otherwise constructed to accommodate an endless belt 11. This belt is driven by drum 12. The

belt passes over and under various rollers 13, 14, 15 and 20 whereby the belt rotates under forming member 9 as a conveyor for conveying the formed filter rods through the process. The aforementioned driving drum and rollers are suitably positioned as shown in the drawing so that the belt passes under forming member 9 in a reasonably parallel manner.

Also positioned in association with forming device 9 and above belt 11 is a substantially endless web of wrapping material 16 such as paper. This wrapping material is fed from supply roll 17 under and over suitable guide rolls 18 and 19. As shown in the drawing the wrapping material is brought into continuous contact with the formed filter element in a manner that the filter element may be enclosed in the wrapping material.

At the other end of the apparatus parts which have just been described there is positioned a paste wheel 21, guide bars 22, sealing means 23 and a cutting device 24. These various parts in the order mentioned serve to apply adhesive to the edges of the wrapping material, to fold over the wrapping material, to seal the wrapped filter element and then cut it into suitable lengths. Since these particular parts and their function may be generally in accordance with the corresponding parts shown in Patent No. 2,794,480, extended description herein appears to be unnecessary.

Attention is now turned to Fig. 2 wherein the jet 6, the tongue 8 and the forming member 9 are shown on a larger scale. It will be further noted that the wrapping material 16, the endless belt 11, as well as rollers 15 and 19 are also shown in this FIG. 2 on a larger scale.

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 which corresponds to the point where pipe 7 (of FIG. 1) enters. The inner walls of this chamber as at 37 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.

It will be observed that the jet 6 is preferably positioned at a certain angle to tongue 8 of the forming member 9. Also the jet is suitably shaped on the outside thereof such as at 39 so as to permit the ready movement of the web of wrapping material thereunder as well as the movement of the endless belt 11.

The angle of positioning of the jet with respect to the forming member may be described in several ways. That is, the longitudinal axis of the jet is preferably positioned about 30 degrees above or below the longitudinal axis of the forming member 9. Or, looking at the interior of the jet the upper wall of the interior of the jet is about 45 degrees above the horizontal axis of the forming member and the lower wall about 15 degrees above such horizontal axis.

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 I have found that a jet of about 2 inches diameter at the entrance end and about 5/8 inch diameter at the discharge end is quite satisfactory. That is, such a jet will handle 10,000-20,000 filaments of a size of 1 to 10 denier per filament. Further information concerning the jet will be apparent from the examples set forth hereinafter showing the handling of filaments of a denier from 2-5.

While the air or other gas can be directly introduced into the jet through conduit 7, if desired suitable control valves can be incorporated with the jet to provide the de-

sired control over the volume and/or pressure of the fluid going into the jet. That is, by using variable control in the gas line it is possible to produce filter rods with some variation in weights. Expressed in another way, filter rods with more uniform weights and/or pressure drops can be produced from filaments that may vary somewhat in weight. The control may consist of a means of varying the air pressure applied to the jet or the orifice opening in the jet. In general, for making filter rods for cigarettes I prefer that the orifice 38 be of a diameter of about 5/8 inch.

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 1 pass over and under rolls 2 and 3 until they arrive at position 4 where they are fed into the jet of the present invention. 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 the band of crimped filaments are positioned 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 member 9 to the subsequent steps accomplished by parts 21, 22, and 23 of sealing the wrapping material around the rod and cutting the rod into suitable lengths.

A still further understanding of my invention will be had from a consideration of the following examples which are set forth for illustrating certain preferred embodiments of the instant invention.

Example I

In accordance with this example various pairs of filter elements were made up of the same kind and size of filaments. That is, in each pair of filter elements there was used cellulose acetate continuous filaments of a denier less than 16 per filament and of a band containing at least 4,000 filaments.

However, one of the filter elements of each pair was compacted and formed by the prior art procedure of drawing or pulling the filaments through the forming member. The other filter of the pair was produced in accordance with the present invention and passed through jet 6 whereby the filaments were pushed by the air in a relaxed state into the forming member 9. This was accomplished by supplying approximately 8 p.s.i.g. of air through pipe 7 into the jet.

Of these several pairs of filters thus made up and tested the following comparisons were noted. A filter rod in accordance with the prior art and without using the jet of the present invention comprised of 5 D./F., 60,000 total denier gave an average pressure drop of 5.9 inches of water and a weight of 0.813 gram per rod. A rod made by the present invention gave a pressure drop of 7.94 inches of water and had a weight of 0.843 gram. In other words, it may be observed from this higher weight that the filter rod by the present invention was more highly compacted and firmer. Another pair made from 2 D./F., 40,800 total denier continuous filament tow gave pressure drops of 8.4 and 10.5 inches of water and weights of 0.607 and 0.631 gram per rod respectively. That is, here again the firmer rod produced by the present invention was of greater weight and, therefore, more compact.

The rods made from the last-mentioned 2 D./F. continuous filament tow were attached in a comparable manner to cigarettes and smoked in a smoking machine in the usual manner for testing the filtration efficiency. The filters made by the present invention gave a removal of 35% which was 5% higher than the removal obtainable

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by the prior art filters. This 5% increase in removal is considered a substantial improvement in this filtration comparison considering that the filters of the present invention were being compared with one of the best prior art type of filters.

Example II

In accordance with this example rods designated BNC were produced by the process of the present invention from 2.1 D./F., 48,000 total denier cellulose acetate tow. Test rods from these runs which were made by the present invention showed that the filter elements had a weight of 0.4975 gram and a pressure drop of 11.9 inches of water and gave a removal of at least 31%. These filter elements of the present invention were compared with rods designated BNJ produced by prior art procedures from 2.1 D./F., 54,000 total denier cellulose acetate tow. The rod weight of these prior art type of elements was 0.5635 and the pressure drop was 11.9 inches of water. These rods made by the prior art, even though they were made from a bundle of filaments of some 6,000 greater total denier gave only a removal of 28%. In both instances the rods were each 24.7 mm. in circumference and 60 mm. long.

Example III

In accordance with this example filter elements designated 4 PN were produced in accordance with the present invention by passing 2.1 D./F., 40,800 total denier cellulose acetate tow through the aspirating jet of the present invention into the forming means. The formed rods had a weight of 0.631 gram. Since the purpose of this particular example was to compare the hardness of the filter element the rod produced by the present invention was tested and found to have a hardness value of 8.1.

The procedure for testing hardness is briefly as follows:

The hardness of a filter rod is determined by measuring the transverse compression of the rod under a suddenly applied load of specified magnitude. The rod is placed lengthwise on a flat platen and centered under a vertically positioned anvil. The anvil is one-half inch in diameter and has a flat end which is parallel to the platen. The anvil is brought into very light contact with the rod. The anvil is then suddenly released and allowed to press down on the rod. By means of a suitable gage, the movement of the anvil is measured in units of 0.1 mm. and this measurement is the hardness value. The total weight of the anvil is 347.5 gr. Since the rod continues to compress at a decreasing rate with time, the measurement is made 10 seconds after the load is applied. It is evident that a firm rod is compressed less than a soft rod so a low reading indicates firmness. The above described method is used by a majority of the filter and cigarette manufacturers. Generally a hardness value of 9.0 or lower indicates that the filter will perform satisfactorily in the assembly machines which attach filter tips to cigarettes and the tip will have a firmness which is pleasing to the average smoker.

For comparison with the rods made by the present invention rods designated 4 QR were produced by the prior art procedure from the same kind of filaments, namely 2.1 D./F., 40,800 total denier cellulose acetate tow. These prior art rods weighed 0.6185 gram and exhibited a hardness value of 12.5 when tested in the same apparatus and by the same method as just described. All of the rods tested were 24.7 mm. circumference and 90 mm. long.

As apparent, the smaller number of 8.1 exhibited by the rods of the present invention indicates that the rods of the present invention were considerably firmer than the prior art rods.

Example IV

A cellulose acetate tow of 3.2 D./F.—78,000 total denier processed in the conventional manner produced a 90 mm. rod weighing 1.066 grams. A 15 mm. tip removed 36% of the smoke solids. When processed with the aid of the aspirating air jet, the 90 mm. rod weighed

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1.096 grams and a 15 mm. tip removed 41% of the smoke solids. This increase in removal was effected with less than 0.3 in. additional pressure drop for the tip.

This invention can be used to form filters from fibrous or filamentary materials other than cellulose acetate as shown by the following examples, although the crimped continuous cellulose ester filaments represent the preferred embodiment.

Example V

Cotton sliver was prepared by conventional carding and drawing operations to form a sliver weighing 150 grams per yard. This sliver was fed to the forming and wrapping unit without my invention and formed into rods 90 mm. long by 24.7 mm. circumference. These rods weighed 0.91 gram per rod and had a pressure drop of 9.0 inches. Another similar sliver but weighing 170 grams per yard was processed in the same manner, yielding rods weighing 1.02 grams per rod and having 10.8 in P.D. The first sliver was also processed on the machine with my aspirating jet replacing the conventional trumpet. These rods weighed .98 gram per rod and had a pressure drop of 10.8 inches. It will be seen that the pressure drop increased to the value obtained for the heavier sliver without my invention but the weight was intermediate between that obtained for the light and heavy slivers. This indicates more efficient utilization of the material.

Example VI

A tow comprised of polyester filaments, 0.7 D./F., 28,000 TD, 30 crimps per in. was processed without the use of the aspirating jet. The resulting 90 mm. rod had a pressure drop of 10 inches and a 15 mm. tip attached to a 70 mm. tobacco portion removed 43% of the smoke solids. When the same tow was processed using the aspirating air jet, the rod weight increased somewhat, the pressure drop of the 90 mm. rod increased to 11.1 inches and a 15 mm. tip removed 48% of the smoke solids. An increase in removal of this magnitude would not have been obtained by increasing the total denier of the tow enough to give the same pressure drop when making rods without the aspirating air jet.

While in the above examples there was 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 15 p.s.i.g. It will be observed 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. That is, the present invention will successfully process filaments, for example, crimped 25 crimps per inch whereas the prior art processes were not successful in handling such type of filaments due to excessive breakage of the filaments. Therefore, the present invention will function satisfactorily not only on filaments heretofore used in the manufacture of filters but will operate successfully on finer more highly crimped filaments than heretofore have been regarded as practical for use.

I claim:

1. An apparatus for the manufacture of tobacco smoke filter elements out of continuous crimped filaments which comprises roll means for feeding said filaments to a truncated shaped jet, said jet being in close association with a compacting and forming means, said jet having a large open end positioned toward said roll means and a small end of the jet adjacent and positioned close to said compacting and forming means, said small end of the jet being provided internally with means for the injection of a

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gas within the jet whereby the filaments are motivated through the jet and pushed into the compacting and forming means to form a filter, and an endless belt device in association with the apparatus for feeding wrapping material around the filter.

2. An apparatus in accordance with claim 1 wherein the jet is positioned at about a 30° angle to the compacting and forming means.

3. An apparatus in accordance with claim 1 wherein the truncated shape in the large end is about 2 inches in diameter and on the small end is about 5/8 inch in diameter.

4. An apparatus in accordance with claim 1 wherein the jet is comprised of an inner member, the entrance end of which is more than twice the diameter of the exit of an outer member, said inner member being threaded into the outer member to provide an air chamber between the members, which air chamber exits internally close to the exit of the smaller outer member.

5. A method of making a filter element from spread out crimped continuous substantially untwisted filaments which comprises passing a band of several thousand of said spread out untwisted filaments into a cone shaped jet positioned in close proximity to and at an angle to compacting and forming means, supplying a gas to the jet whereby the spread out filaments are motivated into and through the jet and thereby upon exiting from the jet are pushed into the aforesaid closely positioned compacting and forming means thereby being formed into the filter element, also supplying a filter element wrapping web to the forming means whereby the filter formed as aforesaid is wrapped, sealing the wrapped web around the filter element and cutting the filter element to length.

6. The method in accordance with claim 5 wherein the filaments are comprised of several thousand cellulose acetate filaments of a denier between 1-16.

7. A method in accordance with claim 5 wherein the

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filaments are relatively fine filaments of a denier per filament of between 2-3.

8. In a process of manufacturing filter elements from plasticized cellulose acetate substantially untwisted filaments wherein the filaments are conducted into a compacting and forming means which shapes the filaments into the filter, the improvement step which comprises passing the filaments into and through a cone shaped air jet immediately adjacent the forming means whereby the filaments are motivated into the forming means in a relaxed condition without twisting.

9. A process in accordance with claim 8 wherein the air pressure supplied to the jet for motivating the filaments is from 2 to 15 p.s.i.g.

10. In the process of manufacturing filter elements from a band of several thousand continuous crimped untwisted filaments the improvement steps which comprise spreading out the crimped filaments into a band of filaments, then conducting the band of filaments through a cone shaped air jet in which there is straight-line air flow in the direction of movement of the filaments, said jet being positioned at an angle to and immediately adjacent filter forming means and applying air pressure to the jet sufficient to motivate and push the filaments into and through the jet and into the immediately adjacent forming means.

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