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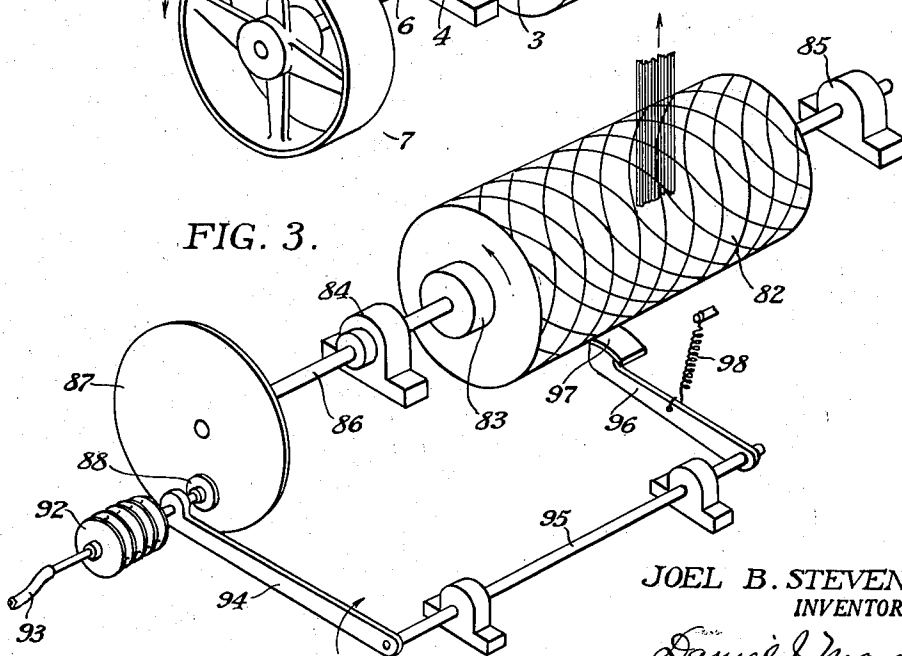
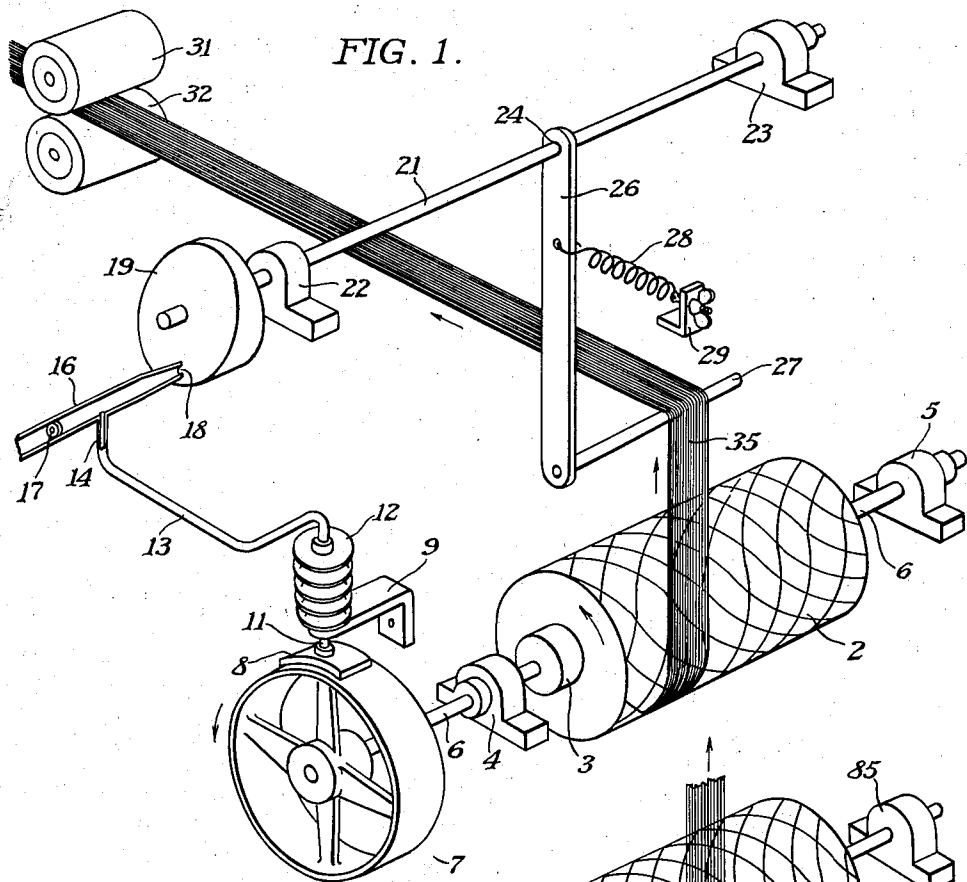
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PROCESS FOR PREPARING TOBACCO SMOKE FILTERING ELEMENTS

Filed Feb. 9, 1955

2 Sheets-Sheet 1



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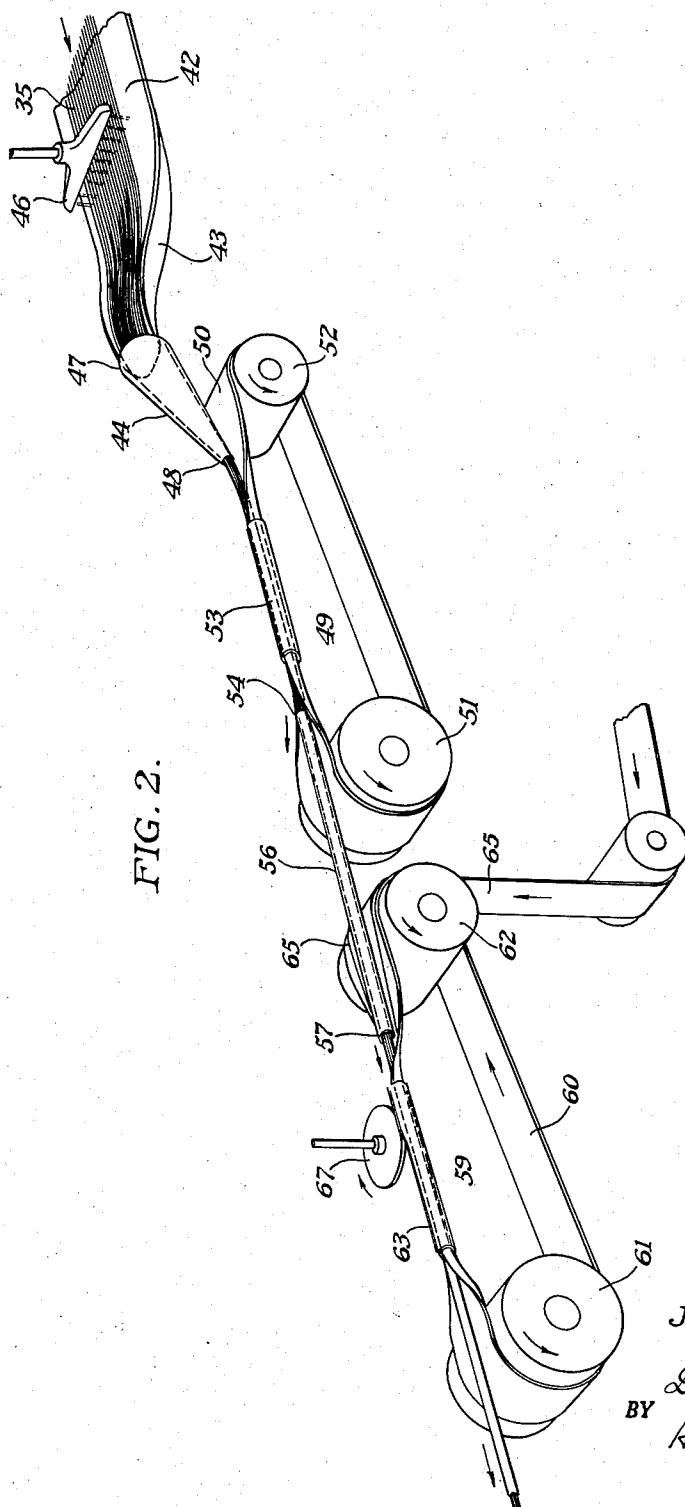
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PROCESS FOR PREPARING TOBACCO SMOKE FILTERING ELEMENTS

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This invention relates to method and apparatus for manufacturing tobacco smoke filter elements. More particularly this invention concerns a process and apparatus particularly adapted for use in the conversion of cellulose acetate tow into tobacco smoke filter elements.

In recent years a number of tobacco smoke filter elements have been made from textile fibers. In making these filter elements, various sources of the textile filaments such as from cones or the like packages of yarn, are unwound in a conventional manner on conventional equipment. The unwound yarn is fed into a forming device whereby the textile fibers are shaped to a rod or cylinder or other desired form for the filter. The shaped textile material is then wrapped or otherwise more permanently conformed on the surface so that the element retains its shape. The shaped element is then fed into conventional cigarette making machinery where it becomes attached to the cigarettes as a filter.

While the filters formed in the past by conventional procedure and with existing equipment permit the production of useful filters, there have been certain disadvantages. That is, some of the filters may not be as uniformly packed as desired, or they vary in packing from other filter elements of the same production. Also, prior filters may be subject to channelizing. That is, there may exist in the filament bundle relatively long, straight axial passages which permit portions of the smoke to pass through the filter substantially unimpeded. It is known that part of the filtering action obtains from impingement of the smoke particles on the filaments. Even though it has been customary to use crimped fibers, there still is the possibility that the resultant filter elements may possess parallel channels between the filaments due to some debundling or opening up of the fibers in the prior art procedures of making the filter elements.

After considerable investigation I have found that filter elements of the class described can be manufactured in an improved manner by improved procedure and apparatus herein described and a more uniform and efficient filter element obtained.

This invention has for one object to provide an improved method and apparatus for manufacturing tobacco smoke filter elements from textile filaments. A particular object is to provide an apparatus whereby the filter filaments may be incorporated into the tobacco smoke filter element in a relatively uniform manner. Still another object is to provide a procedure for making textile filaments into tobacco smoke filter elements, which elements are relatively free of any undesired channels. A particular object is to provide a new apparatus assembly for accomplishing the preceding objects. Another object is to produce a relatively uniformly packed, non-channelized tobacco smoke filter element from cellulose acetate fibers. Other objects will appear hereinafter.

I have found that certain of the lack of uniformity in filter elements of the class aforesaid is due to a lack of uniformity of feeding the filaments into the filter element

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forming steps. In other words, the textile filaments used in manufacturing filters may be furnished in a package exemplified by a ball warp. This comprises a cylindrical, flangeless, cardboard tube around which the filaments are wound. That is, the package is made up of filaments in the form of a tow or strand of about 4,000 to 100,000 individual filaments of a size that the total denier of the tow may be between 40,000 and 125,000. The filaments in the form of the tow or strand are traversed axially along the tube forming the package. The helix angle of the wind on such a package is commonly 10° to 25°. A particular package of the type under discussion may be 18" in circumference, 29" in length and weigh about 80 lbs.

When such packages are unwound on conventional equipment and the package is at its maximum circumference of about 18", the speed, tension on the filaments and delivery of the filaments to the filter making machine may be considerably different than the speed, tension, delivery, etc. when the circumference of the package has fallen to only one-half its original circumference, for example.

I have found that if suitable control is applied to the feed as will be described in detail hereinafter, that an improvement may be obtained in filter element manufacture and that a more uniform filter may be produced by delivering more uniform filter filaments to the filter making machine.

In addition to the lack of uniformity aforementioned, there may be the channelizing referred to above. I have found that if in addition to improving the feed, that in the filter manufacturing step certain procedures may be applied to better position the filaments within the filter so that channelizing may be minimized or eliminated.

For a further understanding of my invention reference will be made to the attached drawings forming a part of the present application. In the drawings:

Fig. 1 represents a side elevational, semi-diagrammatic view of an apparatus arrangement which may be used for more uniformly feeding the filaments to the filter forming operation;

Fig. 2 is likewise a semi-diagrammatic, side elevation view of an apparatus arrangement for forming the filaments into a tobacco smoke filter unit or element;

Fig. 3 is a semi-diagrammatic, side elevation view of modification of certain of the apparatus parts that may be used in connection with the apparatus of Fig. 1.

Referring to Fig. 1, 2 represents the package of filaments which are to be made into the tobacco smoke filtering units. As shown, 2 comprises a package known as a ball warp. However, my invention applies to other types of packages of filaments.

The package 2 is positioned on a suitable mandrel 3 which is carried in journals 4 and 5. The shaft 6 from the mandrel is rigidly attached to a suitable wheel 7. Positioned at some suitable point on the wheel is a brake shoe 8. This brake shoe may be constructed of fibrous material or other conventional brake shoe material. The exact construction of the brake shoe is not a limitation on the present invention. The brake shoe is held in position by means of a bracket 9. The brake shoe is connected by means of a movable plunger rod 11 to bellows 12. The upper portion of the bellows is connected by conduit 13 to source of fluid pressure comprising nipple 14.

Nipple 14 is positioned on the side of a tube device 16 which has metering orifice 17 in one end and the regulating orifice 18 on the other end. The metering orifice is positioned in close contact with the cam 19 which is of unsymmetrical thickness. It will be noted that the cam is constructed unsymmetrically in such a manner and slope that its rotation in one direction tends to close the

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opening of orifice 18. In the other direction it tends to open the space. Cam 19 is mounted on the end of shaft 21 which is carried by bearings 22 and 23.

Mounted intermediate of shaft 21, as at 24, is a dancer arm assembly 26. A cylindrical yarn guide arm 27 extends from the side of the dancer 26. Also, the dancer is attached through spring mechanism 28 to a bracket 29.

Positioned in close proximity to the parts described are a pair of draw rolls 31 and 32. These draw rolls may be the same as customarily used in the textile art. That is, they comprise the usual type of roll carrying a cork, plastic or rubber covering or the like adapted to grasp the fibers without injury thereto, and exert tension thereon.

As will be explained in detail hereinafter, the discharge from the draw rolls 31 and 32 may feed to the tobacco smoke filter element manufacturing operation shown in Fig. 2.

The operation of the apparatus shown in Fig. 1 is apparent to a substantial extent from inspection of the drawing and the description of the apparatus which has already been set forth. The yarn in the form of crimped tow or cord 35 is withdrawn from the package and carried over the side arm 27 and into the nip of the draw rolls. In threading the draw rolls the tow may be spread out somewhat and rolls 31 and 32 will keep the tow spread out. Driving power (not shown) is applied to the draw rolls so that tension is applied on the tow 35 causing the package 2 to unwind. A suitable source of fluid pressure, as for example compressed air, is applied to the metering orifice 17. Since this is a sized orifice, the volume of air passing through it is proportional to the differential pressure across it, and orifice 18 constitutes a variable or regulatory orifice. Since the air passing through 17 must escape through 18, the air pressure downstream from 17 will be an inverse function of the effective orifice size of 18. If orifice 17 is substantially smaller than the average effective area of the regulatory orifice 18, the volume of air passing through 17 will be nearly constant. The air pressure in 14, 13, and 12 will therefore be an inverse function of the effective area of regulatory orifice 18. Accordingly the braking pressure exerted on brake shoe 8 is a function of the size of regulatory orifice 18, which is in turn controlled by the position of cam 19. The pressure of the brake shoe on wheel 7 may be adjusted manually (as by raising or lowering the braking assembly) to permit the package to rotate at the desired speed under the conditions discussed above.

The dancer arm 26 is positioned substantially vertically by suitably adjusting the tension of spring 28.

With the various adjustments made, and keeping a relatively uniform stream of compressed air on the metering orifice 17, the yarn 35 may be uniformly withdrawn by the draw rolls 31 and 32. That is, if there is an increase in tension on the yarn, it moves rod 27. This movement of rod 27 in turn moves dancer arm 26 which in turn moves shaft 21, thereby moving the unsymmetrical cam 19. This movement of the unsymmetrical cam in close proximity with the regulating orifice allows more air to escape from the regulating orifice. This in turn reduces the air pressure on the brake shoe thereby permitting the package 2 to rotate more readily to a point where the yarn is being unwound uniformly in accordance with the predetermined conditions referred to above. On the other hand, if the package tends to rotate too freely, the spring 28 moves the arm 26 and the cam so as to close off the orifice to some extent, thereby causing the brake to apply.

Referring now to Fig. 2, 42 represents an apron or collecting plate upon which the uniformly withdrawn, and therefore more uniform filaments emerging from draw rolls 31 and 32 may be discharged. This plate may be comprised merely of smooth metal gradually curved at 43 so that the discharged filaments can be readily conducted to the tapered horn 44. Positioned intermediate

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of the collecting plate 42 may be one or more spray nozzles, powder adding means or the like device 46. This device, or devices 46, are for the purpose of adding plasticizer, powdered charcoal, fuller's earth, asbestos fibers, or the like additives or other treating agents which it may be desired to incorporate with the discharged, spread, uniform fibers. The plate 42 also serves in a small way as a reservoir or storage space for the fibers delivered from the draw rolls 31 and 32 prior to their being pulled through the apparatus of Fig. 2.

The tapered horn may be comprised of a truncated metal tube having a large end 47 and a smaller exit portion 48.

The smaller end 48 feeds into the first garniture 49 (also known as a folder). The garniture is provided with conveyer belt 50 carried on positively driven pulleys 51 and 52. The upper portion of the garniture device is at 53 provided with a curved construction made up of formed metal sheets whereby the filaments which have been bundled at 48 may be further bundled or formed into a cylindrical rod shape. Preferably this construction at 53 is such that the formed filaments discharged therefrom at 54 will have a smaller diameter than the final size desired. Positioned adjacent discharge 54 is a thin walled tube 56 having a highly polished interior. Preferably the bore of this tube is slightly tapered with a larger diameter at the end 57.

Positioned adjacent to the discharge 57 is a second garniture or folder 59 of a construction generally similar to garniture 49. That is, suitable conveyer belt is provided at 60, which conveyer belt is motivated by drive rolls 61 and 62. Means is provided at 63 for further forming the already partially formed fibers into the desired filter shape.

Also, provision is made at 65 for feeding in filter wrapping material as paper (from a source not shown) so that the wrapping material passes upwardly and over the drive pulley 63 and into contact with the formed filaments.

Suitable mechanism, as a conventional paste wheel, is provided at 67 for sealing the wrapping material around the formed filter element.

The operation of the apparatus in accordance with Fig. 2 may be generally in accordance with the following. A suitable source of uniformly supplied crimped tow is received on plate 42. Any of the desired additives such as plasticizer or the like can be incorporated at this point. The prepared tow is then fed into the tapered horn 47 and is picked up therefrom by conveyer belt 50. Conveyer belt 50 conducts the already partially shaped filaments to garniture forming means 53. Inasmuch as this forming means is preferably slightly smaller than the desired final diameter, the fibers are closely compacted. The partially formed rod emerging at 54 then passes into the thin walled slightly tapered tube 56. From tube 56 the partially formed rod then enters the second garniture forming member 63. This latter garniture is supplied with paper and the rod wrapped and sealed in the conventional manner. However, the speed of the second garniture as controlled by the rotation of pulleys 61 and 62 is less than the speed of operation of pulleys 51 and 52, preferably on the order of 60-90%. As a result, the rod is continuously shortened in the thin walled tube and as it enters the second garniture. This causes a contraction to take place very uniformly and acts to increase the degree of crimp of the individual fibers as the fibers are already weakened at the point of crimp.

The finished wrapped rod discharged at 71 comprises a relatively uniformly packed filter arrangement with few if any channels therein.

Referring now to Fig. 3, there is shown a modified construction which may be used in connection with the apparatus of Fig. 1. In this Fig. 3, the yarn package 82 is carried on a mandrel 83. The mandrel rides in bearings 84 and 85 substantially the same as the corresponding construction of Fig. 1. The mandrel is connected

through shaft 86 with a disk 87. The disk 87 is provided with brake shoe 88, bellows 92 and source of fluid pressure 93, likewise generally comparable to similar parts shown in Fig. 1.

However, in the instance of Fig. 3, the brake shoe is mounted on a movable arm 94. This arm is in direct connection through rod 95 with the feeler mechanism 96. This feeler mechanism is in contact by means of the smooth metal plate 97 with the package being unwound, being held there by spring 28.

The construction shown in Fig. 3 is designed to provide a brake which will compensate for changes in the diameter of the package. In order to provide even more accurate constant tension, the braking action should decrease as the diameter of the package being unwound decreases. With the construction shown in Fig. 3 the feeler 97 rides lightly against the package being unwound and positioned the bellows 92 and brake shoe 88 on the disk 87 in such a manner that the torque developed by the tension of the tow decreases.

It can be seen, therefore, from the foregoing, that I have provided an apparatus and process whereby filaments for tobacco filter units may be rendered more uniform before the filter making step and then fed through the filter making steps in a manner whereby the filaments are better compacted and the crimp is returned or increased. I have found that better filter elements result from my improvements in that the finished filters are more uniform and free of channels. While my unwinding procedure using apparatus of Figs. 1 and 3 as applied to crimped yarn may reduce the crimp to some extent because of the tension exerted by the draw rolls, still the remaining crimp in the yarn delivered from the draw rolls is more uniform than in prior art procedures where the yarn is, so-to-speak, unwound more or less at random.

That my filter making yarn will be more uniform may be further observed from the following examples set forth to illustrate this detail.

Example I

In accordance with this example, procedures generally represented by the best prior art practices were followed. A 5 D/F, 100,000 denier tow was withdrawn from a ball warp at a speed of 40 meters per minute. Standard tension measuring device was applied to the yarn as by inserting it in contact with a guide over which the yarn passed. The tension on the full ball was the relatively low tension of 2 lbs. However, this tension rose to about 8 lbs. when the tube was nearly empty.

Example II

In accordance with this example the yarn to be used in making tobacco smoke filtering elements was unwound in accordance with the procedure and using the apparatus of the present invention which has been described in detail above. A 16 D/F, 80,000 denier tow was withdrawn from a ball warp at a speed of 40 meters per minute. That is, as shown in Fig. 1, the yarn was passed over guide 27 and into the nip of draw rolls 31 and 32. The apparatus of the present invention was adjusted as by adjusting the tension on spring 28 and the other parts so that the tension was about 2 lbs. Air pressure was applied, as already described above, so that a uniform braking action was maintained on wheel 7. The entire 80 lbs. package was unwound and the tension during and at the termination of unwinding remained substantially constant. Accordingly, the product delivered from the draw rolls was generally much more uniform than the product obtained in the preceding example.

Even if some of the initial crimp in the yarn is removed by the two pound tension aforementioned, this does not present any problem in the present invention. The filter forming assembly of Fig. 2 acts to restore crimp, or in some instances even to increase the crimp. That is, as pointed out above, pulleys 61 and 62 (of

Fig. 2) may be operated at a lower speed than pulleys 51 and 52. This causes the fibers to compact somewhat in tube 56. As already mentioned above, this causes the crimp to return or increase as the fibers are already weakened at the point of previous crimp. Hence, in the process of the present invention the resultant filter elements are relatively free of any straight fiber pairs which would tend to form a channel. Accordingly, the resultant filter elements by the present invention which are more compacted and shortened somewhat by the treatment described above, permit the production of a filter element where the tobacco smoke will impinge on the crimped sections.

While the described apparatus is regarded as quite satisfactory, because of its simplicity, and it gives an improved product, this does not preclude making certain changes therein. That is, the present invention is not limited to the use of pneumatic sensing and controlling devices. Electromagnetic or hydraulic equipment may be used. The sensing element for example might employ pneumatic elements which pneumatic elements would actuate an electrical brake control. A particularly important aspect to note is that I have provided a brake powered from an external source in a sensing member capable of detecting changes in the tow being unwound and regulating the power input to the brake in correlation with the detected changes.

In connection with the filter forming machine portion of Fig. 2, other features known to the cigarette making art may be incorporated in the mechanism. The paste to seal the wrapper may be applied from an orifice rather than from a wheel. Any of the known types of belt guides, paper guides, heated sealers, or cut off mechanisms may be employed. The paper wrapper can be joined to the filament bundle by applying one or more thin lines of a suitable adhesive to the inner surface of the wrap. This feature would preclude the possibility of having the filament bundle slip out of the wrap when cut in short lengths.

I claim:

1. The method of making tobacco smoke filter elements from packages of crimped, substantially continuous tows of about 4,000 to 100,000 individual filaments of a size that the total denier of the tow is between 40,000 and 125,000, which comprises unwinding the packages by passing the continuous filaments from the package through rotating draw rolls, rotating so as to draw the filaments from the package as well as spread out the filaments into a band, placing a pneumatic sensing means in contact with the filaments being thus withdrawn, correlating the sensing means in a predetermined manner with a braking means in pneumatic braking association with the package being unwound, regulating the pneumatic input to the braking means in correlation with the sensing device so that the filaments of the tow are substantially uniformly withdrawn from the package and substantially continuously feeding said tow filaments thus uniformly withdrawn to the further tobacco smoke filter element making steps which comprise supplying additives to the uniformly withdrawn spread-out filaments, passing the filaments thus treated through a tapered horn, then through a forming garniture, a forming tube and a second forming garniture in series, the process being characterized in that in the first forming the filaments are compacted to a greater amount than in the second forming and the feed to the second forming garniture is at a lower rate than in the first forming garniture, whereby a more uniform packed tobacco smoke filter element which is relatively free of channels is obtained and wrapping the filaments thus compacted.

2. A method of manufacturing relatively uniformly packed tobacco smoke filter elements from a package of crimped continuous cellulose ester tow, which comprises withdrawing the tow from said package, passing the withdrawn tow upstream to positively driven draw

rolls whereby the tow is spread out into a band of filaments, said withdrawal being in a manner that there is a substantially constant tension in the tow between the package and said upstream draw rolls, substantially continuously feeding the filaments thus uniformly withdrawn to the further tobacco smoke filter element making steps which include passing the filaments through a tapering horn, then through two forming garnitures in series whereby said filaments are formed into the filter elements.

3. The method in accordance with claim 2 wherein the formed filaments discharged from the first garniture have a smaller size than the desired final size of the filter element.

4. The method of making tobacco smoke filter elements from packages of crimped substantially continuous tows of about 4,000 to 100,000 individual filaments of a size that the total denier of the tow is between 40,000 and 125,000 which comprises withdrawing the tow from the package so that a sensing means is in contact with the filaments being withdrawn correlating the action of the sensing means with a braking means, regulating the power input to the braking means so that the 4,000 to 100,000 filaments of the tow are substantially uniformly withdrawn from the package and feeding the uniformly withdrawn filaments to associated tobacco smoke filter element manufacturing steps in series whereby a more uniform packed tobacco smoke filter element is obtained which is relatively free of channels.

5. In a method of making tobacco smoke filter elements from a package of crimped continuous tow of about 4,000 to 100,000 individual filaments of a size that the total denier of the tow is between 40,000 to 125,000, the steps which comprise withdrawing the filaments from the package in a manner so that the filaments of the tow are substantially uniformly withdrawn from the package and feeding the withdrawn uniform tow filaments to filter forming and wrapping steps which are characterized in that the first forming step contains a garniture which is smaller than the garniture in a later forming step and that the feed to the later forming step is at a lower rate than in the first forming step, and wrapping the formed tow whereby a more uniformly packed tobacco smoke filter element is obtained which is relatively free of channels.

6. In a process of making tobacco smoke filter elements from a package of substantially continuous crimped tow of about 4,000 to about 100,000 individual filaments, the

procedure of opening the crimped 4,000 to 100,000 filament tow which comprises passing the tow from a package thereof to upstream, positively driven draw rolls whereby the tow is spread out into a band, continuously sensing the tension of the tow running from the package to said upstream draw rolls, applying a braking force to the rate of withdrawal of the tow from the package in inverse proportion to the sensed tension of the tow and to an extent sufficient to produce a substantially constant tension in the tow between the package being unwound and said upstream draw rolls, feeding the tow thus withdrawn and banded to further upstream means whereby the tow is formed into a filter element which is more uniformly packed and relatively free of channels.

7. In a process of making a relatively uniform tobacco smoke filter element from a package of substantially continuous filament tow of about 4,000 to 100,000 individual crimped filaments of a size that the total denier of the tow is between 40,000 and 125,000, the improvement feature which comprises withdrawing the tow from the package and passing the withdrawn tow to upstream, positively driven draw rolls whereby the tow is spread out at least to some extent into a band, this withdrawal of the tow being characterized in that the withdrawn tow is under uniform tension and feeding the uniformly withdrawn tow into filter forming and wrapping steps.

8. A process of the class set forth in claim 7 wherein the filter element forming steps comprise two steps, the first forming step compacts the tow smaller than the second forming step and the feed to the second forming step is at a lower rate than in the first forming step.

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