

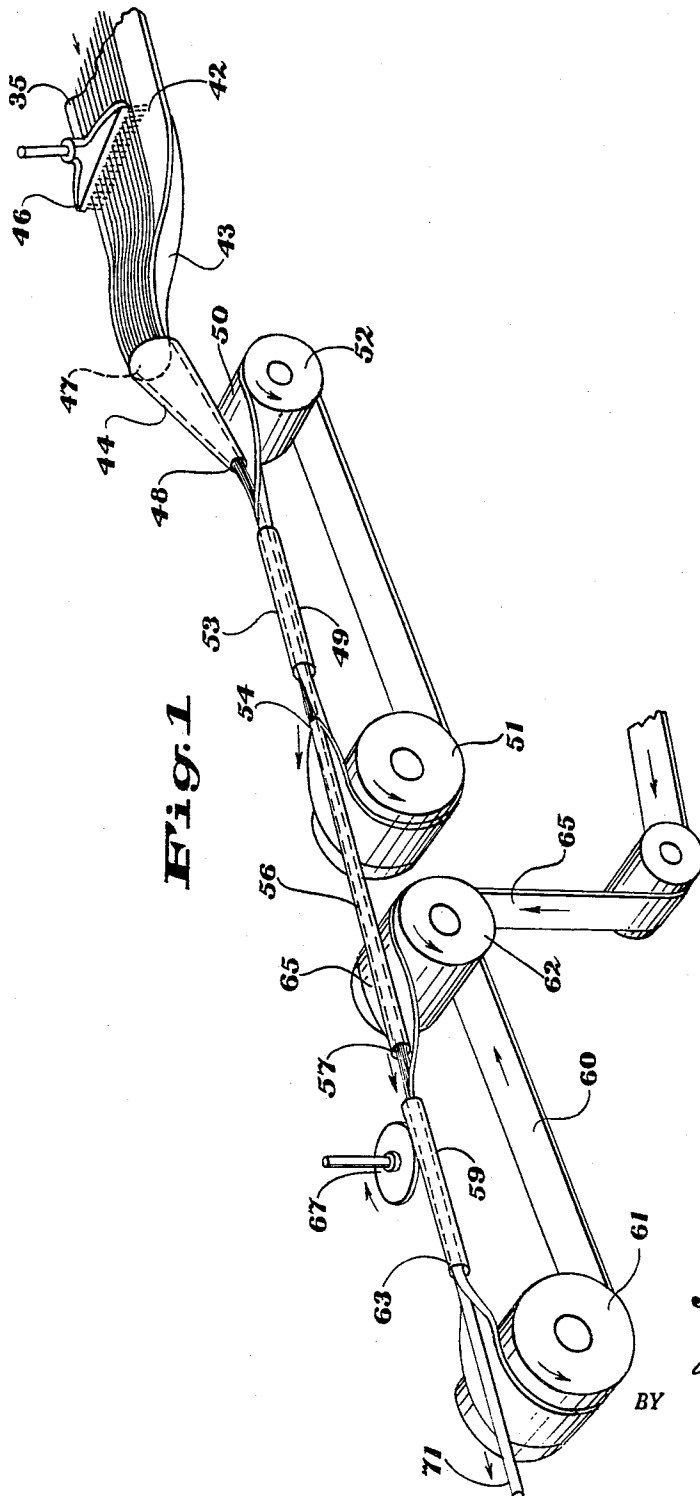
Feb. 11, 1964

J. B. STEVENS  
PROCESS AND APPARATUS FOR PREPARING TOBACCO  
SMOKE FILTERING ELEMENTS

3,120,690

Filed Dec. 5, 1960

2 Sheets-Sheet 1



**Fig. 1**

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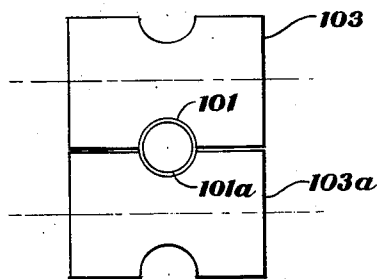
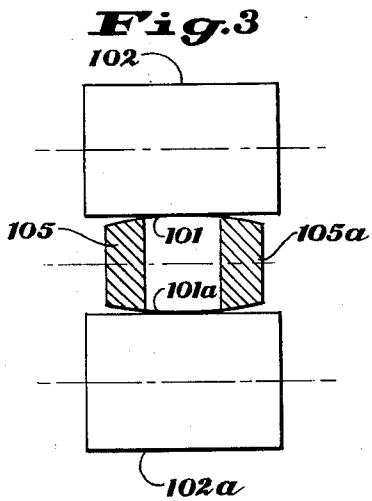
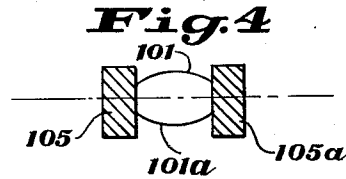
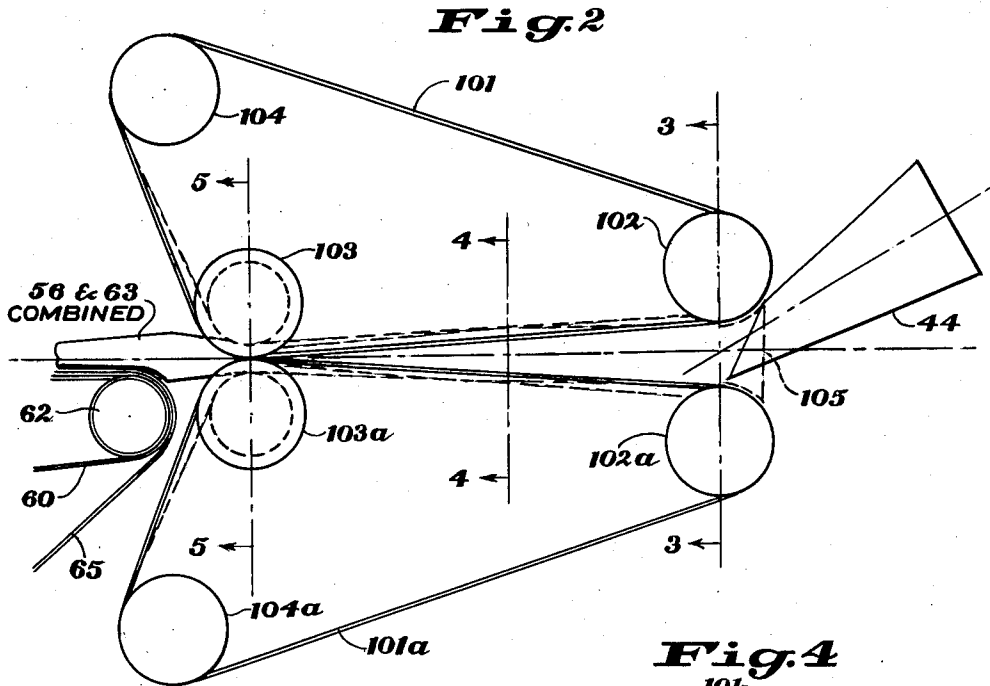
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3,120,690

**PROCESS AND APPARATUS FOR PREPARING TOBACCO SMOKE FILTERING ELEMENTS**

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Filed Dec. 5, 1960, Ser. No. 73,724

7 Claims. (Cl. 28—1)

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.

This application is a continuation-in-part of parent application Serial No. 487,017, filed February 9, 1955, now U.S. Patent 2,964,440.

In recent years certain types 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 forming steps. This subject matter is more fully referred to in the aforesaid parent application.

In addition to the lack of uniformity just mentioned,

there may be certain channelizing. 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. This feature is disclosed in detail herein.

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

FIG. 2 is a semi-diagrammatic, side elevation view of a modification of the first forming means shown in FIG. 1.

FIGS. 3, 4 and 5 are detailed views of certain sections, taken on the lines A—A, B—B and C—C of FIG. 2.

Referring to FIG. 1, 42 represents an apron or collecting plate upon which preferably uniformly withdrawn, and therefore more uniform filaments emerging from suitable draw rolls or the like 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 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 prior to their being passed through the apparatus of FIG. 1.

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 conveyor 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. This construction at 53 is such that the formed filaments discharged therefrom at 54 may have a smaller diameter than the final size desired. Positioned adjacent discharge 54 is a thin walled tube 56 having a highly polished interior. The bore of this tube may be slightly tapered with a larger diameter at the end 57.

Positioned adjacent to the discharge 57 is a second garniture of folder 59 of a construction generally similar to garniture 49. That is, suitable conveyor belt is provided at 60, which conveyor belt is motivated by drive rolls 61 and 62. Means are 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 pulleys 62 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. 1 may be generally in accordance with the following. A suitable source of preferably 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 may be slightly smaller than the desired final diameter, the fibers are closely compacted. The partially formed rod emerging at 54 then passes into the thin wall slightly tapered tube 56. From tube 56 the partially formed rod then enters the second garniture forming member 59. 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 discharges at 71 comprises a relatively uniformly packed filter arrangement with few if any channels therein.

Reference is now made to FIGURES 2, 3, 4 and 5 which cover a modification of the first forming means shown in FIG. 1. In these figures, 101 and 101a represent two endless belts disposed generally on opposite sides of the tow which has previously been processed (i.e., banded, debundled or fluffed, treated to bond, and if desired, treated with a powdered or fibrous additive). In these figures each element is generally duplicated by a like element which is identified by the suffix *a*. In the following description, reference to the duplicate element is sometimes omitted.

Endless tape 101 is positioned by rollers 102, 103, and 104. One or more of these rollers is positively driven by any conventional means. All powered rollers turn at the same linear speed which speed is generally greater than the linear speed of tape 60 and wrap 65 of the final forming and wrapping means. However, advantages result from the use of the pre-forming and feeding means even when it runs at the same linear speed as the final forming means.

Rollers 102 and 104 may be cylindrical as indicated in FIG. 3 or they may be either slightly concave or slightly convex. Roller 103 has a semicircular groove in its face as shown in FIG. 5. Belt 101 and roller 103 are of a size such that in cooperation with 101a and 103a the tow is compressed to a cylindrical shape and it is completely enclosed by the belts so that all portions of the tow are urged forward uniformly.

To enclose and confine the filter forming material as it enters the tapes, stationary side shields 105 and 105a are disposed to fill the gaps between the belts as shown in FIG. 4. Each guide is tapered either uniformly or at least where it enters rollers 103 and 103a. The tow contacting surface of side shields 105, 105a should have long wearing surfaces with a low coefficient of friction. Suitable materials include hardened steel, bone fiber, Teflon and others.

Between rollers 102 and 103 the tow compacting chamber changes from a comparatively large section which is roughly rectangular to a smaller circular section. One intermediate section is indicated by FIG. 4 which is a section on B-B in FIG. 2. If desired, one or more properly contoured rollers or stationary belt guides can be placed between rollers 102 and 103 to support the belt in the desired cross-sectional form. Likewise the inner surfaces of side shields 105, 105a can be contoured to develop the circular cross-section.

Belts 101, 101a may be woven by known methods from natural or synthetic fibers or they may be formed from suitable rubber-like materials.

The formation and wrapping of cellulose acetate filter rods using a standard cigarette garniture (or folder) is well known to those skilled in the art. The disadvantages

of such a mechanism is that the tow is not compacted and urged forward as uniformly as desired. The tow is motivated by one tape acting through the wrap. Initially the wrap contacts less than half the surface of the tow. The remainder of the tow surface is confined but not moved forward by a stationary tongue. Consequently the tow hangs back and is not possible to obtain a rod wherein the fibers are completely relaxed. In other words, the filaments are stretched to some extent and the fibers have less crimp than is desired. When using the apparatus shown in FIGURE 2, more than one-half the surface of the tow is in contact with motivating surfaces and there is essentially no tendency to elongate the filaments.

Considering FIG. 1, the first, or upstream, forming means can be operated at a higher linear speed than the second means whether the first means be essentially a conventional garniture or a double belt forming means depicted by FIG. 2. In such case the filaments will be "shortened" (more highly crimped) as the tow passes through transition element 56 of FIG. 1. To facilitate this longitudinal compression, it is desirable to reduce the tow circumference in the first forming means below the finished circumference. Transition tube 56 can then be a diverging funnel, facilitating passage of the tow. The resilience of the crimped fibers will ensure that the tow expands to its final circumference.

Using the first forming means of FIG. 2, advantages are derived from using two forming means even when they operate at the same linear speed. In such case the thrust imparted to the tow through more than half of its surface results in filter rods having a uniform pressure drop.

It can be seen, therefore, from the foregoing, that I have provided an apparatus and process whereby filaments may be 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.

For a further understanding of this invention reference is made to the following examples illustrating certain preferred embodiments.

#### Example 1

Tobacco smoke filter rods were made from a cellulose acetate tow composed of 5-denier filaments using apparatus disclosed in U.S. Patent 2,794,480. The forming and wrapping means (62 of the patent) was a conventional garniture.

Using the same type of tow, additional rods were made with a double forming means similar to FIG. 1 of the present invention. The two forming means were essentially cigarette garnitures modified slightly to accommodate the transition tube 56. The linear speed of the first forming means was 10% greater than the linear speed of the second forming (and wrapping) means. A third rod was made by the conventional process using a tow of higher total denier. Results of comparative tests on the three types of rods are tabulated below:

Garniture.....	Single	Double	Single
Tow:			
D./F.....	5	5	5
Total Denier.....	70,000	70,000	78,000
Crimp per in.....	7.5	7.5	7.5
Rod:			
Length, mm.....	90	90	90
Circumference, mm.....	24.8	24.8	24.8
Weight of tow, gms./rod.....	0.730	0.802	0.814
Pressure drop, in. of water.....	7.1	8.8	8.6

It will be seen that the double garniture of the present invention produced a rod which had a higher pressure drop per unit weight than did the conventional process. This improved effectiveness resulted from the increase in the amount of fiber surface presented to the gas stream.

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## Example II

Filter rods were made from a 3 d./f., 64,000 T.D. tow using the conventional single garniture and a double garniture with the first element similar to FIG. 2. Analysis of the rods gave the following results:

Garniture.....	Single	Double
Rod:		
Length, mm.....	90	90
Circumference, mm.....	24.8	24.8
Weight of tow, gms. per rod.....	0.715	0.900
Pressure drop, in. of water.....	10.2	16.1

Here again, a modest increase in the weight of the filter material resulted in a disproportionate, but favorable, increase in rod pressure drop.

## Example III

A 2.1 d./f., 48,000 T.D. tow was processed using the conventional garniture and the double forming means of FIG. 2. The two sections of the double garniture were run at the same linear speed to check the effect on uniformity for rods of the same average weight and pressure drop. The analyses are tabulated below:

Garniture.....	Single	Double
Rod:		
Length, mm.....	90	90
Circumference, mm.....	24.8	24.8
Tow weight, gms./rod--		
Average, 25 rods.....	0.634	0.683
Std. deviation.....	0.020	0.018
Pressure drop, in. of water--		
Average, 15 rods.....	15.6	15.6
Maximum.....	16.6	16.3
Minimum.....	14.7	14.8
Range.....	1.9	1.5

It will be seen that the double garniture resulted in a modest but worthwhile improvement in the uniformity of both the weight and pressure drop of the rods.

In connection with the filter forming machine portion of FIG. 1, 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.

It is thought apparent from the foregoing description that the double garniture apparatus and process of the present invention permit the production of a better filter element. The tow filaments may be feed more uniformly with less possibility of the crimp being reduced, for example.

Although the invention has been described in detail with reference to preferred embodiments thereof, 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 by the appended claims.

I claim:

1. The process of making a uniform, spread out tow into a tobacco smoke filter element which comprises

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feeding said tow into and through a plurality of forming means which comprise a first garniture, a tube and a second garniture in series and controlling the feed to said second garniture so that it is slower than the feed to the first garniture whereby compactness is obtained in said filter element.

2. The process for making crimped cellulose acetate continuous filament tow into tobacco smoke filter elements including feeding the tow through a plurality of forming devices in series, the steps characterizing the process in that the rate of feed of the tow to the later forming steps is at a lower rate than the rate of feed to the first forming steps whereby improved compactness is obtained in said filter elements.

3. A process in accordance with claim 2 wherein a paper wrapper which has adhesive on its inner surface is applied around the filter element.

4. An apparatus for the manufacture of tobacco smoke filter elements from substantially continuous crimped textile tow, said apparatus comprising in series means for receiving the tow, a tapered horn in association with one end thereof and also in association with a first garniture, a tube means, said tube means being interposed between the first garniture and a second garniture.

5. An apparatus in accordance with claim 4 wherein the tube is of larger diameter at the end adjacent the second garniture than at the other end, said tube having a highly polished interior.

6. The process of making a uniform, spread out tow into a tobacco smoke filter element which comprises introducing a uniformly supplied, crimped bundle of tow filaments to a plasticizer application zone, applying plasticizer to said filaments in said plasticizer application zone, feeding the filaments prepared with plasticizer into a tapered horn and partially shaping the filaments therein, picking up said filaments from said tapered horn by a conveyor belt and conducting the partially shaped filaments to first garniture forming means, closely compacting said filaments in said first garniture forming means into a partially formed rod, passing said partially formed rod into second garniture forming means at a speed less than that at which the partially shaped filaments are conducted into said first garniture forming means, thereby increasing the degree of crimp of the filaments of said rod, and wrapping and sealing said rod in said second garniture forming means.

7. An apparatus for the manufacture of tobacco smoke filter elements from substantially continuous crimped textile tow which comprises means for applying plasticizer to said tow, a tapered horn positioned following said means for applying plasticizer and associated at its opposite extremity with first forming means, tube conducting means between said first forming means and second forming means, means for introducing paper wrapping material to said second forming means, a paste wheel in association with said second forming means and means for moving said tow at a slower rate through said second forming means than through said first forming means.

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2,794,480	Crawford et al. ....	June 4, 1957
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