Oct. 10, 1967 A. H. AGETT ET AL 3,345,917

MACHINE AND METHOD FOR CONTROLLING THE CIRCUMFERENCE OF PAPER WRAPPED CIGARETTE FILTER RODS

Filed Dec. 28, 1964 3 Sheets-Sheet 1

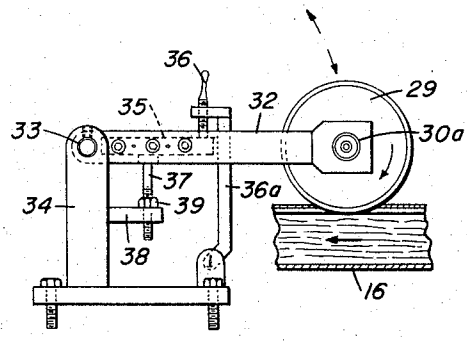

FIG. 10

FIG. 1

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Filed Dec. 28, 1964 3 Sheets-Sheet 2

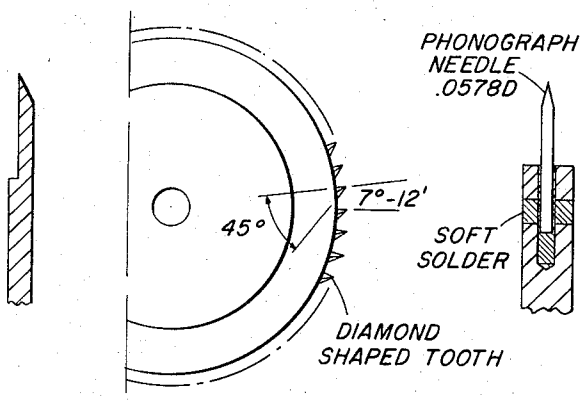

FIG. 2

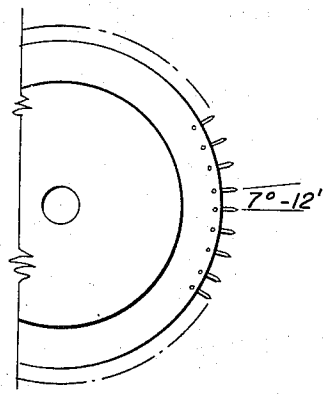

FIG. 3

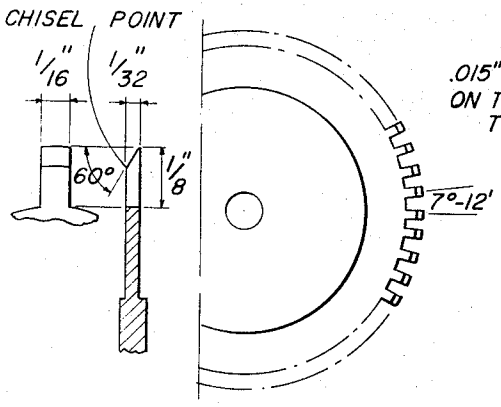

FIG. 4

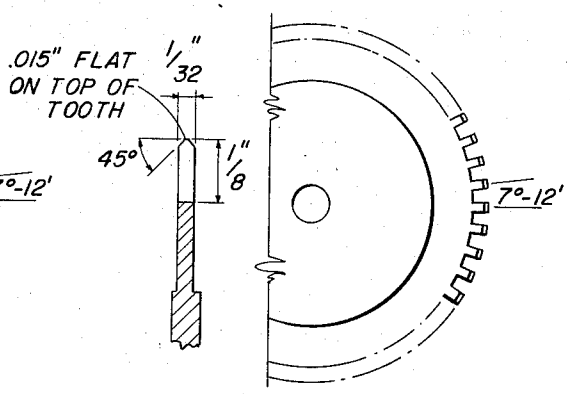

FIG. 5

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MACHINE AND METHOD FOR CONTROLLING THE CIRCUMFERENCE OF PAPER WRAPPED CIGARETTE FILTER RODS

Filed Dec. 28, 1964 3 Sheets-Sheet 3

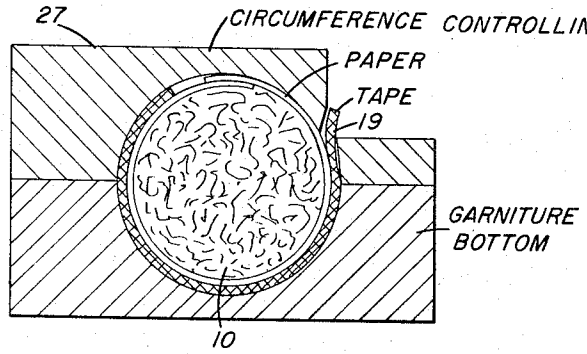

FIG. 7

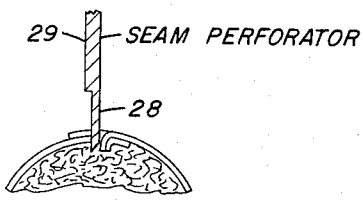

FIG. 8

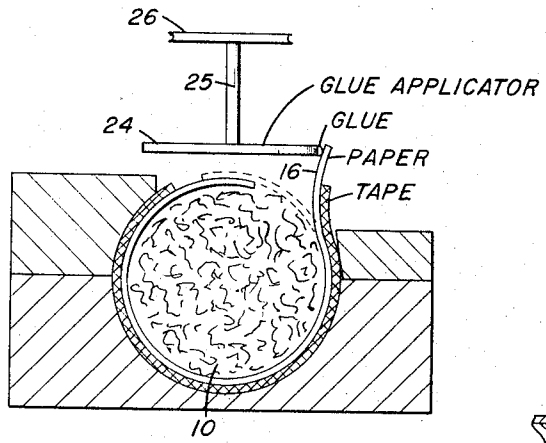

FIG. 6

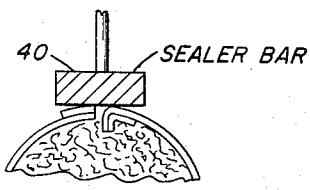

FIG. 9

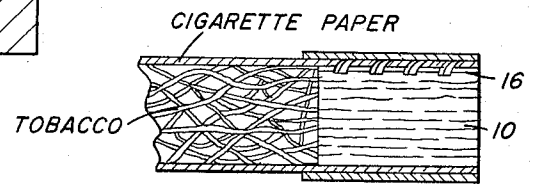

FIG. 11

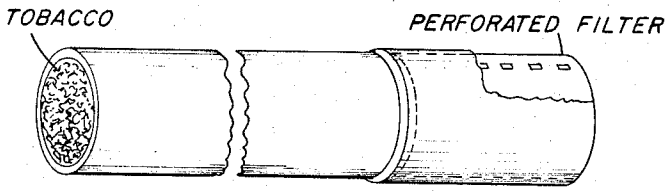

FIG. 12

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3,345,917

MACHINE AND METHOD FOR CONTROLLING THE CIRCUMFERENCE OF PAPER WRAPPED CIGARETTE FILTER RODS

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Filed Dec. 28, 1964, Ser. No. 421,276
7 Claims. (Cl. 93—1)

This invention relates to cigarette filter making machinery and a cigarette filter making process and more particularly to an improvement in such machinery and process which provides a means of ensuring uniformity of circumference of a paper wrapped filter by perforating the paper, after it has been wrapped around the filter material and overlapped to form a seam, in such manner as to prevent slippage of the paper layers at the seam and to hold them in place with or without the aid of a gluing or adhesive sealing operation.

In the manufacture of filter type cigarettes the filter unit or filter plug in some types of filter cigarettes consists of a cylindrical mass or rod of crimped synthetic filaments encased in a thin paper wrap in the same manner that tobacco is wrapped in the making of non-filter type cigarettes. The synthetic filaments, in the form of a crimped continuous filament tow containing many thousands of fine denier filaments is continuously fed, together with a narrow continuous strip of paper, into a filter making machine, as for example, a machine such as described in U.S. Patent to Wexler 3,016,945, where the tow is shaped and compressed into the form of a substantially cylindrical rod and continuously encased in the paper wrap. As paper and tow pass through the machine the paper is caused to overlap a fraction of an inch to form a seam. Just prior to formation of the seam adhesive is continuously applied at the point of overlap. After filter rod and paper pass this point, the overlapping adhesive-coated surfaces of the paper are brought together and the adhesive activated by means of a heated sealing means such as a hot iron or electrically heated sealing bar. The resulting product is a cylindrical filter rod which should have as nearly as possible the same diameter and circumference as the tobacco bearing portion of the cigarette of which it is to become a part.

It has been found that even with extreme refinement in the tow and paper handling parts of the filter making machinery and the exercise of extreme caution in operation, non-uniformity in the circumference of the wrapped tow or filter rod product often occurs. Such non-uniformity is largely due to the springy nature of the crimped filamentary material making up the tow when it is compressed into the form of a cylinder or rod and the fact that this outward expansive force or "springiness" tends to cause the overlapping portions of the paper in which the filamentary material is confined to slip or slide one over the other. Since the degree of springiness is not, because of the nature of the crimped filamentary material, uniform along the length of the rod, it follows that whatever slippage occurs because of this expansive force, will also be non-uniform. As will be more fully set forth hereinafter, it is the principal object of the present invention to provide a means of preventing such slippage and thus to attain the desired filter rod circumference uniformity.

The extreme, not to say critical, importance of filter rod uniformity in the manufacture of filter cigarettes of the type employing filamentary filter plugs will be evident from a brief consideration of the process by which such cigarettes are made as explained hereinafter.

This invention has as a principal object to provide a means of obtaining circumference uniformity of paper wrapped cigarette filter rods.

A further object in to provide a means and method of locking together the overlapping portions of the paper wrap of a paper wrapped filamentary cigarette filter rod to prevent slippage between these overlapping portions, whereby circumference uniformity of the rod is obtained.

A further object is to provide an improved process of cigarette filter rod manufacture wherein a thin paper is wrapped around a cylindrically shaped bundle of resilient filamentary material in such manner as to form an overlapped seam in which the overlapped portions of the paper forming the seam will be locked in place during and subsequent to application of an adhesive to one of the contiguous paper surfaces.

A still further object is to provide an improved cigarette filter rod making machine which will ensure that the paper wrap of the filter is continuously overlapped to form a seam and that the contacting surfaces of the paper layers of the seam thus formed are locked into non-slipping relationship.

Another object is to provide an improved paper wrapped filamentary cigarette filter rod comprising a substantially cylindrical mass of filamentary tobacco smoke filter material encased in a paper wrap provided with an overlapped seam and in which the overlying and underlying portions of the paper wrap are mechanically locked in place against slippage one over the other.

Another object is to provide an improved filter cigarette assembly comprising a tobacco bearing element and a filter element which is a paper wrapped substantially cylindrical rod of filamentary tobacco smoke filtering material of uniform diameter along its length and in which overlapping portions of the paper wrap are mechanically locked in place against slippage one over the other.

Other objects will appear hereinafter.

These objects are accomplished by the following invention which, in its broader aspects, comprises the inclusion in a cigarette filter rod making machine of a perforating wheel which serves (after the application of adhesive to one surface of one of the overlapping portions of the paper wrap surrounding the filter material which are to be joined) to form a seam and after the circumference of the wrapped filter product has been determined, continuously perforates both the overlapping and underlying portions of the paper at short, spaced intervals along the seam in such manner as to force out from, but not completely sever, small portions of both layers of paper in such manner as to form a lock which will prevent the paper layers from sliding one on the other and thereby cause a vibration in the circumference of the filter product from that which is desired. This method of obtaining an interlocking seam in the paper wrapped cigarette filter product in accordance with our invention will be more readily understood by reference to the drawings in which,

FIGURE 1 is a semi-diagrammatic side elevational perspective view of a cigarette filter rod making machine of a type similar to machines commonly employed in the tobacco industry for making cigarettes and illustrating the positioning of the perforating wheel in accordance with the invention herein described.

FIGURES 2, 3, 4 and 5 are fragmentary elevational views of a perforating wheel constructed in accordance with our invention and illustrating several preferred forms of teeth which may be employed to produce the perforated interlocks along the seam of the paper wrap of the cigarette filter rod.

FIGURE 6 is an enlarged cross-sectional, elevational view along the line 6—6 of FIGURE 1 and illustrating the manner in which the paper wrap of the filter unit is partially circumferentially formed and also illustrating the manner in which the sealing adhesive is applied to a restricted portion of the inner surface of one edge of the paper.

FIGURE 7 is also an enlarged, cross-sectional, elevational view along the line 7—7 of FIGURE 1 and illustrating the manner in which the paper wrap of the filter unit is overlapped to form a seam prior to the formation of the perforated interlock of the invention.

FIGURE 8 is an enlarged fragmentary, cross-sectional, elevational view along the line 8—8 of FIGURE 1 illustrating the manner in which the perforating wheel forms the interlocks along the seam of the paper wrap following the overlapping operation illustrated in FIGURE 7.

FIGURE 9 is an enlarged fragmentary, cross-sectional, elevational view along the line 9—9 of FIGURE 1 and illustrating the manner in which the seam of the paper filter wrap is heat sealed by the application of a suitable source of heat such as a heated sealer bar.

FIGURE 10 is an elevational side view of a mechanism for regulating the height of the perforating wheel with respect to the paper seam being perforated.

FIGURE 11 is an enlarged fragmented, sectional, elevational view showing a filter cigarette having incorporated therein as the filter element a segment of a completed paper wrapped filter rod prepared in accordance with the invention and further illustrating the manner in which the perforated interlocks are formed along its seam line to prevent slippage of the overlying and underlying paper layers and to maintain the circumference of the rod uniform along its length.

FIGURE 12 is an enlarged fragmented, sectional, elevational view of a cigarette having incorporated therein as the filter element a filter rod prepared in accordance with the invention and illustrating the manner in which the filter element is attached to the tobacco bearing portion thereof.

In the following examples and description we have set forth several of the preferred embodiments of our invention but they are included merely for purposes of illustration and not as a limitation thereof.

Our invention will be more fully understood by reference to FIGURE 1 of the drawing which is a semi-diagrammatic side elevational view in perspective of a cigarette filter rod making machine of a type which is similar to machines commonly employed in the tobacco industry for making cigarettes and showing the positioning of the perforating wheel on the machine in accordance with the invention. This figure also illustrates both the steps of the process by which cigarette filter rods of our invention are prepared and the mechanism employed.

In the following description we have described the machine for, and the overall process of, making cigarette filter rods in accordance with our invention.

Numeral **10** designates a multifilament crimped cigarette filter tow which, for example, may consist of a large number of individual crimped cellulose acetate filaments such as a tow of 30,000 to 100,000 total denier the individual filaments of which may be composed of cellulose and have a denier per filament within the range of 1–25. Such a tow and its method of preparation is set forth in Crawford and Stevens U.S. Patent 2,794,480. Tow **10**, fed from a suitable supply (not shown), passes over a pair of delivery rolls **11** and **12**, thence into garniture **13** which is the total assembly extending between points (a) and (b) of FIGURE 1.

Tow **10** passes into the garniture through the large outer end of horn **14** which causes the individual filaments to converge and become more and more consolidated as they pass through the horn. Disposed immediately beyond horn **14** is tongue **15** which may be in the form of a half funnel which serves further to consolidate and shape the incoming tow **10** into a substantially cylindrical or rod-like form.

Numeral **16** designates a roll of thin paper similar to cigarette paper which is provided to form the wrap around the filter rod. This paper passes over a series of guide rolls **17** and **18** and is then carried onto the upper surface of an endless belt or tape **19** which may be in the form of a heavy woven fabric or equivalent material. Tape

19 is carried around driven roll **20** (driven by any suitable means, not shown) and over a series of guide rolls **21**, **22** and **23** in such manner and at such appropriate linear speed as to provide a supporting and conveying surface for the paper wrap and the filter rod as paper and tow progress from (a) to (b) in the garniture. Paper wrap **16** comes in contact with the partially shaped tow **10** at approximately the entrance of tongue **15** and tape **19** then carries both paper and tow along with it through the garniture.

At approximately the position indicated by (c), tow **10**, paper wrap **16** and tape **19** assume approximately the form shown in cross-section FIGURE 6. At this point glue applicator wheel **24**, fixedly mounted on shaft **25**, driven through pulley **26** through means not shown, picks up adhesive from an adhesive reservoir, also not shown, and applies the adhesive in the form of a continuous bead to the edge of the inner surface of paper wrap **16** also as shown in FIGURE 6.

As the paper wrapped filter rod progresses through the garniture to approximately the point designated by (d) it meets the folder block or circumference controlling unit **27** shown in FIGURE 7. At this point the paper wrap is caused to overlap at the edges to form an overlapped seam while tape **19** veers off in the manner shown.

The circumference of the cigarette filter rod having been determined by its passage through circumference controlling unit or folder block **27**, then passes to a point in the garniture designated (e) where it comes in contact with the cutting or perforating teeth **28** of perforating wheel **29** as shown in FIGURE 8. Folder block **27** is provided with a slot through which perforating wheel **29** projects to such an extent that its teeth can come in contact with and perforates both the overlying and underlying layers of the paper wrap forming the seam of the filter rod.

The mechanism for and the operation of forming the perforated interlocks in accordance with our invention is as follows:

Perforating wheel **29** is mounted on shaft **30** which in turn is supported in appropriate bearings **30***a* in arms **32** of supporting frame **31** as shown in FIGURE 1. Arms **32** of this supporting frame are hinged by means of pin **33** and supports **34** in such manner that perforating wheel **29** may be moved in an arc as desired, thus controlling the depth of perforation which the teeth of the wheel makes in producing the perforated interlocks in the overlapped layers of paper forming the seam of the filter rod as previously described.

It will of course be understood that both the garniture and the perforation depth controlling mechanism will be supported and fixedly mounted on a suitable bench, table, supporting frame or other suitable supporting means (not shown).

Adjustment of the arc of swing of arms **32** and thus of wheel **29** may be accomplished by any appropriate means. One form of adjusting mechanism is shown in FIGURES 1 and 10. In these figures numeral **35** designates a plate fixedly connected to both arms **32** which enables these elements to be lowered or raised simultaneously as desired. Adjusting screw **36** is threaded into the top portion of hinged bracket **36***a* and turning this adjusting screw causes it to bear on the upper surface of plate **35** and thus determines the upward swing of plate **35** and its attached arms **32** and therefore of wheel **29**. The downward swing and therefore the exact and fixed positioning of these arms is determined by stop **37** (see FIGURE 10) which is threaded into bracket **38** attached as shown to one of supports **34**. Numeral **39** is a lock nut which serves to lock stop **37** in place on bracket **38**. Thus by appropriate adjustment of adjusting screw **36** and stop **37** wheel **29** can be held in any desired fixed position in relation to filter rod **16** passing through the garniture.

In the preferred embodiment of our invention perforating wheel **28** rotates freely in bearings **30***a* in the

arms **32** of the supporting frame **31**. Movement of the filter rod through the garniture in the manner described above causes the perforating wheel to rotate, although the wheel could be positively driven if desired. As wheel **28** is carried along by the moving filter rod being formed the desired perforated interlocks are formed continuously and at regularly spaced intervals along the seam of the paper wrap of the filter rod. Any desired depth of penetration of the perforating teeth into the overlapped paper layers forming the seam of the paper wrap may be employed although the actual penetration required need in general only be sufficient to punch out, but not sever, portions of the overlying and underlying layers of the paper wrap at the seam. In other words, penetration need only be sufficient to produce the form of perforated interlock shown in FIGURE 8 or its equivalent.

In FIGURE 8 it is to be particularly noted that the teeth **28** of perforating wheel **29** push through both layers of the overlapped paper wrap at the seam and the resulting perforation pushes down a small portion of both the overlying and the underlying paper layers but does not actually cut out or remove any of the paper material itself. These small forced out paper portions form what may be referred to as a downwardly projecting paper peg or stop which prevents lateral slippage of one layer of paper on another at the steam and thus serve to maintain circumference uniformity of the wrapped filter along its entire length.

Although we have found that a wheel provided with the pyramidal or diamond shaped perforating teeth as shown in FIGURE 2 produces the best form of interlock, perforating wheels having other shapes of perforating teeth as shown in FIGURES 3, 4 and 5 may also be employed to produce satisfactory interlocks. For example FIGURE 3 illustrates a needle type of tooth, FIGURE 4 a chisel point tooth, while FIGURE 5 illustrates a beveled tooth having a minute flat portion on its extreme outer end. While we have found each of these forms of perforating teeth satisfactory in producing the perforated interlock of our invention, other forms of perforating teeth may be employed so long as they are so shaped as to provide a means of breaking out but not completely cutting out small portions of the overlapping paper layers of the filter wrap and to provide a perforated interlock approximately the form of interlock illustrated in FIGURES 8 and 9. Within the broad scope of our invention the primary desideratum is that portions of both the overlying and underlying layers of the paper wrap of the filter rod are pushed down vertically in such manner as to form a projecting fibrous peg or stop which prevents lateral slippage of one layer of paper on another as described and maintains circumference uniformity of the filter rod.

Following the perforating operation itself the paper wrapped filter rod then progresses through the remainder of the garniture until it reaches position (f) where it comes in contact with heated sealer bar **40** as shown in more detail in FIGURE 9. The sealer bar may be a metal plate supplied with an internal heating means such as an electrical resistance or other convenient heat supply. The heat thus applied to the perforated interlocked seam serves to cure the applied adhesive and form a permanently glued joint or seam between the overlapped paper layers. After emerging from the garniture the completed filter rod is cut into segments of any desired length for incorporation into a filter type cigarette.

Our invention will be more readily understood by reference to the following specific example of a typical cigarette filter rod making operation employing the apparatus and process of our invention as described in its preferred form above.

Example I

A cigarette filter tow of 48,000 total denier composed of 16.000 3 D/F cellulose acetate filaments was prepared in accordance with the general procedure described in Crawford and Stevens U.S. Patent 2,794,480. This tow was employed to manufacture a cigarette filter rod in accordance with the present invention by carrying the tow through a mechanism such as described above and illustrated in FIGURE 1 of the drawings. Employing this procedure, a paper tape was wrapped around the tow as the latter was formed into a substantially cylindrical mass of fibers and in such manner as to provide an overlapping seam composed of overlying and underlying paper layers. The seam was perforated at successive predetermined intervals along its length by a perforating wheel such as **29** of FIGURE 1 and having diamond shaped or pyramidal teeth around its rim. The perforating operation was carried out in such manner as to punch out but not completely sever small portions of the overlying and underlying layers of paper, following the application of glue to the inner edge of the overlying paper layer. It was found that the paper projections thus formed prevented slippage of the paper layers one over the other both during and after the gluing step and maintained circumference uniformity along the length of the rod to a high degree. The rod produced as described above had a circumference of approximately 24.8 mm.

As the finished filter rod emerged from the garniture it was cut into segments of approximately 102 mm. in length as shown in FIGURE 1. Measurements were made of the circumference of these filter rod segments by selecting 25 samples at random from a total of 5,000 thus produced. These measurements are recorded in the table following Example III.

In order to obtain a comparison between circumference uniformity in cigarette filter rods produced in accordance with the invention and those produced in accordance with prior art practice a number of control samples were prepared having the same total denier and the same D/F cellulose acetate filaments. Such prior art filter rods were prepared on a machine substantially the same as that illustrated in FIGURE 1 but in which the perforating wheel was omitted and no perforated interlocks were formed along the seam of the filter rod as it was being produced. Twenty-five samples selected at random from 5,000 segments cut from a filter rod produced as just described were measured for circumference uniformity and the results are recorded in the table set forth below. The control filter rods are identified in the table by the designation 2DCD and 2DCG while the filter rods made in accordance with the present invention are identified by the designation 2DCE and 2DCF in the table.

It was found by comparing the circumference uniformity measurements of the two sets of samples that the standard deviation from the average circumference for the control filter rods, that is, those produced in accordance with prior art practice and omitting any perforation of the seam of the paper wrap, was between ± 0.068 and ± 0.058 mm., while the standard deviation of the circumference of the filters produced in accordance with the present invention ranged between ± 0.044 and ± 0.041 mm. The average standard deviation (which is the root means square of the deviations) for the control filters was ± 0.0632, while the average standard deviation of the filters made in accordance with the present invention was ± 0.0425 or an improvement in circumference variation of the filter rods of the invention of 32.7 percent.

Example II

Two sets of filter rod samples, namely, control filter rods and filter rods produced in accordance with the invention were prepared as described in Example I except that the tow was in each case composed of 14,000, 5 D/F cellulose acetate filaments. When the circumference of both the control and the improved filter rods was measured as in Example I, it was found that the standard deviation from the average circumference of the control

filter rods was ±0.120 mm. while the standard deviation of the circumference of the filter rods made in accordance with the present invention was ±0.065 mm. or an improvement in circumference variation of 45.8 percent. The control filter rods are identified in the table given below as 2DCO and the filter rods made in accordance with the invention by the designation 2DCN.

Example III

Control filter rods and filter rods produced in accordance with the invention were prepared as described in Example I except that the tow in each case was composed of 12,000 filaments of 5 D/F cellulose acetate filaments. The following comparisons of the circumference of four samples of each filter rod prepared in this manner were made: The root mean square of the standard deviations, or the average standard deviation, of the twelve circumference measurements of the control filter samples was ±0.0844 mm. from the average circumference. The average circumference standard deviation for the four measurements made of the filter made according to the present invention was ±0.0606 mm. or an improvement in circumference variation of 28.2 percent. The filters used as controls in this example are identified in the table by the designation 2DZW and 2DZX and 2EAE, while the examples made in accordance with the present invention are identified by the designation 2DZZ.

The average circumference standard deviation, or root mean square, of all of the measurements of all of the control filters described in Examples I, II, and III was ±0.0843 mm. while the average circumference standard deviation of all of the measurements of all of the filters made according to the present invention was ±0.0566 mm. or an overall improvement in circumference variation of 32.8 percent.

TABLE

Rod Type	Denier Per Filament	Total Denier	Perforator Wheel	Average Circumference	Standard Circumference Deviation
2DCD	3.0	48,000	None	24.87	.068
2DCG	3.0	48,000	do	24.75	.058
2DCE	3.0	48,000	Pyramid	24.90	.044
2DCF	3.0	48,000	do	24.73	.041
2DCO	5.0	70,000	None	24.91	.120
2DCN	5.0	70,000	Pyramid	24.83	.065
2DZW	5.0	60,000	None	24.89	.114
				24.91	.122
				24.91	.113
				24.90	.068
2DZX	5.0	60,000	do	24.80	.083
				24.79	.058
				24.82	.066
				24.82	.080
2EAE	5.0	60,000	do	24.87	.051
				24.90	.059
				24.87	.085
				24.94	.068
2DZZ	5.0	60,000	Pyramid	24.83	.063
				24.86	.051
				24.85	.068
				24.84	.059

A cigarette filter rod produced in accordance with our invention is illustrated in FIGURE 11. FIGURE 12 illustrates the way in which a segment of such a filter rod is secured to a cigarette to produce the final filter cigarette. It will be noted that an outer paper wrap or coupling is provided to join and secure the filter to the tobacco bearing portion or element of the cigarette. These views also in somewhat exaggerated form further illustrate the structure and positioning of the perforated interlocks in the final cigarette product.

It should be noted that an important feature of our invention is the fact that the perforated interlock provided by perforating or cutting the overlapped paper layers by the cutting wheel in the manner described above provides a means of maintaining the exact desired circumference of the paper wrapped filter unit while the applied adhesive is still in an uncured, liquid or semi-liquid condition and thus prevents slippage between the paper layers in such manner as to undesirably alter the circumference of the filter rod during and after the gluing step. In addition it has been found that the pressure of the perforating wheel following application of the adhesive and during the perforating step results in producing a better bond between the adhesive and the paper than is the case when employing standard sealing means of the prior art in which the applied pressure is much less.

It will be evident that our invention is applicable to maintaining a circumference uniformity in a cigarette filter rod regardless of what the specific circumference may be. In general this circumference will be approximately 24.8 mm. A comparison between measurements of circumference uniformity of filter rods produced in accordance with our invention and corresponding measurements of control samples of filter rods produced in accordance with standard manufacturing procedure in which no interlocks were provided showed that the average standard circumference deviation of six control samples was ±0.0843 mm. while the same average of four samples of filter rods produced in accordance with our invention and provided with perforated interlocks was ±0.0566 mm. This corresponds to an improvement of 32.8 percent in circumference uniformity of filter rods of the invention as compared to filter rods produced in accordance with standard manufacturing methods.

While we have described the benefits of providing a perforated interlock for cigarette filter rods in which the paper wrap is glued or otherwise adhesively joined at a seam, it has been found that an acceptable non-slippable seam may also be provided merely by employing the perforated interlocks of the invention without the use of an adhesive.

It will be seen from the above description of our invention that we have provided a simple, and unusually effective and efficient method of obtaining circumference uniformity in the manufacture of paper wrapped cigarette filter rods by providing a positive means of preventing slippage of the paper layers of the overlying and underlying layers of the paper wrap at the seam.

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

We claim:

1. In a cigarette filter rod making machine, in combination,
   (1) means for conveying a continuous filamentary filter tow in a linear path,
   (2) means for conveying a continuous paper wrap into contact with the tow and along a linear path parallel to the path of the tow,
   (3) means for shaping the tow into the form of a continuous substantially cylindrical rod,
   (4) means for encasing the filter rod in the paper wrap to form an overlapped seam, and
   (5) means for continuously punching out but not completely severing small portions of both overlying and underlying layers of the paper making up the seam to form a plurality of perforated interlocks along the length of the seam, whereby circumference uniformity of the paper wrapped filter rod is maintained.

2. In a cigarette filter rod making machine, in combination,
   (1) means for conveying a continuous filamentary filter tow in a linear path,
   (2) means for conveying a continuous paper wrap into contact with the tow and along a linear path parallel to the path of the tow,
   (3) a garniture for shaping the tow into the form of a continuous substantially cylindrical rod and simul-

taneously encasing the rod in the paper wrap and to form an overlapping seam consisting of overlying and underlying paper layers, and

(4) means for continuously punching out but not completely severing small portions of both the overlying and underlying paper layers of the seam to form a plurality of perforated interlocks along the length of the seam, whereby circumference uniformity of the paper wrapped filter rod is maintained.

3. In a cigarette filter rod making machine, in combination,

(1) means for conveying a continuous filamentary filter tow in a linear path,

(2) an endless belt for conveying a continuous paper wrap into contact with the tow and along a liner path parallel to the path of the tow,

(3) a garniture for shaping the tow into the form of a continuous substantially cylindrical rod and simultaneously encasing the rod in the paper wrap and to form an overlapping seam consisting of overlying and underlying paper layers, and

(4) means for continuously punching out but not completely severing small portions of both overlying and underlying layers of the paper making up the seam to form a plurality of perforated interlocks along the length of the seam, whereby circumference uniformity of the paper wrapped filter rod is maintained.

4. In a cigarette filter rod making machine, in combination,

(1) means for conveying a continuous filamentary tow in a linear path,

(2) an endless belt for conveying a continuous paper wrap into contact with the tow and along a linear path parallel to the path of the tow,

(3) a garniture for shaping the tow into the form of a continuous cylindrical rod and simultaneously encasing the rod in the paper wrap to form an overlapping seam consisting of overlying and underlying paper layers, and

(4) a toothed perforating wheel mounted on the garniture at a point along the run of the rod through the garniture following the formation of the seam, said perforating wheel being rotatable by contact with and by movement of the rod through the garniture to continuously punch out, but not completely sever, small portions of the overlying and underlying layers of the paper making up the seam to form a plurality of perforated interlocks along the length of the seam, whereby circumference uniformity of the paper wrapped filter rod is maintained.

5. In a cigarette filter rod making machine, in combination,

(1) means for conveying a continuous filamentary filter tow in a linear path,

(2) an endless belt for conveying a continuous paper wrap into contact with the tow and along a linear path parallel to the path of the tow,

(3) a garniture for shaping the tow into the form of a continuous cylindrical rod and simultaneously encasing the rod in the paper wrap and to form an overlapping seam consisting of overlying and underlying paper layers,

(4) means for continuously partially wrapping the filter rod in the paper wrap and applying an adhesive in a narrow band to the inner surface of the overlying paper layer adjacent its edge,

(5) means for completing the wrapping of the filter rod in the paper wrap whereby a glued overlapped seam is formed, and

(6) a toothed perforating wheel mounted on the garniture at a point along the run of the rod through the garniture following the formation of the seam, said perforating wheel being rotatable by contact with and by movement of the rod through the garniture to continuously punch out, but not completely sever, small portions of the overlying and underlying layers of the paper making up the seam to form a plurality of perforated interlocks along the length of the seam, whereby circumference uniformity of the paper wrapped filter rod is maintained.

6. In a process for making a paper wrapped cigarette filter plug or rod by wrapping a substantially cylindrical mass of filamentary tobacco smoke filtering material in a paper wrap and forming a seam consisting of overlying and underlying paper layers, the improvement which comprises maintaining circumference uniformity in the filter rod by perforating and punching but not completely severing small portions of both the overlying and underlying paper layers at predetermined intervals along the seam to form a plurality of inwardly projecting interlocks whereby slippage of the contacting overlying and underlying paper layers is prevented.

7. The process portion of claim 6 in which an adhesive is applied to a restricted portion of the inner surface of at least one of the paper layers of the seam prior to the perforating step and wherein the interlock formed by the perforating step prevents slippage of the overlying and underlying paper layers of the seam while the adhesive is in an uncured condition.

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