

RESERVE COPY.

PATENT SPECIFICATION

NO DRAWINGS

893.958



Date of Application and filing Complete Specification: June 3, 1958.

No. 17766/58.

Application made in United States of America on June 7, 1957.

Complete Specification Published: April 18, 1962

Index at acceptance:—Class 130, C1E(2:3).

International Classification:—A24c.

COMPLETE SPECIFICATION

Improvements in or relating to Tobacco Smoke Filtering Elements

5
10
15
20
25
30
35
40
45

We, EASTMAN KODAK COMPANY, a Company organised under the Laws of the State of New Jersey, United States of America, 343 State Street, Rochester, New York, United States of America, (Assignees of GEORGE PATRICK TOUEY and ROBERT CHESTER MUMPOWER) hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to tobacco smoke filtering elements, more particularly for cigarettes.

In addition to the capability of a tobacco smoke filter to filter out certain components, there are a number of other properties that need to be taken into consideration. For example, a cigarette filter should have an acceptable feel in the smoker's mouth. That is, the filter should be firm, not only initially, but it should not become soggy or detached from the cigarette while the cigarette is being smoked. The filter should not have such a high pressure drop that the effort to draw smoke through the filter is noticeable to the smoker. The filter should be economical to make and capable of being made on automatic machinery or otherwise lend itself to mass production at the rapid rate required for cigarette manufacture.

In accordance with the present invention there is provided a tobacco smoke filtering element comprising a predetermined length of a bundle of crimped continuous filaments of a polyolefin, the filaments having a denier between 0.5 and 16 per filament and a crimp of up to 40 crimps per inch.

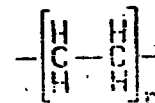
According to one form of the invention the bundle of filaments is wrapped in a heavy paper wrapping having a thickness of 0.08 to 0.15 mm.

Cigarette filters in accordance with the invention are relatively firm and do not become soggy or soft in use from the effect

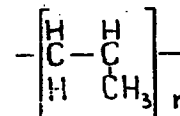
[Price 4s. 6d.]

of mouth or smoke moisture. Moreover, because of the hydrophobic properties of the filaments, the filters do not dry the tobacco smoke or remove certain hydrophilic vapours connected with the aroma of the tobacco smoke.

The polyolefin material which it is preferred to use has a molecular weight above 10,000 and below 1,000,000. Preferably the molecular weight of the polyolefin material would be between 30,000 and 200,000. The softening point of the polyolefin polymer which we prefer to use is between 85°C. and 160°C. Of the several polyolefin materials produced industrially we prefer those known as polyethylene and polypropylene. The structural repeating unit for polyethylene can be represented as:



The structural repeating unit for polypropylene can be represented as:



Either low density polyethylene, namely polyethylenes having a softening point of about 90°C. to 100°C., or high density polyethylenes, which have a softening point of 110°C. to 150°C., can be used in preparing the crimped continuous filaments used in the filters of the present invention.

The particular method of manufacturing the polyolefin material is not a part of the present invention and is known to the industry concerned with such manufacture. In other

words, the desired polyolefin material can be obtained from a polyolefin manufacturer by giving the above specifications of molecular weight and other properties to such manufacturer. It will be noted, however, that the polyolefin material used in the present invention is a material resistant to the absorption of moisture.

After obtaining a suitable polyolefin composition it is spun into a bundle of parallel continuous filaments which are then crimped on a textile tow crimping device. Preferably a device is used which gives a uniform crimp. The number of filaments required in the

bundle to make satisfactory filter rod for subsequent cutting into filter elements will depend on the diameter of the individual filaments in the bundle and the amount of crimp imparted to the filaments. In general, with a crimp within the range of 12 to 30 crimps per inch, it will require 3,500 to 120,000 filaments when the filaments are in the 16 to 0.5 denier per filament range. The following table illustrates how the number of filaments can vary as the diameter of the filaments decreases in tows which have been crimped within the range of 12 to 30 crimps per inch.

Filament Size (Denier per filament)	Range of No. of Filaments in the Rod (25.5 mm. circumference)
0.5	50,000 — 120,000
1	35,000 — 70,000
3	16,000 — 30,000
4	15,000 — 25,000
8	6,000 — 15,000
16	3,500 — 7,500

The exact process used for spinning the polyolefin materials into continuous filaments is not a limitation on the present invention. Any of the methods known in the textile industry for preparing polyolefin filaments may be used for preparing the crimped continuous filaments of the present invention provided that a suitable denier is obtained.

As indicated above, a relatively high degree of crimp is preferably imparted to the tow of parallel filaments. Most of the commercial crimping devices for textile tows are of the "stuffing-box" type, although in some instances the "gear type" is used. We prefer the "stuffing-box" type of textile tow crimping apparatus since it readily permits putting in a range of crimp from about six crimps per inch up to, for example, 40 crimps per inch of an amplitude between about 0.10 inch and 0.01 inch.

By crimps per inch we mean the number of peaks or valleys present after crimping a one inch length of filament. By amplitude of crimps we mean the height of each crimp.

It will be apparent that the actual length of a tow segment, depending upon the number of crimps and the amplitude thereof, may, for example in a segment of one inch length in crimped form, actually occupy $1\frac{1}{2}$ to 2 inches when in an uncrimped condition. Thus, a high degree of crimp increases the bulk of the

tow and imparts firmness to the resultant filter. This firmness is satisfactory from the standpoint of the average smoker who dislikes a soft filter tip in his mouth.

The crimped continuous filaments of a polyolefin produced as above described can readily be fed into existing automatic filter-making machinery. In such machinery a bundle of the crimped continuous filaments is formed into a filter rod which is cut into predetermined lengths for attachment to cigarettes in cigarette machines.

In cutting the filter rod into predetermined lengths in some machines there may be a tendency for the rod to become distorted, due to the relatively soft and waxy nature of the filaments, thereby resulting in incomplete cuts and the production of filters in which some of the filaments protrude from the ends thereof. It is preferred, therefore, to wrap the filter rod, prior to cutting, in a paper wrapper which is appreciably heavier in thickness than the conventional cigarette paper thereby producing a more rigid filter rod. Thus, for example, the conventional wrapper for cigarette filters has a thickness in the range of 0.02—0.04 mm. The proposed wrapper has a thickness in the range of 0.08—0.15 mm. Any suitable type of paper wrapper having this range of thickness can be used and it will be understood, therefore, that the proper thick-



ness can also be obtained by laminates of thinner paper or by the application of a coating to conventional cigarette paper.

Although the use of a stiffer or heavier type wrapper does fulfil the requirement for a rigid filter rod, if desired, other methods may be employed with and without the heavy paper to impart rigidity to the filter. Thus, for example, the bundle of crimped continuous filaments may be passed into a heated metal forming block. By heating the thermoplastic polyolefin filaments they may be not only fused at the surface but the heat will also cause some fusing within the bundle of filaments where the highly crimped filaments contact one another. By this procedure self-contained filter elements may be manufactured without the need of an external wrapper or plasticizer addition or coating the filaments.

Tests of tobacco smoke filter elements consisting essentially of crimped continuous filaments of a polyolefin show that such filter elements in accordance with the present invention will remove a greater quantity of tar and nicotine with about the same or less pressure drop than commercial filter elements now available in the industry.

A further understanding of our invention will be had from a consideration of the following examples.

EXAMPLE I

Polyethylene Filters—A drafted, high-density polyethylene yarn of continuous filaments of 5.0 denier per filament was prepared by melt spinning polyethylene using a 50-hole spinnerette with 0.30 mm. openings. The drafted yarn had a strength of 2.9 grams per denier, a stretch of 30%, and a softening point of 115°C. It was plied into a tow (16,000 filaments) and a portion of the tow was crimped on a textile crimper which produced 25 crimps per inch, all in a direction perpendicular to the length of the filaments. The crimped tow was fluffed out to a width of 12 inches and fed into a filter rod-making machine which produced filter rods wrapped in cigarette paper. The rods were 90 mm. in length and 25.5 mm. in circumference. After being heated for 10 seconds at 120°C. the rods developed a satisfactory degree of firmness and had an average pressure drop (resistance to draw) of 9.3 inches at an air flow

rate of 17.5 ml. per second. Two of the rods were cut into lengths of 15 mm. and these filter tips were attached to 10 king size cigarettes (Brand A) which had been shortened by 15 mm. These filter tipped cigarettes were smoked to butt lengths of 35 mm. on an automatic smoking machine. The smoke which passed through the filters was collected and analyzed for nicotine and tar content. The results of this smoking test and the pressure drop of the filter tipped cigarettes before smoking are shown in Table 1.

EXAMPLE II

Polypropylene Filters—A drafted polypropylene yarn of continuous filaments of 4.8 denier per filament was prepared by melt spinning polypropylene using a 50-hole spinnerette with 0.30 mm. openings. The drafted yarn had a strength of 4.7 grams per denier, an elongation of 35%, and a softening point around 126°C. It was plied into a tow (16,700 filaments) and given 28 crimps per inch. The crimped tow was fluffed out to a width of 12 inches and fed into a filter rod-making machine which compacted it into a tight bundle and wrapped it with white paper having a thickness of 0.10 mm. The resulting filter rods were quite firm due to the heavy paper wrapper and required no heat curing. They were 90 mm. in length and 25.7 mm. in circumference; their average pressure drop was 9.1 inches. Two of the filter rods were cut into lengths of 15 mm. and these filter tips were attached to 10 king size cigarettes (Brand A), shortened by 15 mm. These filter tipped cigarettes were smoked to butt lengths of 35 mm. on the automatic smoking machine and the collected smoke was analyzed for nicotine and tar content. The results of this test are listed in Table 1.

EXAMPLE III

Polyethylene Filters—A portion of the polyethylene tow (33,000 filaments) of Example I was given only 12 crimps per inch. This crimped tow was converted to filter rods, hardened, and tested as 15 mm. filter tips as described in Example I. The pressure drop of the filter tipped cigarettes and the amounts of nicotine and tar obtained are reported in Table 1.



rods
85

90

95

100

TABLE 1

Type of Cigarette Smoked to 35 mm. Butt (85 mm. in length)	Av. Pressure Drop of Cigarettes (in H ₂ O)	Mg. Tar in Smoke (10 cigarettes)	Mg. Nicotine in Smoke (10 cigarettes)	% Tar Removed by Filter	% Nicotine Removed by Filter
Brand A — no filter	3.2	170	26	—	—
Brand A — polyethylene filter Example I	4.1	120	19	29	27
Brand A — polypropylene filter Example II	4.1	124	19	27	27
Brand A — polyethylene filter Example III	3.9	129	20	24	23

It is believed apparent from the foregoing that we have provided a relatively efficient, new and economical tobacco smoke filter. Also, due to the fact that the polyolefin filaments are inherently strong, the tows of these filaments can withstand considerable tension during the filter rod fabrication and this enables filters to be produced at a high rate.

WHAT WE CLAIM IS:—

1. A tobacco smoke filtering element comprising a predetermined length of a bundle of crimped continuous filaments of a polyolefin, the filaments having a denier between 0.5 and 16 per filament and a crimp of up to 40 crimps per inch.

2. A tobacco smoke filtering element according to claim 1, wherein the filaments have a crimp of 19 to 40 crimps per inch.

3. A tobacco smoke filtering element according to claim 1 or 2, wherein the polyolefin has a molecular weight between 30,000 and 200,000 and a softening point between 85°C. and 160°C.

4. A tobacco smoke filtering element according to claim 1, 2 or 3, wherein the bundle contains 3,500 to 120,000 filaments.

5. A tobacco smoke filtering element according to any of the preceding claims, wherein the filaments are oriented substantially

ally longitudinally of the bundle and are joined to adjacent filaments at random points of contact.

6. A tobacco smoke filtering element according to any of the preceding claims, wherein the bundle of filaments is wrapped in a heavy paper wrapper.

7. A tobacco smoke filtering element according to claim 6, wherein the paper wrapper has a thickness of 0.08 to 0.15 mm.

8. A method of making the tobacco smoke filtering elements claimed in claim 6, comprising fluffing out a tow of the crimped continuous filaments of a polyolefin, compacting the fluffed out continuous filaments into a tight bundle of cylindrical form, wrapping the bundle in the heavy paper and cutting the wrapped bundle into elements of the required length.

9. Tobacco smoke filtering elements of crimped continuous polyolefin filaments, substantially as hereinbefore described in the Examples.

10. Method of making tobacco smoke filtering elements from a tow of crimped continuous polyolefin filaments substantially as hereinbefore described.

L. E. T. BRANCH, B.Sc., F.R.I.C.,
Patent Agent. PH



element 20

TABLE 1

Type of Cigarette Smoked to 35 mm. Butt (85 mm. in length)	Av. Pressure Drop of Cigarettes (in H ₂ O)	Mg. Tar in Smoke (10 cigarettes)	Mg. Nicotine in Smoke (10 cigarettes)	% Tar Removed by Filter	% Nicotine Removed by Filter
Brand A — no filter	3.2	170	26	—	—
Brand A — polyethylene filter Example I	4.1	120	19	29	27
Brand A — polypropylene filter Example II	4.1	124	19	27	27
Brand A — polyethylene filter Example III	3.9	129	20	24	23

It is believed apparent from the foregoing that we have provided a relatively efficient, new and economical tobacco smoke filter. Also, due to the fact that the polyolefin filaments are inherently strong, the tows of these filaments can withstand considerable tension during the filter rod fabrication and this enables filters to be produced at a high rate.

WHAT WE CLAIM IS:—

1. A tobacco smoke filtering element comprising a predetermined length of a bundle of crimped continuous filaments of a polyolefin, the filaments having a denier between 0.5 and 16 per filament and a crimp of up to 40 crimps per inch.

2. A tobacco smoke filtering element according to claim 1, wherein the filaments have a crimp of 19 to 40 crimps per inch.

3. A tobacco smoke filtering element according to claim 1 or 2, wherein the polyolefin has a molecular weight between 30,000 and 200,000 and a softening point between 85°C. and 160°C.

4. A tobacco smoke filtering element according to claim 1, 2 or 3, wherein the bundle contains 3,500 to 120,000 filaments.

5. A tobacco smoke filtering element according to any of the preceding claims, wherein the filaments are oriented substantially

ally longitudinally of the bundle and are joined to adjacent filaments at random points of contact.

6. A tobacco smoke filtering element according to any of the preceding claims, wherein the bundle of filaments is wrapped in a heavy paper wrapper.

7. A tobacco smoke filtering element according to claim 6, wherein the paper wrapper has a thickness of 0.08 to 0.15 mm.

8. A method of making the tobacco smoke filtering elements claimed in claim 6, comprising fluffing out a tow of the crimped continuous filaments of a polyolefin, compacting the fluffed out continuous filaments into a tight bundle of cylindrical form, wrapping the bundle in the heavy paper and cutting the wrapped bundle into elements of the required length.

9. Tobacco smoke filtering elements of crimped continuous polyolefin filaments, substantially as hereinbefore described in the Examples.

10. Method of making tobacco smoke filtering elements from a tow of crimped continuous polyolefin filaments substantially as hereinbefore described.

L. E. T. BRANCH, B.Sc., F.R.I.C.,
Patent Agent. PH

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1962.
Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which
copies may be obtained.

