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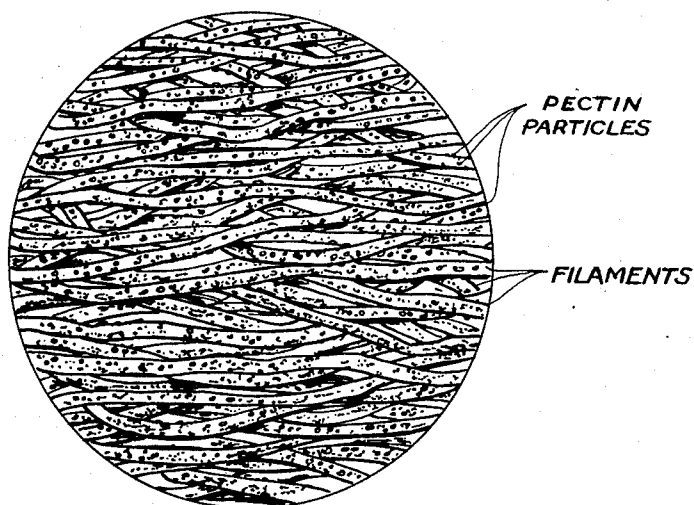
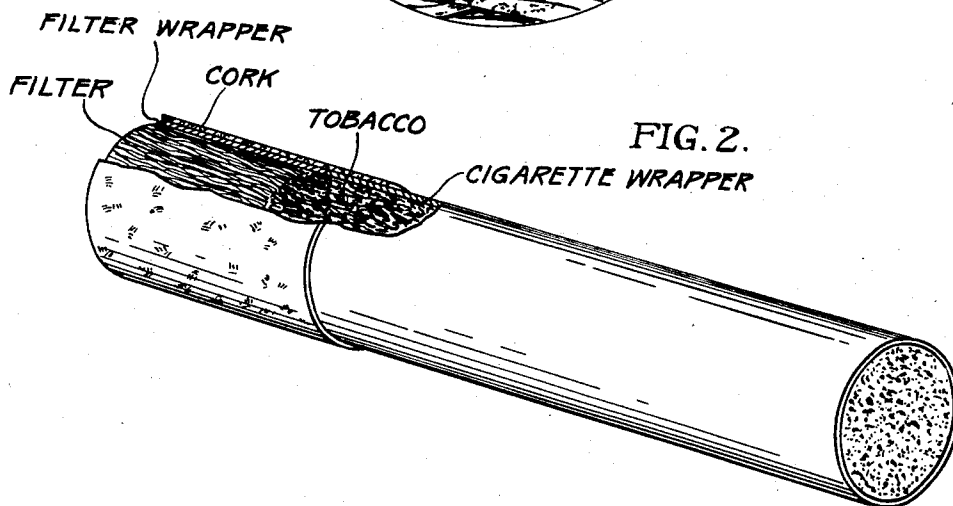
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2,908,280

FIBROUS TOBACCO SMOKE FILTERS

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FIG. 1.



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FIBROUS TOBACCO SMOKE FILTERS

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5 Claims. (Cl. 131—208)

The present invention relates to tobacco smoke filtering material and elements thereof suitable for use in cigarettes, pipes, cigarette holders, and cigar holders. Information concerning the general type of filters of which the present invention is an improvement as well as information concerning the application of droplets of plasticizer onto the filaments is shown in Crawford and Stevens Patents 2,794,480 and 2,794,239.

In the aforementioned patents, newly discovered advantages of a certain type of fibrous tobacco smoke filter are discussed. The preferred type of filter is prepared from a specially conditioned tow of synthetically spun continuous filaments and comprises a structurally unitary rod-like mass of fibers and a wrapper encircling the mass, each fiber of the mass being substantially coextensive therewith, the fibers as a whole being in substantial alignment longitudinally of the mass but substantially each of the individual fibers having a plurality of short portions thereof crimped into diverging and converging relationship to the main fiber axis, a plurality of the fibers having surface solvation bonds to contiguous fibers at random points of contact. Very good results have been obtained in the use of such filters for the removal of nicotine and tars from tobacco smoke, especially in view of the fact that the filters supply other requirements equally as necessary to the success of a tobacco smoke filter.

These filters also have a marked processing advantage over other filters known in the art. However, since the fibers in such filters are substantially parallel to each other, some channeling of the smoke through the filter may be possible, resulting in a decreased filtering action.

In other words, while interference with the smooth flow of combustion products through the channels is provided by the random bonds between adjacent fibers, by incompleteness of fiber orientation, and the short fiber portions which are crimped into diverging and converging relationship to the main fiber axis, yet a certain amount of the smoke in the core of any minute column of smoke passing through the filter apparently may be exposed to somewhat less than a theoretically maximum amount of contact with the fiber surfaces. Experimental investigations have shown that any attempt to reduce the size of smoke channels through the filters by an increase in filter density either through greater compaction or through the use of finer fibers generally also results in an intolerable increase in pressure drop through the filter. Unfavorable conditions also generally result when an increased amount of fiber crimp is employed in order to increase the relative number of divergent and convergent fiber portions.

I now have found that the efficiency of the filters described may be substantially increased without equivalent increase in pressure drop through the filter by depositing certain finely divided solids in the smoke channels provided by the spacing of adjacent fibers. I further have discovered that when powdered pectic substances are employed as the finely divided deposit, unusual efficiency is obtained.

This invention, therefore, has as one object the production of a more efficient cigarette smoke filter con-

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sisting of a bundle of substantially longitudinally oriented textile fibers infused with finely divided powdered pectic substances. Another object is to provide means for increasing the efficiency of a cigarette filter prepared from a textile fiber. A still further object is provision of a filter which is capable of removing nicotine, tars, and other deleterious components of cigarette smoke without causing the smoke to be dry or distasteful. Another object is to increase the efficiency of tobacco smoke filters of the Crawford and Stevens patents without creating a high pressure drop. Other objects will be obvious from the present specification and claims.

Accordingly, the present invention consists, in general, in a tobacco smoke filtering medium comprising a mass of substantially longitudinally aligned fibers, the spacing of substantially all groups of adjacent fibers providing minute passages for smoke therethrough, said mass carrying therein finely divided pectic particles in an amount of 1 to 60% by weight of the mass, said particles occupying positions in and partially blocking said passages whereby a substantial portion of the smoke is impinged either on the fibers or on the pectic particles.

A more specific embodiment of the invention comprises a new tobacco smoke filtering material of synthetically spun continuous filaments and an element made therefrom, the element comprising a structurally unitary rod-like mass of fibers and a wrapper encircling the mass, each fiber of the mass being substantially coextensive therewith, the fibers as a whole being in substantial alignment longitudinally of the mass but substantially each of the individual fibers having a plurality of short portions thereof crimped into diverging and converging relationship to the main fiber axis, a plurality of the fibers having surface solvation bonds to contiguous fibers at random points of contact, the mass carrying substantially uniformly dispersed therein a solid finely divided pectic substance in the amount of 1 to 60% by weight of the mass.

Most advantageously, the invention comprises a filter of cellulose acetate fibers having surface solvation bonds achieved through the application of a plasticizer spray, the filter carrying uniformly dispersed naturally occurring fruit pectin particles in the amount of about 10 to 40% by weight of the filter. By the term "surface solvation" of the fibers as used herein is meant the creation, by the action of a solvent or plasticizer and/or heat, of an adhesive, tacky or readily bonding condition of the fibers by solution or incipient solution of surface portions of the filament material whereby there is produced a welding and adhesion between adjacent filaments contacting at such portions, and by "coalescence" I mean the situation caused by partial or incipient solvation of surface portions of the filaments and resulting in a condition within those portions under which the portions will flow into or unite with similar portions of dissolved or plastic material in contiguous filaments.

Any suitable means known to the art for spreading a powder onto a fibrous surface or through a fibrous mass may be employed in preparing filters of the invention. Thus, for example, the pectic powder can be blown onto the fibers or it can be applied as a slurry in cold water or in a volatile organic vehicle or a plasticizer for the fibers. Another method is to apply the pectic powder to the fibers electrostatically, i.e. to induce a charge on the fibers by friction or other suitable means and then to run the tow in a banded, i.e. spread out condition through a dusting chamber containing a concentrated cloud of pectinaceous dust. Still another method for applying the pectin is to wet the surface of the fibers with an adhesive or a plasticizer before exposing them to a powder spraying device. Preferably, the pectin is continuously applied to an opened and banded moving

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tow formed as described in the Crawford and Stevens applications. That is to say, tow from a supply roll is opened to debundle the filaments and provide a larger and more uniform tow cross section, and the opened tow is spread uniformly to a much larger width of e.g., 8 times its original width, thereby exposing substantially all of the filaments to material, i.e. plasticizer, issuing from a dispenser adjacent which the tow passes. The pectin may be added before, simultaneously with, or after the plasticizer, preferably with or after.

The pectin substances which can be employed in the operation of this invention as powdered, non-toxic additives to a textile fiber tow prior to its conversion to a cigarette filter can be any of the pectic acid esters and salts which are present in certain plant tissues or their derivatives. They constitute up to one-half the dry weight of fleshy fruits, roots, and leaves, and are readily isolated from such products by chemical treatments well known to those skilled in the art. Pectic acid is considered to consist mainly of galacturonic acid units. Therefore, typical examples of the pectic substances which can be used in the invention are pectic acid, sodium pectate, calcium pectate, magnesium pectate, methyl pectate, ethyl pectate, or other pectate esters or salts. Some of these products are commercially available in powdered form, especially the pectic acid salts obtained from apples, oranges and other fruits. These products are given the commercial name of "pectins." An excellent discussion of such products can be found in the book entitled "The Pectic Substances" by Z. I. Kertesz (Interscience Publishers Incorporated, 1951).

The invention is illustrated in the accompanying drawings in which

Fig. 1 represents a magnified view of the interior of a mass of filtering material prepared in accordance with the invention, and

Fig. 2 is a view of a cigarette having attached thereto a tip prepared from a filtering material of the invention.

The invention is further illustrated in the following examples:

Example 1

A crimped continuous filament tow of yarn type cellulose acetate of 5 denier per filament with a total denier of 100,000, and 9 crimps per inch was used to prepare filters in accordance with the preliminary conditioning procedure of Crawford and Stevens. The tow was pulled from a ball warp over stationary tensioning fingers and into a tensioning device functioning to provide tow opening as the first phase of filament separation. The device employed was of the type employing a pair of driven rolls to place under tension tow positioned in the ratch between the driven rolls and a pair of retarded rolls upstream of the driven rolls. The device was equipped with the improved reciprocating striker as disclosed and claimed in Smith pending U.S. patent application Serial No. 416,010 filed March 15, 1954, now Patent No. 2,790,208. Upon being released from the nip of the positively driven tension rolls into a zone of relative relaxation, i.e. relatively little tension, the tow bloomed through inherent forces manifested upon the return of the tow to its original condition.

The partially opened tow of cellulose acetate yarn was slowly pulled over a compressed air banding device as disclosed in the aforementioned Crawford and Stevens patent applications and in pending U.S. patent application Serial No. 356,983, filed May 25, 1953 by Wallace T. Jackson, now Patent No. 2,737,688. The banding device spread out the fibers to a width of six inches. While the tow was in this spread condition it was sprayed with a highly agitated slurry of two parts of a commercial brand of powdered citrus pectin in eight parts dimethoxyethylphthalate plasticizer.

After this spreading and spraying treatment the tow was uniformly collected and fed to a garniture, i.e. a

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cigarette-making machine. The tow was fed into the garniture through a shaping horn which served to condense the conditioned tow back into its original shape of a cord. The cigarette-making machine wrapped the tow with paper and cut it into rods similar in size to a standard size cigarette. The rods contained 2 parts pectin powder, 8 parts plasticizer, and 40 parts cellulose acetate fibers by weight. After the filter rods were given a short heat treatment to cause partial solvation of the acetate fibers by the plasticizer, they were readily cut into 13 mm. filter tip lengths. These tips were attached to a standard brand of cigarettes available on the retail market in the U.S. by means of an adhesive tape. The cigarettes were smoked on a smoking machine similar in design and operation to the smoking machine described by J. A. Bradford, W. R. Harlan and H. R. Hammer in Industrial and Engineering Chemistry, vol. 28, pp. 836-9 (1936). The collected smoke was analyzed for nicotine and tars. The results of the smoking experiment were compared with those obtained from smoking the same brand of cigarettes containing 13 mm. filter tips made from the same tow of cellulose acetate fibers plasticized with 16.7% dimethoxyethylphthalate without the addition of the powdered pectin.

Type of Cigarette Filter Tip (13 mm.)	mg. of tars ¹	mg. of nicotine ¹
Plasticized cellulose acetate tow	139	18
Plasticized cellulose acetate tow containing 4% powdered pectin	121	15

Moisture of the tobacco in each of the cigarettes=12.1%.

¹ Obtained from the collected smoke of ten filtered cigarettes.

The cigarettes containing the cellulose acetate tow filter had an average pressure drop of 27% while those containing the filter of cellulose acetate tow and pectin had an average pressure drop of 28%, where pressure drop is measured as the percent additional time required for a standard tube of water to drain when the cigarette to be measured is inserted into the vent of this tube, compared to the draining time of the same apparatus when the vent is unobstructed with any cigarette to be measured.

Example 2

A loose, i.e. partially opened crimped continuous filament tow of cellulose acetate containing approximately 10,000 filaments of 8 denier per filament was pulled through a bath containing a highly agitated slurry of 25 parts of finely powdered pectic acid (citrus) and 75 parts of a 50-50 water-alcohol solution. After leaving this bath, the tow was drawn through squeegee rolls and then dried. When dry, the tow contained 12% of pectic acid powder by weight uniformly dispersed throughout and strongly adhered to the fibers. The tow was processed into filter rods in a garniture as described in Example 1 and the resulting rods were cut into 13 mm. lengths. The filter tips so produced were attached to standard brand cigarettes and ten of these filter tipped cigarettes were smoked on the smoking machine. The collected smoke was analyzed for nicotine and tars. A control, consisting of the same brand of cigarettes tipped with filters made from the 8 denier per filament tow containing no pectic acid powder was also smoked on the smoking machine and the collected smoke was analyzed in the same manner for nicotine and tars.

	mg. of tars	mg. of nicotine
Acetate tow filter	150	20
Acetate tow filter containing 12% pectic acid powder	110	15

Moisture of the tobacco in each of the cigarettes=11.9%.

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The cigarettes containing the cellulose acetate tow filter had an average pressure drop of 22% while those containing the filter of cellulose acetate tow and pectic acid had an average pressure drop of 25%, where pressure drop is measured as explained in Example 1 above.

Example 3

A tow of cellulose acetate yarn containing approximately 40,000 filaments of 3 denier per filament was spread out to a width of six inches and sprayed with methyl phthalyl ethyl glycollate plasticizer. While the tow was still spread out and wet with the plasticizer it was sprayed with a commercially available finely divided calcium pectate powder and then rolled back into its original form. The impregnated tow was processed into filter rods and the rods were heated at 85° C. for one hour to impart a certain degree of rigidity. The heat treated rods were finally cut into 13 mm. length filter tips. The filter tips were attached to standard brand cigarettes and ten of these cigarettes were smoked on the smoking machine. The collected smoke was analyzed for nicotine and tars. A control consisting of the same brand of cigarettes tipped with a filter of the 3 denier per filament tow containing the plasticizer but no calcium pectate powder was also smoked on the smoking machine and the collected smoke was analyzed in the same manner for nicotine and tars.

	mg. of tars	mg. of nico- tine
Acetate tow filter.....	135	19
Acetate tow filter containing 18% calcium pectate powder.....	104	13

Moisture of the tobacco in each of the cigarettes—12.5%.

The cigarettes containing the cellulose acetate filter had an average pressure drop of 32% while those containing the filter of cellulose acetate tow and calcium pectate had an average pressure drop of 35%, where pressure drop is measured as explained in Example 1 above.

In carrying out the operation of this invention the type of pectic substance employed is not a critical factor. Rather, the form of the substance is more important. The pectic substance should be in a powdered form so that it can be readily slurried in a liquid or passed through a spraying nozzle. Preferably a particle size of about 100 to 200 mesh is employed. Any source of pectin substance which passes this requirement can, therefore, be used.

While unusually good results have been obtained with filters prepared from a crimped continuous filament tow of cellulose acetate fibers sprayed with a plasticizer, e.g. dimethoxyethylphthalate or methylphthalylethylglycollate, it will be recognized by those skilled in the art that the usefulness of the invention extends to other fibrous filters, including those prepared from fibers of viscose, cotton, nylon, polyamides, polyesters, etc., particularly where the fibers are in substantial longitudinal alignment and are coextensive with the body of the filter.

I claim:

1. A tobacco smoke filter element consisting of more than 10,000 continuous crimped cellulose acetate uncoated filaments of at least 5 denier per filament, more than about eight parts by weight of a plasticizer from the group consisting of methylphthalylethylglycollate and dimethoxyethylphthalate, and at least two parts by weight of a pectic material of 100–200 mesh size from the group consisting of pectic acid, sodium pectate, calcium pectate, magnesium pectate, methyl pectate and ethyl pectate

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carried on the surface of said continuous filaments and bonded thereto by said plasticizer.

2. A tobacco smoke filter comprised of continuous crimped uncoated cellulose acetate filaments, a content of plasticizer compatible with said cellulose acetate filaments, said plasticizer being contained in said filaments, and 10–40% of a pectic material of 100–200 mesh size carried on and by said filaments and bonded thereto by said plasticizer.

3. A tobacco smoke filter consisting of more than 10,000 continuous crimped uncoated synthetic filaments, said filaments being oriented substantially longitudinally of the mass of the elements and joined to one another at random points of contact, the filter element being characterized in that the continuous filaments carry on their surface and bonded thereto 10–40% by weight of a pectic material of 100–200 mesh size from the group consisting of pectic acid, sodium pectate, calcium pectate, magnesium pectate, methyl pectate and ethyl pectate.

4. A filter element consisting of continuous crimped cellulose acetate filaments, droplets of plasticizer compatible with the cellulose acetate on the continuous filaments and 10–40% of the weight of the filter element consisting essentially of pectic material bonded to the surface of said continuous filaments by the plasticizer.

5. A tobacco smoke filter consisting essentially of a bundle of several thousand crimped continuous cellulose acetate filaments, substantially all of said filaments extending from end to end of said filter, said filaments containing a content of plasticizer for said cellulose acetate whereby said cellulose acetate filaments are softened at various points so as to cause bonding of the crimped filaments to other crimped continuous filaments and also the plasticizer assisting in the bonding to the filaments of a finely divided additive, 10–40% of a finely divided pectic material additive carried on the surface of said filaments and a wrapper encircling the periphery of the bundle.

References Cited in the file of this patent

UNITED STATES PATENTS

1,954,109	Whitaker	Apr. 10, 1934
1,961,886	Rooker	June 5, 1934
2,108,860	Kauffman	Feb. 22, 1938
2,171,770	Strauch	Sept. 5, 1939
2,228,383	Berl	Jan. 14, 1941
2,355,822	Rugely	Aug. 15, 1944
2,476,582	Browne et al.	July 19, 1949
2,483,406	Francis	Oct. 4, 1949
2,688,380	MacHenry	Sept. 7, 1954
2,707,308	Taylor et al.	May 3, 1955
2,780,228	Touey	Feb. 5, 1957
2,789,563	Taylor et al.	Apr. 3, 1957
2,805,671	Hackney et al.	Sept. 10, 1957

FOREIGN PATENTS

121,414	Australia	Mar. 30, 1944
243,838	Switzerland	June 2, 1947
264,287	Switzerland	Jan. 3, 1950
395,918	Great Britain	July 27, 1933
538,529	Great Britain	Aug. 7, 1941
665,278	Great Britain	Jan. 23, 1952
813,324	France	Feb. 22, 1937
838,419	Germany	May 8, 1952

OTHER REFERENCES

Derr et al.: "Removal of Undesirable Constituents from Tobacco Smoke," reprint from Industrial and Engineering Chemistry, vol. 29, pages 771 to 776, July 1937.