United States Patent

Patterson

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[54] CIGARETTE FILTER CONSTRUCTION

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[52] **U.S. Cl.** **131/10.5,** 131/266

[51] **Int. Cl.** **A24d 01/04**

[58] **Field of Search** 131/9, 10, 10.1–10.9, 131/261–269

[56] **References Cited**

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[57] **ABSTRACT**

A filter is described which is comprised of a high gas permeability plug in combination with a low gas permeability disc.

2 Claims, 4 Drawing Figures

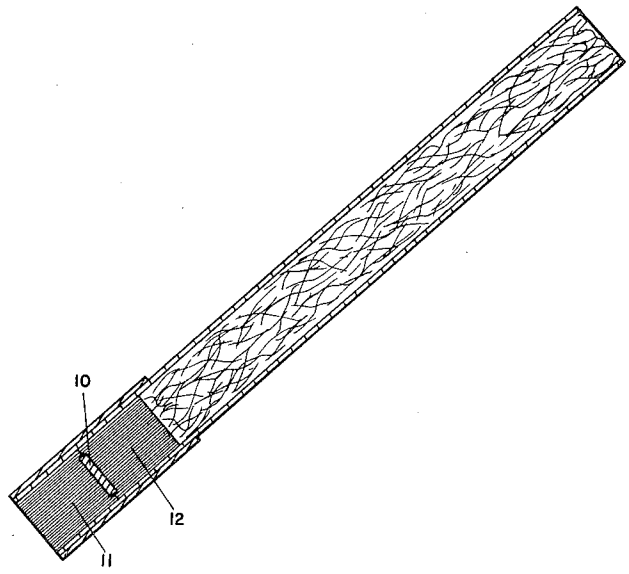
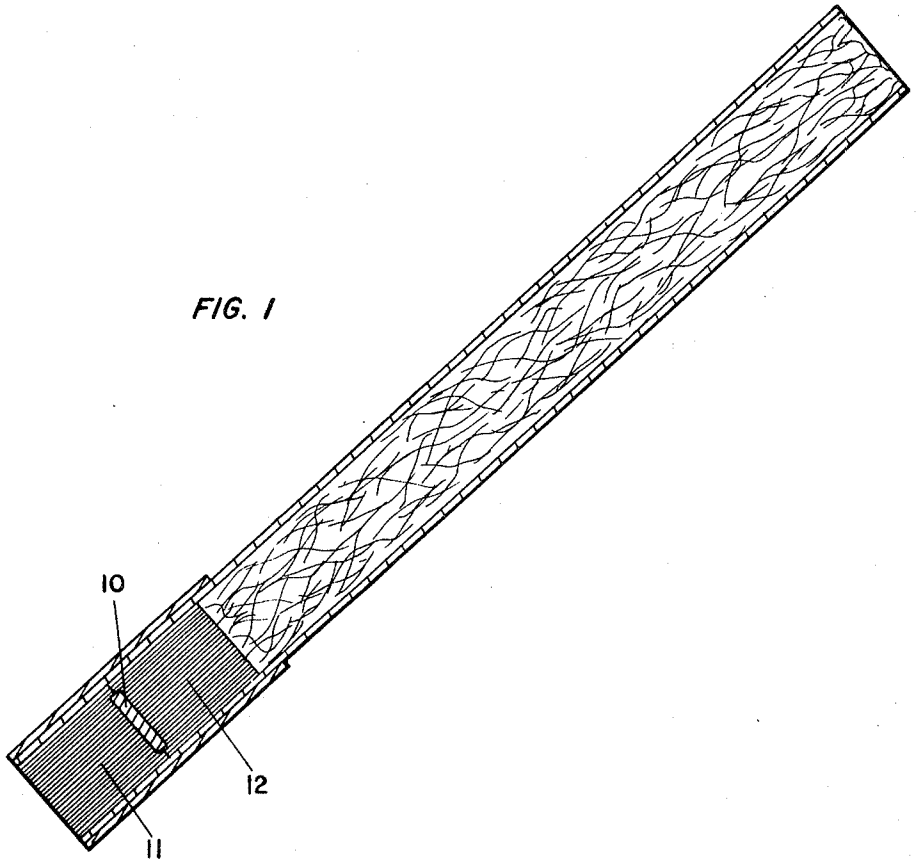


FIG. 1



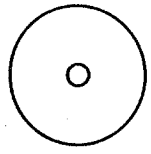


FIG. 2

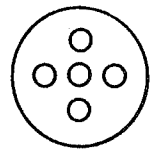


FIG. 3

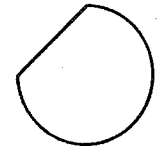


FIG. 4

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CIGARETTE FILTER CONSTRUCTION

BACKGROUND OF THE INVENTION

There has been much interest in the past, particularly as evidenced by the patent literature, in the development of tobacco smoke filters, particularly cigarette filters. Most of the filters described have been effective to some extent, but only a few of the many filters suggested have met with any degree of commercial acceptance.

To be suitable commercially, a tobacco smoke filter must remove a significant amount of particulate matter, i.e., "tar", while exhibiting a draw resistance that is acceptable to the smoker. In other words, the filter must show an acceptable level of smoke removal efficiency at an acceptable pressure drop.

Generally, the filter which has the highest smoke removal efficiency at a given pressure drop is considered to be the best filter. To be commercially acceptable, the filter must also be economically producible. Further, the balance of the smoke stream must not be unduly distorted by the filter.

Because of these factors, only filters of crimped, continuous filament cellulose acetate tow and filters of corrugated paper webs have met with any large commercial acceptance. A minor percentage of these filters contain charcoal to filter the gaseous phase. Other filters, e.g., filters containing other filtration materials and/or baffle arrangements, have experienced little or no success due to economics or a failure to show a smoke removal efficiency to pressure drop ratio superior to conventional cellulose acetate or paper filters.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved tobacco smoke filter, and particularly a cigarette filter, which will have a high smoke removal efficiency at a commercially acceptable pressure drop.

It is another object to provide a filter which will be economically producible and which will not unduly distort the smoke stream.

Other objects of the present invention, if not specifically set forth herein, will be apparent to one skilled in the art upon reading the following detailed description of the invention.

DRAWINGS

FIG. 1 is a side view of a tobacco column and filter exemplary of the filters herein described.

FIGS. 2, 3 and 4 are illustrative of suitable discs.

DETAILED DESCRIPTION OF THE INVENTION

Generally, the filter of the present invention is composed of at least one plug of a conventional filtration material, preferably a high gas permeability plug consisting of a number of crimped, continuous cellulose acetate filaments, in combination with a disc having a low gas permeability. Ordinarily, the filter will be covered with a conventional paper wrapper.

Preferably, the disc employed in the present filter is composed of a highly compacted stereo reticulate mass of natural or synthetic fibers, desirably cellulose, glass or polyolefin fibers, e.g., polypropylene or polyethylene fibers. Discs of non-porous material, e.g., Celluloid, polyolefin, nylon, polyester, etc., may also be used, if the discs are perforated sufficiently, or are of the proper size, to give an acceptable pressure drop. For reasons which will become apparent, however, fibrous discs are preferred.

Regardless of its compositions, the disc, to be acceptable in the present invention, must exhibit an acceptable pressure drop. Generally, this pressure drop must be equivalent to from about 15 mm. to about 60 mm. of H_2O, and preferably, from about 20 to 40 mm. of H_2O.

While a disc having a diameter up to equal that of the tobacco column may be employed, it has been found, surprisingly, that the highest smoke removal efficiency at a given pressure drop is obtained when the disc has a diameter of about 5 to 25 percent less than the diameter of the tobacco column and filter plug. While not wishing to be held to any particular theory, apparently, the spacing around the disc reduces the pressure drop and permits the use of a lower permeability disc, and thus produces greater filtration. In the case of filters for conventional cigarettes, which have a circumference of about 22–27 mm., the disc will have a circumference of from about 16 mm. to about 26 mm.

Ordinarily, the disc will have a thickness of from about 0.1 mm. to about 2.0 mm. The thickness may vary outside these ranges somewhat, however, so long as the required pressure drop is maintained.

As earlier mentioned, it is preferred that the disc be of fibrous composition. During smoking, fibrous discs having the herein described parameters shrink, probably because of the moisture in the tobacco smoke. As a result of this shrinkage, the pressure drop produced by the disc will decrease during smoking. The pressure drop of conventional baffle type filters increase during smoking due to slugging. The combination of the filter disc with conventional filtration material, as herein defined, results in a filter which has a relatively uniform pressure drop throughout the smoking of the attached tobacco column.

As previously noted, the plug used in conjunction with the above described disc is preferably formed from a plurality of longitudinally aligned, crimped, continuous cellulose acetate filaments. Desirably, these filaments have a denier per filament of from about 2 to about 30. The filaments may be of regular cross section or may have a Y, X, or other cross-sectional configuration. Sufficient filaments will ordinarily be employed to yield a plug having a total denier of from about 20,000 to about 80,000.

While cellulose acetate filaments of the type described are the preferred material employed for forming the plug, other fibrous materials, such as other cellulose esters, cellulose ethers, polyolefins, nylons, polyesters and cotton may be used for this purpose, as may paper webs.

In order to be acceptable for use in conjunction with the aforementioned disc, the plug should have a pressure drop of from about 20 mm. to about 90 mm. of H_2O and preferably from about 30 mm. to about 60 mm. of H_2O. Lower pressure drops will not yield a filter having optimum properties and higher pressure drops will be unacceptable to most smokers.

The length of the plug employed is not critical to the present invention so long as the plug exhibits the required pressure drop. Ordinarily, to conform with commercial usage, the plug will have a length of from about 10 mm. to about 30 mm., however.

The overall pressure drop of the filter will normally be from about 40 mm. to about 110 mm. of H_2O, preferably, 50 to 90 mm.

More than one plug may be used in conjunction with the disc. For example, the disc may be disposed between two plugs. In this case, the total length of the plugs would normally be equal to the length of the above described single plug. The two plugs need not, of course, be of equal length.

Similarly, more than one disc may be incorporated into the filter. These discs may be of the same or different composition or configuration. They may be in juxtaposition or separated by a plug of high gas permeability filtration material.

The diameter of the plug will be approximately the same as the diameter of the tobacco column.

FIG. 1 illustrates one embodiment of the invention in which a disc **10** is positioned between two plugs of filamentary filtration material **11** and **12**. It is to be noted that the diameter of disc **10** is less that the diameter of the filter or tobacco column attached. Disc **10** is disposed substantially normally to the longitudinal axis of the tobacco column and plug, as is the case with all filters of the present invention.

If a decrease in the pressure drop produced by the disc is desired, the disc may be perforated with one or more holes as shown, for example, in FIGS. 2 and 3, or an edge of the disc may be trimmed as shown in FIG. 4.

While the present invention has been described as being a combination of a high pressure drop disc with a low pressure drop plug of filtration material, it will be understood by one skilled in the art that the filter may include, or be used in conjunction with, other filtration materials or selective filtration additives, either solid or liquid, such as carbon, silica gel, polyalkylene glycols, etc.

The following examples are presented as illustrative of the present invention and are not to be considered as being in limitation thereof.

EXAMPLE I

A celluloid disc of 8 mm. in diameter of 0.5 mm. in thickness was perforated with five 0.023 inch in diameter holes in a "star" pattern. The disc was placed between two plugs of cellulose acetate tow of 45,000 denier composed of 5 d.p.f. filaments of regular cross section. The composite filter was wrapped in paper. The initial pressure drop, or resistance to draw, of the filters varied from 63 to 82 mm. H_2O. Upon attaching to a tobacco column and smoking, the smoke removal efficiency was found to vary from 52 to 73 percent. Conventional cellulose acetate filters of comparable pressure drop give an SRE of from about 44 to 51 percent.

EXAMPLE II

A paper disc of 0.5 mm. in thickness and 8 mm. in diameter was perforated at the center of an 0.059 inch hole. The paper disc was placed in juxtaposition with a plastic disc with the same diameter similarly perforated. The two discs were then placed between two plugs of 45,000 denier cellulose acetate tow comprised of 5 d.p.f. filaments of regular cross section. The total length of the plug was 20 mm. After wrapping the perforated plug in paper, the pressure drop was measured and found to be from 67 to 81 mm. H_2O. Smoking of the tobacco column attached to the filter showed that the filter had an SRE of 66–76 percent. A conventional cellulose plug of the same dimension has an SRE of from about 48 to 53 percent.

EXAMPLE III

A disc of compressed cellulose fibers was perforated in the center with an 0.059 inch hole and positioned between two tow segments. The filter had an initial pressure drop of 74 mm. of H_2O and an SRE of 46.8 percent.

EXAMPLE IV

A porous paper disc of 8 mm. in diameter was placed between two 10 mm. cellulose acetate plugs having a total denier of 44,000 and comprised of filaments having 3.3 d.p.f. and Y cross section. The pressure drop of the samples varied from 71–75 mm. H_2O. The SRE was approximately 50 percent.

EXAMPLE V

A disc of compacted spray spun polypropylene fibers having a diameter of 8.15 mm. was perforated with a Number 17 needle in the center and placed between two plugs of cellulose acetate filaments having a d.p.f. of 25. The initial pressure drop was 64 mm. H_2O and the SRE was 49.1 percent.

While the present invention has been described in terms of specific embodiments, it is to be understood that any variations and modifications may be made within the scope of the present invention.

What is claimed is:

1. A cigarette filter comprising a wrapped high gas permeability plug of substantially longitudinally aligned, crimped, continuous cellulose acetate filaments having a total denier of approximately 20,000–40,000 with the individual filaments having a denier of from 2 to 30, said plug being in contact with a low gas permeability disc formed of a highly compacted stereo reticulate mass of fibers, said disc manifesting a pressure drop of approximately 20–40 mm. of H_2O, the disc having a diameter which is 5–25 percent less than that of the plug and so oriented within the wrapper as to provide an unobstructed annular smoke path therearound.

2. The cigarette filter of claim 1 in which the fibers of the stereo-reticulate mass are selected from the group consisting of cellulosic, glass and polyolefin fibers—The "Abstract of the Disclosure" has been changed to read:

A cigarette filter is disclosed which is composed of two major elements, that is, a plug of longitudinally arranged crimped and continuous cellulose acetate filaments of 20,000–40,000 denier and secondly a compacted fiber disc which either abuts one end of the plug or is disposed within the body thereof. The disc is composed of a stereo-reticulate compacted mass of natural or synthetic fibers such as cellulose, glass or polyolefin fibers and manifests a pressure drop of preferably between 20–40 mm. of H_2O. The disc is of a diameter which is 5 to 25 percent less than the diameter of the plug and so oriented as to provide an unobstructed annular smoke passage therearound.

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