SMOKER'S FILTER DEVICE

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Filed: May 2, 1974

Appl. No.: 466,407

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ABSTRACT

A smoker's filter device is disclosed for use in removing tars, nicotine and other deleterious substances from tobacco smoke. The device is composed of telescopically nested sleeve members defining an impact barrier and interconnected, flow-reversing passages interposed between the inlet and outlet ends of the filter device to provide a substantially clog-free, labyrinthine filter device for removing tars, fine particulates and the like from tobacco smoke.

5 Claims, 10 Drawing Figures
SMOKER'S FILTER DEVICE

BACKGROUND OF THE INVENTION

This invention relates to devices for removing tars, nicotine, particulate matter and other deleterious substances from tobacco smoke, and is more particularly directed to disposable filtering devices for use in cigarettes, cigars, pipes and similar tobacco products to help reduce adverse effects of smoke inhalation.

A great many filter devices have been proposed over the years seeking to achieve the foregoing general objectives. Such earlier devices have employed designs for filtering the smoke through fibers or cellular structures, impact barriers against which the smoke is impinged at high velocity, expansion/condensation chamber arrangements, venturi orifices, mechanical flow reversal or maze structures, and combinations of these designs. The problems encountered with any type of filter include those of increased flow restriction with increase in filtering action, producing a "hard drawing" characteristic in the smoking device or product that is undesirable and sometimes unacceptable to a smoker, bulkiness or other dimensional objections in an adequate filter; cost of filter material as well as manufacturing costs, such as to make the filter non-economic as a consumable or one-time-use-and-throw-away component.

The present invention is accordingly directed to providing a type of smoker's filter which is more effective in meeting these requirements in a commercially practical device. It is a principal objective to provide a smoking filter that is designed for mass, automated manufacture of the subcomponents and assembly thereof. As a result of designed economies, the novel filter may economically be used on a one-time basis and discarded; generally however it is preferably designed to be effective for reuse on a full pack (20) of cigarettes or a pack (4-6) of cigars or several refills of a pipe, for example. Concomitant with this objective is that of achieving a high degree of filtering efficiency without objectionally altering the draw characteristics, flavor, aroma or other pleasure or satisfaction experiences imparted to the smoker in the use of tobacco products incorporating the filter. Filters of the design characteristics hereinabove described have shown by statistical analysis a greater success in achieving tar removal than others now in commercial use.

A preferred embodiment of the invention is shown in the accompanying drawings and described hereinafter. It will be apparent that numerous details of the described embodiment may be varied from those specifically here illustrated to achieve the same results, and all of such variations as fall within the scope of the appended claims are intended to be covered thereby.

In the accompanying drawings,

FIG. 1 is an exploded assembly view of a filter incorporating the invention and adapted more particularly for use with cigarettes;

FIG. 2 is a view in longitudinal cross section of the assembled filter device of FIG. 1;

FIGS. 3 and 4 are end views, respectively, of the inlet and outlet ends of the device seen in FIG. 2;

FIG. 5 is a view in longitudinal cross section of the component sleeve member of the filter shown in FIGS. 6 and 7;

FIGS. 6 and 7 are, respectively, opposite end views of the component seen in FIG. 5;

FIG. 8 is a view in longitudinal cross section of a jet tube component of the device; and

FIGS. 9 and 10 are, respectively, end views of the opposite ends of the jet tube seen in FIG. 8.

The filter assembly, as seen more particularly in FIGS. 1 and 2 of the drawings, is composed of three telescoping members consisting of an outer tubular sleeve 12, an inner tubular tar receptor sleeve 14 and an orifice or jet tube 16. Outer sleeve 12 is open at its opposite ends and is provided with a counterbore 18 at the inlet end forming a socket for the reception of the end of a conventional cigarette. At its other end housing 12 is formed with an internal annular flange 20 defining a restricted outlet port 22 and an internal annular shoulder 24.

Inner tubular sleeve 14, at its outlet end, has an external annular flange 26 (FIG. 5) of a diameter to make a close piston fit within sleeve 12. As seen in FIG. 2, flange 26 is abutted against internal shoulder 24 of sleeve 12, and the slightly smaller diameter body of inner sleeve 14 is thus radially spaced from the inner surface of tube 12 to define a first annular passage 28 extending axially of the filter device, surrounding sleeve 14. Sleeve 14 is open at its inlet end 30 and is closed adjacent its flanged end by a wall 32 positioned somewhat axially inwardly from flange 26. Inlet end 30 of sleeve 14 is of castellated form, produced by cross-slots 34 molded or cut diametrically into the rim to define radial passages at the end of the sleeve. At the opposite end of sleeve 14, cross-slots 36 are similarly formed and interrupt flange 26, likewise defining radial passages spaced about that end of the sleeve. Accordingly, the flange 26 serves to space the inner sleeve 14 inwardly from the internal wall of the outer sleeve 12 thereby providing the annular passage 28, because it has a greater diameter than that of the external wall of the inner sleeve, and also provides a plurality of radially extending smoke passages by means of the cross-slots 34 while spacing the wall 32 axially from the internal annular shoulder 24 toward the inlet end of the sleeve.

Jet tube 16 is of generally T-shape, having a hollow stem 40 which opens at 42 onto head end 44 of the tube. At its distal end, tube 16 is closed by an end wall 45 perforated by one or more axially oriented restricting orifices 46. The external diameter of head 44 is dimensioned to make a close piston fit with the inner wall of outer sleeve 12 (see FIG. 2), and is abutted against the open inlet end 30 of inner sleeve 14, with stem 40 axially telescoped within that sleeve. The stem is slightly shorter in length than the depth of inner sleeve 14 so that its end wall 45 is spaced in relation to end wall 32 of the sleeve. The adjacent positioning of jet tube orifices 46 to end wall 32 thus provides a generally perpendicular impact barrier structure in the filter. A double-stepped shoulder 48 is formed in the undersurface of head 44, and the larger portion of the shoulder makes a close telescoping fit within the open end of sleeve 14 to help accurately position that end of the sleeve coaxially within the filter. As seen in FIG. 2, the depth of cross-slots 34 is greater than the height of the contacting portion of shoulder 48, so that the air flow by means of the radial passages formed by slots 34 is maintained between first annular passage 28 surrounding sleeve 14 and a second annular passage 50 formed between stem 40 and the inner wall of sleeve 14.
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It will thus be seen that the socket 18 and outlet 22 of sleeve 12 are first intercommunicated for the flow of smoke by way of inlet port 42, hollow stem 40 and restricted orifices 46 of tube 16 to impact against wall 32, opening into annular passage 50; and in turn by way of cross-slots 34 at inlet end 30 of sleeve 14 to annular passage 28, to which communication is made to outlet 22 by way of cross-slots 36. A labyrinthine smoke channel is thus provided, along with an impact barrier against which the entering smoke is directly impinged prior to being caused to flow reversely back-and-forth in the annular channels of the filter before reaching outlet 22.

Certain relationships of physical size are found to be important in achieving good filtering action in a device of acceptable length, and for a cigarette filter about one inch is a maximum. Among the most significant of these relationships is the distance between end wall 45 of jet tube 40 and barrier wall 32 of sleeve 14; also the relative sizes of annular passages 28 and 50. Generally it is found that orifices 46 should produce an effective smoke velocity of about 100 feet per second at average inhalation pressure, and under this set of conditions, a suitable impact effect is produced by spacing end wall 45 from barrier wall 32 approximately 0.052 inch. The total orifice area in end wall 45 producing this result, whether by means of the multiple orifice arrangement shown or an equivalent single orifice, will preferably be between 0.0006 and 0.0007 square inch. Additionally, the cross sectional areas of annular passages 50 and 28 should be substantially the same, approximately 0.0195 to 0.0205 square inch being optimum. Since passage 50 is of smaller diameter, its width is correspondingly larger than that of passage 28, and this arrangement provides greater clear flow area in the region of the filter most susceptible to blockage due to build up of condensed tar adjacent impact wall 32. Finally, double-stepped shoulder 48 should impose some restriction of the passage formed by slots 34 so as to produce a pressure drop between inner passage 50 and outer passage 28 as smoke flows through them. In a preferred arrangement, satisfactory results are produced by making the axial depth of slots 34 about 0.033 inch and their width about 0.094 inch: and in such case the axial height of the larger diameter portion of shoulder 48 should amount to 0.010 inch in conjunction with an axial height of about 0.020 inch for the smaller diameter portion of the shoulder, its diameter being about 0.156 inch.

While the foregoing specific description is directed to a filter for cigarettes, the relationships described are adaptable to filters for cigars and pipes as well.

As seen, the filter is composed of only three members, each of which is ideally suited for fabrication in multiple-cavity injection molding equipment and to be easily assembled automatically by other equipment. These components are held together simply by a press or interference fit requiring no secondary bonding or welding operation. A number of commercially available plastic materials are suitable for molding the components, among which the acrylics are preferred. The filter design is effectively engineered to facilitate mold design and molding techniques, yet close tolerances are enabled to be maintained under practical mass production conditions in the assembled filter. Accordingly an effective filter from a functional standpoint is produced at a cost which compares most favorably with the nearest equivalent commercial smoking filters.

What is claimed is:

1. A smoker's filtering device for tar removal incorporating an impact barrier and a labyrinthine smoke channel, comprising in combination:
   an outer tubular sleeve having open opposite inlet and outlet ends for the passage of smoke thereafter, and having an internal annular shoulder at said outlet end;
   an inner tubular sleeve telescopedically received in said outer sleeve, said inner sleeve being open at one end and closed adjacent the other, an external annular flange at the closed end, each of said ends of said inner sleeve being castellated and one thereof having a portion extending axially beyond the outlet end and radially beyond the external wall of the sleeve, the castellation in said flange comprising means providing a plurality of radially extending slots therein whereby said external flange is interrupted peripherally by the castellation at that end, said external flange being in axial abutment with said internal shoulder of said outer sleeve whereby the body of said inner sleeve is disposed in annularly spaced relation to said outer sleeve to define a first annular passage extending axially in said device and whereby the closed end of the inner sleeve body is spaced from said internal annular shoulder toward the inlet end thereof providing a plurality of radially extending smoke passages through said slot means; and
   an orifice tube comprising a T-shaped plug having a headed end and a hollow stem opening onto the headed end but closed at the distal end, means providing at least one axially directed restricting orifice in said distal end of the stem, said plug being telescopedically received within said inner sleeve, the headed end of said plug making a piston fit in said outer sleeve and abutting the open end of said inner sleeve to close the latter, said stem being of such length as to position said distal end in close axially spaced relation to the closed end of said inner sleeve and provide an impact barrier for smoke issuing from said orifice tube, said stem being smaller in diameter than said inner sleeve to form a second annular axially directed passage encircled by the first but separated therefrom by said inner sleeve except at the castellated end thereof; said inlet and outlet ends of said filter device being sequentially intercommunicated by said hollow stem, orifice, annular passages and castellated formations at the ends of said inner sleeve, to form said labyrinthine smoke channel.

2. A smoker's filtering device as defined in claim 1, wherein said outer and inner sleeves and said orifice tube are all concentrically disposed.

3. A smoker's filtering device as defined in claim 1, wherein the cross-sectional areas of said first and second annular passages are approximately equal but the annular width of the second is greater than that of the first.

4. A smoker's filtering device as defined in claim 1, wherein said orifice tube is formed with a stepped annular shoulder at the junction of said headed end and tube, said stepped shoulder cooperating with the adjacent castellated formation at the open end of said inner sleeve to provide a stepped restriction to the passages formed by said castellated formation.

5. A smoker's filtering device as defined in claim 1, wherein said outer and inner sleeve and orifice tube members are telescoped together with an interference fit to retain them in assembled relation. * * *