# United States Patent

[11] 3,626,952


[72] Inventor **Karol J. Mysels**
**Winston-Salem, N.C.**



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[73] Assignee **R. J. Reynolds Tobacco Company**
**Winston-Salem, N.C.**


[54] **SMOKE FILTER**
**9 Claims, 7 Drawing Figs.**


[52] **U.S. Cl.** ..... **131/10.5,** 131/201, 131/210
[51] **Int. Cl.** ..... **A24d 01/04,** A24f 07/04, A24f 13/06
[50] **Field of Search** ..... 131/10.5, 261 B, 201, 210



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*Primary Examiner*—Samuel Koren
*Assistant Examiner*—J. F. Pitrelli
*Attorney*—Pendleton, Neuman, Williams & Anderson



**ABSTRACT:** A tobacco smoke filter is provided which includes a hollow cylindrical member formed of smoke-impervious material. The member includes a pair of hingedly connected semicylindrical sections and a pair of perforated panels hingedly connected to the semicylindrical sections and disposed therebetween. One of the panels and one of the semicylindrical members cooperate to form a first passageway having an open upstream end and a closed downstream end. The other panel and semicylindrical member cooperate to form a second passageway having a closed upstream end and an open downstream end. The passageways are in communication with one another only through the perforated panels. Smoke is adapted to pass through the perforations of the panel defining the first passageway as a plurality of high-velocity jets which impinge against the adjacent surface of the panel defining the second passageway.

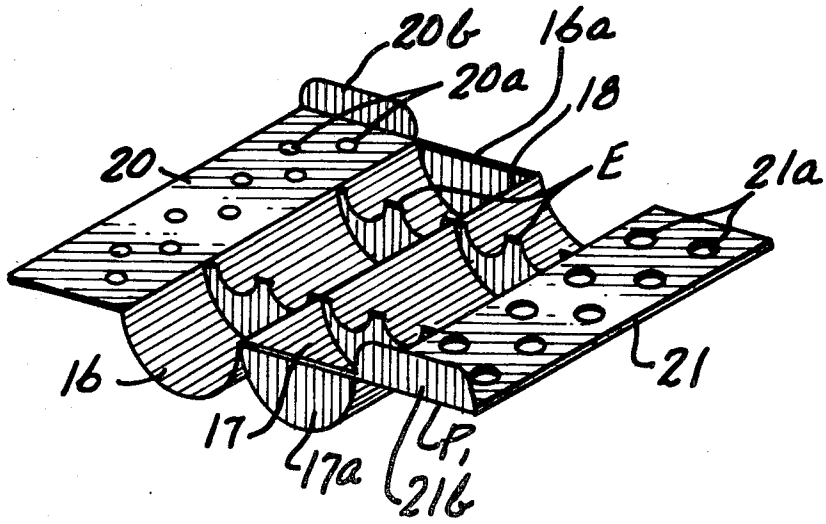



Fig. 1

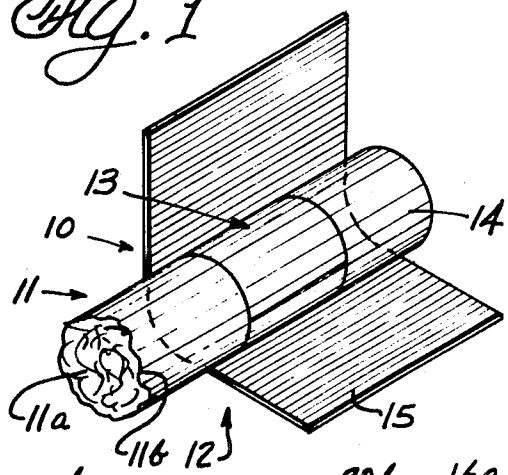



Fig. 2

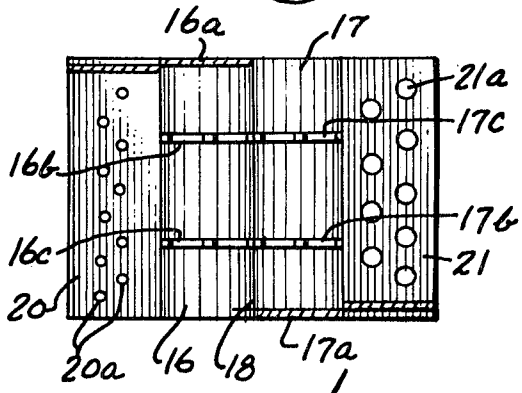



Fig. 3

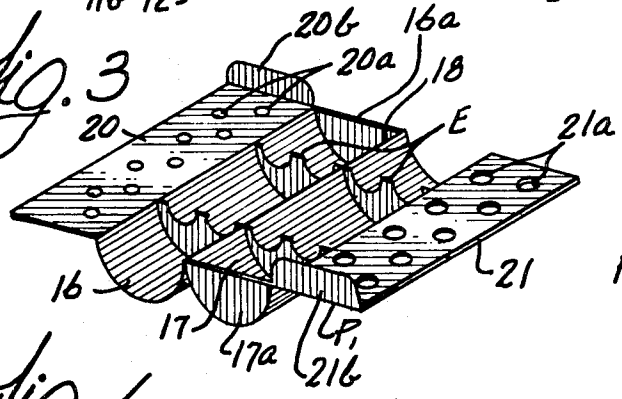



Fig. 5

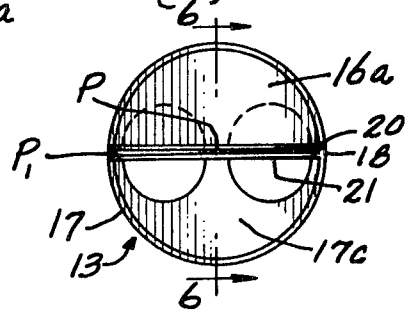



Fig. 6

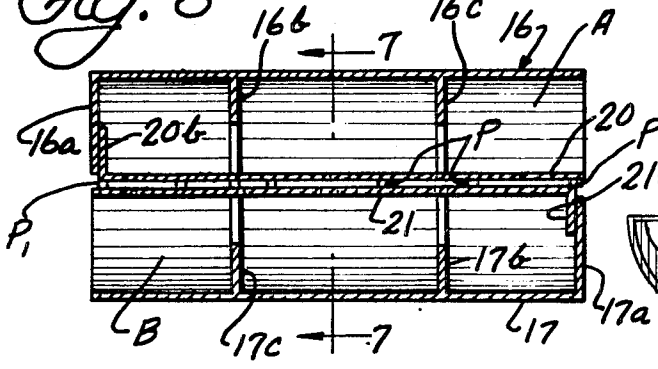



Fig. 4

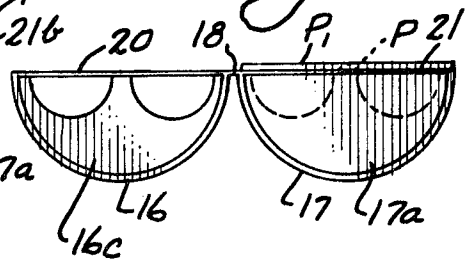
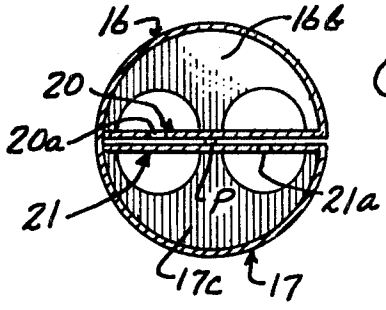



Fig. 7




Inventor
Karol J. Mysels
By - Pendleton, Neuman
Williams & Anderson
Attorneys

# SMOKE FILTER

## BACKGROUND OF THE INVENTION

Various tobacco smoke filters have heretofore been provided; however, because of various design features, they have been beset with one or more of the following shortcomings: a) the filter is of a costly complex construction; b) the filter is not capable of high-speed assembly by automatic equipment; c) the filtering efficiency is low; and d) the pressure drop across the filter is high and increases during smoking.

## SUMMARY OF THE INVENTION

Thus, it is an object of this invention to provide a smoke filter which avoids the shortcomings associated with prior filter constructions.

It is a further object of this invention to provide a smoke filter which comprises a minimum number of component parts.

It is a still further object of this invention to provide a smoke filter which will not deleteriously affect the aroma and taste of the smoke.

It is a still further object of this invention to provide a smoke filter which may be utilized with a variety of tobacco products.

Further and additional objects will appear from the description, accompanying drawings, and appended claims.

In accordance with one embodiment of this invention, an improved smoke filter is provided which comprises an elongated hollow cylindrical member formed of smoke impervious material. The cylindrical member includes a pair of hingedly connected semicylindrical sections and a pair of perforated panels hingedly connected to said sections and disposed intermediate said sections. The panels are arranged in parallel, closely spaced relation. One of the panels cooperates with one of the semicylindrical sections to form a first passageway having an open upstream end and a closed downstream end. The other panel cooperates with the other semicylindrical section to form a second passageway having a closed upstream end and an open downstream end. The two passageways communicate with one another only through the perforated panels. The perforations formed in the panel defining the first passageway are sized so that the smoke passes therethrough only as a plurality of high-velocity jets which impinge against the adjacent surface of the second perforated panel before passing into the second passageway.

## DESCRIPTION

For a more complete understanding of the invention reference should be made to the drawings wherein:

FIG. 1 is a fragmentary perspective view of one form of the improved filter including a hollow cylindrical member which is shown aligned with one end of a tobacco rod to form a filter cigarette; the outer sleeve or tipping paper comprising a component of the cigarette is shown in unfolded condition so as to expose other components of the filter.

FIG. 2 is a top plan view of the hollow cylindrical member shown in FIG. 1, but with the member in a fully unfolded condition.

FIG. 3 is a top perspective view of the hollow cylindrical member of FIG. 2 shown in an unfolded condition.

FIGS. 4 and 5 are end views of the hollow cylindrical member in various stages of being folded.

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5.

FIG. 7 is an enlarged fragmentary sectional view taken along line 7—7 of FIG. 6.

Referring now to the drawings and more particularly to FIG. 1, one form of the improved filter **10** is shown in combination with a tobacco rod **11** to form a filter cigarette **12**. While the improved filter is shown and is hereinafter described with respect to a tobacco rod, it is to be understood, of course, that it is not to be limited thereto but may be utilized in combination with cigarette and/or cigar holders, pipe stems, etc.

Filter **10**, as illustrated, includes a hollow cylindrical member **13**, which is disposed in an endwise abutting relation



with respect to the downstream end of the tobacco rod **11**, a cylindrical plug **14** of fibrous material (e.g., Estron) abutting the downstream end of member **13**, and a sleeve **15** of smoke-impervious material (e.g., tipping paper) which snugly encompasses the member **13**, plug **14**, and downstream end of the tobacco rod **11** and retains same in a predetermined fixed relation. If desired, the plug **14** may be eliminated.

The tobacco rod **11** is of conventional construction and includes a core **11***a* of compacted shreds of blended tobacco. The core is encompassed by a sleeve **11***b* of conventional cigarette paper. The length of the rod **11** may vary as desired.

The hollow cylindrical member **13** is preferably of a smoke-impervious plastic material, such as polyethylene, polypropylene, and the like and is formed by injection molding or the like. In molding the member, it is arranged in a fully unfolded position, as seen in FIGS. **2** and **3**. Member **13**, in the illustrated embodiment, includes a pair of semicylindrical sections **16** and **17** which are of like configuration and have adjacent elongated edges thereof hingedly connected to one another along a foldline **18**. Hingedly connected to the opposite or outer elongated edge of each semicylindrical section are perforated panels **20** and **21**. The panels **20** and **21** assume parallel, closely spaced relation and are disposed intermediate the folded semicylindrical sections **16** and **17** when the latter assume inverted superposed relation, see FIGS. **5–7**.

Semicylindrical sections **16** and **17** are of substantially like configuration, except that section **16** has the downstream end thereof closed by a semicircular smoke barrier **16***a* whereas section **17** has the upstream end thereof closed by a similar semicircular smoke barrier **17***a*. Intermediate the ends of each semicylindrical section **16** or **17** are disposed one or more reinforcing baffles **61***b–c*, or **17***b–c*. The baffles extend transversely of the axis of each section and the inner edge E of each baffle is serrated or provided with a plurality of openings, see FIG. **7**, so as to permit flow of the smoke past the baffle. The baffles serve to reinforce each semicylindrical section and to retain the perforated panels in parallel relation. The number of baffles utilized will depend upon the length of the section and the thickness of material utilized in forming the section.

Panel **20** cooperates with semicylindrical section **16** to form a first passageway A having an open upstream end which abuts the downstream end of the tobacco rod **11**. The downstream end of passageway A, as previously mentioned, is closed by smoke barrier **16***a* carried by the section **16**. Panel **21**, on the other hand, cooperates with semicylindrical section **17** to form a second passageway B having an open downstream end which abuts plug **14**, when the latter is used. The two passageways A and B communicate with one another only through the perforated panels **20** and **21**.

The number and size of the perforations **20***a* formed in panel **20** are such that the smoke is adapted to flow therethrough in the form of a plurality of high-velocity jets. For example, there may be 10 circular perforations each being of the same size and presenting a total cross-sectional area of about 0.001 square inch.

The perforations **21***a* formed in panel **21**, on the other hand, are substantially larger in size than perforations **20***a* and are laterally offset with respect thereto. In the illustrated embodiment of panels **20** and **21**, it will be noted, that the perforations **20***a* are arranged in two closely spaced parallel rows which are aligned with an area formed between two widely spaced parallel rows of perforations **21***a* formed in panel **21**.

One or both of the panels **20** or **21** are provided with a plurality of projections P which contact the adjacent surface of the other panel and maintain the adjacent surfaces in a predetermined closely spaced (e.g., 0.01 inch) parallel relation. By reason of the close proximity of the inner surface of panel **21** to the inner surface of panel **20**, the high-velocity smoke jets will impinge against the inner surface of panel **21** causing deposition thereon of the liquid and/or solid particles entrained in the smoke jets. $P_1$ projections, see FIG. **4**, extend across the upstream and downstream ends of the member **13** and prevents smoke from the rod initially passing between

panels **20** and **21** rather than through passageway A and then subsequently passing though passageway B.

It is preferred that the thickness of panel **20** be less than about 0.01 inch so as to reduce as much as possible the pressure drop across the panel. Because of the comparatively large size of the perforations **21***a* formed in panel **21**, no significant increase in pressure drop results by reason of the smoke passing therethrough.

In order to assure a more effective smoke barrier at the downstream end of passageway A and the upstream end of passageway B, panels **20** and **21** may be provided with end partitions **20***b* and **21***b*, respectively. The partitions also facilitate folding of the respective panels during forming of the hollow cylindrical member **13**. Each partition is disposed to the inside of the adjacent barrier **16***a* or **17***a* formed in the semicylindrical section **16** or **17**.

In folding member **13**, the panels **20** and **21** are first folded simultaneously inwardly relative to sections **16** and **17** so as to overlie same, see FIG. **4**. Following this initial fold, the two sections **16** and **17** and the corresponding panels **20** and **21** are then folded as units about foldline **18**, see FIG. **5**. The aforenoted sequence of folding can be readily performed by automatic equipment. The outer diameter of the fully folded member **13** closely approximates the outside diameter of the tobacco rod **11**, see FIG. **1**.

Once the member **13** is positioned adjacent the end of the tobacco rod **11**, the plug **14** is then placed in position whereupon the sleeve **15** is brought into encompassing relation with the tobacco rod end, member **13**, and plug **14**. The assembling of the filter components and the positioning thereof with respect to the tobacco rod may be readily accomplished by utilizing conventional techniques and apparatus well known in the cigarette-making art.

The relative positions of the panels and semicylindrical sections may vary from that shown in FIGS. **2** and **3** without departing from the scope of the invention. Furthermore, the arrangement, number, and shape of the perforations formed in the panels may also vary from that shown.

Thus, it will be seen that an improved smoke filter has been provided which utilizes a minimum number of component parts thereby greatly facilitating the assembly of said filter. The improved filter is highly effective in removing liquid and/or solid particles from the smoke. The filtering characteristics of the improved filter remain fairly constant during smoking and no significant change in pressure drop across the filter occurs.

I claim:

**1**. A smoke filter for attachment to one end of a tobacco rod comprising a hollow cylindrical member formed of smoke-impervious material; said member including first and second semicylindrical sections, and perforated first and second panels; said sections and panels being foldably interconnected whereby said sections are disposed in inverted substantially superposed relation and said panels are arranged in closely spaced substantially parallel relation and disposed intermediate said inverted sections; the first section and the first panel cooperating with one another to form a first passageway having an open upstream end and a closed downstream end, the second section and the second panel cooperating with one another to form a second passageway having a closed upstream end and an open downstream end, said first and second passageways communicating with one another only through said perforated panels; the perforations of said first panel being of a size whereby the smoke passes therethrough as a plurality of high-velocity jets which impinge against the adjustment surface of the closely spaced second panel before entering said second passageway.

**2**. The smoke filter of claim **1** wherein the semicylindrical sections and the perforated panels comprising said hollow cylindrical member are of a unitary construction.

**3**. The smoke filter of claim **1** wherein the perforations of said second panel are of substantially greater size than the perforations of said first panel.

**4**. The smoke filter of claim **1** wherein each semicylindrical section is provided with an inwardly projecting reinforcing baffle.

**5**. The smoke filter of claim **1** including a cylindrical plug of fibrous porous material disposed in abutting aligned relation with respect to the downstream end of said hollow cylindrical member, and smoke impervious means for retaining said cylindrical member and plug in assembled relation.

**6**. The smoke filter of claim **1** wherein said semicylindrical sections each have an elongated edge thereof foldably interconnected to one another, and the panels are foldably connected to the other elongated edges of said semicylindrical sections.

**7**. The smoke filter of claim **1** wherein at least one of said panels carries spacer means engaging the other panel and maintaining said panels in a predetermined closely spaced parallel relation.

**8**. The smoke filter of claim **1** wherein said first panel includes a transversely extending smoke barrier disposed adjacent the downstream end of said first passageway, and said second panel includes a transversely extending smoke barrier disposed adjacent the upstream end of said second passageway.

**9**. The smoke filter of claim **1** wherein said first semicylindrical section includes a transversely extending smoke barrier disposed adjacent to and closing off the downstream end of said first passageway, and said second semicylindrical section includes a transversely extending smoke barrier disposed adjacent to and closing off the upstream end of said second passageway.

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