United States Patent

[11] 3,631,867

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[54] **SMOKE FILTER**
11 Claims, 20 Drawing Figs.

[52] **U.S. Cl.** ..... **131/261 B,** 131/10.7, 131/201
[51] **Int. Cl.** **A24d 01/04,** A24f 07/04, A24f 13/06
[50] **Field of Search** ..... 131/10.5, 261 B, 199, 201, 210, 216

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ABSTRACT: A smoke filter is provided wherein the filter includes a laminated module provided with a pair of elongated smoke passageways separated from one another by a perforated lamina. The module is encapsulated by an elongated smoke impervious member whereby the upstream end of one module passageway and the downstream end of the other passageway are exposed. The elongated member is initially a solid extruded rod which is subsequently provided with an elongated longitudinally extending slot formed in one side thereof into which the laminated module is inserted. Subsequent to the insertion of the module into the member slot, the open side of the slot is closed thereby encapsulating the module therein.

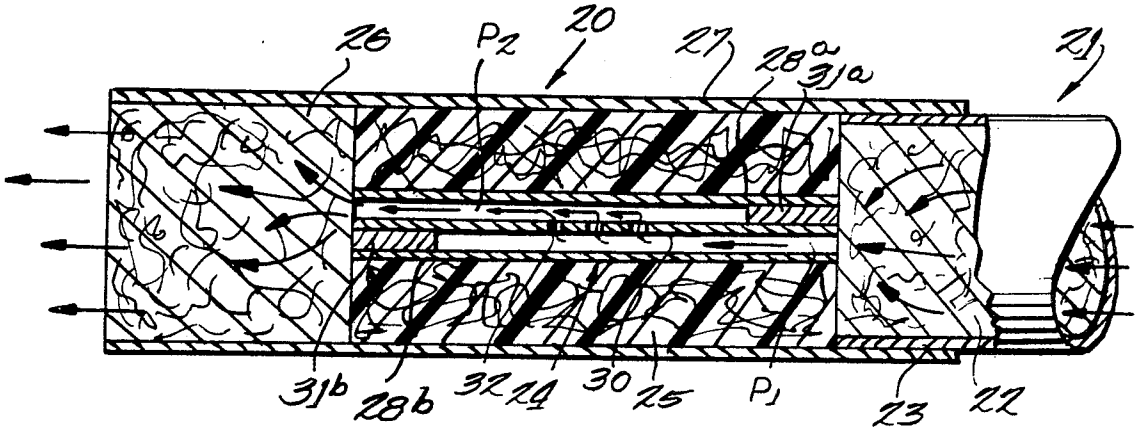


Fig. 4

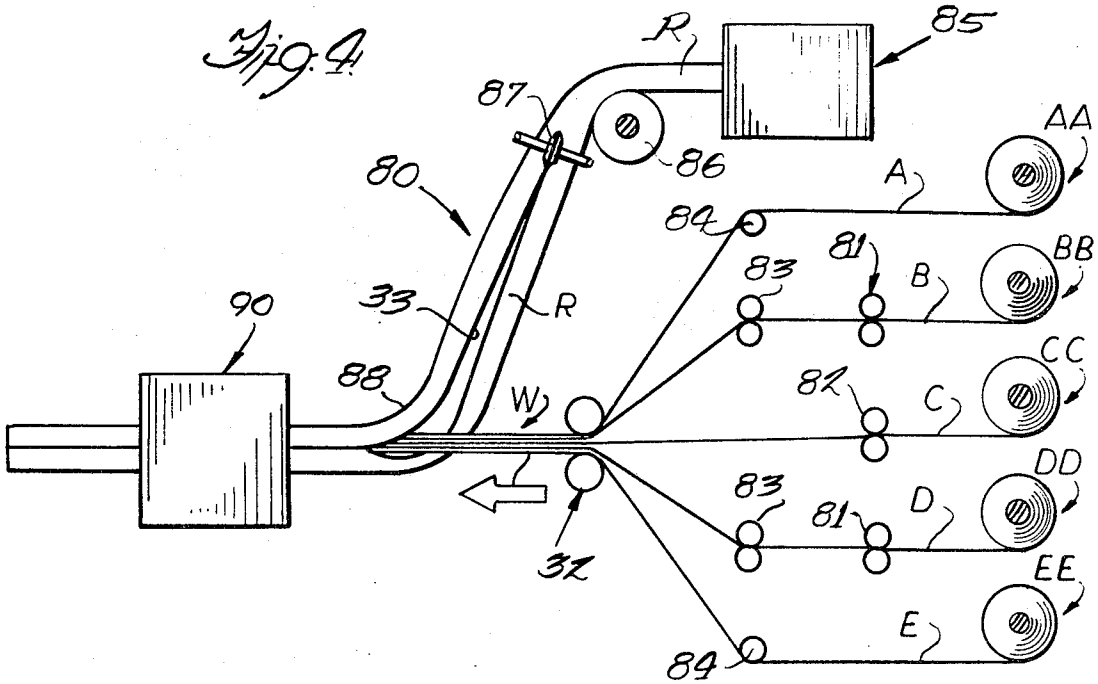


Fig. 1.

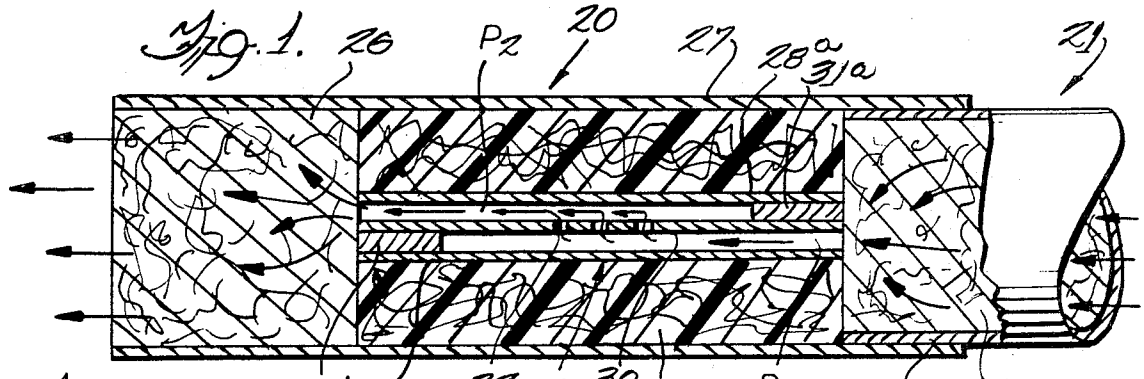


Fig. 7

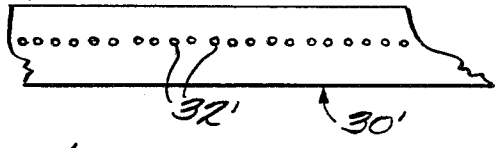


Fig. 8.

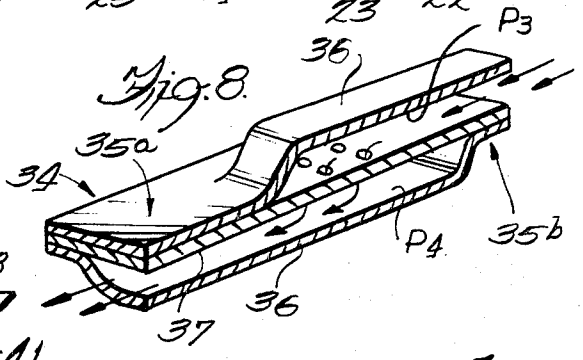
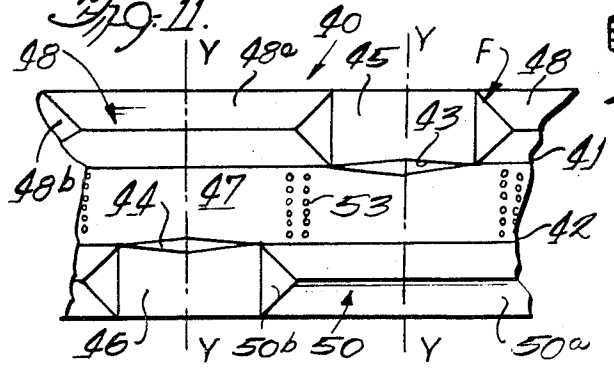


Fig. 11.



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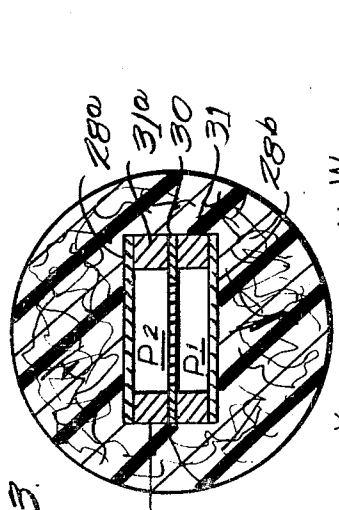


Fig. 3.

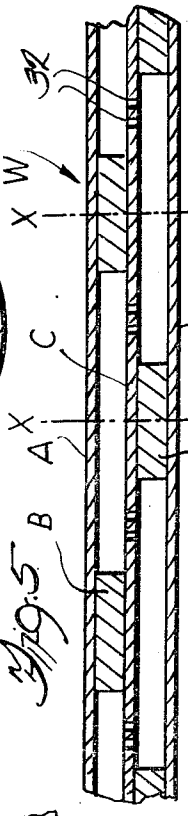


Fig. 5

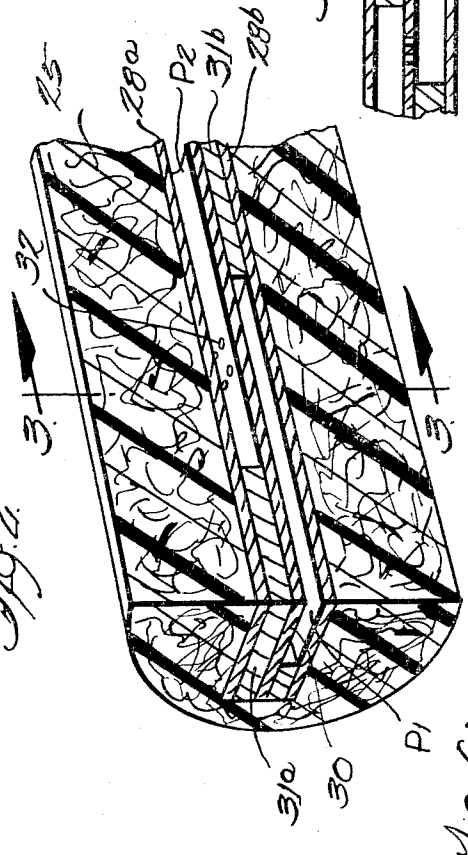


Fig. 4.

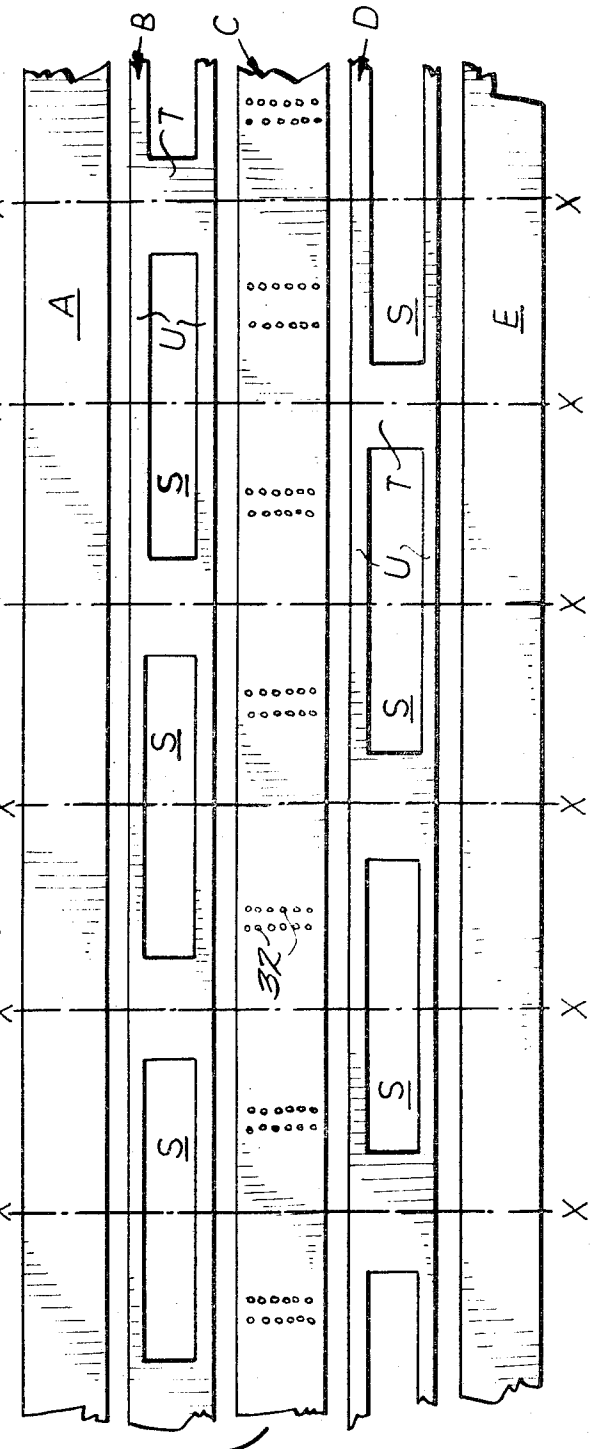


Fig. 6.

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Fig. 9

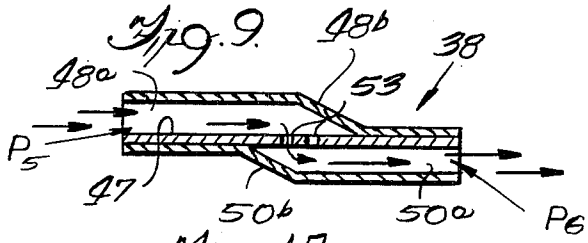


Fig. 10

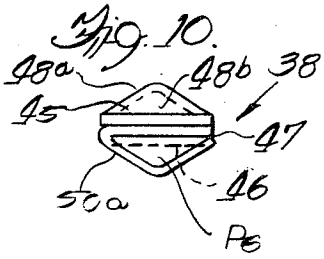


Fig. 14

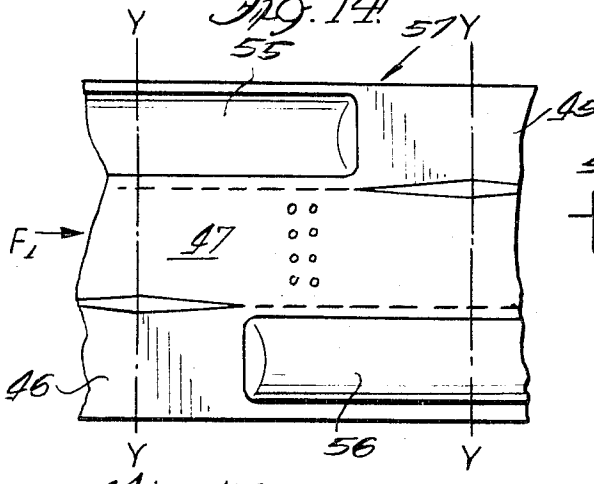


Fig. 12

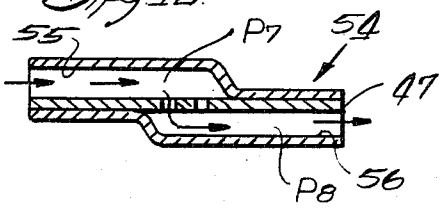


Fig. 13

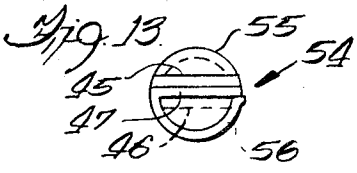


Fig. 17

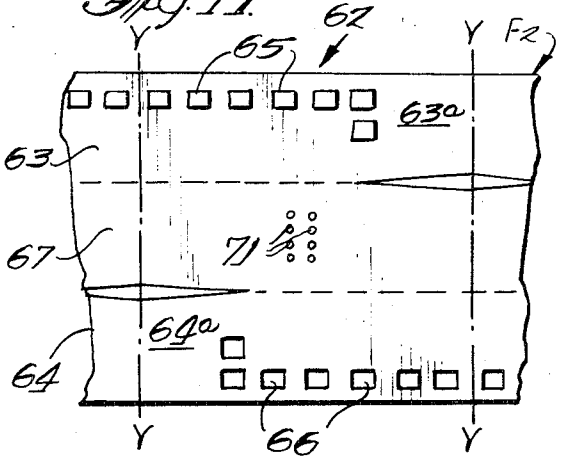


Fig. 19

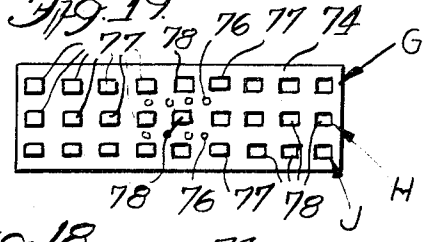


Fig. 18

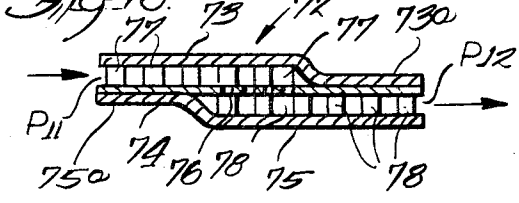


Fig. 15

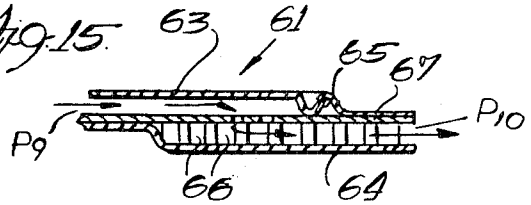
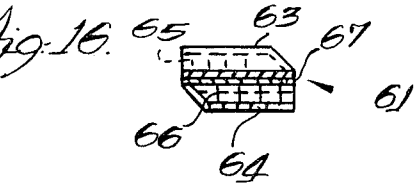


Fig. 16



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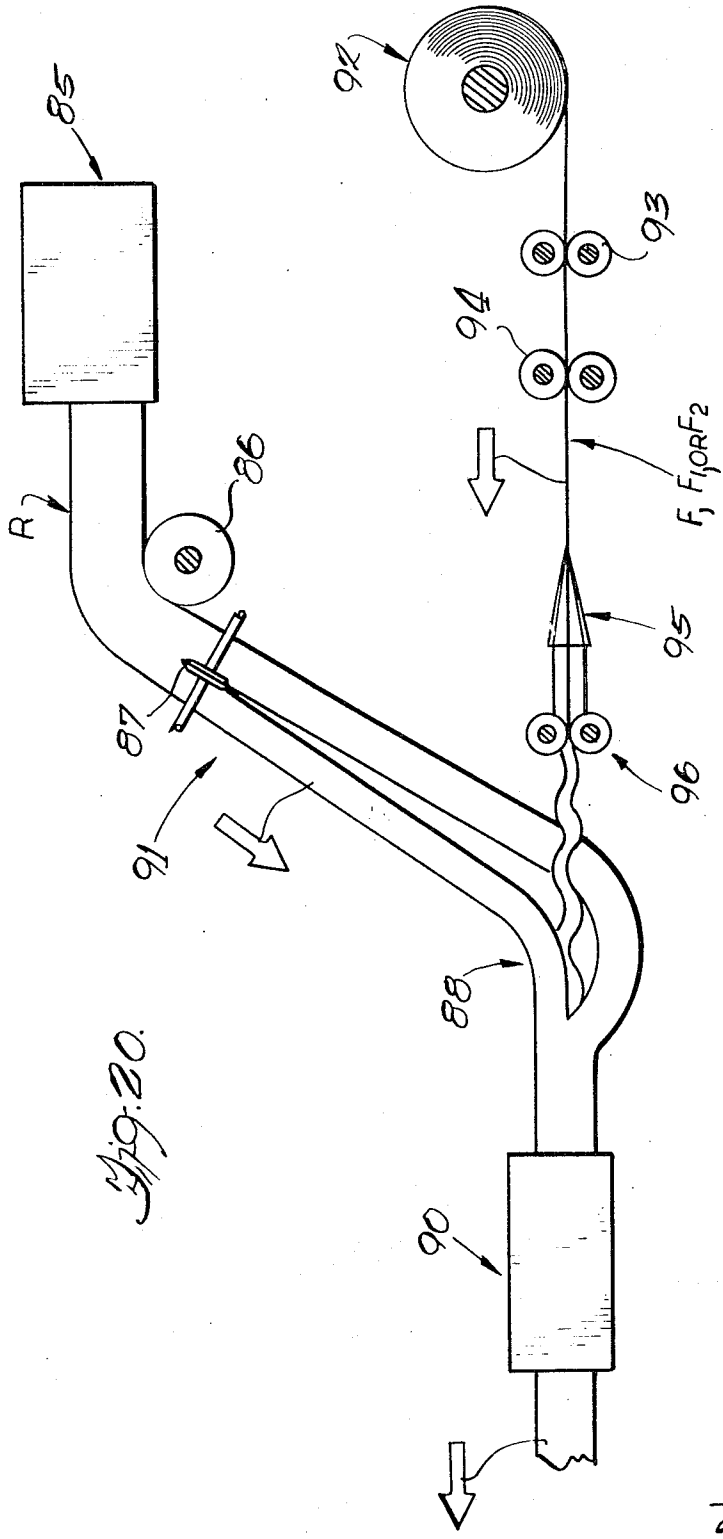


Fig. 20.

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SMOKE FILTER

BACKGROUND OF THE INVENTION

The production of a filter cigarette has oftentimes presented serious problems to the manufacturer because of the number of components comprising the filter and the difficulty of assembling said components in a manner which is compatible with the present production rates and techniques utilized in the cigarette-making art. Many filter cigarettes currently on the market are ineffective in removing liquid and/or solid particles entrained in the tobacco smoke and the pressure drop which develops across the filter increases during smoking thereby causing discomfort to the smoker. In other instances, the components comprising the filter are inordinately high in cost and are of complex construction.

SUMMARY OF THE INVENTION

Thus, it is an object of this invention to provide a filter for a cigarette which is not beset with the shortcomings aforenoted.

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 a smoke filter is provided which includes a laminated module provided with a pair of elongated smoke passageways separated from one another by a perforated lamina. The module is encapsulated by an elongated member formed of smoke impervious material whereby the upstream end of one module passageway and the downstream end of the other module passageway are exposed.

DESCRIPTION

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

FIG. 1 in an enlarged, fragmentary, vertical sectional view of one form of the improved smoke filter shown affixed to one end of a tobacco rod.

FIG. 2 is an enlarged, fragmentary, perspective, vertical sectional view of the filter shown in FIG. 1.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is a diagrammatic, fragmentary view illustrating one method of forming the filter shown in FIG. 2.

FIG. 5 is an enlarged, vertical sectional view of a continuous web consisting of a plurality of laminated modules of the type shown in FIG. 4 and arranged in end-to-end relation.

FIG. 6 is an enlarged fragmentary plan view of the various strips comprising the continuous web shown in FIG. 5; for clarity the said strips are arranged in side-by-side parallel relation.

FIG. 7 is a fragmentary plan view of a modified form of the center perforated strip shown in FIG. 6.

FIG. 8 is an enlarged, fragmentary, perspective, vertical sectional view of a second form of laminated module.

FIG. 9 is a vertical sectional view of a third form of laminated module.

FIG. 10 is a downstream end view of the module of FIG. 9.

FIG. 11 is a fragmentary plan view of a strip from which the module of FIG. 9 is formed.

FIG. 12 is similar to FIG. 9, but showing a fourth form of laminated module.

FIG. 13 is a downstream end view of the module of FIG. 12.

FIG. 14 is similar to FIG. 11, but showing a strip from which the module of FIG. 12 is formed.

FIG. 15 is similar to FIG. 12, but showing a fifth form of laminated module.

FIG. 16 is a downstream end view of the module of FIG. 15.

FIG. 17 is similar to FIG. 14, but showing a strip from which the module of FIG. 15 is formed.

FIG. 18 is similar to FIG. 15, but showing a sixth form of laminated module.

FIG. 19 is a plan view of the center lamina of the module shown in FIG. 18.

FIG. 20 is a diagrammatic, fragmentary view, similar to FIG. 4, illustrating a second method of forming a filter embodying a module, such as shown in FIGS. 9, 12, 15, and 18.

Referring now to the drawings and more particularly to FIG. 1, one form of the improved smoke filter 20 is shown affixed to one end of a tobacco rod 21, the latter comprising a core 22 of compacted shreds of blended tobacco and an outer wrapping 23 of conventional cigarette paper.

The illustrated improved filter 20 includes a laminated module 24 which is encapsulated within an elongated cylindrical member 25 formed of a smoke impervious material such as foam plastic or the like. The ends of the module 24 are coterminus with the ends of member 25. A cylindrical plug 26 of smoke pervious material (e.g. cellulose acetate fibers such as Estron) is positioned in abutting aligned relation with respect to the downstream end of the cylindrical member 25 and module 24. If desired, the plug 26 may be omitted.

The cylindrical member 25 and plug 26 are retained in a fixed relation by a sleeve 27 of tipping paper. The sleeve 27 also affixes the member 25 to the downstream end of the tobacco rod 21.

The laminated module 24, as illustrated in FIGS. 1–5, includes a pair of outer laminae 28*a* and *b*, a perforated center lamina 30, and a pair of intermediate laminae 31*a* and *b*, the latter functioning as spacers so as to position the outer laminae in closely spaced, parallel relation with respect to the center lamina.

The module 24 is preferably formed from a continuous web W, see FIG. 4, which, in turn, is formed of a plurality of strips A, B, C, D, and E. The strips, when arranged in superposed relation subsequent to passing between a pair of combining rollers 32, eventually form the laminae of the module 24, The various strips comprising the web W are shown in FIG. 6.

The outer laminae 28*a* and *b* of the module 24 are preferably formed of thin material such as plastic, foil, or paper. The remaining laminae 30 and 31*a* and *b* may also be formed of a similar material. The intermediate laminae 31*a* and *b* function to space each outer lamina approximately 0.015 inch from the center lamina 30. The outer lamina 28*b*, intermediate lamina 31*b*, and center lamina 30 cooperate to form a shallow passageway P_1, see FIGS. 1 and 2, which has an open upstream end and a closed downstream end. In a similar manner outer lamina 28*a*, intermediate lamina 31*a*, and center lamina 30 cooperate to form a second shallow passageway P_2 which has a closed upstream end and an open downstream end.

The perforations 32 formed in center lamina 30 serve as the only means of communication between passageways P_1 P_2. In the illustrated embodiment, the perforations 32 are arranged in two transversely extending rows of six perforations each. The perforations are preferably of uniform round configuration and have a diameter of approximately 0.01 inch. Because of the sizing of the perforations, the smoke passes therethrough from passageway P_1 into passageway P_2 in the form of a plurality of high-velocity jets. The smoke jets upon entering shallow passageway P_2 impinge against the adjacent surface of outer lamina 28*a* causing liquid and/or solid particles entrained in the smoke jets to be deposited thereon. Subsequent to the impingement, the smoke then flows downstream through passageway P_2 and out through plug 26.

The number, size, and arrangement of the perforations 32 in the center lamina 30 may be varied, if desired. For example, in FIG. 7, a modified center lamina 30′ is shown wherein the perforations 32′ thereof are arranged in a centrally disposed longitudinally extending row.

The strips A and E, see FIG. 6, from which the outer laminae 28*a* and *b* are formed, are of smoke impervious material. The strips B and D, on the other hand, are each provided with a plurality of elongated slots S which are arranged in longitudinally space relation. The portions T disposed intermediate adjacent slots and the side portions U disposed on opposite sides of each slot, cooperate with one another to ultimately define one end limit and the side margins of the

passageway P_1 or P_2 formed in the module 24. A plurality of parallel transversely extending cut lines x—x are shown in FIG. 6 which determine the length of each lamina cut from the various strips A–E. It will be noted in FIG. 6 that the T portions of strip B are in staggered relation with respect to the T portions of strip D. By reason of this arrangement, passageway P_1 will have an open upstream end and a closed downstream end, and passageway P_2 will have a closed upstream end and an open downstream end.

The strip C, it will be noted, is provided with longitudinally spaced pairs of transversely extending rows of perforations 32. One pair of rows is provided for each module 24. Each pair of rows of perforations is disposed substantially centrally of adjacent cut lines x—x.

After the strips A–E have been brought together by the combining rollers 32 to form the web W, see FIG. 4, the latter is inserted into an elongated slot 33 formed in the side of a continuous extruded rod R which eventually forms the encapsulating member 25 of filter 20. The manner of assembling the filter 20 will be described more fully hereinafter.

FIG. 8 discloses a second form 34 of a laminated module which can be substituted for the module 24, previously described. In module 34, the intermediate laminae 31*a* and *b*, which function as spacers, have been eliminated and in place thereof each outer lamina 35*a* or *b* is embossed at 36. Each embossment 36 cooperates with the perforated center lamina 37 to form a shallow passageway P_3 or P_4. The embossments 36 of laminae 35*a* and *b* are formed by passing the strips A and E between embossing rollers, not shown, before the strips reach the combining rollers 32.

FIGS. 9 and 10 disclose a third form 38 of module which may be substituted for the other two modules previously described. The principal distinction between module 38 and modules 24 and 34 is that module 38 is formed from a blank 40, see FIG. 11, which is cut from a single, wide strip F of thin material. The length or end limits of blank 40 are defined by transverse cutlines y—y. The width of strip F is approximately three times greater than the width of strip A, B, C, D, or E. Strip F has formed thereon a pair of elongated, parallel, longitudinally extending foldlines 41 and 42 which are interrupted at predetermined intervals by elongated slots 43 and 44. It will be noted that the slots 43 in foldline 41 are in staggered relation with respect to the slots 44 of foldline 42. The foldlines 41 and 42 define a pair of outer lamina-forming panels 45 and 46 which are separated from one another by a center lamina-forming panel 47. Panels 45 and 46 are each provided at predetermined intervals with elongated embossments 48 and 50. Embossments 48 project downwardly while embossments 50 project upwardly relative to the plane of panel 47. Each embossment 48 or 50 is twice its desired length and is formed by a pair of elongated converging sidewalls 48*a* or 50*a* and pair of converging triangular end walls 48*b* or 50*b*. The portions of panel 45 and 46 disposed between adjacent embossments 48 or 50 are secured by adhesive or the like to the center panel 47 when the blank 40 is folded so as to form module 38, see FIGS. 9 and 10. In forming module 38, the panel 45 including the embossments 48 thereof is folded upwardly over panel 47, and panel 46 with its embossments 50 is folded downwardly so as to subtend panel 47. How these folding operations are accomplished will be discussed more fully hereinafter.

As seen in FIG. 9, embossment 48 in the finished module 38 cooperates with panel 47 to form an elongated, shallow passageway P_5 which has an open upstream end and a closed downstream end; the closing of the latter end being accomplished by an embossment end wall 48*b*. Embossment 50, on the other hand, cooperates with panel 47 to form a second elongated shallow passageway P_6. Passageway P_6 by reason of end wall 50*b* has a closed upstream end, while the other, or downstream end is open.

The slots 43 and 44 which interrupt foldlines 41 and 42, respectively, facilitate folding of the panels 45 and 46 relative to panel 47. The staggered relation of the slots in one foldline with respect to the slots in the other foldline, results in the passageways P_5 and P_6 being in partial overlapping relation, see FIG. 9. Communication between the passageways is effected only through the perforations or orifices 53 formed in panel 47. Perforations 53 and 32, in the illustrated embodiments, are of the same configuration and are arranged in two parallel, transversely extending rows. Thus, the smoke passes from passageway P_5 to passageway P_6 in the form of a plurality of high-velocity jets. The jets impinge against the sloping sidewalls 50*a* causing liquid and/or solid particles entrained in the smoke to be deposited thereon.

FIGS. 12 and 13 show a fourth form of module 54, which closely resembles module 38, previously described, except for the configuration of the embossments 55 and 56 formed in panels 45 and 46, respectively. The embossments 55 and 56 cooperate with the center panel 47 of the blank 57, when the latter is folded, to form passageways P_7 and P_8. Blank 57, as seen in FIG. 14 is taken from a single strip F_1 of thin foldable material as in the case of blank 40. The length of blank 57 is determined by the spacing between transverse cutlines Y—Y.

FIGS. 15 and 16 disclose a fifth form of module 61 which like modules 38 and 54 is formed from a single strip F_2 of thin foldable material, see FIG. 17. From the strip F_2, a module blank 62 is formed. The length of the blank is determined by the spacing between the transverse, parallel cutlines Y—Y. In lieu of a single embossment being formed in each outer lamina-forming panel 63 and 64, a plurality of spacer embossments 65 and 66 are formed in the respective panels. In FIG. 17, the embossments 65 project upwardly from the plane of panel 63 and the embossments 66 extend downwardly from the plane of panel 64. The embossments 65 and 66 preferably extend like amounts in opposite directions from the respective panels; thus, when the blank 62 is folded so as to form the module 61, the embossments 65 will contact one surface of the center panel 67 thereby spacing the remainder of panel 63 a predetermined distance from panel 67 so as to form an elongated shallow passageway P_9, see FIG. 15. In a like manner, embossments 66 engage the opposite surface of center panel 67 and cause the remainder of panel 64 to coact with panel 67 to form a second elongated shallow passageway P_{10}.

The outer elongated edge of each panel 63 and 64 is spaced from the center panel surface; however, this presents no problem when the module is encapsulated by the member 25 because the latter will bridge this gap between the outer edge and the center panel.

The number, shape, and arrangement of the embossments 65 and 66 may vary from that shown without adversely affecting the filtering efficiency of the module. It should be noted, however, that the location of the embossments is such that they do not block any of the perforations 71 formed in the center panel 67. During folding of the blank 62 to form module 61, the portions 63*a* and 64*a* of panels 63 and 64 are brought into face-to-face contact with the center panel 67 so as to form a closed end of the respective passageway p_9 or P_{10}.

FIG. 18 discloses a sixth form of module 72 which includes laminae 73, 74, and 75; the latter being obtained from three separate strips of thin material, not shown. The center lamina 74, as shown in FIG. 19, is provided with a plurality of perforations 76 which are arranged in two parallel rows. In addition to the perforations, lamina 74 is provided with a plurality of embossments 77 and 78 which are arranged in three parallel elongated rows G, H, and J. The rows of perforations 76 are disposed intermediate the rows of embossments.

Each row G, H, and J is provided with embossments which extend in opposite directions. Embossments 77 extend upwardly from the plane of lamina 74 and are adapted to engage the underside of lamina 73, whereas embossments 78 depend from the plane of the lamina 74 and are adapted to overlie the lamina 75. The extent to which each of the embossments projects from the lamina 74 is substantially the same; thus, when the laminae of the module 72 are assembled, laminae 73 and 74 coact to form a shallow downstream passageway P_{11} and laminae 74 and 75 coact to form a shallow downstream

passageway P_{12}. Outer laminae 73 and 75, each have an end portion 73*a* and 75*a* thereof adhesively secured directly to the center lamina 74 thereby forming a closed end for the passageway P_{11} or P_{12}.

FIG. 4 discloses diagrammatically one method 80 for forming a filter 20, such as shown in FIG. 1. Each strip A–E is taken form stock rolls AA, BB, CC, DD, and EE which are mounted in vertically spaced relation. The axis of each roll is preferably horizontally disposed. Each strip B and D upon being withdrawn from its respective rolls BB or DD, passes between a pair of punch rollers 81 which form the elongated slots in the strip. Strip C, on the other hand, upon leaving roll CC passes between a pair of perforating rollers 82 whereupon the perforations 32 or 32' are formed therein.

Strips B and D, upon leaving the rollers 81, pass between glue rollers 83 whereupon suitable adhesive is applied to opposite faces thereof. Strips A and E pass over guide rollers 84 prior to approaching the combining rollers 32. As the strips A–E pass between the combining rollers 32, the strips are arranged in superposed, aligned relation so as to form the laminated web W, a portion of which is shown in vertical section in FIG. 5. The slotting of the strips B and D effected by the rollers 81 in such that the slots S in strip B are in staggered relation with respect to the slots S in strip D when the web W is formed.

Simultaneously with the formation of web W there is formed an extruded cylindrical solid rod R which is preferably formed of foam plastic such as polypropylene, polyethylene, polystyrene and the like. The rod R is discharged from one end of an extruder assembly 85, which may be of a conventional design. The rod passes around a guide roller 86 and then moves past a rotating blade 87 which produces a continuous slot or pocket 33 in one side of the rod R. The rod may be possessed of an inherent tendency causing the slot 33 to open up or such opening up of the slot can be produced mechanically. Subsequent to the slot opening up, the rod at 88 is caused to bend so that it is moving in a direction parallel to the direction of movement of web W whereupon the web passes into the rod R through the open slot 33. The width and thickness of the web W is less than the diameter of the rod R so that as the rod and inserted web pass through a standard folder and overwrapping unit 90, the web will be completely encapsulated by the rod. If desired, the encapsulating rod upon leaving unit 90 may be overwrapped by a thin sleeve or membrane, not shown, or else heat may be applied causing the sides of the slot to fuse together. The encapsulating rod then passes beneath a cutter, not shown, located downstream of the unit 90 at which point two-up or four-up sections are cut from the continuous encapsulating rod. To the opposite ends of the encapsulating rod sections are attached tobacco rods in a manner well known in the cigarette making art.

FIG. 20 discloses a second method 91 of forming the improved filter. The second method is similar to method 80, except that in place of five separate strips A–E, there is but a single strip F, F_1 or F_2 provided in order to form a module 38, 54, or 61. The single strip is at least three times as wide as any of the strips A–E. The wide single strip F, F_1 or F_2 is taken from a stock roll 92 and initially passes between a pair of perforating rollers 93 causing the desired perforations to be formed in the central portion of the strip which ultimately becomes the center lamina of the module. After the perforating rollers, the strip is directed between a pair of scoring, slotting, and embossing rollers 94 wherein outer laminae and a center lamina are defined. The perforated, scored, slotted, and embossed strip is then engaged by a pair of fixed plows 95 whereby one outer lamina is folded so as to overlie the center lamina and the other outer lamina is folded so as to underlie the said center lamina. The strip in such a folded state leaves the pair of plows and passes between a pair of rollers 96 which produce a crimping effect on the folded strip whereby staggered portions of the outer laminae are adhesively secured to opposite surfaces of the center lamina. After engagement with rollers 96, the web is inserted into the slotted side of the extruded rod R in the same manner as previously described with regard to method 80.

Thus, utilizing either of the aforedescribed methods the laminated modules and the encapsulating rodlike members of the improved filters may be readily and continuously formed at a rate which is comparable to the rate of production of the tobacco rods or the like to which the improved filters are attached. The filter components are inexpensive, easy to assemble and form a smoke filter which is highly effective in removing liquid and/or solid particles entrained in the smoke.

I claim:

1. A smoke filter for use with a tobacco rod, comprising an elongated laminated module having upstream and downstream ends, and an elongated member of smoke impervious material encapsulating said module whereby the upstream and downstream ends of the latter are exposed; said module including outer laminae, a center lamina having a plurality of small perforations, and spacer means intermediate said center lamina and each outer lamina and cooperating therewith to form a pair of elongated smoke passageways, one passageway having an open upstream end and a closed downstream end, and the second passageway having a closed upstream end and an opened downstream end; communication between said passageways being through the perforations of said center lamina whereby the smoke flow therethrough is a plurality of high-velocity jets which impinge against the outer lamina surface defining said second passageway; said module laminae being completely assembled relative to one another prior to said module being engaged by said encapsulating member.

2. The smoke filter of claim 1 wherein said spacer means comprises a second pair of laminae, each lamina of said second pair being provided with an elongated open-ended slot; the open end of the slot of one lamina being substantially coterminus with the open upstream end of said one passageway and the open end of the slot of the other lamina being substantially coterminus with the open downstream end of said second passageway.

3. The smoke filter of claim 2 wherein each module lamina is formed from a separate narrow strip of thin smoke impervious material.

4. The smoke filter of claim 1 wherein said outer laminae are foldably connected to opposite elongated peripheral segments of said center lamina.

5. The smoke filter of claim 4 wherein said spacer means comprises an embossment formed in one of the laminae defining each passageway.

6. The smoke filter of claim 4 wherein said module is formed from a blank of foldable sheet material; said blank including a pair of elongated substantially parallel foldlines defining a pair of outer laminae, and a perforated center lamina disposed between said outer laminae; one foldline terminating at its upstream end in an elongated open-end slot, and the other foldline terminating at its downstream end in a second elongated open-end slot.

7. The smoke filter of claim 6 wherein the portion of each outer lamina coextensive with the foldline being disposed in substantially spaced relation with respect to said center lamina when said outer laminae are folded relative to said center lamina to form said module having said pair of elongated passageways.

8. The smoke filter of claim 7 wherein each outer lamina is provided with a recessed inner surface portion which cooperates with said center lamina to form a passageway.

9. The smoke filter of claim 7 wherein a lamina forming each passageway is provided with spacer-forming embossments which are adapted to engage the other passageway-forming lamina and maintain said laminae in a predetermined spaced relation when said blank is folded to form said module.

10. The smoke filter of claim 7 wherein the length of each lamina is substantially coextensive.

11. The smoke filter of claim 1 including a cylindrical plug of smoke pervious fibrous material disposed in abutting

aligned relation with the downstream end of said elongated encapsulating member, and a sleeve of tipping paper encompassing said plug and said elongated member.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,631,867 Dated January 4, 1972

Inventor(s) Hoyt S. Beard

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 33, after "24" delete the comma (,) and insert a period (.).

Column 2, line 72, "space" should be -- spaced --.

Column 4, line 56, "P_9" should be -- P_9 --.

Column 4, line 74, "downstream" should be -- upstream --.

Column 5, line 23, "in such" should be -- is such --.

Signed and sealed this 16th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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