United States Patent

Sherrill

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[54] **FILTER CONSTRUCTION AND METHOD OF FORMING SAME**

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Related U.S. Application Data

[63] Continuation of Ser. No. 837,746, June 30, 1969, abandoned.

[52] **U.S. Cl.** **131/10.5,** 131/201, 131/210

[51] **Int. Cl.**.....**A24d 01/04,** A24f 07/04, A24f 13/06

[58] **Field of Search**.....131/10.5, 261 B, 201, 210, 131/212 A, 213

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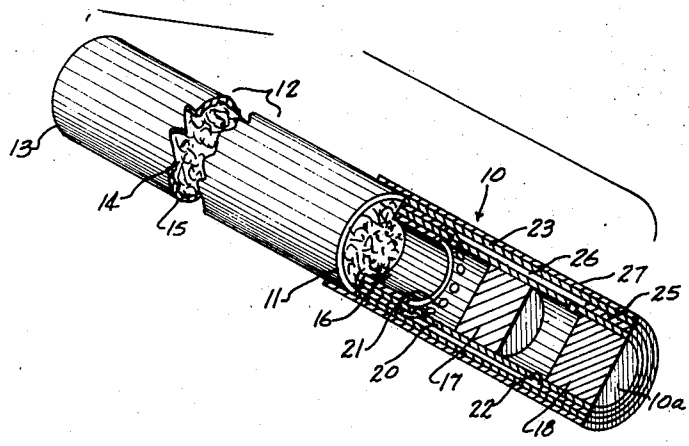
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[57] **ABSTRACT**

A filter construction is provided which is adapted for use at the downstream end of a tobacco rod. The filter embodies a smoke barrier which abruptly deflects the direction of flow of the smoke through the filter and causes the deflected smoke to pass through a plurality of perforations at a high velocity. The high velocity smoke impinges against a smoke impervious surface and is further deflected prior to being emitted from the filter. The impingement of the high velocity smoke causes solid and/or liquid particles entrained in the smoke to be deposited on the smoke impervious surface.

4 Claims, 10 Drawing Figures



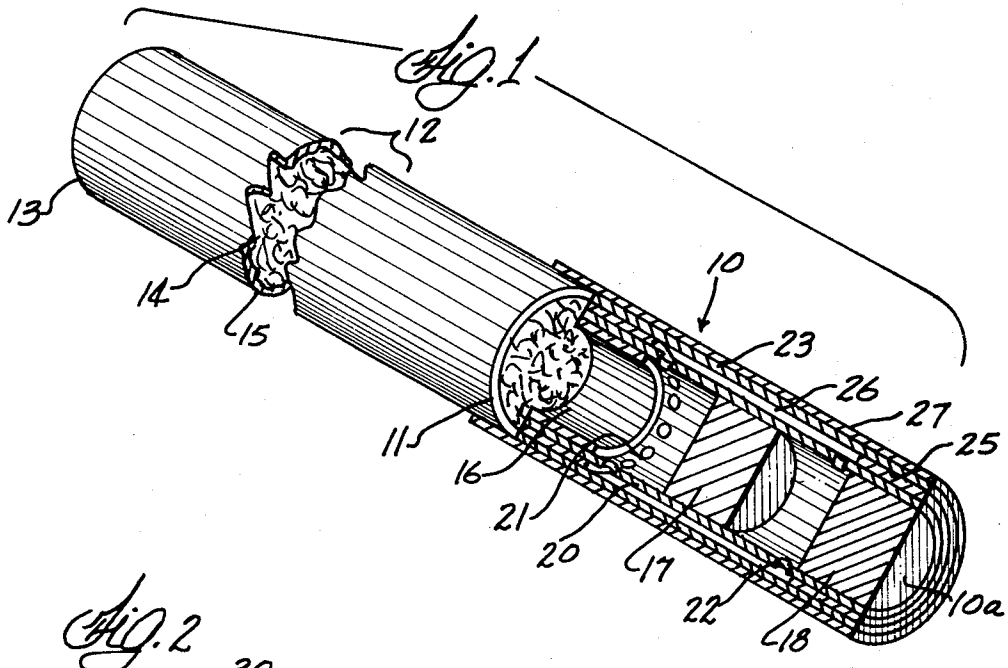


Fig. 1

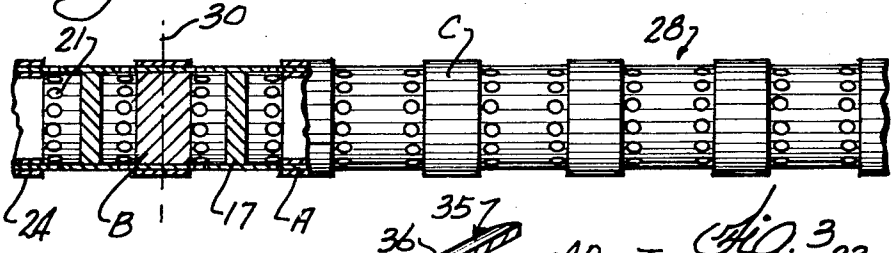


Fig. 2

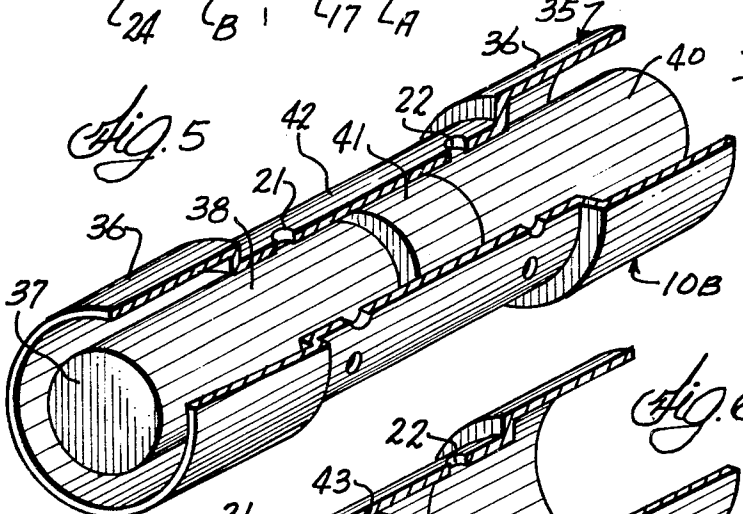


Fig. 5

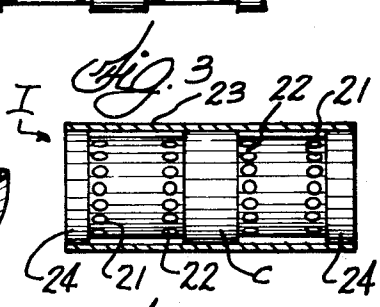


Fig. 3

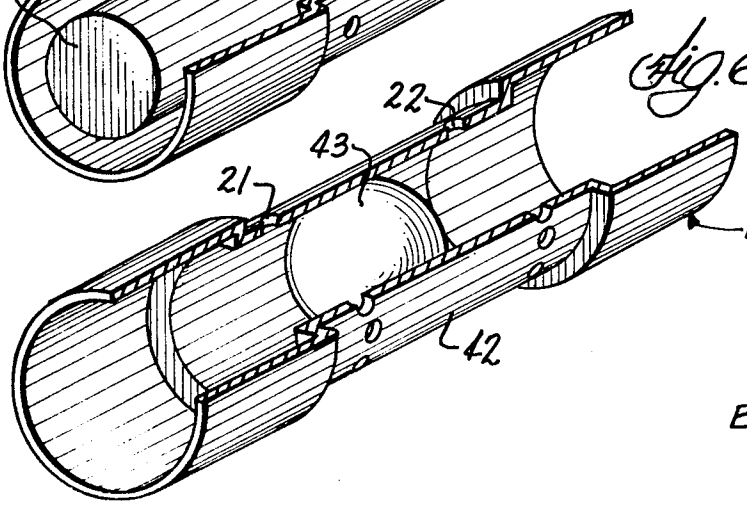


Fig. 6

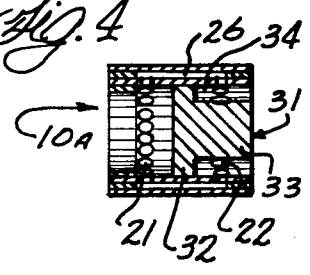


Fig. 4

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Fig. 7

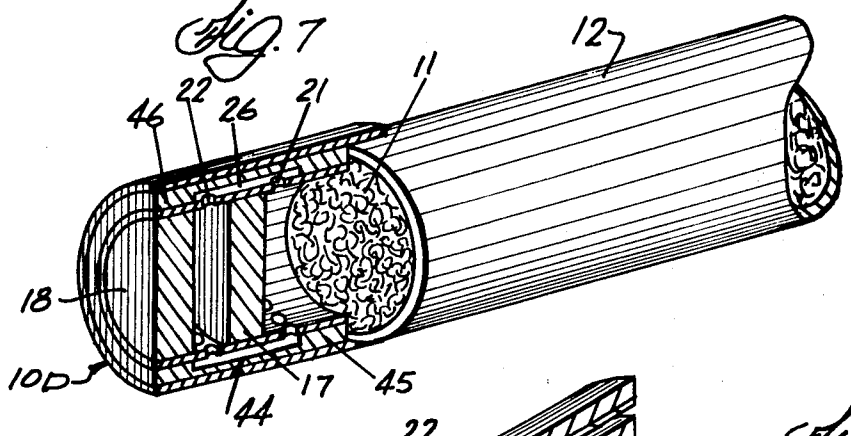


Fig. 8

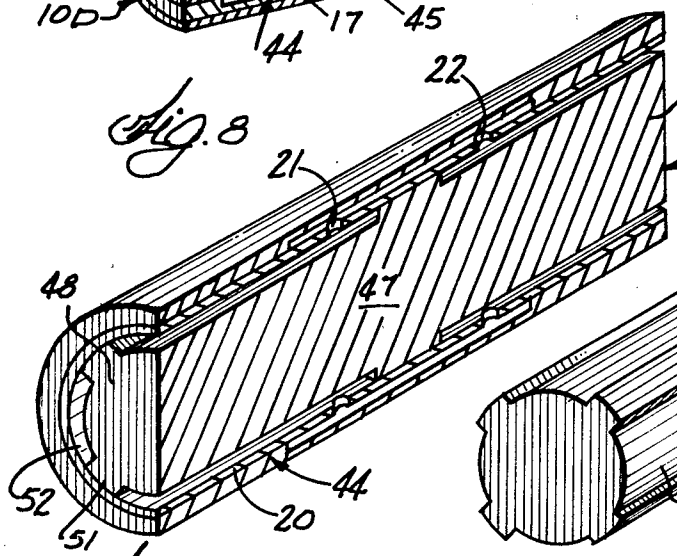


Fig. 9

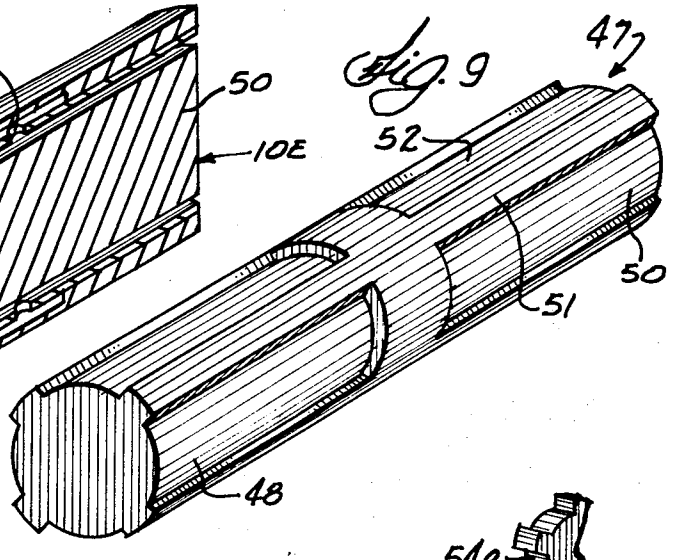
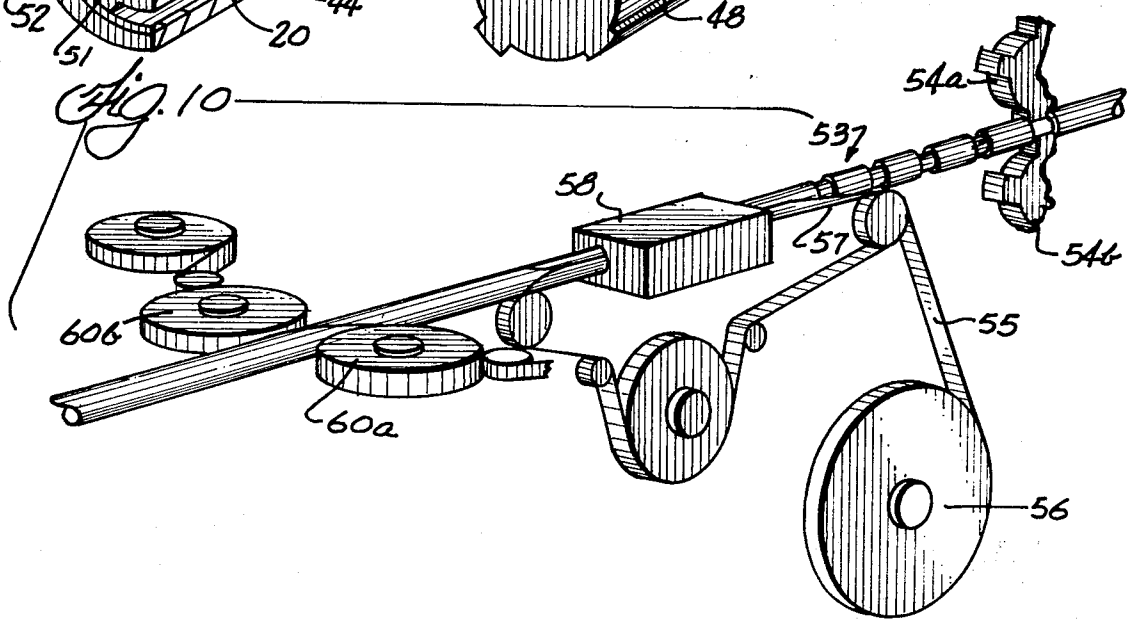


Fig. 10



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FILTER CONSTRUCTION AND METHOD OF FORMING SAME

This is a continuation of application Ser. No. 837,746, filed June 30, 1969, now abandoned.

BACKGROUND OF THE INVENTION

Various filters for cigarettes and the like have heretofore been utilized; however, because of certain design characteristics, they have been beset with one or more of the following shortcomings: (a) they are ineffective in removing the undesirable particles from the smoke as it passes therethrough; (b) they are of costly construction; and (c) they are difficult to form and are not suitable for high speed production.

SUMMARY OF THE INVENTION

Thus, it is an object of this invention to provide a filter which overcomes the aforenoted shortcomings.

It is a further object of this invention to provide a filter which may be formed by automatic equipment, the operation of which is well understood in the cigarette-making art.

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

In accordance with one embodiment of this invention, a filter for cigarettes or the like is provided which includes an outer sleeve unit which is affixedly secured to one end of a tobacco rod. The outer sleeve unit is preferably formed of a smoke impervious sheet material such as paper. Disposed within the outer sleeve unit is a second or inner sleeve unit. Portions of the exterior surface of the second sleeve unit are spaced from the interior surface of the outer unit and cooperate therewith to form a shallow passageway which encircles the second unit and extends a predetermined longitudinal distance with respect thereto. The second unit is provided with at least one set of perforations, the latter being arranged so as to substantially encircle the second sleeve unit. Disposed within the second sleeve unit and located downstream of the set of perforations is a smoke barrier piece, the periphery of which is in sealing engagement with the interior surface of the second sleeve unit. The set of perforations is in communication with the shallow passageway and because of the size of each perforation the smoke is caused to pass therethrough at a high velocity into the shallow passageway. Due to the high velocity of the smoke entering the passageway and the close proximity of the interior surface of the outer sleeve unit forming a wall of said passageway, solid and/or liquid particles entrained in the smoke impinge against and are deposited upon said interior surface prior to the smoke being emitted from the filter.

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 affixed to one end of a tobacco rod and showing the filter in longitudinal section.

FIG. 2 is a fragmentary side elevational view of an elongated unit formed of a plurality of partially assembled filters of the type illustrated in FIG. 1 and with the filters thereof arranged in alternately inverted end-to-end relation, and showing one end of the unit in longitudinal section.

FIG. 3 is a side elevational view of a two-up filter piece severed from the unit of FIG. 2; said piece including an outer sleeve unit shown in longitudinal section.

FIG. 4 is a longitudinal sectional view of a first modified form of the improved filter.

FIG. 5 is a fragmentary perspective view partially in section of a second modified form of the improved filter and shown with the outer sleeve unit removed.

FIG. 6 is similar to FIG. 5 but showing a third modified form of the improved filter.

FIG. 7 is similar to FIG. 1 but showing a fourth modified form of the improved filter affixed to one end of a tobacco rod.

FIG. 8 is a perspective longitudinal sectional view of a fifth modified form of the improved filter.

FIG. 9 is a perspective view of the smoke barrier component for the filter shown in FIG. 8.

FIG. 10 is a fragmentary schematic view of a portion of the automatic equipment used in forming a filter such as shown in FIG. 5 or 6.

Referring now to the drawings and more particularly to FIG. 1, one embodiment **10** of the improved filter is shown affixed to the downstream end **11** of a tobacco rod **12**. The opposite end **13** of the rod is referred to as the lightable end. The filter **10** and the rod **12** in the illustrated embodiment constitute the basic elements of a filter cigarette. The rod **12** per se is not intended to be possessed of patentable invention and therefore it may take various other forms from that shown without departing from the scope of the invention. The rod, as shown, includes a core **14** formed primarily of compacted shreds of blended types of leaf tobacco. The extent to which the shreds are compacted is carefully controlled so that smoke generated at the lighted end **13** may be readily drawn through the rod and out through the downstream end **11** when only a small amount of suction is applied to the free or discharge end **10a** of the filter. The core is encompassed by an elongated sheet of suitable cigarette wrapping paper **15**. The elongated edges of the wrapping **15** are normally secured by adhesive in an overlapping relation.

The method of forming the rod **12**, the component parts comprising same, and the equipment used in forming same are well known in the cigarette-making art. The initial length and diameter of the rod may be varied as desired.

Filter **10**, as illustrated in FIG. 1, includes a short tubular member **16** which abuts the rod end **11**. The member **16** is preferably formed of suitable sheet material; however, if desired, it may be extruded from suitable plastic material which would not deleteriously affect the flavor and aroma of the smoke passing therethrough. Member **16** in the illustrated embodiment is provided with a relatively large central opening.

Spaced a predetermined distance downstream of member **16** is a smoke barrier piece **17** which may be formed of suitable plastic, paper pulp or the like. Whatever the material of which the piece **17** is formed, it must be impervious to the smoke emitted from the end **11** of the rod **12**. In addition to the barrier piece **17**, there may also be provided a porous plug or mass **18** which provides a final filtering action on the circulating

smoke prior to the latter leaving the end 10a of the filter and being drawn into the mouth of the smoker. The plug 18 may be formed of various types of materials such as cellulose acetate or the like.

The member 16, barrier piece 17, and plug 18 are retained in their proper spaced relation by an inner sleeve unit 20 which snugly encompasses said component parts. The unit 20 is preferably formed from suitable paper stock; but other suitable thin material, such as a plastic, may be used if desired. Prior to the paper stock being brought into encompassing relation with member 16, piece 17, and plug 18, it has sets of perforations 21 and 22 formed therein. The perforations comprising each set are arranged so that they encircle the formed sleeve unit 20, see FIGS. 1 and 2. The sets of perforations are spaced relative to one another so that set 21 is disposed upstream of barrier piece 17 and set 22 is disposed downstream thereof.

Encompassing inner sleeve 20 is an outer or second sleeve unit 23 which is formed from a sheet of smoke impervious material such as paper. The interior surface of unit 23 is held in closely spaced relation with respect to the exterior surface of unit 20 by a pair of spacer elements 24 and 25. Each element may be formed from a narrow strip of sheet material which is adhesively applied to the exterior surface of unit 20 and completely encircles same. It will be noted that elements 24 and 25 are positioned relative to one another so that both sets of perforations 21 and 22 are disposed therebetween. The spacing 26, which is formed between spacer elements 24 and 25 and the interior and exterior surfaces of units 23 and 20, respectively, functions as a shallow passageway which completely encircles unit 20. Both sets of perforations 21 and 22 are in communication with one another only through passageway 26. It will be noted that passageway 26 provides a means for the smoke to circumvent barrier piece 17 when it is drawn through the filter. In the illustrated filter 10, both units 20 and 23 are coextensive with one another. Outer sleeve unit 23 may be secured to the end 11 of the rod 12 by tipping 27 which is preferably formed of a suitable paper material, but other suitable thin material may also be used.

Thus, with filter 10, when the smoke is drawn therethrough, it will first flow through the center opening in member 16 and then, because of barrier piece 17, will be deflected and forced to flow outwardly through the perforations comprising set 21. The perforations are symmetrically arranged about the unit 20 and are sized so that the smoke when passing therethrough will attain a high velocity. Because of the shallowness of passageway 26, the high velocity smoke, upon leaving the perforations 21 in the form of jets, will impinge with considerable force against the portions of interior surface of unit 23 which are directly opposite the perforations 21 and cause the direction of flow to be abruptly changed. When this abrupt change in flow direction occurs, a very substantial number of the relatively heavy solid and/or liquid particles, which are entrained in the high velocity smoke, will be deposited upon the interior surface of unit 23.

Subsequent to impinging the interior surface, the smoke travels rearwardly or downstream along passageway 26 until it abuts spacer element 25 whereupon it again encounters an abrupt change of direction and is forced to flow inwardly through the set 22 of perforations. It is preferred that the size of perforations 22 be larger than perforations 21 so as to minimize the pressure drop which might occur by reason of the filter.

FIG. 2 illustrates one method by which the filter 10 is formed. In practicing this method, the inner sleeve unit 20 is formed from a web of paper or the like which has been previously perforated so as to form the sets of perforations. As the web travels through the forming machine and prior to said web being shaped into an elongated tubular unit 28, see FIG. 2, a plurality of members A, barrier pieces 17, and plugs B are fed out and spotted onto the traveling web surface by conventional means well known in the cigarette-making industry. Members A and plugs B are of such axial dimensions that, when subsequently cut, they will form two members 16 and two plugs 18, respectively, of the required length. Once the components A, 17, and B are in proper relative positions, the web passes suitable plows which will form the web into the elongated tubular unit 28. After unit 28 has been formed, the spacer elements C are applied by adhesive or the like to the exterior surface of the unit by conventional methods. Elements C are of double axial dimension so that when the unit 28 is subsequently cut, each element C will form elements 24 and 25. The spacing between adjacent elements C on the unit 28 is such that as each element C, or alternate elements C, are moved into alignment with the cutting blade (the plane of which is shown in a dotted line 30 in FIG. 2) either a section having an axial length equal to a single or double filter will be formed.

Before or after the section is cut, the exterior surface thereof is encompassed by a second web of paper or the like which forms the outer sleeve unit 23. A two-up form of section I is shown in FIG. 3 to which is subsequently affixed at opposite ends thereof two tobacco rods 12, one for each end. Following attachment of the rods to opposite ends of section I, the latter is cut in two at its midpoint so that two complete filter cigarettes are formed. The attachment of the rods to the section I and the subsequent cutting of the latter are performed in a manner also well understood in the cigarette-making art.

In lieu of the spacer elements 24 and 25, the outer surface of the inner sleeve unit 20 or the interior surface of the outer sleeve unit 23 may be embossed so as to form outwardly or inwardly extending ribs which would serve to provide the desired spacing between the sleeve units defining the shallow passageway 26.

FIG. 4 discloses a modified filter 10A wherein a barrier piece 31 has been provided which includes a disc-shaped upstream end 32 and a downstream rodlike end 33 of reduced diameter. The outside diameter of end 32 is dimensioned so that it is in sealing engagement with inner sleeve unit 20. The axial length of end 33, on the other hand, is such that it provides the proper axial spacing between disc-shaped end 32 and a plug, not shown, if one is to be used. The latter plug would be of the same construction as plug 18 previously described. If desired, the plug may be omitted entirely whereupon the length of end 33 may be longer.

The outside diameter of end 33 is such that it will form a second shallow passageway 34 between the interior surface of the inner unit 20 and the exterior of

the rodlike end **33**. The second shallow passageway **34** extends from the downstream side of the disc-like end **32** to either the end of the filter or a plug, whichever the case may be.

With the modified filter **10A**, the smoke enters the first shallow passageway **26** in the same way as previously described for filter **10**, and then it flows from passageway **26** into second shallow passageway **34** through the second set of perforations **22**. By reason of the shallowness of passageway **34** and the disposition of perforations **22**, the smoke upon entering passageway **34** will impinge against the exterior surface of the rodlike end **33** and cause whatever solid and/or liquid particles still entrained in the smoke to be deposited thereon. Barrier member **31** may be formed of plastic, paper pulp or other suitable material.

FIG. **5** illustrates another modified partially assembled filter **10B** wherein an inner sleeve unit **35** formed of suitable plastic or the like is provided. Unit **35** has shoulders **36** formed at opposite ends thereof which serve the same function as spacer elements **24** and **25** previously described.

In place of the tubular member **16**, barrier piece **17** and plug **18** as incorporated in filter **10**, a single insert **37** is provided in filter **10B**. Insert **37** is preferably formed from bar stock which has been extruded or otherwise formed. The axial length of insert **37** coincides substantially with that of sleeve unit **35** so that the upstream end **38** of insert **37** will abut the end **11** of the tobacco rod **12**, and the downstream end **40** of the insert **37** will terminate at the free end of the filter or at a plug, similar to plug **18**, whichever the case may be.

To facilitate assembly of filter **10B** the unit **35** may comprise two half-cylinder sections, not shown, which are bonded to one another along their respective longitudinally extending edges. Prior to bonding the half-cylinder sections, the insert **37** is properly positioned therebetween.

At approximately mid-length of insert **37**, it will be noted there is provided an outwardly extending annular flange **41**. The outer periphery of the flange is in sealing engagement with the portion **42** of unit **35**, which is disposed between the sets of perforations **21** and **22**.

FIG. **6** shows another modified filter **10C** which substitutes a ball or spherical piece **43** of suitable smoke impervious material for the insert **37**. The diameter of the ball **43** corresponds to the outer diameter of insert flange **41**. One advantage of utilizing the ball **43** is that greater tolerance is permitted in spotting the ball between the sets of perforations **21** and **22**. Because of the snug fit between the ball **43** and sleeve unit **35**, when the latter is formed, the ball will remain in a fixed position therein. If desired, however, adhesive may be utilized to retain the ball in a fixed position within the sleeve unit.

FIG. **7** shows still another modified filter **10D** wherein the outer sleeve unit **44** is formed of plastic or other suitable material, and at opposite ends thereof there are formed inwardly extending flanges or shoulders **45** and **46**. The extent to which the shoulders **45** and **46** project will determine the shallowness of passageway **26**. Shoulders **45** and **46** take the place of the shoulders **36** formed in filter **10B** and C, and the spacer elements **24** and **25** of filter **10**. In filter **10D**, the tubular member **16** of filter **10** has been eliminated and instead the upstream ends of inner unit **20** and outer unit **44** abut the end **11** of the tobacco rod **12**.

In instances where unit **44** is plastic, the unit is formed from two half-cylinder sections, which are bonded together after barrier piece **17** and plug **18** have been properly positioned therein, in a manner similar to that described for filters **10B** and C.

FIG. **8** illustrates another modified filter **10E** wherein an elongated insert **47** is substituted for the barrier piece **17** and plug **18** of filter **10D**. Insert **47** closely resembles insert **37** of filter **10B**; however, the exterior surfaces of both the downstream and upstream ends **48** and **50** of insert **47** have formed thereon a plurality of symmetrically arranged elongated longitudinally extending ribs **51**. Each rib **51** engages and braces the interior surface of the sleeve unit **20**. Thus, between adjacent ribs **51** there is provided narrow, shallow channels **52** through which the smoke travels before it passes through perforations **21** and after it passes through perforations **22**. As in the case of insert **37**, insert **47** may be formed of plastic or other suitable material which has been extruded or otherwise formed.

FIG. **10** shows schematically a portion of one type of apparatus which might be used in assembling filter **10E**. With such apparatus, a rod **53**, comprising a plurality of inserts **47** integrally connected in end-to-end relation, is fed intermittently in an axial direction at a predetermined rate by a pair of power driven feed wheels **54***a* and *b*. Each of said wheels has a toothed periphery which engages the channels **52** formed between the ribs **51** of the insert. An extruder, not shown, may be coupled directly to the infeed end (right-hand end as seen in FIG. **10**) of the apparatus, in which case the wheels **54***a* and *b* will be fast forming wheels which form channels **52** or other desired configurations. Spaced a predetermined distance downstream of wheels **54***a* and *b*, a web **55** of paper or the like, having sets of perforations **21** and **22** formed therein, is brought into encompassing relation with the moving rod **53**. The web **55** is taken from a bobbin or spool **56**. If desired, the web **55** may be perforated subsequent to being withdrawn from the bobbin **56**. Along with the sets of perforations **21** and **22**, a registering stripe can be printed on the web which will facilitate properly registering the sets of perforations on the rod **53** and also registering the encased rod **53** within the outer sleeve unit **44**.

Just prior to the web **55** contacting rod **53**, it is engaged and subtended by a driven belt **57**. The belt **57**, web **55**, and rod **53** then move past a conventional folder bottom **58**, the structure and function of which are well known in the cigarette-making art. Upon leaving the folder bottom **58**, the rod **53** is completely encased within a sleeve formed from web **55** and then passes between a second pair of wheels **60***a* and *b*. Carried on the periphery of each wheel **60***a* and *b* are half-cylinder sections which cooperate to form outer sleeve unit **44**. Prior to each half-cylinder section reaching the encased rod **53**, a suitable adhesive is applied to the exposed elongated mating edges of the half-cylinder sections. In place of adhesive, the two half-cylinder sections can be held in mating relation by a suitable wrapping of paper, not shown.

If desired, the wheels **60***a* and *b* may be heated by suitable heating elements which would facilitate bonding of the half-cylinder sections together. At a

predetermined station, not shown, downstream of wheels **60***a* and *b*, the rod **53**, which is encased in web **55** and successive sleeve units **44**, is cut into appropriate lengths to which one or more tobacco rods are subsequently attached.

Similar apparatus may be utilized in assembling filters **10**B, C and D. In any case, the manner of assembling the various components comprising the filter is performed expeditiously by utilizing equipment and techniques well understood in the cigarette-making art and thus such manner of assembly is compatible with the equipment and techniques utilized in forming the tobacco rods and the like.

Thus, it will be seen that a filter has been provided which utilizes an impingement action to effectively remove solid and/or liquid particles from the smoke. In addition, the improved filter may be quickly and automatically assembled.

I claim:

1. A disposable filter affixed to the downstream end of an elongated tobacco rod, said filter comprising a cylindrical end member positioned adjacent the downstream end of the rod, said end member being provided with a passageway through which smoke from the tobacco rod is caused to flow longitudinally upon leaving the rod downstream end; a substantially rigid smoke barrier piece disposed in predetermined spaced, aligned, downstream relation with respect to the downstream end of said end member; a thin wall first sleeve unit of a flexible sheet material encompassing and sealingly contacting the outer periphery of said end member and said barrier piece and retaining same in said predetermined spaced relation, said first sleeve unit being provided with a set of small perforations arranged in sleeve unit-encircling relation and in registration with the space between the end member and said barrier piece and through which the smoke is caused to flow outwardly as high velocity smoke jets; and a smoke impervious second sleeve unit of a flexible sheet material encompassing said first unit whereby predetermined segments of the first unit exterior surface and the second unit interior surface are in closely spaced relation and form a shallow second passageway communicating with said set of perforations and circumventing said barrier piece, the high velocity smoke jets upon being emitted outwardly from said set of perforations impinging against the closely adjacent portions of the interior surface segment of said second unit uniformly spaced radially outwardly of said perforations causing deposition thereon of solid and liquid particles entrained in the high velocity smoke jets, said shallow second passageway having a smoke discharge end disposed downstream of said barrier piece.

2. The filter of claim **1** including an elongated rodlike member extending downstream from said barrier piece, the exterior of said rodlike member being closely adjacent to but spaced from the interior surface of said first sleeve unit; said first sleeve unit including a second set of small perforations arranged in sleeve-unit encircling relation and disposed downstream of said first set of perforations and said barrier piece, said shallow second passageway being closed off downstream of said second set of perforations whereby smoke flows from said second passageway inwardly through said second set of perforations as a plurality of high velocity smoke jets and impinges against portions of the exterior of said rodlike member disposed opposite the perforations of said second set prior to the smoke being emitted from the downstream end of said filter.

3. The filter of claim **2** wherein the barrier piece and the rodlike member are in the form of coaxial cylinders, the former having a radius greater than that of the latter.

4. The filter of claim **3** wherein the barrier piece and the rodlike member are of unitary construction and the outer cylindrical surface of said barrier piece is in sealing contact with the first sleeve unit.

* * * * *