United States Patent [19]

Thomas

[11] **3,926,199**

[45] **Dec. 16, 1975**

[54] **TOBACCO SMOKE FILTER**

[76] Inventor: **Leonard L. Thomas,** 375 NW. Cypress, Orange, Calif. 92668

[22] Filed: **Feb. 12, 1975**

[21] Appl. No.: **549,335**

[52] **U.S. Cl.** ..... **131/187;** 131/198 R; 131/210

[51] **Int. Cl.²** **A24F 5/04**

[58] **Field of Search** ..... 131/187, 198 R, 198 A, 131/210

[56] **References Cited**

UNITED STATES PATENTS

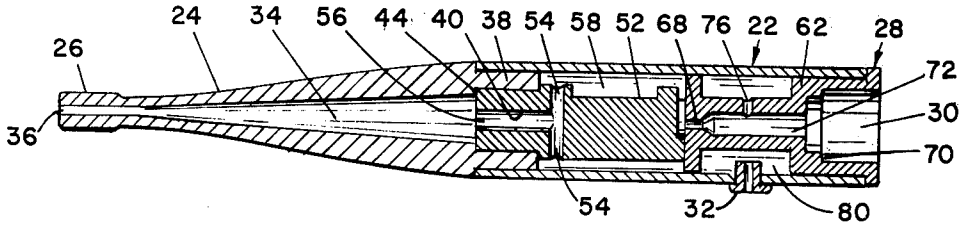
1,261,038	4/1918	Lebreche	131/210
1,989,069	1/1935	Warnke	131/198 R
2,954,772	10/1960	Lebert	131/187 X
3,313,308	4/1967	Grasso	131/210 X
3,343,547	9/1967	Gill, Jr.	131/187 X
3,367,343	2/1968	White et al.	131/187
3,472,238	10/1969	Blount et al.	131/187
3,636,960	1/1972	Blount et al.	131/187
3,685,522	8/1972	Kleinhans	131/198 A
3,810,476	5/1974	Thomas	131/187

Primary Examiner—Joseph S. Reich
Attorney, Agent, or Firm—Grover A. Frater

[57] **ABSTRACT**

An efficient filter for cigars and cigarettes results from a special smoke flow path and precooling structure. The flowpath extends through a cigar or cigarette holder. It proceeds through two restrictions in series. The smoke is made to change flow direction after the first restriction and is allowed to expand in limited degree. It is allowed to expand in greater degree and is made to flow with turbulence over a tar collection surface after passing the second restriction. The effect of that arrangement is to condense a large proportion of the tars and nicotine out of the smoke in a way that avoids significant altering of the flow path shape. The smoke is precooled by the introduction of ambient air which is mixed with the smoke upstream from the restrictions. The filtering efficiency is not much affected by the ratio of air to smoke so that the holder is useful in aiding smokers to withdraw from the smoking habit by the method of successively increasing the proportion ratio of air to smoke.

16 Claims, 11 Drawing Figures



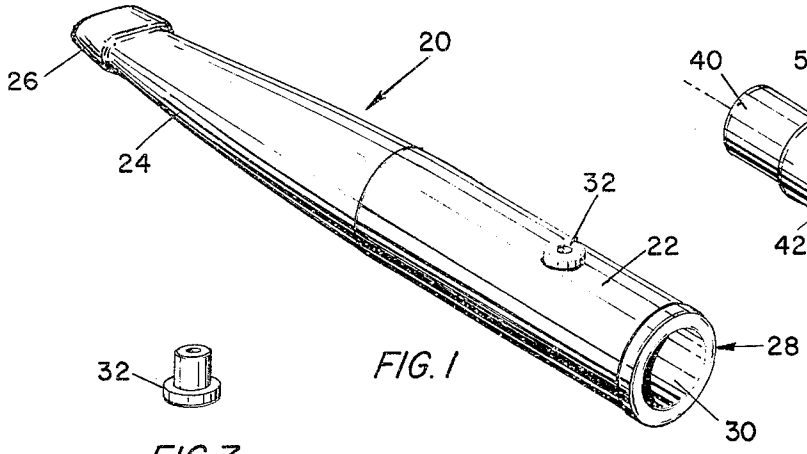


FIG. 1

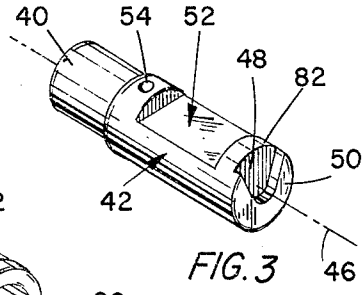


FIG. 3

FIG. 7

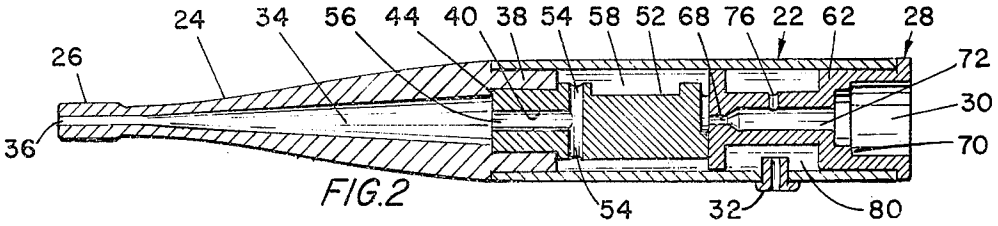


FIG. 2

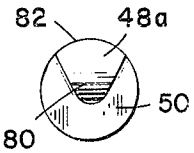


FIG. 5

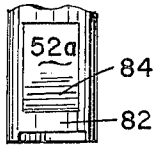


FIG. 4

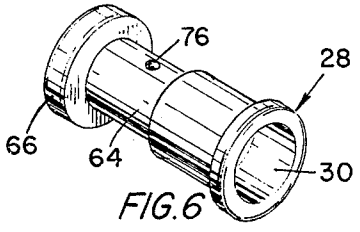


FIG. 6

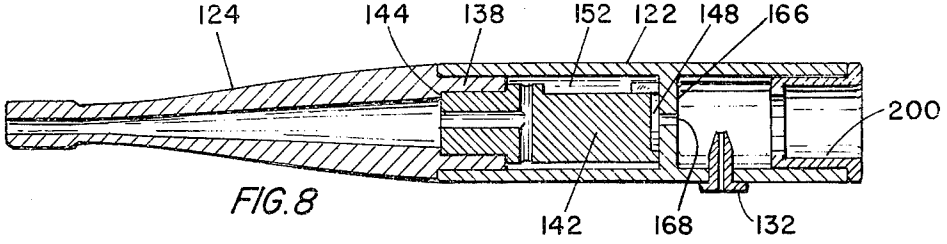


FIG. 8

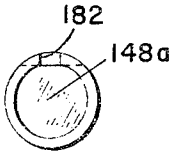


FIG. 11

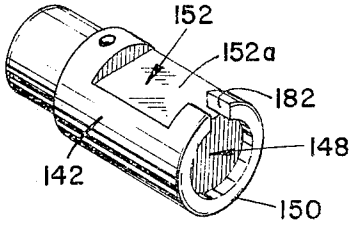


FIG. 10

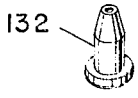


FIG. 9

TOBACCO SMOKE FILTER

This invention relates to improvements in cigarette filters.

It employs a means for introducing ambient air into the smoke stream. That means may, and in the preferred embodiment does, utilize a removable air inlet fitting that is inserted into the side of the filter unit. The structure of the invention can be utilized in a kit in which the air inlet fitting of the filter is periodically changed for one having a larger air inlet opening. The effect of that is to diminish the quantity of smoke which reaches the smoker's lungs as each inlet fitting is replaced with another which permits entry of more air. Introducing more and more air into the smoke stream over a period of time is one of the methods employed to help smokers withdraw from the habit. Thus it is that the structure of the invention is useful as a cigarette filter or as an element in a smoker's withdrawal kit, or both.

BACKGROUND

It is well known in the art to assist cigarette and cigar smokers to overcome the smoking habit by providing a filter in the form of a holder into one end of which an end of the cigar or cigarette is inserted. Smoke passes through the holder to a bit at the other end. A quantity of air is introduced into the smoke stream by way of an opening on the side of the holder. In most "smokers' withdrawal" holders, some provision is made for increasing the quantity of air that enters the holder in a sequence of steps.

Cigarette smoke is not entirely homogeneous. It includes some constitutents that are more dense than others and which are condensed at different temperatures than others. If the smoke is made to follow a tortuous path or labyrinth within the holder, some of the materials will condense and will be precipitated out of the smoke and will collect on the interior surfaces of the flow path. That process is accelerated by the introduction of the outside air because that air exerts a cooling effect on the smoke.

The interaction of outside air and the tortuous flow path makes it possible to produce a holder whose function is both to introduce outside air and to provide a filter for precipitating out tars and nicotine products so that they are retained in the holder.

SUMMARY

The invention is founded on the discovery of a flow path arrangement and ambient air inlet system which are efficient in precipitating solid matter out of tobacco smoke. Stated another way, the invention relates to a structure which defines an air inlet and air-and-smoke flow path which exhibits an ability to separate out tars and nicotines from tobacco smoke. To provide such a structure is one of the major objectives of the invention.

There are a number of design objectives to be reached in creating a device of this kind. It must operate so that the user experiences a feel, in terms of suction pressure, which is normal in the sense that the act of smoking feels like it does when the holder is omitted. If the filter fails to do that, it will likely fail to find acceptance. Similarly, it must be available at a reasonable price so that another requirement is that the design be capable of mass production at low cost. Perhaps most important, the device must perform the filtering function efficiently and, if it is to be used as a withdrawal kit, it must perform its function efficiently and have a proper feel over a wide range of air-to-smoke ratios. An object of the invention is to provide an apparatus which will satisfy all of those requirements and and one more. It is one thing to produce a design which has those qualities when it is first put into service. It is another matter to produce a design which will continue to exhibit those qualities over a reasonably long period of use. The more efficient the filtering action, the greater the amount of solids and semi-solid materials collected within the device whereby the flow path may be altered and modified. It is an object of this invention to provide a cigarette and cigar holder which will efficiently filter out solids and semi-solids over a wide range of air-to-smoke ratios and which will be substantially uniform in its performance over a long period of use.

To provide the proper feel in terms of the suction pressures required during the inhalation process, the flow path must be restricted at some point along its length to small diameter. The flow of smoke and entrained solids and semi-solids is greatly accelerated at that point. Since the smoke and entrained particles reach substantially the same velocity at that point, the kinetic energy of the components that are to be filtered out can be made greater than that of the smoke at that point if those solids and semi-solids can be condensed as they pass through the flow path restriction. It is convenient to place a barrier immediately downstream from that restriction. The barrier will force a change in flow direction. The condensed material, having greater kinetic energy, some of it will be unable to turn the corner and will impinge upon the barrier, there to remain. While that approach is effective, it results in a deposit that tends to diminish the area of the flow path and to alter the feel of the device after the smoker has smoked several cigarettes or cigars. One solution for that problem is to employ two restrictions in series and to eliminate expansion of smoke after the first restriction whereby condensation of the solids and semi-solids is not completed until after the second restriction.

This invention utilizes that technique, but the structure differs from the prior structures in several respects. Expansion after the first barrier is controlled so that the accumulation of condensed material at that point is spread over a wider area, thus to avoid any significant diminuition of the flow area. Further, the flow surfaces past the second restriction are arranged to cause eddies that assist in directing condensing material over a wide area of flow path surface as it expands. Operation is enhanced by introducing ambient air to the smoke stream at a point upstream from the first barrier and at a point closely adjacent to the center of that stream to insure uniform intermixing of smoke and air throughout the duration of an inhalation suction by the smoker. The objective is to cool all of the smoke as uniformly as possible prior to the time that it goes through the first barrier. To augment that, one of the preferred embodiments of the invention employs a metal structure for introducing ambient air into the flow path. The metal is placed close to the flow path to facilitate heat transfer from the smoke to the metal. Cigarette smoke is very hot so that the temperature differential is great. The mass of the smoke is so low that the quantity of heat that it carries is small. As a consequence, the temperature of the metal is elevated

only slightly and the efficiency of heat transfer from the smoke to the metal remains high throughout the time that it takes to smoke a cigarette or cigar. In the drawings:

FIG. 1 is a perspective view of a holder for cigars and cigarettes which embodies the invention;

FIG. 2 is a view in longitudinal, central section of the cigarette holder of FIG. 1;

FIG. 3 is a perspective view of the smoke flow control element of the unit of FIGS. 1 and 2;

FIG. 4 is a side view of a fragment of the control element shown in FIG. 2 showing how condensed material adheres to it;

FIG. 5 is a front view of the control element of FIG. 3 together with condensate illustrating how the condensate builds up on the forward part of the control element;

FIG. 6 is a perspective view of the air inlet control unit of the holder of FIGS. 1 and 2;

FIG. 7 is a perspective view of the air insertion nipple that is incorporated in the unit of FIGS. 1 and 2;

FIG. 8 is a view in longitudinal, central section of an alternative form of holder;

FIG. 9 is a perspective view of the air inlet nipple that is used with the embodiment of FIG. 8;

FIG. 10 is a perspective view of the smoke control element that is incorporated in the holder of FIG. 8; and

FIG. 11 is a view in front elevation of the smoke control element that is shown in FIG. 10.

In FIG. 1 the holder 20 consists of four parts that are visible from the exterior. The body 22 is a right cylinder. At its rearward end it is assembled with the shank 24 which terminates in a bit 26. At the other end the element 28 is called an inlet air control unit. It slips into the forward end of the body 22 except that it has a flange which abuts against the forward end of the body 22 as best shown in FIG. 2. The fourth element is a nipple 32 which is press fitted laterally through a hole in the side wall of the body 22.

In FIG. 2 the shank 24 is seen to have a central opening 34 that extends entirely through the shank and terminates at the bit in an exit opening 36. At its forward end the shank 24 has reduced outside diameter so that it forms a cylindrical forward extension 38 which is telescoped into the rear end of the body 22. The rearward end 40 of the smoke control element 42 has reduced diameter and it fits into the forward end of the central opening 34. The forward end of the central opening is enlarged to form a shoulder 44 which is abutted by the rear face of end 40.

The control element 42 is generally cylindrical. It is symmetrical about its central axis 46 except for the V-shaped recess 48 at its forward end 50 and except for the cut away region 52 which is formed at one side of the element intermediate its ends. It has two exit openings 54. Those openings are joined by a hole that extends entirely through the body rearwardly of region 52 and forwardly of reduced end 40 on a plane through its central axis. The hole intersects with a rearwardly extending axial opening 56. The latter opens to the outlet opening 34 of the shank.

As best shown in FIG. 2, the outer diameter of the smoke control element 42 is smaller than the inner diameter of body 22. Because of that, an annular cavity is formed in the assembled holder which cavity extends entirely around element 42 forwardly of its rear portion 40. For identification that cavity is called the first annular cavity and it has been associated with the reference numeral 58. At the rear the first annular cavity is closed by the cylindrical forward end extension 38 of the shank. At its forward end the first annular cavity is closed by a barrier which, in this case, is the rear face of the inlet air control unit 28. It will be apparent that the first annular cavity is cylindrical except at the cut away region or transverse notch 52 and except at the forward face 50 by reason of the recess 48 in that face.

The inlet air control unit 28 is generally cylindrical. As previously indicated, it has an outwardly extending flange at its forward end which abuts against the forward end of the body 22 and limits the degree of its insertion. Rearwardly of the flange, the unit has an outer diameter corresponding to the inner diameter of the tube except in a region near its end where it has reduced diameter. That region of reduced diameter is cylindrical and it is identified by the reference numeral 64. The rearward portion 66 is called the barrier. Its rear face abuts the forward face 50 of the smoke control element. It is formed with a central flow opening or restriction or acellerating opening 68 which is located, in this embodiment, on the longitudinal axis of the unit. That axis is coincident with the axis 46 of the smoke control element 42. As best shown in FIG. 2, the flow opening 68 is but one end of an axial opening that extends entirely through the unit 28. The forward part of the opening has a socket 30 having a diameter to receive cigars and cigarettes of standard size. The diameter is stepped at 70 to form portions that will receive different standard sizes.

In the portion of the flow path under the reduced diameter cylindrical region 64, the opening 72 has relatively small diameter whereby to confine smoke to a flow path of relatively small cross-sectional area prior to entering the first flow restriction 68. The cross-sectional area is made small to facilitate the cooling of smoke that flows through it. In this embodiment the inlet air control unit 28 is made of metal to promote transfer of heat from the smoke to the unit.

Ambient air is drawn in through the nipple 32 which is disposed so that it extends through an opening in the side wall of the body 22. It opens to a second cylindrical cavity around the region 64. The air then flows through a small, transverse, opening 76 which extends entirely through the wall of section 64 at a point upstream from the flow opening 68. Opening 76 has small diameter. Air flowing through it is accelerated and it expands. That tends to cool the smoke whereby heat is transferred from the smoke to the air. The cooling is insufficient to accomplish any significant amount of condensation of the solids and semi-solids that are to be taken from the smoke. Nonetheless, it serves to lower the temperature so that condensation will be more complete after the smoke has traversed the restricted opening.

In the preferred form the opening 76 has a cross-sectional area at least equal to the cross-sectional area of that air inlet nipple which has the inlet opening of largest cross-sectional area. There is some acceleration of air through nipple 32 and expansion of that air as it enters the cavity 80 surrounding section 64 of the air inlet control unit takes place. As it expands it tends to cool the air inlet control unit to supplement its function in cooling the smoke as it passes through. Since the ratio of inlet air to smoke remains substantially constant, regardless of inlet suction pressure, the amount of cooling is relatively independent of suction pressure.

After being mixed with air the smoke passes through the flow opening **68.** The area of that opening is small and the velocity of the mixture is greatly increased. The material to be filtered out is in gaseous form as it passes through that opening. It is accelerated to the same speed as is the smoke and air. Immediately upon exiting opening **68** the smoke enters the recess **48** where it is permitted to expand and to cool. That cooling results in condensation of some of the material to be removed. It turns to solid and semi-liquid form. It forms into droplets or otherwise collects into units that have greater mass and therefore greater kinetic energy than does the smoke and air. Some of that substance impinges upon the surface **48***a* at the bottom of the recess **48** and adheres to it. FIG. **5** illustrates by the darkened area **80** the manner in which these condensed materials are deposited on the surface **48***a*. With continued use, that discolored area will extend toward the upper edge of the recess.

The recess **48** is made very shallow so that expansion is limited. Upon emerging at the open end of the V-shaped recess the smoke must abruptly change direction and travel rearwardly in the first annular cavity **58.** It enters that cavity over the rim **82** and first enters the cavity in the region of the cut out **52.** The space between the rim and the inner surface of the tubular body **22** is sufficiently narrow so that it forms as restricted channel. The smoke and the filterable material that it carries is accelerated as it passes over the rim **82** through that channel. Because of the acceleration, little, if any, tar and nicotine is deposited on the rim. Little, if any, of it is deposited on the inner surface of the body **22.** Flow along that inner surface tends to be rapid and laminar in character. But there is expansion in the cut out area **52** and there is turbulence. The result is that tars and nicotine are deposited on the surface **52***a* of the cut away region and that material is deposited in the manner shown by the darkened area **84** in FIG. **4.** With continued use that area increases in breadth and in length. After traversing into the region of the annular cavity **58** beyond the rim **82** the smoke tends to be dispersed and it enters the openings **54** and exits opening **56,** traverses the channel **34** and finally, emerges from the exit opening **36** at the end of bit **26.**

It is important that the recess into which the smoke flows after passing through the first accelerating opening **68** be one in which the gas is free to expand in some degree, but which has an exit in which the gas is reaccelerated. It is important that the gas upon being accelerated the second time be permitted to expand and that it be turbulent in its flow over a surface where condensing tars and nicotine can be collected. Condensing material adheres best to previously condensed material. It is important to present a relatively large surface to the expanding turbulent body of smoke and to arrange that surface in a flow path having a large enough area so that building up a layer of condensed tars and nicotine does not have significant effect in impeding flow or reducing turbulence.

An alternative construction that meets that criteria is shown in FIG. **8.** The shank **124** and bit and the forward cylindrical element **138** and the shoulder **144** are substantially like shank **24,** bit **26,** sleeve **38** and shoulder **44** of FIG. **1.** The cylindrical body **122** of the embodiment of FIG. **8** is substantially like the cylindrical body **22** of FIGS. **1** and **2** except that the barrier **166** is formed integrally with the body **122** and comprises a wall or web extending entirely across its inner diameter. It is formed with a small accelerating flow opening **168** which extends on the longitudinal axis through the barrier. The difference between elements **42** and **142** can be understood by comparing FIGS. **3** and **10** and FIGS. **5** and **11.** In FIG. **10** the recess **148** in the forward face **150** is circular. It is shallow and it is concentric with the central axis through the unit. Unlike the V-shaped recess **48,** it does not open at one edge of the element. Communication with the cut out region **152** is had through a slot cut longitudinally through what is the edge, or rim, **82** in the first embodiment. The slot is cut to expose walls **182** which form a very narrow channel through which air and smoke and the filterable materials they contain are accelerated in passing from the recess **148** to the cut out area **152.** Here, the turbulence occurs at the junction of the rearward edge of walls **182** and the forward edge of the cut out **152.** Tar and nicotine condensate that is deposited down the surface **148***a* of the recess **148** forms a pattern similar to that shown in FIG. **5.** The condensate that is deposited on surface **152***a* at the bottom of recess or cut out **152** forms a pattern similar to what is shown in FIG. **4** except that the area immediately rearward of the flow notch is clear of condensate and the level of condensate tends to be higher on either side of that clear area.

The embodiment of FIG. **8** does not have a structure which corresponds directly to the air inlet control unit **30** of the first described embodiment. It includes a cup insert **200** into which the end of a cigarette or cigar may be inserted and which limits the degree of insertion. However, the embodiment of FIG. **8** does include a means for injecting ambient air into the flow stream of smoke at a point upstream from the first accelerating opening **168** and substantially in line with the axis of that opening. That is accomplished by making the air inlet nipple **132** longer than the nipple **32** of the first described embodiment. It is made sufficiently long so that its end is substantially in line with the axis of opening **168.** This embodiment relies on the difference in temperature between the air and the smoke to accomplish all of the cooling prior to expansion in the first expansion recess **148.** Air passing through the inlet nipple **132** is accelerated and it expands when it intersects with the flow of smoke so that the transfer of heat from the smoke to the air is facilitated.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art.

I claim:

1. In a holder for a cylindrically shaped tobacco smokers' product, the holder having an exit opening at one end and a recess for receiving the end of the tobacco product at its opposite end, the interior walls of which define a passageway for smoke from the recess to the exit opening, the improvement which comprises:

a holder body having means defining a cylindrical cavity;

smoke flow control means in the form of a generally cylindrically having an end face and member having an outer diameter less than the inner diameter of said body and having a region of its outer surface cut away intermediate its ends;

said smoke flow control means being disposed axially within said cavity means for forming, with said body, means providing a substantially annular cavity extending around the inner periphery of said

body, a portion the length of which has a greater cross-sectional area than the remainder thereof; and

means for introducing smoke into said annular cavity comprising means providing a recess in said end face of said member and a smoke accelerating channel formed by the outer surface of said member and said body and extending from said recess means to said cut away region.

2. The invention defined in claim **1** which further comprises a barrier means for confining the flow of smoke to flow through said recess means which barrier means comprises a barrier extending across the interior of said body in abutment with said end face of said member, said barrier having means providing a smoke flow opening therethrough opening to said recess means at a point removed from said channel.

3. The invention defined in claim **2** which further comprises air control means for admitting ambient air into the interior of said body at a point upstream from said barrier, said air control means comprising a hollow air inlet element, opening at a point upstream from said flow opening means and adjacent to a line extending through said flow opening and parallel with the axis of said body.

4. The invention defined in claim **3** in which said flow opening means is located substantially on the central axis through said holder body, said air inlet element having an outlet opening at a point adjacent to said axis.

5. The invention defined in claim **2** in which said recess means is V-shaped and of substantially uniform depth, the recess means opening at its widest dimension at the side of said element at which said cut out is formed.

6. The invention defined in claim **4** in which said recess means is V-shaped and of substantially uniform depth, the recess means opening at its widest dimension at the side of said element at which said cut out is formed.

7. The invention defined in claim **2** in which said recess in the end of said element is circular, of substantially uniform depth, and concentric with the axis of said element;

said channel being formed by means providing a slot in the exterior surface of said element interconnecting said recess and said cut away portion.

8. The invention defined in claim **4** in which said recess in the end of said element is circular, of substantially uniform depth, and concentric with the axis of said element;

said channel being formed by means providing a slot in the exterior surface of said element interconnecting said recess and said cut away portion.

9. The invention defined in claim **3** in which said air control means comprises:

a hollow cylindrical element having its axis concentric with the flow opening means through said barrier, having diameter less than the inner diameter of said body to form a second annular cavity with said body;

said air control means further comprising means providing an air inlet opening formed through the wall of said cylindrical member for affording communication from said second annular cavity means to the flow path for smoke upstream from the flow opening means in said barrier; and

means in the form of an opening in the wall of said holder body for admitting ambient air from the exterior of said body to said second annular cavity means.

10. The invention defined in claim **6** in which said air control means comprises:

a hollow cylindrical element having its axis concentric with the flow opening means through said barrier, having diameter less than the inner diameter of said body to form a second annular cavity with said body;

said air control means further comprising means providing an air inlet opening formed through the wall of said cylindrical member for affording communication from said second annular cavity means to the flow path for smoke upstream from the flow opening means in said barrier; and

means in the form of an opening in the wall of said holder body for admitting ambient air from the exterior of said body to said second annular cavity means.

11. The invention defined in claim **8** in which said air control means comprises:

a hollow cylindrical element having its axis concentric with the flow opening means through said barrier, having diameter less than the inner diameter of said body to form a second annular cavity with said body;

said air control means further comprising means providing an air inlet opening formed through the wall of said cylindrical member for affording communication from said second annular cavity means to the flow path for smoke upstream from the flow opening means in said barrier, and

means in the form of an opening in the wall of said holder body for admitting ambient air from the exterior of said body to said second annular cavity means.

12. The invention defined in claim **3** in which said means for admitting ambient air comprises an elongated nipple extending into the interior of said body at a point upstream from said barrier and flow opening means, said nipple terminating at a point adjacent the axis of said flow opening means through said barrier.

13. The invention defined in claim **6** in which said means for admitting ambient air comprises an elongated nipple extending into the interior of said body at a point upstream from said barrier and flow opening means, said nipple terminating at a point adjacent the axis of said flow opening means through said barrier.

14. The invention defined in claim **8** in which said means for admitting ambient air comprises an elongated nipple extending into the interior of said body at a point upstream from said barrier and flow opening means, said nipple terminating at a point adjacent the axis of said flow opening means through said barrier.

15. The invention defined in claim **2** in which said barrier is formed of metal.

16. The invention defined in claim **13** in which said holder body is formed of metal.

* * * * *