Oct. 4, 1960 H. A. LEBERT 2,954,774

TOBACCO TAR REMOVAL STRUCTURE

Filed May 20, 1958

Fig. 1

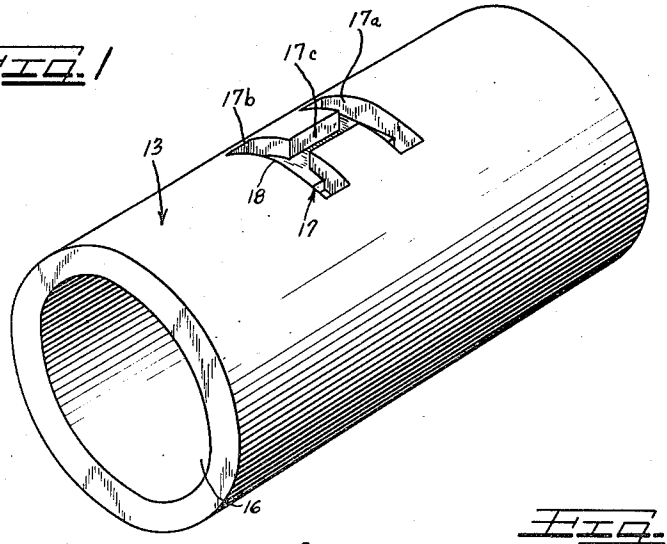


Fig. 2

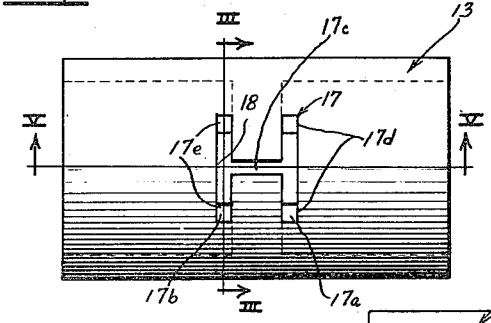


Fig. 3

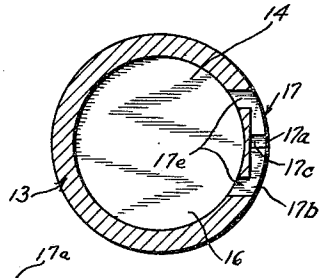


Fig. 4

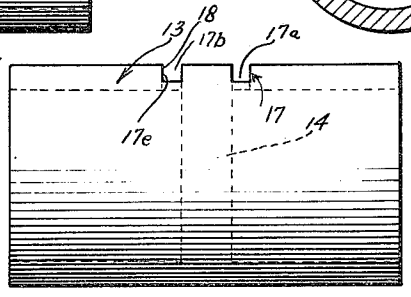
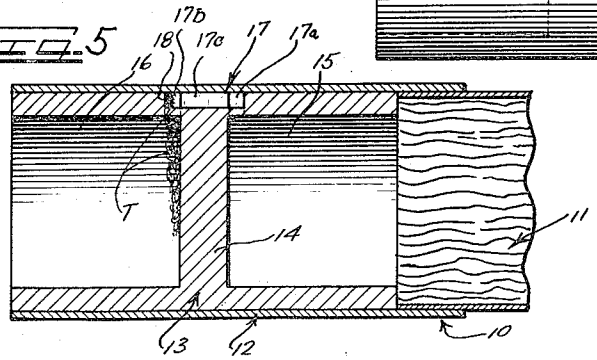


Fig. 5



Inventor
HERBERT A. LEBERT

By Bill Sherman Meroni Gross & Simpson Attys.

United States Patent Office

2,954,774

Patented Oct. 4, 1960

2,954,774

TOBACCO TAR REMOVAL STRUCTURE

Herbert A. Lebert, Millbrae, Calif., assignor to MacFarland, Aveyard & Company, Chicago, Ill., a corporation of Delaware

Filed May 20, 1958, Ser. No. 736,630

6 Claims. (Cl. 131—10)

The present invention relates to tobacco smoking structures such as a cigarette and the like. More particularly, the present invention relates to a filter tip having a tar removal structure therein which tar removal structure is provided with a venturi passageway area so that the velocity of tobacco smoke passing through the venturi area may be accelerated and heavy tars in the smoke may be removed from the smoke as a consequence of their impingement upon a barrier which confronts the downstream end of the venturi passageway area.

The majority of present day filter-tip cigarettes use cellulose filaments in varied amounts with various binders and additives. However, in spite of the many thousands of fine filaments, the filter tips still have considerable air space between the filaments for a 5/16" diameter filter tip can be compressed into a 1/8" diameter rod or bundle, that is, a reduction in cross-sectional area from approximately .07 square inch to .01 square inch or the equivalent of an air passage of approximately .06 square inch or 9/32" diameter. Such a large air passage is in marked contrast to the 1/32 inch or less orifice herein used to create high velocity impingement tar collection.

According to the present invention, a very important feature of the same involves the concept of manufacturing the tar removal structure from papier-mache, plastic and the like whereby the structure is attached to a cigarette by means of a band of paper wrapped around the downstream end of the cigarette as well as the tobacco tar removal structure. This construction permits the cost for a filter tip for a cigarette to be maintained at a minimum since the tobacco tar removal structure is considerably less expensive than a conventional cellulose tobacco tar removal structure.

It is clear that conventional filter tips trap or collect such tar as they do stop by virtue of the maze formed by the filaments and the circuitous path the smoke travels in passing along the length (approximately 9/16") of the filter tip.

In contrast to the above conventional filter tips, it is here contemplated that a tobacco tar removal structure be formed from papier-mache and the like which structure is comprised of a tube having a transverse closure portion intermediate the open ends of the tube blocking the tube and with the structure further having a smoke passage area including a venturi passage area as well as an impingement barrier which passage area links the upstream and downstream open ends of the tube by bridging the transverse partition through the peripheral wall of the tube. When the filter tip cigarette is ignited and upon a suction force being applied to the open end of the filter tip, tobacco smoke may be drawn longitudinally through the cigarette and the filter tip and during the course of the travel of the smoke the velocity of the smoke is greatly increased during the passage of the smoke through the tobacco tar removal structure with the heavy tars being impinged upon the impingement barrier prior to the smoke passing into the mouth of the smoker.

According to the present invention, an important object is to form the critical sized smoke passage or venturi in the tortuous smoke channel area so that the venturi will operate to speed up the smoke to a terrific velocity exceeding, e.g. 100 ft. per second so that the heavy (high temperature formed) tar molecules or particles will not be able to meander their way through the tortuous smoke channel area, but will, instead, impinge against and come to rest on the paper-like barrier that confronts or stands in their high speed, straight line path from the venturi. The lighter weight aromatic, low temperature formed smoke particles or fractions which go to make up a safe, enjoyable smoke will change their high speed straight line path in the barrier and thereby will be deflected away from the barrier through the channel area and out through the open end of the tube.

In the past, expansion cooling of tobacco smoke has been practiced and structures developed to attain this end have required an elongated expansion chamber for the smoke to expand which structure is conventional in the art. According to the present invention, the manufacturing cost of the filter tip may be kept to a minimum since the expansion chamber is not required and the dimensions of the conventional filter tip may remain substantially unaltered despite the inclusion of the critical passage area in the filter tip. In fact, if it is desired, the over-all length of the filter tip may be reduced without interference with the tar removal operation of the filter tip.

If the filter tip construction is manufactured with an orifice or venturi area, for example, equivalent to an .028"–.030" diameter hole, all the tars regarded harmful by modern medical thinking will be deposited that is, impinged on the filter tip filaments and thereby removed from the tobacco smoke.

The present structure or tar filter device fundamentally differs from previous types of tar filter devices by obtaining tar separation by means of providing a structure adapted to cause tar separation by impingement of high velocity tar ladened smoke against an impingement barrier. According to certain principles of the present invention, the entire cross-section of the smoke stream is subject to the action of the impingement barrier so that tars and the like are removed by high velocity smoke impingement against the barrier. Tests tend to indicate the present new technique is far more effective than any previously known tar filtering device in effectively removing tars and especially the more dangerous high temperature tars from tobacco smoke while at the same time enabling the smoker to obtain a pleasurable smoke without a hard draw.

The results of research by independent experts in this field tend to indicate that the tars extracted from the lower temperature-burning ranges (560° to 720° C.) produce few or no cancers. The number of cancers increased sharply through the use of tar taken from tobacco burning from the higher temperature ranges (720°–880° C.). Tests have also shown that a cigarette burns between 800° to 880° C. so that the more dangerous high temperature tars are presently being inhaled by the cigarette smokers. (See Time magazine, April 22, 1957, page 50.)

By using an orifice with a .028" to .030" diameter and a distance between the impingement barrier and the orifice of 1/32" to 1/16", the best results are obtainable. In other words, by constructing a device incorporating the above dimensional range, the smoker may have a more pleasurable easy draw smoke with the high percentage removal of the tars including the more dangerous high temperature tar. Early tests of structure utilizing this principle tend to indicate that at least 40% of the tars may be removed. This 40% represents nearly

100% of the high temperature tars. The low temperature aromatic fractions or tars are passed on to the smoker.

Accordingly, an object of the present invention is to provide a new and improved tobacco tar removal structure which may be manufactured at a substantially reduced cost as compared to the conventional cellulose filter tips used on cigarettes and which tar removal structure has the capacity to remove substantially all of the tars regarded harmful by modern medical thinking from the smoke prior to the passage of the smoke into the mouth of the smoker.

Still another object of the present invention is to provide a new and improved molded tube-type of a tobacco tar removal structure for assembly with a cigarette and the like.

Yet another very important object of the present invention is to provide a filter tip for a cigarette possessing means for the removal of tobacco tars from tobacco smoke through the use of an impingement barrier employed at a spaced and effective distance from the Venturi orifice which causes the smoke to flow at a sufficient velocity to cause separation of tar as the smoke strikes the impingement barrier.

A still further important object of the present invention is to provide a filter tip cigarette having novel means for separating tars including a high percentage of high temperature tars from tobacco smoke while at the same time allowing the smoke to be drawn through the cigarette without great difficulty and enabling a smoker to obtain a pleasurable smoke without the danger attendant with the drawing of the high temperature tars into the body and the lungs of the smoker.

According to the general features of the present invention, a tubular tar removal structure has been provided for removing tobacco tars from tobacco smoke which structure is provided with an H-shaped grooved area in the tubular wall of the structure which grooved area longitudinally bridges a transverse barrier which internally closes the tube thereby forcing the tobacco smoke to flow along a tortuous path through the structure.

While the tobacco tar removal structure has been illustrated in conjunction with a cigarette it will be appreciated the structure could also be used in other tobacco smoking structures such as a pipe or a holder for cigarettes or cigars.

Other objects and features of the present invention will more fully become apparent from the following detailed description taken in conjunction with the accompanying drawings illustrating therein a single embodiment and in which:

Figure 1 is an enlarged isometric view of a tobacco tar removal structure;

Figure 2 is a side elevation of a tobacco tar removal structure;

Figure 3 is a cross-sectional view taken substantially on the line III—III of Figure 2 looking in the direction indicated by the arrows;

Figure 4 is a side elevation of the tobacco tar removal structure shown in Figure 2 only with the structure being rotated 90 degrees; and

Figure 5 is a fragmentary cross-sectional view of a filter tip cigarette with the section through the tobacco tar removal structure taken on the line V—V of Figure 2 looking in the direction indicated by the arrows.

The reference numeral **10** in Figure 5 indicates generally a filter tip cigarette including a cigarette **11**, a tubular preferably paper sleeve **12**, and a tobacco tar removal structure **13**. The cigarette **11** and the tobacco tar removal structure **13** are in abutting coaxial engagement with one another and the sleeve **12** is overlappingly secured by glue and the like to the cigarette as well as the tobacco tar removal structure, thereby securing the cigarette **11** in assembly with the structure **13** to form the filter tip cigarette **10**.

As is evident in Figure 3, the tobacco tar removal

structure **13** is of a circular formation. The tobacco tar removal structure **13** has an intermediate transverse partition **14** which partition closes the tube defined by the structure **13** separating upstream and downstream open ends of the tube indicated generally at **15** and **16** Figure 5. Passage means or a grooved area **17** is provided in the peripheral wall of the tubular tar removal structure which extends longitudinally across the transverse closure partition **14**. The grooved area **17** is of a more or less H-shape configuration and the paper sleeve **12** prevents radial escape of the smoke.

The means **17** comprises a grooved area in the peripheral wall of the tube and includes a smoke inlet grooved passageway area **17***a*, a smoke outlet grooved passageway area **17***b*, and a smoke accelerating longitudinally extended grooved venturi passageway area **17***c*. The smoke inlet and outlet grooved passageway areas **17***a* and **17***b* are disposed on opposite sides of the transverse partition **14** and the grooved venturi passageway area **17***c* links the inlet and outlet grooved passageway areas together. The grooved areas **17***a* and **17***b* each includes a pair of radial passages **17***d*, **17***d* and **17***e*, **17***e* which allow smoke to flow from the downstream open end **15** through the venturi passageway area **17***c* and then out through the upstream open end **16**.

The grooved area **17** further includes an impingement barrier area spaced axially downstream and in confronting relation to the venturi **17***c*.

Smoke is free to pass through the cigarette **11** into open end or chamber **15** and then through the radial passages **17***d*, **17***d* into grooved area **17***a* whereupon the smoke is confined in a localized reduced sized stream as it passes through the venturi grooved area **17***c* between the radial passages **17***d*, **17***d*. The smoke velocity is accelerated as the smoke passes through the venturi **17***c* and is directed at the barrier **18** at high velocity to allow tars T to be removed from the smoke as a consequence of their impingement against the barrier **18**. After the smoke strikes the barrier **18** the smoke is deflected circumferentially and then radially through the radial passages **17***e*, **17***e* and then out through the open end **16** into the mouth of the smoker.

In the past, the problem presented has been one of providing sufficient smoke flow to satisfy the smoker while at the same time removing the deleterious tars, etc. In the structure of the present invention, this problem is overcome by providing the venturi orifice or passageway **17***c* which greatly increases the velocity of smoke stream passing through the filter tip so that when the stream strikes the barrier, the tar is lodged and collected upon the peripheral surface of the paper or other suitable material and the resulting purified smoke alters its course through the structure and passes onto the smoker through the downstream end of the filter tip. By referring to the removal of tars, the term "tars" should be regarded as embracing tars, resins, and other harmful substances. While there will be variations in the size of the orifice, depending upon the character of the smoke, the density of the cigarette mass, etc. in general effective results are obtained when the orifice diameter is from .025 to .038 (square inch areas of .0005 to .001). Very satisfactory results have been obtained where the orifice diameter is .028 inch to .032 inch (.0006 to .0008 square inch). As a preferred example, I have employed effectively an orifice having a diameter of .030 (.0007 square inch), which gives excellent tar removal and ease of drawing.

The critical orifice size is correlated with the impingement barrier which is located as close as possible to the orifice or venturi outlet consistent with the free flowing of the collected tars; i.e., without impairing the flowing of the tar away from the point of impingement. In practice, I have found that a satisfactory range is a distance of .005" to .030". In the specific example referred to, the impingement barrier **18** is preferably

spaced from the orifice or venturi 17c by 1/64 of an inch (.015"), or approximately one-half the orifice diameter.

The operation resulting from the structure shown herein is in contrast to the operation of cooling devices heretofore employed with cigarettes or cigarette holders. Such cooling devices bring about a peripheral cooling of the smoke but allow substantial core portions of the tars to pass onto the smoker. In my structure, the entire cross-section of the smoke stream is subject to the action of the impingement area 18 so that the tars T and other harmful particles are removed by the foregoing high velocity impingement action upon the barrier 18.

The slight spacing between the outlet of the orifice and the barrier enables the smoke stream to reach the barrier with substantially undiminished speed, while at the same time enabling the purified smoke to change direction, whereas tar fractions, by reason of their high inertia, cannot change direction and therefore deposit on the first surface contacted.

If the tobacco tar removal structure 13 is manufactured from an absorbent type of material the tars T will impregnate a substantial area of the impingement barrier area 18 by a capillary action depending on the absorbency of the material. If the material used in the tobacco tar removal structure is relatively non-absorbent than the tars will appear in greater concentration along the surface of the grooved area 17b and particularly at the impingement barrier area 18 and will flow onto the rearward face of the partition 14 as visual evidence of a "safe" smoke.

If the tobacco tar removal structure is manufactured from papier-mache, the cost of material may be reduced by about one-half or less as compared to the cost of material for the cellulose acetate used in conventional filter tip cigarettes. Through the use of the high velocity impingement principle approximately 40% of the tars including a very high percentage of the more dangerous high temperature tars may be removed from the smoke which is about four times the amount removed by conventional filters.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A tobacco tar removal structure comprised of a tube having a transverse tube closing partition intermediate the opposed upstream and downstream open ends of the tube, and smoke passage means in the periphery of the tube linking the upstream open end of the tube with the downstream open end of the tube, said smoke passage means including smoke accelerating means comprising a venturi passageway area extending longitudinally in the periphery of the tube connecting the upstream and the downstream open ends enabling smoke to flow from the upstream open end of the tube, across the transverse partition and out through the downstream open end of the tube, said smoke passage means including an impingement barrier area disposed in confronting relation to the downstream end of the venturi passageway area with the harmful tobacco tars adapted to be removed from the tobacco smoke as a consequence of their high velocity acceleration and impingement against the barrier area, said venturi passageway area being defined by a .0005 to .001 square inch area for the acceleration of the smoke stream to a high velocity, said impingement barrier being spaced from the downstream side of the venturi passageway area a distance approximating .005 to .030 of an inch, said smoke passage means comprising a generally H-shaped grooved area including parallel grooves and a linking groove with the linking groove comprising the venturi passageway area.

2. A tobacco tar removal structure comprised of a tube having a transverse tube closing partition intermediate the opposed upstream and downstream open ends of the tube, and smoke passage means in the periphery of the tube linking the upstream open end of the tube with the downstream open end of the tube, said smoke passage means including smoke accelerating means comprising a venturi passageway area extending longitudinally in the periphery of the tube connecting the upstream and the downstream open ends enabling smoke to flow from the upstream open end of the tube, across the transverse partition and out through the downstream open end of the tube, said smoke passage means including an impingement barrier area disposed in confronting relation to the downstream end of the venturi passageway area with the harmful tobacco tars adapted to be removed from the tobacco smoke as a consequence of their high velocity acceleration and impingement against the barrier area, said venturi passageway area being defined by a .0005 to .001 square inch area for the acceleration of the smoke stream to a high velocity, said impingement barrier being spaced from the downstream side of the venturi passageway area a distance approximating .005 to .030 of an inch, said smoke passage means comprising a generally H-shaped grooved area including parallel grooves and a linking groove with the linking groove comprising the venturi passageway area, said tube comprising molded papier mache.

3. A filter tip for a cigarette comprised of a tubular sleeve and a tobacco tar removal structure comprised of a tube telescoped in assembly internally of the sleeve with the tube having a transverse tube closing partition intermediate the opposed upstream and downstream open ends of the tube closing of the tube, and smoke passage means linking the upstream open end of the tube and the downstream open end, said smoke passage means comprising a grooved area in said tube with the sleeve overlying the grooved area forming a closure to prevent radial escape of smoke through the filter tip, said means including a smoke inlet passageway area in the periphery of the tube on the upstream end thereof on an upstream end of the transverse partition, said means further including a smoke outlet passageway area in the periphery of the tube on the downstream end thereof on a downstream side of the transverse partition, and said means still further including smoke accelerating means comprising a venturi passageway area defined by a .0006 to .0008 square inch area extending longitudinally across the transverse partition in the periphery of the tube connecting the smoke inlet passageway area with the smoke outlet passageway area enabling smoke to flow from the upstream open end of the tube, across the transverse partition and out through the downstream open end of the tube, said smoke outlet passageway area including an impingement barrier area disposed in confronting relation and spaced from the downstream end of the venturi passageway .005 to .030 of an inch with the harmful tobacco tars adapted to be removed from the tobacco smoke as a consequence of their high velocity acceleration and impingement against the barrier area.

4. A filter tip cigarette comprised of a tubular sleeve and a tobacco tar removal structure comprised of a tube telescoped in assembly internally of the sleeve with the tube having a transverse tube closing partition intermediate the opposed upstream and downstream open ends of the tube, and smoke passage groove means in the periphery of the tube with the sleeve overlying the groove means forming a closure to prevent radial escape of smoke, said means linking the upstream open end of the tube with the downstream open end of the tube, said smoke passage means including smoke accelerating means comprising a venturi passageway area defined by a .0005 to .001 square inch area extending longitudinally in the periphery of the tube connecting the upstream and the downstream open ends enabling smoke to flow from the upstream open end of the tube, across the transverse partition and out through the downstream open end of the tube, said smoke passage means including an impingement barrier area disposed in confronting relation and

spaced from the downstream end of the venturi passageway area .005 to .030 of an inch with the harmful tobacco tars adapted to be removed from the tobacco smoke as a consequence of their high velocity acceleration and impingement against the barrier area.

5. A tobacco tar removal structure for use with smokable articles, the structure having a body with respective opposite ends one of which is adapted to be disposed downstream and the other of which is adapted to be disposed upstream, said body providing a solid partition impervious to smoke, said body having an outer periphery within which there is a smoke passageway, said passageway having an entry opening thereinto from the upstream end of the body and an exit opening to the downstream end of the body whereby smoke entering the passage through the entry opening is conducted through the passageway past the partition and out through the exit opening, said passageway having therein between said openings a portion of the passageway providing a single venturi orifice of a cross-sectional flow area of .0005 to .001 square inch through which all of the smoke must pass in flowing through the passageway and as a consequence attains a high velocity, and said passageway having an angularly directed portion thereof leading from the downstream end of said venturi orifice portion and providing a barrier in confronting relation to said downstream end of the venturi orifice portion in spaced relation of .005 to .030 inch so that all of the smoke must impinge against said barrier on issuing at high velocity from said downstream end of the venturi orifice portion of the passageway to deposit tars on the barrier and then move laterally through said angular portion of the passageway in continuing downstream through the passageway toward said exit opening.

6. In a tar removal device for use with a smokable article, a tubular member having one end adapted to be disposed upstream to receive smoke theretoward and an opposite end adapted to be disposed downstream, said member having intermediate and spaced from each of its ends a smoke impervious partition thereby dividing the member into an upstream chamber and a downstream chamber which respectively open from the respective ends of the member, respective smoke passage openings from said chambers through the wall of the member defining the chambers to the outer periphery of the member, a passageway in the outer periphery of the member connecting said openings, said passageway defining in a portion thereof a single orifice of a cross-sectional flow area of .0005 to .001 square inch through which all of the smoke must pass in moving through the passageway and thereby attain high speed acceleration, and an impingement barrier in said passageway downstream from said venturi orifice in spaced confronting relation of about .005 to .030 inch against which all of the smoke impinges, said barrier being in offset relation to the opening to the downstream chamber so that the smoke is diverted laterally from the barrier after impingement thereagainst in moving toward and into said downstream chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

688,060	Bussert	Dec. 3, 1901
1,594,606	Clivio	Aug. 3, 1926
2,511,898	Brothers	June 20, 1950
2,764,513	Brothers	Sept. 25, 1956

FOREIGN PATENTS

4,727	Great Britain	1887
387,707	Great Britain	Feb. 13, 1933
760,772	Great Britain	Nov. 7, 1956