Oct. 4, 1960 H. A. LEBERT 2,954,772

REMOVAL OF TAR AND OTHER DELETERIOUS SUBSTANCES FROM TOBACCO SMOKE

Filed May 28, 1957

Fig. 1

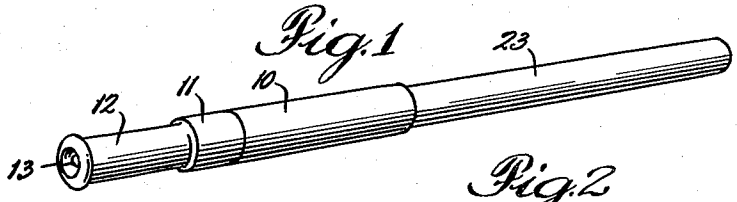


Fig. 2

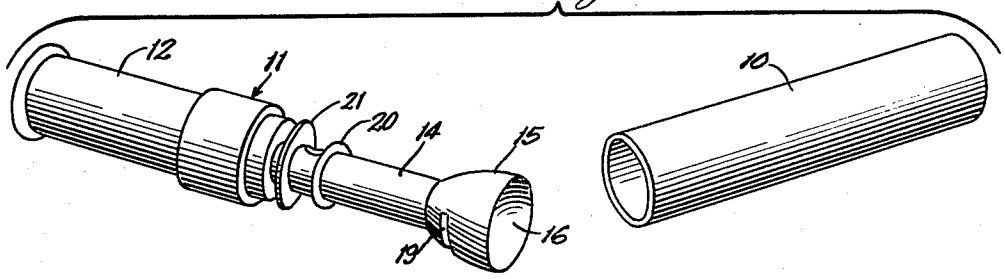


Fig. 3

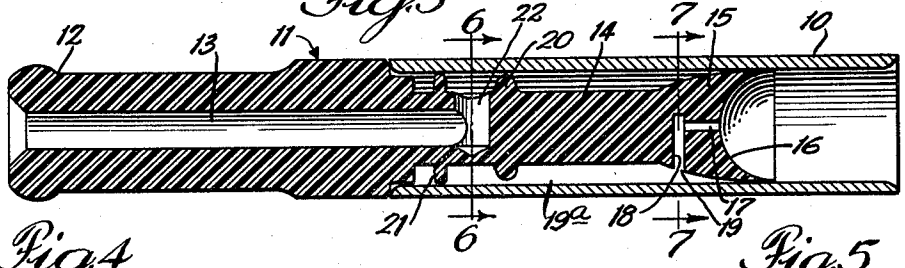


Fig. 4

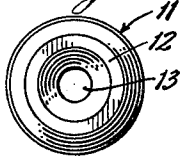


Fig. 5

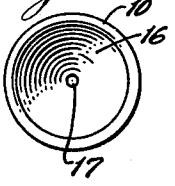


Fig. 6

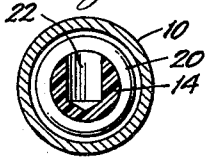


Fig. 7

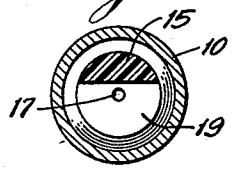


Fig. 9

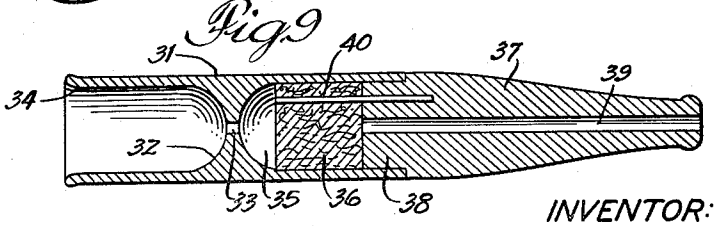
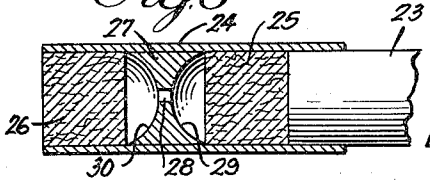


Fig. 8



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REMOVAL OF TAR AND OTHER DELETERIOUS SUBSTANCES FROM TOBACCO SMOKE

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5 Claims. (Cl. 131—10)

This invention relates to the removal of tar and other deleterious substances from tobacco smoke, and more particularly to an orifice and impingement barrier combination for the removal of tars, resins, and other harmful substances in the smoke. In the following description, such harmful substances will be referred to for convenience as "tars."

The present application is a continuation-in-part of my copending application, Serial No. 622,656, filed November 16, 1956, for Auxiliary Filtration Means for Filter-Type Cigarettes.

Many devices have been proposed for the treatment of tobacco smoke and for the elimination of portions or fractions therefrom. The removal of tars has posed an especial problem because of their known deleterious effects. Screens and orifice-equipped disks have been proposed, the effective opening for the flow of smoke being quite minute, but while some tar is removed in the operation of such devices, a satisfying flow of smoke is not obtained. Further, a sufficient proportion of the tars is not removed.

An object of the present invention is to provide a method and means for the tar removal from tobacco smoke through the use of an impingement barrier employed at a spaced and effective distance from a Venturi orifice or a small orifice which causes the smoke to flow at a sufficient velocity to cause separation of the tar as the smoke strikes the impingement barrier. A further object is to provide a tar removal structure in a cigarette holder, the structure permitting ready separation of the parts for cleaning and effecting automatic cleaning of some of the parts in the separation operation. A still further object is to provide a smoking device in which the undesired tar is collected on one of the component parts of the device for ready removal when the parts are separated. Yet another object is to provide, in combination with a cigarette or the like, a tar removal device which may be formed as a part of the cigarette, etc. Other specific objects and advantages will appear as the specification proceeds.

The invention is shown, in an illustrative manner, by the accompanying drawing, in which—

Figure 1 is a perspective view of a cigarette holder embodying one form of my invention; Fig. 2, a perspective view of the component parts of the holder, shown in spaced-apart relation; Fig. 3, a longitudinal sectional view of the complete holder; Fig. 4, an inner end view of the holder; Fig. 5, an outer end view of the holder; Fig. 6, a transverse sectional view, the section being taken as indicated at line 6—6 of Fig. 3; Fig. 7, a transverse sectional view, the section being taken as indicated at line 7—7 of Fig. 3; Fig. 8, a broken longitudinal sectional view of a cigarette equipped as a part thereof with a tar-removing device embodying my invention; and Fig. 9, a longitudinal sectional view of a cigarette holder with a throw-away portion.

In the illustration given in Figs. 1 to 7, inclusive, 10 designates a tube which may be formed of metal, plastic, or any other suitable material. 1 designates a mouthpiece stem or device which may be formed of plastic, composition material, or any suitable material and which has a portion adapted to serve as a core for the tube 10.

The member 11 is provided with a mouthpiece portion 12 having a longitudinal passage 13 extending therethrough. The core portion 14, which extends within the barrel of the tube 10, has a forward closure portion 15 forming an effective seal across the diameter of the tube 10. The forward face of the closure is preferably dished, as indicated at 16, to form a collection space for smoke which is to be drawn through the Venturi orifice 17.

The orifice 17 is of critical size because it is desired to cause the smoke passing through this portion of the closure 15 to reach a velocity which will effectively deposit the high distillation tars upon a barrier surface 18 formed by the slotting of the member 14. This slotting provides a rear impingement wall 18 upon which the tar is deposited.

I find that there is a critical correlation between the size of the orifice 17 and the impingement barrier 18, involving the spacing between the discharge of the orifice and the barrier 18, to bring about two important results. One result is that an effective and satisfying draw of smoke is achieved, and too, substantially all of the tars are removed. At the same time, this permits the light aromatic smoke fractions and the nicotine to pass through so as to satisfy the smoker.

The core portion 14 is preferably reduced in diameter centrally to provide a tar collection chamber 19*a*, and there is interposed toward the rear of the chamber a dike member 20 for holding the tars so located. A closure ring or flange 21 is provided adjacent the mouthpiece portion 12, and between the members 20 and 21 a transverse passage or port 22 communicates with the mouthpiece passage 13. Thus the flow of smoke may travel through the collection space 16, the orifice 17, the slot 19, and thence through the tar collection chamber 19*a* around the dike 20 and thence through the lateral passage 22 into the mouthpiece passage 13.

With the structure shown, the smoke is raised to a high velocity through the short orifice or passage 17 and is impinged upon the wall 18 just as the velocity of the smoke is lessening, with the result that the tars form on and cling to the impingement barrier and, as the smoke proceeds, the collected tars are drawn outwardly through the slot and onto the walls of the core 14. Here, the tar material moves toward the mouthpiece 12 until it strikes the dike member 20. After striking the dike 20, the tar begins to build back in the opposite direction, filling up the chamber 19*a*, but always preferentially clinging to the core 14. When the member 11 is withdrawn from the tube 10, the tarry material can be readily wiped from the core 14 and the cleaned core then replaced in the position shown in Fig. 3. Should any tar collect upon the inner walls of the tube 10, this tar is removed automatically by the withdrawal of the stem or member 11, in this operation the closure member 15 serving as a wiper of the inner wall of the tube.

While, in the foregoing description, I have described the impingement barrier as one formed within the core 14, the barrier being an integral part of the structure, it will be understood that the barrier may be provided by other means and, in fact, may be provided by a conventional cellulose filter or by any other suitable means, and further, the tar removal structure may be incorporated within the cigarette as it is prepared in manufacturing operations. In Fig. 8, the cigarette 23 is supported within a paper tube or wrapper 24. In the tube, adjacent the cigarette end, is a cellulose filter 25, and at the inner end of the tube 24 is another filter 26. Between the filter segments 25 and 26 is interposed a closure 27 formed of molding material such as wood flour, wood

pulp, plastic, or any substantially impervious material. The closure is provided with an orifice **28**, and the member **27** is preferably provided on each side with concave faces **29** and **30**.

In the structure shown in Fig. 8, the filter section **25** serves to protect the orifice **28** from tobacco fragments, while the filter **26** serves as an impingement barrier for collecting the tars. The dished face **29** provides a collection space for smoke that is to enter the orifice **28**, while the dished face **30** provides a spacing between the orifice outlet and the impingement barrier **26**. The collection space for the smoke ahead of the orifice provides an important contribution to the effective removal of tar from the smoke. This collection space, which may, if desired, be considerably enlarged, enables smoke to be drawn rapidly through the orifice at higher velocities than would otherwise be the case, since the smoke passes through open or free space and is not subject to friction engagement with the tobacco mass. The increased velocity resulting from the use of a reservoir or collection space for smoke produces a more efficient removal of the tar by reason of the impingement of the smoke at higher velocities upon the barrier **26**. It will be understood that the cigarette may be constructed in a variety of ways to incorporate tar removal devices incorporating my invention.

In the modification shown in Fig. 9, I provide a disposable tube **31** provided centrally with a closure member **32** having therein an orifice **33**. The tube is provided with an outer mouth portion **34** adapted to receive a cigarette, and on its inner side with an opening **35** adapted to receive a filter **36**. A mouthpiece **37** is provided with a reduced forward end portion **38** adapted to be received in the tube chamber **35** and having a longitudinal passage **39** communicating with the space **35**. I provide a pin **40** which has one end embedded within the body of the mouthpiece **37** and a free end portion extending through the filter **36**. The pin is useful in extracting a residue portion of the cigarette within the tube portion **34** while at the same time the pin serves a double function in attaching the mouthpiece more firmly to the filter **36**. The pin **40** serves the further important function of cleaning the orifice **33**, should this be necessary, after the removal of the burned end of the cigarette.

As heretofore stated, 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 result is achieved by employing an impingement barrier in combination with an orifice which greatly increases the velocity of the smoke stream so that when the stream strikes the barrier, the tar is lodged upon the barrier and the resulting purified smoke alters its course and passes on to the smoker. While there will be variations in the size of the orifice and in the spacing of the barrier from the outlet of the orifice, depending upon the character of the smoke, the density of the cigarette mass, etc., I find that in general effective results are obtained where 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 was .028 to .032 (.0006 to .0008 square inch). As an example, I have employed effectively an orifice having a diameter of 0.030 (.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 $\frac{1}{32}$ to $\frac{8}{32}$ of an inch, or about .01 to .25 of an inch. A preferred distance is .05 to .10 of an inch. In the specific example referred to, the barrier is spaced from the orifice outlet by $\frac{3}{32}$ of an inch (.093 inch), or approximately three times the orifice diameter.

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

The barrier may be a solid barrier or a material which forms a relatively dense medium compared to air such as a conventional cellulose filter tip as used on cigarettes, wad of cotton, absorbent paper, and similar substances. 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 or, in the case of a barrier formed of fiber, etc., to pass through the filter, whereas tar fractions, by reason of their high inertia, cannot change direction and therefore deposit on the first surface contacted.

The passage or orifice is effective in greatly increasing velocity of the smoke so that it is substantially in excess of 100 feet per second. Of course, the velocity will vary considerably with different smokers and with cigarettes of varying degrees of density. By spacing the barrier close to the outlet of the orifice, the attained high velocity is effective in lodging the tar fractions directly on the fiber where a fibrous barrier is used, or upon the carrier wall where an impervious barrier is employed, and further, such high velocity is effective, in the case of the solid carrier wall, in moving the viscous tar along the barrier face to an unobstructing position in a reservoir space. The space between orifice outlet and impingement barrier may be, as stated, from 0.01 to 0.25". In the preferred structure, the spacing is about .05 to .10".

In the structure shown in Fig. 8, the various components of the cigarette tip are symmetrical and may be assembled end for end providing the closure is in the center and one or more filter sections are placed about it. The tip may be assembled separately and applied to a cigarette, or it may be formed with the cigarette at the time of manufacture, in which case the tube **24** may be the same cork or plain type wrapper now employed in the forming of filter cigarettes.

In the structure shown in Fig. 9, the cigarette may be placed within the end portion **34** of the tube **31**, and the orifice **33** combines with the forward face of the filter **36**, which serves as an impingement barrier, for the removal of tars, etc. When the filter becomes saturated with tars, the entire tube member **31** with the filter **36** may be discarded and a new tube with filter installed. As already stated, the pin **40** is effective in removing the burned end portion of the cigarette within the tube end **34** and also for cleaning the orifice **33** while during the smoking operation the pin is sheathed within the filter **36** in the inner end portion of the tube **31**.

The member **11** may be formed of any suitable material. I have found that certain plastic materials such as nylon are particularly useful because of the resiliency afforded, permitting ready assembly with the tube **10** while at the same time providing effective wiping action as well as sealing the tube. The forming of the dished face in the forward end of the closure at **16**, is not only effective in providing a smoke collection space, but also provides thin resilient peripheral edges about the closure to increase its wiping and sealing action.

While, for the purpose of illustration, I have described the invention in connection with a smoking product referred to as a cigarette, it will be understood that the invention is applicable to the treatment of smoke from other tobacco products where the problem of tar removal is present.

While, in the foregoing specification, I have set forth specific structure and procedure in considerable detail for

the purpose of illustrating embodiments of my invention, it will be understood that such details of structure and procedure may be varied widely by those skilled in the art without departing from the spirit of my invention.

I claim:

1. In a tobacco smoking structure having a smoke passage, orifice defining means in said smoke passage for accelerating tobacco smoke at a velocity of at least 100 feet per second and including a single smoke stream constriction opening having an overall cross-sectional area approximating .0005 to .001 square inch, and impingement barrier structure in the tobacco smoking structure disposed in close confronting relation to the accelerated smoke stream at the downstream end of the smoke stream constricting opening and presenting a flow-interrupting mass of solid matter in the path of and confronting substantially all of the smoke in the stream so that harmful tar particles are deposited upon the barrier substantially solely by impingement as distinguished from by expansion and condensation, said impingement barrier structure being spaced from the smoke stream constricting structure a distance of approximately not more than .10 inch.

2. The structure of claim 1 further characterized by being embodied in the interior of a holder for the tip of a cigarette and the like.

3. The structure of claim 1 further characterized by being embodied in the interior of a cigarette and the like.

4. The structure of claim 1, wherein said flow-interrupting mass of solid matter comprises a relatively dense but porous media.

5. The structure of claim 1, wherein said flow-interrupting mass of solid matter comprises a solid wall.

References Cited in the file of this patent

UNITED STATES PATENTS

299,357	Dittenhoefer	May 27, 1884
925,381	Regenold	June 15, 1909
1,594,606	Clivio	Aug. 3, 1926
1,996,990	Cullen	Apr. 9, 1935
2,245,484	Leavens	June 10, 1941
2,511,898	Brothers	June 20, 1950
2,544,206	Wilson	Mar. 6, 1951
2,705,013	Brothers	Mar. 29, 1955
2,764,513	Brothers	Sept. 25, 1956
2,785,681	Fessler	Mar. 19, 1957

FOREIGN PATENTS

2,414	Great Britain	1915
7,227	Great Britain	1911
760,772	Great Britain	Nov. 7, 1956