

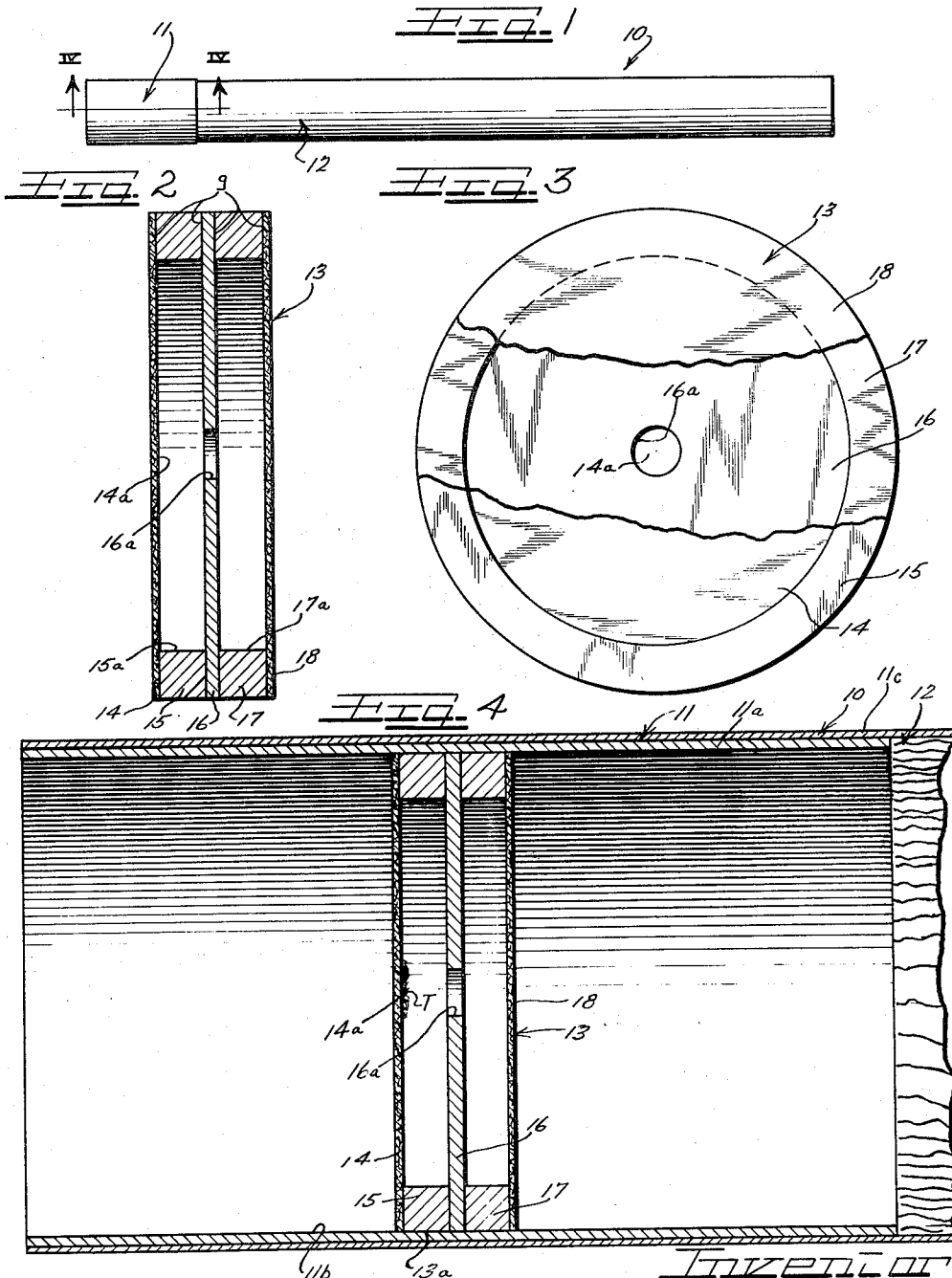
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TOBACCO TAR REMOVAL STRUCTURE

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TOBACCO TAR REMOVAL STRUCTURE

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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 and an apparatus and a method of manufacturing the same which tar removal structure is provided with a venturi passageway area so that the velocity of tobacco smoke passing through the passageway 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 $\frac{5}{16}$ " diameter filter tip can be compressed into a $\frac{1}{8}$ " 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 $\frac{1}{32}$ " diameter. Such a large air passage is in marked contrast to the $\frac{1}{32}$ 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 strips of material such as paper and the like with certain of the strips being pre-punched and with at least certain of the strips having an adhesive material applied to them so that when the strips of material are disposed in superimposed abutting relationship they will be connected together to form a laminated strip of material whereupon the laminated strip of material is again punched to form tobacco tar removal structures. By virtue of this construction, the tobacco tar removal structure cost for a filter tip can be maintained at a minimum. Furthermore, the filter tip cost for a cigarette can be substantially reduced since it is well known that cellulose which is the material most commonly used in filter-tip cigarettes is considerably more expensive than the paper-like materials and the like which are used in the formation of the tar removal structure for a cigarette to form a filter-tip cigarette according to the features of the present invention.

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 $\frac{1}{16}$ ") of the filter tip.

In contrast to the above conventional filter tips, a length of laminated material comprised of layers of paper and the like are cut in such a manner that circular portions of the length of laminated material are punched out and since the length of laminated material is pre-punched, each of the circular portions which have been cut out is provided with critical sized smoke orifice or venturi as well as an impingement barrier spaced longitudinally from the downstream end of the venturi. After the tobacco tar removal structure has been formed it is assembled with

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a tubular filter tip sleeve as well as with a cigarette. When the filter tip cigarette is ignited and upon a suction force being applied to the open end of the sleeve, 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. Another advantage of the present invention is that by manufacturing the tar removal structure from paper, the cost of the paper used in the tar removal structure will be substantially reduced as compared to the cost of the cellulose used in the conventional 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.

According to the practice of still another principle of my invention, the smoke is strained to prevent longitudinal movement of relatively large tobacco particles having a tendency to interfere with the longitudinal flow of the suction actuated smoke prior to the acceleration of the smoke whereupon the smoke stream is accelerated to increase the velocity of the smoke stream by decreasing the cross-sectional area of the smoke stream and impinging the high velocity smoke against a barrier confronting the stream of smoke to remove the harmful tar particles from the smoke prior to the passage of the smoke into the mouth of the smoker.

Yet still another object of the present invention is to provide a new and improved tobacco tar removal structure comprised of a series of disks and rings with one of the disks being comprised of porous paper having a high wet strength factor which disk comprises the impingement barrier and permits the smoke to pass therethrough after the harmful tars have been impinged upon the fibers of the disk.

Other objects and features of the present invention will more fully become apparent in view of the following detailed description taken in conjunction with the accom-

panying drawings illustrating therein a single embodiment and in which:

Figure 1 is a side elevation of a filter tip cigarette;

Figure 2 is an enlarged cross-sectional view of a tobacco tar removal structure;

Figure 3 is an enlarged fragmentary front elevation of the tobacco tar removal structure shown in Figure 2;

Figure 4 is an enlarged fragmentary cross-sectional view taken substantially on the line IV—IV of Figure 1 looking in the direction indicated by the arrows.

The reference numeral 10 indicates generally a filter tip cigarette which is comprised of a filter tip 11 and a cigarette 12. Disposed internally of the filter tip 11 is a tobacco tar removal structure 13 as is shown in Figure 4. The filter tip includes a tubular sleeve 11a having an internal circular surface 11b which may be in frictional detachable engagement with circular peripheral surface area 13a of the tobacco tar removal structure intermediate the opposite ends of the sleeve 11. Preferably the surface area 13 is permanently fastened by glue and the like to the sleeve surface 11b to form an air tight connection. The cigarette 12 abuts against the sleeve 11a and which sleeve and cigarette are preferably permanently fastened by glue and the like to an outer filter sleeve 11c comprised of paper.

The tobacco tar removal structure 13 is generally in the form of a partition extending across the inside of the sleeve 11a and is comprised of a circular disk 14, an annular ring 15, a circular disk 16, an annular ring 17, and a circular disk 18. The disks 14 and 18 are preferably comprised of a wet strength felted fabric having a thickness approximating .0015". Excellent results may be obtained through the use of a single ply of a "Scotkin" dinner napkin or its equivalent. The rings 15 and 17 as well as the disk 16 are preferably comprised of a non-porous paper. The rings preferably have a thickness approximating .030" and the disk 16 preferably has a thickness approximating .007". The elements comprising the tobacco tar removal structure 13 preferably have their confronting surface areas adhesively secured together by means such as glue as is indicated by the reference character *g* in Figure 2.

The intermediate disk 16 is provided with a longitudinal or axially extending venturi passageway 16a and the disk 14 provides an impingement barrier 14a disposed downstream of the outlet end of the venturi passageway 16a and in confronting longitudinal alignment therewith.

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 16a 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 on to 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 (.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 14a is preferably spaced from the orifice or venturi 16a by $\frac{1}{32}$ of an inch (.03125"), or approximately 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 14a so that the tars T and other harmful particles are removed by the foregoing high velocity impingement action upon the barrier 14a.

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 as a consequence of the smoke being deflected, whereas tar fractions, by reason of their high inertia, cannot change direction and therefore deposit on the fibers of the paper barrier 14a. The tars T will impregnate a substantial area of the barrier 14a by a capillary action depending on the absorbency of the paper.

During the smoking of the filter tip cigarette 10 the fibers of the relatively porous disk 18 will operate as a screen to prevent any tobacco particles from entering the venturi passageway 16a and clogging the same.

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. In a tobacco tar removal structure, comprised of a series of laminations separated from one another by spacer elements, one of said laminations comprised of a substantially non-porous disk-like element having a single venturi passageway opening therethrough approximating .0005 to .001 sq. in. cross-section, and another of said laminations comprising a piece of wet strength porous paper-like material comprising an impingement barrier disposed in confronting spaced relation of about .005" to .030" to the venturi passageway area on the downstream side thereof, whereby smoke is adapted to be drawn through the venturi passageway and directed at the barrier at high velocity with the tar being removed from the smoke upon being lodged on the wet strength paper-like material comprising the barrier and the smoke passing on through the barrier.

2. In a tobacco tar removal structure, comprised of a series of laminations separated from one another by spacer elements with said laminations and said spacer elements bearing adhesive securing them together in unitary assembly, one of said laminations comprised of a substantially non-porous disk-like element having a single venturi passageway opening therethrough approximating .0005 to .001 sq. in. cross-section, and another of said laminations comprising a piece of wet strength porous paper-like material comprising an impingement barrier disposed in confronting spaced relation of about .005" to .030" to the venturi passageway area on the downstream side thereof and with said impingement barrier having a thickness approximating .0015" whereby smoke is adapted to be drawn through the venturi passageway area and directed at the barrier at high velocity with the tar being removed from the smoke upon being lodged on the wet strength paper-like porous material comprising the barrier and the smoke passing on through the barrier.

3. In a tobacco tar removal structure, an assembly adapted to provide a partition within a tubular passageway normally providing for substantially free flow of tobacco smoke from an upstream position to a down-

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stream position, a disk of substantially non-porous material having a single venturi smoke passageway opening therethrough of about .0005 to .001 sq. in. cross-section, a porous paper-thin disk through which smoke may pass under suction substantially uniformly over the entire exposed area of the porous disk but in which the material presents a substantially solid barrier in depth to the movement of smoke so that substantially every particle of smoke is deflected laterally as it moves downstream through the porous disk, and means securing said porous disk in spaced confronting relation to said non-porous disk on the downstream side of said venturi orifice passageway and with the porous disk providing an impingement barrier disposed in confronting downstream spaced relation of about .005" to .030" from the downstream side of said venturi orifice passageway, whereby smoke issuing downstream from said venturi orifice passageway is compelled to impinge against said barrier at high velocity so that tars carried thereby will be deposited upon the fibers in the impinged barrier while the cleansed smoke will move laterally relative to the fibers and pass thereby downstream through the porous disk.

4. In a tobacco tar removal structure, an assembly adapted to provide a partition within a tubular passageway normally providing for substantially free flow of tobacco smoke from an upstream position to a downstream position, a disk of substantially non-porous material having a single venturi smoke passageway opening therethrough of about .0005 to .001 sq. in. cross-section, a porous felted paper-like disk through which smoke may pass uniformly under suction over the entire exposed area of the porous disk, and means securing said porous disk in spaced confronting relation to said non-porous disk on the downstream side of said venturi orifice passageway and with the porous disk providing an impingement barrier disposed in confronting downstream spaced relation of about .005" to .030" from the downstream side of said venturi orifice passageway, whereby smoke issuing downstream from said venturi orifice passageway is compelled to impinge against said barrier at high velocity so that tars carried thereby will be deposited upon the felted material in the impinged barrier while the cleansed smoke will move laterally relative to the felted material and pass thereby downstream through the porous disk.

5. In a tobacco tar removal structure, a tubular member adapted to be used with a smokeable article for the

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passage of all smoke through the tubular member, said tubular member having a smoke blocking partition therein including a substantially non-porous disk having a single orifice opening of about .0005 to .001 sq. in. cross-section therethrough through which all smoke moving downstream through said member must pass and thereby attain a high velocity, and the partition further including on the downstream side of said non-porous disk a disk of porous paper-like material through which all of the smoke must pass after leaving said orifice and said porous disk providing an impingement barrier disposed in confronting spaced relation of about .005" to .030" downstream from the discharge end of said orifice.

6. In a tobacco tar removal structure, a substantially non-porous disk having a single passageway opening therethrough of an orifice diameter of about .0005 to .001 sq. in. cross-section, a pair of identical substantially uniformly porous paper-like disks having said non-porous disk disposed concentrically therebetween, spacer rings between the margins of the non-porous disk and said porous disks and maintaining the porous disks spaced from the non-porous disk about .005" to .030", and means securing the disks and the rings in permanently assembled relation, said structure being disposable in the smoke path of a smokable article with one of said porous disks upstream and serving as a tobacco filter but permitting smoke to pass substantially freely therethrough toward said non-porous disk to then move downstream through said opening and attain high velocity therethrough so as to impinge against the porous disk downstream from the opening and serving as a barrier for impingement thereagainst of the high velocity smoke stream so that tars will deposit on the barrier before the smoke moves on through the downstream porous disk.

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