Nov. 28, 1961 H. A. LEBERT 3,010,458

DEVICE FOR REMOVAL OF TAR AND OTHER DELETERIOUS SUBSTANCES FROM TOBACCO SMOKE

Filed April 22, 1958

Fig. 1

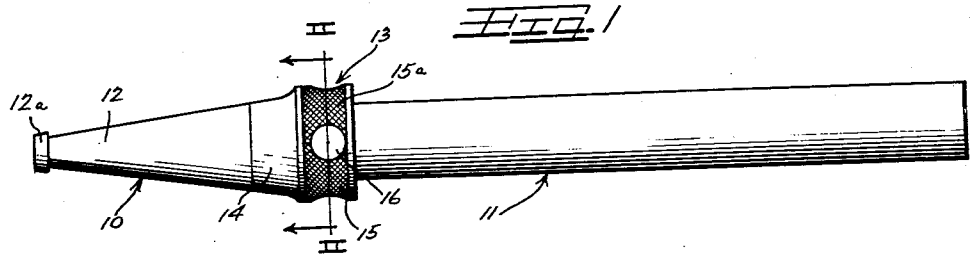


Fig. 2

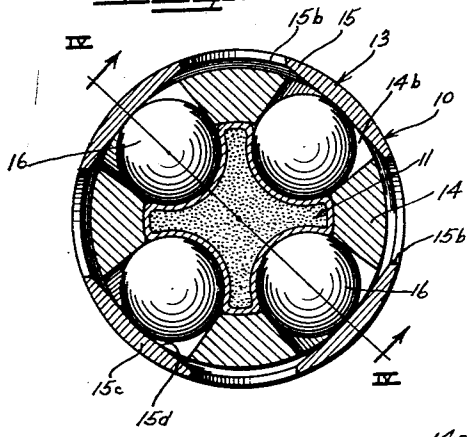


Fig. 3

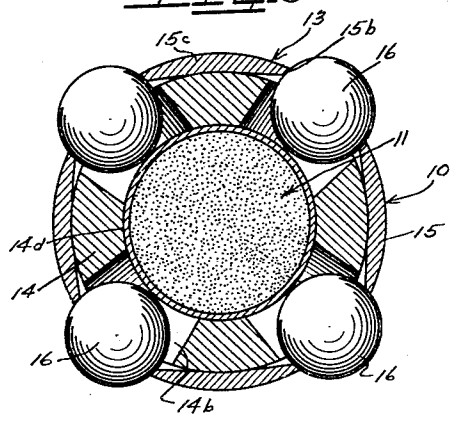


Fig. 4

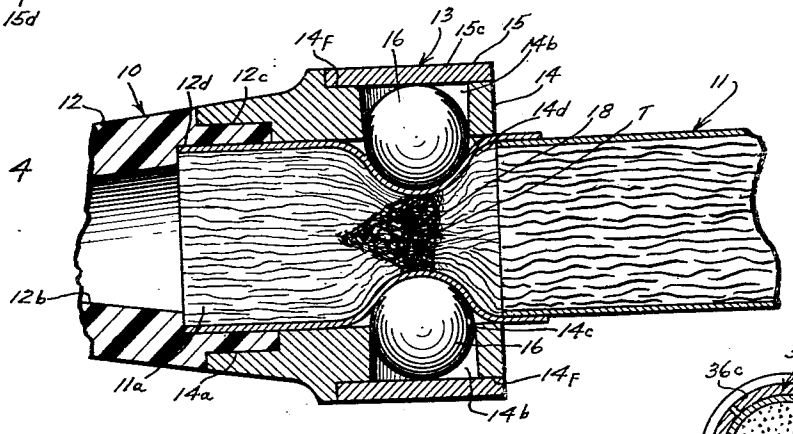


Fig. 5

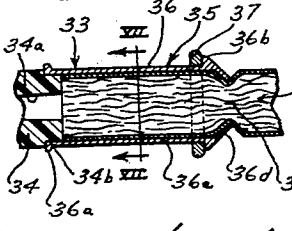


Fig. 6

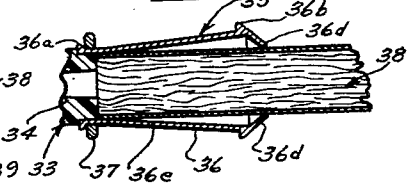
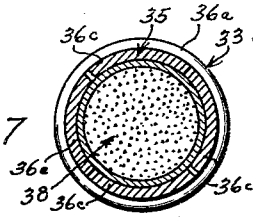


Fig. 7



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DEVICE FOR REMOVAL OF TAR AND OTHER DELETERIOUS SUBSTANCES FROM TOBACCO SMOKE

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The present invention relates to apparatus for the removal of tar and other deleterious substances from tobacco smoke. More particularly, the present invention relates to an orifice and an 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."

According to the present invention means are disclosed for constricting an end area of a filter tip or conventional type of a cigarette in a manner whereby the longitudinal smoke passageway area at the localized area of constriction is reduced in such a manner that a venturi passageway area is created for accelerating tobacco smoke at high velocity thereby enabling the heavy relatively harmful tars to be removed from the tobacco smoke.

In the past, many devices have been proposed for the treatment of tobacco smoke and for the elimination of portions or fractions of component parts of the smoke therefrom. The removal of tars has posed a serious problem because of their known harmful effects to health. 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. Furthermore, a sufficient proportion of the tars are not removed.

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 laden 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.)

Early experiments indicate that where the velocity expansion cooling principle is used to obtain tar separation, a relatively low percentage of the high temperature tars are separated out of the smoke as opposed to the use of the instant relationship involving high velocity tobacco smoke impingement without expansion wherein a relatively high percentage of high temperature tars are separated.

In the application of this new technique, manufacturing advantages are present since structures of this type are far more compact than those using the velocity-expansion principle where a relatively large chamber is required for condensing the smoke.

By using a venturi orifice with a .028" to .030" diameter, 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 while the low temperature aromatic fractions or tars are passed on to the smoker.

If the means herein disclosed is applied to a filter-tip cigarette of the type wherein the filter tip is comprised of cellulose filaments in varied amounts with various binders and additives new and greatly improved results may be obtained. It will be appreciated that with conventional filter tips despite the fact they are comprised of 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 3/32" diameter. Such a large air passage is in marked contrast to the 1/32" or less orifice used to create high velocity-impingement tar collection according to the present invention.

Accordingly, an important object of the present invention is to preform the critical sized smoke passage or venturi in one end of the cigarette 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 filaments of the filter tip or on the tobacco particles contained in the end of the cigarette. The lighter weight aromatic and low temperature formed smoke particles or fractions will go on to make up a safe, enjoyable smoke by deviating from their high speed straight line path after the smoke strikes the barrier, and flow into the mouth of the smoker.

Another object of the present invention is to provide a cigarette holder structure which is adapted to receive a cigarette which structure is particularly constructed so that it is not necessary to clean it because of the fact that means are provided on the structure for constricting the cigarette in a manner whereby the tars are collected within the cigarette.

Yet another object of the present invention is to provide a cigarette holder structure of the type above characterized which structure may be manufactured on a large production basis at an economical cost.

A further object of this invention is to provide a tobacco tar removal insert structure having new and improved means for separating tars from tobacco smoke which insert structure is adapted for use in a tobacco burning smoking structure.

Yet another object of the invention is to provide a highly compact structure for separating the tar from tobacco smoke.

A further object of the present invention is to provide a new and improved apparatus for removing tobacco tars whereby substantially all the tars regarded harmful by modern medical thinking will be deposited within the cigarette and thereby removed from the tobacco smoke.

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 accompanying drawings illustrating therein several embodiments and in which:

FIGURE 1 is a side elevation of a multi-part cigarette holder structure carrying a cigarette which holder structure has tar separation structure according to the principles of the present invention;

FIGURE 2 is an enlarged cross-sectional view taken substantially on the line II—II of FIGURE 1 looking in the direction indicated by the arrows;

FIGURE 3 is an enlarged fragmentary cross-sectional view similar to FIGURE 2 only illustrating the relationship of the holder structure with respect to the cigarette prior to the constriction of the cigarette by means provided on the holder structure;

FIGURE 4 is an enlarged fragmentary cross-sectional view taken substantially on the line IV—IV of FIGURE 2 looking in the direction indicated by the arrows;

FIGURE 5 is a fragmentary cross-sectional view of a modified type of multi-part cigarette holder structure which structure is shown as having means for carrying a cigarette and for constricting a localized area of the cigarette according to the principles of the present invention;

FIGURE 6 is a fragmentary cross-sectional view similar to FIGURE 5 only showing the means for constricting the cigarette in an expanded position; and

FIGURE 7 is an enlarged cross-sectional view taken substantially on the line VII—VII of FIGURE 5 looking in the direction indicated by the arrows.

The reference numeral **10** designates generally my multi-part cigarette holder and filter structure which supports a cigarette **11** at one end thereof.

The structure **10** includes a mouth piece portion **12**, and a collar structure **13**. The mouth piece portion may be made from any suitable materials although I have found that excellent results may be attained through the manufacture of the mouth piece portion **12** from a suitable plastic, such as thermo-plastic, a suitable composition, or any suitable material. The structure **13** may be made from any suitable material.

The mouth piece **12** has a reduced tip end **12***a* which is adapted to be inserted into the mouth of the smoker and also includes a longitudinal smoke passageway **12***b* extending the full length of the mouth piece portion **12**. Disposed on the opposite end of the mouth piece portion **12** in longitudinally spaced relation to the reduced portion **12***a* is an annular stepped shouldered area **12***c* (FIGURE 4), which shouldered area provides a seat for the collar structure **13** as will be hereafter further described.

It will be noted that the passageway **12***b* in FIGURE 4 is flared outwardly toward the collar structure **13** from the reduced tip end **12***a* and is provided with an annular cigarette seat area **12***d* which underlies the collar seat area **12***c*.

The collar structure **13** includes a tubular collar portion **14**, an annular ring or band **15**, and a series of circumferentially arranged ball bearings **16**.

The tubular collar portion **14** is provided with an annular stepped seat area **14***a* at one end for matching abutting engagement with the seat area **12***c* on the mouth piece **12**. The tubular collar portion is further provided with circular opening walls **14***b* each of which defines an opening for the receipt of one of the ball bearings **16**. As is evident in FIGURE 4 the circular opening walls **14***b* are tapered in a radially inwardly extending direction with a radially inner edge area **14***c* on each of the walls **14***b* providing stop means to limit the radial inward displacement of the ball bearings **16**.

It will further be noted that the tubular collar portion **14** has a circular inside surface area **14***d* which is adapted to frictionally engage with the cigarette **11** and in this connection it will be appreciated that the tubular wall area **14***d* has a diameter slightly in excess of the outside diameter of the cigarette **11**.

Mounted upon the tubular collar portion is the annular band or ring **15** which may be knurled as is indicated at **15***a* in FIGURE 1 in order to facilitate rotation of the ring or band **15**. The tubular collar portion **14** further includes a stepped annular ring seat area **14***f* (FIGURE 4). The band **15** is adapted to be retainingly sustained upon the reduced end or the stepped ring seat area **14***f* with the stepped ring surface **14***f* more or less providing a bearing surface.

The ring or band **15** is provided with circumferentially arranged circular openings each defined by a ring opening wall area **15***b* (FIGURE 2).

The ring opening wall areas **15***b* are further defined in that they are beveled and have a diameter slightly smaller than the outside diameter of the ball bearing **16** so that when the compnents of the collar structure **13** are assembled together the ball bearings **16** will be unable to become dislodged from the collar structure **13**.

Intermediate sections **15***c* are provided between each of the openings **15***b* which intermediate sections function as cam means for the radial movement of the ball bearings. Each of the intermediate ring sections **15***c* has a relatively flat inner surface area **15***d* which is adapted to be moved into and out of engagement with the radially outer most edge area of the ball bearing **16** upon circumferential rotation of the ring or band **15**.

As is shown in FIGURES 1–4 the cigarette **11** comprises a filter tip type of cigarette including a filter tip end portion **11***a* which is comprised of cellulose filaments and/or the like.

To smoke a cigarette through the use of the instant cigarette holder structure **10** the smoker has only to telescope the filter tip end **11***a* into the tubular opening defined by the tubular edge area **14***d* on the tubular collar portion until the filter tip is bottomed in the annular seat area **12***d* provided on the mouth piece **12**. Then by rotating the ring or band **15** the opening wall structure **15** functions to displace the ball bearings **16** radially and thus driving the relatively rigid inwardly projecting portions thereof into the filter tip **11***a* to constrict the filter tip and provide a localized venturi area indicated generally at **18** within the filter tip **11***a* so that tars T may be removed from the tobacco smoke. As the ring or band is rotated the relatively flat edge area **15***d* on the intermediate ring sections **15***c* eventually engages against the radially outermost surface area of the ball bearing **16** thereby locking the ring or band **15** in position. As is illustrated, four ball bearings **16** have been provided for constricting the filter tip **11***a*. It is conceivable that the number of ball bearings used may be varied without deviating from the scope of the present invention.

According to the present invention, it will be appreciated that the collar structure **13** operates to constrict the cigarette to produce a venturi area of a predetermined square inch area depending upon the type of materials used in the cigarette and the dimensions of the elements of the collar structure.

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 a venturi orifice or passageway which greatly increases the velocity of the smoke stream passing through the filter tip so that when the stream strikes the barrier comprised of a multiplicity of fibrous strands such as cellulose, the tar is lodged and collected upon the peripheral surface of the fibrous strands and the resulting purified smoke alters its course through the strands and passes onto the smoker through the downstream end of the filter tip **11***a*. 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 where the effective orifice diameter is from .025 to .038 (square inch areas of .0005 to .001). This range of effective orifice diameter is readily attainable by the user of the holder **10** by manipulating the control ring **15** to drive the balls **16** radially toward one another compressively relative to the embraced smokable article, to an extent which experience as to required drawing suction and taste informs the user is optimum for the subject article.

The operation resulting from the structure shown herein is in contrast to the operation of cooling devices heretofore employed with cigarettes where a relatively large expansion chamber is required. Such cooling devices bring about a peripheral cooling of the smoke but allow substantial core portions of the tars to pass onto the smoker without the tars being removed therefrom. In the present structure, the entire cross-section of the smoke stream is subject to the action of the impingement barrier comprising the downstream end of the filter tip so that the tars and other harmful particles are removed by the foregoing high velocity impingement action upon the barrier.

The passage or orifice is effective in greatly increasing the velocity of the smoke so that it is substantially in excess of 100 feet per second. If more than one orifice is used the total square inch area should fall within the range given. Of course, the velocity will vary considerably with different smokers and cigarettes of varying degrees of density. By positioning the impingement barrier area comprising the cigarette fibers in confronting relation to the outlet of the orifice area, the attained high velocity is effective in lodging the tar fractions directly upon the cigarette fibers thereby removing them from the smoke.

Shown in FIGURES 5, 6 and 7 is a modified mouth piece structure indicated generally at **33**. The holder structure **33** includes a mouth piece portion **34** as well as a collar structure **35** suitably bonded to the mouth piece portion **34** in much the same manner that the collar structure **13** is bonded to the mouth piece **12** at the area of their intersection by suitable means such as glue and the like. The mouth piece portion **34** has an internal smoke passage area **34***a* to permit longitudinal movement of tobacco smoke therethrough. The mouthpiece portion **34** further includes a stepped collar seat area **34***b*.

The collar structure **35** is comprised of a tubular collar portion **36** as well as an annular ring or band **37**. The band **37** is disposed on the radially outer side of the tubular collar portion **36** which collar portion **36** is telescoped internally of the band. The tubular collar portion is of a resilient construction and may be comprised of any suitable material such as spring steel and the like. It will be noted in FIGURE 6 that the downstream end of the tubular collar portion is normally of a reduced diameter as compared to the generally upstream end area thereof when the ring **37** is at the downstream end of the collar portion **36**. Still further, the tubular collar portion is provided with axially spaced annular stop areas **36***a* and **36***b* defining a pocket or recess in which the ring or band **37** is lodged against accidental displacement. The band **37** is longitudinally movable between the stop areas **36***a* and **36***b* to permit the structure to be engaged and disengaged with a cigarette **38**.

As is evident from FIGURE 7 the tubular collar portion **36** is of a segmental construction including four segments each of which is indicated generally at **36***c*. The tubular collar portion terminates in a generally radially inwardly axially forwardly inclined annular extension area **36***d* which extension area **36**d is adapted to be embedded within an end portion of the cigarette **38** to thereby constrict the cigarette fibers or tobacco strands. The cigarette is in this instance suitably illustrated as a conventional type cigarette instead of a filter type cigarette shown in the first form of the invention. It will be understood the collar structure **35** is also adaptable for use with a filter tip cigarette.

Each one of the segments **36***c* of the collar portion **36** is particularly constructed so that the offset angled extension area **36***d* is disposed in angular relation to a main body portion **36***e* so that as the band **37** is moved longitudinally in frictional engagement with the body portions **36***e*, the body portions **36***e* are radially resiliently deflected against the outer periphery of the cigarette and the extensions area is embedded within the cigarette to create a venturi passage area **39** of the same type as the venturi passage area **18** previously described.

It will be observed that in both forms of the invention and having particular reference to FIGURES 2, 4 and 5, the opposing squeezing members constrict the narrow circumferential area of the butt end portion of the smokable article engaged thereby to at least one-half the normal circumferential diameter of the constricted area whereby the fibrous material in the constriction is compacted into the venturi-like orifice restriction that compels high velocity smoke acceleration in passing therethrough upon drawing smoke from the lighted end of the article through the butt end portion thereof. By reason of the inherent radial adjustability of the squeezing members the smoker can readily adjust the device in each instance to effect maximum compression or a slightly backed off relation of the squeezing members to attain lesser or relieved compression to enable a freer draw, depending upon his preferences as to tar removal and freedom of draw.

The term "cigarette fibers" where used has been used in a generic sense to include filter tip fibers and the fibers in a regular cigarette such as the tobacco and paper fibers.

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 smokable article holder, a mouthpiece having a socket portion at one end providing a socket, a passage through the mouthpiece leading rearwardly from the socket, the socket being receptive of the butt end section of a smokable article, said socket portion having a plurality of respective radial recesses carrying therein respective ball bearings providing opposed generally radially movable squeezing members arranged to be normally spaced apart so as to receive a smokable article butt end section freely into the socket, and a constricting ring carried by the holder and engaging said members to drive the members generally radially toward one another into opposed squeezing relation to a narrow circumferential portion of a smokable article butt end section in the socket and spaced from the free end of such butt end section, said members being movable by said ring to constrict the narrow circumferential portion of the butt end section to at least one-half its normal circumferential diameter so as to compact the material in the constricted portion into an orifice restriction compelling high velocity smoke acceleration through the orifice restriction upon drawing of smoke through the restriction and the butt end section from the opposite and lighted end portion of the article, whereby the material of the article downstream from the orifice restriction provides an impingement barrier against which the high speed smoke impinges to deposit tars thereon and then moves on through the remainder of the butt end section to exit from its free end and pass on through said passage.

2. In a smokable article holder, a mouthpiece having a socket portion at one end providing a socket, a passage through the mouthpiece leading rearwardly from the socket, the socket being receptive of the butt end section of a smokable article, said socket portion having a plu-

rality of circumferentially spaced relatively generally radially movable opposed squeezing and constricting elements and including means movably mounting said elements on the socket portion symmetrically about the axis of said socket, said elements being arranged to be normally spaced apart so as to receive a smokable article butt end section freely into the socket, each of said elements presenting a relatively rigid inwardly projecting smokable-article-gripping and squeezing portion spaced substantially forwardly from the inner end of the socket, and a constricting ring carried by the holder and engaging said elements to drive the elements generally radially toward one another and forcing said rigid portions into opposed squeezing relation to a narrow circumferential portion of a smokable article butt end section in the socket and spaced from the free end of such butt end section, said elements being movable by said ring to constrict the narrow circumferential portion of the butt end section to at least one-half its normal circumferential diameter so as to compact the material in the constricted portion into an orifice restriction compelling high velocity smoke acceleration through the orifice restriction upon drawing of smoke through the restriction and the butt end section from the opposite and lighted end portion of the article, whereby the material of the article downstream from the orifice restriction provides an impingement barrier against which the high speed smoke impinges to deposit tars thereon and then moves on through the remainder of the butt end section to exit from its free end and pass on through said passage.

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