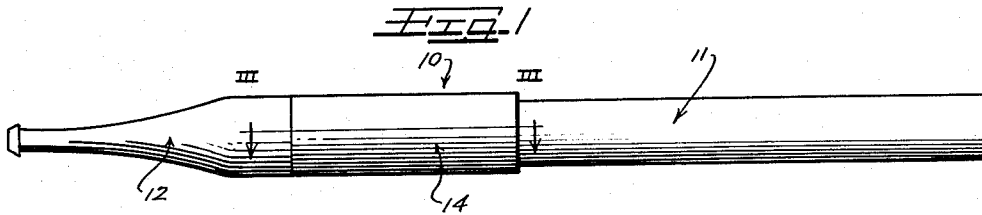
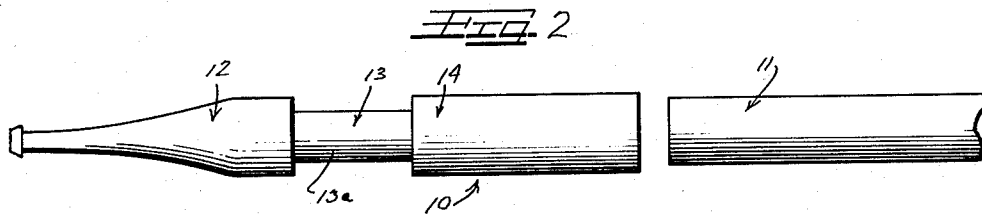
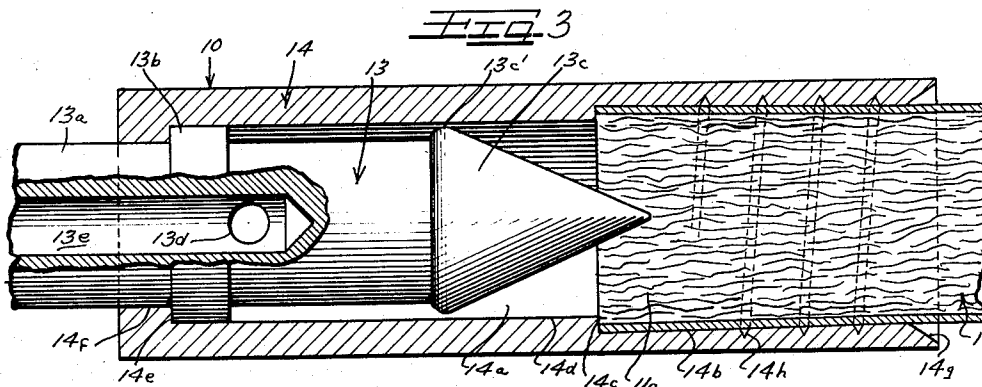
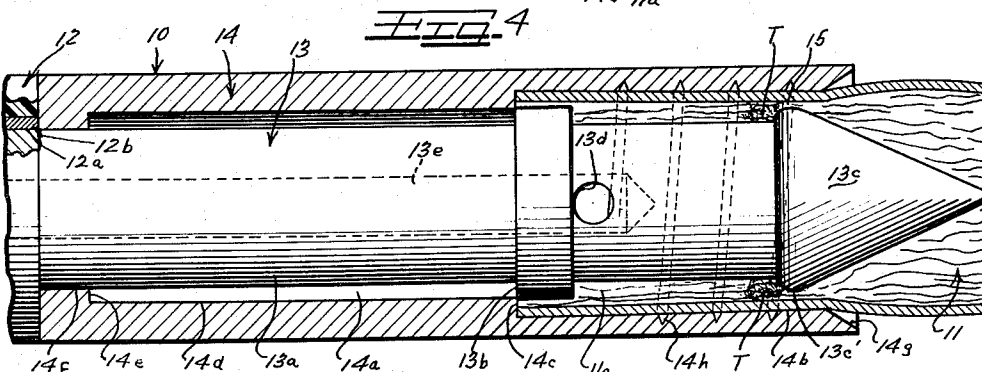
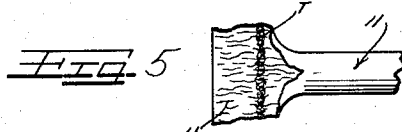


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 DEVICE FOR REMOVAL OF TAR AND OTHER DELETERIOUS
 SUBSTANCES FROM TOBACCO SMOKE
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**DEVICE FOR REMOVAL OF TAR AND OTHER
DELETERIOUS SUBSTANCES FROM TOBACCO
SMOKE**

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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 radially outwardly displacing an end area of a cigarette in a manner whereby the longitudinal smoke passageway area is reduced creating a venturi passageway area 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 ve-

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locity 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 area or smoke passage area equivalent to 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 are 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 $\frac{5}{16}$ " diameter filter tip can be compressed into a $\frac{3}{8}$ " 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 $\frac{9}{32}$ " diameter. Such a large air passage is in marked contrast to the $\frac{1}{32}$ " 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 air low temperature formed smoke particles or fractions which go to make up a safe, enjoyable smoke will deviate from their high speed straight line path after striking 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 and the like which structure is particularly constructed so that it may be readily cleaned.

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 exploded view similar to Figure 1 only showing how an intermediate tubular portion is moved away from the plunger so that the cigarette may be deposited within the intermediate tubular portion;

Figure 3 is an enlarged fragmentary cross-sectional view taken substantially on the line III—III of Figure 1 looking in the direction indicated by the arrows and wherein the plunger is in preliminary engagement with the cigarette;

Figure 4 is an enlarged fragmentary cross-sectional view similar to Figure 3 only showing the plunger in telescoped engagement with the cigarette; and

Figure 5 is a fragmentary view of the end of the cigarette engaged within the holder shown in Figure 4 which end has been broken and spread out to illustrate the tobacco tar ring deposit.

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 is comprised of three parts including a mouthpiece portion 12, a plunger or needle element 13, and a sleeve structure 14. The mouthpiece portion may be made from any suitable materials although I have found that excellent results may be attained through the manufacture of the mouthpiece portion 12 from a suitable plastic, such as thermo-plastic, a suitable composition, or any other suitable material. The plunger element 13 and the sleeve structure 14 may be made from any suitable material such as aluminum and the like.

As is evident from Figures 2 and 4 the plunger element 13 has its downstream end telescoped internally of the mouthpiece 12. To this end, the mouthpiece 12 is provided with a longitudinal passageway 12a to allow smoke to pass from end of the mouthpiece to the other. At the upstream end of the passageway 12a as shown in Figure 4, a bushing 12b is disposed in or is carried within the passageway 12a. The bushing 12b is preferably made from aluminum or some other suitable material. As was mentioned above, the downstream end of the plunger element 13 is frictionally engaged with the bushing 12b to secure the plunger element 13 in assembly with the mouthpiece portion 12.

Prior to the assembly of the plunger element 13 with the mouthpiece portion 12 it is necessary for the plunger element 13 to be assembled with the sleeve structure 14. Before discussing the manner in which the elements 13 and 14 are assembled together it will be expedient to describe the elements in detail.

The plunger or needle element 13 is possessed of a shank portion 13a as well as an offset shouldered area 13b disposed intermediate of the length of the shank portion 13a. Disposed at the upstream end of the shank portion 13a is a conical head portion 13c which head portion has a shouldered head area offset radially outwardly of the shank portion 13a as indicated at 13c'. In order for the cigarette tar removal structure to function properly the offset shouldered head area 13c' has a critical dimension with respect to the outside diameter thereof since this area of the conical head portion cooperates with the sleeve structure 14 in the formation of a venturi orifice or passageway area indicated generally at 15 in Figure 4.

Disposed between the plunger shoulder area 13b and the plunger head 13c is a radially extending port or pas-

sageway 13d which communicates with a longitudinally or axially extending smoke passageway 13e. The longitudinal passageway 13e is in axial alignment and in communication with the passageway 12a in the mouthpiece 12.

The sleeve structure 14 is of a tubular construction and has an axially or longitudinally extending passageway 14a. The central bore or passageway is defined by a stepped internal tubular surface area which stepped surfaces are indicated at 14b, 14c, 14d, 14e, and 14f. The tubular sleeve structure 14 is possessed of an annular beveled edge area 14g to enable the cigarette 11 to be more readily telescoped axially in frictional engagement with the sleeve surfaces 14b and 14c. In this respect it will be noted that the sleeve surface 14c faces axially and is an abutment surface against which the downstream end of the cigarette is adapted to be abutted when in assembly with the sleeve structure 14. The sleeve surface 14b is tapered axially away from and radially outward of the beveled edge 14g which surface 14b is also provided with a spiral thread 14h to enable the cigarette when telescoped internally of the sleeve structure to be in secure frictional engagement with the reverse tapered sleeve surface 14b.

To assemble the needle element 13 with the sleeve structure 14 it is necessary that the end of the shank which is to be frictionally engaged with the mouthpiece be initially telescoped into the sleeve passageway central opening 14a and then through the reduced sleeve passageway central opening defined by the stepped sleeve passageway internal shoulder surface 14f. After the end of the shank portion 13a has been moved axially through the sleeve structure 14 it is then in a position to be telescoped inside of the mouthpiece bushing 12b as previously described.

When the components of the structure 10 are in assembly together the diameter of the shank portion 13a as well as the shouldered area 13b is slightly smaller than the inside diameter of the passageway surfaces 14d and 14f thereby enabling a sliding fit between the needle element 13 and the sleeve structure 14.

To assemble a cigarette of either a filter tip type or a regular type with the tar removal cigarette holder structure 10 the cigarette 11 is placed in axial alignment with the sleeve socket afforded by the internal surface 14b of the sleeve 14, the butt end of the cigarette then being moved axially of the lead-in beveled edge 14g and then upon a twisting motion being applied relative to the sleeve 14 and the cigarette 11 they are twisted into assembly together. The reverse tapered sleeve surface 14b has a diameter slightly smaller than the outside diameter of the cigarette 11 so that the end of the cigarette telescoped within the passageway area 14a will snugly engage with the reverse tapered sleeve surface 14b in a manner whereby the outside periphery of the cigarette will be bulged and interlocked within the spiral thread 14h. After the downstream end of the cigarette 11 has been abutted against the sleeve surface 14c the sleeve 14 carrying the cigarette 11 may be moved relative to the mouthpiece 12 and the plunger or needle element 13 to cause the conical head 13c to be moved axially into the end of the cigarette telescoped within the sleeve structure 14. As a consequence of the needle head 13c being projected axially into the cigarette 11 the tobacco fibers or filter fibers 11a will be radially and axially compacted. The radial spacing between the shouldered head area 13c' and the area of the reverse tapered sleeve surface 14b disposed radially outwardly thereof is critical in the creation of the annular venturi orifice or passageway area 15. If the radial spacing between the shouldered sleeve head area 13c and the radially confronting reverse tapered area 14b is altered one of two things may occur. If the spacing is too great the tar removal rate will be decreased thereby reducing the effectiveness of the tar removal structure. On the other hand, if the spacing is too small, and the fibers are packed too compactly, the smoker may experience a

relatively hard draw when smoking the cigarette which would be very likely unsatisfactory to the smoker.

To remove the cigarette 11 from the sleeve structure 14 it is necessary to move the mouthpiece 12 and the sleeve structure 14 axially apart causing the enlarged needle head portion 13c to be substantially disengaged with respect to the cigarette 11 whereupon the cigarette may be readily twisted and disengaged from the sleeve structure 14.

By removing the paper of the cigarette and spreading the cigarette fibers the tar smear or stain will be clearly evident from an examination of the cigarette 11 in the manner shown in Figure 5.

According to the present invention, it will be appreciated that the sleeve structure 14 cooperates with the plunger or needle element 13 to compress the cigarette fibers 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 holder elements of the cigarette structure 10.

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 harmful tars, etc. In the structure of the present invention, this problem is overcome by providing a venturi orifice or passageway area which greatly increases the velocity of the smoke stream passing through the cigarette so that when the stream strikes the barrier comprised of a multiplicity of fibrous strands such as tobacco or cellulose fibers, the tar is lodged and collected upon these fibrous strands and the resulting purified smoke alters its course through the strands and passes onto the smoker through the downstream end of the mouthpiece 12. While there will be variations in the size of the orifice area, depending upon the character of the smoke, the density of the cigarette mass, etc., 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 are obtained where the orifice diameter is .028" to .032" (.0006 to .0008 sq. inch). As a preferred example, I have employed effectively an orifice area or orifice having a diameter of .030 (.0007 sq. inch), which gives excellent tar removal and ease of drawing and it is therefore desirable to attain this relationship by appropriate adjustment of the present holder.

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 area is effective in greatly increasing the 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 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.

After the smoker has ignited the cigarette 11 and sucked on the mouthpiece 12 smoke will be drawn through the venturi 15 and the smoke will then flow into the radial and axial plunger passages 13d and 13e as well as the mouthpiece passage 12a into the mouth of the smoker. The shouldered area 13b, which is also telescoped into

the cigarette also cooperates with the sleeve surfaces 14c and 14d in providing a smoke barrier insuring smoke flow through the passages as above described.

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 cigarette holder including a mouthpiece having a plunger extending therefrom, the plunger having an elongated shank with a conical forwardly pointed head portion on its forward end, said head portion having an annular shoulder projecting radially a predetermined distance beyond the diameter of the adjacent portion of the shank, a shoulder on the shank spaced rearwardly from said head shoulder and spaced substantially forwardly from the mouthpiece, the shank having a longitudinal passage with an opening between said shoulders and leading in smoke conveying relation to the mouthpiece, an elongated sleeve having a rear end internal shoulder providing a central opening in which the shank is slidably engaged, said sleeve providing a forward socket into which a cigarette butt end portion is engageable, the socket end portion of the sleeve being projectable beyond the plunger head when the sleeve is moved forwardly until the internal shoulder engages said rear shoulder on the shank, said head shoulder being of predetermined smaller diameter than the wall defining said socket so as to enable forcing of the conical head longitudinally into the butt end portion of a cigarette in the socket to thereby displace the tobacco in the butt end portion of the cigarette and compress the tobacco into a tubular mass of greatest density about said head shoulder but of slightly less density where the tubular mass of tobacco is permitted to expand toward said shank between said head shoulder and said rear shoulder, whereby smoke drawn through said dense mass about the head shoulder attains substantial velocity and impinges against the less dense mass rearwardly from the shoulder to thereby deposit tars on the less dense mass and then move on to and through said passage.

2. A holder as defined in claim 1, wherein the wall of the socket tapers toward a greater diameter rearwardly from the forward end of the socket to thereby increase the expansion area for the tubular mass of tobacco rearwardly from said head shoulder.

3. A holder as defined in claim 1, wherein the wall of said socket has means coactive with the butt end portion of the cigarette when said head is driven into said butt end portion to effect improved grip of the butt end portion of the cigarette.

4. A holder as defined in claim 1, wherein the wall of the socket tapers toward a smaller diameter from the rear to the forward end thereof so that the density of the tobacco about said head shoulder can be controlled by the depth to which the head is driven into the butt end portion of the cigarette along said socket.

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