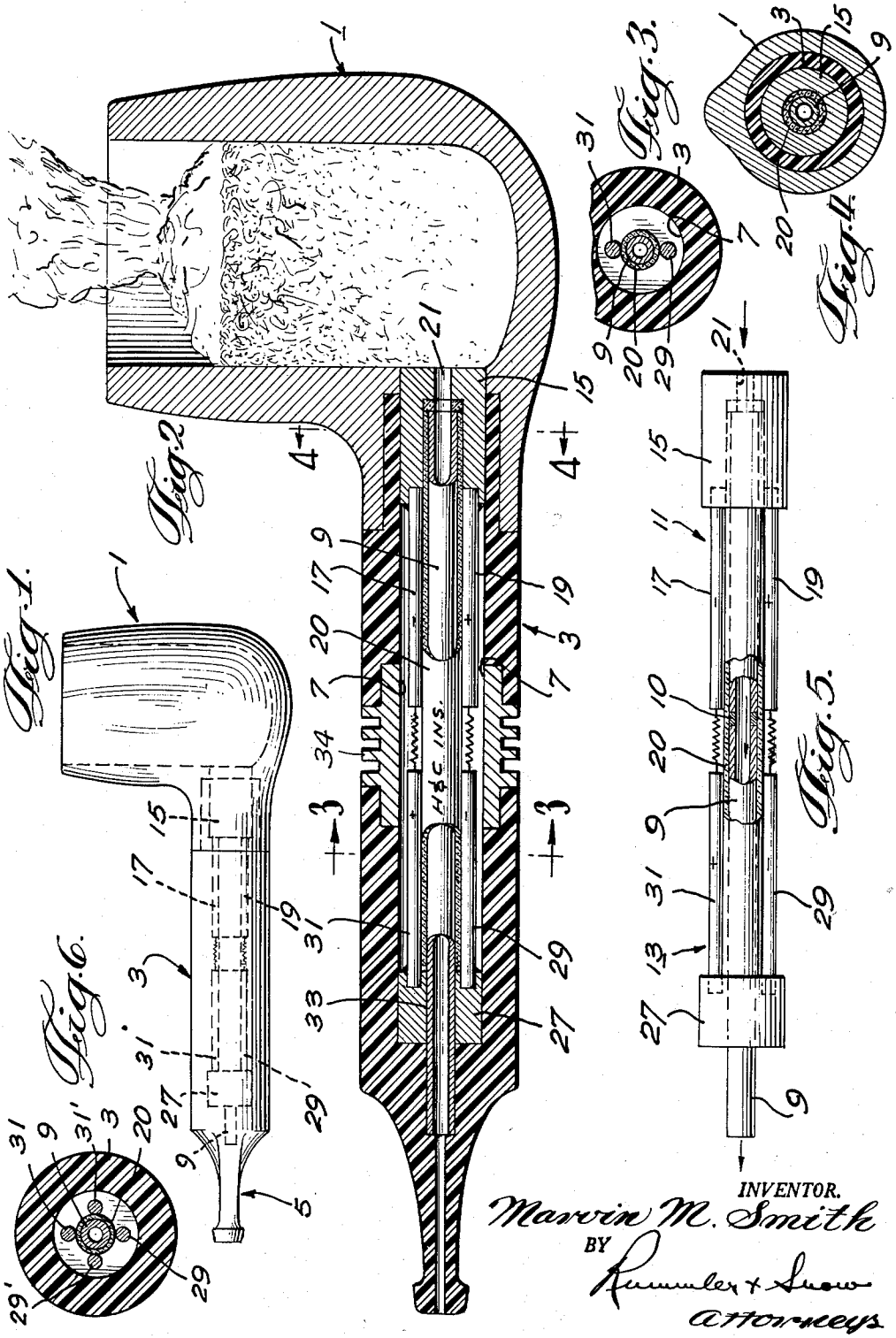
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INSTRUMENT FOR COOLING SMOKE

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INSTRUMENT FOR COOLING SMOKE

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This invention relates to an improved means for cooling smoke in a smoking instrument and to remove undesirable tars and other volatile materials from the smoke. More particularly, this invention relates to an improved pipe or the like which provides a new instrument utilizing the unique properties of thermoelectric semi-conductors to provide a Peltier refrigerating cell activated by a Seebeck generator activated by the heat from the burning tobacco, to cool the smoke passing through the stem to the mouthpiece.

Although the instant invention is applicable to a wider range of subject matters than to tobacco smoking instruments, the invention arose as a solution to the particular problems there posed. Recently much research and investigation has been undertaken in regard to an alleged correlation between heavy smoking and lung cancer. While the studies have revealed a high correlation between heavy smoking and lung cancer no causative relationship has yet been proven although the correlation is so high as to imply that one does exist. Among the factors believed to be more probably responsible for producing the carcinogenic effect are the volatile tars and other substances which are produced by the burning tobacco and transmitted in gaseous form to the lungs of the smoker where the volatile materials are condensed, leaving deposits on the lungs. These substances cumulatively have been shown to produce cancer in the lungs of other animals, notably rats.

In analyzing the transmission of these substances from the burning tobacco to the lungs of the smoker it is to be particularly noted that from the time the smoke leaves the burning tobacco until it enters into the mouth of the smoker it is not cooled sufficiently to condense the undesirable tars and substances from the smoke stream.

Therefore, it is a primary object of this invention to provide a smoking instrument which includes means for the condensation of the tars and other volatile or vaporized substances from the smoke stream prior to entering the mouth of the smoker.

It is a further object of this invention to provide a means for condensing undesirable tars and moisture from a smoke stream flowing through a smoking instrument which means may be practiced within the conventional length limitations of such devices and which may provide a temperature differential of significant magnitude to effect an improved effective condensation and tar removal beyond that which could normally be expected from conventional filter devices.

However, in order to create the necessary temperature differential, some refrigerating means is necessitated which can establish a temperature in the smoking instrument, adjacent the smoke stream, below that of the ambient temperature. Such refrigerating devices necessarily call for a source of energy to produce such heat absorption to accomplish such cooling.

To provide for the cooling effect, the present invention utilizes a Peltier refrigerating cell employing a pair of different thermoelectric semi-conductor materials which, when activated by electrical energy, produce a cooling effect. Such a Peltier cell can be constructed on a very miniature scale to fit the demands and limitations of the ordinary pipe or the like or, for that matter, laboratory equipment which may necessitate condensation of volatile materials from smoke.

However, the problem remains as to what source of

energy could be utilized to activate the Peltier refrigeration cell. Once again, the limitations imposed by the size of pipes, cigarette holders and laboratory equipment necessitate that such energy supplying means be limited severely in size and yet produce sufficient current to activate the Peltier cell to furnish the required cooling of the smoke stream. To solve this the instant invention teaches the use of a Seebeck generator which utilizes the heat from the burning tobacco to create an electrical current to activate the Peltier cell. While this is the preferred embodiment, since it is self energizing, this invention also recognizes that a small mercury cell battery could be used within the limitation imposed by the size of cigarette holders and pipes to furnish the required current to the Peltier cell.

Therefore it is a further object of this invention to provide a smoking instrument which includes a self energizing cooling unit; and more particularly, which employs a Seebeck generator actuated by the burning tobacco to provide current to a Peltier refrigeration cell to cool the smoke stream, before it reaches the smoker's mouth, and to perform the before mentioned changes of the physical properties of the volatiles and moisture carried by the smoke.

Other objects and advantages of the instant invention are to provide a particularly effective and inexpensive smoke cooling arrangement of elements within the limitations of space imposed by conventional smoking instruments; to provide the most effective materials for achieving condensation of tars from the smoke flow; to provide a durable, reliable instrument having no moving parts which obviates the possibility of breakdown and the necessity for repair.

Other objects and advantages of the instant invention will be apparent from following description and the specific embodiments of the invention shown in the accompanying drawings in which:

FIGURE 1 is a side elevational view of a pipe of conventional form utilizing the instant invention;

FIG. 2 is an enlarged central longitudinal view in section showing the improved smoke cooling and condensing unit embodied within a pipe having a radiator section in the pipe stem;

FIG. 3 is a partial cross-sectional view taken substantially on the plane of line 3—3 in FIGURE 2;

FIG. 4 is a cross-sectional view taken substantially on the plane of line 4—4 in FIGURE 2;

FIG. 5 is a side elevational view, with parts shown in section, of the condensation and cooling unit per se; and

FIG. 6 is a cross-sectional view, as taken substantially on the plane of lines 3—3 in FIGURE 2, showing a modified arrangement for the positive and negative legs of the cooling unit for increasing the operating capacity of the assembly.

Although the particular cooling and condensation unit embodying the means which are the subject of the instant invention is shown as applied to a pipe it is to be particularly noted that this unit can be applied to many analogous installations and situations, including use with certain laboratory types of equipment, without departing from the spirit of this invention.

As seen in FIGURE 1, the instant invention is particularly adapted for use with a conventional pipe including a wooden bowl which receives tobacco which is burned therein to provide smoke which normally flows through an appropriate bore formed within a plastic or hard rubber stem 3 when the smoker draws upon the mouthpiece 5 at the end of the stem 3.

As best seen in FIGURE 5 the smoke cooling and condensation means may be formed as a compact unit which

is fitted into the bore 7 from the smoke entering end of the stem 3 and which is appropriately secured therein.

Generally, the smoke cooling and condensation unit is comprised of a central elongated metallic smoke and condensation tube 9, made of an appropriate metal such as aluminum, through which all the smoke is confined to travel to the mouthpiece and around the smoke entering end of which is secured a Seebeck generator 11 which receives heat from the burning tobacco and converts it into electricity which activates a Peltier refrigerating cell 13 which surrounds the tube 9 adjacent the outlet end.

More particularly, the Seebeck generator 11 includes a metallic junction band 15 to which the ends of the negative leg 17 and the positive leg 19 are integrally secured so as to be thermally and electrically conductive. The junction band 15, as shown, is generally cylindrical and has a bore 21 extending axially therethrough. This bore is counterbored, for about three fourths the length of the cylinder, to a diameter sufficiently larger than the outside diameter of the condensation tube 9 to receive the end portions of tube 9 and an axially extending insulating sleeve 20, which surrounds the tube 9, therein. Preferably the bore of the tube 9 and the bore 21 of the cylinder 15 are of the same diameter and the end of the sleeve 20, adjacent the pipe bowl, extends beyond the end of the tube and is internally enlarged to the diameter of the tube bore to provide an unbroken surface for the passage through which smoke may be drawn from the bowl through the tube 9 to the mouthpiece 5.

The negative leg 17 and the positive leg 19 are substantially identical in length and are arranged around the periphery of the tube 9 in axially parallel relation therewith and with respect to each other and may be secured to the junction 15 by means of appropriate holes drilled in the junction and by brazing or other conventional means. These legs 17 and 19 are further insulated both electrically and thermally from tube 9 by means of the insulation sleeve 20 which extends lengthwise of the tube between the tube and the legs. The legs 17 and 19 should be appropriately located on the junction cylinder 15 so that each receives a substantially equal amount of heat therefrom. In the instant case, due to the length of the junction cylinder 15 as shown, the heat is diffused throughout the junction and the body of the junction serves to transmit substantially equal amounts of heat to the ends of the legs 17 and 19.

The negative leg 17 and the positive leg 19 may be made of any two different thermoelectric semi-conductor materials. Materials found suitable for this purpose are bismuth telluride for the negative leg 17 and lead telluride for the positive leg 19. It is to be emphasized, however, that any two different thermoelectric semi-conductor materials may be used.

The Peltier refrigeration cell 13 is actually the converse of the Seebeck generator. The Peltier refrigeration cell includes a junction body 27 which is shown as being generally annular in construction to fit within the bore 7 of the pipe stem. This junction 27 is of an electrically conductive metallic material, preferably aluminum, and is provided with appropriate bores for receiving negative leg 29 and positive leg 31 which are bonded therein in any conventional fashion. The negative leg 29 and the positive leg 31 may be identical with the negative leg 17 and the positive leg 19, respectively, but for practical purposes the semi-conductors in the Seebeck unit or cell 11 should be of a material able to withstand higher temperatures than the material in the semi-conductors of the Peltier cell 13. Further, these legs 29—31 are mounted in the same manner as the legs 17—19 and are insulated from the tube 9 by means of the insulating tube 20, which extends therebetween, as shown in FIGURE 2.

The central bore 33 of the annular connector body 27 receives the smoke tube 9 which is tightly fitted therein to provide efficient thermo-conductivity therebetween. As shown, the smoke tube 9 extends outwardly beyond the junction body 27 and into the mouthpiece to provide as much cooling and condensation surface as may be possible for the smoke traveling therethrough. Also, as indicated at 10 in FIGURE 5, the smoke tube 9 may be in two sections connected end to end by a suitable insulating material so that heat from the section at the hot end will not have a direct path to the cool end. It is to be noted that the annular body 27 and the metallic junction band 15 cooperate to provide a firm support within the pipe stem for the generator and cooling unit assembly.

When the negative leg 17 is connected to the positive leg 31 and the negative leg 29 is connected to the positive leg 19, the Seebeck and Peltier cells are then connected in electrical series providing a complete circuit for the flow of any current produced by the generator or Seebeck unit. The amount and voltage of current generated by the Seebeck unit, is, of course, determined by the heat applied to the junction band or cylinder 15 and by the mass of the negative and positive legs of semi-conductor material. Where the heat source is limited, as in the devices herein described and shown, the generating capacity of the Seebeck unit can be increased by employing additional negative and positive legs arranged as shown in FIGURE 6, wherein 29' and 31' indicate the added elements in a Peltier cell, the Seebeck and Peltier cells being of the same general form.

In operation the previously described smoking instrument operates as follows:

When the tobacco in the bowl 1 is substantially in the position shown in FIGURE 2 the burning of the top layer will provide hot smoke which is drawn through the remainder of the tobacco in the bowl, through the aluminum tube 9 and the mouthpiece 5, and into the mouth of the smoker. Due to the amount of tobacco initially in the bowl 1, the smoke will be somewhat cooled and filtered as it moves through this tobacco to demand only a minimal amount of cooling by the cooling and condensing unit. However, as the tobacco continues to burn downwardly in the bowl less and less tobacco will be present to filter and cool the smoke and hence the smoke traveling through tube 9 during this portion of the burning will be much hotter and will present a relatively great demand for cooling. To appropriately accommodate the different loads which will thus be placed upon the cooling and condensation unit, the metallic junction 15 is positioned adjacent the bottom interior of the bowl to provide a maximum exposure to the heat source. Thus the heat which is received by the metallic junction 15, whether by conduction, radiation or convection, is generaly proportional to the temperature of the smoke entering the tube 9 and hence the load of volatiles and tars in the smoke. In this manner the generating and cooling capacity of the assembly is substantially self-regulating according to demand.

Junction 15, because of its mass, serves to diffuse the heat received throughout its surface so that the negative leg 17 and the positive leg 19 are subjected to the same temperature. These different thermoelectric semi-conductor legs react to heat applied to the connected ends in an unknown manner to produce a current flow through any secondary conductive device connected across the opposite ends of the legs. In the device shown in FIGURE 5, this current flow is conducted to the legs of opposite polarity in the Peltier refrigerating cell 13 to stimulate this cell at its forward end, to produce a significant cooling effect at its rearward end where the legs 29 and 31 are connected by the junction element 27. This cooling of the junction body 27, which also acts as an electrical connector to complete the circuit through the Peltier and Seebeck cells, makes the body 27 act as a refrigerator which, because of its thermal contact with a relatively large area of the smoke tube 9, creates a significant temperature differential between the smoke en-

tering end of that tube and the rear end from which the smoke enters the user's mouth so that the smoke is cooled to a greater extent than is possible with ordinary smoking devices.

When the smoker initiates any drawing action on the mouthpiece 5 the tobacco is caused to burn more rapidly in the bowl causing more heat to be immediately received by junction band 15, both by radiation and convection, as well as by conduction through the bowl body, thereby increasing the electric current flowing to the Peltier cell to reduce the temperature of the junction body 27 and the adjacent area of the smoke tube 9. As the smoke passes through the cooled rear portion of the smoke tube, the smoke is not only cooled but also the volatile tars and other deleterious materials contained in the smoke are condensed out of the smoke and thus removed before the smoke enters into the smoker's mouth. Indeed, the combination effect is to produce a cooler smoke having less toxic materials likely to affect the health of the smoker. It will be understood that some heat is extracted from the smoke stream by the junction band 15. However, because the band 15 is also heated by radiation and convection, the major and most effective cooling of the smoke is done in the rearward portion of the tube 9 under the influence of the Peltier cell junction band 27.

The peculiar characteristics of thermoelectric semiconductors as used in the Peltier cell results in an absorption of heat at one end of the cell and a production of heat at the other end of the cell when the cell is traversed by an electric current. This is a widely known phenomena referred to as the "Thomson" effect. Therefore, cooling from the outside of the pipe is only necessary to remove the heat of the electrical resistance in the Peltier cell at the end thereof connected to the source of electrical energy to effect higher efficiency of its cooling function. Such cooling from the outside of the pipe may be enhanced by inserting a radiating section 34 in the pipe stem, adjacent the hot end of the Peltier cell, as shown in FIGURE 2. Further, since there are usually time lags or gaps between the smoke loads drawn by the smoker, the constant action of the Peltier refrigerating cell provides a cold sink or temperature drop in the portion of the smoke tube adjacent the junction band 27 ordinarily sufficient to accommodate the heavy loads when they do occur.

From the previous description it will be seen that an improved smoking instrument has been provided which produces a significant cooling of the smoke, sufficient to condense and remove the tars and other volatile materials therefrom and which may be practiced within the conventional length limitations of smoking instruments; which provides a temperature differential, between the entering smoke and the leaving smoke, of sufficient magnitude to effect an improved cooling of the smoke beyond that which could be normally expected from conventional filter and thermal radiation devices; which includes a self-energizing cooling unit; and more particularly which employs a Seebeck generator actuated by the burning tobaccos to provide current for activating a Peltier refrigeration cell to cool the smoke stream before it reaches the smoker's mouth.

Although but one embodiment of my invention has been herein shown and described it will be understood that details of the structure and arrangement shown may be altered without departing from the spirit of the invention as defined by the following claims.

I claim:

1. In a smoking instrument including means for holding tobacco for burning and a stem for conveying smoke from said holding means to a mouthpiece, the improvement comprising a metallic tube in said stem to convey said smoke therethrough, two pairs of thermo electric semi-conductor legs, each pair including a negative leg and a positive leg spaced from each other and from said tube, one of said pairs terminating adjacent the tobacco holding means and the other pair terminating adjacent the mouthpiece, a first metallic junction means on said holding means for conducting heat to the adjacent ends of each of said adjacent legs and connecting said ends electrically, the negative leg of each of said pairs being electrically connected serially with the positive leg of the other of said pairs, and an annular metallic junction electrically and thermally connecting the ends of the legs adjacent the mouthpiece, said tube extending through said annular junction and being in contact therewith.

2. In a smoking instrument including means for holding tobacco for burning and a stem extending from said holder to convey smoke to a mouthpiece, the improvement comprising a metallic tube in said stem through which said smoke is confined to travel, two longitudinally spaced pairs of thermo electric semi-conductor legs located in said stem, each of said pairs including a negative leg and a positive leg spaced from each other and from said tube, one of said pairs terminating adjacent the tobacco holding means and the other pair terminating adjacent the mouthpiece, a first metallic junction means abutting said holding means to conduct heat to the adjacent ends of said one pair of legs and providing an electrical connection therebetween, electrical junction means connecting the adjacent end of each negative leg to the adjacent end of the positive leg of the other pair of legs, a second metallic junction electrically and thermally connecting the ends of said other pair of legs adjacent the mouthpiece, and said tube extending through said second metallic junction in surface to surface contact therewith.

3. In a smoking instrument including means for holding tobacco for burning and a stem extending from said tobacco holding means to a mouthpiece for conveying smoke thereto, the improvement comprising a metallic tube in said stem to convey smoke therethrough, a Seebeck generator unit mounted within said stem adjacent said holding means, a Peltier refrigerating cell unit mounted within said stem adjacent said mouthpiece, said Seebeck generator including negative and positive thermoelectric semi-conductor legs spaced from each other and having a metallic heat conductor means extending into said holding means to be heated by the burning tobacco and thermally and electrically connect the ends of said Seebeck legs nearest said holding means, said Peltier refrigerating cell including negative and positive thermo electric semi-conductor legs spaced from the other and mounted within said stem adjacent said mouthpiece, and having a metallic junction mounted within said stem to thermally and electrically connect the ends of said Peltier legs nearest to said mouthpiece, and electrical leads connecting the free end of the negative thermo electric semiconductor leg of each unit to the adjacent free end of the positive thermo electric semi conductor leg of the opposite unit, said junction surrounding said metallic tube in surface to surface contact therewith.

4. In a smoking instrument including means for holding tobacco for burning and a stem extending from said holding means to convey smoke to a mouthpiece, the improvement comprising an aluminum tube in said stem to convey smoke therethrough, a first metallic junction band mounted on said holder to be heated by the burning tobacco therein, a first pair of elongated legs each of a different semi-conductor material embedded in said instrument and each having one end thermally connected to said first junction band and the other end extending toward said mouthpiece, a second pair of elongated legs of different semi-conductor materials connected in electrical series with said first legs and embedded in said stem between said mouthpiece and said first legs, and a second metallic junction band connecting the ends of said second pair of legs nearest said mouthpiece and engaging said tube in surface to surface contact.

5. The smoking instrument as described in claim 4, wherein the first metallic junction band is located adja-

cent that portion of the tobacco holding means toward which the burning of the tobacco progresses.

6. A smoking instrument comprising a holder for burning tobacco, a stem extending from said holder and terminating in a mouthpiece, a metallic smoke conducting tube in said stem extending between said holder and mouthpiece, a Peltier cell in said stem comprising a pair of legs of mutually different semi-conductor materials, said legs being connected at one end by a junction band of electrically and thermally conductive material, means for thermally connecting said junction band and said smoke tube, and means for electrically inciting said Peltier unit.

7. A smoking instrument comprising a holder for burning tobacco, a stem extending from said holder and terminating in a mouthpiece, a metallic smoke tube in said stem extending between said holder and mouthpiece, a Peltier cell in said stem comprising a pair of legs of different semi-conductor materials, said legs being connected at one end by a junction band of electrically and thermally conductive material, means for thermally connecting said junction band and said smoke tube, means for electrically inciting said Peltier unit, and means in said stem adjacent the ends of said legs opposite said junction band for radiating heat from said leg ends to the atmosphere surrounding said stem.

8. In a smoking instrument including means for holding tobacco for burning and a stem extending from said holding means to convey smoke to a mouthpiece, the improvement comprising an aluminum tube in said stem to convey smoke therethrough, a first metallic junction band supported by said holding means and disposed to be heated by the burning tobacco therein, a first pair of elongated legs each of a different semi-conductor material embedded in said instrument and each having one end thermally connected to said first junction band and the other end extending toward said mouthpiece, a second pair of elongated legs of different semi-conductor materials connected in electrical series with said first legs and embedded in said stem between said mouthpiece and said first legs, a second metallic junction band connecting the ends of said second pair of legs nearest said mouthpiece and engaging said tube in surface to surface contact, and means in said stem adjacent the serially connected ends of said first and second pairs of legs for radiating heat from said serially connected ends to the atmosphere surrounding said stem,

9. The smoking instrument as described in claim 8, wherein the first metallic junction band is located adjacent that portion of the tobacco holding means toward which the burning of the tobacco progresses.

10. Means for condensing volatiles from gaseous products of combustion comprising a conduit for said gaseous products leading away from a combustion means source thereof, a Peltier cell comprising a pair of legs of mutually different semi-conductor materials each having one end connected integrally with a junction band of electrically and thermally conductive material, a condensation zone in said conduit remote from said combustion means source, means for connecting said junction band and said conduit adjacent the condensation zone thereof and in thermally conductive relation therewith, and means for electrically inciting said Peltier unit.

11. Means for condensing volatiles from gaseous products of combustion comprising, a combustion means normally operating to produce gaseous combustion products at varying volumetric rates, a conduit for said gaseous products having a connection with said combustion means to receive and convey said gaseous products, a condensation zone portion in said conduit remote from said combustion means, electrically incited means in thermally conductive relation with the condensation zone portion of said conduit for cooling said condensation zone, the cooling effect of said means being proportional to the electrical incitation thereof, and means operatively controlled by said combustion means for varying the cooling effect of the last named means in direct relation with the rate of production of said gaseous products by said combustion means.

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