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H. S. BEARD
METHOD FOR MANUFACTURING JET IMPINGEMENT TYPE
FILTERS FOR SMOKING ARTICLES

3,778,328

Filed Aug. 13, 1971

2 Sheets-Sheet 1

FIG. 1

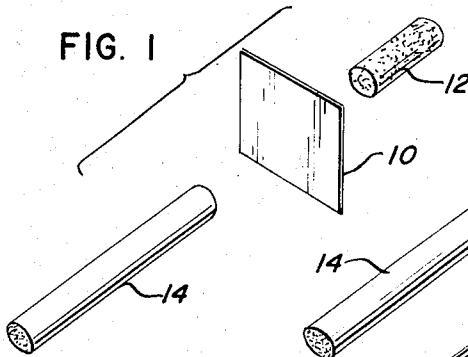


FIG. 2

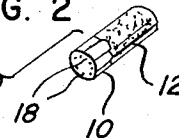


FIG. 3

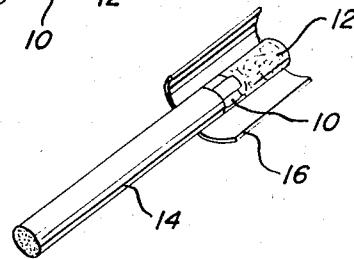


FIG. 9

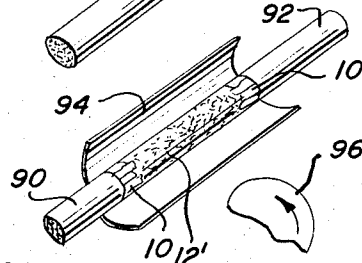


FIG. 6

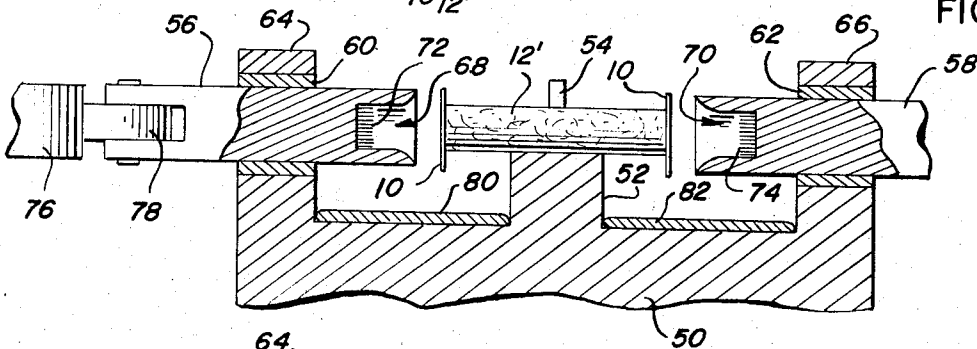


FIG. 7

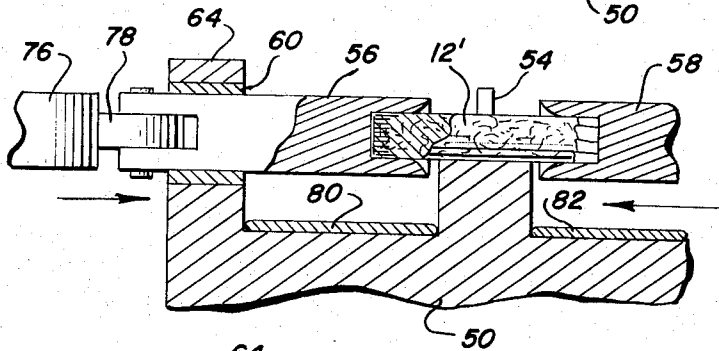
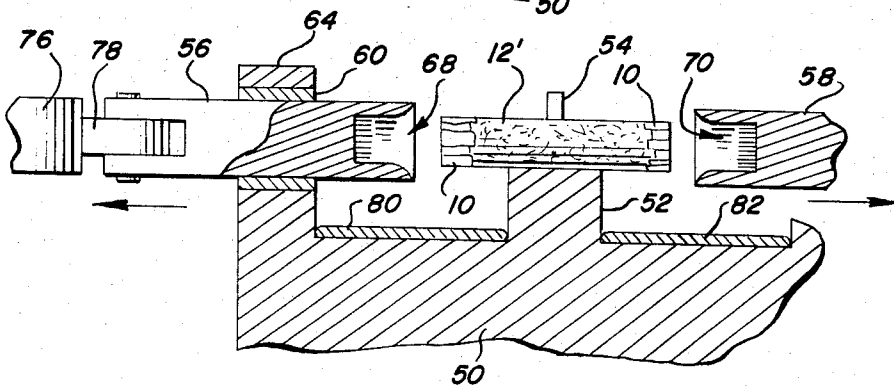


FIG. 8



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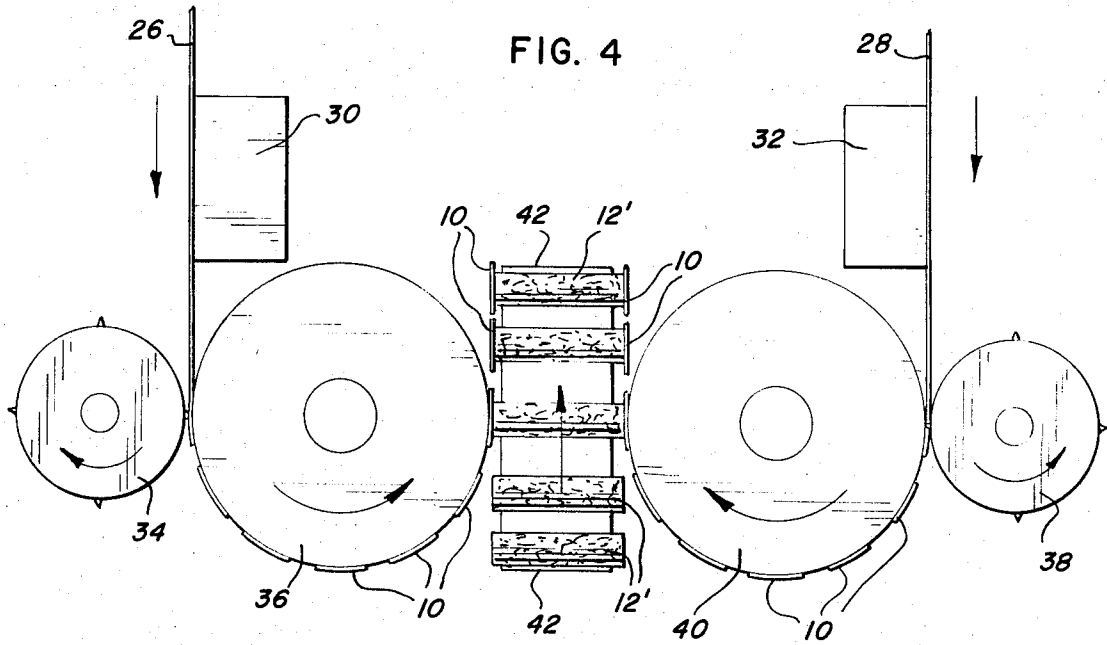
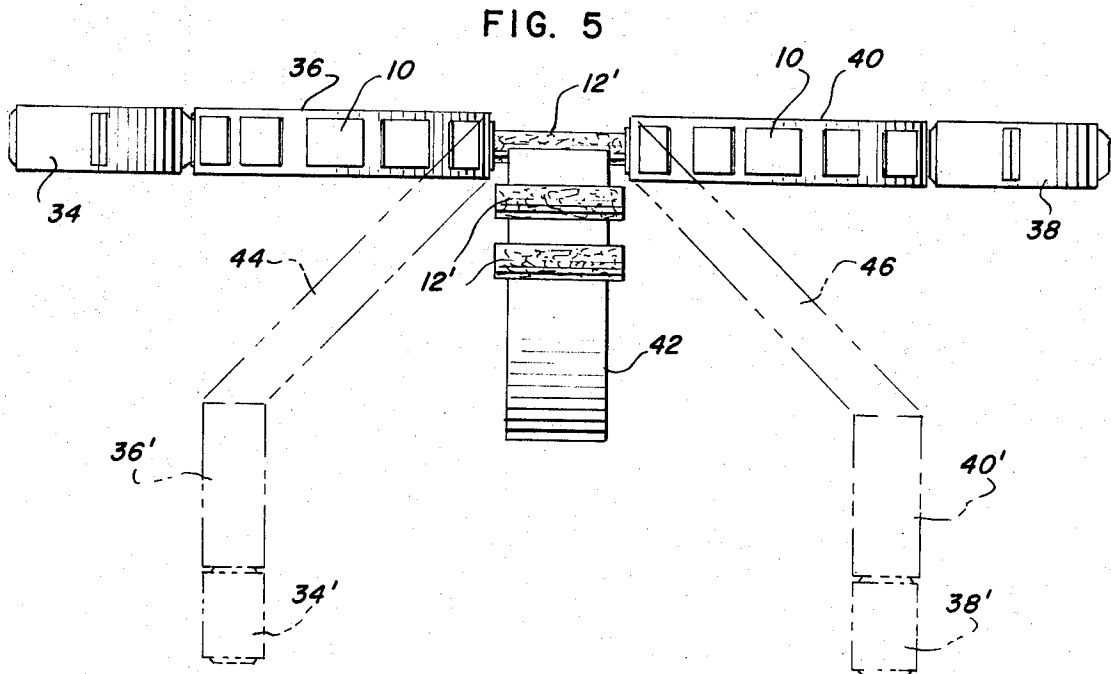
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2 Sheets-Sheet 2



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3,778,328

METHOD FOR MANUFACTURING JET IMPINGEMENT TYPE FILTERS FOR SMOKING ARTICLES

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U.S. Cl. 156—215

4 Claims

ABSTRACT OF THE DISCLOSURE

This improved process and apparatus for manufacturing jet impingement type filters for smoking articles utilizes a substantially air impervious sheet material and a rod of smoke pervious filter material. A tab of the sheet material is positioned over the end of the rod of filter material with peripheral areas of the tab extending radially outwardly from the longitudinal surface of the rod. The peripheral areas are folded over the end of the rod so as to form a cup-like enclosure or cap and are secured to the surface of the rod, preferably by a heat-activatable, pressure-sensitive adhesive which is precoated on the sheet material. Smoke passing perforations are provided in the sheet material and function, in the finished combination when smoked, as accelerating jets or orifices for the smoke which impinges on the pervious filter material.

The preferred apparatus for assembling the filter comprises a female die, means for successively aligning filter rods adjacent the opening therein with tabs of the sheet material therebetween and means for effecting relative reciprocal movement whereby the female die caps the tabs over the filter ends. The resulting filter plug is then disposed in gaseous communication with a smokable material such as a cigarette rod by, for example, an overwrap of conventional tipping paper.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an improved process and apparatus for the continuous, high speed manufacture of jet impingement type filter plugs. More specifically, it relates to a low cost and reliable method and apparatus which makes it practical to provide highly efficient jet impingement type filters wherein the smoke passes through a plurality of accelerating jets in a sheet material and impacts directly upon the surfaces of a superjacent porous filter medium.

While the present invention is described herein with particular reference to impingement filters for cigarettes employing porous plugs of cellulose acetate fibers as the impaction surfaces, it should be understood that the invention is not necessarily limited thereto. The method and apparatus can also be employed for preparing filter plugs for various smoking articles other than cigarettes and may utilize various other conventional and non-conventional porous filter media, as those skilled in the art will recognize in the light of the present disclosure.

Description of the prior art

One effective technique in the continued drive to lower the total particulate matter in the smoke of smoking articles such as cigarettes is the use of jet impingement devices, alone or, preferably, in combination with a porous filter medium. Prior art jet impingement filters have, however, suffered from a number of shortcomings which tend to inhibit their widespread utilization. Certain prior art devices, for example, are relatively complicated structurally. They involve the assembly of hard-to-handle items such as discs, pills, capsules or other structural elements which must be carefully oriented.

Some of the more complicated jet impingement type filters also require the development of new manufacturing methods and machinery and do not lend themselves to production on existing filter tip cigarette manufacturing apparatuses. As a consequence, otherwise satisfactory machines have to be discarded and substantial new capital investment incurred. The departure from proven manufacturing techniques is also accompanied by transition and shakedown periods, often accompanied by excessive downtime, uneconomic production rates, employee training complications, unreliability and quality control difficulties.

In addition to the above factors which are reflected in higher costs, certain prior art impingement type filters add unduly to the length of the filter section. This requires some sacrifice in the length of the tobacco rod to maintain a standard overall size. Employing a porous filter medium as the impaction surfaces and eliminating any intervening void space between the accelerating jets and the porous filter-medium minimizes the length problem and provides a desirable combination filter. But the continued demand for lower unit cost and the unsatisfactory solutions to manufacturing problems such as set forth above has continued to inhibit the widespread use of such combination impingement filters.

It is to the solution of these various problems that the method and apparatus of the present invention are addressed, as more fully set forth in the following objects.

OBJECTS OF THE INVENTION

It is therefore a general object of the present invention to provide an economically-feasible method and apparatus for producing smoking articles having jet impaction filters, which method and apparatus lend themselves to continuous, high speed production techniques. It is another general object to provide a low cost, reliable and simplified method and apparatus for producing jet impingement filters which employ a porous filter medium for the impaction surfaces as well as for conventional filtering. It is another general object to provide an improved method and apparatus for producing a combination jet impingement-porous medium filter which is free of longitudinal void spaces and requires substantially no more space than a simple porous medium filter plug.

It is a specific object to provide a highly efficient, simplified method and apparatus for producing combination impingement-porous medium filters, which involve no hard-to-handle components and utilize proven filter and cigarette making technology. It is another specific object to provide a high speed, continuous apparatus which can be "grafted" onto conventional filter tip cigarette assembly machinery without excessive capital investment.

It is another specific object to provide a method and apparatus for producing combination jet impingement-porous medium filter tip cigarettes without incurring the high investment associated with completely new machinery, and the time delays and other manufacturing problems associated with the design, construction, de-bugging and breaking-in thereof. It is still another specific object to provide a highly efficient, low cost and versatile method and apparatus for producing combination jet impingement-porous filter medium cigarette filters, which are competitive cost-wise with other methods and apparatuses.

These and other objects of the present invention will become apparent as the detailed description proceeds.

SUMMARY OF THE INVENTION

These objects are achieved in a particular embodiment by a simplified process and a low-cost apparatus for assembling a normally substantially air impervious sheet material and a rod of smoke pervious filter material. A plurality of smoke passing perforations is formed in the

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normally substantially air impervious sheet material to provide the desired accelerating jets or orifices. The sheet material is positioned over the end of the rod of smoke pervious filter material such as a conventional fibrous cellulose acetate filter rod with a peripheral portion of the sheet extending radially outwardly from the longitudinal surface of the rod.

The peripheral surface of the sheet material is then folded over the end of the rod so that with the central portion in direct contact with the end surface of the rod and the peripheral surface in contact with the side surface of the rod, a cup-like enclosure or cap on the end is formed. This cap is secured to the rod, preferably by means of a heat-activatable, pressure-sensitive adhesive coating on the sheet material. The resulting filter plug rod is then disposed in gaseous communication with a smokable material such as a cigarette rod. This is conveniently carried out by aligning the cigarette rod and filter plug rod end to end and securing and sealing the two together with conventional tipping paper.

A preferred apparatus for preparing the combination filter comprises a female die means which is disposed to receive successively the elongated rods of smoke pervious filter material internally, the latter acting as male die means. Tab feeding means successively feed tabs of the sheet material between the female die means and the aligned elongated rods. Means are also provided for effecting relative reciprocal movement between the elongated rods and the female die means whereby the sheet material is cupped or capped over the rod end and secured thereto. In the embodiment wherein a heat-activatable, pressure-sensitive adhesive is employed to secure the sheet material to the elongated rods, heating means, preferably in the form of electrical heaters, are provided to activate the adhesive.

In a preferred embodiment of the method and apparatus, a double size filter rod with jet impingement tabs cupped over each end is prepared, cigarette rods are secured to both ends, and the resulting dual cigarette transversely cut centrally to produce two substantially identical filter tip cigarettes. This preferred technique of initially producing a double cigarette filter permits the method and apparatus to be readily tied in with conventional filter tip manufacturing techniques which employ the dual or double cigarette approach.

As those skilled in the art will recognize, the filter, both before and after the double cupping operation, has substantially the same dimensions as an ordinary double porous filter rod without the impingement filtering feature. Thus the double filter rod can be detoured at an appropriate point from a conventional filter tip cigarette assembly machine into the cupping apparatus of the present invention and then returned to the conventional machine for completion of the assembly operation. In the completion phase, cigarette rods are aligned at each end of the double filter, wrappers of tipping paper having a heat-activated adhesive thereon are applied so as to span abutting ends of the filter and cigarette rods and the resulting double cigarette sliced into two substantially identical filter-tipped cigarettes. Assembly machinery for such purposes is disclosed, for example, in McArthur U.S. Pats. 3,420,243, 3,470,884 and 3,484,582.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention and detailed aspects thereof will be more clearly understood from the following description of particular method and apparatus embodiments for producing filter tip cigarettes, which should be read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of the three unassembled components of a filter tip cigarette which are assembled by the method and apparatus of the present invention;

FIG. 2 is a perspective view of the impingement type filter prepared by the method and apparatus of the present invention prior to assembly with a cigarette rod;

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FIG. 3 is a perspective view illustrating the final assembly of the impingement type filter and cigarette rod by means of an overwrap of tipping paper;

FIG. 4 is a diagrammatic plan view of a portion of the apparatus of the present invention and shows an intermediate step in the novel method of manufacturing the impingement type filter;

FIG. 5 is a diagrammatic elevation view corresponding to FIG. 4 with an alternative feeding arrangement illustrated in dashed lines;

FIGS. 6, 7 and 8 are diagrammatic views of another portion of the apparatus, partly in section, and show three successive stages in the filter cupping and jet perforation steps; and

FIG. 9 is a perspective view diagrammatically illustrating the tipping paper wrapping and double cigarette severing steps.

It should be understood that these drawings are not necessarily to scale and that graphic symbols and diagrammatic representations are employed in some instances. It should also be understood that details shown in some figures may be omitted in other figures to facilitate illustrations of still other details. Further, in some figures, mechanical details which do not relate to the essence of the present invention have been omitted for simplicity and economy of drawings. Thus, the drawings may depart in certain respects from appearance of actual physical embodiments. It should also be understood, of course, that the invention is not necessarily limited to the particular embodiments illustrated herein.

DETAILED DESCRIPTION OF THE DRAWINGS INCLUDING PREFERRED EMBODIMENTS

Referring to FIGS. 1, 2 and 3, the impingement filter prepared by the method and apparatus of the present invention comprises a tab 10 of normally substantially air impervious sheet material which is positioned over the end of a rod 12 of smoke pervious filter material and folded to form a cup or cap thereover. It is then oriented and combined with cigarette rod 14 by means of conventional tipping paper 16 which spans the abutting ends to form a complete cigarette. A plurality of smoke passing perforations 18 in tab 10 (FIG. 2) act as accelerating jets or orifices for the cigarette smoke which passes therethrough and impacts on the porous filter material of rod 12.

In the illustrated exemplar, sheet material 10 has a square configuration, the side dimension of which is sufficient whereby peripheral portions extend beyond the outer surface of filter rod 12 by about 2-4 millimeters or more. These peripheral portions are folded over the end of filter rod 12, as illustrated in FIG. 2, to form the cup-like enclosure or cap. The cap is secured and sealed to the outer surface of filter rod 12, preferably by an adhesive, e.g., a heat-activatable, pressure-sensitive adhesive such as one of the vinyl acetate acrylic copolymers. Similarly, the inner central portion of the cap is adhered directly to the rod end.

Sheet material 10 is manifestly not limited to a square configuration. It may be otherwise configured to meet the dictates of manufacturing convenience and cost considerations, so long as a central portion and peripheral area are provided to obtain the desired end cup or cap. Thus, for example, tab 10 may have a rectangular, circular or even irregular configuration.

The composition of sheet material 10 is not critical so long as it meets accepted standards for such a cigarette component. It may, for example, comprise conventional cigarette tipping paper. It may also be prepared from laminated papers, plastic films, aluminum foil, composite laminates of these materials, or the like.

The sheet material may also comprise high porosity paper so long as the porosity is not so great as to preclude sufficient pressure drop under normal smoking conditions to obtain the desired acceleration of the smoke as it

passes through the accelerating jets. It is in this sense that the term "normally substantially air impervious sheet material" is used herein to characterize the porosity exclusive of the accelerating jets or perforations. In a preferred embodiment, a highly plasticized paper having a thickness in the range of about .001 to .003 inch, e.g., .002 inch, is employed.

The number of smoke passing perforations 18 in tab 10 may typically range from about 10 to 30, preferably 15 to 25. The approximate diameter of the perforations or holes may range from about .005 to about .015 inch, fewer perforations being required when a larger diameter is employed and a greater number of perforations when a smaller diameter is employed. Sufficient perforations of a given size must, of course, be present so that the draw or pressure drop across the sheet material is not excessive.

The perforations may be formed by forcing the sheet material against a plurality of needles set in the bottom of the cupping device as hereinafter described. Other conventional techniques may also be employed at any convenient step in the process to obtain the perforations, e.g., the use of a continuous punching wheel, flame burning, spark perforation, or the like. The hole pattern may vary, although it is preferred that the perforations be reasonably evenly distributed over a substantial portion of the center of the paper which registers and is in contact with the end of the filter rod. Thus, for example, the pattern may be circular, as depicted in FIG. 2, or may be configured as concentric circles, a spiral, or any other well distributed pattern.

The porous filter rod 12 may be of conventional design, i.e., a low draft filter plug of fibrous material such as cellulose acetate yarn, a particular form being marketed under the trademark "Estron." Such filters have substantially the same diameter as the cigarette rod and conventionally have a length of approximately 20 millimeters.

The cigarette rod 14 may be of any conventional design, i.e., a cylindrical rod of tobacco encased in either standard porosity or high porosity cigarette paper which may optionally have a plurality of air dilution perforations therein. The particular cigarette rod 14 per se and the particular filter rod per se are not essential parts of the invention other than being necessary components employed in the practice of the process and operation of the apparatus. Thus, since they are within the skill of the art, they need not be described in further detail.

Referring to FIGS. 4 and 5, which illustrate an embodiment of the method and apparatus for positioning the tabs of sheet material 10 over the ends of filter rods, the sheet material is supplied in the form of elongated strips 26 and 28 from supply rolls (not shown). The outward facing surfaces of elongated strips 26 and 28 as viewed in FIGS. 4 and 5 are coated with a suitable heat-activatable, pressure-sensitive bonding material. The adhesive bonding material is activated by heaters 30 and 32 to render the adhesive tacky. In the case of the aforementioned vinyl acetate acrylic polymers, an adhesive temperature in the range of about 150 to 200° F. is usually adequate.

Heated and tacky strip 26 then passes between knife drum 34 and ledger drum 36 wherein the elongated strip is cut or otherwise severed into individual tabs 10. Similarly, heated and tacky elongated strip 28 passes between knife drum 38 and ledger drum 40 to be cut into matching tabs 10. The peripheral speed of ledger drum 36 and 40 exceed that of knife drums 34 and 38, respectively, whereby tabs 10, which are vacuum carried on the respective ledger drums, are separated by a finite space, e.g., about 1/4 inch. Ledger drums 36 and 40 may optionally be heated to maintain the tackiness of the adhesive coating on the tabs.

The rotational speed of ledger drums 36 and 40 is coordinated with that of filter rod tabbing drum 42 whereby tacky tabs 10 register with and are pressed against the ends of filter rods 12' as they come together. The filter

rods are designated 12' in FIGS. 4-9 because they are double length, e.g., about 40 millimeters, and are to be distinguished from the single length filter rods 12 of FIGS. 1-3.

As aforementioned, tabs 10 are held on ledger drums 36 and 40 by conventional vacuum means (not shown), the vacuum being released as the transfer of the tabs to the filter rods occurs. Filter rods 12' are carried on drum 42 by conventional pocket carrying means (not shown).

Shown in dotted lines in FIG. 5 is a variation which permits the knife drums 34' and 38' and ledger drums 36' and 40' to rotate in a plane disposed at 90° to that shown in solid lines. In this alternate embodiment, 45° transfer drums 44 and 46 vacuum carry the respective tabs from ledger drums 36' and 40', respectively, sticking them directly on the ends of the filter rods 12', as in the embodiment depicted in solid lines.

Referring to FIG. 6, the filter rods 12' with unfolded tabs 10 adhered centrally to the ends thereof are then transferred from tabbing drum 42 (FIGS. 4 and 5) to rotating circular cupping drum 50 where they are held in a pocket on upstanding center portion 52 by rail 54 or by vacuum means (not shown) or by other known conventional means. Each of a plurality of the pocket positions on cupping drum 50 is accompanied by twin plungers 56 and 58 which slide in bearings 60 and 62 on outlying rim portions 64 and 66 of drum 50.

Plungers 56 and 58 have shaped apertures 68 and 70 therein with beveled lips which function during the folding operation as female die means in conjunction with the filter rods as the male die. A series of piercing needles 72 and 74 having axes parallel to that of the corresponding rod 12' in the pocket of drum 50 are located at the bottom of apertures 68 and 70. They function to perforate central portions of tabs 10 as the tabs are folded.

As drum 50 rotates, cam 76 and cam follower 78 and opposed cam and cam follower (not shown) on the opposite side cause plungers 56 and 58 to move inwardly, as shown in FIG. 7, whereby the tabs are folded over the respective ends of filter rods 12'. Simultaneously, filter rods 12' also act as punch pads for the hole-piercing needles 72 and 74. The tacky adhesive on the surface of tabs 10 assures that the folded ears of the tabs stay in place after the plunger is retracted, as shown in FIG. 8. Supplemental heating in the form of electric heater bands 80 and 82 may optionally be added to insure the tackiness of the adhesive.

The completed cupped filter rod is then transferred to conventional apparatus for forming filter tip cigarettes. This is schematically illustrated in FIG. 9 wherein tobacco rods 90 and 92 are aligned with the cupped filter rod 12' and tipping paper 94 wrapped therearound so as to span the abutting ends. The resulting double cigarette is then severed by knife blade or saw 96 to form two substantially identical filter tip cigarettes.

The formation of the cigarettes in conventional apparatus is facilitated by the fact that the jet impingement filter does not significantly lengthen the conventional porous Estron filter. Thus the cupped filter prepared by the method and apparatus of the present invention can be assembled into a complete cigarette in conventional cigarette assembly machinery without significant changes therein.

From the above description it is apparent that the objects of the present invention have been achieved. While only certain embodiments have been set forth, alternative embodiments and various modifications will be apparent from the above description to those skilled in the art. These and other alternatives are considered equivalents and within the spirit and scope of the present invention.

Having described the invention, what is claimed is:

1. A process of preparing a filter plug for a smoking article for a normally substantially air-impervious sheet

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material and a rod of smoke pervious non-tobacco filter material, which process comprises:

- (a) providing said sheet material with an adhesive coating thereon;
 - (b) positioning said sheet material over the end of said rod so as to adhere a central portion of said sheet material to the end of said rod, a peripheral area of said sheet material extending radially outwardly from the longitudinal surface of said rod;
 - (c) positioning said rod with a central portion of said sheet material adhered to the end thereof adjacent, and in alignment with, the restricted opening of a female die means and forcing said sheet material into said restricted opening using said rod as a male die so as to fold said peripheral area over said longitudinal surface and form a cup-like enclosure over said end;
 - (d) during the formation of the cup-like enclosure, simultaneously forming a plurality of smoke-passing perforations in said central portion of said sheet material by forcing at least a portion of said sheet material against a plurality of hole-piercing needles located within said female die means employing the end of said rod of smoke pervious filter material as a punch pad; and
 - (e) securing at least a portion of said peripheral area to said surface by means of said adhesive coating.
2. The process of claim 1 wherein said adhesive coating is a heat-activatable, pressure-sensitive adhesive coating and including the step of heating said coating whereby to adhere said central portion of said sheet material to the

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end of said rod when said sheet material is positioned thereover and to adhere to least a portion of said peripheral area to said surface when said peripheral area is folded thereover.

3. The process of claim 1 wherein said sheet material is supplied in elongated form and including the step of successively cutting tabs of sheet material therefrom of sufficient size for carrying out the steps of said process on a repeated basis.

4. The process of claim 1 wherein steps (a), (b), (c), (d) and (e) are carried out in connection with both ends of said rod and including the additional step of transversely severing the resulting filter plug rod substantially in the center to form two substantially identical filter plugs.

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U.S. Cl. X.R.

93—1 C; 131—94; 156—212, 221, 250, 253, 256, 309