Filter element incorporating a breakable capsule, method of manufacturing a cigarette having a filter element incorporating a breakable capsule and apparatus for manufacturing the cigarette having a filter element incorporating a breakable capsule

The present invention is directed to a filter, comprising a tow material comprising at least one cavity, wherein the at least one cavity holds at least one capsule, wherein a shape of the at least one cavity comprised in the tow material is complementary to an outer shape of the at least one capsule, and wherein the tow material comprises at least two segments of tow material surrounding the at least one capsule, and filter paper placed on an outer surface of the tow material such that the filter paper is capable of holding together the at least two segments of the tow material and the at least one capsule.

**FIG. 3**
FIELD OF THE INVENTION

The present invention relates to smoking articles having a filter, and in particular, to a filter element, a cigarette comprising the filter element, a method for manufacturing the cigarette, an apparatus for manufacturing the filter element and an apparatus for manufacturing the cigarette element.

BACKGROUND OF THE INVENTION

Popular smoking articles, such as cigarettes, have a substantially cylindrical rod shaped structure and include a charge, roll or column of smokable material such as shredded tobacco that may be in cut filler form surrounded by a paper wrapper thereby forming a so-called "smokable rod" or "tobacco rod." Normally, a cigarette has a cylindrical filter element aligned in an end-to-end relationship with the tobacco rod. Typically, a filter element comprises a cellulose acetate tow plasticized using triacetin, and the tow is circumscibed by a paper material known as "plug wrap." A cigarette can incorporate a filter element having multiple segments, and one of those segments may comprise activated charcoal particles. Typically, the filter element is attached to one end of the tobacco rod using a circumscibing wrapping material known as "tipping paper." The tipping material and plug wrap, may be perforated in order to provide for the dilution of drawn mainstream smoke with ambient air. Descriptions of cigarettes and the various components thereof are set forth in Tobacco Production, Chemistry and Technology, Davis et al. (Eds.) (1999). A cigarette is employed by a smoker by lighting one end thereof and burning the tobacco rod. The smoker then receives mainstream smoke into his/her mouth by drawing on the filter end of the cigarette.

The sensory attributes of cigarette smoke can be enhanced by applying additives to tobacco and/or by otherwise incorporating flavoring materials into the various components of a cigarette, as it is described in detail in Leffingwell et al., Tobacco Flavoring for Smoking Products, R.J. Reynolds Tobacco Company (1972). For example, one type of tobacco flavoring additive is menthol, as described in detail in Borschke, Rec. Adv. Tob. Sci., 19, p. 47-70, (1993). Various proposed methods for modifying the sensory attributes of cigarettes have involved the suggestion that filter elements may be used as vehicles for adding flavor to the mainstream smoke of those cigarettes. U.S. Patent Publication No. 2002/0166563, to Jupe et al., proposes the placement of adsorbent and flavor-releasing materials in a cigarette filter. U.S. Patent Publication No. 2002/0020420, to Xue et al., proposes the placement of fibers containing small particle size adsorbents/absorbents in the filter. U.S. Patents No. 4,941,486, to Dube et al., and No. 4,862,905 to Green, Jr. et al., propose the placement of a flavor-containing pellet in a cigarette filter. Other types of cigarette filters incorporating flavoring agents are described in U.S. Patents No. 3,972,335, to Tiggelbeck et al., 4,082,098 to Owens, Jr., 4,729,391 to Woods et al., and 5,012,829 to Thesing et al.

Cigarettes having adjustable filter elements that allow smokers to select the level of flavor that is available for transfer into mainstream smoke have also been proposed, as described for example in U.S. Patents No. 4,677,995, to Kallianos et al., and 4,848,375, to Patron et al. Some proposed cigarettes may be manipulated, reportedly for the purpose of providing components of their filter elements with the propensity to modify the nature or character of mainstream smoke. Such cigarettes are described by U.S. Pat. Nos. 3,297,038, to Homburger, 3,339,557, to Karalus, 3,420,242, to Boukar, 3,508,558, to Seyburn, 3,513,859, to Carty, 3,596,665, to Kindgard, 3,669,128, to Cohen, and 4,126,141, to Grossman. Some proposed cigarettes have capsules positioned in their filter elements, and the contents of those capsules reportedly are released into the filter elements upon rupture of those capsules in the attempt to alter the nature or character of the mainstream smoke passing through those filter elements. Such cigarettes are described in U.S. Patent Nos. 3,339,558, to Waterbury, 3,366,121, to Carty, 3,390,686, to Irby, Jr. et al., 3,428,049, to Leake, 3,547,130, to Harlow et al., 3,575,1809, to Carty, 3,602,231, to Dock, 3,625,228, to Dock, 3,635,226, to Horsewell et al., 3,685,521, to Dock, 3,916,914, to Brooks et al., 3,991,773, to Walker, and 4,889,144, to Tateno et al. PCT Patent Publication No. WO 03/009711, to Kim, proposes a filtered cigarette having at least one capsule containing aromatic material disposed in the filter section of that cigarette. The application of pressure to the capsule reportedly causes the capsule to burst and discharge aromatic material into the filter so as to change the taste of the tobacco experienced during the course of smoking. Some proposed cigarettes have capsules positioned in their filter elements, and the contents of those capsules reportedly are released into the filter elements upon rupture of the capsule in order to deodorize the filter element after the cigarette is extinguished, as described by U.S. Patent Publication No. 2003/0098033, to MacAdam et al.

Cigarettes also included a filter possessing a cylindrical plastic container containing water or a liquid flavor solution. Such cigarettes are described in U.S. Patents Nos. 4,865,056, to Tamaoki et al. and 5,331,981, to Tamaoki et al. The cylindrical casing within the filter reportedly may be deformed upon the application of an external force, and a thin wall portion of the casing is consequently broken so as to permit the release of the liquid within the casing into an adjacent portion of the filter.
a different flavor, depending upon the smoker's immediate desire. The flavor of such a cigarette might be selected based on the smoker's desire for a particular flavor at that time, or a desire to change flavor during the smoking experience. For example, changing flavor during the smoking experience may enable a smoker to end the cigarette with a breath refreshing flavor, such as menthol flavor. Accordingly, it is desirable to provide a cigarette that is capable of providing different sensory experiences at the discretion of a smoker.

Some smokers may also desire a cigarette that is capable of selectively releasing a deodorizing agent upon completion of a smoking experience. Such agents may be used to ensure that the remaining portion of a smoked cigarette yields a pleasant aroma after the smoker has finished smoking that cigarette. Accordingly, it is desirable to provide a cigarette that is capable of releasing a deodorizing agent, particularly at the discretion of the smoker.

Some smokers may desire a cigarette that is capable of selectively moistening, cooling, or otherwise modifying the nature or character of the mainstream smoke generated by that cigarette. Because certain agents that can be used to interact with smoke are volatile and have the property to evaporate over time, the effects of those agents upon the behavior of those cigarettes may require the introduction of those agents near the commencement of the smoking experience. Accordingly, it is desirable to provide a cigarette that is capable of selectively moistening, smoothing or cooling the smoke delivered to a smoker at the discretion of that smoker.

In summary, it is desirable to provide smokers with the ability to modify their smoking experience. That is, it is desirable to provide a cigarette that can selectively provide a manner or method for altering, in a controlled way, the nature or character of the mainstream smoke produced by that cigarette. In particular, it is desirable to provide a cigarette that is capable of releasing an agent for modifying the sensory attributes of the mainstream smoke (e.g., by flavoring that smoke).

In the art, various methods are known for manufacturing cigarettes with capsules inserted in the filter, such as providing two cigarettes with a two-up filter rod having open cavities at each end, and inserting the capsules into each of the respective cavities located at each end of the filter rod. The tobacco rods are axially aligned at each respective end of the two-up filter rod such that the ends exposing the cavities of the filter rod abut the ends of each respective tobacco rod. Next, the tobacco rods are attached to the two-up filter rod using tipping material that circumscribes the outer periphery of the filter rod and adjacent regions of the tobacco rods. Thereafter, the two-up filter rod is cut in half along cut lines to produce two individual filtered cigarettes, with each cigarette possessing a breakable capsule in its filter. The cigarettes so produced have the general format and configuration described previously. The manner of inserting the capsule into the cavity can vary. The capsule can be dropped into the cavity, inserted or pushed into the cavity using a plunger-type of device, injected into the cavity as assisted by the flow of air.

The production of filter rods, filter rod segments and filter elements, and the manufacture of cigarettes from those filter rods, filter rod segments and filter elements, can be carried out using the types of equipment that has been employed to provide cigarette filters, multi-segment cigarette filters and filtered cigarettes. The multi-segment cigarette filter rods can be manufactured using a cigarette filter rod making device available under the brand name Multi from Hauni-Werke Korber & Co. KG. Six-up rods, four-up filter rods and two-up rods that are conventionally used for the manufacture of filtered cigarettes can be handled using conventional-type or suitably modified cigarette rod handling devices, such as tipping devices available as Lab MAX, MAX, MAX S or MAX 80 from Hauni-Werke Korber & Co. KG. Such devices set are described in U.S. Patent Nos. 3,308,600, to Erdmann et al., 4,281,670, to Heitmann et al., 4,280,187, to Reuland et al., 4,280,187, to Reuland et al., and 6,229,115, to Vos et al.

To summarize, the known technologies available for encapsulating the capsule in the cigarette filter consist either of putting the capsule in the filter tow flow before the tow is shaped as a filter rod and converted from the filter paper, or putting the capsule in a gap between two filter pieces and wrapping around with the filter paper. Each of these methods of manufacture suffers from significant drawbacks such as the process of manufacture involves close checking control in the filter making machine, the capsule is movable in the compartment between the two filter parts that could lead to unwanted crush of the capsule and its liquid content may impregnate the tipping paper and contaminate the fingers of the consumer. In the art this problem is attempted to be solved by using special coated filter paper, that is expensive.

Further, irrespective of which method is selected for the fabrication of the cigarette with flavored capsule inserted in the filter, the manufacturing apparatus for the applicable filters has to be a dedicated manufacturing apparatus that may not be easily converted to manufacturing normal cigarette filters, should additional manufacturing capacities be needed for the cigarettes without capsules inserted in the filters.

Therefore, it would be highly desirable to provide a filter element, a cigarette comprising the filter element, a method for manufacturing the filter element, a method for manufacturing the cigarette, an apparatus for manufacturing the filter element and an apparatus for manufacturing the cigarette element that provide smokers with the ability to modify their smoking experience, and that do not exhibit any of the disadvantages mentioned above.

SUMMARY OF THE INVENTION

The present invention is directed to a filter com-
prising a tow material comprising at least one cavity, wherein the at least one cavity holds at least one capsule, wherein a shape of the at least one cavity comprised in the tow material is the same as an outer shape of the at least one capsule, and wherein the tow material comprises at least two segments of tow material surrounding the at least one capsule, and filter paper placed on an outer surface of the tow material such that the filter paper is capable of holding together the at least two segments of the tow material and the at least one capsule.

The present invention is also directed to a method of manufacturing a filter comprising providing for at least one filter tip comprising tow material, cutting at least two half cavities at two ends of said at least one filter tip, cutting the filter tip at a conveniently elected position to form at least two filter tip parts, providing a capsule between the at least two half cavities made to face each other, joining together the at least two half cavities to form a closed cavity so that the capsule is entrapped within the formed cavity, and wrapping the at least two filter tip parts in filter paper, so that the two filter tip parts are securely joined together.

The present invention is further directed to an apparatus for manufacturing a filter, comprising means for providing at least one filter tip comprising tow material, means for carving at least two half cavities at two ends of the at least one filter tip, means for cutting the filter tip at a conveniently elected position to form at least two filter tip parts, providing said cut filter tip parts so that the at least two half cavities are facing each other, means for providing a capsule between the at least two half cavities facing each other, means for joining the at least two half cavities to form a closed cavity so that the capsule is entrapped within the formed cavity, and means for wrapping the at least two filter tip parts in filter paper, so that the two filter tip parts are securely joined together.

In accordance with embodiments of the present invention, the inner diameter of the at least one cavity is larger than the diameter of the at least one capsule. A difference between the inner diameter of the at least one cavity and the diameter of the at least one capsule is in the range of 0.5 mm to 1 mm.

The filter of the present invention is part of a cigarette or is part of a smoking article. The filter has an outer cylindrical shape connected to a tobacco rod, the filter having an end proximal to the tobacco rod and an end distal from the tobacco rod.

The methods and the apparatus of the present invention comprise means for providing the cut filter tip parts such that the at least two half cavities are facing each other, the means rotating the cut filter tip parts 180 degrees around an axis parallel with the direction of cutting the at least one filter tip, such that the at least two half cavities are facing each other.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and are not restrictive of the invention as claimed. The accompanying drawings, which constitute a part of this specification, illustrate certain embodiments of the invention and, together with the detailed description, serve to explain the principles of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to assist the understanding of embodiments of the invention, reference will now be made to the appended drawings, in which like reference numerals refer to like elements. The drawings are exemplary only, and should not be construed as limiting the invention.

Fig. 1 is an exploded perspective view of a smoking article having the form of a cigarette;

Fig. 2 is a perspective view of the filtered cigarette;

Fig. 3 is a perspective view of the filtered cigarette, in accordance with the present invention.

Fig. 4 is a schematic representation of the steps involved by the method of manufacturing a filter in accordance with the method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, Fig. 1 shows a smoking article 100 possessing representative components of a smoking article. The cigarette 100 includes a generally cylindrical rod 102 made of a charge or roll of smokable filler material 104 contained in a circumscribing wrapping material 106. The rod 102 is conventionally referred to as a "tobacco rod." The ends of the tobacco rod are opened to expose the smokable filler material. At one end of the tobacco rod 102 is the lighting end 108, and at the other end is positioned a filter element 110. The cigarette 100 is shown as having one optional printed band 112 on printed wrapping material 106, and that band circumscribes the cigarette rod in a direction transverse to the longitudinal axis of the cigarette. That is, the band provides a cross-directional region relative to the longitudinal axis of the cigarette. The band can be printed on the inner surface of the wrapping material (i.e., facing the smokable filler material) or on the outer surface of the wrapping material. Although the cigarette can possess a wrapping material having one optional band, the cigarette also can possess wrapping material having further optional spaced bands numbering two, three, or more.

The wrapping material of the tobacco rod 106 can have a wide range of compositions and properties. The selection of a particular wrapping material will be readily apparent to those skilled in the art of cigarette design and manufacture. Tobacco rods can have one layer of wrapping material, or more than one layer of circumscribing wrapping material, such as is the case for the so-called "double wrap" tobacco rods. Exemplary

The cigarette 100 includes a filter element 110 positioned adjacent to one end of the tobacco rod 102 such that the filter element and tobacco rod are axially aligned in an end-to-end relationship, preferably abutting one another. Filter element 110 may have a generally cylindrical shape, and the diameter thereof may be essentially equal to the diameter of the tobacco rod. The ends of the filter element permit the passage of air and smoke therethrough. The filter element 110 includes filter material 114 (e.g., plasticized cellulose acetate tow) that is over-wrapped along the longitudinally extending surface thereof with circumscribing plug wrap material 116. The filter element 110 may possess a cavity (not shown) into which at least one capsule (not shown) is positioned. The filter element 110 can have two or more filter segments (not shown), and/or flavor additives incorporated therein. Further details regarding the filter element itself, segments thereof (not shown), the production and shape of a cavity (not shown) therein, and capsules (not shown) that are positioned within the cavity, are provided hereinafter.

The filter element 110 can be attached to the tobacco rod 102 by tipping material 118, which circumcribes both the entire length of the filter element and an adjacent region of the tobacco rod 102. The inner surface of the tipping material 118 is fixedly secured to the outer surface of the plug wrap 116 and the outer surface of the wrapping material 106 of the tobacco rod, using a suitable adhesive; and hence, the filter element and the tobacco rod are connected to one another. A ventilated or air diluted smoking article can be provided with an optional air dilution means, such as a series of perforations 120, each of which extend through the tipping material and plug wrap (e.g., pre-perforated tipping material and porous plug wrap can be employed, or the filter element can be provided with a circumscribing ring of laser perforations).

A conventional tobacco rod 102, the filter element 110 and the cigarette 100 resulting from the combination thereof described can be manufactured using various types of conventional cigarette and cigarette component manufacturing techniques and equipment. Such techniques and equipment are described in U.S. Patent Nos. 10/324,836, filed Dec. 20, 2002 and 10/440,290, filed May 16, 2003. The manners and methods suitable for the commercial production of cigarettes of the present invention using the tobacco rods, filter elements, and other components described herein will be readily apparent to those skilled in the art of cigarette manufacture.

The outer portion of the filter element is constructed of material and in a manner such that the outer portion is generally permeable to drawn mainstream smoke. The outer portion can be constructed of a material suitable for use as a cigarette filter material, such as a suitable tow material. For example, the filter material can be provided by suitably plasticized cellulose acetate tow, polypropylene tow, or the like. Other suitable materials for construction of the outer portion of the filter element are readily apparent to those skilled in the art of cigarette filter design and manufacture. Additional information regarding the methods and apparatus for manufacturing the representative types of suitable filter elements are set forth in U.S. Patent Nos. 4,046,063, 4,064,791, 4,075,936, 4,357,950, and 4,508,525, all to Berger.

The tobacco materials useful for manufacturing the above referenced smoking article can vary. Tobacco materials can be derived from various types of tobacco, such as flue-cured tobacco, burley tobacco, Oriental tobacco or Maryland tobacco, dark tobacco, dark-fired tobacco and Rustica tobaccos, as well as other rare or specialty tobaccos, or blends thereof. Descriptions of various types of tobaccos, growing practices, harvesting practices and curing practices are set for in Tobacco Production, Chemistry and Technology, Davis et al. (Eds.) (1999). Most preferably, the tobaccos are those that have been appropriately cured and aged.

Typically, tobacco materials for cigarette manufacture are used in a so-called "blended" form. For example, certain popular tobacco blends, commonly referred to as "American blends," comprise mixtures of flue-cured tobacco, burley tobacco and Oriental tobacco. Such blends, in many cases, contain tobacco materials that have a processed form, such as processed tobacco stems (e.g., cut-rolled or cut-puffed stems), volume expanded tobacco (e.g.,uffed tobacco, such as dry ice expanded tobacco (DIET), preferably in cut filler form). Tobacco materials also can have the form of reconstituted tobaccos (e.g., reconstituted tobaccos manufactured using paper-making type or cast sheet type processes). The precise amount of each type of tobacco within a tobacco blend used for the manufacture of a particular cigarette brand varies from brand to brand. See, for example, Tobacco Encyclopedia, Voges (Ed.) p. 44-45 (1984), Browne, The Design of Cigarettes, 3.sup.rd Ed., p. 43 (1990) and Tobacco Production, Chemistry and Technology, Davis et al. (Eds.) p. 346 (1999).

Tobacco materials typically are used in forms, and in manners, that are traditional for the manufacture of smoking articles, such as cigarettes. The tobacco normally is used in cut filler form (e.g., shreds or strands of tobacco filler cut into widths of about (fraction 1/10) inch to about (fraction 1/60) inch, preferably about (fraction 1/20) inch to about (fraction 1/35) inch, and in lengths of about 1/4 inch to about 3 inches). The amount of tobacco filler normally used within the tobacco rod of a cigarette ranges from about 0.6 g to about 1 g. The tobacco filler normally is employed so as to fill the tobacco rod at a packing density of about 100 mg/cm^3 to about 300 mg/cm^3, and often about 150 mg/cm^3 to about 275 mg/cm^3.
If desired, the tobacco materials of the tobacco rod can further include other components. Other components include casing materials (e.g., sugars, glycerin, cocoa and licorice) and top dressing materials (e.g., flavoring materials, such as menthol). The selection of particular casing and top dressing components is dependent upon factors such as the sensory characteristics that are desired, and the selection of those components will be readily apparent to those skilled in the art of cigarette design and manufacture. See, Gutcho, Tobacco Flavoring Substances and Methods, Noyes Data Corp. (1972) and Leffingwell et al., Tobacco Flavoring for Smoking Products (1972).

Referring to now to FIG. 2, FIG. 2 shows a cigarette 100 comprising a capsule 220 inserted into the filter as known in the art. The cigarette 100 possesses a tobacco rod 102 and a filter element 110. The filter element 110 includes a cavity 214. The cavity 214 is a hollow region that may extend along the longitudinal axis of the filter element for a portion of the length of the filter element. At least one breakable capsule 220 is disposed in the cavity 214, and the open end of the cavity faces one end of the tobacco rod 102. Each breakable capsule 220 most preferably carries a payload incorporating a compound that is intended to introduce some change to the nature or character of mainstream smoke drawn through that filter element (e.g., a flavoring agent). That is, the capsule 220 may be ruptured at the discretion of the smoker to release the capsule payload. The filter element 110 is bound along its outer circumference by a layer of plug wrap 116 (e.g., porous paper plug wrap), and connected to the tobacco rod 102 by tipping material 118 (e.g., essentially air impermeable tipping paper). The filter element 110 and the tobacco rod 102 are aligned in an end-to-end relationship, preferably abutting one another, and hence the capsule 220 within the cavity 214 remains physically lodged in a desired location within the cigarette 100. A plurality of perforations 210 optionally can be provided in the tipping paper 118 and, plug wrap 116, for air dilution purposes.

The overall shape of the central cavity 214 is determined by the construction of the filter element 110. The filter element 110 includes in the example of Fig. 2 an axially elongated inner portion, a cavity 214 that is open at the end proximal to the tobacco rod 102.

A representative cavity 214 extends approximately half the overall length of the filter element 220. That is, the cavity is open at one end and closed at the other end, at least relative to allowing for passage of the capsule 220. The axially elongated outer element or section 226, preferably comprised of cellulose acetate tow or other suitable cigarette filter material, surrounds the inner element or section 222. As such, the passage or cavity 214 is component fashioned within a filter element segment, rather than a cavity formed by the longitudinal spacing of two cylindrical filter segments (e.g., as is the case for commercially marketed "cavity filters"). As such, the capsule 220 is located within an airspace within a filter element that is open at one end. The capsule is enclosed by filter material at the other longitudinal end of that filter element; and the capsule is enclosed by filter material in the region that surrounds the capsule in a transverse direction relative to the longitudinal axis of the filter element. The longitudinal surface of the outer portion 226 of the filter material of the filter element is in turn bound or circumscribed by plug wrap 116.

The tipping material 118 connecting the filter element 110 to the tobacco rod 102 can have indicia (not shown) printed thereon. For example, a band (not shown) can indicate to a smoker the general location or position of the capsule 220 within the filter element 110. These indicia may help the smoker to locate the capsule 220 so that it can be more easily ruptured by squeezing the filter element 110 directly outside the position of the capsule. The indicia on the tipping material 118 may also indicate the nature of the payload carried by the capsule 220. For example, the indicia may indicate that the particular payload is a spearmint flavoring by having a particular color, shape, or design.

The optional perforations 210 can be made by various techniques known to those of ordinary skill in the art, such as laser perforation techniques. As these techniques are carried out after insertion of a capsule 220 into the filter 110, care is taken to avoid damaging the capsules during the formation of the perforations 210. One way to avoid damage is to use air dilution techniques, such as those employing laser perforation technologies, involves locating the perforations at a position adjacent to the position of the capsule 220. In such a manner, radiation, heat or physical forces acting upon the filter 110 during perforation processes do not have such a great propensity to damage the capsule. Alternatively, so-called off-line air dilution techniques can be used (e.g., through the use of porous paper plug wrap and pre-perforated tipping paper).

The dimensions of a representative cigarette 100 can vary. Preferred cigarettes are rod shaped, and can have diameters of about 7.5 mm (e.g., circumferences of about 22.5 mm to about 25 mm); and can have total lengths of about 85 mm to about 100 mm. The length of the filter element 110 can vary. Typical filter elements can have lengths of about 20 mm to about 40 mm. In one preferred embodiment, the length of the filter element 110 is about 27 mm and the length of the tobacco rod 102 is about 58 mm. The tipping paper 118 can circumscribe the entire filter element 110 and about 4 mm of the length of the tobacco rod 102 in the region adjacent to the filter element. A representative cavity 214 can extend from one end of the filter element 110 about 13 mm along the length of that filter element. A representative cavity 214 can have a diameter of about 4 mm at the open end of the filter element 110. A capsule 220 can be positioned about 6 mm to about 8 mm from the open end of the filter element 110.

In use, the smoker lights the lighting end 108 of the cigarette 100 and draws smoke into his/her mouth
through the filter element 110 at the opposite end 224 of the cigarette. The smoker can smoke all or a portion of the cigarette 100 with the capsule 220 intact. During the portion of the smoking experience that the capsule 220 remains intact, smoke generated in the tobacco rod 102 is drawn principally through the filter material 226 located in the outer peripheral region of the filter element 110 to the smoker. Most preferably, the overall character or nature of the drawn smoke is virtually unaffected to any significant degree as a result of the presence of the intact capsule 220 within the filter element 110. If desired, the smoker may rupture the capsule 220 at any time before, during, or even after, the smoking experience. Breakage of the capsule 220 acts to release the contents that are contained and sealed therewith. Release of the contents of the capsule into the filter element thus enables the smoker to achieve the intended benefit of action of certain of those contents, whether that benefit results from flavoring or scenting the smoke, cooling or moisturizing the smoke, freshening the scent of the cigarette butt, or achieving some other goal associated with modifying the overall composition of the smoke or altering the performance characteristics of the cigarette. That is, in highly preferred embodiments, a portion of the payload (e.g., portions of a flavoring agent) that has been released into the filter element is incorporated into each subsequent puff of mainstream smoke that is received through that filter element.

[0040] Cigarettes exhibit desirable resistance to draw, whether or not the capsules within their filter elements are broken. For example, an exemplary cigarette exhibits a pressure drop of between about 50 and about 110 mm water pressure drop at 17.5 cc/sec. air flow. Preferred cigarettes exhibit pressure drop values of between about 70 mm and about 180, more preferably between about 80 mm to about 150 mm, water pressure drop at 17.5 cc/sec. air flow. Typically, pressure drop values of cigarettes are measured using a Filtrona Filter Test Station (CTS Series) available from Filtrona Instruments and Automation Ltd.

[0041] Application of physical pressure to the capsule 220, for example by a squeezing action provided by the fingers of the smoker to the filter element 110, causes relevant regions of the filter element to deform and hence causes the capsule to rupture and release its payload to the cavity interior 214 of the filter element. The rupture of the capsule 220 can be discerned by an audible pop, snap, or a rapid decrease in the resistance to the pressure applied by the smoker. Rupture of the capsule 220 causes contents of its payload to disperse throughout the cavity 214, throughout the filter tow material in the outer element 226, and potentially to some extent into the tobacco rod 102. Most preferably, the overall cylindrical shape of the filter element returns to essentially its original shape after the application of pressure to the filter element is ceased.

[0042] A cigarette in accordance with the present invention has a configuration that is generally similar with the one discussed above in connection with figures 1 and 2. A cigarette in accordance with the present invention is distinct from the exemplary cigarettes proposed in Figs. 1 and 2 in various aspects that will be described in the following in connection at least with the embodiment of the invention illustrated in connection with Fig. 3.

[0043] A cigarette 300 has a cylindrical filter element 302 aligned in an end-to-end relationship with the tobacco rod 304. The filter element 302 may comprises a cellulose acetate tow plasticized using triacetin, and the tow is circumscribed by plug wrap paper or filter paper 304. The filter element 302 is attached to one end of the tobacco rod 304 using a circumscribing wrapping material 306, known as “tipping paper.” The tipping paper 306 and plug wrap 304 may be perforated via a series of perforations 308 in order to provide for the dilution of drawn mainstream smoke with ambient air. The cigarette 300 is employed by a smoker by lighting one end thereof 310 and burning the tobacco rod 304. The smoker then receives mainstream smoke into his/her mouth by drawing on the filter end 312 of the cigarette.

[0044] The filter element 302 of the present invention is shown as having a capsule 314 positioned in the filter element, the contents of the capsule being dischargeable into the filter elements upon rupture of the capsule, in the attempt by the smoker to alter the nature or character of the mainstream smoke passing through the filter element 302. The capsule 314 is shown as being positioned within a cavity 316 formed within the tow material 318, the cavity 316 having same shape as the capsule 314.

[0045] The person skilled in the art will appreciate that the shape of the capsule 314 illustrated in Fig. 3 is only exemplary and that the capsule may have any other shape apparent for the person skilled in the art. By way of example, the capsule may be cylindrical, parallelepipedal, a cube, a star, may be unicameral or multi-cameral, etc. Further, the cavity 316 is as well shaped in various shapes, following the preferred shape of the capsule. All these shapes and configurations are considered to be comprised within the scope of the present invention. The person skilled in the art will further appreciate that instead of a capsule other suitable bodies carrying a substance may as well be employed. It will be further yet appreciated by the person skilled in the art that more than one capsule or suitable bodies may be inserted in the filter in accordance with the present invention.

[0046] For cigarettes in accordance with the present invention, the portion of the filter element that possesses the cavity into which the capsule or capsules are placed and maintained is such that the cavity effectively maintains its overall shape during the manufacture, storage and use of the cigarette. For example, for a preferred embodiment of the present invention, the ends of the inner region, portion or member of a filter element manufactured from filter element components arranged in a generally concentric manner can be generally described as providing a structure of cavity walls that can be somewhat rigid or resilient in nature. Overall, the filter element
Preferably, a representative filter element possessing a central cavity has a diameter of about 5 mm at its widest point. However, the walls of the cavity may be defined by compressible and deformable material (e.g., plasticized cellulose acetate), and the cavity may be manufactured so as to have a greater or smaller diameter. Accordingly, the cavity may accept one or more capsules having diameters of at least about 1 mm, typically at least about 2 mm, often at least about 3 mm, and the largest around 4 mm. Typically, the capsules have diameters that do not exceed about 6 mm, often do not exceed about 5 mm, and frequently do not exceed about 4.5 mm. Certain preferred capsules have diameters in the range of about 3 mm to about 4 mm in diameter, and certain highly preferred capsules are approximately 3.5 mm in diameter. For a cigarette having a diameter of about 7 mm to about 8 mm, and preferably of 7.9 mm, a typical cavity having a diameter of about 4 mm can readily accept and maintain in the desired position within the filter element a capsule having a diameter of about 3.5 mm.

The general shape of the central cavity can vary. One type of cavity has a generally cylindrical shape. That is, the inner portion of a representative filter segment defines a central cavity having a generally cylindrically shaped portion. Another type of cavity has a generally spherical shape. That is, the inner portion of a representative filter segment defines a central cavity having a generally spherically shaped portion. As already mentioned, the cavity and the held capsule may have any shape apparent for the person skilled in the art. The diameter of the cavity that holds the capsule will always be slightly larger than the diameter of the held capsule, especially if the contemplated shape for the capsule and cavity is spherical. Otherwise, for it is envisioned in accordance with the present invention that a separation space always exist between the walls of the holding cavity and the capsule irrespective of the space of the capsule. Such separation space may be in the range of 0.5 mm to 2 mm and preferably in the range of 1 mm to 0.5 mm.

The cavity can possess various favorable properties for the insertion, placement, retention, protection and/or rupture of the capsule inserted therein. The interior surface of the inner portion of the filter segment can possess a roughened, adhesive, tacky, other particular surface suitable for the retention of a capsule at a fixed position within the cavity. For example, the cavity wall can possess a coating of triacetin plasticizers capable of causing some adhesion with the capsule.

Therefore, to summarize, a filter 302 in accordance with the present invention comprises at least a tow material 318 comprising at least one capsule 314, wherein the cavity 316 holds at least one capsule 314, and wherein the tow material 318 comprises at least two segments of tow material 318 surrounding the at least one capsule 314, and filter paper 306 placed on an outer surface of the tow material 318 such that the filter paper 306 is capable of holding together the at least two segments of the tow material 318 and the at least one capsule 314. An inner diameter of the at least one cavity 316 is larger than an outer diameter of said at least one capsule 314. A difference between the inner diameter of the at least one cavity 316 and the outer diameter of the at least one capsule 314 is preferably in the range of 0.5 mm to 1 mm.

The filter 302 is part of a cigarette 300 or of another smoking article. The filter 302 has an outer cylindrical shape connected to a tobacco rod 304, and has an end proximal to the tobacco rod 304 and an end distal from the tobacco rod 304.

FIG. 4 illustrates a succession of steps comprised in a method for manufacturing the cigarette, in accordance with the present invention.

Essentially, the manufacturing process of a cig-
arete in accordance with the present invention may be broken down in 4 distinct phases, that may be identified most generally as the phase of filter rod production, the phase of filter rod cutting and assembling with the capsule, the application of the filter paper and tipping phase. [0056] The production of filter rods, filter rod segments and filter elements, and the manufacture of cigarettes from those filter rods, filter rod segments and filter elements, in accordance with this invention, can be carried out using the types of rod-forming units that have been employed to provide cigarette filters, multi-segment cigarette filters and filtered cigarettes. Multi-segment cigarette filter rods can be manufactured using a cigarette filter rod making device available under the brand name Mulfii from Hauni-Werke Korber & Co. KG of Hamburg, Germany. Other types of commercially available filter rod making equipment may similarly be used, such as the model KDF-2 available from Hauni-Werke Korber & Co. KG, or the model Decoufle available from Decoufle of France. Six-up rods, four-up filter rods and two-up rods that are conventionally used for the manufacture of filtered cigarettes can be handled using conventional-type or suitably modified cigarette rod handling devices, such as tipping devices available as Lab MAX, MAX, MAX S or MAX 80 from Hauni-Werke Korber & Co. KG.

[0057] A filter material 318 is supplied and is passed into a rod forming unit. The filter material can vary and is any material that can be employed in providing a tobacco smoke filter for cigarettes. Preferably a traditional cigarette filter material is used, such as cellulose acetate tow, gathered cellulose acetate web, polypropylene tow, gathered cellulose acetate web, gathered paper, strands of reconstituted tobacco, or the like. Especially preferred is filamentary tow such as cellulose acetate, polyolefins such as polypropylene, or the like. For example, cellulose acetate tow having 3 denier per filament and 35,000 total denier can provide a suitable filter rod. As another example, cellulose acetate tow having 8 denier per filament and 40,000 total denier can provide a suitable filter rod. [0058] At least a portion of the filter material is generally absorbent of liquids, and hence capable of absorbing the liquid payload components released from a capsule into the tow material for delivery to the smoker (or otherwise allowing for movement or transfer of the released capsule components throughout filter element). For example, filamentary tow such as cellulose acetate is processed using a conventional filter tow processing unit such as a commercially available E-60 supplied by Arjay Equipment Corp., Winston-Salem, N.C. Other types of commercially available tow processing equipment, as are known to those of ordinary skill in the art, may similarly be used. Normally a plasticizer such as triacetin is applied to the filamentary tow using known techniques. Other suitable materials for construction of the filter element will be readily apparent to those skilled in the art of cigarette filter design and manufacture. [0059] For the purposes of the present description, it is assumed that a single filter rod or a multiple filter rod comprising a filter tow are manufactured using the techniques described above, in the phase dedicated to the filter rod production. More details regarding the filter rod productions will be offered in the following while describing an exemplary apparatus for the filter rod production. [0060] A filter rod generally can be further subdivided into cylindrical shaped filter elements using techniques as are known by the skilled artisan familiar with conventional cigarette manufacturing. The filter rod includes filter material encased in circumscribing wrapping material, as described above in connection with at least Fig. 3, such as conventional air permeable or air impermeable paper plug wrap, or other suitable wrapping material. As an example, four cavities may be individually spaced at predetermined intervals within a multi filter rod. In particular, each of the cavities is positioned along the rod in a spaced apart relationship from one another. The rod can be used as a "four up" rod to provide four filter elements. Other configurations such as the so called "six up" rods also can be manufactured. Rod sizes for use in the manufacture of filter elements for cigarettes can vary, but typically range in length from about 80 mm to about 140 mm, and from about 16 mm to about 27 mm in circumference. For example, a typical rod having a 100 mm length and a 24.53 mm circumference exhibits a pressure drop of from about 200 mm to about 400 mm of water. [0061] After the filter rod has been produced, as discussed above, the filter rod is cut and assembled with at least one capsule. Subsequent to being cut, in the extremities of the filter rod two half rounds 402 are being carved, by suitable techniques. Exemplary techniques for building the two half rounds 402 are laser carving, pressing, or milling. Specifically, the filter rod 302 may be cut, by any suitable means, either in the middle or at any elected point, depending upon where in the filter rod is the intended position of the capsule. For the purposes of the following description, it is assumed that the filter rod is cut in the middle, along a line 404, but this is not to be interpreted as a limitation. [0062] A capsule 314 is supplied. As illustrated in Fig. 4 the capsule is a spherical, single chamber capsule 314. As it will be apparent for a person skilled in the art, a capsule of any other shape may be employed, and as a result the half cavities discussed above as being carved at the extremities of the filter rod will not necessarily be round, but will be carved to take any suitable shape to envelope the capsule. As discussed above in connection with Fig. 3, the sizes specific to the two cavities are slightly larger than the sizes specific to the capsule, allowing therefore that a small distance is present between the capsule and the enveloping two half cavities. [0063] The at least two cut parts of the filter rod are rotated 180 degrees around a direction parallel to their direction of cutting. As a result the extremities of the filter rod that have been carved to comprise two half cavities, are facing each other. The capsule 314 is conveniently placed between the two cut parts of the filter rod. [0064] As it will be apparent for a person skilled in the
art, should the filter be intended to be employed with multiple capsules, the operations enumerated above may be repeated to create as many cavities as necessary to accommodate more than one capsule.

[0065] The two extremities of the filter rod are brought together in the direction of the arrows forming therefore a filter rod with a cavity hosting a capsule therein. As it may be observed from the figure the capsule in entrapped in the cavity, and the filter tow is carved such that a small portion of the filter tow is still present between the cavity and the outer surface of the filter.

[0066] During the subsequent phase of the manufacturing process a filter paper 406 is applied on the outer surface if the filter comprising the cavity holding the capsule, created as described above. The filter paper is responsible for holding together the two or multiple parts of the filter material, in such a way that the parts are securely held abutting against each other. No other reinforcement means are necessary for holding together the cut portions of the filter, providing therefore for a simplified manufacturing process of the filter comprising an aromatic capsule.

[0067] The manufactured filter is subsequently joined with a tobacco rod by wrapping the filter and the extremity of the tobacco rod in a tipping paper 408, forming therefore a cigarette with an aromatic capsule therein, as illustrated for example in Fig. 3 of this document.

[0068] In an alternative embodiment of the invention, the succession of steps described above may be employed starting from a multi filter tip rod, wherein a plurality of cavities are carved, via for example laser carving, and said multiple filter rod is cut along conveniently selected cutting lines that traverse a center point of said carved cavities.

[0069] Therefore, to summarize a method of manufacturing a filter in accordance with the present invention comprises providing for at least one filter tip comprising tow material, carving at least two half cavities at two ends of the at least one filter tip, cutting the filter tip at a conveniently elected position to form at least two half filter tip parts, providing a capsule between the at least two half cavities that are made to face each other, for example by rotating the cut filter tip parts 180 degrees around an axis parallel with the direction of cutting said at least one filter tip, so that the at least two half cavities are facing each other, joining the at least two half cavities to form a closed cavity so that the capsule is entrapped within the formed cavity, and wrapping the at least two filter tip parts in filter paper, so that the two filter tip parts are securely joined together.

[0070] A filter comprising a capsule manufactured in accordance with the present invention has the advantage that when the capsule is broken during smoking the liquid released from the capsule is trapped within the cavity formed in the tow filter material surrounding the cavity. Since the liquid does not seep toward the outside of the filter, because is being stopped by both the remaining tow filter material, the filter paper and the tipping paper, the user smoking experience is enhanced without its fingers being stained by the liquid.

[0071] This property of the filter is further enhanced in the filters of the present invention when the step of carving the at least two half cavities at the two ends of the at least one filter tip are formed by pressing a half round hole. As a result of pressing the tow material, the density of the fibers in that region is increased. This creates an additional barrier for the liquid that might seep towards the surface of the filter after the capsule is broken.

[0072] The present invention is as well directed to an apparatus for manufacturing the cigarette comprising a filter including a breakable capsule.

[0073] In accordance with the present invention an apparatus for manufacturing the cigarette comprising a filter including a breakable capsule comprises means for providing at least one filter tip comprising tow material, means for carving at least two half cavities at two ends of said at least one filter tip, means for cutting the filter tip at a conveniently elected position to form at least two filter tip parts, means for making the at least two half cavities face each other, for example for rotating the cut filter tip parts 180 degrees around an axis parallel with the direction of cutting said at least one filter tip, means for providing a capsule between the at least two half cavities facing each other, means for joining together the at least two half cavities to form a closed cavity so that the capsule is entrapped within the formed cavity, and means for wrapping the at least two filter tip parts in filter paper, so that the two filter tip parts are securely joined together.

[0074] Exemplary means for the implementation of the present invention are described as follows: The filter material, which has been compressed into a cylindrical composite, is received into a rod-forming unit. The cylindrical composite is fed into a wrapping mechanism, which includes an endless garniture conveyor belt or other garniture means. The garniture conveyor belt is continuously and longitudinally advanced using an advancing mechanism such as a ribbon wheel or cooperating drum so as to transport the cylindrical composite through the wrapping mechanism. The wrapping mechanism provides a strip of wrapping material to the outer surface of the cylindrical composite in order to produce continuous wrapped rod.

[0075] The strip of wrapping material is provided from a rotatable bobbin. The wrapping material is drawn from the bobbin, is trained over a series of guide rollers, passes under a block, and enters the wrapping mechanism of the rod-forming unit. The endless garniture conveyor belt transports both the strip of wrapping material and the cylindrical composite in a longitudinally extending manner through the wrapping mechanism while draping or enveloping the wrapping material about the cylindrical composite. The wrapping material that circumscribes the filter material can vary. Typically, the wrapping material is a porous or non-porous paper that is commercially available, and is known in the industry as "plug wrap." Exemplary highly porous plug wrap papers are available.
from Schweitzer-Maudit International as Porowrap Plug Wrap 17-M1, 33-M1, 45-M1, 65-M9, 95-M9, 150-M4, 260-M4 and 260-M4T.

[0076] The seam formed by an overlapping marginal portion of wrapping material has adhesive (e.g., hot melt adhesive) applied thereto at an applicator region in order that the wrapping material can form a tubular container for the filter material. Alternatively, the hot melt adhesive may be applied directly upstream of the wrapping material’s entry into the garniture of the wrapping mechanism or block, as the case may be. The adhesive can be cooled using a chill bar in order to cause rapid setting of the adhesive. It is understood that various other sealing means and other types of adhesives can be employed in providing the continuous wrapped rod.

[0077] The continuous wrapped rod passes from the sealing means and is subdivided (e.g., severed) at regular intervals at the desired, predetermined length using a cutting assembly which includes as a rotary cutter, a highly sharpened knife, or the like. It is particularly desirable that the cutting means not flatten or otherwise adversely affect the shape of the rod. The rate at which the cutting assembly severs the continuous rod at the desired points is controlled relative to the rate at which the capsules are inserted into the continuous web of filter material in one embodiment. The cutting assembly is geared in a direct drive relationship to the drive assembly of the rod-making apparatus. Alternatively, the cutting assembly has a direct drive motor synchronized with the drive assembly of the rod-forming unit and feedback controlled by coupling with the capsule inspection means to adjust the cutting assembly drive should the capsules insertion location shift out of position. A suitable manner for providing the required timing for severing the continuous rod at the desired length and with the desired number of capsules positioned at the predetermined intervals therein will be apparent to the skilled artisan.

[0078] The succession or plurality of rods are collected for use in collection means which is a tray, a rotary collection drum, or the like.

[0079] The means for providing a capsule between the at least two half cavities facing each other includes a rotatable member having the shape of a wheel, which may be optionally held in place within a ledger housing. The capsule insertion unit also includes a hopper and/or other transfer means for feeding or otherwise providing a passageway for the capsules to the rotatable member. Alternatively, the rotatable member is driven by a pulley and belt coupled with the main drive assembly of the rod-making apparatus. Alternatively the rotatable member has an independent drive motor synchronized with or controlled by the main drive assembly.

[0080] In operation, the capsules are delivered from a feed hopper to a pan of a carousel. As the carousel rotates, centrifugal force moves the capsules to the perimeter of the pan where the capsules gather over and around the holes. As the carousel rotates, each lifter, mounted flush with its hole, rises and captures a capsule, lifting the capsule to a predetermined apex beneath its respective transfer tube. The capture of the capsule may be assisted with vacuum supplied through the lifting stem. When the capsule reaches its apex and the transfer tube is aligned over the shelf, a positive air pressure is applied to the stem lifter that then blows the capsule up into the transfer tube and down to the ball catcher. As the carousel further rotates, the capsule moves along the shelf and at its terminus, drops into a pocket of the insertion wheel. The insertion wheel and the carousel are driven in synchronization so that each transfer tube aligns with a pocket of the insertion wheel. The carousel and insertion wheel may be driven in synchronization geared to a single motor, or may have independent drives that are servocontrolled for synchronization. As the insertion wheel rotates, the capsules held within the pocket are brought into contact with the filter material where the capsule is then ejected from the pocket into the gathering filter material.

[0081] Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing description; and it will be apparent to those skilled in the art that variations and modifications of the present invention can be made without departing from the scope or spirit of the invention. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

[0082] Legend of elements:

100 - smoking article/cigarette;
102 - cylindrical rod;
104 - filter material;
106 - wrapping material;
108 - lighting end;
110 - filter element;
112 - printed band;
114 - filter material;
116 - wrap material;
118 - tipping material;
120 - series of perforations;
200 - filter;
214 - cavity;
220 - series of perforations;
226 - axially elongated outer element;
224 - opposite end of the cigarette;
300 - cigarette;
302 - filter;
304 - tobacco rod;
306 - filter paper;
308 - series of perforations;
310 - one end of a cigarette;
312 - filter end distal from the tobacco rod;
314 - capsule;
316 - cavity;
318 - tow material;
402 - two half rounds;
404 - cut line;
406 - filter paper, and
408 - tipping paper.

Claims

1. A filter (302), comprising:
   a tow material (318) comprising at least one cavity (316),
   wherein said at least one cavity (316) holds at least one capsule (314),
   wherein a shape of said at least one cavity (316) comprised in the tow material (318) is complementary to an outer shape of the at least one capsule (314), and
   wherein said tow material (318) comprises at least two segments of tow material (318) surrounding said at least one capsule (314); and
   filter paper (306) placed on an outer surface of the tow material (318) such that the filter paper (306) is capable of holding together the at least two segments of the tow material (318) and the at least one capsule (314).

2. The filter (302) of claim 1, wherein an inner diameter of said at least one cavity (316) is larger than a diameter of said at least one capsule (314).

3. The filter (302) of claims 1 and 2, wherein a difference between the inner diameter of said at least one cavity (316) and the diameter of said at least one capsule (314) is in the range of 0.5 mm to 1 mm.

4. The filter (302) of anyone of claims 1 to 3, wherein said filter (302) is part of a cigarette (300).

5. The filter (302) of anyone of claims 1 to 3, wherein said filter is part of a smoking article.

6. The filter (302) of anyone of claims 1 to 4, wherein the filter (302) has an outer cylindrical shape connected to a tobacco rod (304), said filter (302) having an end proximal to the tobacco rod (304) and an end distal from the tobacco rod (312).

7. A method of manufacturing a filter, comprising the following steps:
   providing at least one filter tip comprising tow material;
   carving at least two half cavities at two ends of said at least one filter tip;
   cutting said filter tip at a conveniently elected position to form at least two filter tip parts;
   providing a capsule between the at least two half cavities made to face each other;
   joining together the at least two half cavities to form a closed cavity such that the capsule is entrapped within the formed cavity; and
   wrapping the at least two filter tip parts in filter paper, such that the two filter tip parts are securely joined together.

8. A method of manufacturing a filter according to claim 7, comprising the additional step of:
   rotating said cut filter tip parts 180 degrees around an axis parallel with the direction of cutting said at least one filter tip, such that the at least two half cavities are facing each other before providing a capsule between the at least two half cavities made to face each other.

9. An apparatus for manufacturing a filter, comprising:
   means for providing at least one filter tip comprising tow material;
   means for carving at least two half cavities at two ends of said at least one filter tip;
   means for cutting said filter tip at a conveniently elected position to form at least two filter tip parts;
   means for providing said cut filter tip parts such that the at least two half cavities are facing each other;
   means for providing a capsule between the at least two half cavities facing each other;
   means for joining together the at least two half cavities to form a closed cavity such that the capsule is entrapped within the formed cavity; and
   means for wrapping the at least two filter tip parts in filter paper, such that the two filter tip parts are securely joined together.

10. An apparatus for manufacturing a filter according to claim 9, wherein:
   the means for providing said cut filter tip parts such that the at least two half cavities are facing each other are means for rotating said cut filter tip parts 180 degrees around an axis parallel with the direction of cutting said at least one filter tip, such that the at least two half cavities are facing each other.
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Place of search: Munich 21 December 2011  
Date of completion of the search: 21 December 2011  
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