

LIQUID RELEASE DEVICE FOR A SMOKING ARTICLE

The present invention relates to a device for releasing a liquid which upon activation provides flavouring or other smoke modification to a smoking article, for example a cigarette. The present invention also relates to a smoking article comprising such a liquid release device.

Smoking articles including liquid additives which modify the smoking characteristics of the smoking article are known in the art.

For example, US-A-4 889 144 discloses a flavourant encapsulated in frangible particles which are enclosed in a hollow space within the filter of a cigarette. To release the flavour, the smoker crushes the particles prior to smoking by application of a force to the outer surface of the filter.

The smoking articles disclosed in US-A-5 067 500 comprise a container including an additive. Relative rotation or axial movement of the container components causes the container with the additive to be opened, or a capsule containing the additive material to be pierced by protrusions. Thus, an air flow pathway is provided so that the additive material can modify the characteristics of the smoking article.

US-A-2004/0261807 discloses smoking articles with a filter element including at least one frangible capsule. The filter element is made of plasticized cellulose acetate tow. The smoking articles may be smoked without breaking the capsule or the capsule may be crushed before, during or after smoking.

There is a need to improve the controlled delivery of a liquid to a smoking article, for example to modify the smoking characteristics of the smoking article effectively and selectively.

According to the present invention there is provided a smoking article, preferably a cigarette, comprising a rod of smokable material and a liquid release device in axial alignment with the rod, the device comprising: a stationary porous element fixed with respect to the rod; a mobile porous element axially aligned with and axially movable relative to the stationary porous element; and at least one frangible capsule of liquid retained between the elements, whereby axial movement of the mobile element from a first position in which the capsule is intact toward the stationary element to a second

position causes the capsule to rupture and release the liquid into the porous elements, the mobile element being restrained against undesired axial movement in at least one, preferably both, of the first and second positions.

5 The smoking article according to the invention has the advantage that the mobile element cannot be completely separated from the remainder of the smoking article. This ensures that the movable element is not removed, for example while the smoker is drawing on the cigarette. There is therefore no risk of the mobile element being
10 swallowed.

 In the smoking articles of the invention, the liquid release device is the mouthpiece and acts as a smoke modifier delivery device. Upon activation by the smoker, that is as the mobile element of the device is moved to the final condition, release of the smoke modifying
15 agent or agents from the capsule is effected in a controlled manner, ideally immediately before the article is smoked. In use, as the mainstream smoke passes through the device, the agent or agents is desorbed from the porous surface of the axially aligned elements of the device.

20 In a liquid release device of the invention, the elements are held together in such a way that they are capable of relative axial movement but cannot readily be completely separated from each other. This can advantageously be achieved by the elements being a friction fit with each other, or by employment of a deformable
25 connector between them. The connector is of a material which can be readily deformed by a smoker pushing the mobile element toward the stationary element and may be, for example, a perforated or slotted plug wrap surrounding the mobile element and the stationary porous element. The plug wrap may be for example stiff or standard porous
30 cellulose acetate.

 When the mobile element is moved towards the stationary porous element, the deformable connector collapses into the space between the mobile element and the stationary porous element without breaking. Thereby the connection of the mobile element and the stationary porous
35 element is maintained and the mobile element remains restrained against undesired axial movement away from the stationary porous element. In this case the undesired axial movement of the mobile

element is any movement of the mobile element away from the stationary porous element beyond the initial first position.

Preferably slots in the plug wrap paper are angled relative to the longitudinal direction of the smoking article. This reduces the stiffness of the connector and thus eases the movement of the mobile element relative to the sleeve. By a slot is meant a hole which is longer in a first direction than in a second direction perpendicular to the first.

In a preferred embodiment the connector comprises plug wrap with or without perforation or slots that wraps the mobile element only for a fraction of the circumference of the mobile element, for example between 90 to 180 degrees, preferably 120 degrees.

Preferably, the liquid release device is a cylinder of circular cross section and has a diameter of a conventional cigarette, which is typically between about 6mm and about 9mm.

It is preferred that the liquid release device further comprises a sleeve around at least a part of one of the elements, one of the elements being fixed relative to the sleeve and the other element being movable relative to the sleeve. The sleeve accommodates at least one and preferably both of the two axially aligned elements. The sleeve may also serve to hold the elements together. Preferably, the sleeve is fixed to the mobile element. Also preferably, the sleeve is around at least a portion of the stationary element, and may be attached thereto.

In a preferred embodiment of the liquid device, the sleeve is provided by a relatively rigid tube designed to retain the two axially aligned elements by a friction fit. Preferably, the tube is substantially cylindrical and has a uniform circular cross-section, the outer diameter being in the range of from about 6mm and to about 9mm. Preferably, the tube length is between about 8mm and about 10mm. Advantageously, the tube is made of a rigid material which cannot easily be squeezed. A preferred tube material is a suitable thermoplastic material, such as a polyolefin, preferably a polyethylene, or rigid soft board. The tube is preferably air-impermeable. In some embodiments, the tube circumscribes only the opposed end portions of the elements, the opposite end of each element, the free end, extending beyond the sleeve (in the first position).

In a smoking article of the present invention, the liquid release device is permanently attached to the wrapped rod of tobacco or other smoking material, for example to make a cigarette or similar smoking article, by tipping fixed to part or all of the stationary element.

5 The tipping may be fixed directly to the stationary element or indirectly by being attached to a sleeve of the liquid release device. Preferably, the sleeve is provided by rigid soft board or by the tube described above.

10 Preferably, a smoking article according to the invention has about the same resistance to draw as a comparable smoking article without the liquid release device. It is preferred that the liquid release device is about 9mm or less in length in the final condition.

15 In a smoking article according to the invention, the stationary element is fixed to the rest of the smoking article such that it does not move relative to the rest of the smoking article during proper use and handling of the device and the smoking article. Upon application of longitudinal force on the free end of the mobile element, the mobile element moves axially toward the stationary element. Typically, the stationary and the mobile element each have a substantially
20 cylindrical shape. The opposed end faces of the elements are preferably of substantially respective complementary male and female configurations.

In some embodiments, the end face of one of the elements opposed to the other element has a cavity for reception of the capsule which
25 is closed by the opposed end face of the said other element. In some preferred embodiments, the end face of the said other element has a cylindrical boss of substantially the same diameter as the cavity. In a preferred embodiment, the capsule is spherical and the end face of one element is conical and extends away from the body of the said one
30 element, and the end face of the other element is of generally complementary shape, and the cavity is a part spherical cavity in the centre of the end face of the said other element, the diameter of the cavity is substantially equal to but slightly greater than the diameter of the capsule.

35 In other embodiments, the capsule or capsules is in an annular chamber defined by opposed end faces of the elements.

In a first, starting, condition, the mobile element is in the first position and the opposed end faces of the stationary and the

mobile elements do not abut each other but are spaced apart and define a space which accommodates the frangible capsule or capsules. In a second, final, condition, the mobile element is in the second position and the end faces of the two elements at least partially abut each other and the space has almost disappeared. Both the first and the second positions are predefined. To change from the first to the second condition the mobile element is moved toward the stationary element. This axial movement causes rupture of the capsule or capsules and release of the liquid therefrom.

The space defined by the opposed end faces of the two elements in the starting condition is designed to retain the capsule or capsules in a defined and stable position, to protect and preserve the integrity of the said capsule or capsules. The space is shaped so that the capsule can be inserted easily during manufacture of the device. Advantageously, the space is only slightly larger than the capsule it accommodates. In some embodiments, the end face of the mobile element has at least one protruding component which can pierce the capsule when the mobile element is moved and facilitates rupture of the capsule. Preferably, the opposed end faces of the two axially aligned elements have a substantially complementary configuration.

In some preferred embodiments of lit-end smoking articles according to the invention, the device is designed so that a smoking article incorporating the device cannot be smoked properly until the device is in the final condition, that is, until the capsule or capsules has been ruptured and the liquid released. This can be achieved by providing significant ventilation (air flow) into and through the device when it is in the first condition to the extent that drawing on the mouth end of the smoking article results in insufficient, if any, air flow draws through the tobacco or other smoking material, so that the article cannot be ignited or burning cannot be sustained. When the device is in the final condition, the air flow directly into the device is significantly reduced, by a significant increase in the resistance to the air flow, allowing sufficient air flow through the tobacco or other smoking material and so allowing the smoking article to be readily smoked. This can be achieved by provision of a ventilation zone, preferably in the form of a circumferential ring, overlying the gap between the mobile element and the stationary element in the first condition or elsewhere. Means

and methods for providing such a ventilation zone are well known in the art and include, for example, a suitable number of perforations which may be arranged in one or more lines. Ventilation in other parts of the smoking article of the invention, in particular in a filter element, may be provided so that ventilation takes place as desired during smoking of the smoking article.

In preferred embodiments, the device comprises mechanical retention means to define and maintain the device in the starting condition until movement of the mobile element is effected. Such retention means may also be employed in the final condition when the mobile element has been moved to rupture the capsule. For example, a suitable mechanical retention system involves projections and corresponding depressions which engage with one another to maintain the desired position. In some embodiments, the retention system acts in a ratchet-like manner effectively retaining the mobile element within the sleeve and allowing it to move only toward the stationary element. In other embodiments, the mobile element has a circumferential ridge around it which fits in a corresponding first groove in the stationary element or in the sleeve when the device is in the starting condition, restraining it against undesired movement. Preferably, a corresponding second groove is provided in the stationary element or in the sleeve in which the ridge fits when the device is in the final condition. It will be appreciated that, alternatively, the mobile element may have a circumferential groove into which fit corresponding ridges on the stationary element or on the sleeve. In yet other embodiments, in which a tube is employed, the mobile element has a row of protrusions or teeth and the inner wall of the tube has one or two grooves. The first groove is located toward the end of the tube accommodating the mobile element and the second groove is located closer to the other end of the tube (and to the stationary element). In the first position, the teeth of the mobile element are mechanically engaged with the first groove. In the second position, the teeth are engaged with the second groove. The mobile element has at least two, preferably at least four teeth. The teeth and the grooves are preferably shaped so that relative movement of the tube and the mobile element is possible in one direction only. Thus, movement of the mobile element from the starting condition to the final condition is possible, but movement of the mobile element out of

the tube or from the final condition to the starting condition is prevented. In other embodiments, rows of detents to receive the teeth are provided in the tube wall instead of grooves.

The two axially aligned elements are made of an air permeable and inherently porous material, for example of a porous thermoplastic material. Alternatively, the elements may be composed of or formed from sintered metal, steel mesh, ceramic materials, heat treated cellulose acetate, non-woven materials, or fibrous materials, for example bi-component, continuous or staple fibre media made by an extrusion or pultrusion process. It is preferred that the elements are of very low, or substantially no, filtration efficiency. Filtration may be provided, for example by a suitable filter plug located between the device and the wrapped rod of tobacco or other smoking material. Suitable filter plugs are known in the art and may comprise one or more filter elements. The filter plug may be of any suitable filter material, such as cellulose acetate or paper. If desired, charcoal or other known adsorbent materials may be distributed in another filter material, such as cellulose acetate. Preferably, smoking articles according to the invention include a single, double, triple or multiple filter. More preferably, the filter plug is a dual filter plug.

A preferred material to form the inherently porous elements of the device is a thermoplastic material, more preferably a sinterable thermoplastic material. A preferred thermoplastic material to make the elements is a polyolefin, including, but not limited to, ethylene vinyl acetate (EVA); ethylene methyl acrylate (EMA), polyethylenes, polypropylenes, ethylene-propylene rubbers, ethylene-propylenediene rubbers, polystyrene, a biodegradable aliphatic polyester, such as polylactic acid, and mixtures and derivatives thereof. A particularly preferred polyolefin is a polyethylene. Examples of suitable polyethylenes include low density polyethylene (LDPE), linear low density polyethylene (LLDPE), high density polyethylene (HDPE), ultra-high molecular weight polyethylene (UHMWPE), and derivatives thereof.

Porous thermoplastic materials suitable for use in forming the two axially aligned elements of the device of the invention are known in the art and readily commercially available. If desired, the porous thermoplastic materials may further comprise additives, such as lubricants, fillers or colourants. Advantageously, the elements are

moulded from a sintered porous thermoplastic material in one continuous and contiguous piece. Preferably, both elements are of the same material, which has been approved for use in food by a competent regulatory authority.

5 The porous material can be any material, preferably a high density material, capable of adsorbing and/or absorbing flavourant compositions at the concentration employed in the capsule or capsules. Preferably, the average pore size (pore diameter) of the porous material used to make the elements is at least about 10 microns,
10 preferably in the range of from about 5 microns, preferably from about 50 microns, to about 300 microns, preferably to about 250 microns. Advantageously, the average pore volume or average void volume, that is the average ratio of the air volume of the porous material to the total volume of the said material, ranges between about 40% and about
15 60%. A particularly preferred polyethylene material for the mobile and stationary elements is an inherently porous high density polyethylene (HDPE), coarse type, obtainable from Porex, Porous Products Group, Germany. The HDPE has an average pore size of 130 microns and an average void volume of 55% and a density of 0.46g/cm^3 or an average
20 void volume of 40% and a density of 0.57g/cm^3 .

Capsules for incorporation in the devices of the invention comprise an impermeable outer shell enclosing a liquid charge. Preferably, the capsule is substantially spherical. Typically, the capsule is a sphere of from about 1mm to about 5mm, preferably about
25 1mm to about 4mm, in diameter; the size is essentially determined by the amount of encapsulated liquid and the amount of active agent to be available to mainstream smoke. The outer shell may be of any suitable material, typically a polymeric material, compatible with the capsule contents. Examples of suitable materials include an alginate,
30 polyvinyl acetate and cellulose. The outer shell may include a filler such as gelatine and optionally a softening agent, such as glycerol, and/or a preservative. Methods and techniques to make capsules suitable for use in the present invention are known in the art.

The liquid charge encapsulated in the frangible capsule comprises
35 at least one active agent or compound which, upon its release from the capsule, is capable of modifying one or more properties of a smoking article as it is smoked; preferably, the mainstream smoke is modified, particularly preferably the particulate phase of the mainstream smoke.

For example, a smoke modifying agent in the capsule may be a flavourant or a smoke modifying agent other than a flavourant, such as water or a chelating agent, for example citric acid. Each puff taken by the smoker as the smoking article is smoked has enhanced flavour and aroma.

Flavourants which may be useful for the present invention include, for example, essential oils, oleoresins, absolutes, fruit concentrates, fruit extracts, distillates and natural-artificial chemicals. Examples of flavourants which can be included in the capsule in the device are tobacco, cinnamon, spearmint, peppermint, vanilla, orange, peach, blueberry, strawberry flavour, cranberry, geranium extract, linalool, coffee, chocolate, menthol, eucalyptus, clove, ginger and citrus. A preferred flavourant is menthol. The flavourants may be natural or synthetic and more than one flavourant may be present. The flavourant is preferably in a diluent or solvent suitable to act as a carrier, keep the flavour homogeneous, regulate the strength of the flavourant, allow physical fixation and/or act as a preservative. For example, a suitable is an oil of vegetable origin; typically, the carrier will form about 45% of the capsule contents.

A smoke modifying agent other than a flavourant is capable of altering the nature of the mainstream smoke, for example by interacting with at least one constituent of the mainstream smoke or reducing the amount of such at least one constituent while the smoking article is burning, or by having a moistening, cooling or smoothing effect. Preferably, the interaction with the constituent or constituents of the mainstream smoke is selective for the pre-defined constituent or constituents and/or has a positive effect on the smoker or his/her surroundings. As mentioned above, the liquid charge may comprise one, two, three or more flavourants or other smoke modifying agents, or any combination thereof provided that the agents are compatible and do not adversely affect each other.

Preferably, the liquid charge of the capsule comprises one or more flavourants, most preferably menthol.

The strength of the capsule is such that it can be readily crushed by the mobile element of the device on exertion of a reasonably strong longitudinal force but sufficient to facilitate handling of the capsule during manufacture of the device. The force required to crush the capsule depends on its size and shape but is

typically up to about 4N for a spherical capsule of up to 3mm diameter.

The capsule is ruptured by application of an external force which moves the mobile element from the first to the second position. This force is exerted by pushing the mobile element in the longitudinal direction toward the stationary element. Such force can conveniently and gently be applied by one finger on the free end of the mobile element. On rupture, the capsule releases its liquid charge into the stationary and mobile elements; the charge is then absorbed and/or adsorbed by the porous material of the elements.

Optionally, the device includes a removable cap covering the mouth end of the smoking article, in particular, the free end of the mobile element. Advantageously, the external force to move the mobile element from the starting to the final condition is applied while the cap covers the mobile element and before it is removed, for example by peeling it off. The cap must be removed before the smoking article of the invention can be smoked. The cap can be of any shape and of any material so long as it can be removed from the mouth end of the smoking article before the smoking article is smoked. The cap is preferably of a flexible material, such as a film of, for example, polyethylene or polyvinyl acetate. The cap can protect the liquid release device against unintentional activation and may serve as an indication to the smoker of the freshness of the smoking article.

In the smoking articles of the invention, the liquid release device is the mouthpiece and acts as a smoke modifier delivery device. Upon activation by the smoker, that is as the mobile element of the device is moved to the final condition, release of the smoke modifying agent or agents from the capsule or capsules is effected in a controlled manner, ideally immediately before the article is smoked. In use, as the mainstream smoke passes through the device, the agent or agents is desorbed from the porous surface of the axially aligned elements of the device. The liquid release devices of the invention may be used in any smoking article but find particular application in low tar smoking articles.

In the manufacture of a liquid release device and smoking article according to the invention, a tobacco rod, a filter plug and the stationary element may be assembled and wrapped with tipping. Preferably, a dual filter plug is employed, one part of which may be

the stationary element. The capsule may be fixed to one of the elements with a spot of adhesive. The tobacco rod, filter plug and the stationary element may then be attached to the mobile element so that the liquid release device is in the first position, with the capsule
5 between the two elements and intact.

The invention will be further described, by way of example only, with reference to the drawings, in which:

Figure 1 shows a cross sectional view of a cigarette including a liquid release device according to a first embodiment of the
10 invention;

Figure 1A is an exploded enlargement of the area A of Figure 1;

Figure 2 shows a cross sectional view of a cigarette including a liquid release device according to a second embodiment of the invention;

15 Figure 3 shows a cross sectional view of a cigarette including a liquid release device according to a third embodiment of the invention;

Figure 4 shows a cross sectional view of a cigarette including a liquid release device according to a fourth embodiment of the
20 invention;

Figure 5 shows a cross sectional view (on line V - V of Figure 6) of a cigarette including a liquid release device according to a fifth embodiment of the invention;

Figure 6 shows a cross sectional view on line VI-VI of Figure 5;

25 Figure 7 shows a cross sectional view of a cigarette including a liquid release device according to a sixth embodiment of the invention;

Figure 8 shows a cross sectional view of a cigarette including a liquid release device according to a seventh embodiment of the
30 invention;

Figure 9 shows a cross sectional view of a cigarette including a liquid release device according to an eighth embodiment of the invention;

Figure 10 shows a cross sectional view of a cigarette including a
35 liquid release device according to a ninth embodiment of the invention;

Figure 11 shows a cross sectional view of a cigarette including a liquid release device according to a tenth embodiment of the invention;

Figure 12 shows an embodiment of an element of the tenth embodiment of the invention; and

Figure 13 shows a top view of a cap according to the invention.

The embodiments shown in the Figures have several components in common; these have been given the same reference numerals throughout. Each cigarette shown in the drawings includes a tobacco rod 12 only a part of which is shown, formed of a cylinder of tobacco 14 wrapped in cigarette paper 1 (shown in Figure 1), in axial alignment with a liquid release device according to the invention. The liquid release devices each comprise a stationary element 20 and a mobile element 22 and are joined to the rod 12 by tipping 24. A filter plug 26 is interposed between the rod 12 and the device; the stationary element 20 abuts the filter plug 26 and is immobile relative to the rod 12 and the filter plug 26, and the mobile element 22 is in axial alignment with and axially movable relative to the stationary element 20. The free ends of the liquid release devices shown in the Figures are covered by a cap 28 of a flexible polyethylene film material which is peeled off before the cigarette is smoked. The cap 28 may come free as the user pushes the mobile element 22 from the first to the second position, or it may be peeled off by the user of the cigarette once the liquid release device is in the final condition.

The Figures show the embodiments in the starting condition, before activation. To move to the final condition, the mobile element 22 is moved toward the tobacco rod 12 (to the left in the drawings).

The cigarette 110 shown in Figure 1 includes a liquid release device 118 comprising two axially aligned circularly cylindrical elements 20, 22 of porous high density polyethylene. Tipping paper 24 is fixed to and extends along the entire length of the stationary element 20, extends over the filter plug 26 and is fixed to the mouth end region of the cigarette paper wrapper 16 of the tobacco rod 12.

The stationary element 20 defines a cavity 30 formed by a blind cylindrical passage extending axially from its end face opposed to the mobile element 22. The mobile element 22 is located in the passage and is axially movable therein while being a snug fit. When the device 118 is in the first condition, that is, when the capsule is not ruptured,

as shown in Figure 1, the end face 32 of the mobile element 22 and the walls of the passage through the stationary element 20 define the cavity 30, which contains a frangible spherical capsule 34 of diameter d containing a charge of liquid flavourant or other smoke modifier.

5 The end face 32 of the mobile element 22 is spaced from the end wall 36 of the passage through the stationary element 20 by a distance l ; typically, $l = d + 0.2\text{mm}$.

The mobile element 22 protrudes from the passage in the stationary element 24 by a distance p . p is less than l ; typically, p
10 $= 0.8d$.

The mobile element 22 is restrained against movement relative to the stationary element 20. A ridge 38 of triangular section extends circumferentially around the part of the mobile element 22 which is within the passage in the stationary element 20. The circumferential
15 ridge 38 is received in a mating circumferential groove 40 of triangular section in the wall of the blind passage in the stationary element 20, best seen in Figure 1A, which is an exploded enlargement of the area A in Figure 1. A second triangular section circumferential groove 42 extends around the wall of the blind passage nearer to the
20 end wall 36 of the passage; the two grooves 40, 42 are separated by a distance p , the same as the distance by which the mobile element 22 extends beyond the stationary element 20.

The annular end face of the stationary element 20 and the free end face of the mobile element 22 are covered by the cap 28.

25 To operate the device, the user gently pushes on the cap 28 axially toward the tobacco rod 12, preferably with one finger, thus moving the mobile element 22 from a first position along the passage in the stationary element 20 toward the capsule 34; the force required to achieve this must be sufficient to push the circumferential ridge
30 38 in the mobile element out of the first groove 40 in the passage wall. As the mobile element 22 is pushed along the passage to a second position it impinges on and crushes the capsule 34, releasing the liquid charge into the porous elements 20, 22. When the circumferential ridge 38 reaches and seats in the second groove 42 in
35 the passage wall, in the second position, the free end face of the mobile element 22 is flush with the annular end face of the stationary element 20, so that the cigarette 110 has a conventional appearance, and the increase in resistance to further movement tells the user that

no further pushing is required. The user then lights the cigarette 110 and smokes it; the liquid from the capsule 34, now in the porous polyethylene elements, is entrained in the smoke and flavours and/or otherwise modifies it.

5 In the cigarette 210 of Figure 2, the stationary element 20 has a blind central axial passage extending from its end face opposed to the mobile element 22. The mobile element 22 is of the same outer diameter as the stationary element 20 and has a cylindrical boss 44, of substantially the same diameter as the passage in the stationary
10 element 20. The boss 44 extends centrally from the end face 46 opposed to the stationary element 20 into the blind passage in the stationary element 20 and can move axially in the passage. The end face 48 of the boss 44 defines, with the walls of the blind passage, a cavity 30 in which is a frangible capsule 34 of diameter d containing liquid
15 flavourant and/or other smoke modifier. The end face 48 of the boss 44 is spaced from the end wall 36 of the blind passage by a distance l . Typically, $l = d + 0.2\text{mm}$.

A sleeve around the mobile 22 and stationary 20 elements is provided by an impermeable polyethylene tube 50 which circumscribes
20 the stationary element 20 except for a circumferential flange 52 at the end which abuts the filter plug 26. An end of the wall of the tube 50 abuts the said flange 52. The tube 50 circumscribes the end portion of the body (that is, the portion of greatest diameter) of the mobile element 22 which opposes the stationary element 20. The tipping 24
25 circumscribes and is fixed to the tube 50 and the flange 52 of the stationary element 20, extends over the filter plug 26 and attaches the device 218 to the tobacco rod 12. The mobile element 22 is a sliding fit in the tube 50 and extends beyond the tube and the tipping 24 by a distance p , less than l ; typically $p = 0.8d$.

30 There is an annular chamber 54 around the part of the boss 42 of the mobile element 22 which does not extend into the passage in the stationary element 20. This annular chamber 54 is defined by the circumferential surface of this part of the boss 42, the annular end face of the stationary element 20, the opposed face of the body of the
35 mobile element 22 and the inner surface of the tube 50; its axial length is p .

The tipping 24 and the tube 50 are perforated in the region overlying the annular chamber 54 by a number of perforations 56 which admit air to the annular chamber 54.

The mobile element 22 of this embodiment is restrained against unwanted axial movement in a similar manner to that of the cigarette 110 shown in Figures 1 and 1A, by interaction between a circumferential ridge 38 around the body of the mobile element 22 and mating first 40 and second 42 circumferential grooves around the inner surface of the tube 50. A cap 28 covers the free end face of the mobile element 22 and the annular end face of the tube 50.

In the starting condition shown in Figure 2, the cigarette 210 cannot be smoked; when the smoker draws on the cigarette, the perforations 56 allow such an air flow into the annular chamber 54 through the mobile element 22 into the smoker's mouth that insufficient air is drawn through the tobacco rod to allow it to be lit or to sustain burning. As the mobile element 22 is pushed, the circumferential ridge 38 around it is pushed out of the first circumferential groove 40. As the mobile element ruptures the capsule 34 and closes the annular chamber 54 covering the perforations 56, the ridge 38 is received in the second circumferential groove 42 to hold the mobile element in position. The cigarette can then be smoked. When the capsule 34 is ruptured, the liquid charge is released into the stationary 20 and mobile 22 elements.

In the cigarette 310 of Figure 3, the sleeve 58 is of rigid soft board which underlies the tipping 24 for its entire length and circumscribes the filter plug 26, the stationary element 20 and part of the mobile element 22. The stationary element 20 is fixed to the sleeve 58, which attaches the device 318 to the filter plug 26 and the tobacco rod 12. The mobile element 22 is a sliding fit in the sleeve 58 and is of generally the same shape as the mobile element of the liquid release device 218 shown in Figure 2.

A frangible capsule 34 of diameter d containing a charge of liquid is in the cavity 30 defined by the blind central axial passage extending into the stationary element 20 from its end face opposed to the mobile element 22 and the end face 48 of the cylindrical boss 44 extending from the mobile element 22 partly into the passage. The end face 48 of the boss 44 is separated from the end wall 36 of the passage by a distance l ; typically, $l = d + 0.2\text{mm}$. The mobile element

22 extends beyond the end of the sleeve 58, and of the tipping 24, by a distance p , less than l ; typically, $p = 0.8d$.

The cigarette 310 of this embodiment is rendered unsmokable in the same way as the cigarette 210 shown in Figure 2, by provision of
5 perforations 56 through the tipping 24 and the sleeve 58 into the annular chamber 54, which are covered as the mobile element 22 is moved toward the stationary element 20 to rupture the capsule 34.

The mobile element 22 is restrained against axial movement in the same way as the mobile element of the cigarette shown in Figures 1 and
10 1A, by interaction of a circumferential ridge 38 on the boss 44 of the mobile element 22 with grooves 40, 42 around the wall of the blind passage in the stationary element 20.

The device 318 operates in the same way as the device 218 of Figure 2.

15 The cigarette 410 shown in Figure 4 is similar to the cigarette 310 shown in Figure 3. In the device 418 of this embodiment, however, it is the mobile element 22 which has the blind central axial passage in it and the stationary element 20 which has the boss 44' extending into the passage, defining between them a cavity 30' for the capsule
20 34.

The elements 20, 22 are constrained against relative axial movement in the same way as in the cigarettes 110, 210, 310 shown in Figures 1, 2 and 3. In this case, however, there is a circumferential ridge on the stationary element 20, around the boss 44', and the two
25 corresponding grooves are in the mobile element 22, in the wall of the blind passage.

The device 418 operates in the same way as the device 318 shown in Figure 3.

The cigarette 510 shown in Figures 5 and 6 is similar to that of
30 Figure 4, but a plurality (seven in this embodiment, as can be seen in Figure 6) of frangible capsules 34' are held in the annular chamber 54 around the boss 44' of the stationary element 20, between the stationary element 20 and the mobile element 22.

In this embodiment, the axial length m of the annular chamber 54
35 between the opposed faces of the stationary 20 and mobile 22 elements is typically $d + 0.1\text{mm}$, where d is the diameter of the capsules 34'. The mobile element 22 extends a distance p , less than m , beyond the sleeve 58; typically, $p = 0.8d$.

The elements 20, 22 are constrained against relative axial movement in the same way as in the cigarette 410 shown in Figure 4.

The cigarette 510 is unsmokable in the starting condition, shown in Figure 5, because of the large amount of ventilation provided through the perforations 56 in the sleeve 58 and tipping 24. Application of longitudinal force at the mouth end of the device 518 moves the mobile element 22 toward the stationary element 20, covering the perforations 56 and rupturing the capsules 34', releasing the liquid charge into the elements 20, 22.

In the cigarette 710 shown in Figure 7, the stationary 20 and mobile 22 elements of the liquid release device 718 are similar to those of the device 418 shown in Figure 4.

In this embodiment, however, an impermeable movable sleeve 60 of rigid soft board circumscribes and is fixed to the mobile element 22. The stationary element 20 is fixed to the filter plug 26 by a highly porous plug wrap 62 which circumscribes the length of the plug 26 and the body (the larger diameter portion) of the stationary element 20 but not the boss. The filter plug 26, and thus the device 718, is fixed to a wrapped tobacco rod 12 by tipping 24 which circumscribes the rod 12 and the filter plug 26 only in the region where they abut one another.

The movable sleeve 60 extends over the annular chamber 54 between the opposed faces and circumscribes, but is not fixed to, the stationary element 20 and the mouth end of the filter plug 26. In the starting condition, shown in Figure 7, the movable sleeve 60 stops short of the tipping 24 by a distance p , exposing the highly porous plug wrap 62 of the filter plug 26 in a band of width p around the plug 26.

The elements 20, 22 are constrained against relative axial movement in the same way as in the cigarette 410 shown in Figure 4.

In the starting condition shown in Figure 7, the cigarette 710 is substantially unsmokable, because when the smoker draws on the cigarette, so much air is admitted into the filter plug 26 through the exposed band of the highly porous plug wrap 62 that lighting and/or burning of the tobacco rod 12 cannot be achieved. When the movable element 22 is pushed toward the stationary element 20, the impermeable movable sleeve 60 slides over the exposed band of plug wrap 62, and finally abuts the tipping 24, to prevent air from entering the filter

plug 26 circumferentially. The cigarette 710 can then be lit and smoked. As the movable element 22 is moved toward the stationary element 20, the capsule 34 is ruptured, releasing a charge of liquid into the elements.

5 The cigarette 810 shown in Figure 8 is similar in structure to and functions in the same way as the cigarette 710 shown in Figure 7. In the liquid release device 318 of this embodiment, however, the stationary element 20 and the movable element 22 have the same configurations as those of the cigarette 310 shown in Figure 3. That
10 is, it is the stationary element 20 which has a blind central axial passage and the movable element 22 which has a boss 44 extending into the passage to define the cavity 30 in which is the capsule 34.

 The elements 20, 22 are constrained against relative axial movement in the same way as in the cigarette 310 shown in Figure 3.

15 The device 308 of this embodiment operates in the same way as that already described for the cigarette 710 shown in Figure 7.

 Figure 9 shows a cigarette 910 similar to the cigarette 810 shown in Figure 8. However, in the liquid release device 918 of this embodiment a number of smaller spherical capsules 34' are held in the
20 annular chamber 54 around the boss 44 of the mobile element 22. In this respect the arrangement of this embodiment is similar to that of the liquid release device 518 shown in Figures 5 and 6; the annular chamber 54 has an axial length m ; typically $m = d + 0.1$ mm, where d is the diameter of the capsules 34'. The movable sleeve 60 stops short of
25 the tipping 24 by a distance p ; typically $p = 0.8d$.

 The elements 20, 22 are constrained against relative axial movement in the same way as in the cigarette 810 shown in Figure 8.

 The cigarette 910 of this embodiment functions in the same way as already described for the cigarette 710 shown in Figure 7.

30 The liquid release device 1018 of the cigarette 1010 shown in Figure 10 has a sleeve circumscribing the stationary 20 and mobile 22 elements, which sleeve is a polyethylene tube 50. The end region of the stationary element 20 which abuts the filter plug 26 has a circumferential flange 52 which is not circumscribed by the tube 50,
35 and the free end of the mobile element 22 extends beyond the tube 50 by a distance p .

 The elements 20, 22 have complementary conical opposed faces; that of the mobile element 22 is a frustoconical surface extending

from the body of the element, and that of the stationary element 20 is a conical surface extending into the element. The capsule 34 is retained in a hemispherical cavity in the centre of the conical face of the stationary element 20; the diameter of the cavity is only very slightly larger than the diameter of the capsule 34. The stationary 20 and mobile 22 elements are separated, in the starting condition of the device shown in Figure 10, by an axial distance l ; typically, $l = d + 0.2\text{mm}$, where d is the diameter of the capsule 34. The distance p by which the mobile element 22 extends beyond the tube 50 is less than l ; typically, $p = 0.8d$.

The mobile element 22 is held in the position shown in Figure 10 by co-operation between a circumferential row of teeth 64 around the mobile element 22 which are received in a first circumferential groove 40 in the inner face of the tube 50. A second circumferential groove 42 is provided in the inner face of the tube 50 nearer than the first groove 40 to the stationary element 20, to receive the teeth 64 when the mobile element 22 is moved toward the stationary element. The teeth 64 on the mobile element 22 can be formed by small cuts or nicks in the circumferential surface of the mobile element 22; these act against the grooves 40, 42 to prevent movement of the mobile element out of the free end of the tube 50 and to restrain the mobile element 22 against unintended or accidental movement toward the stationary element 20. This restraint is overcome when sufficient force is applied to the cap 28 to push the mobile element 22 toward the stationary element 20. This causes the end of the frustoconical surface of the mobile element 22 to impinge on the capsule 34 and rupture it, so that the liquid charge flows into the elements 20, 22. The end of the frustoconical face of the mobile element 22 can be hardened if necessary to ease rupture of the capsule.

Those components of liquid release devices according to the invention which are fixed together, that is, which are immobile relative to each other, may be fixed in any suitable manner, for example by adhesive or they may be a tight friction fit where this is possible. For example, in the liquid release devices 218, 1018 shown in Figures 2 and 10, the stationary element 20 can be a tight friction fit in the tube 50 or it can be fixed in the tube with adhesive.

The liquid release device 1118 of the cigarette 1110 shown in Figure 11 has a sleeve circumscribing the stationary 20 and mobile 22

elements. Tipping paper 24 is fixed to and extends along the entire length of the stationary element 20, extends over the filter plug 26 and is fixed to the mouth end region of the cigarette paper wrapper 16 of the tobacco rod 12. The tipping paper has an inner lining 51 of stiff porous plug wrap, for example made from cellulose fibres. The stationary porous element 20 comprises a high density core 20 surrounded by a low density annulus 21 of cellulose acetate. Likewise the mobile element 22 comprises a high density core 22 surrounded by a low density annulus 21 of cellulose acetate. The tipping 24 is perforated by a number of perforations 56 which admit air into the low density annulus 21 through the inner lining 51 of stiff porous plug wrap.

The stationary porous element 20 and the mobile element 22 are linked to each other by a deformable connector 74, shown in Figure 12. The connector 74 is of a material which can be readily deformed by a smoker pushing the mobile element 22 toward the stationary element 20; it may be a perforated porous plug wrap that is affixed around the circumferential surfaces of the stationary porous element 20 and the mobile element 22. An embodiment of such a deformable connector 74 is shown in Figure 12. The perforated porous plug wrap 70 comprises a number of angled slots 72 that weaken the perforated porous plug wrap 70 in the region of the annular chamber 54. In an alternative embodiment (not shown) the deformable connector 74 may be a strip of deformable material, for example light weight paper or porous plug wrap, which is wrapped around only a part of the circumferences of the stationary porous element 20 and the mobile element 22; for example only a half, a third, a quarter or a sixth of the circumferences of the stationary porous element 20 and the mobile element 22 are wrapped. This corresponds to wrapping around 180 degrees, 120 degrees, 90 degrees or 60 degrees, respectively. Alternatively any other fraction of the circumference may be wrapped; less than 180 degrees is preferred and 120 degrees is especially preferred.

In use, the mobile element 22 is moved towards the stationary element 20, breaking the capsule 34 as has already been described. During this movement the deformable connector 74 crumples into the annular chamber 54 without breaking or tearing of the connector 74, maintaining the link between the mobile element 22 and the stationary element 20. Because the link between the mobile element 22 and the

stationary element 20 is maintained, the mobile element 22 is restrained safely inside the liquid release device 1118.

The cap 28 of the cigarette 1110 is shown in Figure 13. It is made, for example, from laminated biodegradable food grade polymer film. The cap 28 of Figure 13 comprises a circular section 23 and a pull tab 25. The circular section 23 is initially adhered to the end section of the smoking article 1110 by an adhesive spot 29 and covers the end section of the smoking article 1110 to preserve freshness. The pull tab 25 of the cap 28 is adhered to the side of the liquid release device 1118 by a further adhesive spot 29.

It will be appreciated that the smoking articles of the invention can be provided with any features conventionally found on smoking articles, such as ventilation (in addition to any ventilation employed to prevent the smoking article from being lit and/or smoked when the liquid release device is in the first condition).

The invention provides a liquid release device for use in smoking articles which allows a smoker to modify the smoking characteristics of a smoking article conveniently and effectively.

CLAIMS

1. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110), preferably a cigarette, comprising a rod (12) of smokable material and a liquid release device (118), (218), (318), (418), (518), (718), (818), (918), (1018), (1118) in axial alignment with the rod, the device comprising:

a stationary porous element (20) fixed with respect to the rod (12);

a mobile porous element (22) axially aligned with and axially movable relative to the stationary porous element (20); and

at least one frangible capsule (34), (34') of liquid retained between the elements (20), (22),

whereby axial movement of the mobile element (22) from a first position in which the capsule (34), (34') is intact toward the stationary element (20) to a second position causes the capsule to rupture and release the liquid into the porous elements,

the mobile element (22) being restrained against undesired axial movement in at least one, preferably both, of the first and second positions.

2. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to claim 1 further comprising a sleeve (24), (50), (58), (60) around at least a part of one of the elements (20), (22), one of the elements being fixed relative to the sleeve and the other element being movable relative to the sleeve.

3. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to any preceding claim in which the liquid in the at least one frangible capsule comprises at least one agent capable of modifying one or more properties of the smoking article, preferably at least one flavourant, more preferably menthol.

4. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010) according to any preceding claim in which the restraint is provided by cooperation between at least one male part (38) on one of the elements (20), (22) and least one female part on the other element.

5. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to any claim 1 to 4 in which the restraint is provided by a deformable connector (74).

5 6. A smoking article (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to any preceding claim including a ventilation zone (56), (62) for admission of ventilating air into at least one of the elements (20), (22), the ventilation zone (56), (62) being open when the mobile element (22) is in the first position and
10 at least partly covered when the mobile element is in the second position.

7. A smoking article (210), (310), (410), (510), (1010), (1110) according to claims 2 and 6 in which the ventilation zone is provided
15 by perforations (56) through the sleeve (50), (58).

8. A smoking article (710), (810), (910) according to claim 6 in which the circumferential surface of the smoking article has an air permeable portion (62) and in which when the mobile element (22) is in
20 the first position, the said air permeable portion (62) is exposed to admit air into the smoking article to render it unsmokable and when the mobile element (22) is in the second position the said air permeable portion (62) is sufficiently covered by the sleeve (60) to allow the smoking article to be smoked.

25 9. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to any preceding claim further comprising a filter plug (26) disposed between the rod (12) of smokable material and the liquid release device (118), (218), (318),
30 (418), (518), (718), (818), (918), (1018), (1118).

10. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010), (1110) according to any preceding claim in which the device (118), (218), (318), (418), (518), (718), (818), (918),
35 (1018) (1118) is fixed to the rod (12) by tipping (24).

11. A smoking article (110), (210), (310), (410), (510), (710), (810), (910), (1010) according to any preceding claim in which the mouth end

of the liquid release device (118), (218), (318), (418), (518), (718), (818), (918), (1018), (1118) is covered by a cap (28).