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(54) CONSUMABLE CARTRIDGE FOR AN AEROSOL GENERATION DEVICE

(57) A consumable cartridge 10 for an aerosol generation device is disclosed. The consumable cartridge 10 comprises a casing 12, a first heating element 14 provided within the casing 12 and arranged to be inductively heated, and where the first heating element 14 defines a cavity within. A second heating element 16 is provided radially within the cavity and is arranged to be conductively heated by receiving heat energy from the first heating element 14. Aerosol forming material is arranged within the casing such that an aerosol is formed when the aerosol forming material is heated by the first and second heating elements.

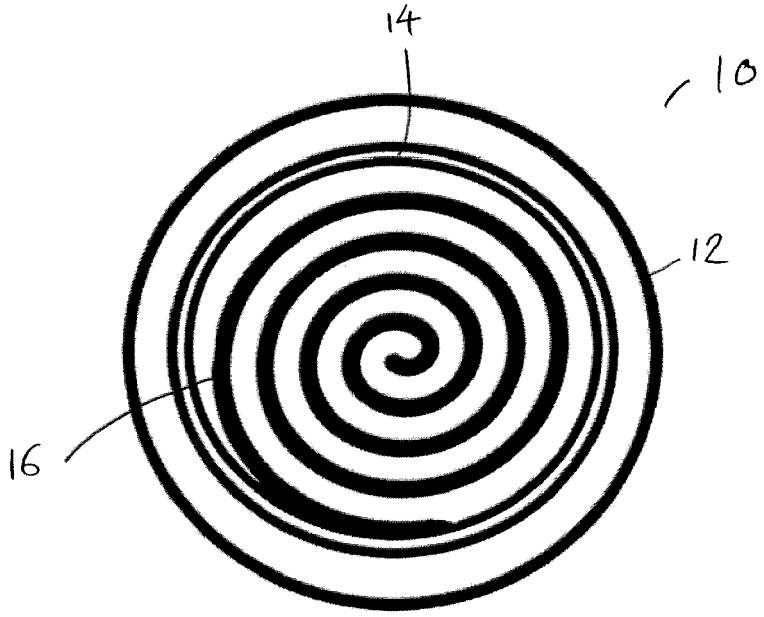

FIG. 1A

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Description

[0001] The present invention relates to a consumable cartridge for use with an aerosol generation device.

Background

[0002] A number of new generation smoking devices have been introduced that seek to provide an alternative to conventional cigarettes. One such device is described in EP 2772148A2. In this arrangement a smoking device is provided with a mouthpiece, a casing, an electrical heater and a battery. A consumable cartridge can be installed in the device adjacent the heater in the smoking device. The consumable cartridge has a casing which encloses tobacco material. The heater can heat the casing of the cartridge, causing the tobacco contained within to heat without burning, which releases an aerosol. This aerosol or vapour can then be inhaled by a user through the mouthpiece.

[0003] As described above, consumable cartridges known in the art normally heat a casing, which in turn heats an aerosol forming material within the casing. It is desirable to maximise the heat transferred to the tobacco material for a more effective and efficient use of smoking device and consumables, and to provide a casing that can be handled more easily.

Summary

[0004] According to an aspect of the invention there is provided a consumable cartridge for an aerosol generation device, the consumable cartridge comprising: a casing; a first heating element provided within the casing arranged to be inductively heated, where the first heating element defines a cavity; a second heating element provided radially within the cavity, the second heating element arranged to be conductively heated by receiving heat energy from the first heating element; and a solid or semi-solid aerosol forming material provided within the casing adapted to form an aerosol upon receiving heat from the first and second heating elements.

[0005] In this way two different heating mechanisms are used to effectively generate heat within a casing that contains an aerosol forming material, such as tobacco. The first outer heating element generates heat by induction and is shaped to form a cavity within. The second inner heating element is provided inside the cavity and transfers heat from the outer heating element via conduction to the aerosol forming material. By using induction heating, the consumable cartridge does not require electrical electrodes on its outer casing in order to receive energy to generate heat. The cartridge may have a generally cylindrical shape with a circular cross-section. The casing can be handled and allows the aerosol forming material to be transported easily.

[0006] Preferably a first portion of the aerosol forming material is arranged between the casing and the first heating element and a second portion of the aerosol forming material is provided within the cavity. In this way it is possible for the heat generated across the whole surface of the first heating element to be more effectively utilised. It should be clear that the second heating element conductively receives a portion of heat generated by the first heating element, and the remaining heat generated by the first heating element can therefore be transferred to the aerosol forming material arranged around it. The aerosol forming material may be in the form of one or more sheets that are arranged between the casing and the first heating element. The sheets may be layered relative to each other, and largely cover the internal cylindrical surface of the casing.

[0007] Preferably the first portion of the aerosol forming material has a higher density than the second portion of aerosol forming material. In this way the density of the aerosol forming material in the cartridge varies along the cross-section of the cartridge. The first portion of aerosol forming material would only be heated by the first heating element and by providing material of a higher density allows the transfer of heat from the first heating element to the first portion to be more effective. In use the second portion of aerosol forming material is heated by both the first and second heating elements (where the second heating element readily transfers heat via conduction) and therefore the second portion can have a lower density and effectively receive heat and generate aerosol.

[0008] Preferably the second heating element comprises a mesh. In this way it is possible for the mesh to provide an interconnected network, or bundle, of fibres such that the heat energy received from the first heating element can effectively travel through the second heating element. The mesh may comprise a plurality of fibres, and wherein each fibre is in contact with at least one additional fibre. The fibres may be arranged in an unwoven configuration where the fibres interlock and/or overlap with other fibres, or the fibres may be arranged in a woven configuration. The mesh may extend from one end of the cylindrical casing to the other end, such that the heating element provides heat within the casing across the full length of the casing. The mesh may be made of a heat-conducting material such as steel.

[0009] Preferably the first heating element comprises a sheet of susceptor material. In this way the surface area of the first heating element can be maximised and effectively generate more heat via induction.

[0010] Preferably at least a portion of the second heating element is in contact with the first heating element. In this way the heat generated by the first heating element can effectively and rapidly be transferred, via conduction, to the second heating element. It should be understood that there may be multiple points or portions of contact between the first and second heating elements.

[0011] Preferably the first heating element is arranged to circumferentially surround the second heating element. In this way the first heating element can effectively generate heat via induction and transfer the generated

heat to the surrounding aerosol forming material and the second heating element. A sheet of susceptor material can also be wrapped or rolled into a cylinder shape which forms the cavity within (in which the second heating element and aerosol forming material is provided). Preferably the first heating element fully circumferentially surrounds the second heating element.

[0012] Preferably the second heating element is spirally wound within the cavity defined by the first heating element. In this way the second heating element can be easily formed by rolling the second heating element into a spiral arrangement and placed into the first heating element. It is possible for the spiral arrangement of the second heating element to distribute the second heating element and aerosol forming material in an even or regular manner within the cavity such that heat generated by the second heating element can be effectively transferred to the aerosol forming material, thereby generating an aerosol.

[0013] Preferably the first heating element and the second heating element are provided as a single sheet which is rolled together with the aerosol forming material, where the second heating element is rolled into the first heating element. In this way the consumable cartridge can be constructed in a simple and effective manner, which advantageously optimises manufacture and reduces costs.

[0014] Preferably the single sheet is layered between two layers of aerosol forming material before the second heating element is rolled into the first heating element. In this way it is possible to provide a larger surface area of the heating element to heat the aerosol forming material. For example, the aerosol forming material can be layered relative to the heating element (e.g. above or below a sheet of the heating element) such that the layer of aerosol forming material and the heating element layer are rolled into a spiral arrangement to be provided within the casing. It is also possible to improve heating efficiency by separating adjacent layers of the heating element with the aerosol forming material such that there is no connection between adjacent layers of the heating element.

[0015] Preferably the casing comprises paper. The casing may also be made from an insulating material such as glass to allow a user to see inside the casing, or from other materials such as ceramics or metals.

[0016] According to another aspect of the invention there is provided an aerosol generation device, comprising: a battery; a magnetic field generator configured to generate a magnetic field upon receiving electrical energy from the battery; and the consumable cartridge according to the present invention, wherein the first heating element is configured to generate heat in response to the magnetic field, and wherein the aerosol forming material can form an aerosol upon receiving heat that is formed by the first and second heating elements.

[0017] The aerosol generation device may have a cartridge holder portion and a controller section. The cartridge holder portion may have an outlet through which a user of the aerosol generation device may inhale an aerosol. The cartridge holder portion may also have a chamber in which the cartridge can be inserted. The cartridge holder portion may also house the magnetic field generator which surrounds the cartridge chamber and is configured to receive electrical energy from the battery in order to create the electromagnetic field which in turn causes the first heating element to be inductively heated.

[0018] The battery may be located in a controller section of the aerosol generation device. The controller section may have an inlet through which air can flow into a constructed aerosol generation device. The aerosol generation device may allow a passage of airflow, by which air enters the aerosol generation device via the inlet, and where the air flows into and through the cartridge via holes or perforations in the cartridge and where the air and aerosol from the cartridge exits the aerosol generation device via the outlet.

Brief description of the figures

[0019] Embodiments of the invention are now described, by way of example, with reference to the drawings, in which:

Figure 1A is a cross-sectional end view of a cartridge in an embodiment of the invention;

Figure 1B is a cross-sectional side view of a cartridge in an embodiment of the invention; and

Figures 2A and 2B are an exploded side view and a constructed side view of an aerosol generation device in an embodiment of the invention.

Detailed description

[0020] Figure 1A and Figure 1B show cross-sectional views of a cartridge 10 from an end view and a side view respectively in an embodiment of the invention. The cartridge 10 has a generally cylindrical shape with a circular cross-section. The cartridge 10 has a casing 12 which accommodates a first heating element 14 and a second heating element 16 provided within a cavity space defined by the first heating element 14. The first heating element 14 is in the shape of a hollow cylinder, and the hollow space in the cylinder is the cavity in which the second heating element 16 is provided (i.e. radially within the first heating element 14).

[0021] An aerosol forming material such as tobacco or reconstituted tobacco (not shown) is provided within the cartridge 10 and arranged between the outer surface of first heating element 14 and the inner surface of the casing 12 as well as within the cavity space of the first heating element 14. A number of other products and ingredients may be provided within the casing 12, as will be appreciated by a person skilled in the art. The second heating element 16 is sheet of conductive material, such as steel, and is rolled into a loosely-wound spiral arrangement with

aerosol forming material rolled within the spiral arrangement. It should also be understood that the second heating element 16 can be provided in other arrangements, such as a zig-zag or periodic waveform arrangement

[0022] The casing 12 can be made from paper or cardboard, or can also be made from an insulating material such as ceramics or metals. The first heating element 14 is made from a material which can generate heat by induction heating, such as iron or its alloys. This means that the first heating element 14 responds to an alternating magnetic field by generating eddy currents and where the flow of the eddy currents through the resistance of the inductive material causes heat to be generated.

[0023] The second heating element 16 is made from a material with a high thermal conductivity such as metals including copper, aluminium or its alloys. Iron or steel alloys may also be used for the second heating element 16. The second heating element 16 is configured to receive heat generating by the inductively heated first heating element 14 via thermal conduction and to rapidly distribute the heat across the second heating element 16. It is possible for the second heating element 16 to also be heated by induction, but this is not essential.

[0024] The first and second heating elements 14, 16 are provided as mesh sheets which increase the surface area of the heating elements and improve air flow through the cartridge 10. The mesh gauge and mesh size are suitably selected such that the aerosol forming material can be substantially contained with the heating elements. The aerosol forming material is provided in the form of strips, sheets or loose particles. It is also possible for the first and second heating elements 14, 16 to be non-woven fibre sheets of material, such as metal wools or even planar sheets of material without gaps.

[0025] The first heating element 14 and the second heating element 16 may be formed into a cylinder and a spiral separately before being constructed together, or in an alternative embodiment, a sheet of the first heating element 14 may be joined with a sheet of the second heating element 16 (such as being sewn together) before the two heating elements are rolled together such that the second heating element 16 is rolled within the first heating element 14. In a preferred embodiment the first heating element 14 fully surrounds the second heating element 16 by effectively forming a closed-off cylinder around the spiralled second heating element 16 within. To improve heat conduction from the first heating element 14 to the second heating element 16 it is also preferable that at least a portion of the second heating element 16 is in contact with the first heating element 14. However it should be understood that contact is not essential for thermal conduction to occur between the two heating elements. The aerosol forming material may be provided in the heating elements 14, 16 by layering the aerosol forming material over and/or under the sheets of the heating elements 14, 16 before the heating elements are rolled or otherwise formed into a cylinder or spiral / roulade arrangement. Alternatively strips or loose particles of tobacco, or other aerosol forming material, may be inserted into the heating elements after construction.

[0026] Figure 2A and 2B shows the cartridge 10 in an aerosol generation device 20 in exploded and constructed views respectively in another embodiment of the invention. The aerosol generation device 20 has a cartridge holder portion 22 and a controller section 24.

[0027] The cartridge holder portion 22 has an outlet 26 or mouthpiece through which a user of the aerosol generation device 20 may inhale an aerosol. The cartridge holder portion 22 includes a chamber 28 in which the cartridge 10 can be inserted. The cartridge holder portion 22 further includes an electromagnet 30 which is configured to receive an alternating electric current from a battery 32 in the controller section 24 of the device and thereby generate an alternating magnetic field to penetrate the cartridge 10.

[0028] The controller section 24 also includes control electronics 34 which causes the battery 32 to provide the alternating current to the electromagnet 30. The electromagnet 30, the battery 32 and the control electronics 34 collectively form the magnetic field generator which provides an alternating magnetic field to the cartridge 10.

[0029] The controller section 24 also has an inlet 36 through which air can flow into a constructed aerosol generation device 20, as seen in Figure 2B. In the constructed device air enters the aerosol generation device via the inlet 36, and continues into and through the cartridge 10 via holes or perforations in the cartridge 10 (not shown), and where the air mixed with aerosol formed in the cartridge 10 exits the aerosol generation device 20 via the outlet 26.

Claims

1. A consumable cartridge for an aerosol generation device, the consumable cartridge comprising:

   a casing;
   a first heating element provided within the casing arranged to be inductively heated, where the first heating element defines a cavity;
   a second heating element provided radially within the cavity, the second heating element arranged to be conductively heated by receiving heat energy from the first heating element; and
   a solid or semi-solid aerosol forming material provided within the casing adapted to form an aerosol upon receiving heat from the first and second heating elements.

2. The consumable cartridge of claim 1, where a first portion of the aerosol forming material is arranged between the casing and the first heating element and a second portion of the aerosol forming material is provided within the cavity.

3. The consumable cartridge of claim 2, where the first portion of the aerosol forming material has a higher density than the second portion of aerosol forming material.

4. The consumable cartridge of any of the preceding claims, where the second heating element comprises a mesh.

5. The consumable cartridge of any of the preceding claims, where the first heating element comprises a sheet of susceptor material.

6. The consumable cartridge of any of the preceding claims, where at least a portion of the second heating element is in contact with the first heating element.

7. The consumable cartridge of any of the preceding claims, where the first heating element is arranged to circumferentially surround the second heating element.

8. The consumable cartridge of claim 7, where the first heating element fully circumferentially surrounds the second heating element.

9. The consumable cartridge of any of the preceding claims, where the second heating element is spirally wound within the cavity defined by the first heating element.

10. The consumable cartridge of any of the preceding claims, where the first heating element and the second heating element are provided as a single sheet which is rolled together with the aerosol forming material, where the second heating element is rolled into the first heating element.

11. The consumable cartridge of claim 10, where the single sheet is layered between two layers of aerosol forming material before the second heating element is rolled into the first heating element.

12. The consumable cartridge of any of the preceding claims, where the casing comprises paper.

13. An aerosol generation device, comprising:

a battery;
a magnetic field generator configured to generate a magnetic field upon receiving electrical energy from the battery; and
the consumable cartridge of any of the preceding claims, wherein the first heating element is configured to generate heat in response to the magnetic field, and wherein the aerosol forming material can form an aerosol upon receiving heat that is formed by the first and second heating elements.

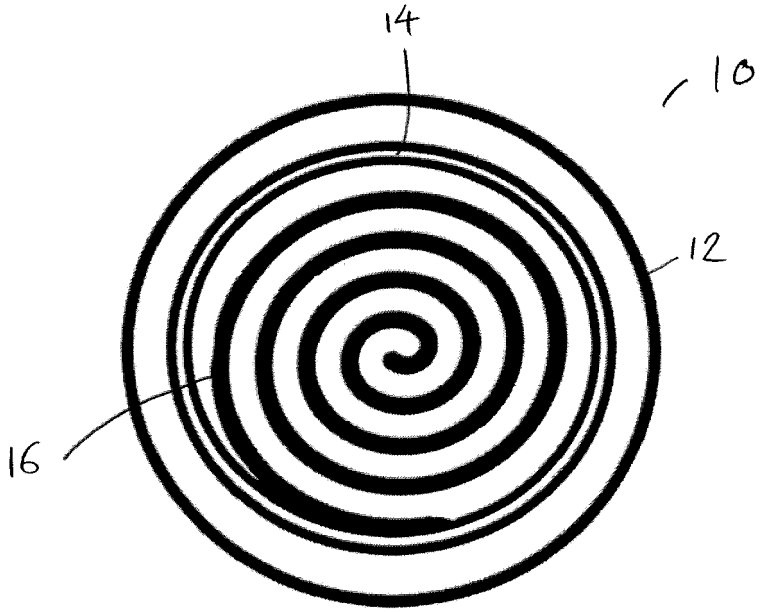

FIG. 1A

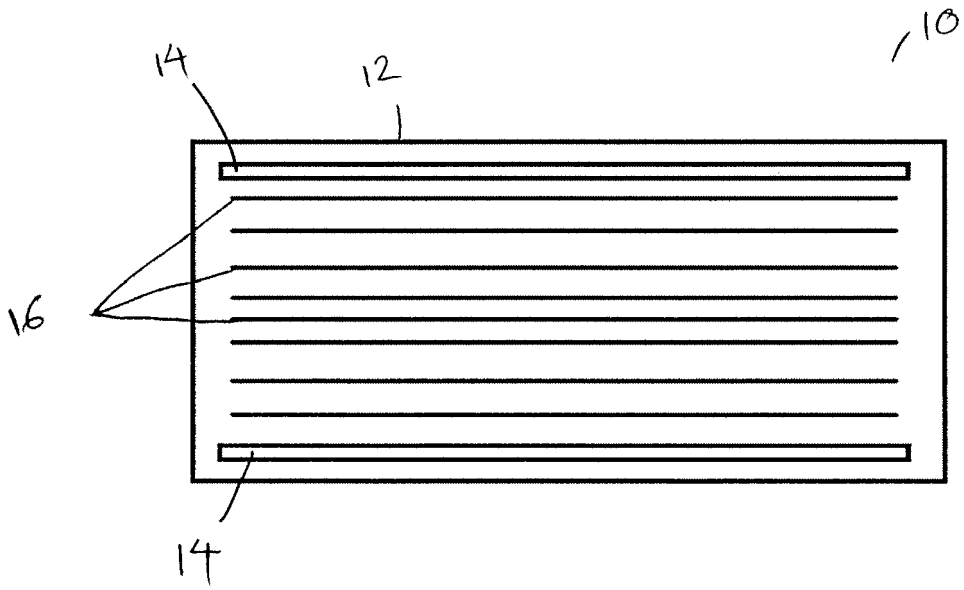

FIG. 1B

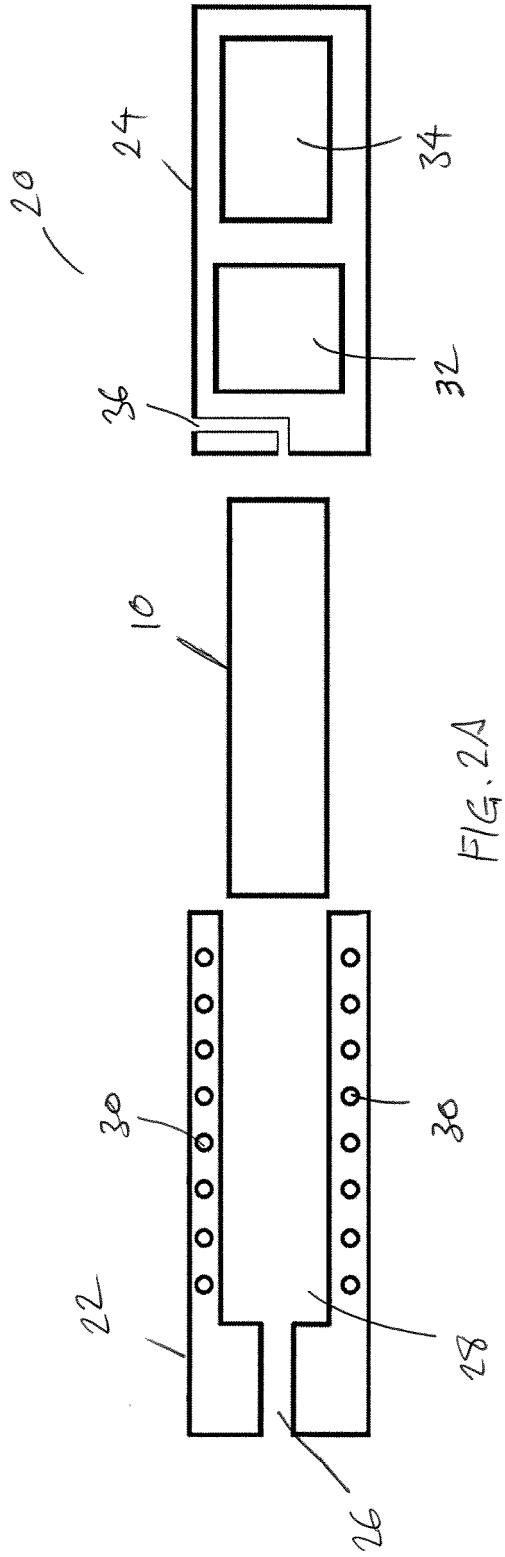

FIG. 2A

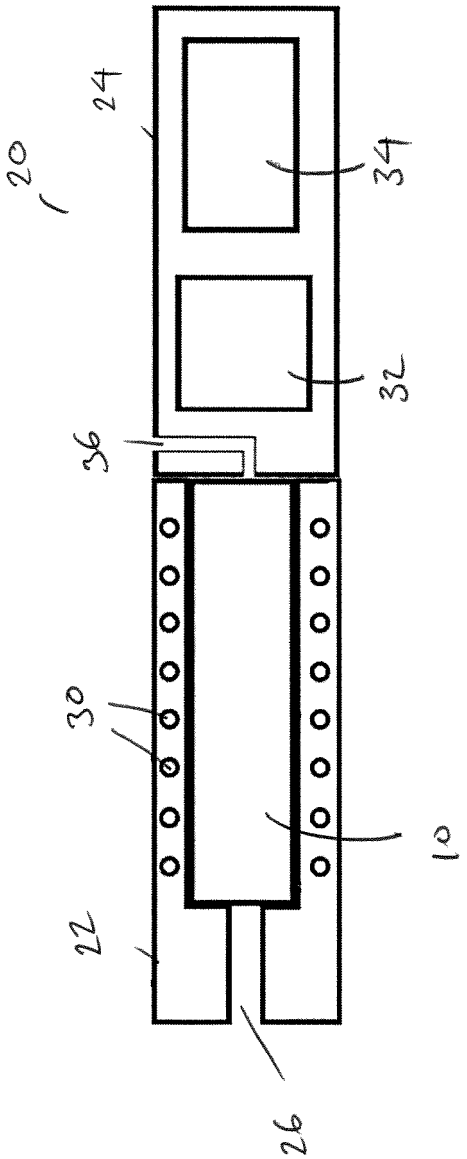

FIG. 2B

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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 7294

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2018/228217 A1 (MIRONOV OLEG [CH] ET AL) 16 August 2018 (2018-08-16) * paragraphs [0101] - [0105]; figures 1-4 * -----	1-13	INV. A24F40/465 A24F40/42
A	WO 2019/016737 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 24 January 2019 (2019-01-24) * page 5, lines 3-12; figures 1, 2, 5 * -----	1-13	
A	WO 2019/030363 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 14 February 2019 (2019-02-14) * page 13, lines 6-24; figures 1-4 * -----	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

A24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 May 2020	Schwarzer, Bernd

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 20 7294

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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