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(72) Inventor: **Gidding, Marinus Theodorus Franciscus Maria**
6661 NS, Elst (NL)

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(74) Representative: **Hylarides, Paul Jacques et al Arnold & Siedsma**
Sweelinckplein 1
2517 GK The Hague (NL)

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(71) Applicant: **Vituvia Operations Limited**
1060 Nicosia (CY)

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(54) **Device and method for filtering smoke**

(57) The present invention comprises a device for filtering tobacco smoke from a tobacco product, comprising a housing in which the tobacco product can be arranged, and a filter for filtering tobacco smoke, the housing comprising:

- a tobacco reservoir for holding tobacco,
- an outside air feed for feeding from the environment outside air necessary for the combustion of the tobacco,
- a tobacco smoke discharge for discharging tobacco smoke caused by the combustion,

- a filter connected to the tobacco smoke discharge for filtering substances harmful to the environment from the tobacco smoke;

- a mouthpiece which is connected to the tobacco reservoir and the smoke discharge and with which a smoker can inhale the tobacco smoke from the tobacco reservoir and can exhale the tobacco smoke to the tobacco smoke discharge, **characterized in that** the filter comprises at least one of an absorption filter unit, an electrostatic filter unit, an ionization filter unit (76,101), a centrifugal filter unit, a UV filter unit or an ozone filter unit.

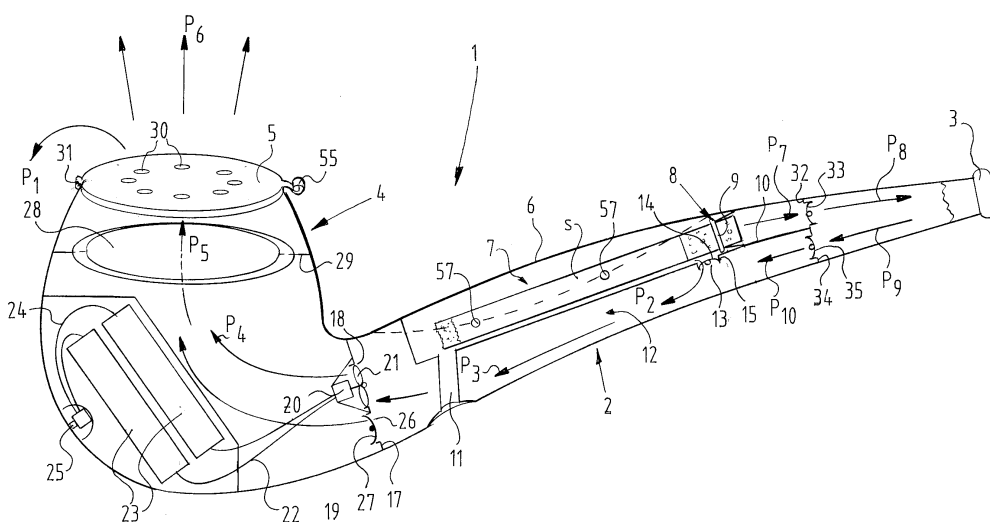


FIG. 1

Description

[0001] The present invention relates to a device and method for filtering tobacco smoke.

[0002] The fact that smoking tobacco can damage the health has been known for some considerable time. Many campaigns have already been mounted by, among others, governments in order to persuade people to stop smoking, or at least to influence smoking behaviour. The purpose of these campaigns has always been until very recently to persuade smokers to stop smoking altogether, wherein the argument has been that smoking is hazardous to the health of the smoker him/herself. It is however becoming increasingly apparent that smoking can not only damage the health of the smoker him/herself, but also of passive smokers present in the vicinity of the smoker. A passive smoker is here understood to mean any random person who, although this person does not him/herself smoke, is nevertheless forced to inhale tobacco smoke of someone else. The health of passive smokers can hereby be seriously affected.

[0003] While a smoker can defend himself with the argument that it is up to him/her to decide whether he/she indulges in habits damaging to his/her own health, the passive smoker does not have this option. This is an important reason why smoking is being officially forbidden more and more in public places. The consequence hereof is that the smoker is often forced to go outside public buildings to be able to enjoy a smoke. This is a problem, particularly for the hardened smoker, who will go to great lengths to be able to enjoy his/her tobacco.

[0004] It is an object of the invention to resolve the above stated problems. It is more specifically an object of the present invention to provide a method and device with which the passive smoker is protected from harmful substances from the tobacco smoke of a smoker.

[0005] According to one aspect of the present invention, there is provided a device for filtering tobacco smoke from a tobacco product, comprising a housing in which the tobacco product can be arranged, and a filter for filtering tobacco smoke, the housing comprising:

- a tobacco reservoir for holding tobacco,
- an outside air feed for feeding, from the environment, outside air necessary for the combustion of the tobacco,
- a tobacco smoke discharge for discharging tobacco smoke caused by the combustion,
- a filter connected to the tobacco smoke discharge for filtering substances harmful to the environment from the tobacco smoke which can be guided therealong,
- a mouthpiece which is connected to the tobacco reservoir and the smoke discharge and with which a smoker can inhale the tobacco smoke from the tobacco reservoir and can exhale the tobacco smoke to the tobacco smoke discharge.

[0006] In the device not only is tobacco smoke filtered when the smoker has lit the tobacco and is not (yet) inhaling the smoke, but also the tobacco smoke once it has been inhaled and then blown out again by the smoker. This means that practically all tobacco smoke is filtered, and people in the vicinity of the smoker are therefore no longer inconvenienced by the fact that the smoker is smoking. The device makes it possible for instance to smoke in a small closed space without others in the space having to be passive smokers.

[0007] According to a preferred embodiment, the tobacco smoke discharge and the tobacco reservoir are arranged relative to each other for generating, as a result of convection, one or more forced gas flows in the smoke discharge, by which flow tobacco smoke is continuously discharged. In this embodiment use is made of the fact that hot air tends to rise. The tobacco in the tobacco reservoir causes hot smoke which rises to a filter provided above the tobacco reservoir. The filter removes the harmful substances from the smoke and discharges the filtered part of the smoke. No electrical or mechanical means are therefore necessary in this embodiment to realize the required discharge of tobacco smoke, which results in, among other things, an unlimited lifespan and a relatively simple construction.

[0008] According to another preferred embodiment, the present invention comprises gas displacing means for generating one or more forced gas flows in the smoke discharge, by which flow tobacco smoke is discharged. Measures are taken in this embodiment to generate the gas flows required for discharge of tobacco smoke using mechanical and/or electronic means, such as suction means with which smoke can be drawn from the tobacco reservoir. In a particularly advantageous embodiment, the gas displacing means comprise one or more fans. The gas displacing means can also be embodied in the form of pumps, for instance of the centrifugal type or the membrane type.

[0009] According to a preferred embodiment, the present invention comprises a device wherein the fan can be driven with an electric motor, and in the housing there is provided a compartment in which the electric power supply, in particular one or more batteries, can be accommodated.

[0010] According to a preferred embodiment of the present invention, the device comprises regulating means for guiding the gas flows through the smoke discharge and the mouthpiece.

[0011] According to a preferred embodiment, the present invention comprises a device wherein the regulating means comprise at least a first non-return valve between the tobacco reservoir and the smoke discharge, at least a second non-return valve between the tobacco reservoir and the mouthpiece and at least a third non-return valve between the mouthpiece and the smoke discharge.

[0012] According to a preferred embodiment, the present invention comprises a device wherein the non-

return valves are adapted, in a standby situation in which the tobacco has been lit and no inhalation or exhalation is taking place, to allow through the gas flow from the tobacco reservoir to the smoke discharge and to prevent the gas flow from the reservoir to the mouthpiece.

[0013] According to a preferred embodiment, the present invention comprises a device wherein the non-return valves are adapted, in an inhaling situation where tobacco smoke is being inhaled by a user via the mouthpiece, to allow through the gas flow from the reservoir to the mouthpiece.

[0014] According to a preferred embodiment, the present invention comprises a device wherein the non-return valves are adapted, in an exhaling situation where the user exhales the inhaled air via the mouthpiece, to prevent the gas flow from the mouthpiece to the reservoir and allow through the gas flow from the mouthpiece to the smoke discharge.

[0015] According to a preferred embodiment, the present invention comprises a device wherein the regulating means comprise a closing membrane with which the throughfeed in a determined direction can be prevented and the throughfeed in the opposite direction can be left substantially clear.

[0016] According to a preferred embodiment, the present invention comprises a device which is adapted, in a standby situation in which the tobacco has been lit and no inhalation or exhalation is taking place, for forced discharge of the tobacco smoke via the tobacco smoke discharge.

[0017] According to a preferred embodiment, the present invention comprises a device which is adapted, also in an exhaling situation where at least a part of the inhaled air is being exhaled by the user via the mouthpiece, for forced discharge of the tobacco smoke via the tobacco smoke discharge.

[0018] According to a preferred embodiment, the present invention comprises a device wherein the tobacco smoke discharge comprises a first discharge channel for discharging tobacco smoke in the standby situation and a second discharge channel for discharging the tobacco smoke exhaled in the exhaling situation.

[0019] According to a preferred embodiment, the present invention comprises a device wherein a fan is arranged in the first discharge channel.

[0020] According to a preferred embodiment, the present invention comprises a device wherein the first and second discharge channel are combined to form a single smoke discharge channel, and the fan is arranged in the combined smoke discharge channel.

[0021] According to a preferred embodiment, the present invention comprises a device wherein at the position of the tobacco reservoir the housing comprises a removable closing cover to enable placing of tobacco in the tobacco reservoir, and wherein the outside air feed is formed by a number of throughflow openings provided in the closing cover.

[0022] According to a preferred embodiment, the

present invention comprises a device wherein the outside air feed comprises an air passage extending from the outside of the housing to the tobacco reservoir.

[0023] According to a preferred embodiment, the present invention comprises a device wherein the air passage is embodied to enable lighting of the tobacco via the passage.

[0024] According to a preferred embodiment, the present invention comprises a device wherein the pressure caused by a fan is lower than the pressure caused by inhalation by the user.

[0025] According to a preferred embodiment, the present invention comprises a device wherein the forced gas flow has a flow rate of a maximum of 10% of the flow rate of the inhaled or exhaled gas flow.

[0026] According to a preferred embodiment of the present invention, the device comprises holding means for holding the tobacco product such as a cigarette or a cigar.

[0027] According to a preferred embodiment, the present invention comprises a device wherein the tobacco product is rolling tobacco.

[0028] According to a preferred embodiment, the present invention comprises a device which can be held by the mouth of a person.

[0029] According to a preferred embodiment, the present invention comprises a device wherein the total weight amounts to a maximum of 1 kg, preferably a maximum of 300 g.

[0030] According to a preferred embodiment of the present invention, a device comprises a supply compartment for temporary storage of additional tobacco.

[0031] According to a preferred embodiment of the present invention, a device comprises a lighter compartment for storing a lighter with which the tobacco can be lit.

[0032] According to a preferred embodiment of the present invention, a device comprises a switch for switching on one or more of the fans.

[0033] According to a preferred embodiment of the present invention, a device comprises a detector arranged in or close to the tobacco reservoir for directly or indirectly detecting tobacco smoke, wherein the detector is coupled to the switch for switching on the one or more fans in the case of tobacco smoke and switching them off in the absence of tobacco smoke.

[0034] According to a preferred embodiment of the present invention, a device comprises

- a temperature sensor arranged in or close to the tobacco reservoir for generating a temperature signal representative of the temperature,
- a control means coupled to the temperature sensor, the one or more fans and/or to the switch for switching on the one or more fans above a preset temperature and switching them off below a preset temperature, this on the basis of the temperature signal.

[0035] According to a preferred embodiment, the

present invention comprises a device wherein the filter contains active carbon.

[0036] According to a preferred embodiment, the present invention comprises a device wherein the filter is an ion filter.

[0037] According to a preferred embodiment of the present invention, a device comprises a cathode and an anode between which the smoke can be guided for ionizing at least some of the substances in the smoke under the influence of an electric field between the cathode and anode, and collecting means for collecting the ionized substances.

[0038] According to a preferred embodiment of the present invention, a device comprises means for generating aromatic substances.

[0039] According to a preferred embodiment of the present invention, a device comprises a filter compartment which is provided in the housing and which can be closed off from the environment with a removable closing valve, wherein one or more replaceable filters can be placed in the filter compartment.

[0040] According to a preferred embodiment, the present invention comprises a device wherein the tobacco reservoir is open at its top and along the upper edges thereof there are provided a number of openings connecting to the tobacco smoke discharge for the purpose of drawing off the smoke produced in the tobacco reservoir.

[0041] It is further possible for instance to arrange a number of components of the device, such as the power supply, the control and/or the filter, in a separate second housing. The second housing can for instance be carried in an (inside) pocket of the clothing of the smoker, or be fastened via a strap to the belt or round the neck of the smoker. The connection between the two housings takes place by means of electric wiring for the power supply and the control and an air tube along which the air to be inhaled and/or exhaled can be guided. In this embodiment the first housing, which is held in the mouth by the smoker, can be given a lighter form, which may in some cases enhance the comfort of the device. This embodiment also provides the option of a more powerful power supply with a longer lifespan or a more extensive filter for cleaner filtering of the tobacco smoke.

[0042] In a further preferred embodiment the housing is therefore constructed from a first housing part and a second housing part, wherein at least the mouthpiece, the tobacco reservoir and the feed for outside air are arranged in the first housing part and wherein at least the tobacco smoke discharge, the filter and the gas displacing means are distributed over the first and second housings.

[0043] According to a second aspect of the present invention, there is provided a method for filtering tobacco smoke from a tobacco product, comprising of:

- arranging the tobacco product in a tobacco reservoir in a housing provided with one or more filters for

filtering tobacco smoke;

- lighting the tobacco product;
- continuously discharging gases containing tobacco smoke from the tobacco reservoir via a first tobacco smoke discharge provided in the housing, guiding the gases through said filter and subsequently discharging the filtered gases to the outside air;
- carrying gases containing tobacco smoke, during inhalation, from the tobacco smoke reservoir to a mouthpiece connected to the housing;
- during exhaling of previously inhaled gases containing tobacco smoke, guiding the gases through the filter via the mouthpiece and a second tobacco smoke discharge provided in the housing, and subsequently discharging the filtered gases to the outside air.

[0044] The method preferably also comprises of generating one or more forced gas flows in the smoke discharge, the gases containing tobacco smoke being discharged by this flow. The method can also comprise of drawing gases containing tobacco smoke substantially continuously from the tobacco reservoir to the tobacco smoke discharge and driving thereof through the filter.

[0045] The method preferably comprises of forced discharge of the tobacco smoke via the tobacco smoke discharge in a standby situation in which the tobacco has been lit and no inhalation or exhalation is taking place. The method furthermore preferably comprises of forced discharge of the tobacco smoke in an exhaling situation where at least a part of the inhaled air is being exhaled by the user via the mouthpiece.

[0046] In a particularly advantageous embodiment, the method comprises of:

- providing a detector arranged in or close to the tobacco reservoir;
- directly or indirectly detecting tobacco smoke in the tobacco reservoir;
- generating said gas flows for discharging tobacco smoke only when tobacco smoke is present.

[0047] In another particularly advantageous embodiment, the method comprises of:

- measuring the temperature in or close to the tobacco reservoir;
- generating said gas flows for discharging the tobacco smoke only at a preset maximum temperature or in the case of a maximum temperature increase.

[0048] In the two latter embodiments the forced gas flow by the gas displacing means is only activated when smoking actually takes place, i.e. when the tobacco is actually lit. This means that the smoker himself no longer has to activate the device (for instance with an on/off switch) and this prevents the gas displacing means by mistake not being switched on or remaining switched on

for too long. In the former case unfiltered smoke could enter the environment, while in the latter case the power supply of the gas displacing means will be quickly exhausted.

[0049] In a further preferred embodiment, the device comprises one or more solar cells for converting solar energy to electrical energy, wherein the solar cells are connected to the power supply for charging thereof. Depending on the amount of sunlight, the solar cells ensure that the power supply does not have to be separately recharged, for instance via the mains electricity in the case of a rechargeable power supply, or must be replaced in the case a non-rechargeable power supply such as batteries is applied, or at least that the power supply is exhausted less rapidly.

[0050] Further advantages, features and details of the present invention will be elucidated on the basis of the description of several preferred embodiments thereof. Reference is made in the description to the accompanying figures, in which:

- figure 1 shows a cross-section, partly in perspective, of a first preferred embodiment of the invention;
- figure 2 shows a partly cut-away top view of a second preferred embodiment of the invention;
- figure 3 shows a side view of the embodiment of figure 2;
- figure 4 shows a cross-section, partly in perspective, of a third preferred embodiment;
- figure 5 shows a cross-section, partly in perspective, of a fourth preferred embodiment of the invention; and
- figures 6a and 6b show views of a fifth preferred embodiment of the invention.

[0051] Figure 1 shows a first preferred embodiment of the invention. Device 1 is here constructed from a housing 2 which is provided at a proximal end with a mouthpiece 3 and provided at a distal end with a cover 5 provided with throughflow openings. In the shown embodiment the casing 2 takes the form of a pipe. However, within certain limits lying within reach of the skilled person, the device can take a random different form.

[0052] Housing 2 has an elongate part 3 and an upright part 4 connected thereto. Arranged on an outer end of elongate part 3 is mouthpiece 3 which in known manner takes a form such that it can be held readily and comfortably in the mouth by a smoker. The upright part 4 is provided on the opposite end of elongate part 3 of housing 2.

[0053] Provided in elongate part 3 is a filling flap 6 which can be folded open and shut in known manner, for instance using hinges 57. In elongate part 3 adjoining the inner side of filling flap 6 is provided a reservoir 7 in which the tobacco product, for instance one or more cigarettes, optionally provided with cigarette filter, or a cigar, can be arranged. For the case that a cigar or cigarette (s) are applied, a holding element 8 is provided in com-

partment 7. Holding element 8 can be embodied in many ways. The element can for example be constructed from a clip 9 of resilient material attached to the wall 10 of compartment 7. The cigarette(s) can be fixed inside compartment 7 using this clip 9.

[0054] In addition to the closable space 7 in which the tobacco product can be arranged, the elongate part 3 comprises a lighting channel 11 which extends from the outer surface of elongate part 3 of housing 2 and the inner wall of compartment 7. The channel forms an open connection between the outside air and the space 7 inside elongate part 3, this such that lighting channel 11 debouches at a position suitable for lighting tobacco possibly placed in space 7. In the case of a cigar or cigarette this means that lighting channel 11 debouches in the vicinity of the outer end thereof. If however loose rolling tobacco is placed in the space, the positioning of lighting channel 11 is of less importance, just as long as channel 11 debouches at a position where tobacco is situated.

[0055] Lighting channel 11 also has the function of supplying the oxygen necessary for combustion of the tobacco from the outside air to tobacco compartment 7 in housing 2. Once the lighting channel has been used to light the tobacco, it therefore functions as air feed channel.

[0056] Also provided in elongate part 3 is a smoke discharge channel 12 which extends from the proximal end of tobacco compartment 7 into the upright part 4 and which connects onto cover 5. Between space 7 and smoke discharge channel 12 there are provided one or more openings 13 which can be closed using one-way valve 14, also referred to as non-return valve. In the shown embodiment a one-way valve 14 is made up of a membrane, for instance of rubber, arranged on the wall of smoke discharge channel 12 at one fixing point 15. The one-way valve 14 herein closes said openings 13 between space 7, in which the tobacco is situated, and smoke discharge channel 12. Because one-way valve 14 is manufactured from flexible membrane, air flowing from space 7 to smoke discharge channel 12 will open the valve so that this air is carried almost freely or at least with little resistance from space 7 to smoke discharge channel 12, while an airflow in the opposite direction, i.e. from smoke discharge channel 12 to space 7, causes valve 14 to close so that the airflow from smoke discharge channel 12 to space 7 is interrupted.

[0057] As already mentioned, a mouthpiece 3 is provided at the proximal end of the elongate part. In the shown embodiment this has a funnel shape. Other forms can however also be envisaged. Between the space 7 in which the tobacco product can be arranged and the mouthpiece 3 there is provided a partition wall 32 which, in accordance with the above described method, is provided with a number of openings and on which is mounted a one-way valve in the form of a membrane 33. One-way valve 33 is mounted such that an airflow from space 7 to the interior of mouthpiece 3 can take place practically unimpeded, while a displacement in the opposite direc-

tion through valve 33 is prevented. A partition wall 34 is likewise provided between mouthpiece 3 and smoke discharge channel 12. In partition wall 34 are arranged one or more openings which can be closed using a further one-way valve 35. This latter is embodied here such that an airflow from mouthpiece 3 to smoke discharge space 12 can take place practically unimpeded, while a displacement of gases in the opposite direction is prevented.

[0058] Many variants of said one-way valve are possible, all falling within the scope of the present invention. A one-way valve should be understood to mean all means which ensure that a gas flow in a first direction is impeded much less than a gas flow in the opposite direction. No gas or only little gas will herein pass through the valve in the blocking direction, while a gas flow along the valve is possible in the release direction. Depending on the embodiment, a gas flow will encounter more or less resistance when passing through the valve in the release direction. This resistance can be preset and can be applied to ensure a correct flow of the gases through the different channels of the device.

[0059] Figure 1 shows that between the elongate part 3 and the upright part 4 of device 1 there is provided a partition wall 17 which is provided with a circular opening 18. Fixed against the rear of partition wall 17 is a support 19 to which a fan 20 is coupled. Fan 20 is embodied here such that the blades 21 thereof extend substantially in one plane with partition wall 17. Fan 20 is connected via electric wiring 22 to one or more batteries 23 which are accommodated in a battery compartment arranged separately in upright part 4. In the shown embodiment wiring 24 is also provided which is connected to an on/off switch 25 which can be operated from the outside of housing 2 and with which fan 20 can be switched on and off.

[0060] Provided in partition wall 17 are additional openings 26 which can be closed with one or more further one-way valves 27. The one-way valve is arranged on the downstream side of partition wall 17 so that airflow from the smoke discharge channel to upright part 4 is possible with a relatively low resistance, while an airflow in the opposite direction is prevented.

[0061] Two walls 17 are otherwise shown in figure 2 for the sake of clarity. In reality however, there is a single wall in which the opening for the fan and the openings for membrane 27 are both arranged. One-way valve 27 hereby provides an "overflow" option parallel to through-flow opening 18 to enable processing of sudden, large quantities of smoke resulting from exhalation by the smoker.

[0062] A filter 28 is arranged downstream of fan 20. In the shown embodiment the filter consists of an exchangeable disc-like filter component 28. The filter component consists of a filter pad in which active carbon or another suitable absorption material is arranged with which the harmful substances can be filtered out of the smoke gases. The pad extends in a position transversely of the direction of displacement of the smoke in order to make the active area thereof as large as possible.

[0063] In an alternative embodiment, such as for instance in the embodiments of figures 4 and 5, an electrically driven ion filter is provided instead of the absorption filter. The operation of the filter will be described hereinbelow with reference to the embodiments shown in figures 4 and 5.

[0064] In the embodiment shown in figure 1 the filter 28 rests on a wall 29 which is provided with throughflow openings (not shown) and which is placed transversely over the full cross-section of upright part 4. As stated above, the upright part 4 is closed with a cover plate 5 provided with throughflow openings 30. The cover plate is mounted on the upright part 4 of device 1 using hinges 31. At a position opposite that of the hinges there is provided a handle 55 by which the cover plate can be grasped to open or close it (arrow P₁). In the closed position the part 4 is fixed relative to upright part 4 by means of a snap connection (not shown).

[0065] During use the device 1 functions as filter mechanism for the smoke gases caused by the burning tobacco, so that harmful substances from the smoke gases do not enter the environment, or only do so to a greatly reduced extent. The use of the device is described hereinbelow on the basis of a number of situations. In the standby situation the tobacco in the tobacco compartment is lit, but no inhalation or exhalation by the smoker takes place. In the "inhale" situation the smoker inhales via mouthpiece 3 tobacco smoke from tobacco smouldering in tobacco reservoir 7. In the "exhale" situation the smoker finally exhales the inhaled air via the mouthpiece.

[0066] An example of the method and use of the device according to the invention is described hereinbelow. The smoker first arranges a filter 28 in the device by folding open the discharge plate, placing on wall 29 and optionally clamping a filter pad 28 using means which are not shown, and once again closing discharge plate 25. The smoker then opens filling flap 6 by pivoting it open, whereby the tobacco space 7 is left clear. In the tobacco space is then placed the tobacco product, i.e. one or more cigarettes, one or more cigars and/or rolling tobacco. After filling flap 6 has once again been closed, the device is ready for use. To this end the tobacco in space 7 is lit via lighting channel 11. When a cigarette or cigar is arranged, an outer end is brought to combustion for this purpose. When rolling tobacco is used, this is lit at a random position via lighting channel 11.

[0067] After filter 28 has been placed in the above described manner, the user switches on fan 20 by operating on/off switch 25. Fan 20 provides an underpressure in smoke discharge channel 12. As a consequence of this underpressure the membrane 14 is opened and gases flow from tobacco compartment 7 into smoke discharge channel 12. As a result of the fact that the exit of the air feed channel (lighting channel) 11 is disposed at the one end of the compartment and openings 13 are placed at the opposite end, a draught of air is created which is sufficient to keep the tobacco burning. The pressure drop

over openings 13 and valve 14 is set here such that it is smaller than the pressure drop over membrane 35 and the associated openings in wall 34. This prevents air being drawn in particularly via the mouthpiece, which could cause a reduced draw of the tobacco.

[0068] Fan 20 thus draws in the smoke gases of the smouldering tobacco, causes the smoke gases to pass through membrane 27 and carries them to the interior of the upright part 4 and subsequently guides them to the outside via filter 28 and discharge plate 5.

[0069] As set forth above, there occurs in the standby situation a weak flow of a mixture consisting of air supplied via lighting channel 11 and smoke caused by combustion of the tobacco via the one-way valve 14, one-way valve 27 and filter 28 (arrows P_2 - P_6), since the pressure to be overcome by the air over one-way valve 14 is lower than the pressure which must be overcome between tobacco space 7 and via the combination of one-way valves 33 and 35. In the standby situation (practically) no smoke flows via mouthpiece 3 to the outside, and virtually all smoke gases will therefore reach the outside world via filter 28 and discharge valve 4. This means that as long as the smoker does not make use of mouthpiece 3, all smoke gases are filtered by filter 28, so that no harmful smoke gases, or at least only a smaller quantity thereof, will reach the environment.

[0070] When a smoker makes use of mouthpiece 3 and inhales the smoke (inhaling situation), the smoke gases in tobacco space 7 will be inhaled via one-way valve 33 and mouthpiece 3 (arrow P_7 and arrow P_8). One-way valves 14 and 35 further prevent flows from smoke discharge channel 12 via tobacco compartment 7 to mouthpiece 3 or from smoke discharge channel 12 directly to mouthpiece 3. These latter flows are of course undesirable since they contain mainly outside air.

[0071] When the smoker now blows out the inhaled smoke again (exhaling situation) into mouthpiece 3 (arrow P_9), the smoke is held back by one-way valve 33 (shown as a membrane in figure 1) so that the smoke does not enter tobacco space 7. The smoke is carried via one-way valve 35 into smoke discharge channel 12 and discharged in the above described manner mainly via the additional openings 26 and via filter 28 (arrows P_2 - P_6). The additional openings 26 are provided in order to enable processing of the relatively high flow rate of exhaled air (the flow rate of the inhaled air is generally much smaller). Valve 14 moreover prevents exhaled smoke which has entered smoke discharge channel 12 being blown back again to tobacco space 7. This means that all smoke gases inhaled by the smoker via mouthpiece 3, to the extent at least that these have not been absorbed by the body itself, are discharged once again via mouthpiece 3, wherein a filtering of the exhaled smoke gases takes place. This prevents the exhaled smoke gases reaching the environment.

[0072] Figures 2 and 3 show an alternative embodiment of the present invention. In this embodiment the device 1' is built up of a droplet-shaped casing 2 which

is provided on one side with a mouthpiece 3. Although this mouthpiece differs in form from the mouthpiece shown in figure 1, the present mouthpiece has a similar function. In the shown embodiment a tobacco space 40 is provided in which a quantity of tobacco (in this case rolling tobacco) can be arranged. Tobacco space 40 is provided on the top with a removable cover flap 41 so that it can be readily filled by the user. Cover flap 41 is provided with throughflow openings 42 which are provided for the supply of oxygen used in the process of combustion of the tobacco in tobacco space 40. Provided between tobacco space 40 and mouthpiece 3 is a first channel 43. Arranged transversely thereof is a partition wall 44 in which a one-way valve 45 is placed in above described manner. The one-way valve is embodied here such that gases from the tobacco space to mouthpiece 3 can pass practically unimpeded through partition wall 44, while a displacement in the opposite direction is prevented. On either side of the first channel 43 openings are further arranged in the channel wall which can be closed using two further one-way valves 47 and 47'. Valves 47 and 47' are arranged on the outer side of the channel wall, so that while smoke from channel 43 can be discharged outward, flow in the opposite direction is prevented. On the side walls of channel 43 are arranged smoke discharge channels 48 and 48' which debouch in a single common discharge channel 49. Channel 49 is closed using a smoke filter 50 which can be arranged in the manner to be described below.

[0073] In addition to the above stated channel 43 between tobacco space 40 and mouthpiece 3, on an opposite side of the tobacco space there is provided a suction channel 52 arranged concentrically relative to the common channel 49. A partition wall 53 provided with an opening is arranged in suction channel 52. A fan 54 also arranged on partition wall 53 can herein draw in gases from tobacco space 40 via said openings in partition wall 53.

[0074] The above mentioned channels 48, 48' debouch in the common channel 49 via a number of openings arranged in the respective channel walls 60, 60' and one-way valves 61 and 61' arranged in the respective channels. The one-way valves are once again arranged such that gases from channels 48, 48' can reach the common channel 49, but gases from the common channel 49 cannot penetrate into channels 48, 48'.

[0075] In use a user first places a filter 50 in device 1 by removing cover flap 56, which is arranged on casing 2 using a snap connection, placing a filter pad 50 and once again fastening cover plate 56 to casing 2. The user then switches on fan 54 by operating an on/off switch 62 which is connected to fan 54 using electric wires 63, 63' and batteries 64, 64' and wires 65, 65'.

[0076] In the standby situation the fan 54 draws in air via openings 42 in valve 41. The fan herein draws the membrane 45 fixedly against partition wall 44 so that no air is sucked into tobacco space 40 via mouthpiece 3. the air drawn into tobacco space 40 enables combustion

of the tobacco in combustion space 40. A mixture of this air and combustion gases from tobacco space 40 is further carried away via channel 52 (arrow P_1) in the direction of filter 50. The air enters the common channel 49 (arrow P_2) and the mixture enters the environment via openings 51 in cover plate 56. When the smoker is therefore not using his/her mouthpiece, the smoke gases, as a result of combustion of the tobacco in tobacco space 40, enter the environment via channel 52, channel 49, filter 50 and cover flap 56.

[0077] When the smoker then places his/her mouth on mouthpiece 3 and inhales (inhaling situation), one-way valve 45 is pulled open and smoke gases enter the body of the smoker via tobacco space 40, channel 43 and mouthpiece 3. Valves 47,47' (and additional valves 61,61') ensure that no outside air is drawn to mouthpiece 3 via channel 49 and channels 48,48'.

[0078] When the smoker (in the exhaling situation) then exhales the inhaled smoke gases again into mouthpiece 3 (arrow P_5), one-way valve 45 is pressed shut and valves 47,47' on either side of channel 43 are pressed open. The exhaled smoke gases hereby enter respective channels 48, 48' and are discharged via one-way valves 61,61' into the common discharge channel 49 (arrow P_6 , P_7). Valves 61,61' or valves 47,47' can be omitted in another embodiment. Only one set of valves, arranged at a random position in the channels (access to or discharge from) 48,48', is in principle necessary to ensure a correct operation of the device. It is however recommended to provide the valves as close as possible to the vicinity of mouthpiece 3 so as to prevent smoke gases in channels 48 and 48' nevertheless entering the environment via the mouthpiece in the standby situation, even though this is unlikely to occur.

[0079] In the embodiment shown in figures 2 and 3 a separate supply compartment 67 is also provided. A supply of tobacco products, for instance a quantity of rolling tobacco, can be stored in this compartment for later use. Also provided in this embodiment is a compartment 68 in which a lighter (A) can be arranged. This lighter can be of a standard type and can be taken out of compartment 68 to light the rolling tobacco in tobacco compartment 40. It will be apparent that many variants for lighting the tobacco are still possible. A lighter placed fixedly in the casing can thus be envisaged, the nozzle of this lighter emerging inside tobacco space 40 so that the tobacco can be lit. This variant has the advantage that the tobacco can be lit directly and the lighter does not have to be taken out of the compartment.

[0080] Figure 4 shows a third preferred embodiment of the invention. The parts corresponding to the above described embodiments are designated as far as possible in the figure with the same numerals, and the description of such parts is for the most part dispensed with. The embodiment comprises a pipe-like part 70 which is provided on a proximal end with a per se known mouthpiece 3. On the distal end of pipe-like part 70 there is provided a tobacco burning space 71 in which a quantity of pipe

tobacco (T) can be placed. The burning space 71 is not closed in this embodiment, but is open at the top. Provided along the peripheral edge on the top of pipe 70 are suction openings 72 which are connected to an discharge channel 73 (only shown schematically in figure 4). Discharge channel 73 is connected to a suction channel 74 in which is arranged a partition wall 66 provided with a fan 76. The suction channel debouches in a collecting space 75 in which an ion filter 76 is arranged. A partition wall 77 is provided between collecting space 75 and suction channel 74. Arranged in partition wall 77 are openings (not shown) which can be closed using a one-way valve (in the form of a membrane) 78. An inhaling channel 79 is further connected to the burning space 71, preferably on the underside thereof. The inhaling channel 79 debouches in mouthpiece 3. A wall 80 is again arranged in inhaling channel 79, which wall is provided with openings (not shown) and against which is arranged a one-way valve (in the form of a membrane) 81. From mouthpiece 3 an exhaling channel 82 also runs to a further collecting space 69. Provided between collecting space 75 and collecting space 69 of exhaling channel 82 is a partition wall 83 in which a large number of openings (not shown) are arranged and against which one-way valves (in the form of a membranes) 84,84',84" are arranged.

[0081] Arranged in collecting space 75 is an ion filter 76 which is powered via electrical wires and a power supply 86. The power supply is provided in a power supply component 87. Power supply 86 can be switched on and off by means of an on/off switch 88 connected via electrical wires 89 to power supply 86.

[0082] Further provided between power supply 86 and the ion filter is a control 85 for controlling the ion filter. The control comprises for instance a transformer for increasing the voltage to a value suitable for a proper operation of filter 76. The control can also contain an electronic circuit (for instance a microcontroller) with which the ion filter can be controlled on the basis of measuring signals from a smoke detector or temperature sensor (not shown) discussed hereinbelow.

[0083] The operation of ion filter 76 is as follows. The airflow consisting of a mixture of outside air and tobacco smoke is drawn in by fan 76 and guided along a number of metal plates 86 under high voltage (several kV). Particles in the airflow are hereby negatively charged. By then guiding the air along a positively charged filter 87 (only shown schematically in the figures), the particles will deposit there. Filter 87 filters particles from the airflow which are as small as 0.1 micron or smaller, whereby the filter is especially effective in filtering tobacco smoke. After leaving ion filter 76, the purified air is discharged via discharge openings 88 provided in pipe 70.

[0084] In another preferred embodiment which is not shown, the purified air passes through an additional absorption filter after the ion filter. In an absorption filter harmful constituents are removed from the smoke gases by absorption. In most cases an active carbon filter will be applied, but filters which make use of other absorption

material are also possible. Because the air is first already filtered by the ion filter, the carbon filter can be given a relatively thin form, whereby the airflow encounters less resistance (the resistance over the ion filter is in any case negligible compared to the resistance over a carbon filter). The carbon filter moreover requires less cleaning or replacement.

[0085] In a further preferred embodiment (not shown), a mechanical filter can be applied instead of or in addition to the above stated filters, for instance a filter in which the smoke gases are guided along a metal grid or fabric of small mesh width, such as for instance in the form of high efficiency particulate air (HEPA) filters known in the field.

[0086] In other embodiments use is made of UV radiation filters, centrifugal filters, ozone filters and the like known per se in the field. In a particularly advantageous embodiment, filtering takes place in a number of steps, for instance first by a mechanical filter, subsequently by an absorption filter and finally by an electrostatic filter or (preferably) by an ozone filter, so that not only harmful particles and/or gases are removed from the smoke gases but the smell of the smoke gases, which is perceived as unpleasant, is also diminished.

[0087] In use the smoker lights the tobacco (T) in tobacco space 71 in the usual manner. The air required for the combustion is available via the upper side of the tobacco space, since this is open. The smoke generated in the tobacco space is then drawn off via suction openings 72 close to the edge of pipe 70 and guided in the direction of the ion filter via discharge channel 73 and suction channel 74. After being filtered in ion filter 76 and after optionally being filtered in an additional carbon filter provided downstream, clean air leaves the pipe via openings 88. Owing to the suction action of electric motor 76, in the standby situation the drawn-off air will move toward the outside via suction channel 74 and the space 75.

[0088] In the inhaling situation the smoker inhales via mouthpiece 3 the tobacco smoke supplied via discharge openings 72, discharge channel 73 and inhalation channel 79. Owing to the great force with which the smoker inhales the resistance provided by valve 81 is overcome so that the smoke can continue on its way via inhalation channel 79 until the smoke reaches mouthpiece 3. In the exhaling situation the smoker blows the smoke, once again via the mouthpiece, into an exhalation channel 82, which smoke is guided via a number of one-way valves 84, 84', 84" to ion filter 76. There the air is filtered and discharged via opening 88. The one-way valve 81, which has a blocking function in the direction opposed to direction P_{10} , moreover prevents exhaled air being blown back via inhalation channel 79 into tobacco space 71.

[0089] Finally, figure 5 shows a fourth preferred embodiment of the invention. In this embodiment no use is made of a fan to draw in air, but use is made of the principle that air rises through being heated (convection). In figure 5 there is provided an upright tube 90 which is provided at its bottom end with a closing cover 91. This

latter is attached to tube 90 using hinges and can be readily folded open and shut by gripping a closing handle 92. Arranged in closing cover 91 are air feed openings 93 along which air can be carried into the tube (P_{11}). A cigarette (S) is fixed clampingly in the tube using a clamping sleeve 94, this such that the outer end for lighting points downward. The cigarette is arranged in a tobacco space 112 which is closed with a first wall 95 which defines a compartment in which the power supply 107 and control 108 of ion filter 101 are placed. Tobacco space 112 is also closed with a wall 110 in which, in above described manner, a number of openings are arranged and against which a one-way valve 103 in the form of a membrane is mounted. Finally, tobacco space 108 is closed using a further partition wall 97 against which a membrane 104 is arranged. Between walls 97 and 110 a further partition wall 96 extends to the top of tube 90. Partition wall 96 defines a filter space 99 and an air feed/discharge space 98. The air feed/discharge space 98 connects onto a mouthpiece 105.

[0090] During use the smoker opens closing cover 91 using handle 92, places a cigarette or cigar in clamping sleeve 94 and lights the cigarette or cigar S at the outer end remote from clamping sleeve 94. Once the cigarette begins to burn, the smoker closes the cover 91 again. As a result of openings 93 in the cover, air required for combustion of the tobacco in cigarette S is supplied (arrow P_{11}). As a result of the fact that the air is heated by the combustion at the lower end of tube 90, convection of the air (mixture of outside air and smoke gases) occurs and the air is displaced upward (arrow P_{12}) in the direction of membrane 104. This latter is embodied such that it is slightly open at all times, so that the resistance in upward direction is extremely low. Air (outside air and smoke gases) will hereby flow as a result of convection into filter space 99 via the openings provided in wall 97. As a consequence of the very low air resistance over ion filter 101 the convection in filter space 99 is sufficient to guide the contaminated air along the ion filter and discharge it via openings 102 in tube 90 (arrow P_{16}). One-way valve 103 further has a resistance in the direction of arrow P_{14} which is much greater than that of membrane 104. This means that upward flowing air cannot enter the feed/discharge space 98 via the openings in wall 110.

[0091] When the smoker draws on mouthpiece 105 (inhaling situation), said resistance of valve 103 is overcome and the smoke at the clamping sleeve end of the cigarette will be drawn directly through the openings in wall 110. The air then enters the smoker via feed/discharge space 98 and mouthpiece 105.

[0092] When the drawn-in smoke is once again blown into the mouthpiece (exhaling situation), the following takes place. One-way valve 103 fulfils a blocking function in a downward direction, which means that the blown-out smoke cannot enter space 112 via this valve. Some openings are however provided in partition wall 96 which are closed with one-way valves in the form of membranes 100, 100'. The exhaled smoke now enters filter space 99

(arrow P_{17}) and is guided along ion filter 101. After being filtered, the exhaled air is discharged via openings 102 (arrow P_{16}).

[0093] Membrane 104 has a negligible resistance in upward direction. In downward direction however, membrane 104 fulfils a blocking function, just as the other membranes. This blocking function ensures that exhaled smoke, which has entered filter space 99 via membranes 100, 100', cannot penetrate into tobacco space 112 via partition wall 97.

[0094] Suction means, such as for instance one or more fans, can therefore be omitted in the present embodiment as long as tube 90 remains disposed somewhat vertically. This means that power supply 107 only need be used for ion filter 101, and can therefore have a relatively long lifespan.

[0095] In the shown embodiment the power supply 107 is embodied with pill-like exchangeable batteries 111, also referred to as button cells) which have a relatively long lifespan. The batteries are connected to the ion filter via a control 108, for instance in the form of electronic circuits, such as a microcontroller, a transformer and so on.

[0096] In the shown embodiment a saliva collector 106 is also provided in the feed/discharge space 98 of tube 90, this on the side of mouthpiece 105. The device could otherwise become clogged as a result of saliva present in the exhaled air and entering feed/discharge space 98. Saliva collector 106 can be cleaned via removal of a saliva drain plug 107.

[0097] In other embodiments a detector is arranged in or close to tobacco space 7, 40, 71, 112 which detects the presence of smoke in the tobacco space. Detectors can be envisaged here which measure the presence of smoke directly. Variants can however also be envisaged wherein the presence of smoke is not determined directly but in indirect manner, for instance by making use of a temperature sensor. When the temperature for instance exceeds a value pre-stored in the control unit, or when the temperature inside the tobacco space rises relatively quickly in a short period, the control unit or the detector concludes that the tobacco in the tobacco space has been lit and generates an electrical signal representative thereof. On the basis of this signal the control unit then activates the fan, so that from that moment the forced flow is excited in the channels of the device. Likewise, when the temperature falls below a determined value or in the case of a relatively rapid drop in the temperature in a determined time period, the control can conclude that the tobacco in the tobacco space is no longer burning. The control unit then deactivates the fan, optionally with a preset time delay. This prevents the fan being active for too long and ensures a long lifespan of the power supply.

[0098] In an embodiment which is not shown, means are also provided for generating aromatic substances. When the fan is activated, for instance by operating the switch or by the above stated activation by the control

unit, a per se known component can also be activated with which aromatic substances are generated. The aromatic substances preferably enter the smoke discharge channel and are carried outside together with the flow of smoke gases. The aromatic substances ensure that the smell of tobacco smoke, which for many people is unpleasant, is eliminated.

[0099] Figures 6A and 6B show a further preferred embodiment of the invention. Figure 6A shows a device 113 which is constructed from a housing 114 with an elongate droplet shape, wherein the housing is provided on the top side with a first pivotable cover 115 and provided on the underside with a second pivotable cover 125. In similar manner as in the above described embodiments, housing 114 is provided with channels and one-way valves with which a correct flow of smoke gases can be realized. Figure 6A shows that, in order to protect the health of the user when cover 115 is opened, an (additional) filter 118 can be arranged close to the mouthpiece 116 of housing 114, this such that the smoke gases from a cigarette drawn in via a one-way valve 119 must first pass through filter 118 before they can be drawn in by the user. This ensures that the air finally inhaled by the user is always pre-filtered. The filter is arranged by being clamped between wall 127 and a part of outer wall 128 of housing 114 (direction P_{18}). A cigarette (S) can then be pushed into a clip 117 intended for this purpose (direction P_{19}). Once the cigarette has been arranged, the cover 115 is closed (P_{20}).

[0100] Housing 114 is also provided with a rotatable flap 125 in which the above mentioned carbon pad 123 can be laid. After closure (P_{21}) of flap 125, the smoke gases can be readily filtered by the carbon filter and leave the device via openings 129. This situation is shown in figure 6B. The device is now ready for use. The cigarette is now lit by a lighter (not shown) provided close to the outer end of the cigarette.

[0101] The invention is not limited to the above described preferred embodiments thereof. The rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

Claims

1. Device for filtering tobacco smoke from a tobacco product, comprising a housing in which the tobacco product can be arranged, and a filter for filtering tobacco smoke, the housing comprising:

- a tobacco reservoir for holding tobacco,
- an outside air feed for feeding from the environment outside air necessary for the combustion of the tobacco,
- a tobacco smoke discharge for discharging tobacco smoke caused by the combustion,
- a filter connected to the tobacco smoke discharge for filtering substances harmful to the en-

vironment from the tobacco smoke;

- a mouthpiece which is connected to the tobacco reservoir and the smoke discharge and with which a smoker can inhale the tobacco smoke from the tobacco reservoir and can exhale the tobacco smoke to the tobacco smoke discharge, **characterized in that** the filter comprises at least one of an absorption filter unit, an electrostatic filter unit, an ionization filter unit (76,101), a centrifugal filter unit, a UV filter unit or an ozone filter unit.

2. Device as claimed in claim 1, wherein the mechanical filter comprises a metal grid or fabric of small mesh width.

→ page 23 lines 31-32

3. Device as claimed in claim 1 or 2, wherein the filter comprises at least a combination of a mechanical filter unit comprising a HEPA filter unit and an absorption filter unit.
4. Device as claimed in any of the preceding claims, wherein the mechanical filter and absorption filter are arranged in the smoke discharge so as to filter the discharged smoke first by the mechanical filter and subsequently by the absorption filter.

→ page 24 lines 1-10

5. Device as claimed in claim 3 or 4, wherein the filter comprises a combination of an electrostatic filter unit, a HEPA filter unit and an absorption filter unit.
6. Device as claimed in any of the preceding claims, wherein the absorption filter unit comprises an active carbon filter unit.
7. Device as claimed in claim 6, wherein the active carbon filter unit comprises a filter pad extending in a position transversely of the direction of the displacement of the smoke in the smoke discharge.

→ page 15 lines 6-14

8. Device as claimed in any of the preceding claims, comprising a cathode and an anode between which the smoke can be guided for ionizing at least some of the substances in the smoke under the influence of an electric field between the cathode and anode, and collecting means for collecting the ionized substances.
9. Device as claimed in any of the preceding claims, comprising gas displacing means for generating one or more forced gas flows in the tobacco smoke discharge, wherein the gas displacing means are con-

figured to substantially continuously force gases containing tobacco smoke from the tobacco reservoir to the tobacco smoke discharge and drive the gases through the filter, both in a standby situation in which the tobacco has been lit and no inhalation or exhalation is taking place and in an exhaling situation where at least a part of the inhaled air is being exhaled by the user via the mouthpiece.

10. Device as claimed in any of the foregoing claims, comprising a filter compartment which is provided in the housing and which can be closed off from the environment with a removable closing valve, wherein one or more replaceable filters can be placed in the filter compartment.
11. Device as claimed in any of the foregoing claims, which is adapted, in a standby situation in which the tobacco has been lit and no inhalation or exhalation is taking place, for forced discharge of the tobacco smoke via the tobacco smoke discharge.
12. Device as claimed in claim 11, which is adapted, also in an exhaling situation where at least a part of the inhaled air is being exhaled by the user via the mouthpiece, for forced discharge of the tobacco smoke via the tobacco smoke discharge.
13. Device as claimed in any of the foregoing claims, also comprising a detector arranged in or close to the tobacco reservoir for directly or indirectly detecting tobacco smoke, wherein the detector is coupled to the switch for switching on the one or more fans in the case of tobacco smoke and switching them off in the absence of tobacco smoke.
14. Device as claimed in any of the foregoing claims, comprising:

- a temperature sensor arranged in or close to the tobacco reservoir for generating a temperature signal representative of the temperature,
- control means coupled to the temperature sensor, the one or more fans and/or to the switch for switching on the one or more fans above a preset temperature and switching them off below a preset temperature, this on the basis of the temperature signal.

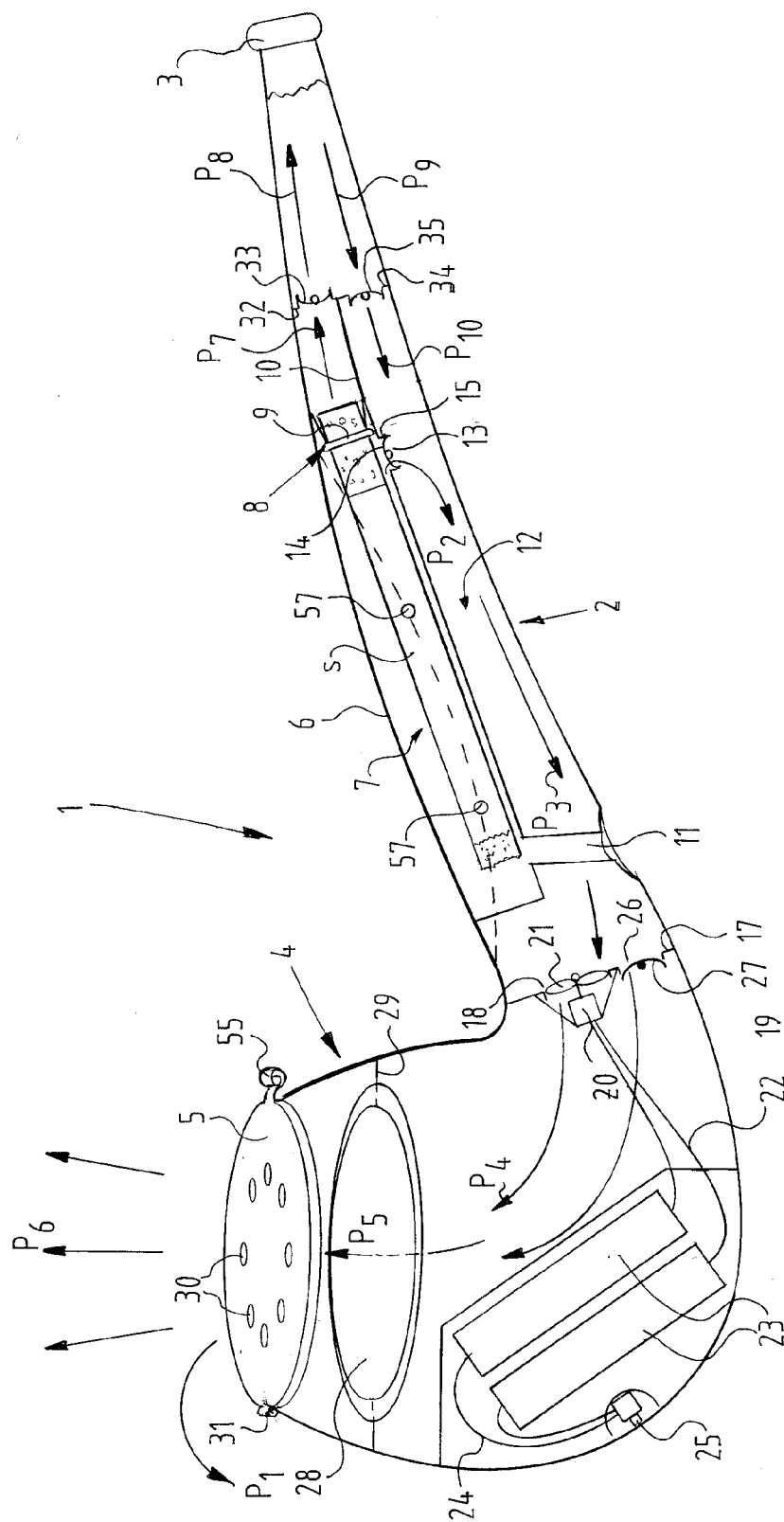
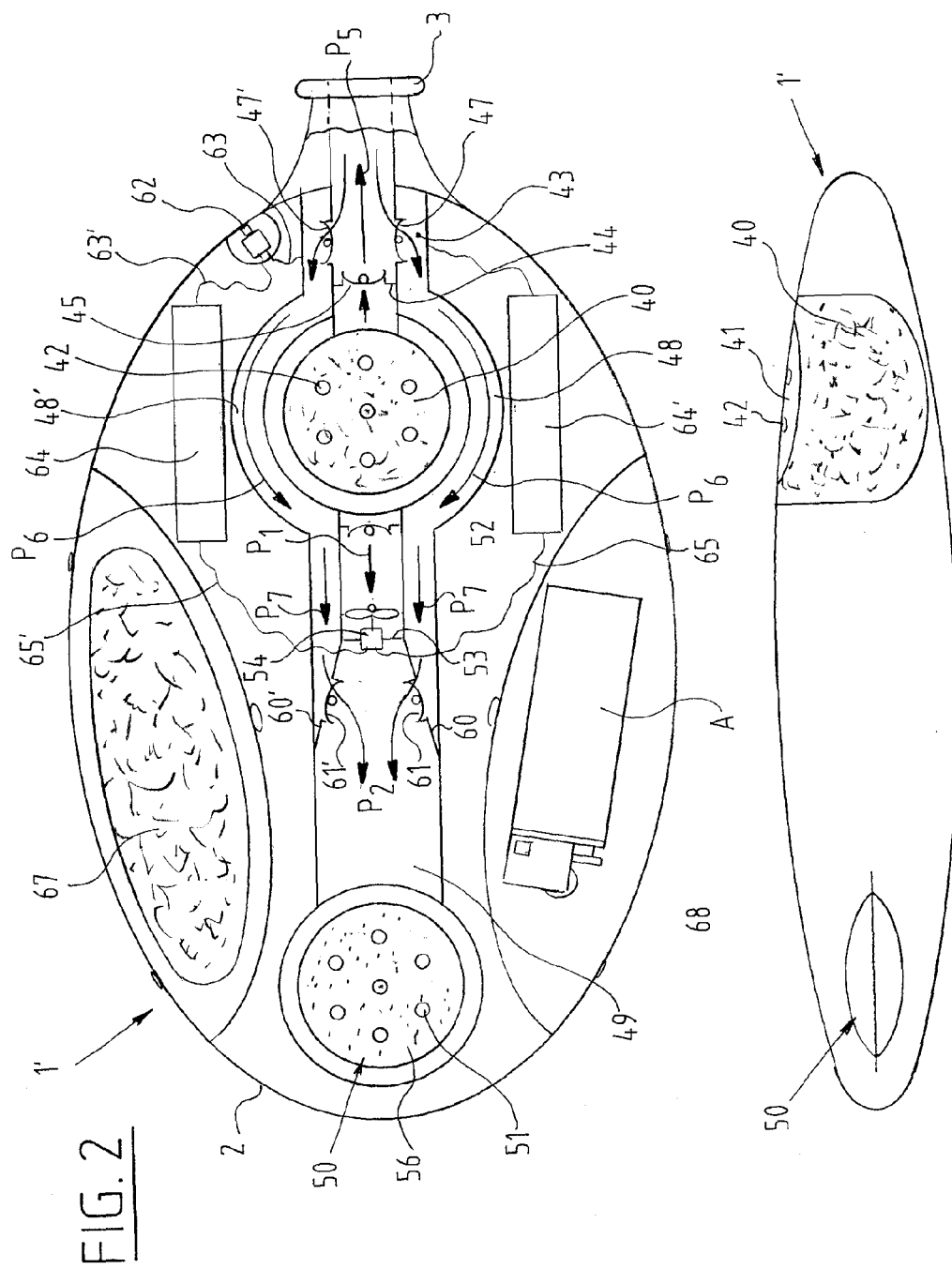


FIG. 1



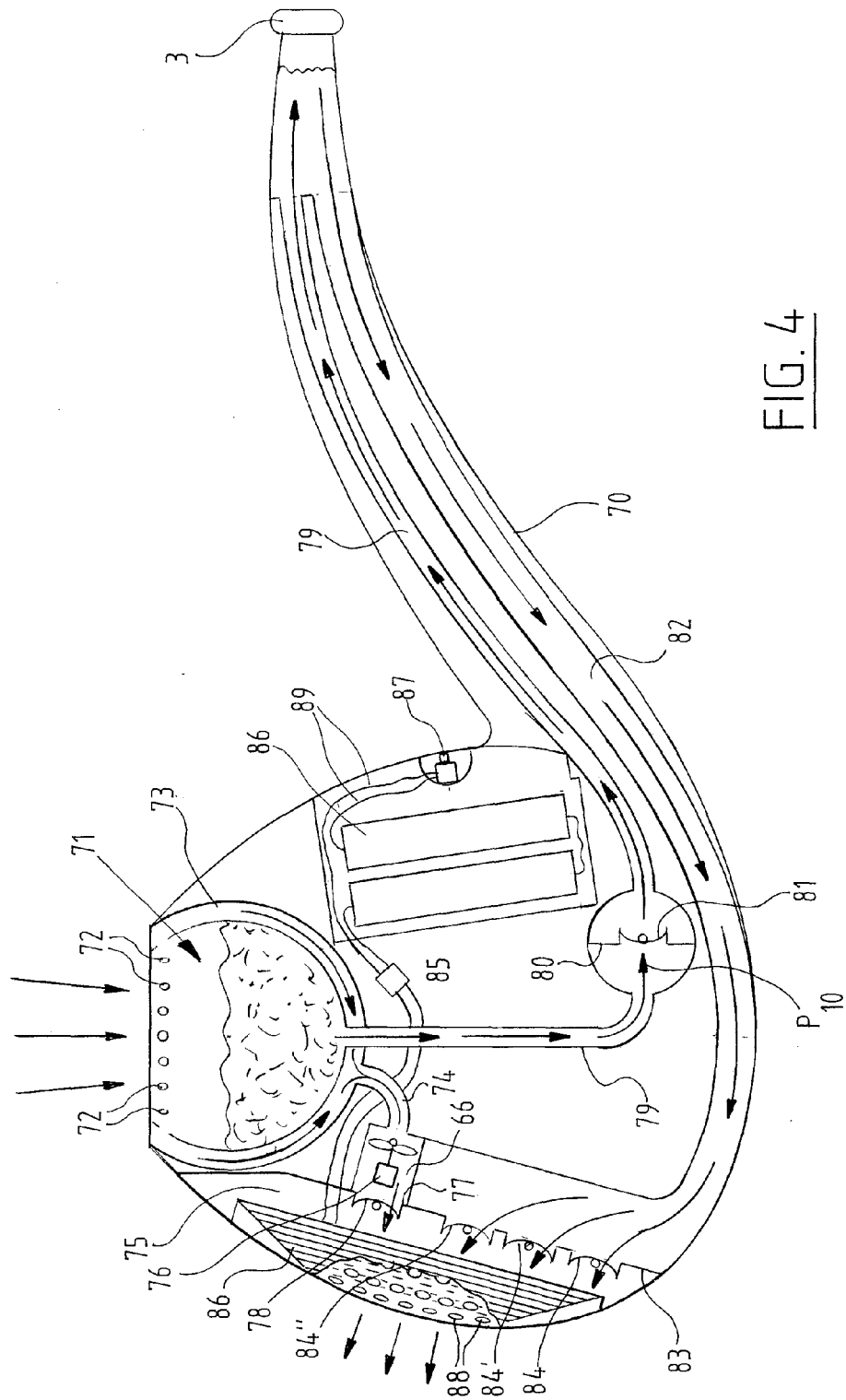
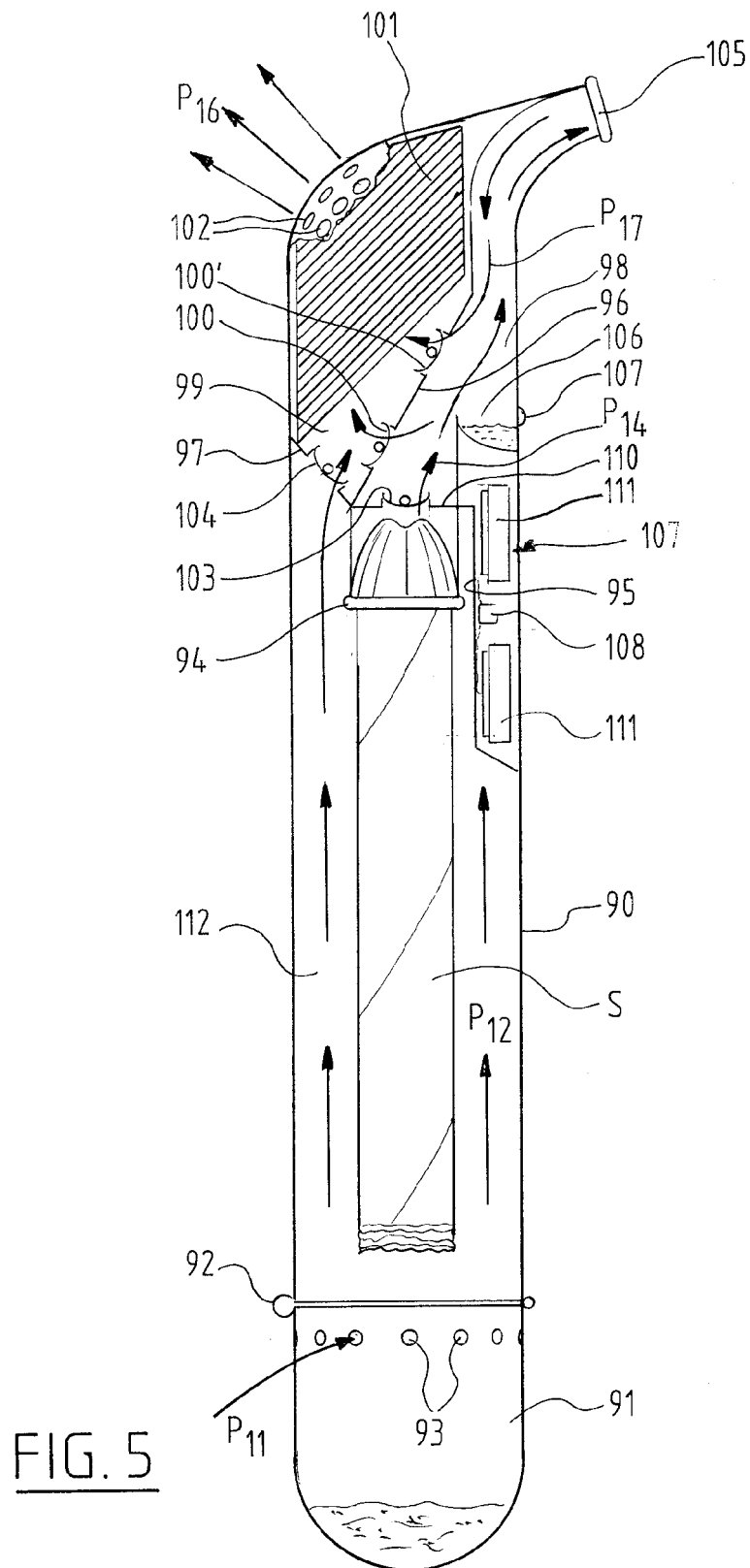
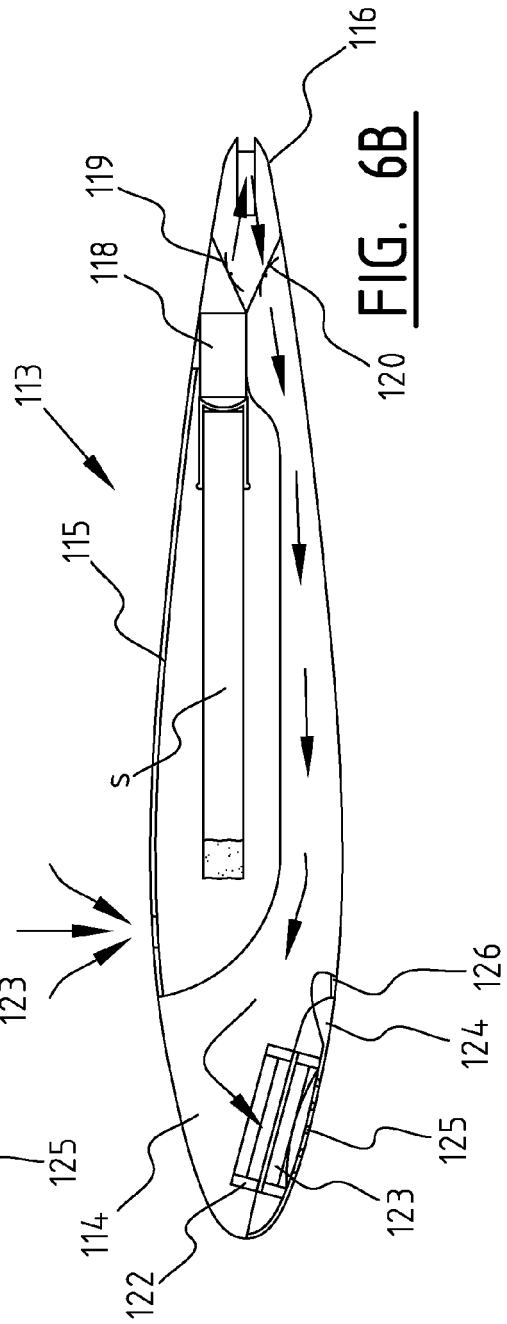
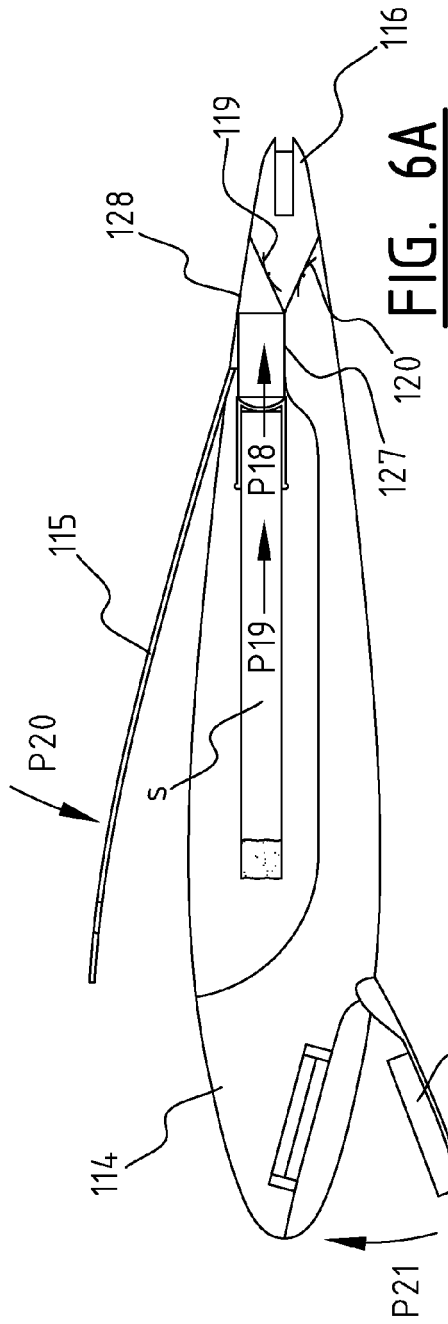


FIG. 4







EUROPEAN SEARCH REPORT

Application Number
EP 10 16 9082

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			A24F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 August 2010	Examiner MacCormick, Duncan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 10 16 9082

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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