A SMOKING SYSTEM HAVING A LIQUID STORAGE PORTION AND IMPROVED AIRFLOW CHARACTERISTICS

The present invention relates to a smoking system having a liquid storage portion.

WO 2007/078273 discloses an electrical smoking system which uses a liquid as an aerosol forming substrate. The liquid is stored in a container formed of a porous material. The container communicates with a heater vaporiser, powered by a battery supply, via a series of small apertures. In use, the heater is activated by the mouth of the user for switching on the battery power supply. Further, suction on the mouthpiece by the user causes air to be drawn through the porous container for liquid, over the heater vaporiser, and into the mouthpiece and subsequently into the mouth of a user.

The electrically heated smoking systems of the prior art, including that referred to above, do have a number of advantages, but there is still room for improvement. It is therefore an object of the invention to provide an improved smoking system.

According to a first aspect of the invention, there is provided a smoking system comprising: a capillary wick having a fibrous or spongy structure for holding liquid; at least one heater for heating the liquid in at least a portion of the capillary wick to form an aerosol, the heater comprising a coil of wire at least partially surrounding the capillary wick; at least one air inlet, at least one air outlet and a chamber between the air inlet and air outlet, the air inlet, the air outlet and the chamber being arranged so as to define an air flow route from the air inlet to the air outlet via the capillary wick so as to convey the aerosol to the air outlet; and at least one guide for channeling the air flow in the air flow route and the at least one guide defining a constricted air flow cross section over the wick, which will force the air flow to accelerate, so as to control particle size in the aerosol.

In use, when the heater is activated, the liquid in the at least one portion of the capillary wick is vaporized by the heater to form a supersaturated vapour. The supersaturated vapour is mixed with and carried in the air flow from the at least one air inlet. During the flow, the vapour condenses to form an aerosol in the chamber, and the aerosol is carried towards the air outlet into the mouth of a user. In this specification, the upstream and downstream relative positions are described in relation to the direction of air flow as it is drawn from the air inlet to the air outlet.

The smoking system according to the invention provides a number of advantages. Most significantly, the at least one guide improves the air and aerosol flow through the smoking system. In particular, the management of the air and aerosol flow through the smoking system by the guides allows either control of the air flow upstream of the capillary wick or control of the air and aerosol flow downstream of the capillary wick or both. The inventors have appreciated that management of the air flow, in particular the air flow direction and the air flow speed, allows the particle size in the resulting aerosol to be controlled and preferably reduced compared with known devices. This improves the smoking experience. Moreover, control of the air and aerosol flow can reduce the

a certain number of refills of the liquid storage portion. Preferably, the liquid storage portion is arranged to hold liquid for a pre-determined number of puffs.

The capillary wick, with the ~~may have a~~ fibrous or spongy structure may, for ~~For~~ example, ~~the capillary wick may~~ comprise a plurality of fibres or threads. The fibres or threads may be generally aligned in the longitudinal direction of the smoking system. Alternatively, the capillary wick may comprise sponge-like material formed into a rod shape. The rod shape may extend along the longitudinal direction of the smoking system. The structure of the wick forms a plurality of small bores or tubes, through which the liquid can be transported to the heater, by capillary action. The capillary wick may comprise any suitable material or combination of materials. Examples of suitable materials are ceramic- or graphite-based materials in the form of fibres or sintered powders. The capillary wick may have any suitable capillarity and porosity so as to be used with different liquid physical properties such as density, viscosity, surface tension and vapour pressure. The capillary properties of the wick, combined with the properties of the liquid, ensure that the wick is always wet in the heating area. If the wick is dry, there may be overheating, which can lead to thermal degradation of liquid.

Preferably, the at least one guide channels the air flow by controlling the air flow velocity, that is to say, the speed of the air flow and the direction of the air flow. This may be by directing the air flow in a particular direction. Alternatively or additionally, this may be by controlling the speed of the air flow. The air flow speed may be controlled by varying the cross sectional area of the air flow route, so as to take advantage of the Venturi effect. Air flow through a constricted section increases in speed in order to satisfy the equation of continuity. Similarly, air flow through a wider section decreases in speed.

Preferably, the at least one guide is arranged so that the air flow speed over the wick is greater than the air flow speed upstream of the wick. This is preferably achieved by the guides defining a constricted air flow cross section over the wick, which will force the air flow to accelerate.

Preferably, the at least one guide is arranged to control the particle size of the aerosol to have a diameter substantially less than 1.5 micro meters (μm). Even more preferably, the at least one guide is arranged to control the particle size of the aerosol to have a diameter substantially less than 1.0 micro meters (μm).

In one embodiment, the smoking system further comprises a housing and the at least one guide for channelling the air flow is provided by the internal shape of the housing. That is to say, the internal shape of the assembly itself channels the air flow. Preferably, the inside surface of the housing walls have a shape which forms guides to channel the air flow. The guides provided by the internal shape of the housing may be provided upstream of the capillary wick. In that case, the guides channel the air flow from the air inlet towards the capillary wick. Alternatively or additionally,

rectangular in shape, or may have a patterned shape which may form a coil-like structure when rolled around the capillary wick. Other alternatives include a heating wire or filament, for example a Ni-Cr, platinum, tungsten or alloy wire.

For the~~In a preferred embodiment, the at least one~~ heater which comprises a coil of wire at least partially surrounding the capillary wick~~. In that embodiment, preferably~~ the wire is preferably a metal wire. Even more preferably, the wire is a metal alloy wire. The coil may extend fully or partially along the length of the capillary wick. The coil may extend fully or partially around the circumference of the capillary wick. In a preferred embodiment, the coil is not in contact with the capillary wick. This allows the heating coil to heat the capillary wick but reduces wastage by not vaporizing more liquid than necessary. This also reduces the amount of liquid which condenses on the inside walls, thereby reducing cleaning requirements.

The at least one heater may heat the liquid in the capillary wick by means of conduction. The heater may be at least partially in contact with the wick. Alternatively, heat from the heater may be conducted to the liquid by means of a heat conductive element. Alternatively, the at least one heater may transfer heat to the incoming ambient air that is drawn through the smoking system during use, which in turn heats the liquid by convection. The ambient air may be heated before passing through the system. Alternatively, the ambient air may be first drawn through the wick and then heated.

In one embodiment, the smoking system is an electrically heated smoking system. In that embodiment, the smoking system may further comprise an electric power supply. Preferably, the electric power supply comprises a cell contained in a housing. The electric power supply may be a Lithium-ion battery or one of its variants, for example a Lithium-ion polymer battery. Alternatively, the power supply may be a Nickel-metal hydride battery, a Nickel cadmium battery, a Lithium-maganese battery, a Lithium-cobalt battery or a fuel cell. In that case, preferably, the electrically heated smoking system is usable by a smoker until the energy in the power cell is used up. Alternatively, the electric power supply may comprise circuitry chargeable by an external charging portion. In that case, preferably the circuitry, when charged, provides power for a pre-determined number of puffs, after which the circuitry must be re-connected to the external charging portion. An example of suitable circuitry is one or more capacitors or rechargeable batteries.

If the smoking system is an electrically heated smoking system, the smoking system may further comprise electric circuitry. In one embodiment, the electric circuitry comprises a sensor to detect air flow indicative of a user taking a puff. The sensor may be an electro-mechanical device. Alternatively, the sensor may be any of: a mechanical device, an optical device, an opto-mechanical device, a micro electro mechanical systems (MEMS) based sensor and an acoustic sensor. In that case, preferably, the electric circuitry is arranged to provide an electric current pulse