located on the surface of the carpet and/or between fibres of the carpet, and resulting in a significant amount of energy being imparted to the dust. With the brush bar rotating in such a direction that the bristles move from the front edge of the opening towards the rear edge, the rotating bristles sweep dust rearwardly through the opening and into the suction cavity. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the opening through the cleaner head towards the separating apparatus.

To facilitate cleaning of the floor surface, it is known to provide lights on the cleaner head to illuminate a region of the floor surface. This can improve the visualisation of debris, hairs and other objects on the floor surface. For example, US6672735 describes a vacuum cleaner having a lighting system containing a plurality of ultra-bright light emitting diodes (LEDs) for illuminating the floor surface.

SUMMARY

In a first example, the present disclosure provides a cleaner head for a vacuum cleaner, the cleaner head comprising an optical system for illuminating debris upon a region of a work surface located in front of the cleaner head, the optical system comprising a laser diode which emits green light.

In one aspect, the present disclosure refers to a cleaner head for a vacuum cleaner, the cleaner head comprising an optical system for illuminating debris upon a region of a work surface located in front of the cleaner head, the optical system comprising a light source which emits green light, wherein the cleaner head comprises opposing side walls, and the optical system is located adjacent one of the side walls of the cleaner head.

The use of a laser diode to illuminate debris disposed on a region of the work surface can reduce power consumption, as the power to light conversion efficiency of a laser diode is generally significantly higher than that of a light emitting diode (LED) and so, for a given optical power output, less electrical power needs to be supplied to a laser diode. As less electrical power needs to be provided to a laser diode, during use laser diodes tend to generate less heat than LEDs, and so there is no requirement to provide any heat dissipation device, such as a fan or a heat sink, to transfer heat from the laser diode to the ambient atmosphere.

The term “green light” means light having a wavelength in the range from 495 to 570nm. Compared to other colours of light of the same luminosity, green light appears

may have a non-circular curvature or shape, and may be a straight line so that the optical system illuminates debris upon a region of the work surface which is in the shape of a triangle.

The sector preferably has a central angle in the range from 70 to 110°. The central axis, located angularly midway between the two radii bounding the sector, is preferably aligned at an angle in the range from 35 to 65°, more preferably at an angle in the range from 40 to 50°, to the front edge of the cleaner head. One of the radii bounding the sector is preferably aligned at an acute angle of less than 20°, more preferably less than 10°, to the front edge of the cleaner head to maximise debris illumination on a region of the work surface located immediately in front of the cleaner head. The other one of the radii bounding the sector preferably extends outwardly beyond the plane containing the side wall which is proximate to the optical system, and so is preferably aligned at an obtuse angle to the front edge of the cleaner head so as to illuminate debris upon a region of the work surface lying outside of the path of forward movement of the cleaner head. Each of these radii is preferably longer than the maximum width of the cleaner head so as to illuminate debris upon regions of the work surface lying on either side of the path of forward movement of the cleaner head.

In a second example the present disclosure provides a cleaner head for a vacuum cleaner, the cleaner head comprising an optical system located towards one side of the cleaner head, the optical system comprising a light source and beam shaping means for receiving light emitted from the light source and directing the light towards a work surface on which the cleaner head is disposed so as to illuminate debris upon a region of a planar work surface, said region being in the shape of a sector having a central axis aligned at an angle in the range from 35 to 65° to a front edge of the cleaner head, and one of the radii bounding the sector aligned at an acute angle of less than 20° to the front edge of the cleaner head. The light source is preferably a laser diode.

In a third example, the present disclosure provides a vacuum cleaner comprising a cleaner head as aforementioned. The vacuum cleaner is preferably in the form of a handheld or

stick vacuum cleaner. The vacuum cleaner is preferably a battery-powered vacuum cleaner.

The optical system is preferably actuated by a controller of the vacuum cleaner. The controller is preferably arranged to actuate the optical system when a suction source of the vacuum cleaner, typically a motor-driven fan unit, is switched on to draw an airflow into the vacuum cleaner through the cleaner head. The controller may supply a constant power to the optical system so that the intensity of the light emitted from the optical system does not vary whilst the suction source is switched on. Alternatively, the controller may vary with time the power supplied to the optical system so that the output optical power of the optical system varies with time.

The power supplied to the optical system may be varied stepwise, or it may be varied gradually. In a preferred example, the power supplied to the optical system is increased gradually from when the suction source is switched on until a maximum supply power is reached. In a preferred example, the maximum optical output power of the laser diode, which in that example is 10mW, is reached within 1sec, more preferably within 0.5sec, of the suction source being switched on. The rate of increase of the power supplied to the optical system may be constant, or it may vary with time. For example, the rate of power increase may be relatively low when the suction source is switched on, and increase gradually, or stepwise, with time. As a further alternative, the controller may delay supplying power to the optical system for a period of time after the suction source has been switched on. This period of relatively low, or no, power supply to the optical system can accommodate a period of time during which the user is positioning the cleaner head on the work surface following the switching on of the suction source, and so accommodate a period of time in which the optical system is not projecting light towards the work surface to be cleaned.

In a fourth example the present disclosure provides a vacuum cleaner comprising a suction source and a cleaner head through which an airflow is drawn into the vacuum cleaner by the suction source, and a controller for controlling the suction source, the cleaner head

comprising an optical system for illuminating a region of a work surface located in front of the cleaner head, and wherein, when the suction source is switched on, the controller is arranged to vary with time the power supplied to the optical system.

In another aspect, the present disclosure refers to a vacuum cleaner comprising a cleaner head as disclosed herein, and a suction source for drawing an airflow into the vacuum cleaner through the cleaner head.

When the suction source is switched off, the controller is preferably arranged to immediately stop supplying power to the optical system. The controller may be arranged to adjust the supply of power to the optical system depending on change in a state of either the cleaner head or the vacuum cleaner whilst the suction source is switched on. For example, the controller may suspend, reduce or otherwise adjust the supply of power to the optical system depending on an orientation of either of the cleaner head or the vacuum cleaner. One of the cleaner head or the vacuum cleaner may comprise a sensor which outputs to the controller a signal which varies depending on its orientation, and the controller may be arranged to adjust the supply of power to the optical system depending on the output from the sensor. As another example, the controller may adjust the supply of power to the optical system if the cleaner head is lifted away from the work surface. The cleaner head may comprise a sensor such as jockey wheel which detects whether the cleaner head has been lifted from the work surface, or a sensor which detects the pressure of air within the suction chamber, and the controller may be arranged to adjust the supply of power to the optical system depending on a signal received from that sensor. This can reduce the power consumption of the optical system when there is a change in the behaviour of the vacuum cleaner which can be indicative of a break in a cleaning process, for example, the relocation of the vacuum cleaner to another part of a home, and so conserve the energy of the battery.

Features described above in connection with the first example of the disclosure are equally applicable to each of the second to fourth examples of the disclosure, and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred features of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

CLAIMS

1. A cleaner head for a vacuum cleaner, the cleaner head comprising an optical system for illuminating debris upon a region of a work surface located in front of the cleaner head, the optical system comprising a light source which emits green light, wherein the cleaner head comprises opposing side walls, and the optical system is located adjacent one of the side walls of the cleaner head.

2. A cleaner head according to claim 1, wherein the light source is a laser diode.

3. A cleaner head according to claim 1 or 2, wherein the cleaner head comprises a suction chamber, and the optical system is located between said one of the side walls and the suction chamber.

4. A cleaner head according to claim 2 or claim 3, wherein the cleaner head comprises an agitator, and the optical system is located to one side of the agitator.

5. A cleaner head according to any preceding claim, wherein the optical system is positioned so that the central axis of a light beam emitted by the optical system contacts a horizontal work surface upon which the cleaner head is located at an acute angle in the range from 0 to 10°.

6. A cleaner head according to claim 5, wherein the acute angle is in the range from 0 to 5°.

7. A cleaner head according to any preceding claim, wherein the optical system is positioned so that a light beam is emitted from the cleaner head at a height of less than 10mm from a work surface upon which cleaner head is located.

8. A cleaner head according to any preceding claim, wherein the majority of the region of the work surface upon which debris is illuminated by the optical system is bounded by two planes each containing a respective side wall of the cleaner head.

9. A cleaner head according to any preceding claim, wherein the optical system comprises beam shaping means for receiving light emitted from the light source and directing the light towards the work surface such that, when the cleaner head is disposed upon a planar work surface, the optical system illuminates debris lying upon a region of the work surface which is in the shape of a sector.

10. A cleaner head according to claim 9, wherein the beam shaping means comprises a lens.

11. A cleaner head according to claim 9 or claim 10, wherein the central axis of the sector is aligned at an angle in the range from 35 to 65° to the front edge of the cleaner head.

12. A vacuum cleaner comprising a cleaner head according to any preceding claim, and a suction source for drawing an airflow into the vacuum cleaner through the cleaner head.

13. A vacuum cleaner according to claim 12, in the form of a handheld vacuum cleaner.

14. A vacuum cleaner according to claim 12 or claim 13, in the form of a battery-powered vacuum cleaner.

15. A vacuum cleaner according to any of claims 12 to 14, comprising a controller for controlling the optical system.

16. A vacuum cleaner according to claim 15, wherein the controller is arranged to actuate the optical system when the suction source of the vacuum cleaner is switched on.