

1

## VACUUM CLEANER WITH SENSING SYSTEM

### BACKGROUND OF THE INVENTION

This invention relates generally to vacuum cleaners, and more particularly to a vacuum cleaner equipped with a system for sensing and signaling a condition relating to the vacuum cleaner (e.g., the presence of dirt on the surface being cleaned or the need to change a filter).

In conventional vacuum cleaners, it is known to provide lights on the suction head ("floor nozzle") of the vacuum to illuminate the area in front of the vacuum. Further, some cleaners are equipped with a dirt sensor and a small indicator lamp or lamps on the floor nozzle, body or handle of the vacuum which illuminate when dirt is sensed. To view the lamp(s), the operator must look to that spot on the vacuum to determine if the dirt sensor has sensed the presence of dirt. These indicator lamps do not project a beam onto the surface being cleaned; they simply go on and off and the person using the cleaner must look at the lamp itself to determine whether it is on or off.

There is a need therefore for an improved sensing system which provides a readily visible signal when a condition is sensed.

### SUMMARY OF THE INVENTION

In general, a vacuum cleaner of one embodiment of this invention comprises a floor nozzle movable by a user of the vacuum cleaner over a floor to suction dirt from the floor, a sensing system for sensing a condition relating to the vacuum cleaner and for generating a signal in response to said condition, and a sensor-responsive light system on the floor nozzle responsive to the signal for projecting light onto the floor for observance by said user.

In a second embodiment, a vacuum cleaner of this invention comprises a floor nozzle movable by a user of the vacuum cleaner over a floor to suction dirt from the floor. An illumination system on the floor nozzle projects illuminating light in a forward direction onto the floor to illuminate a working area of the floor over which the floor nozzle is moved. A dirt-sensing system senses dirt suctioned into the vacuum cleaner and generates a signal in response to either the presence or absence of dirt. A sensor-responsive light system on the floor nozzle, separate from said illumination system, is responsive to the signal for projecting light onto the floor for observance by the user.

Other objects will become in part apparent and in part pointed out hereinafter.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of one embodiment of a vacuum cleaner incorporating a sensing system of this invention;

FIG. 2 is a front perspective of a floor nozzle of the cleaner of FIG. 1;

FIG. 3 is a view similar to FIG. 2 but with a cover of the nozzle removed to show a sensor-responsive light system and an illumination system of the cleaner;

FIG. 4 is a rear perspective of FIG. 3 with parts shown in section to show a sensing system of the cleaner;

FIG. 5 is an enlarged portion of FIG. 3 with parts shown in section to show an agitator and a suction flow passage to the rear of the agitator;

2

FIG. 6 is a view similar to FIG. 3 but with parts of the sensor-responsive light system and the illumination system exploded away from the nozzle;

FIG. 7 is an enlarged perspective of a portion of a frame for holding LED devices of the sensor-responsive light system and the illumination system;

FIG. 8 is a top plan schematic view of the cleaner showing an exemplary light pattern emitted by the LED devices;

FIG. 9 is an enlarged portion of FIG. 8 showing one-half of the light pattern, the other one-half being symmetrical with respect to the centerline of the cleaner;

FIG. 10 is a schematic side elevation of the cleaner showing the pitch angles of the light beams emitted by the light systems;

FIG. 11 is a side elevation showing the line of sight of a person operating the cleaner;

FIG. 12 is an exemplary electrical circuit of the sensing system, sensor-responsive light system and illumination system of the cleaner; and

FIG. 13 is a top plan schematic view of a second embodiment of the cleaner showing a different array of LED devices on the cleaner.

Corresponding reference numbers indicate corresponding parts throughout the drawings.

### DETAILED DESCRIPTION

Referring now to the drawings, and first more particularly to FIGS. 1-4, one embodiment of a vacuum cleaner of this invention is indicated in its entirety by the reference numeral 1. In this embodiment, the vacuum cleaner is an upright vacuum cleaner, but it will be understood that this invention is also applicable to canister vacuum cleaners and other types of cleaners. In general, the vacuum cleaner comprises a floor nozzle, generally designated 3, movable by a user over a floor to suction dirt from the floor. The nozzle is equipped to sweep dirt from the floor up into nozzle for delivery to a waste bag or other collection device. A sensing system, generally designated 5 (FIG. 4), is provided on the nozzle 3 for sensing a condition relating to the vacuum cleaner and for generating a signal in response to that condition. The condition may be the presence of dirt, for example, but other conditions are contemplated (e.g., whether a filter or dirt receptacle needs to be replaced). The cleaner 1 also includes a sensor-responsive light system 7 (FIG. 3) on the floor nozzle responsive to the generated signal for projecting light in a forward direction onto the floor F (FIG. 10) where it may readily be observed by the user. In addition, the cleaner of this particular embodiment also includes an illumination system 9 (FIG. 3) on the floor nozzle 3 for projecting illuminating light in a forward direction onto the floor to illuminate a working area of the floor over which the floor nozzle is moved. The relevant components of the cleaner 1 are described in more detail below.

Referring to FIGS. 2 and 5, the floor nozzle 3 has a front 13, back 15, and opposite sides 17. The nozzle 3 comprises a base tray 21, a removable cover 31 on the base tray, a front bumper 33 attached to the base tray, and wheels 35 on the base tray at the back of the base tray. An agitator 41 (e.g., a power brush roll in FIG. 5) is mounted on the base tray 21 and rotates about a generally horizontal axis extending side-to-side with respect to the nozzle 3 to sweep dirt from the floor up along an air flow path 45 defined in part by a housing 47 on the base tray for delivery to a collection device. An upright handle 51 (FIG. 1) is pivoted at its lower end to the base tray 21 for use by an operator to move the nozzle along the floor. Other