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(54) **FAN MODULE**

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(57) **ABSTRACT**

The present invention relates to a fan module (10) that is comprised of a stationary fan element (1) and of a movable fan element (2) that has the ability to rotate. The fan module (10) has contact surfaces (5) on an outside lateral surface (4) that can be used to supply an operating voltage to an electric motor of the fan module (10). Consequently, a fan module (10) according to the invention can be quickly assembled and disassembled, allowing it to be replaced during continuing operation.

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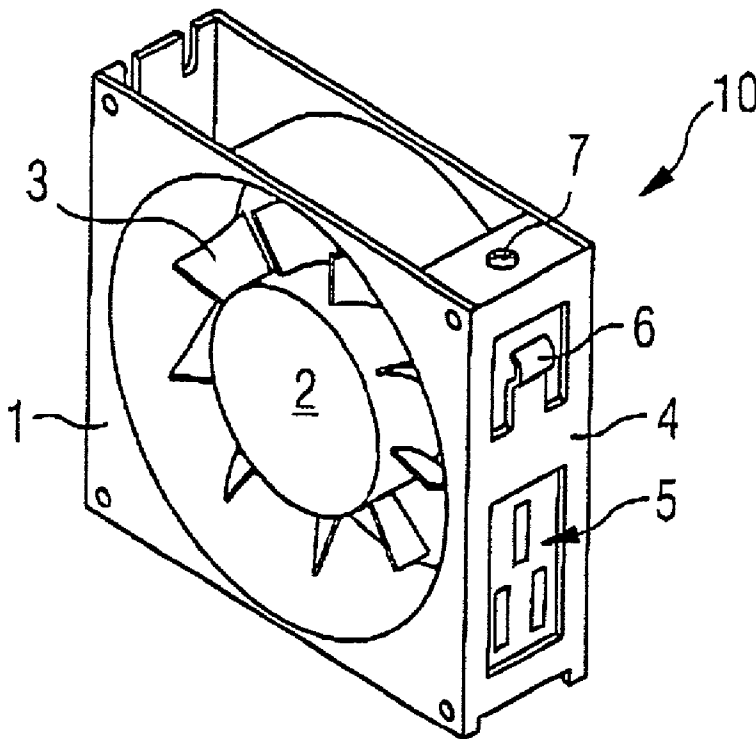


FIG 1

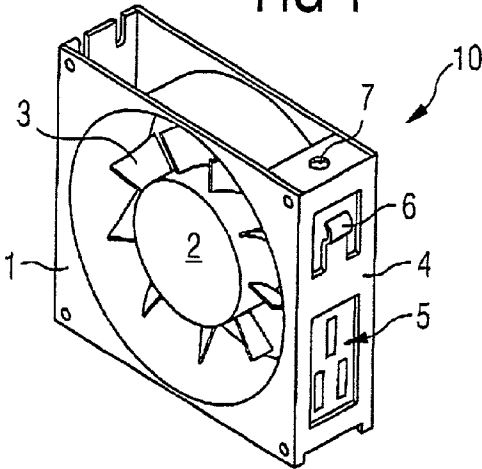


FIG 2

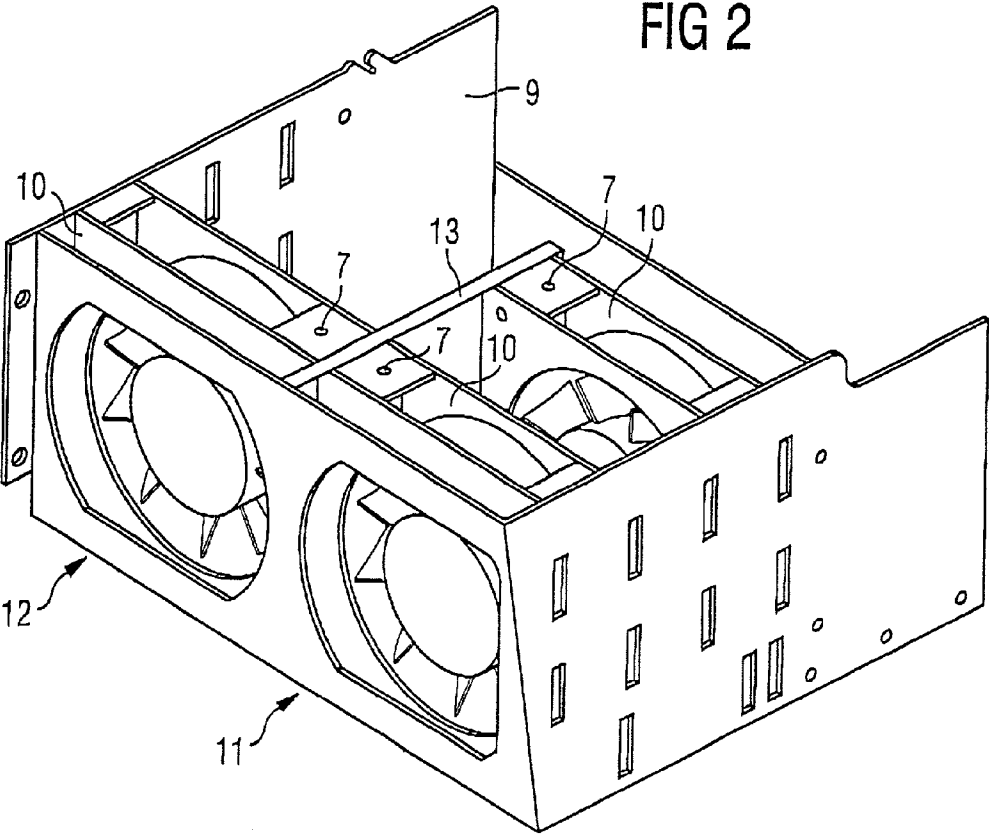


FIG 3

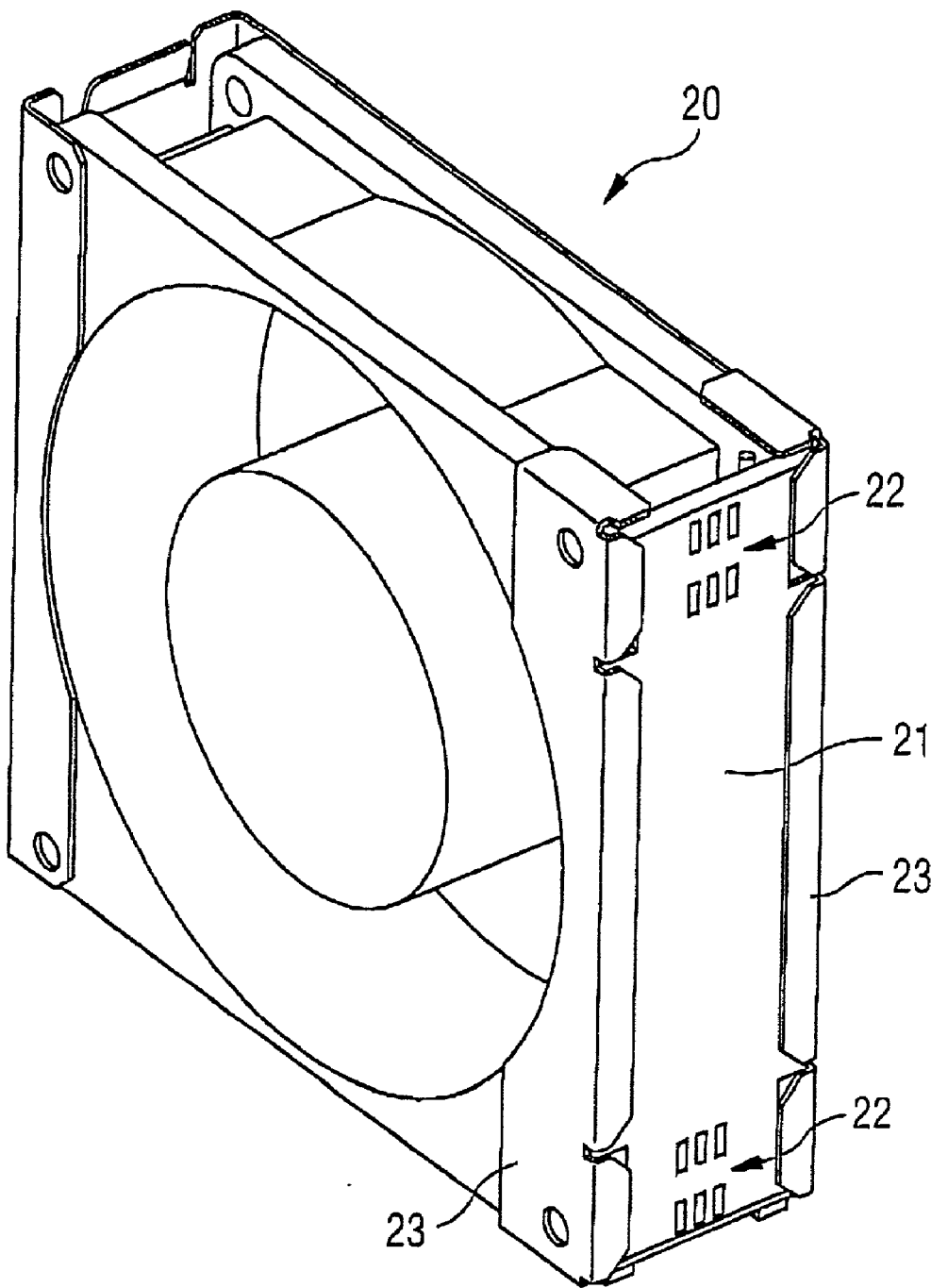


FIG 4

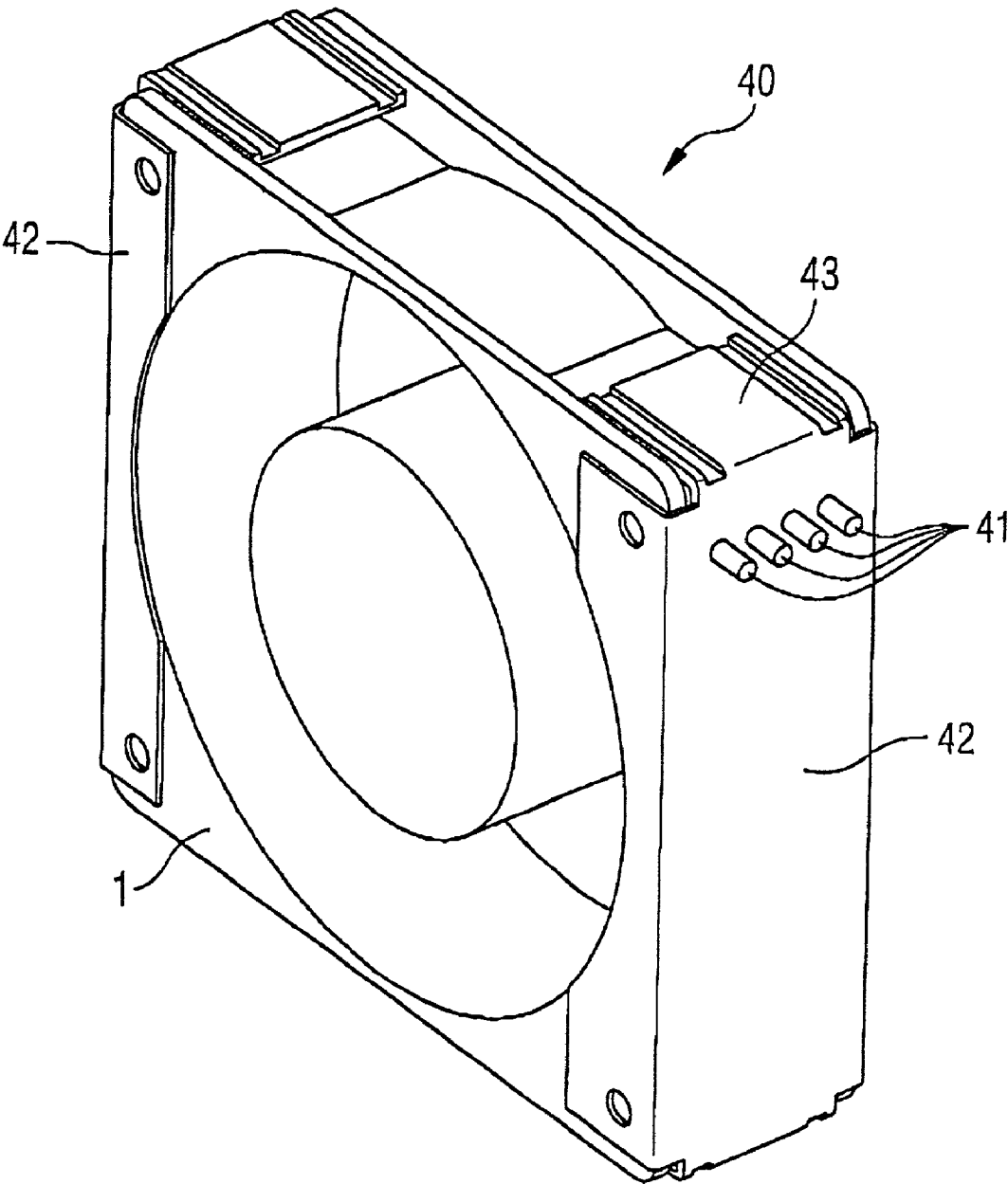
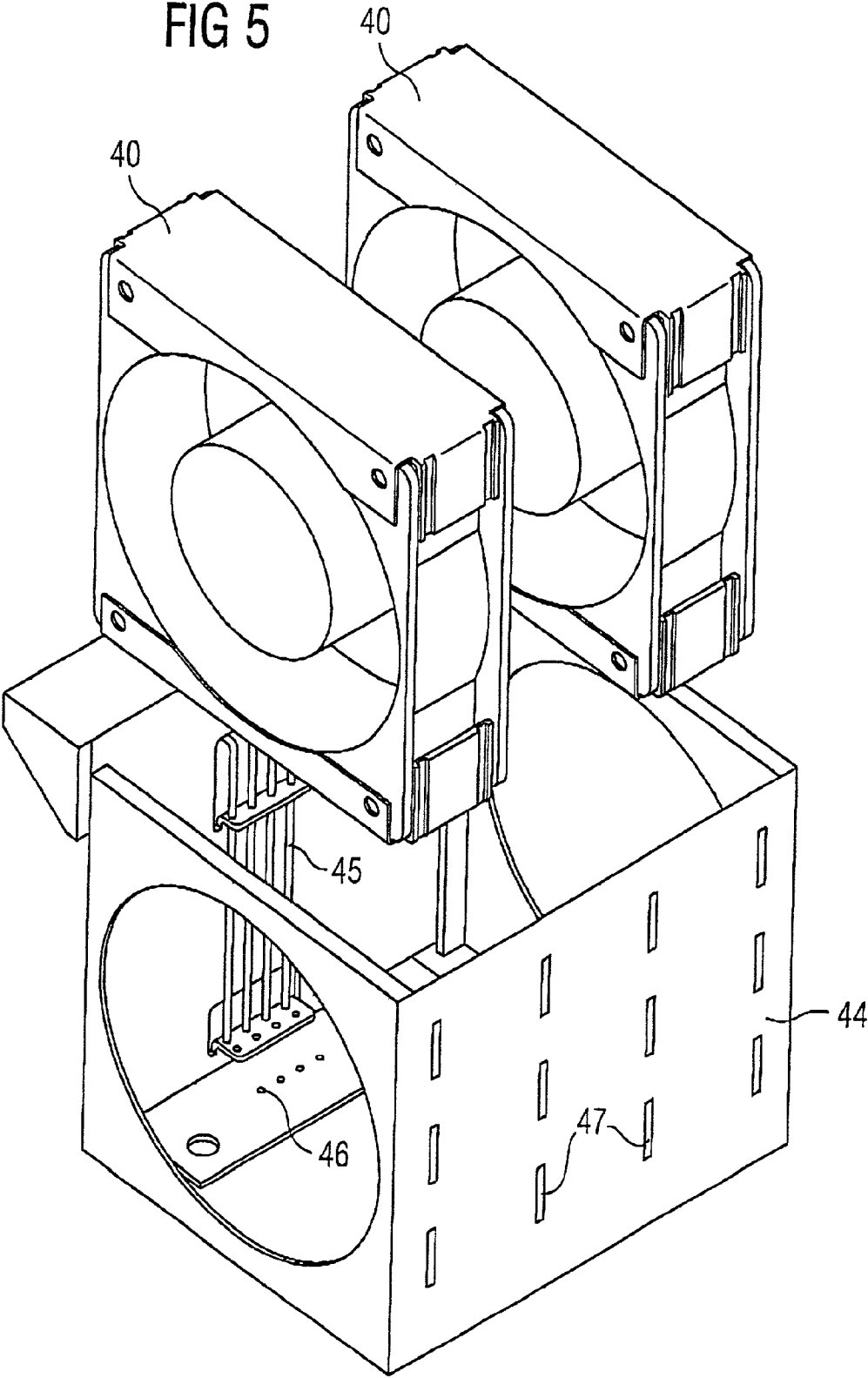


FIG 5



FAN MODULE

[0001] The present invention relates to a fan module that is comprised of a stationary fan element and a movable element positioned with the ability to rotate, and the latter is partially enclosed by the stationary fan element in order to generate an air flow, and the movable fan element can be set to rotate by way of an electric motor.

[0002] Pad modules of this type are used in electric devices of any kind. Primarily, computer systems require such fan modules for cooling purposes in order to prevent the overheating of power pack components and processors. A fan failure will inevitably lead to overheating of the instrument and may cause irreparable damage.

[0003] In general, disruptions of a fan module are detectable before the device fails completely, and it is possible to replace the fan module in time. However, this is a relatively complex process, because the fan modules are fixedly mounted and cabled. In any case, replacing a fan module constitutes a considerable invasion into the system, making it necessary for the device to be shut down. But for large computer systems, for example servers, continuous operation is desired or necessary. Even though, as a rule, several fan modules are envisioned in computer systems of this type that jointly cool the system, which means that the failure of a single fan module does not lead to a total cooling failure, a defective fan module must nevertheless be replaced as quickly as possible, resulting in the need to switch off the entire computer.

[0004] Therefore, it is the subject-matter of the present invention to propose a fan module that is quickly replaceable, even while the computer continues to be in operation. In this effort, the needed space requirement may not greatly exceed that of fan modules according to the state of the art.

[0005] According to the invention, this objective is achieved with a fan module of the type referred to at the outset. It is characterized by the fact that contact surfaces for supplying the electric motor with an operating voltage are arranged on one outside lateral surface of the stationary fan element.

[0006] The realization of a fan module according to the invention makes it possible for the fan module to be fastened and hooked up by inserting it into a fan housing that is provided for this purpose. This option ensures the quick and easy replacement of these components. The contact surfaces on the lateral surface require very little space, allowing this solution to be implemented even in applications where volume is critical. A principal aspect provides that, in addition to the possibility of inserting the module, the electrical connection for driving the fan is established simultaneously, thereby eliminating any manual cabling. In comparison to plug contacts, this is a cost-effective solution which offers, moreover, further advantages in terms of the space requirements.

[0007] An advantageous embodied example of the invention provides for a latching or a clamping medium in the area of the lateral surface of the stationary fan element, intended for the mechanical fastening of the fan module in a fan housing into which the fan module is inserted.

[0008] This ensures a safe hold.

[0009] Spring or sliding contacts are arranged in a fan housing into which the fan module according to the invention is inserted in such a way that, in the inserted state of the fan module, the spring or sliding contacts act in conjunction with the contact surfaces of the fan module. An advantageous apparatus, especially for larger computer systems, provides that spring or sliding contacts for several fan modules are arranged on a joint circuit board.

[0010] Subsequently, the invention will be explained in greater detail based on an embodiment shown in:

[0011] **FIG. 1** a fan module according to the invention, and in

[0012] **FIG. 2** a fan housing with several fan modules in accordance with **FIG. 1**, and in

[0013] **FIG. 3** a fan module with a detailed representation of the contact surfaces, and in

[0014] **FIG. 4** a further embodiment of a fan module according to the invention, and in

[0015] **FIG. 5** the apparatus of two fan modules according to **FIG. 4** in one housing.

[0016] **FIG. 1** shows a fan module **10** according to the invention. The module has a stationary fan element **1** and a fan element **2** that is positioned with the ability to rotate. The latter is equipped with fan wings **3** that generate an air flow when the movable fan element **2** is rotated. Contact surfaces **5** are arranged on an outside lateral surface **4** of the stationary fan element **1**. They serve, to supply the operating voltage for the electric motor which drives the mobile fan element. In addition, these contact surfaces can be used to transmit information, for example regarding the rotational speed. Moreover, a latching element, in the embodiment in **FIG. 1** this is a spring point **6**, is realized in order to latch the fan module inside a correspondingly shaped fan housing. Furthermore, the fan module has a status LED display **7** that indicates if the fan module is operating properly, or if an abnormal operating state is present.

[0017] In **FIG. 2**, several fan modules **10** are built into one fan housing **9**. Three fan modules are arranged in two rows in the configuration represented here; in particular, in the one row **11** two fan modules **10** are connected in series, and only one fan module is envisioned in the other row **12**. A housing lid, that can be used to close the fan housing and that simultaneously fixes the fan modules in place, is not shown in **FIG. 2**. It allows for the elimination of latching elements **6** on the individual fan modules **10**.

[0018] A partition **13** is envisioned between the two rows **11** and **12** that constitutes, at the same time, a circuit board for fastening spring contacts. The spring contacts are envisioned to establish an electric connection with the contact surfaces **5** of the inserted fan modules **10**. Favorable embodiments envision additional spring elements on the housing walls opposite to the circuit board **13**, exerting a force on the fan module in such a way as to cause the contact surfaces **5** and the corresponding spring or sliding contacts to be pressed onto one another.

[0019] A status LED display **7** is envisioned for each of the fan modules **10**. Furthermore, information regarding the operating state of the fan modules **10** is transmitted via the contact surfaces **5** to a control electronics unit situated on a

computer. If an error is reported there, the service technician can isolate the defective module **10** with a single glance at the installed fan modules **10**. It is advantageous that the same fan modules can be installed on both sides of the fan housing, because they are axial-symmetrical.

[0020] Due to the quick and simple replacement capability of the fan modules **10**, replacement work can be done during continuing operation; which means the fan modules **10** have "hot plug" capability. Since the described contacts use space very efficiently, the realization according to the invention, including all of its advantages, does not lead to an expansion of the construction volume of the fan housing **9**.

[0021] **FIG. 3** shows a fan module **20** with a detailed visible realization of the contact surfaces **22**. The contact surfaces **22**, which provide connections for the power supply and for the signal evaluation, are arranged in groups of 2x3 individual surfaces, respectively, and are mounted on a circuit board **21**. Plug connectors connecting a fan motor and, if need be, a status indicator to the circuit board and consequently to the contact surfaces are located on the back side of the circuit board **21**. This, however, is not visible in the figure. The circuit board **21** itself is held in place via sheet metal **23**, while, of course, many other possibilities are conceivable as fastening mechanisms.

[0022] **FIG. 4** shows a second embodied example of a fan module according to the invention. In contrast to the embodiment in **FIG. 3**, this embodiment does not envision a circuit board that is equipped with contact surfaces, with the circuit board being fastened to the stationary fan element by way of sheet metal; but envisioned instead is a contact pin clip **42** that is plugged onto the stationary fan element **1**. In a preferred embodiment, the contact pin clip is realized as a plastic injection molded part, thereby ensuring simple and cost-effective manufacturing. Another advantage consists in the fact that the dimensions of the fan modules with installed contact pin clips **42** are only slightly larger than the dimensions of fan modules without contact pin clips.

[0023] The contact pin clip is equipped with partially springy contact pins **41**. These contact pins **41** allow for secure electric contacting of the fan module over a wide tolerance range. The spring excursion of the contact pins **41** is relatively large, thereby ensuring safe contacting even in the presence of large tolerances of the fan housing and aggravated operating conditions (e.g. vibrations). The contact pins are arranged on the contact pin clip **42** in such a way that they can be connected to the fan motor by way of a plug connectors

[0024] Using the contact pin clips **42**, the assembly of fan modules according to the invention is very quick and simple. After the plug connection with the contact pins **41** has been established, there remains only the contact pin clip that needs to be plugged onto the stationary fan element **1**.

[0025] In the shown advantageous realization, the contact pin clip **42** is additionally outfitted with two springy guiding and latching elements **43** that are arranged perpendicular in relation to a middle section of the contact clip and that extend, consequently, on the lateral surfaces of the fan module. The guiding and latching elements are responsible for guiding the fan module during the insertion process into the corresponding fan housing **44**. Using the appropriate latching elements of the fan housing, in the completely

inserted position, a latching action is possible, which in turn is especially easily implemented due to the fact that the latching elements **43** are realized as springy.

[0026] In addition, it is possible to envision measures that will release the latching of the contact pin clips from the wall of the fan housing **44** again. But they not represented in **FIG. 4**.

[0027] **FIG. 5** shows the complete apparatus comprised of two fan modules in accordance with **FIG. 4** and a fan housing **44**. Accordingly, the fan modules **40** are inserted into the housing **44** in such a way that the partially springy contact pins are situated on the underside acting in conjunction inside the housing with the corresponding counter-contact surfaces on a circuit board **46**. The corresponding connections for triggering and possibly monitoring of the fan modules **40** can be arranged on the circuit board **46**; and the functions, previously described in connection with **FIGS. 1 to 3**, are possible in the present instance.

[0028] In contrast to the representations in **FIG. 1** and **FIG. 2**, the embodiments in **FIG. 4** and **FIG. 5** are not equipped with status indicators on the fan modules **40** themselves. Instead, status indicators are envisioned on the circuit board **46** inside the housing **44**. Since the circuit board **46** cannot be seen from the upper side of the housing **44**, the status indications are guided upward by way of optical wave guides **45**, thereby allowing that the operating status of the inserted fan modules **40** can be read from the upper side of the housing.

[0029] Stampings **47** are envisioned on the side wall of the fan housing **44** ensuring that the fan modules **40** are properly inserted and positioned inside the housing **44**.

1. Fan module comprised of

a stationary fan element (**1**) and

a movable fan element (**2**), positioned with the ability to rotate, and the latter is partially enclosed by the stationary fan element (**1**), intended to generate an air flow, and the movable fan element (**2**) can be made to rotate by way of an electric motor

wherein contact surfaces (**5**; **41**) are arranged on an outside lateral surface (**4**) of the stationary fan element (**1**) for supplying an operating voltage for the electric motor.

2. Fan module as claimed in claim 1

wherein latching media (**6**; **43**) are envisioned on the stationary fan element (**1**) for latching the fan module (**10**; **40**) inside a fan housing (**9**; **44**), into which the fan module (**10**; **40**) is inserted.

3. Fan module as claimed in claim 1

wherein clamping media are envisioned on the stationary fan element for fastening the fan module (**10**) by way of clamping into a fan housing (**9**), into which the fan module (**10**) is inserted.

4. Fan module as claimed in claim 1

wherein a function display (**7**) is envisioned on the stationary fan element (**10**) indicating the functional capabilities of the fan module (**10**).

5. Fan module as claimed in one of the claims 1 to 4 wherein the contact surfaces are formed by partially springy contact pins (41).
6. Fan module as claimed in claim 5 wherein the contact pins (41) are supported by a contact clip (42) that is plugged onto the stationary fan element (1).
7. Fan element as claimed in claim 6 wherein the contact clip (42) consists of a plastic injection molded part and has two springy latching sections (44) that are arranged perpendicular in relation to a middle section of the contact clip.
8. Fan housing for accommodating fan modules (10) as claimed in one of the claims 1 to 7 wherein plug-in slots are envisioned for several fan modules (10; 40) inside the fan

housing (9; 44), and wherein spring or sliding contact surfaces or stationary contact surfaces are arranged in such a way that, in the inserted state of the fan module (10; 40), the spring or sliding contacts or stationary contact surfaces act in conjunction with the contact surface (5; 41) of the fan module (10; 40).

9. Fan housing as claimed in claim 8

wherein spring or sliding contacts for several fan modules (10; 40) are fastened on a joint circuit board (13; 46).

10. Fan housing as claimed in claim 6 or 9

wherein several fan modules (10; 40) can be accommodated in series and in several rows (11, 12) adjacent to each other.

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