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(54) Title: PLATE FOR COOLING A POWER TOOL

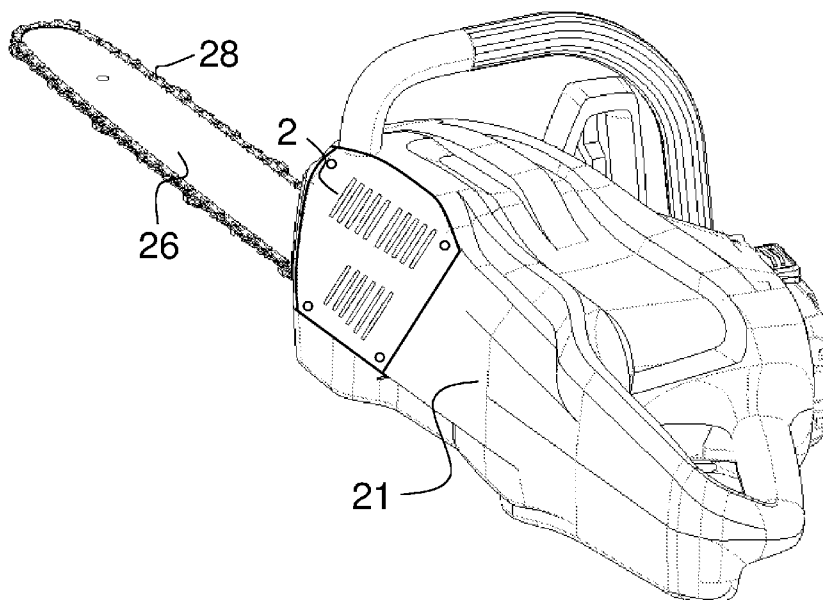


Fig. 2

(57) Abstract: A power tool comprises a non-metallic housing (20) comprising an electrical motor (22) and a battery (24). The electrical motor (24) is controlled by a controller provided on a Printed Circuit Board, PCB, (10), wherein a surface of the PCB (10) is in contact with a metallic cooling plate (2) arranged on a bottom side (21) of the non-metallic housing (20).



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PLATE FOR COOLING A POWER TOOL

Technical field

[0001] The present invention relates generally to power tools and more specific to cooling of power tools, such as chainsaws, trimmers, blowers, hedge trimmers and the like.

[0002] Background art

[0003] During the last decades, power tools have become more and more popular due to the development of more efficient batteries. One advantage with power tools is the possibility to readily control the performance of an electrical motor provided in a housing of the power tool. The electrical motor is controlled by a controller or control unit, the components thereof being provided on a **Printed Circuit Board**, PCB. A problem with the controller and PCB is that they generate heat. Thus, there is a need for cooling the electrical components of the power tool.

[0004] Traditionally, cooling in power tools is provided by incorporating turbines and/or ventilators inside the housing of the power tool, which create an air circulation around the controller and the PCB. However, the introduction of turbines and ventilators increase the complexity and cost of the power tools. Turbines and ventilators also require energy, which will drain the scarce power resource of the batteries used for power tools.

[0005] Another solution to the cooling problem is disclosed in EP 1 961 528, which primarily is directed to the cooling of the electrical motor, but also to cooling of components on an electronic control card. In EP 1 961 528 the electrical motor is enclosed by a housing made of light metal alloy. The housing comprises at least two parts. The electrical motor is in contact with the surface of the housing in order to provide static cooling of a power tool in form of a power tool. To further increase the cooling efficiency the housing may be provided with cooling fins.

[0006] There are at least two problems with having an all metallic housing, even if it is a light metal alloy. Firstly, the weight of the housing and thus the power tool

increases compared to a plastic housing. This makes the power tool more difficult to handle and in the end, it might make the operator more fatigue and will in that sense be a safety issue. Secondly, since the metallic housing is a good heat conductor heat will spread to the entire housing. This heat may make the operator warm or hot and in some cases the operator might also burn himself on the housing. Everyone that has touched a hot surface knows that this can cause sudden movements away from the heat, which could be very dangerous if you are holding a power tool in your hands.

[0007] Thus, there is a need to find an efficient way to preform cooling of a power tool, which does not jeopardize the safety of an operator and which is simple and does not require any additional power from the battery.

Summary of invention

[0008] An object of the present invention is to accomplish a power tool having efficient cooling, while at the same time keeping the complexity of the power tool as low as possible.

[0009] According to one aspect this is accomplished by a power tool comprising a non-metallic housing comprising an electrical motor and a battery. The electrical motor is controlled by a controller provided on a Printed Circuit Board, PCB, wherein a surface of the PCB is in contact with a metallic cooling plate arranged on a bottom side of the non-metallic housing.

[0010] In an embodiment of the power tool, the metallic cooling plate is made of aluminium or alloys thereof.

[0011] In another embodiment of the power tool, the metallic cooling plate is made of magnesium or alloys thereof.

[0012] Furthermore, the metallic cooling plate may further comprise a cavity, the size of which is adapted to receive the PCB.

[0013] In yet another embodiment of the power tool, the metallic cooling plate is provided with vent holes. A part of these vent holes may be provided inside the

cavity. In order to prevent dust the vent holes may furthermore be covered by or provided with a filter on a side of the metallic cooling plate that is directed to the inside of the housing.

[0014] Preferably, the housing of the power tool is made of plastic.

[0015] By providing a metallic bottom plate at the bottom side of the non-metallic housing of the power tool in contact with the PCB, cooling of the PCB and its components is provided without leading heat to the parts of the housing that might be in contact with an operator. This solution will thus not affect the safety as the solution according to the cited prior art. Furthermore, the use of a cooling plate eliminates the need to use turbines and ventilators to cool the power tool. In this way, a simple solution to the problem has been achieved without substantially affecting the weight of the power tool.

Brief description of drawings

[0016] The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

[0017] Fig. 1 is a schematic side view of a power tool, exemplified as a chainsaw, according to an embodiment.

[0018] Fig. 2 is perspective view looking at the bottom side of the power tool.

[0019] Fig. 3 is a metallic cooling plate according to an embodiment.

[0020] Fig. 4 is a metallic cooling plate according to an embodiment.

[0021] Fig. 5 is a metallic cooling plate according to an embodiment.

[0022] Fig. 6 is a schematic view of a printed circuit board and its components.

Description of embodiments

[0023] In the following, a detailed description of the cooling plate of the power tool will be presented.

[0024] With reference to Fig. 1 a schematic side view of a power tool according to an embodiment of the present invention is shown. It should be understood that even if Fig. 1 exemplifies the power tool with an electrical chainsaw, the present invention is not limited to this. An electrical chainsaw is merely an example of a power tool. Other examples are trimmers, blowers, hedge trimmers etc. The electrical chainsaw tool comprises a cutting chain 28 that is rotatably mounted on a chain guide 26. In other embodiments, the cutting chain is substituted by other tools. When operated the cutting chain 28 is rotated by means of a drive pinion. The drive pinion is driven by an electrical motor 22, which is powered by a battery 24. The output of the electrical motor 22 is controlled by a controller provided on a **Printed Circuit Board**, PCB 10. Some of the components 12 of the controller are schematically depicted in the Fig. 1. The electrical motor 22, the battery 24, the PCB 10 and the components provided thereon are all enclosed by a housing 20. The housing 20 is made of a non-metallic material preferably plastic or composite or the like. The aim of the present invention is to provide cooling for the PCB 10 and all the components 12 thereon. Thus, the described housing 20 is representative for a general housing of a power tool.

[0025] Turning now to Fig. 2 a perspective view of the power tool is shown, looking at the bottom side 21 of the power tool. The same reference numerals denote the same objects as in Fig. 1. They are therefore not repeated here once again. Not previously shown in Fig. 1, but now shown in Fig. 2 is a metallic cooling plate 2. It is the metallic cooling plate 2 that is used to cool the PCB 10 and its components 12. Different embodiments of the cooling plate 2 are shown in more detail in Figs. 3 to 5. A more detailed view of the PCB 10 and its components 12 is shown in Fig. 6.

[0026] Turning now to Fig. 3, the cooling plate 2 will be described in more detail. In Fig. 3 to Fig. 5 the cooling plate 2 is essentially square-shaped. However, these shapes are only examples of how a cooling plate 2 may be configured. The important thing is that the shape of the cooling plate 2 is adapted to the bottom side 21 of the housing 20 and to the PCB 10, which it is cooling.

[0027] In Fig. 3 the cooling plate 2 comprises a cavity 4, the size and depth of which is adapted to receive the PCB 10. The cooling plate 2 and/or the cavity 4 may furthermore also be adapted to receive or be in direct contact with some of the components 12. This may provide more cooling effect directly to a specific component 12 if it is desired. For example, a processer may be provided with a cooling flange that is in direct contact with the cooling plate 2.

[0028] The cooling plate 2 may furthermore be provided with vent holes 26, which allows that air from the outside reaches inside the housing 20 and cools the PCB 10. The vent holes may be designed in numerous different way when it comes to size, number and where on the cooling plate 2 they are provided. Different examples of vent hole 6 configurations are shown throughout Fig. 3 to Fig. 5. For example, in Fig. 5 a part of the vent holes 6 are provided in the cavity 4. It is believed to be within the capability of a person skilled in the art to design the size, number and place of the vent holes 6.

[0029] Furthermore, in some embodiments the vent holes 6 may be covered by a filter on a side of the metallic cooling plate 2 that is directed towards the inside of the housing 20. The filter is used to prevent dust and other particles to enter into the housing 20 of the power tool.

[0030] The cooling plate 2 may also comprise through holes 8, which are used to fasten the cooling plate 2 to the bottom side 21 of the housing 20. The number of through holes 8 is, as recognized by a person skilled in the art, adapted to the geometry of the cooling plate 2 and the geometry of the bottom side 2 of the housing 20. Different examples of through holes 8, and placement thereof are shown throughout the Figs.

[0031] As mentioned above the cooling plate 2 is made of metal. In one embodiment, the cooling plate 2 is made of aluminium or alloys thereof. In another embodiment, the cooling plate 2 is made of magnesium or alloys thereof. When choosing the type of metal to be used as cooling plate 2, it is important to bear in mind the cooling effect of the metal and the weight of the metal. It is important that

the cooling plate 2 does not add to much weight to the overall weight of the power tool.

[0032] Turning now to Fig. 6 a more detailed view of the PCB 10 and its components 12 are shown. The components 12 constitute different parts of a controller, such as a processor, a memory etc. that are used to control the electrical motor 22.

[0033] Although, the present invention has been described above with reference to specific embodiments, it is not intended to be limited to the specific form set forth herein. Rather, the invention is limited only by the accompanying claims.

[0034] In the claims, the term “comprises/comprising” does not exclude the presence of other elements or steps. Furthermore, although individually listed, a plurality of means or elements may be implemented by e.g. a single unit or processor. Additionally, although individual features may be included in different claims, these may possibly advantageously be combined, and the inclusion in different claims does not imply that a combination of features is not feasible and/or advantageous. In addition, singular references do not exclude a plurality. The terms “a”, “an”, “first”, “second” etc do not preclude a plurality. Reference signs in the claims are provided merely as a clarifying example and shall not be construed as limiting the scope of the claims in any way.

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CLAIMS

1. A power tool comprising a non-metallic housing (20) comprising an electrical motor (22) and a battery (24), said electrical motor (24) being controlled by a controller provided on a Printed Circuit Board, PCB, (10), wherein a surface of the PCB (10) is in contact with a metallic cooling plate (2) arranged on a bottom side (21) of the non-metallic housing (20).
2. The power tool according to claim 1, wherein the metallic cooling plate is made of aluminium or alloys thereof.
3. The power tool according to claim 1, wherein the metallic cooling plate is made of magnesium or alloys thereof.
4. The power tool according to any of the previous claims, wherein the metallic cooling plate (2) further comprises a cavity (4), the size of which is adapted to receive the PCB (10).
5. The power tool according to any of the previous claims, wherein the metallic cooling plate (2) is provided with vent holes (6).
6. The power tool according to claim 5, wherein a part of the vent holes (6) are provided in the cavity (4).
7. The power tool according to any of the previous claims, wherein the vent holes (6) are covered by a filter on a side of the metallic cooling plate (2) that is directed towards the inside of the non-metallic housing (20).
8. The power tool according to any of the previous claims, wherein the non-metallic housing is made of plastic.

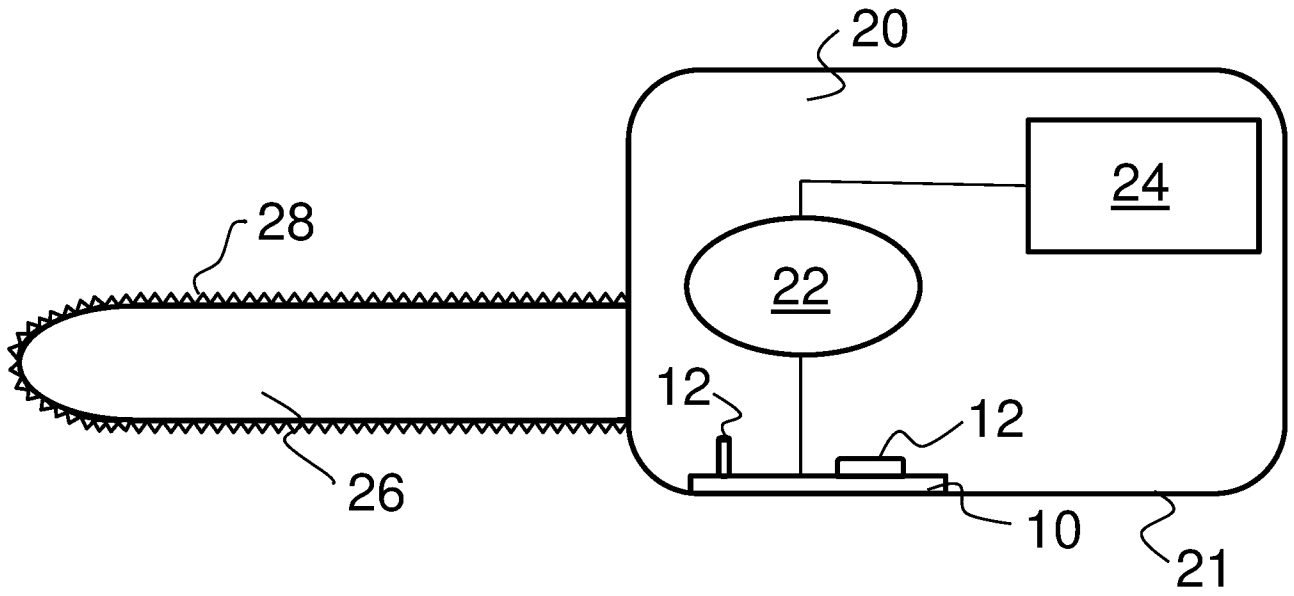


Fig. 1

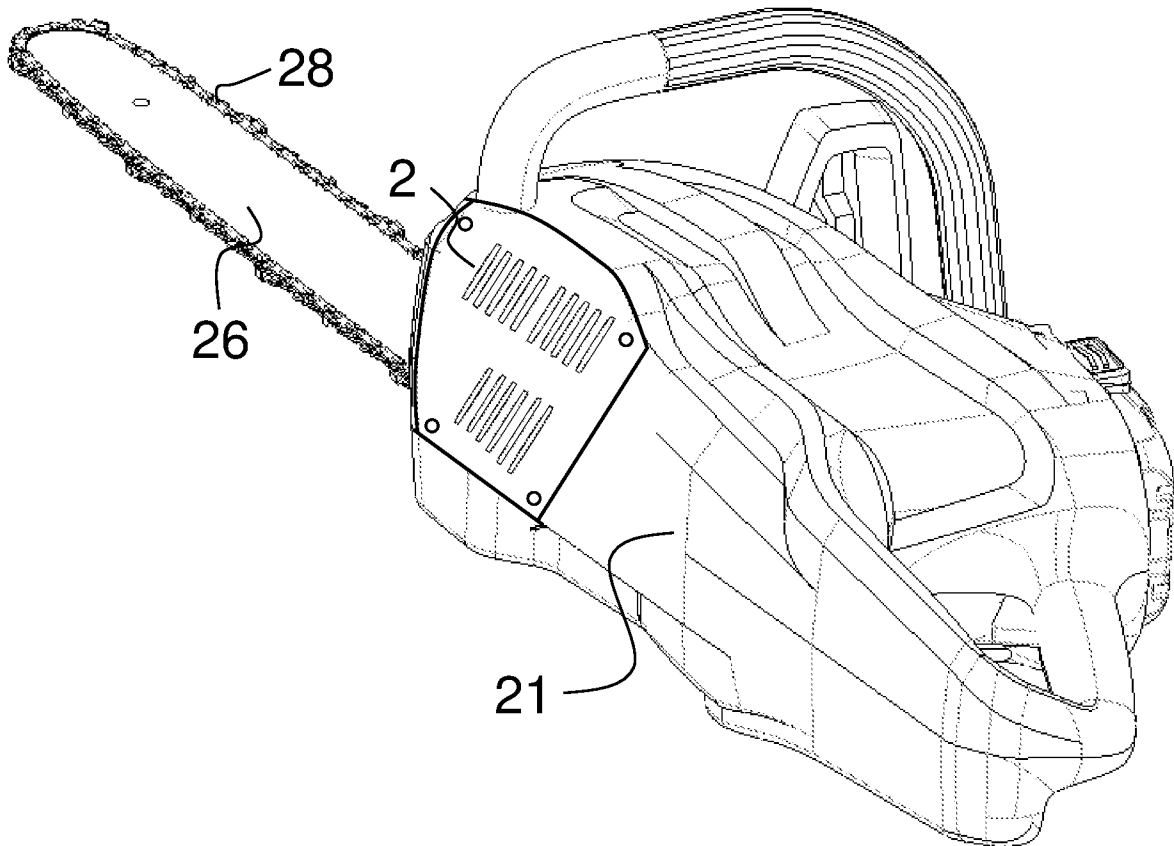


Fig. 2

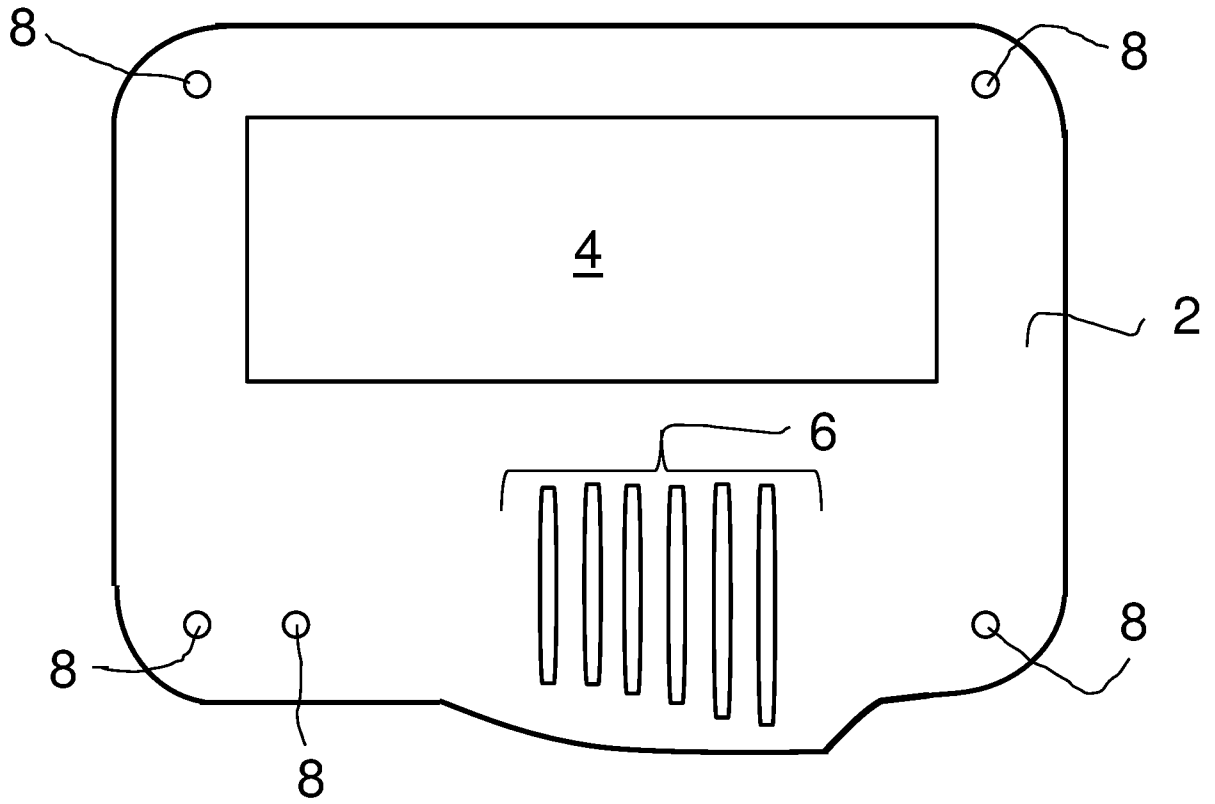


Fig. 3

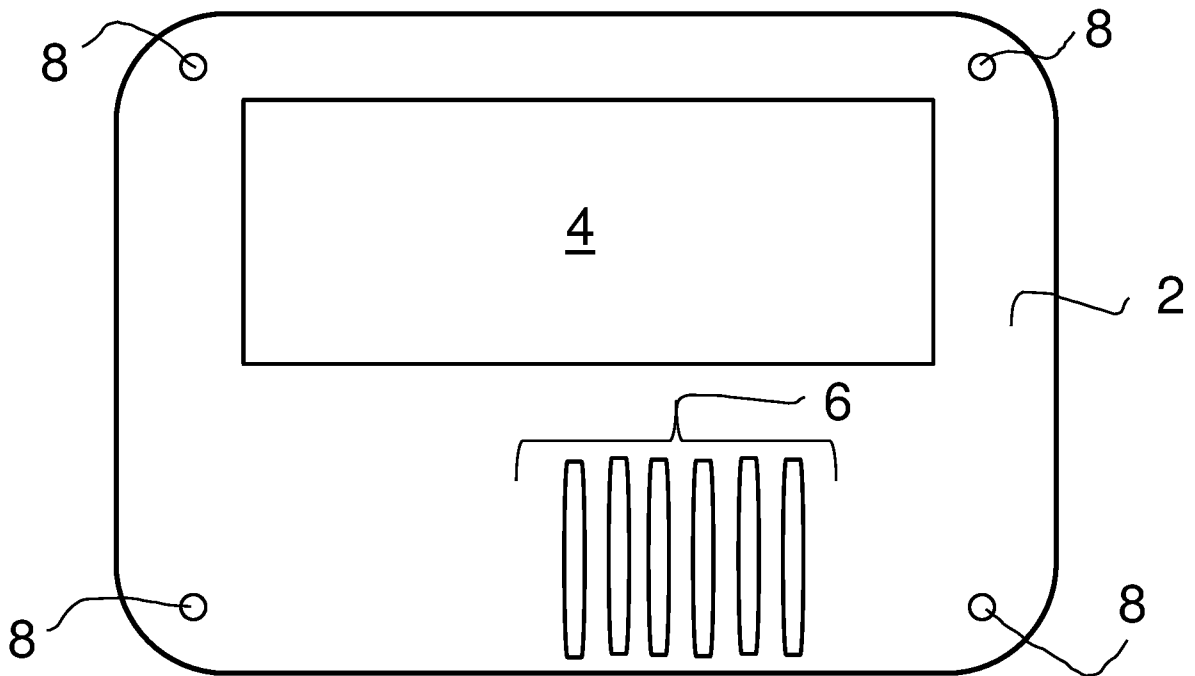


Fig. 4

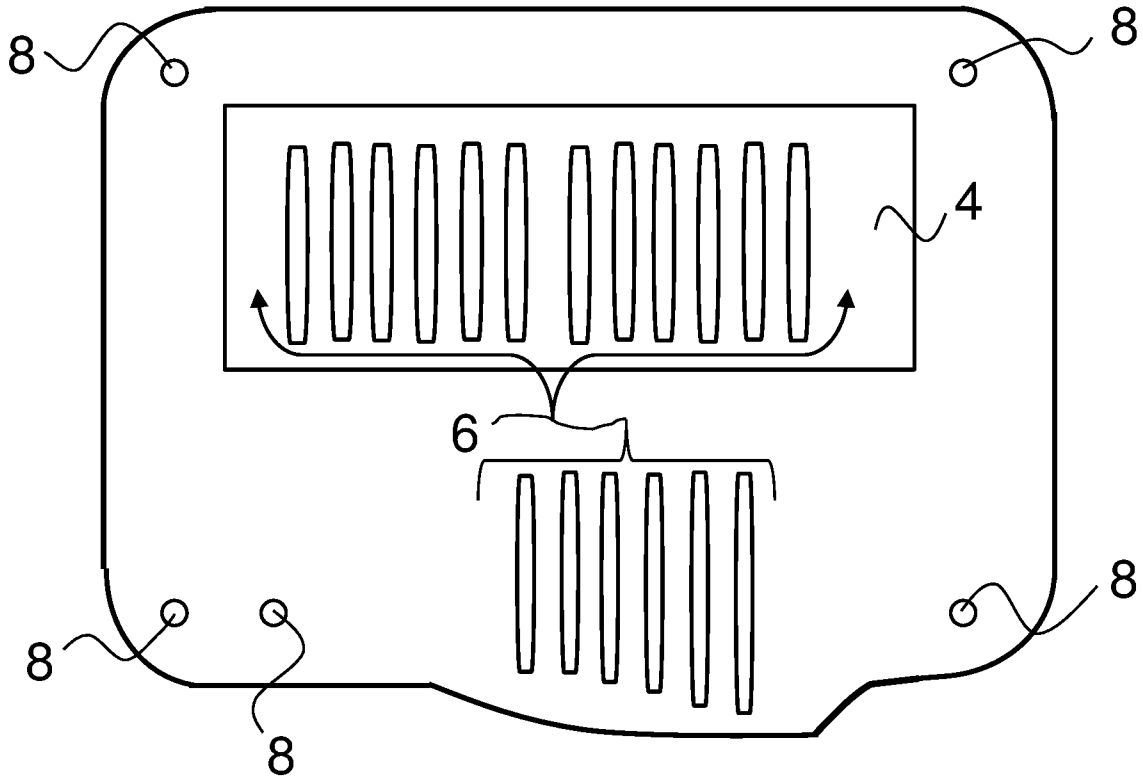


Fig. 5

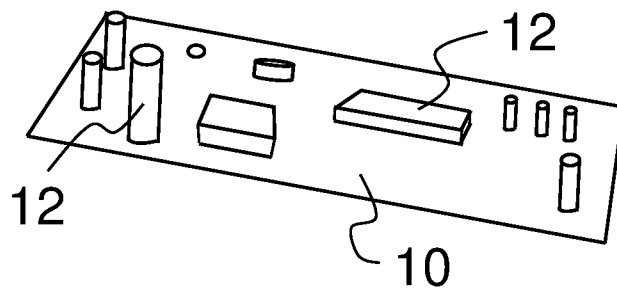


Fig. 6

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER B23D 57/02(2006.01)j According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B23D Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS,CNTXT,DWPI,SIPOABS,ISI WEB OF KNOWLEDGE,GOOGLE SCHOLAR: cooling,PCB,motor, plate,housing, cover,cavity,battery,filter,vent,hole,metallic		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101668616 A (PELLENC SA.) 10 March 2010 (2010-03-10) page 4 lines 9-25, figures 1-4	1-8
A	CN 202292694 U (CHANGZHOU GELIBO TOOL CO., LTD.) 04 July 2012 (2012-07-04) the whole document	1-8
A	CN 205724951 U (SHI, JINGJING) 23 November 2016 (2016-11-23) the whole document	1-8
A	CN 1240277 A (TAIDA ELECTRONIC IND. CO., LTD.) 05 January 2000 (2000-01-05) the whole document	1-8
A	WO 2013076373 A1 (KEMPPI OY.) 30 May 2013 (2013-05-30) the whole document	1-8
A	US 2015156919 A1 (ABB OY.) 04 June 2015 (2015-06-04) the whole document	1-8
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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Name and mailing address of the ISA/CN STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA 6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088 China		Authorized officer TANG, Tiantian
Facsimile No. (86-10)62019451		Telephone No. 86-(10)-53962821

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2017/103734

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	101668616	A	10 March 2010	KR	20100014657	A	10 February 2010
				CA	2679083	C	22 April 2014
				MX	2009009055	A	15 January 2010
				CN	101668616	B	13 February 2013
				EP	1961528	A1	27 August 2008
				FR	2912947	B1	12 February 2010
				JP	2014210339	A	13 November 2014
				JP	2010519078	A	03 June 2010
				RU	2464161	C2	20 October 2012
				BR	PI0807780	A2	03 June 2014
				WO	2008122718	A1	16 October 2008
				US	9744685	B2	29 August 2017
				AT	545491	T	15 March 2012
				AU	2008235394	B2	28 November 2013
				NZ	579606	A	30 June 2011
				DK	1961528	T3	21 May 2012
				EP	1961528	B1	15 February 2012
				FR	2912947	A1	29 August 2008
				HK	1137695	A1	30 August 2013
				US	2010083513	A1	08 April 2010
				RU	2009135786	A	10 April 2011
				JP	5952346	B2	13 July 2016
				CY	1112910	T1	13 April 2016
				ES	2382685	T3	12 June 2012
				PL	1961528	T3	31 July 2012
				AU	2008235394	A1	15 October 2009
				CA	2679083	A	25 February 2008
				PT	1961528	E	19 March 2012
				MX	305184	B	13 November 2012
				IN	200903187	P2	25 December 2009

CN	202292694	U	04 July 2012	None			

CN	205724951	U	23 November 2016	None			

CN	1240277	A	05 January 2000	CN	1112626	C	25 June 2003

WO	2013076373	A1	30 May 2013	EP	2782700	A4	21 October 2015
				CN	103958114	A	30 July 2014
				EP	2782700	A1	01 October 2014
				FI	124216	B	15 May 2014
				RU	2014124038	A	27 December 2015
				US	9308605	B2	12 April 2016
				FI	20116165	A	24 May 2013
				US	2014319111	A1	30 October 2014
				IN	201403556	P4	03 July 2015

US	2015156919	A1	04 June 2015	CN	104684353	B	21 July 2017
				EP	2879476	A1	03 June 2015
				CN	104684353	A	03 June 2015
				US	9433123	B2	30 August 2016
				EP	2879476	B1	29 June 2016
