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Description

The present invention relates to a cooking appliance, and more particularly, to a safety device associated with such an appliance.

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A cooking appliance is known of the type comprising a vessel adapted to receive food to be cooked, a fan adapted to generate an air flow, a motor adapted to drive the fan, a deflector capable of directing the flow of air into the vessel, and an electric heating element arranged between the fan and the vessel and adapted to heat the air.

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Such an appliance is disclosed for example in application WO 2006/000700. In This document, the appliance is a fryer enabling frying to be performed with a very small amount of oil, thanks on the one hand to the flow of hot air and, on the other hand, to the presence of a blade rotatably mounted in the vessel and adapted to move the food to be cooked. Another cooking appliance is known from the document US 2004/0089648 A.

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The object of the present invention is to provide a novel appliance having improved safety.

According to the invention, the appliance of the afore-mentioned type comprises a safety device adapted to cut off the electrical power supply to the electrical heating element when the power consumption of the motor is outside a normal operating range defined by an upper limit and a lower limit.

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Thus, according to the invention the same device enables the power supply to the electrical heating element to be cut off when the motor has stopped as a result of a power failure of the latter (its consumption is low — or even zero — and therefore below the lower limit of the normal operating range) as a result of a mechanical jamming of the motor (its consumption is high and therefore above the upper limit of the normal operating range).

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Other features and advantages of the present invention will become apparent in the description of an embodiment given by way of non-limiting example and illustrated by the accompanying drawings, in which:

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Fig. 1 is a sectional view of an exemplary embodiment of a food cooking appliance according to the invention;

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Fig. 2 is a sectional view of the appliance illustrated in Fig. 1, in which the vessel of the appliance has been removed;

5 Fig. 3 is a perspective view of the heating device of the appliance illustrated in Figs. 1 and 2, in which the heating means are shown partially exposed;

Fig. 4 is a rear perspective view and a partial exposed view of the ventilation device of the appliance illustrated in Figs. 1 and 2;

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Fig. 5 is a diagram of the electric circuit of the cooking appliance illustrated in Figs. 1 and 2, including the safety device;

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Fig. 6 is a diagram of the electrical circuit of the safety device of Fig. 5, and of its immediate surroundings;

Fig. 7 is a diagram illustrating the effect of the safety device; and

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Fig. 8 is a diagram illustrating the hysteresis phenomenon associated with the safety device.

The food cooking appliance 1 illustrated in Fig. 1 (here, an electric fryer for frying food by circulation of hot air flow) comprises a cooking chamber 2, a device for producing hot air 3 which comprises a fan 4 and an electrical heating device 5 arranged in the air flow generated by the fan 4, and a fan motor 6 adapted to drive the fan 4.

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In the embodiment illustrated in the figures, the cooking chamber 2 is delimited on the one hand by a housing 7 having an upper opening for allowing access to the cooking chamber 2, and on the other hand by a cover 8 adapted to cover this opening.

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In the present example, in order to improve the control of the hot air feed into the cooking chamber 2, the hot air generating device 3 (the fan 4 and the electrical heating device 5) is arranged in a duct 9 which is connected to the cooking chamber 2 via an air inlet 10 and an air outlet 11. This arrangement also enables a pulsed air heating with a high air flow rate to be obtained.

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In the present example, the fan 4 is arranged upstream of the electrical heating device 5, thereby simplifying the construction of the fan 4.

The air Inlet 10 is provided in a wall (here, side) of the housing 7 and, in the present example, it comprises a grille 12 capable of protecting the device 3 for producing hot air, and in particular the fan 4, which in this case is located just behind the air inlet 10 (which allows better suction of the air in the cooking chamber 2). The air outlet 11, for its part, is arranged in the cover 8. Furthermore, in the present example another air outlet 13 is provided in the cover 8 next to the air outlet 11.

The fan 4 and the fan motor 6 belong to a ventilation unit 14 which also comprises a frame 15 supporting the fan 4.

The fan 4 is a centrifugal fan whose hub is situated at the right of the air inlet 10. Thus, the suction is axial and the expulsion is lateral, which enables a large airflow to be generated using a compact fan 4.

The frame 15 partially defines the duct 9 and comprises a deflecting wall 16 surrounding at a distance, in an annular manner, the fan 4 so as to form a channel 17 with the latter. This deflecting wall 16 enables the air flow coming from the fan 4 to be channelled to the electrical heating device 5, wherein the cross-section of the channel 17 increases in the direction of the latter.

The electrical heating device 5 comprises a resistive heating element 20, an insulating support 21 on which the resistive heating element 20 is wound, and a metal casing 22, housing the resistive heating element 20 and the insulating support 21. This arrangement enables an electrical heating device 5 to be obtained that is capable of heating the air to temperatures greater than 200°C, while allowing a simple design and construction of the appliance 1.

In the present embodiment, in order to have ducted air in the electrical heating device 5 and thus a better distribution of the heat produced by this device, the latter comprises an air inlet 23 and an air outlet 24. The air inlet 23 and the air outlet 24 are formed by openings made in the housing 22, on both sides of the resistive heating element 20. The air inlet 23 is arranged opposite the fan 4 and is formed by the part of the channel 17 not bounded by the deflecting wall 16. The air outlet 24 is defined by a series of openings arranged in the cover 8.

In the present example, a deflector 25 enables the air from the electrical heating device 5 to be diverted to the cooking chamber 2. Here, this deflector 25 is part of the cover 8 and forms the part of the duct 9 that extends from the air evacuation unit 24 to the air outlet 11.

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The deflector 25 is made of plastic material capable of withstanding the temperature of the air coming from the electrical heating device 5 (for example is made of PBT), thereby simplifying the construction of the appliance 1.

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The cooking appliance 1 comprises, in the cooking chamber 2, a vessel 26 which is a designed to receive food to be cooked, and a blade 27 which is rotatably mounted in the vessel 26 and which is designed to stir the food and the oil. The appliance also includes an electric stirring motor 28 that is adapted to drive the rotation of the blade 27, this stirring motor 28 being arranged under the cooking chamber 2.

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Finally, the cooking appliance 1 comprises an outer shell 29 that protects the cooking chamber 2 from the outside, a hot air generation device 3, the fan motor 6, the stirring motor 28 and the assembly of the electric components enabling the electrical heating device 5 and the two motors 6, 28 to be supplied with power and controlled. This shell 29 comprises an upper access opening that is blocked by the cover 8.

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The electric circuit of the cooking appliance 1 is shown in Fig. 5.

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The cooking appliance 1 comprises a general switch 30 for controlling its power supply and a thermostat 31 enabling the heating temperature of the resistive heating element 20 to be controlled.

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For safety reasons, the cooking appliance 1 also comprises two supplementary switches 32, 33 allowing the whole appliance to be supplied with power only if the cover 8 is closed. In addition, the electrical devices are protected by different electrical fuses 34, 35: a first 34 for the general protection of the electrical circuit, and a second 35 for protecting the fan motor 6. In addition, the resistive heating element 20 is protected by a thermal fuse 36.

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Furthermore, a diode bridge 37 enables the electric current necessary to power the fan motor 6 to be rectified. This diode bridge 37 can support 1000 V.

According to the invention, the cooking appliance 1 also comprises a safety device 38, which is adapted to cut off the electrical power supply of the resistive heating element 20 when eaten the power consumption of the fan motor 6 is beyond a normal operating range defined by an upper limit and a lower limit.

The safety device 38 is formed by an electronic module 38 which has five connectors: two 39, 40 for its power supply, two 41, 42 for its connection with the resistive heating element 20, and one 43 for measuring the power supply to the fan motor 6 and comparing it with the limits of the normal operating range. The three connectors 39, 40, 43 associated with the fan motor 6 are supplied with rectified current and are therefore connected to the diode bridge 37.

Preferably, this electronic module 38 is accommodated in a housing close to the fan motor 6. Here, the thermostat 31 and the thermal fuse 36 are in contact with the metal housing 22.

In the present example the safety device 38 comprises a measuring element 44, which is adapted to measure the electric current consumed by the fan motor 6, a comparator 45, which is adapted to compare the consumption of the fan motor 6 with the limits of the normal operating range, and a power relay 46 that is adapted to cut off the power supply to the resistive heating element 20 depending on the result of the comparison.

More specifically, the measuring element 44 is formed by a power resistor 44 that connects the connector 43 that is connected to the outlet of the fan motor, to the connector 40 which is connected directly to the diode bridge 37 (earth). In the present example this resistor 44 has a power of 2 W.

The comparator 45 comprises an input 47 connected to the measuring element 44 and an output 48 connected to the power relay 46, the outlet 48 providing an electric current that is either on or off. More specifically, the comparator 45 comprises two comparison elements 49, 50, wherein each comparison element 49, 50 compares the measured power with one of the two limits of the operating range. Each comparison element 49, 50 comprises an input pin which is connected to the input 47 of the comparator 45, an output pin which is connected to the output 48 of the latter, and a pin associated with the corresponding limit of the operating range.

The power relay 46 comprises on the one hand an actuator 51, which is connected to the output 48 of the comparator 45 and to the connector 39 that is connected to the input of the fan motor 6, and on the other hand a switch 52, which is connected to the two connectors 41, 42 that are connected to the resistive heating element 20. The actuator 51 is controlled depending on the presence or not of a current at the output of the comparator 45, and consequently causes the switch 52 to close or open.

Fig. 7 illustrates the operation of the safety device 38: in the upper part is illustrated the variation over time of the intensity at the output of the measuring element 44, and in the lower part is illustrated the corresponding variation over time of the state of the power supply to the resistive heating element 20. It can clearly be seen that when the fan motor 6 is not powered, the measured intensity is lower than the lower limit I_{min} and the resistive heating element is not powered; when the fan motor 6 is mechanically locked, the measured intensity is higher than the upper limit I_{max} and neither is the resistive heating element 2 powered (the thermal fuse 36 protects the resistive heating element 20); and when the fan motor 6 is operating, the measured intensity is in the operating range and the resistive heating element 2 is supplied with power.

Moreover, Fig. 8 illustrates the hysteresis phenomenon associated with the safety device 38 (with the comparator 45), eliminating the vibrations of the power relay 46 when its state changes.

By way of example, for an appliance 1 supplied with an alternating current of 230 V, with the measured resistance 44 of 2 W, the two limits of the normal range can be 60 mA (+/- 20 mA) and 230 mA (+/- 20 mA). More specifically, the values indicated above relate to the change of states of the power relay 44 from its open state to its closed state. For the change of states in the opposite direction, the values are reduced by 40 mA. For the same appliance supplied with a 120 V current, the two limits of the normal range can be 130 mA (+/- 40 mA) and 500 mA (+/- 40 mA), the hysteresis value being 80 mA.

The present invention is in no way limited to the described embodiment, but includes numerous modifications in the scope of the claims.

Thus, the fan and the electrical heating device are not necessarily arranged in a duct connected to the cooking chamber. In particular, the fan and/or the electrical heating device

can be arranged in the cooking chamber. Moreover, the fan is not necessarily a centrifugal fan. Likewise, the electrical heating device need not comprise a metal housing accommodating a resistive heating element wound on an insulating support. It may also not include an air inlet and an air outlet.

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It is also possible that the deflector is not arranged in a duct, or even that the air from the hot air generation device is fed directly to the cooking chamber.

Patentkrav**1. Apparat til kogning af fødevarer (1) omfattende**

- et kogekammer (2),
- 5 - en indretning til fremstilling af varmluft (3) omfattende en ventilator (4) og en elektrisk varmeindretning (5) anbragt i luftstrømmen genereret af ventilatoren (4), hvor indretningen til fremstilling af varmluft (3) er anbragt i en ledning (9) forbundet til kogekammeret (2) via et luftindløb (10) og et luftudløb (11), hvor den elektriske varmeindretning omfatter et luftindtag
- 10 (23) forbundet til luftindløbet (10) og en luftudledning (24) forbundet til luftudløbet (11),
- en ventilationsmotor (6) indrettet til at drive ventilatoren (4),

kendetegnet ved, at

- det omfatter en sikkerhedsindretning (38) indrettet til at afbryde
- 15 strømforsyningen af den elektriske varmeindretning (5), når det elektriske forbrug af ventilationsmotoren (6) er udenfor et normalt driftsområde defineret af en nedre grænse og en øvre grænse,
- hvilken sikkerhedsindretning (38) omfatter:
 - * et måleelement (44) indrettet til at måle elektrisk strøm brugt af
 - 20 ventilationsmotoren (6),
 - * en komparator (45) indrettet til at sammenligne forbruget af ventilationsmotoren (6) med den nedre grænse og den øvre grænse af det normale driftsområde,
 - * og et strømrelæ (46) indrettet til at afbryde strømforsyningen af
 - 25 den elektriske varmeindretning (5) som en funktion af resultatet af sammenligningen,
- og komparatoren (45) udviser et hysteresefænomen ved den nedre grænse og ved den øvre grænse af det normale driftsområde, som sikrer
- 30 forsyning af et varmebestandigt element (20) af den elektriske varmeindretning (5), når ventilationsmotoren (6) er i drift og når den målte intensitet er i det normale driftsområde.

2. Kogeapparat (1) ifølge krav 1, **kendetegnet ved, at** sikkerhedsindretningen (38) er dannet af et elektronisk modul (38).

3. Kogeapparat (1) ifølge krav 2, **kendetegnet ved, at** det elektroniske modul
5 (38) er indsat i et hus nær ventilationsmotoren (6).

4. Kogeapparat (1) ifølge krav 2 eller 3, **kendetegnet ved, at** det elektroniske modul (38) har en første (39) og en anden (40) forbinder til sin strømforsyning, en tredje (41) og en fjerde (42) forbinder til at forbinde med den elektriske
10 varmeindretning (5), og en femte forbinder (43) til at måle forsyningen af ventilationsmotoren (6) og sammenligne den med grænserne af det normale driftsområde.

5. Kogeapparat (1) ifølge et af kravene 1 til 4, **kendetegnet ved, at**
15 måleelementet (44) er dannet af en effektmodstand (44), som sænker spændingen ved grænserne af ventilationsmotoren (6) til en spænding acceptabel for komparatoren (45).

6. Kogeapparat (1) ifølge krav 5 afhængigt af krav 4, **kendetegnet ved, at**
20 effektmodstanden (44) er forbundet både til den anden forbinder (40), som er forbundet til jorden og til den femte forbinder (43), som er forbundet til udløbet af ventilationsmotoren (6).

7. Kogeapparat (1) ifølge et af kravene 1 til 6, **kendetegnet ved, at**
25 komparatoren (45) omfatter to sammenligningselementer (49, 50), hvor hvert sammenligningselement (49, 50) sammenligner den målte forsyning med en af de to grænser af driftsområdet.

8. Kogeapparat (1) ifølge et af kravene 1 til 7, **kendetegnet ved, at**
30 komparatoren (45) omfatter et indløb (47) forbundet til måleelementet (44) og et udløb (48), som tilvejebringer alt-eller-intet-elektrisk strøm, forbundet til strømrelæet (46).

9. Kogeapparat (1) ifølge krav 8 afhængigt af 7, **kendetegnet ved, at** hvert sammenligningselement (49, 50) omfatter en indløbsstift, der er forbundet til indløbet (47) af komparatoren (45), en udløbsstift, der er forbundet til udløbet (48) af komparatoren (45), og en stift associeret med den tilsvarende grænse af driftsområdet.

10. Kogeapparat (1) ifølge et af kravene 8 eller 9 afhængigt af krav 4, **kendetegnet ved, at** strømrelæet (46) omfatter delvist en aktuator (51), som er forbundet på samme tid til udløbet (48) af komparatoren (45) og til den første forbinder (39), der er forbundet til indløbet af ventilationsmotoren (6), og delvist en afbryder (52), som er forbundet til de tredje (41) og fjerde (42) forbindere.

11. Kogeapparat (1) ifølge et af kravene 1 til 10, **kendetegnet ved, at** en sikring (35) er seriemonteret med ventilationsmotoren (6).

12. Kogeapparat (1) ifølge et af kravene 1 til 10, **kendetegnet ved, at** ventilatoren (4) er båret af en ramme (15), som delvist definerer nævnte ledning (9) og omfatter en afbøjningsvæg (16), som ringformigt omgiver ventilatoren og med plads til at lave en kanal (17) med sidstnævnte.

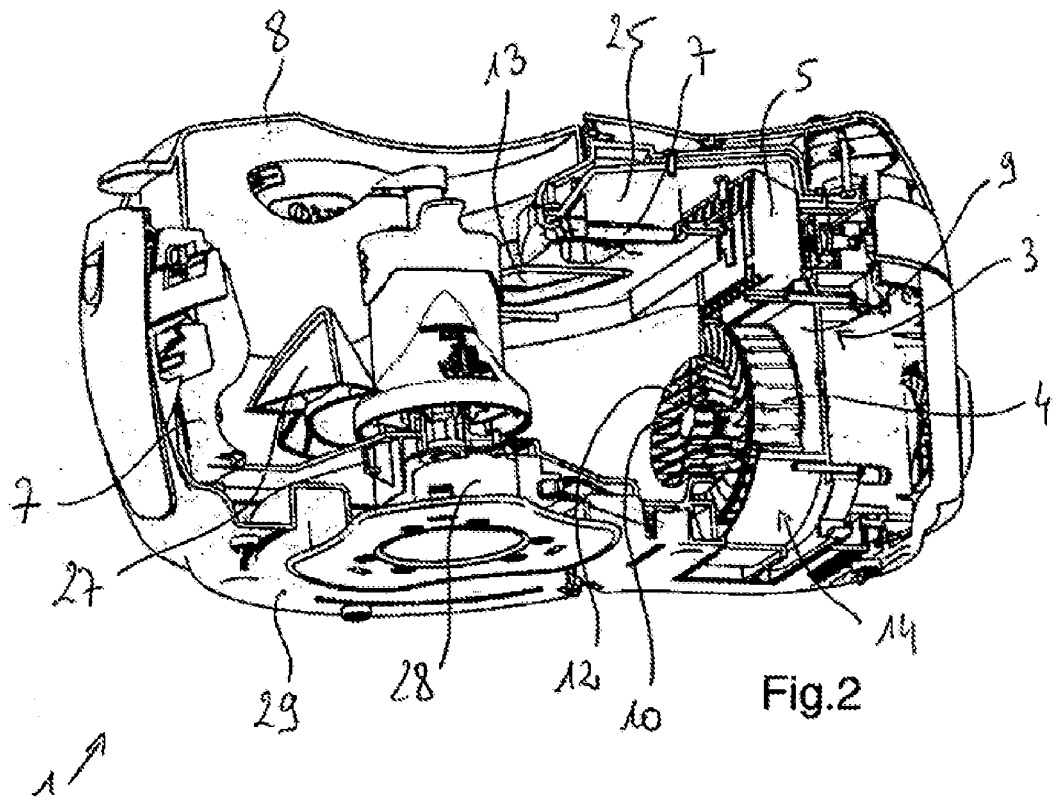
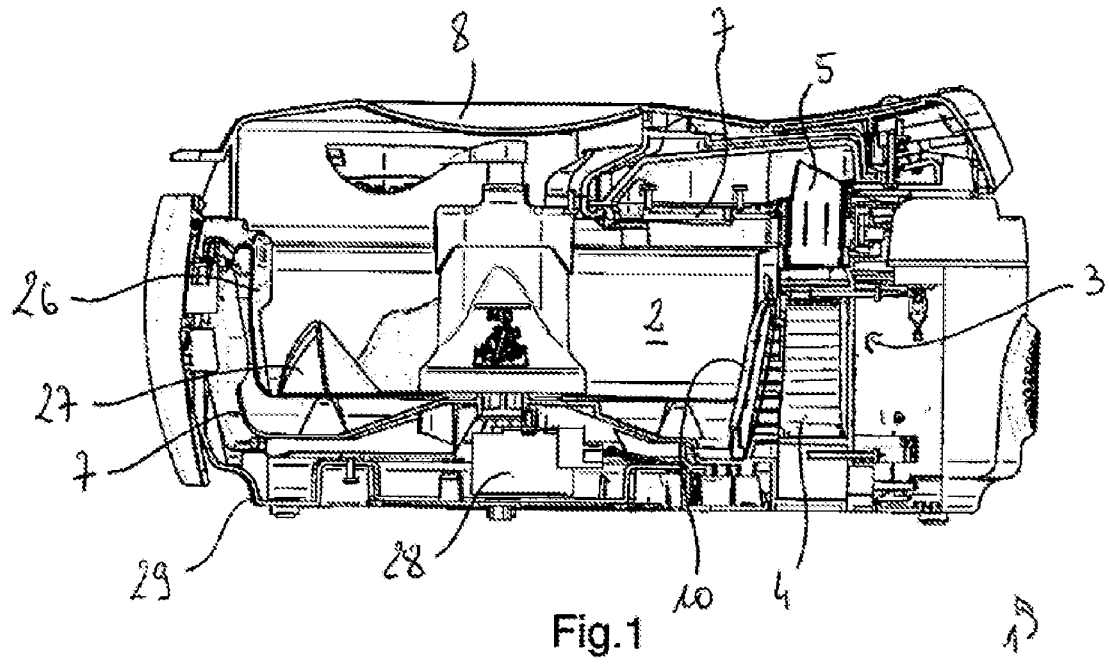
13. Kogeapparat (1) ifølge et af kravene 1 til 12, **kendetegnet ved, at** ventilatoren (4) er anbragt opstrøms af den elektriske varmeindretning (5).

14. Kogeapparat (1) ifølge et af kravene 1 til 13, **kendetegnet ved, at** luftindløbet (10) er dannet af en åbning lavet i en væg, som afgrænser kogekammeret (2).

15. Kogeapparat (1) ifølge et af de foregående krav, **kendetegnet ved, at** luften stammende fra indretningen til fremstilling af varmluft (3) er afbøjet til kogekammeret (2) af en deflektor (25) lavet af plastmateriale.

16. Kogeapparat (1) ifølge et af de foregående krav, **kendetegnet ved, at** det er en elektrisk friture (1) med kogning ved cirkulation af en strøm af varm luft i en beholder (26) anbragt i kogekammeret (2).

- 5 **17.** Friture (1) ifølge krav 16, **kendetegnet ved, at** den omfatter en skovl (27) monteret til at rotere i beholderen (26) og indrettet til at omrøre fødevarer og olie, og en elektrisk omrøringsmotor (28) indrettet til at drive rotation af skovlen (27).



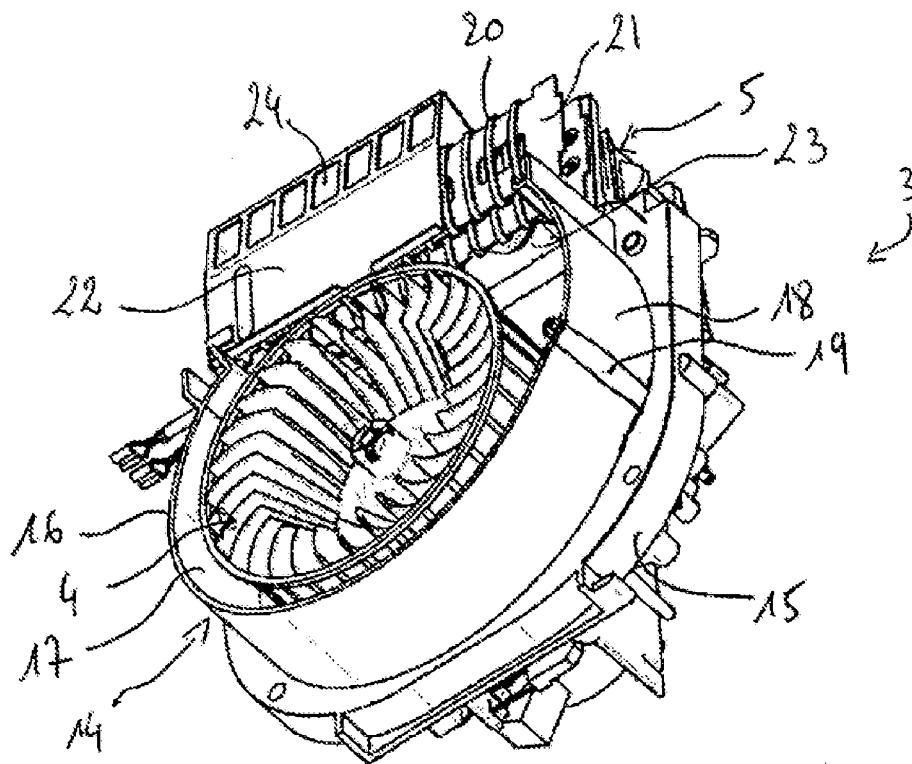


Fig. 3

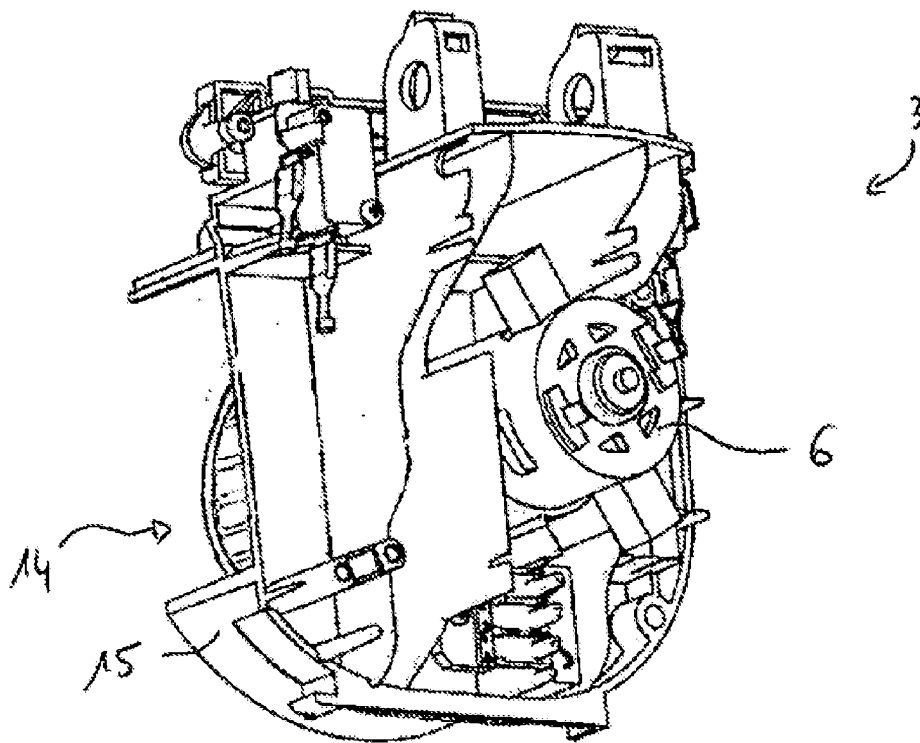


Fig. 4

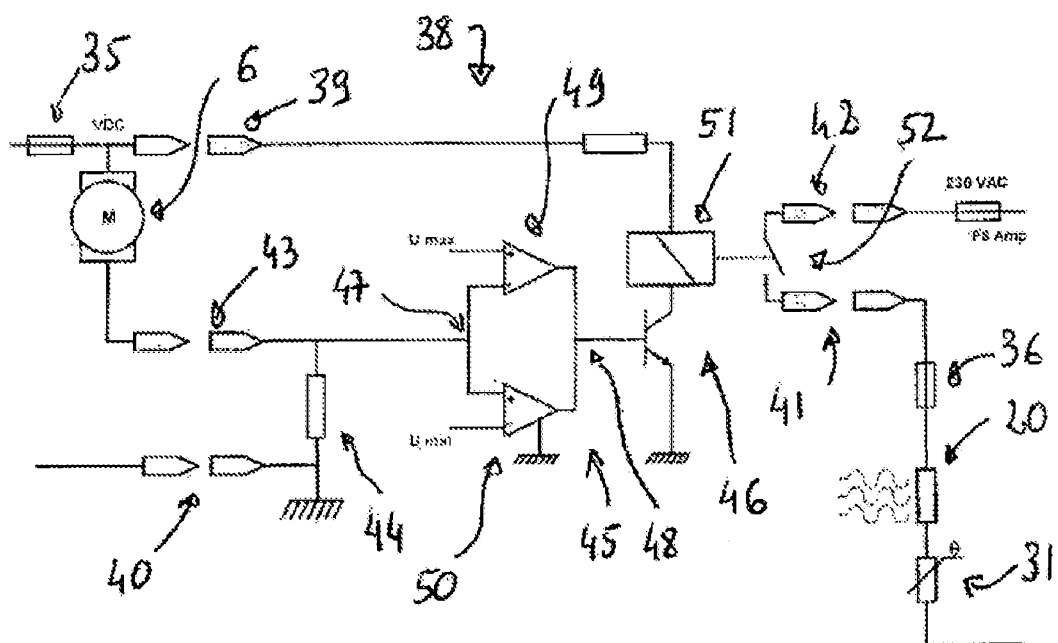
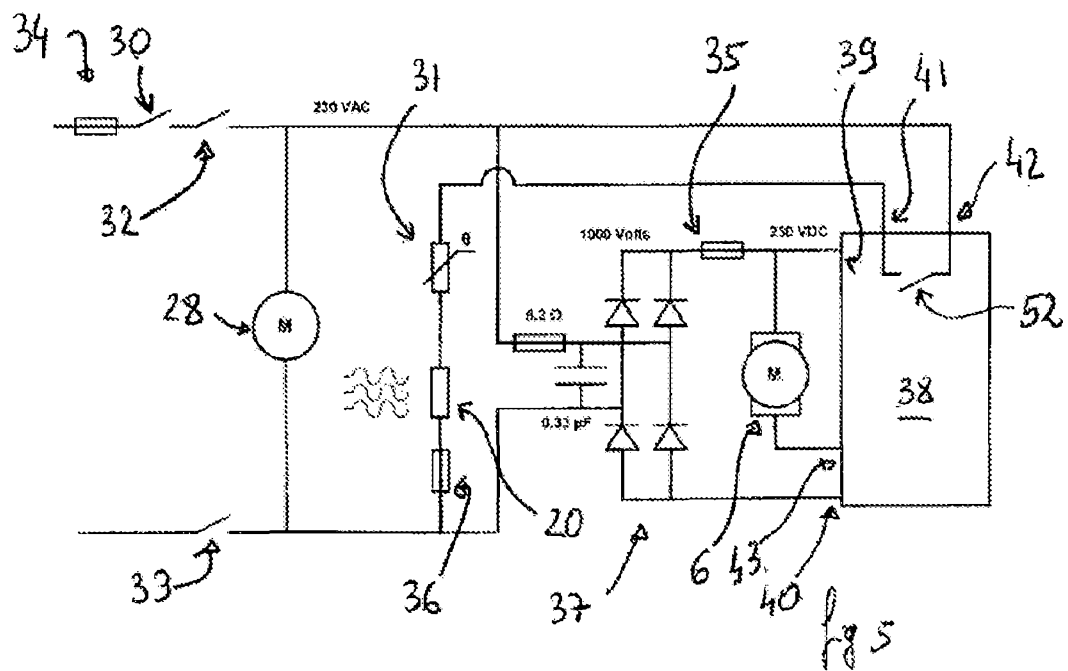


Fig 6

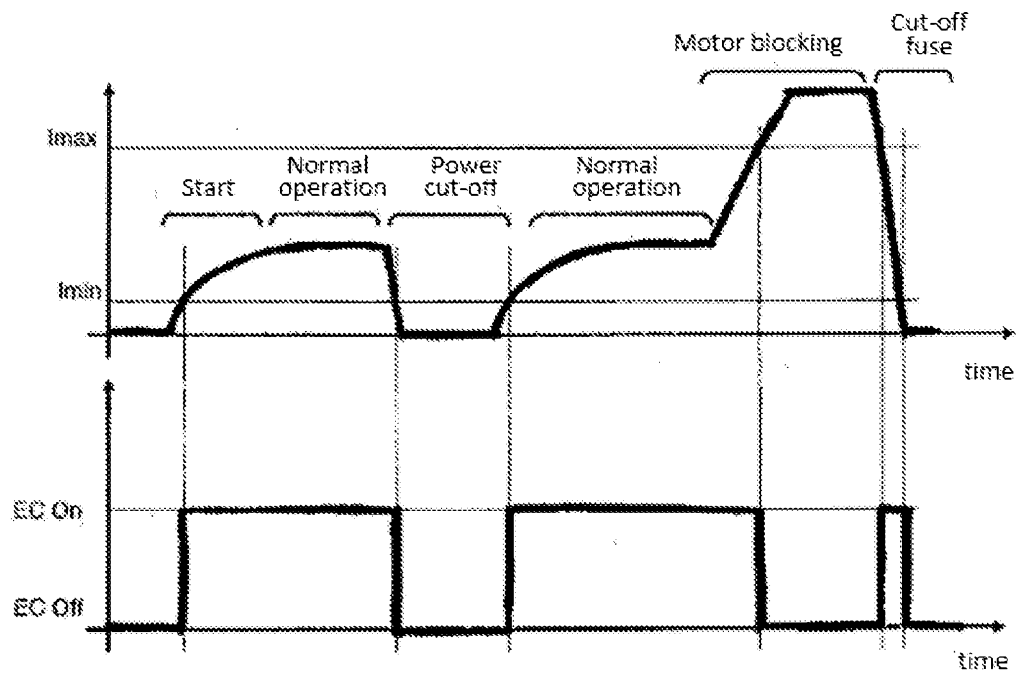


fig 7

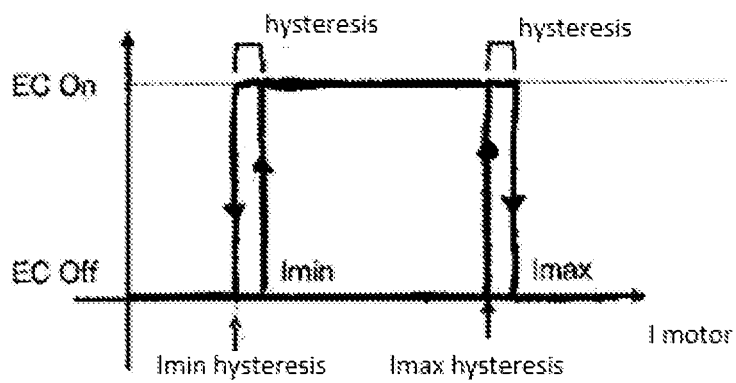


fig 8