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(54) **Apparatus to generate steam usable in an electric household appliance**

(57) Apparatus (10) to generate steam for an electric household appliance comprising a boiler (12) formed by a lower half-shell (18), having a base wall (35) arranged substantially horizontal during use, and by an upper half-shell (16) coupled with the lower half-shell

(18) so as to form a water containing tank, and heating members (20) arranged inside and in contact with the lower half-shell (18) and to heat the water contained inside the boiler (12) in order to transform it into steam. The lower half-shell (18) is made of aluminum and the upper half-shell (16) is made of steel.

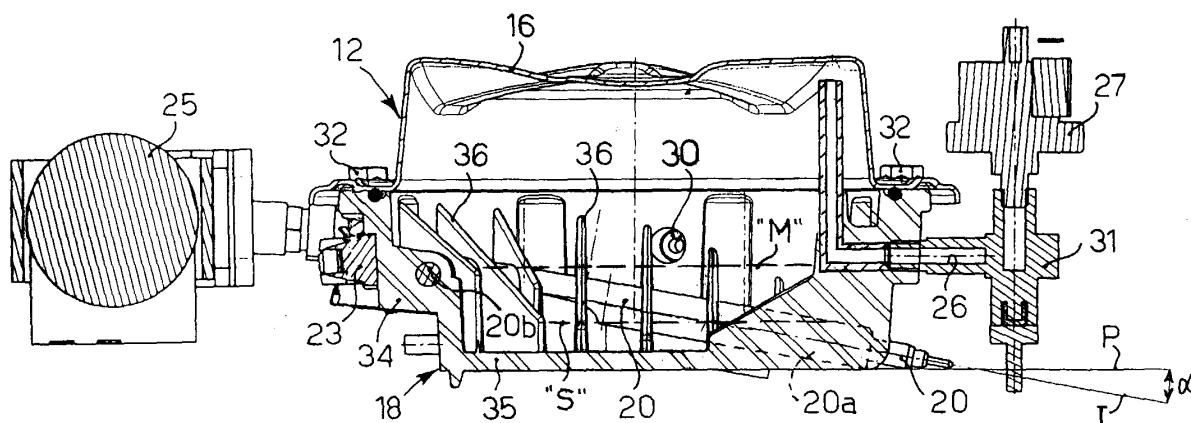


fig. 3

EP 1 486 725 A1

Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus to generate steam able to be associated with an electric household appliance, such as an iron, a steam-cleaning device or suchlike. The apparatus comprises a boiler into which cold water is introduced and is provided in the lower half-shell, made of aluminum, with an electric resistance in order to transform the water into steam. A level thermostat is arranged outside the lower half-shell in order to detect when the water inside the boiler reaches a determinate threshold level.

BACKGROUND OF THE INVENTION

[0002] An apparatus to generate steam is known, able to be associated with an electric household appliance for ironing, or cleaning, which comprises a boiler consisting of two metal half-shells, closed hermetically so as to define a watertight chamber. Cold water is introduced into the boiler and the water is heated until it is transformed into steam by means of an electric resistance, which is associated with the base wall of the boiler.

[0003] To be more exact, a first type of boiler is known, wherein both the half-shells are made of stainless steel, made by molding and welded together. However, the boiler in this first type has the disadvantage that, since the two half-shells are made of steel, the resistance cannot be drowned inside them, but can only be attached on one side thereof, either inside or out.

[0004] The steel boiler also has the disadvantage that it has a low heat inertia. This means that the structure adjusts slowly to the desired operating temperature, with the consequence that there is a high energy consumption in order to heat the water and form steam.

[0005] A second type of boiler is also known, wherein both the half-shells are made of aluminum, and the resistance is drowned in the lower half-shell. This type of boiler, although it has a high heat inertia which allows to reduce to a minimum the overall times needed to heat the water, has the disadvantage that it is very expensive and has a reduced mechanical resistance to the differences in pressure and temperature that occur inside the boiler itself. This is due above all to the presence of microbubbles, which can be created during the hot molding of the half-shells and which can cause fissures or breakages following the sudden changes in temperature and pressure to which the boiler is subjected during use.

[0006] Another disadvantage of known boilers, whether they are made of steel or aluminum, is that the electric resistance normally lies on the base wall in a horizontal position so that, during use, it is completely covered by water. A thermostat is associated with the electric resistance to detect any variation in temperature thereof, when it passes from a condition wherein it is

completely covered by water to a condition wherein, in correspondence with a determinate threshold level, it is not completely immersed in the water.

[0007] When such level is detected, more water is introduced into the boiler.

[0008] However, when this threshold level is reached, since the resistance lies on the base wall of the boiler, the quantity of water remaining in the boiler is already very limited. Consequently, the delivery of steam must be suspended until more cold water has been introduced and heated in the boiler to allow steam to form.

[0009] Moreover, when more water is introduced, the electric resistance is covered completely and almost instantaneously, and is cooled suddenly and completely.

This entails a further lengthening of the times needed to transform the water into steam.

[0010] From EP-A-0821096 it is known a steam generator which comprises a water tank connected to a boiler by a water supply pipe which has inserted inside it an electric delivery pump which controls the supply of water, from the tank to the boiler, when necessary. In particular, the boiler comprises moreover a single heating plate associated in a close-fitting manner on the outside thereof by means of pressure casting. The bottom of the boiler is inclined so as to have at least two portions, a lower portion and an upper portion arranged at different heights and both heated by the heating plate. The heating plate has mounted thereon a thermostatic switch located in the region of the upper portion, directly underneath an opening connected to the water supply pipe, so that the cold water enters into the boiler in such upper portion thereof. This known steam generator has the disadvantage that the opening for the letting of cold water into the boiler is just in the upper portion thereof, which is the part more subjected to reach a high temperature when the level of water into the boiler decreases due to the supply of steam. The direct contact of the cold water with the very hot internal surface of the boiler could cause cracks or breakages of the latter.

[0011] The purpose of the invention is to achieve an apparatus to generate steam, able to be associated with an electric household appliance, such as an iron or a steam-cleaning device or suchlike, with which it is possible to reduce to a minimum the waiting times needed to heat the water in the boiler, so as not to create discontinuity in the formation of the steam, and which has limited costs and also an optimum mechanical resistance to differences in pressure and temperature.

[0012] Another purpose of the present invention is to achieve an apparatus to generate steam wherein, while always ensuring a minimum quantity of water, it is possible to exploit to the utmost the heat of the electric resistance and of the walls of the boiler in order to heat the water.

[0013] Applicant has devised, tested and embodied the present invention to achieve these and other purposes, to overcome the shortcomings of the state of the art and to obtain other advantages.

SUMMARY OF THE INVENTION

[0014] The present invention is set forth and characterized in the main claim, while the dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

[0015] An apparatus to generate steam, according to the present invention and able to be associated with an electric household appliance, comprises a boiler formed by a lower half-shell having a base wall able to be arranged during use substantially horizontal, and by an upper half-shell coupled with the lower half-shell in order to form a tank to contain water. Heating means are arranged inside and in contact with the lower half-shell and are able to heat the water contained inside the boiler in order to transform it into steam.

[0016] According to the invention, the lower half-shell is made of aluminum, while the upper half-shell is made of steel.

[0017] In this way we obtain an apparatus to generate steam with a double advantage: on the one hand, the half-shell associated with the heating means is made of aluminum so as to accelerate as much as possible, thanks to its high heat conductivity, the heating of the water; on the other hand, the upper half-shell, being made of steel, ensures not only that the costs of production are reduced, but also that the possible tensions due to the high variations in temperature and pressure which occur inside the boiler are absorbed. In this way the risk of possible breakages to the walls of the aluminum half-shell is minimized.

[0018] In a preferential embodiment, the heating means are arranged mostly along the inner periphery of the lower half-shell, to optimize the heat exchange therewith.

[0019] In order to further improve the heating of the water, a plurality of elements, such as fins, ribs or such-like are associated with the base wall of the lower half-shell made of aluminum; they rise vertically from the base wall and are in contact with the heating means, in order to increase the usable surface for the heat exchange between the heating means and the water.

[0020] Preferably, the vertical elements are also made of aluminum.

[0021] In a preferential form of embodiment, the heating means are at least partly inclined with respect to the base wall of the lower half-shell so that, when the water reaches a determinate minimum threshold level, at least a portion of the heating means emerges from the water, determining a consequent increase in temperature of the lower half-shell.

[0022] In this way we obtain a boiler wherein, when the aforesaid minimum threshold level is detected, a portion of the heating means is still immersed in a quantity of water that is sufficient to ensure a substantially continuous production of steam.

[0023] Another advantage is that when, after the minimum threshold level has been reached and more water

is added, it progressively covers only the uncovered portion of the heating means, and acquires the heat thereof directly and gradually. This allows to exploit to the utmost the heat of the heating means and the latter, at the same time, are not subject to any sudden cooling.

[0024] In a preferential embodiment, sensor means are also provided to detect the threshold level of the water in the boiler. Such sensor means are of the heat sensitive type and are able to detect the aforesaid increase in temperature of the lower half-shell in order to generate a corresponding electric signal to indicate that said threshold level has been reached.

[0025] This detection by the sensor means occurs almost immediately, precisely because of the high heat conductivity of the aluminum lower half-shell.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] These and other characteristics of the present invention will become clear from the following description of a preferential form of embodiment, given as a non-restrictive example, with reference to the attached drawings wherein:

- fig. 1 is a view from above of an apparatus to generate steam according to the present invention;
- fig. 2 is a front view of the apparatus in fig. 1;
- fig. 3 is an enlarged section from III to III of fig. 1;
- fig. 4 is a section from IV to IV of fig. 1.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT OF THE INVENTION

[0027] With reference to figs. 1 and 2, an apparatus 10 according to the present invention to generate steam, able to be associated with an electric household appliance, comprises: a watertight boiler 12 to contain the water; an electric resistance 20 arranged inside the boiler 12 to heat the water and transform it into steam; a pump 25 able to feed cold water into the boiler 12, through a lateral aperture 30 and a first pipe 24; and a second pipe 26 through which the steam emerges and with which an electro-valve 27 and a thermostat 31 are associated.

[0028] A valve 29 is also associated with the first pipe 24, which prevents the depression generated in the boiler 12, when the water heating is not functioning, from making water flow in through the main pipe.

[0029] The boiler 12 consists of an upper half-shell 16 and a lower half-shell 18, in this case both cylindrical in shape.

[0030] According to a characteristic of the present invention, the upper half-shell 16 and the lower half-shell 18 are made of different materials. To be more exact, the upper half-shell 16, the main function of which is to close the boiler 12, is made of stainless steel, while the lower half-shell 18, with which the electric resistance 20 is associated, and the main function of which is to con-

tain the water and to conduct the heat, is made of aluminum.

[0031] The two half-shells 16, 18 are joined together by means of bolts 32, and between them there is a packing to ensure a watertight seal, for example of the silicone type, not shown in the drawings.

[0032] By making the boiler 12 of two different materials it is possible, compared with known boilers, to combine in an optimum manner the advantages of an aluminum half-shell, which has a high overall heat mass and allows to drown the electric resistance 20, with the advantages of a steel half-shell, which allows to reduce the production costs and ensures that the boiler 12 has a high mechanical resistance. The upper half-shell 16 absorbs the sudden differences in pressure and temperature to which the boiler 12 is subject during use and allows to reduce to a minimum the risk of breakages of the lower half-shell 18.

[0033] To be more exact, in conditions of normal use, the pressure in the boiler 12 varies between about 1 and 3.5 bar.

[0034] The lower half-shell 18 (fig. 3) comprises a base wall 35, substantially plane, and a side wall 34, substantially circular in shape. On the outer side of the latter a first thermostat 23 and a second safety thermostat 28 are attached (fig. 4). The aperture 30 for the letting of cold water into the boiler 12 is realised in the peripheral zone of the lower half-shell 18, in order to avoid that the supply of cold water could contact the upper part of the boiler 12 which is subjected to a sudden rise in temperature.

[0035] More in particular, the first thermostat 23 is able to detect the level of the water in the boiler 12, according to which, as will be explained hereafter in detail, the activation of the pump 25 is commanded, or not, by means of a corresponding electric signal.

[0036] In the embodiment shown here, the lower half-shell 18 comprises inside a plurality of vertical fins 36, which are made in a single piece with the base wall 35 and with the side wall 34, and in each of which the electric resistance 20 is partly drowned.

[0037] To be more exact, the vertical fins 36 are arranged in a spoke-like manner in the peripheral zone of the lower half-shell 18 and ensure that the electric resistance 20 comes into contact with a large surface of heat exchange, in order to ensure and further improve the heating of the water.

[0038] Moreover, the vertical fins 36 advantageously define with the base wall 35 a free surface that is large enough to accommodate possible calcium deposits.

[0039] According to another characteristic of the present invention, the electric resistance 20 is arranged inclined inside the lower half-shell 18 and in this case lies substantially on a plane I which forms an angle α of about 10° with a plane P, substantially horizontal, on which the base wall 35 lies (fig. 3).

[0040] To be more exact, in the embodiment shown here, the electric resistance 20 has at least a lower seg-

ment 20a which is substantially drowned in the base wall 35 and at least an upper segment 20b which is drowned in the side wall 34.

[0041] The inclined arrangement of the electric resistance 20 advantageously allows to exploit to the utmost the heat which it generates, since every partial segment thereof, before being progressively covered by the water, is at a high temperature and is immediately able to heat the water with which it comes into contact, with minimum waiting time.

[0042] In the embodiment shown here, the first thermostat 23 is arranged in correspondence with the upper segment 20b of the electric resistance 20 and is able to detect a variation in temperature of the side wall 34 when, in correspondence with a maximum water level M, the upper segment 20b is completely covered by the water and is cooled.

[0043] To be more exact, the first thermostat 23 is configured so as to block the functioning of the pump 25, by means of a corresponding electric signal, when it detects a first limit temperature of the side wall 34, at about 146°C , with a tolerance of more or less 5°C , and the upper segment 20b is completely covered.

[0044] The same thermostat 23 is also able to detect when the water level diminishes, partly uncovering the electric resistance 20 and causing it to overheat. To be more exact, the first thermostat 23 detects when, in correspondence with a minimum level S of the water in the boiler 12, the lower half-shell 18, and in particular the side wall 34, is subjected to a sudden rise in temperature caused by the overheating of the electric resistance 20. In correspondence with a second limit temperature of the side wall 34, at about 160°C with a tolerance of more or less 7°C , the first thermostat 23 activates the pump 25 by means of a corresponding electric signal.

[0045] The sudden increase in temperature is ensured by the high heat mass of the aluminum and allows to detect the minimum and maximum levels of the water by the first thermostat 23 in a short time.

[0046] To be more exact, the internal volume of the lower half-shell 18 is high enough to ensure that, when the first thermostat 23 detects the minimum level S, there is in any case a quantity of water inside the boiler 12 sufficient to prevent an excessive reduction in the pressure and a consequent discontinuity in the delivery of steam from the boiler 12.

[0047] In the event that there is an excessive overheating of the boiler 12, the second thermostat 28 (fig. 4) detects whether the temperature increases beyond a third limit value of about 180°C , with a tolerance of more or less 5°C , and blocks the functioning of the apparatus 10.

[0048] It is clear, however, that modifications and/or additions of parts can be made to the apparatus 10 as described heretofore, without departing from the field and scope of the present invention.

[0049] For example, according to a variant, the boiler 12 can be of the type where the cold water is loaded

manually, so that instead of the pipe 24 to introduce water through the lateral aperture 30 and the pump 25, a mouth is made on the upper half-shell 16 to load the water from above, in correspondence with the lower portion of the boiler 12.

[0050] According to another variant, the electric resistance 20 can be attached in a relative seating made in the fins 36, and not drowned in the lower half-shell 18.

[0051] According to another variant, if the fins 36 are not included, the electric resistance 20 can be drowned or applied on the inner side of the side wall 34, so as to be able to heat the whole lower half-shell 18.

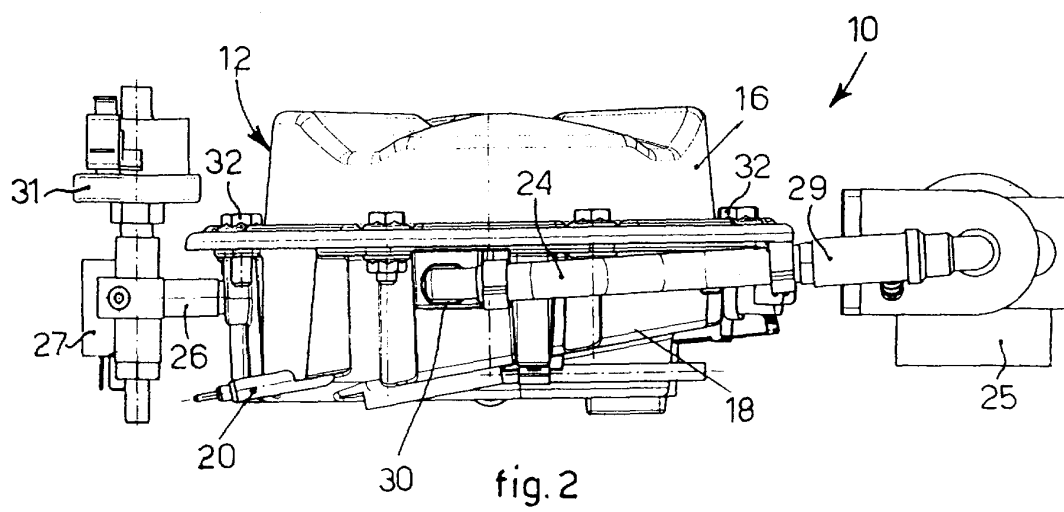
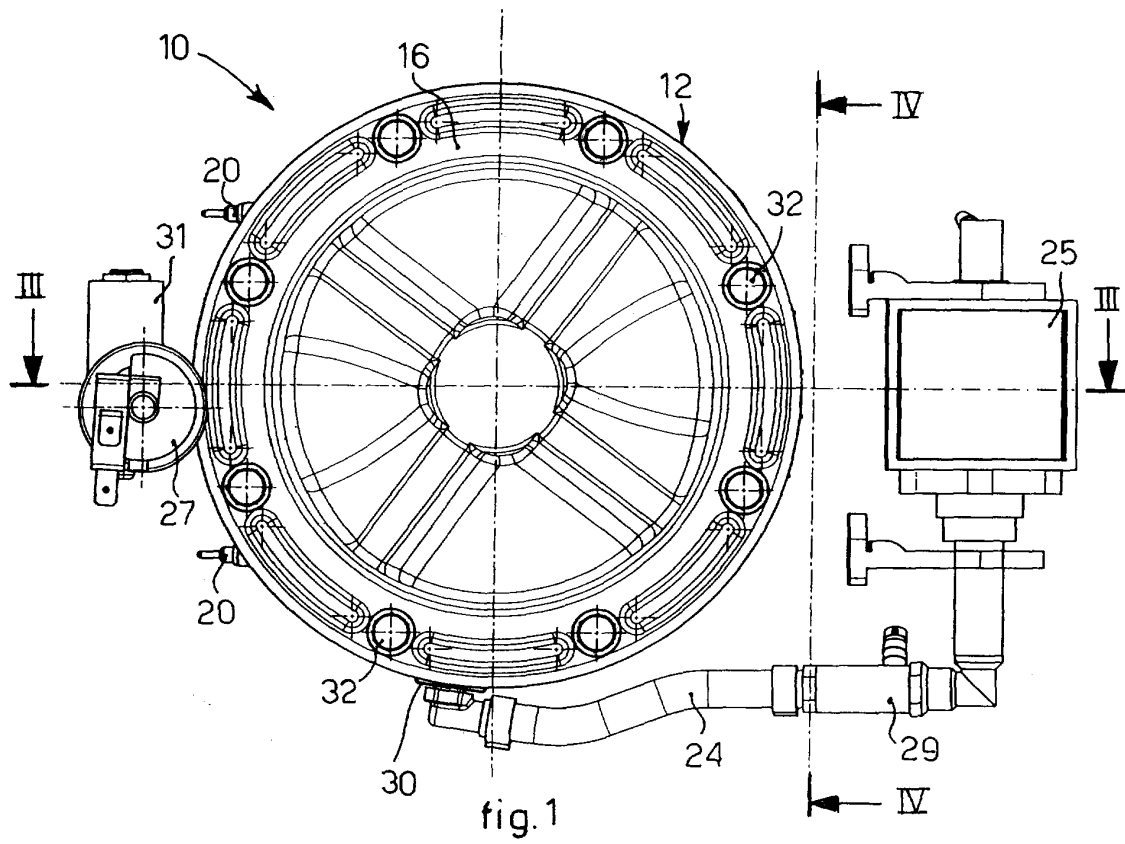
[0052] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other forms of apparatus to generate steam, all of which shall come within the field and scope of the invention.

Claims

1. Apparatus to generate steam for an electric household appliance comprising a boiler (12) formed by a lower half-shell (18), having a base wall (35) able to be arranged substantially horizontal during use, and by an upper half-shell (16) coupled with said lower half-shell (18) so as to form a water containing tank, and heating means (20) arranged inside and in contact with said lower half-shell (18) and able to heat the water contained inside said boiler (12) in order to transform it into steam, **characterized in that** said lower half-shell (18) is made of aluminum and **in that** said upper half-shell (16) is made of steel.
2. Apparatus as in claim 1, **characterized in that** said heating means (20) are at least partly inclined with respect to said base wall (35), so that, when the water reaches a first threshold level (S), at least a portion of said heating means (20) emerges from the water, causing a consequent increase in the temperature of said lower half-shell (18).
3. Apparatus as in claim 1 or 2, wherein sensor means (23) are provided to detect at least said first threshold level (S) of the water in said boiler (12), **characterized in that** said sensor means (23) are of the heat sensitive type and are able to detect said increase in temperature in order to generate a corresponding electric signal to indicate that said first threshold level (S) has been reached.
4. Apparatus as in any claim hereinbefore, **characterized in that** said heating means (20) are arranged in a peripheral zone of said lower half-shell (18).
5. Apparatus as in any claim hereinbefore, wherein

said lower half-shell (18) comprises at least a side wall (34), **characterized in that** said heating means (20) have at least an upper segment (20b) arranged in contact with a corresponding portion of said side wall (34), and at least a lower segment (20a) arranged in contact with a corresponding portion of said base wall (35).

6. Apparatus as in claim 3 and 5, **characterized in that** said sensor means (23) are arranged on an outer side of said side wall (34).
7. Apparatus as in claims 3 and 5, **characterized in that** said sensor means (23) are arranged on an outer side of the portion of said side wall (34) with which said upper segment (20b) is in contact, in order to detect, in correspondence with a second threshold level (M), a variation in temperature of said side wall (34) when said upper segment (20b) is wetted or not by said water.
8. Apparatus as in any claim hereinbefore, **characterized in that**, inside said lower half-shell (18), it comprises a plurality of vertical elements (36) able to increase the surface of heat exchange between the water and said heating means (20).
9. Apparatus as in claim 8, **characterized in that** said vertical elements (36) are made in a piece with said base wall (35).
10. Apparatus as in claim 8 or 9, **characterized in that** said heating means (20) are at least partly associated with said vertical elements (36).
11. Apparatus as in claim 8, 9 or 10, **characterized in that** said vertical elements (36) are arranged in a spoke-like manner inside said lower half-shell (18).
12. Apparatus as in any claim hereinbefore, **characterized in that** said heating means (20) lie substantially on a plane (I) which forms an angle (α) of about 10° with a substantially horizontal plane (P) and on which said base wall (35) lies.
13. Apparatus as in any claim hereinbefore, **characterized in that** an aperture (30) for the letting of cold water into said boiler (12) is realised in the peripheral zone of said lower half-shell (18).



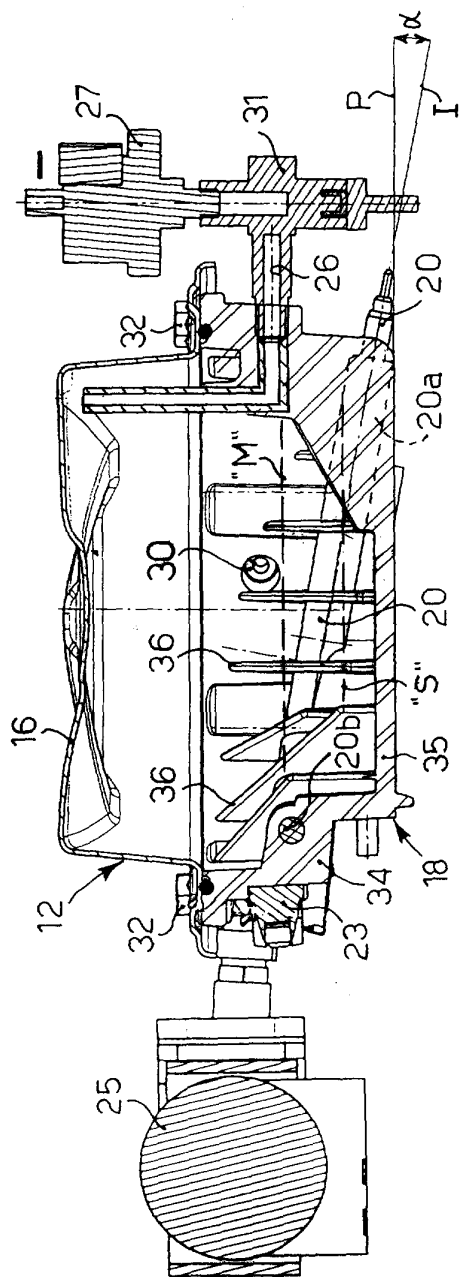


fig. 3

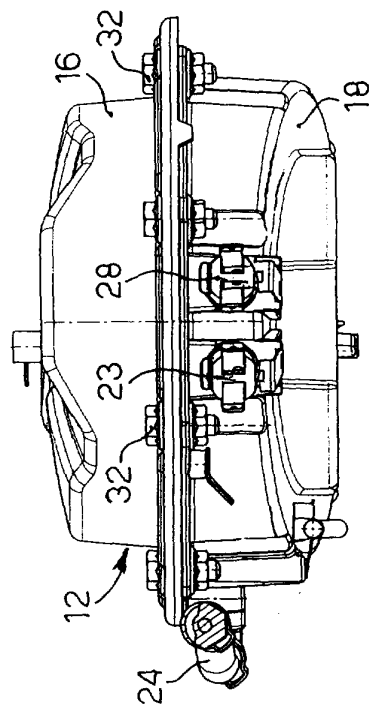


fig. 4



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EUROPEAN SEARCH REPORT

Application Number
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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			F22B D06F
Place of search		Date of completion of the search	Examiner
The Hague		6 September 2004	Van Gheel, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 04 10 1194

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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