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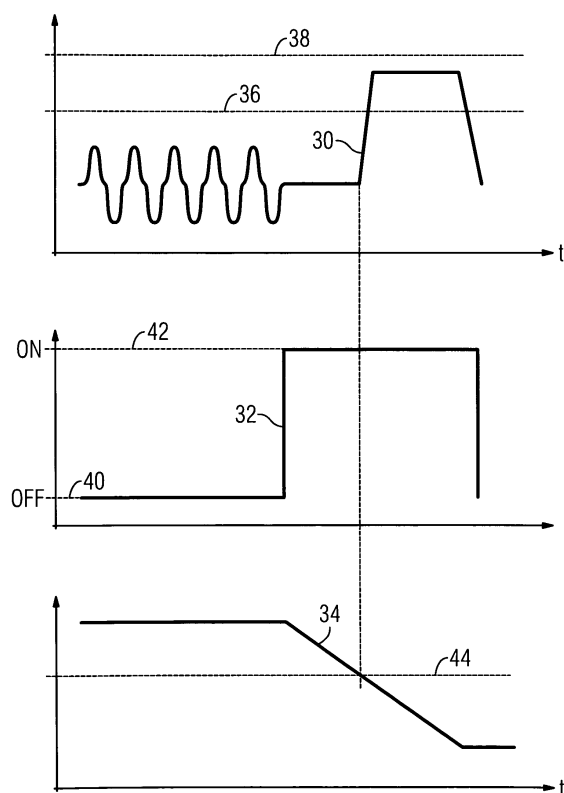
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(54) **A washing machine and method for collecting foreign objects within a washing machine**

(57) A method for collecting foreign or undesired objects in a washing machine comprising a drain filter and a washing group including a drum rotatably arranged inside a tub, the method comprising the following steps:
-lowering the water level (34) in the washing tub (10) by activating at least one drain pump,
-rotating the washing drum (12) with a drum speed (30), which is higher than a necessary drum speed (36) and lower than a critical drum speed (38), wherein said necessary drum speed (36) is defined as that drum speed (30), which is necessary to force the laundry to be attached at the cylindrical surface of the washing drum (12) by centrifugal forces,
-wherein said steps are performed after a washing phase and before at least one rinsing phase and/or spinning phase so that the lowering of the water and the shaking of the washing group due to the rotation of the drum move the foreign or undesired objects towards the drain filter.

FIG 4



Description

[0001] The present invention relates to a washing machine provided for a method for collecting foreign or undesired objects. Further, the present invention relates to a method for collecting foreign or undesired objects within a washing machine.

[0002] Foreign objects like nails, coins and/or paper clips, in a washing machine can cause damages to the components of said washing machine. In particular, if the drain pump is directly mounted on the washing group and the drain circuit is directly connected to the washing tub, then the foreign objects may cause damages. If the user forgets to empty the pockets of the laundry, then these foreign objects can escape from the washing drum and fall into the drain filter or outside the drain filter into the lower part of the washing group during the washing cycle. In particular, the foreign objects can fall below the heating element.

[0003] The foreign objects can start to move between the washing drum and the washing tub, if they are not collected and kept inside the drain filter. The rotations of the foreign objects may cause damages, breakages or faulty working conditions. This movement of the foreign objects may happen during the spinning phases, when the rotation of the washing drum may push the foreign objects like bullets at high speeds.

[0004] In order to avoid the movement of the foreign objects during the spinning phases, it is mandatory to be sure that all these objects are inside of a suitable device and not free to move in the washing tub before starting any rotation of the washing drum at high speed.

[0005] It is an object of the present invention to provide a washing machine and a method for collecting foreign or undesired objects in a washing machine, which allow an improved collecting of the foreign objects in order to prevent damages.

[0006] The object of the present invention is achieved by the washing machine according to claim 1.

[0007] The present invention concerns a method for collecting foreign or undesired objects in a washing machine comprising a drain filter and a washing group including a drum rotatably arranged inside a tub, the method comprising the following steps:

- lowering the water level in the washing tub by activating at least one drain pump,
- rotating the washing drum with a drum speed, which is higher than a necessary drum speed and lower than a critical drum speed, wherein said necessary drum speed is defined as that drum speed, which is necessary to force the laundry to be attached at the cylindrical surface of the washing drum by centrifugal forces,
- wherein said steps are performed after a washing phase and before at least one rinsing phase and/or spinning phase so that the lowering of the water and the shaking of the washing group due to the rotation

of the drum move the foreign or undesired objects towards the drain filter.

[0008] The main idea of the inventive method is the driving of the washing drum at a high speed for a short time. Said drum speed is higher than that speed, which is necessary to force the laundry to be attached to the cylindrical surface of the drum by centrifugal forces. The shaking of the washing group, resulting from the high speed, drives/directs the foreign or undesired objects towards the drain filter where they are collected.

[0009] Preferably the lowering the water level in the washing tub is preformed while the washing drum is rotating. The decreasing water level in the washing tub contributes that the foreign objects are collected in the drain filter. The water is only in the lower portions of the washing tub.

[0010] Preferably, the washing drum is rotated in an opposite rotational direction related to the rinsing and/or spinning phase, i.e. the rotational direction of the drum during the method according to the present invention is opposite to the rotational direction of the drum during the rinsing and/or spinning phase.

[0011] The critical drum speed may be defined as that drum speed, which corresponds with the resonant frequency of the oscillating washing group. The drum speed of the washing drum should be well below the critical drum speed. The critical drum speed is the theoretical angular velocity which excites the natural frequency of moving object, such as the shaft, spider, drum, tub, and further springs and shock absorbers that connect the washing group to the washing machine cabinet. As the speed of rotation approaches the objects natural frequency, the object begins to resonate which dramatically increases systemic vibration.

[0012] Preferably, the steps of the method according to the present invention are performed before each spinning phase. Then, the foreign objects are removed from the space between the washing tub and washing drum and cannot become bullets able to damage the components of the washing machine during the spinning phase.

[0013] In a similar way, the steps of the method according to the present invention should be performed before each rinsing phase.

[0014] Preferably, the water level in the washing tub may be set up at a predetermined level by at least one drain pump before lowering the same.

[0015] In a similar way, the water level in the washing tub may be lowered by at least one drain pump.

[0016] Preferably, the predetermined water level is a maximum water level.

[0017] Preferably, the drum speed according to the present invention may be between 115 rpm and 200 rpm. In particular, the drum speed is between 115 rpm and 180 rpm in the case of a top loader washing drum and between 115 rpm and 150 rpm in the case of a front loader washing drum.

[0018] The object of the present invention is also

achieved by the method according to claim 11.

[0019] According to the present invention the washing machine is provided for a method for collecting foreign or undesired objects and comprises:

- at least one washing tub,
- at least one washing drum arranged within the washing tub and rotatable around a horizontal axis,
- at least one sump arranged in the bottom of the washing tub,
- at least one drain filter for covering the sump, and
- at least one wedge-shaped salient arranged in the bottom of the washing tub, wherein
- the wedge-shaped cross-section of the salient extends along the circumferential direction of the washing tub and the washing drum,
- the sump and the drain filter are arranged in the bottom of a deep portion of the wedge-shaped cross-section of the salient,
- the washing tub, the sump and the salient form a single-piece part, and
- the drain filter is accessible and/or removable from inside the washing drum through an aperture in a cylindrical wall of said washing drum.

[0020] The main idea of the washing machine according to the present invention is the washing tub with the integrated sump and wedge-shaped salient forming a single-piece part. The washing tub with the sump and salient may be made by moulding. Below the deeper portion of the wedge-shaped salient the sump with the drain filter is arranged. Said drain filter below the salient is dedicated for collecting the foreign or undesired objects. The aperture may be closed by a lid or by a lifter of a drum see.

[0021] According to the preferred embodiment of the present invention a plain portion of the wedge-shaped cross-section of the salient is arranged at an upper level in the bottom of the washing tub compared with the deep portion. This contributes that the foreign object fall down into the deep portion of the salient.

[0022] Further, a deepening with at least one heating element may be arranged besides the deep portion of the salient and in the bottom of the washing tub.

[0023] Preferably, the sump is connected or connectable to at least one drain pump. Thus, the sump is a part of the drain conduit. By the action of the drain pump the water itself pump may drive the foreign objects into the drain filter.

[0024] For example, the drain filter may be formed as a sieve.

[0025] According to the preferred embodiment of the present invention the rotational direction of the washing drum during the method for collecting foreign or undesired objects is set up in such a way, that the cylindrical surface of the washing drum passes a plain portion of the wedge-shaped cross-section of the salient at first and then a deep portion of a wedge-shaped cross-section of the salient.

[0026] The novel and inventive features believed to be the characteristic of the present invention are set forth in the appended claims.

[0027] The invention will be described in further detail with reference to the drawings, in which

FIG 1 illustrates a schematic diagram of a sectional top view of the substantial components of a washing machine according to a preferred embodiment of the present invention,

FIG 2 illustrates a schematic diagram of a sectional front view of the substantial components of the washing machine according to the preferred embodiment of the present invention,

FIG 3 illustrates a schematic diagram of a sectional perspective view of the substantial components of the washing machine according to the preferred embodiment of the present invention, and

FIG 4 illustrates a schematic diagram of a drum speed, a switching state of a drain pump and a water level in a tub as function of time for the washing machine according to the preferred embodiment of the present invention.

[0028] FIG 1 illustrates a schematic diagram of a sectional top view of the substantial components of a washing machine according to a preferred embodiment of the present invention.

[0029] In FIG 1 a washing tub 10 with a sump 14 and a heating element 18 is shown.

[0030] The washing tub 10 is provided for receiving a rotatable washing drum 12, which is not shown in FIG 1. The rotation axis of the washing drum 12 extends vertically in the plain of the drawing. The sump 14 is arranged at the bottom of the washing tub 10 and is a part of the drain of said washing tub 10. The sump 14 is connectable to a drain pump, which is not shown in FIG 1. The sump 14 is formed as a deepening in the bottom of the washing tub 10. The sump 14 is covered by a drain filter 16. The drain filter 16 is formed as a sieve. The heating element 18 is also arranged within a deepening at the bottom of the washing tub 10.

[0031] Above and on the left hand side of the drain filter 16 a wedge-shaped salient 20 is arranged at the bottom of the washing tube 10. The height of the wedge-shaped salient 20 increases with a decreasing distance from the heating element 18. A flat portion of the wedge-shaped salient 20 is arranged on the left hand side of the drain filter 16. A deep portion of the wedge-shaped salient 20 is arranged above the drain filter 16. The deepening with the heating element 18 is arranged on the right hand side of the salient 20.

[0032] The flat portion of the salient 20, the deep portion of the salient 20 and the heating element 18 are

arranged serially in respect of the circumferential direction of the washing tub 10 and the washing drum 12, wherein the sump 14 and the drain filter 16 are arranged below the deep portion of the salient 20.

[0033] FIG 2 illustrates a schematic diagram of a sectional front view of the substantial components of the washing machine according to the preferred embodiment of the present invention. The washing drum 12 is arranged within the washing tub 10. The external dimensions of the washing drum 12 are marginally smaller than the internal dimensions of the washing tub 10.

[0034] FIG 2 clarifies the positions of the salient 20, the sump 14, the drain filter 16 and the heating element 18. Further, FIG 2 clarifies the cross-section of the salient 20 along the circumferential direction of the washing tub 10. In this example, the washing drum 12 rotates counterclockwise during the rinsing and spinning phase.

[0035] If there are any foreign objects between the washing drum 12 and the washing tub 10, then said foreign objects may be collected in the drain filter 16 after a rotation of the washing drum 12 at a drum speed, which is higher than a necessary drum speed 36 and lower than a critical drum speed 38. The rotational direction is opposite to the rotational directions of the rinsing and spinning phase, i.e. clockwise in the embodiment here disclosed by way of example. The necessary drum speed 36 is that drum speed, at which the laundry is forced to be attached to the cylindrical surface of the washing drum 12 by centrifugal forces. The critical drum speed 38 is that drum speed, which corresponds with the resonant frequency of the oscillating washing group, the latter being associated to the washing machine cabinet by means of springs at the top and shock-absorbers at the bottom as it is well known in the art. Which resonant frequency can cause the washing group to hit the inside of the washing machine cabinet.

[0036] FIG 3 illustrates a schematic diagram of a sectional perspective view of the substantial components of the washing machine according to the preferred embodiment of the present invention.

[0037] FIG 3 clarifies, that the flat portion of the salient 20, the deep portion of the salient 20 and the heating element 18 are arranged serially in respect of the circumferential direction of the washing tub 10 and the washing drum 12. Thereby the sump 14 and the drain filter 16 are arranged below the deep portion of the salient 20.

[0038] FIG 4 illustrates a schematic diagram of a drum speed 30, a switching state 32 of a drain pump and a water level 34 in the washing tub 10 as function of time for the washing machine according to the preferred embodiment of the present invention.

[0039] During a first phase the drum speed 30 oscillates, since the rotational direction of the washing drum 12 is changed for several times. Said first phase is the proper washing cycle. The water level 34 in the washing tub 10 is high, i.e. the washing tub 10 is completely or substantially filled with water during the first phase. The switching state 32 of the drain pump is in an off-state 40

during the first phase.

[0040] During a second phase the washing drum 12 stands still and the switching state 32 of the drain pump is in an on-state 42. The water level 34 sinks during the second phase until a predetermined maximum water level 44 is achieved.

[0041] A third phase can be started, after the water level 34 in the washing tub 10 goes below the maximum water level 44. During the third phase the washing drum 12 rotates at a great speed. The value of said great speed of the drum is between a necessary drum speed 36 and a critical drum speed 38.

[0042] The necessary drum speed 36 is that drum speed, at which the laundry is forced to be attached to the cylindrical surface of the washing drum 12 by centrifugal forces. For example, the necessary drum speed 12 of a top loader washing machine is between 115 rpm and 180 rpm. The critical drum speed 38 is that drum speed, which corresponds with the resonant frequency of the oscillating washing group.

[0043] The third phase is a cycle provided for collecting the foreign objects in the drain filter 16 and/or in the deepening of the heating element 18. At last, all the foreign objects should be collected in the drain filter 16.

[0044] For the top loader washing machines with the necessary drum speed 36 between 115 and 180 rpm, the washing group tend to move and shake under the actions of laundry unbalance without hitting the cabinet since it is below the critical drum speed 38. This type of behaviour forces the foreign object to fall in the drain filter 16.

[0045] Moreover, if the drum speed 30 is also combined with the action of the drain pump, the water itself drives the foreign objects towards the drain filter 16.

[0046] Although an illustrative embodiment of the present invention has been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as defined by the appended claims.

[0047] List of reference numerals

10	washing tub
12	washing drum
14	sump
16	drain filter
18	heating element
20	salient
30	drum speed
32	switching state of the drain pump
34	water level in the washing tub
36	necessary drum speed
38	critical drum speed
40	off-state of the drain pump

42 on-state of the drain pump
44 maximum water level

Claims

1. A method for collecting foreign or undesired objects in a washing machine comprising a drain filter and a washing group including a drum rotatably arranged inside a tub, **characterized in that** the method comprising the following steps:

- lowering the water level (34) in the washing tub (10) by activating at least one drain pump,
- rotating the washing drum (12) with a drum speed (30), which is higher than a necessary drum speed (36) and lower than a critical drum speed (38), wherein said necessary drum speed (36) is defined as that drum speed (30), which is necessary to force the laundry to be attached at the cylindrical surface of the washing drum (12) by centrifugal forces,
- wherein said steps are performed after a washing phase and before at least one rinsing phase and/or spinning phase so that the lowering of the water and the shaking of the washing group due to the rotation of the drum move the foreign or undesired objects towards the drain filter.

2. The method according to claim 1, wherein the washing drum (12) is rotated in an opposite rotational direction related to the rinsing and/or spinning phase.

3. The method according to claim 1 or 2, wherein the critical drum speed (38) is defined as that drum speed (30), which corresponds with the resonant frequency of the oscillating washing group.

4. The method according to any one of the preceding claims, wherein said steps are performed before each spinning phase.

5. The method according to any one of the preceding claims, wherein said steps are performed before each rinsing phase.

6. The method according to any one of the preceding claims, wherein the drum speed is between 115 rpm and 200 rpm.

7. The method according to claims 6, wherein the drum speed is between 115 rpm and 180 rpm in the case of a top loader washing drum and between 115 rpm and 150 rpm in the case of a front loader washing drum.

8. The method according to any one of the preceding claims, wherein the drain filter is arranged in the bot-

tom of the washing group.

9. The method according to any one of the preceding claims, wherein the drain filter is arranged in a sump, the washing tub and the sump form a single-piece part.

10. The method according to any one of the preceding claims, wherein the drain filter is accessible and/or removable from inside the washing drum through an aperture in a cylindrical wall of said washing drum.

11. A washing machine, in particular a washing machine for household appliances, which washing machine is provided for a method for collecting foreign or undesired objects according to any one of the claims 1 to 10 and comprises:

- at least one washing tub (10),
- at least one washing drum (12) rotatably arranged within the washing tub (10),
- at least one sump (14) arranged in the bottom of the washing tub (10),
- at least one drain filter (16) for covering the sump (14),
- and
- at least one wedge-shaped salient (20) arranged in the bottom of the washing tub (10), wherein the wedge-shaped cross-section of the salient (20) extends along the circumferential direction of the washing tub (10) and the washing drum (12),
- the sump (14) and the drain filter (16) are arranged in the bottom of a deep portion of the wedge-shaped cross-section of the salient (20), the washing tub (10), the sump (14) and the salient (20) form a single-piece part, and
- the drain filter (16) is accessible and/or removable from inside the washing drum (12) through an aperture in a cylindrical wall of said washing drum (12).

12. The washing machine according to claim 11, wherein a plain portion of the wedge-shaped cross-section of the salient (20) is arranged at an upper level in the bottom of the washing tub (10) compared with the deep portion.

13. The washing machine according to claim 11 or 12, wherein a deepening with at least one heating element (18) is arranged besides the deep portion of the salient (20) and in the bottom of the washing tub (10).

14. The washing machine according to any one of the preceding claims, wherein the sump (14) is connected or connectable to at least one drain pump and/or

the drain filter (16) is formed as a sieve.

15. The washing machine to any one of the preceding claims, wherein the rotational direction of the washing drum (12) during the method collecting foreign or undesired objects is set up in such a way, that the cylindrical surface of the washing drum (12) passes a plain portion of the wedge-shaped cross-section of the salient (20) at first and then a deep portion of a wedge-shaped cross-section of the salient (20).

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FIG 1

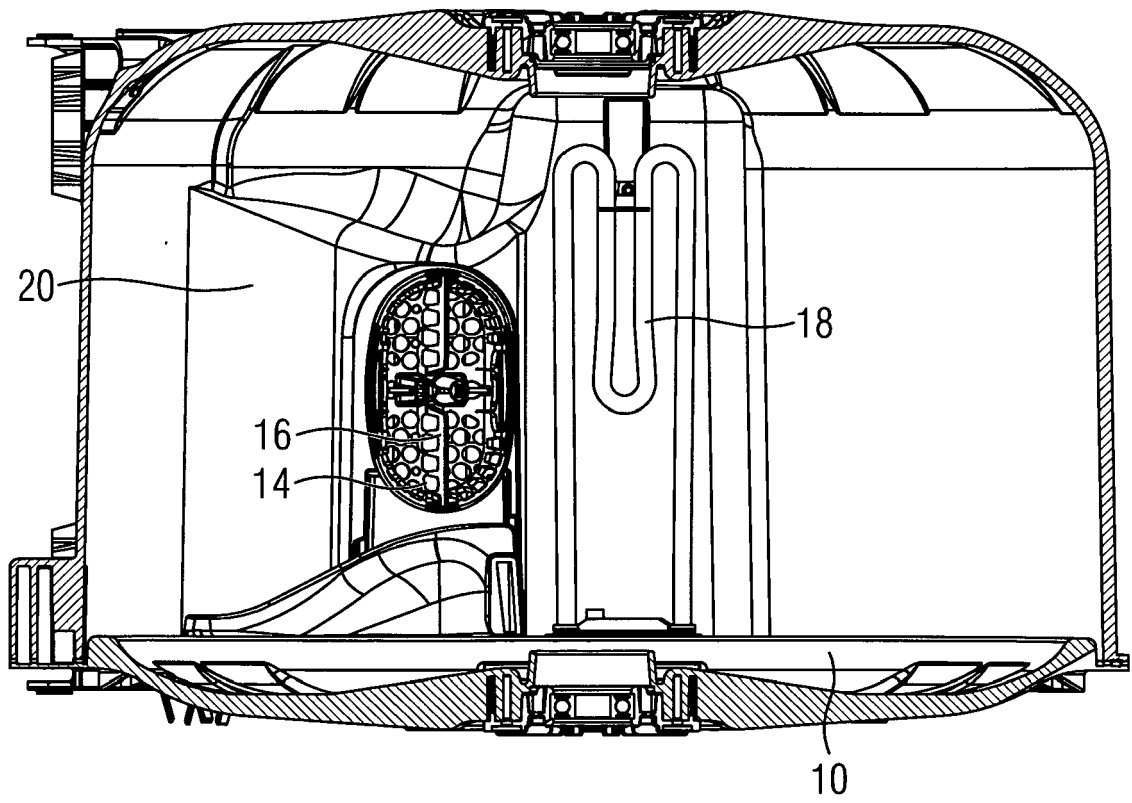


FIG 2

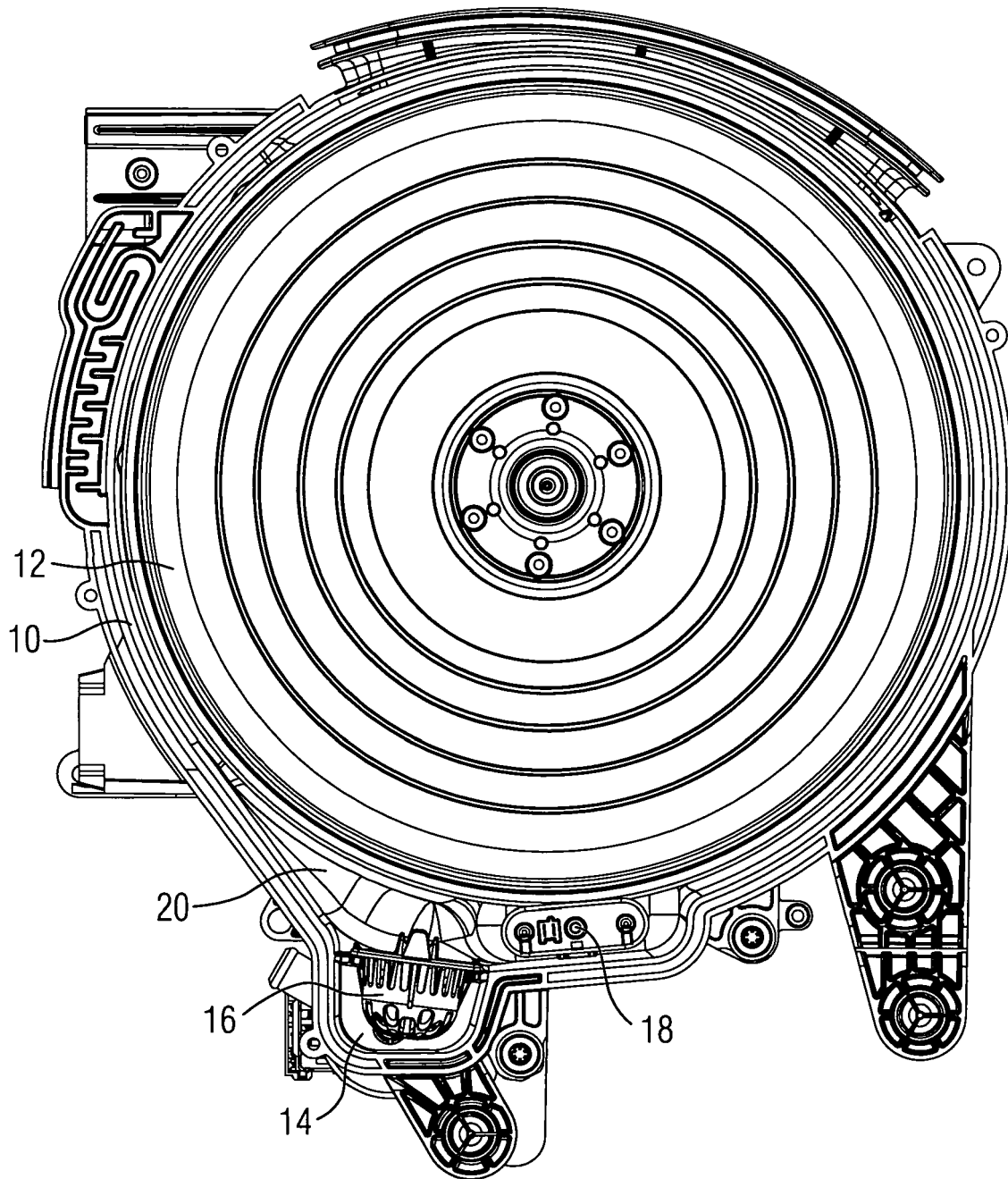


FIG 3

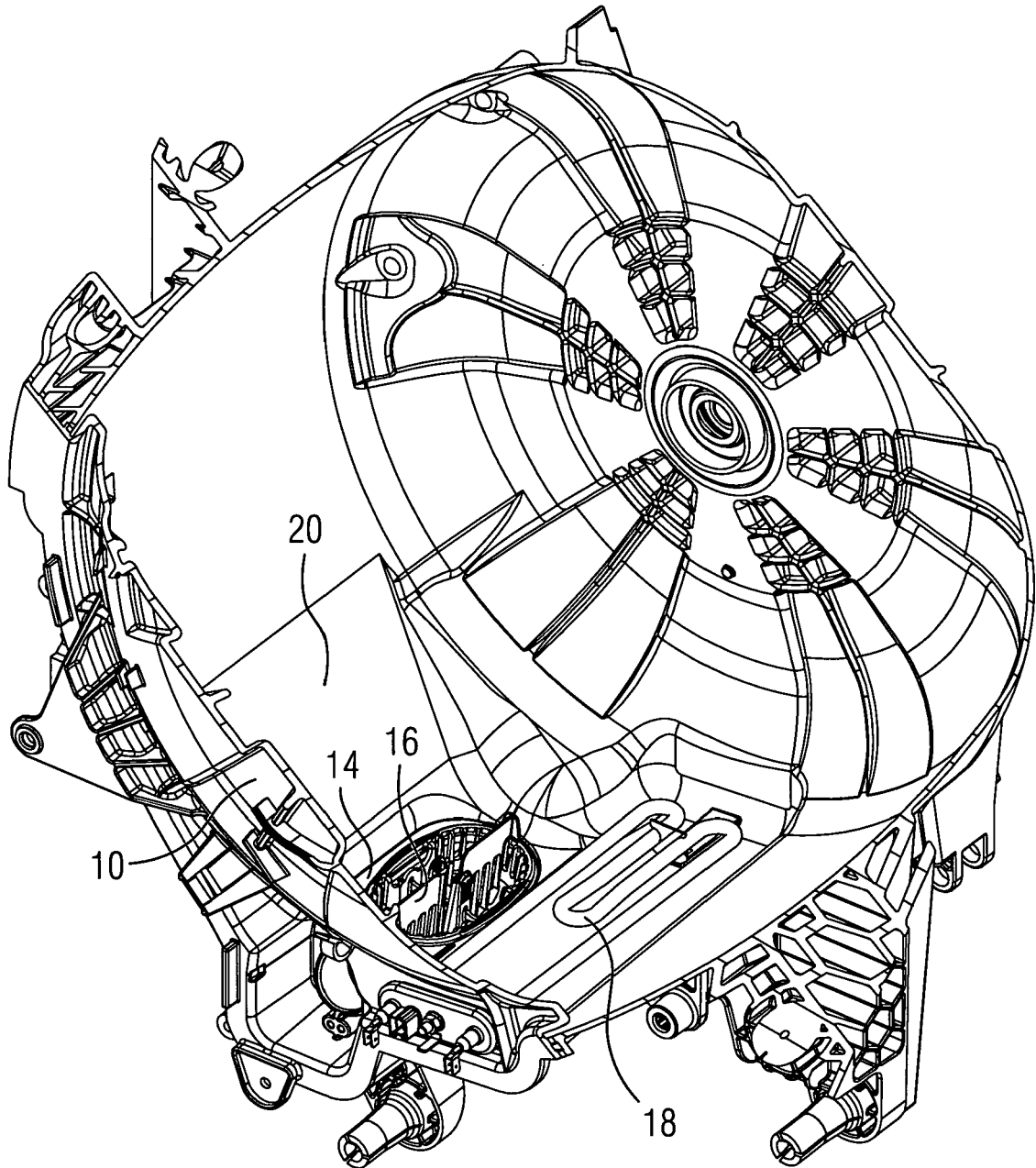
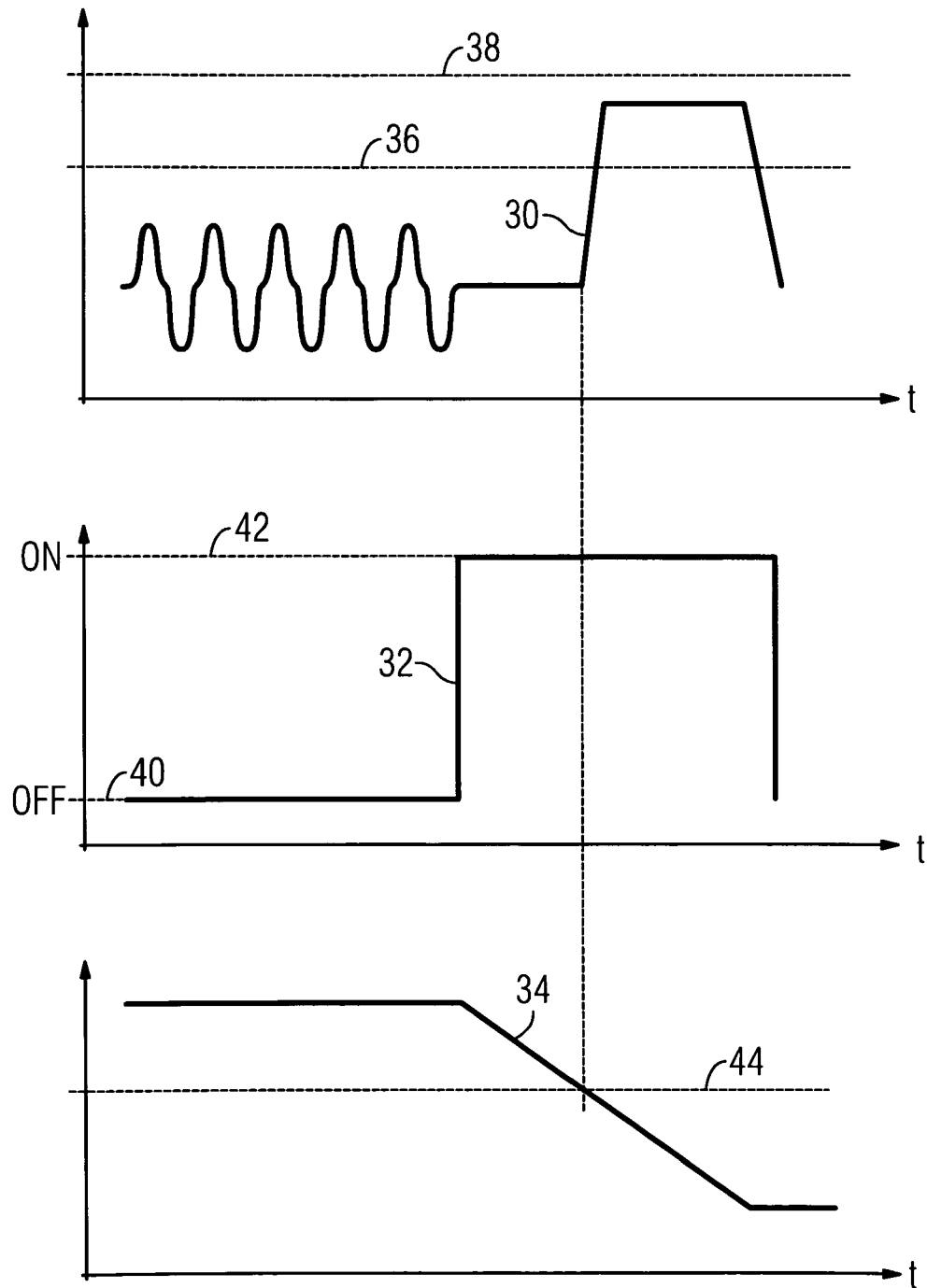


FIG 4





EUROPEAN SEARCH REPORT

Application Number
EP 09 01 2431

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 983 088 A1 (WHIRLPOOL CO [US]) 22 October 2008 (2008-10-22) * paragraph [0011]; figure 1 *	1-10	INV. D06F35/00 D06F39/10 D06F37/26 D06F39/08
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			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 February 2010	Examiner Dupuis, Jean-Luc
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
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 01 2431

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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26-02-2010

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