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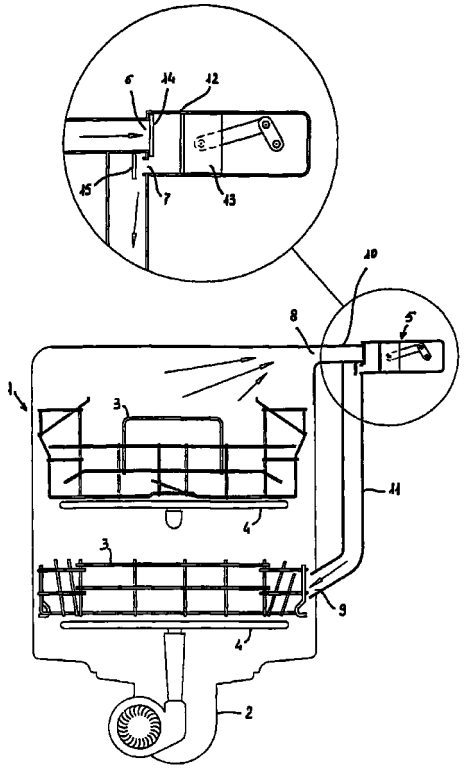
(54) Washing machine with improved drying system

(57) The washing machine comprises a washing vessel (1) in which water vapour is present at the beginning of a drying phase of the washload items accomodated in the same vessel. A compressor (5) is provided to take in the water vapour from the vessel through an inlet (6), to compress the so taken-in water vapour in order to cause it to condense, and to convey it towards an outlet conduit (11).



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Description

[0001] The present invention refers to a washing machine, in particular of the household type, which is also adapted to carry out a cycle for drying the washload contained therein.

[0002] It should be noticed that the term washing machine is used here to mean a clothes drier, a clothes washer-drier or any other similar household appliance, such as in particular a dishwasher.

[0003] Washing machines provided with a drying function for the washload contained in their drum or vessel are well-known in the art. As described for instance in US-A-5 273 061, a condenser is arranged in the washing vessel of a dishwasher and a forced draught of cooling ambient air is caused to flow therethrough. The water vapour that is present in the washing vessel at the end of a rinsing phase performed with hot water condenses on the outer walls of said condenser, thereby promoting drying of the washload items.

[0004] Solutions are also known, such as from instance from the disclosure in US-A-5 056 543, in which the hot moist air that is present in the washing vessel is circulated directly through the condenser, where it therefore cools down and gives off its moisture contents.

[0005] However, all this prior-art solutions tend to be undesirably complicated and expensive, since they require, for drying the washload, the use of an appropriate condenser which must usually be associated to auxiliary cooling media such as air or water.

[0006] A simpler and more advantageous solution is described in EP-A-0 800 786, in which the top and the bottom of the washing vessel of a dishwasher are mutually connected through a conduit running externally of the same vessel, so as to form a closed-loop path along which the water vapour can therefore circulate as the washload is being dried in the vessel. Such a solution enables the washload items to be dried in a homogeneous, but not fully satisfactory manner.

[0007] It therefore is a purpose of the present invention to provide a washing machine provided with an improved washload drying system that is capable of enabling the washload items to be dried in a particularly effective manner, while avoiding to involve any substantial complication from a construction point of view.

[0008] According to the present invention, such aim is reached in a washing machine with an improved washload drying system embodying the features as recited in the appended claims.

[0009] Anyway, characteristics and advantages of the present invention will become more readily understood from the description that is given below by way of non-limiting example with reference to the accompanying drawing, wherein such a drawing is shown to schematically illustrate the main component parts of a preferred embodiment of the washing machine according to the present invention.

[0010] With reference to the drawing, the washing machine is preferably an automatic dishwasher that mainly comprises a washing vessel 1 provided on its lower portion with a sump 2 for collecting the water.

[0011] In a per sè known manner. the vessel 1 accomodates at least a rack 1 for supporting the items (not shown) to be washed by means of water jets adapted to be ejected by appropriate spraying means 4.

[0012] The dishwasher is of the type adapted to automatically perform selectable operation cycles, of which at least one comprises a final washload rinsing phase carried out with hot water (eg. water heated up to a temperature of approx. 70°C). At the end of such a final rinse, water vapour is usually present in the washing vessel so that, for the washload to be dried, such a water vapour must be eliminated or removed therefrom.

[0013] According to a feature of the present invention, the machine further comprises compressor means 5 having at least an inlet 6 and at least an outlet 7. The inlet 6 is connected to an upper aperture 8 of the washing vessel via a conduit 10. The outlet 7 is preferably connected to a lower aperture 9 of the washing vessel via a conduit 11. The compressor 5 and the conduits 10, 11 are preferably arranged on the outside of the washing vessel 1.

[0014] The compressor 5 can be of any type adapted to suit the purpose. For instance, it can be of a type which is readily available on the market with an appropriately and advantageously limited power rating, low space requirements, and at reduced costs, such as for example a Model 006LCD/30-5 compressor of ASF Thomas Industries GmbH, traditionally used in a fully different area of application such as the one of inhalators.

[0015] In a preferred manner, the compressor 5 is of the type comprising a chamber 12 in which a piston 13 is adapted to be actuated with a reciprocating motion by an electric motor, or the like, controlled by the programme sequence control unit of the machine. For reasons of greater simplicity, the motor and the programme sequence control unit are not shown in the drawing. It shall anyway be appreciated that the compressor 5 can also be of a different type, such as for instance of the electromagnetic type with the moving member oscillating with a reciprocating motion.

[0016] In a preferred manner, the inlet 6 and the outlet 7 of the compressor are associated to respective non-return valves 14, 15. Furthermore, the inlet 6 has preferably a cross-section area that is larger than the one of the outlet 7.

[0017] As it will be explained in greater detail further on, the vessel 1, the compressor 5 and the conduits 10, 11 practically form a drying system, preferably, but not necessarily or exclusively in a closed-loop configuration, along which the water vapour that develops in the washing vessel is therefore capable of being circulated in a single direction, as this is shown by the arrows in the drawing.

[0018] Upon conclusion of the above mentioned final rinsing phase, the compressor 5 is adapted to be driven in view of performing a drying phase in the manner described below.

[0019] During the suction stroke of the piston 13 (rightwards in the drawing), the compressor 5 takes in water vapour from the washing vessel 1 via the conduit 10 and the valve 14 which opens in order to enable the water vapour to enter the chamber 12.

[0020] During the compression stroke of the piston 13 (leftwards in the drawing), the water vapour so taken in by the compressor is compressed in the chamber 12 and caused to escape through the valve 15 which opens accordingly. Such a compression of the water vapour causes the latter to substantially condense.

[0021] It therefore clearly emerges that such an operation of the compressor 5 during the drying phase enables the water vapour to be effectively eliminated, while the resulting condensate is conveyed along the outlet conduit 11. In the preferred case in which said conduit 11 is connected to the lower aperture 9 of the vessel, as already indicated earlier in this description, the condensate is capable of collecting in the sump 2 for being then discharged in a per sè known manner.

[0022] Fully apparent is at this point also the constructional and operational simplicity of the machine according to the present invention which (as this has been verified also experimentally) is able to dry the washload items contained in its vessel 1 in a particularly quick, complete and effective manner.

[0023] The performance of the drying system can be further enhanced by arranging at least a portion of the chamber 12 of the compressor in a heat-exchange relation with the ambient on the outside of the washing vessel 1, wherein said ambient is at a temperature T0 (eg. 25°C) that is substantially lower than the temperature T (approx.70°C) prevailing inside the vessel at the beginning of the drying phase. In fact, the compression of the water vapour inside the chamber 12 of the compressor causes also the temperature thereof to correspondingly increase up to a value T1 > T > T0, wherein such a temperature T1 may for instance have a value of approx. 80°C.

[0024] As a result, the greater temperature difference T1 - T0 between the compressed water vapour and the ambient outside the compressor enables the water vapour to be more effectively cooled down, thereby promoting its condensation.

[0025] It will be appreciated that the above described washing machine can undergo a number of modifications without departing from the scope of the present invention.

Claims

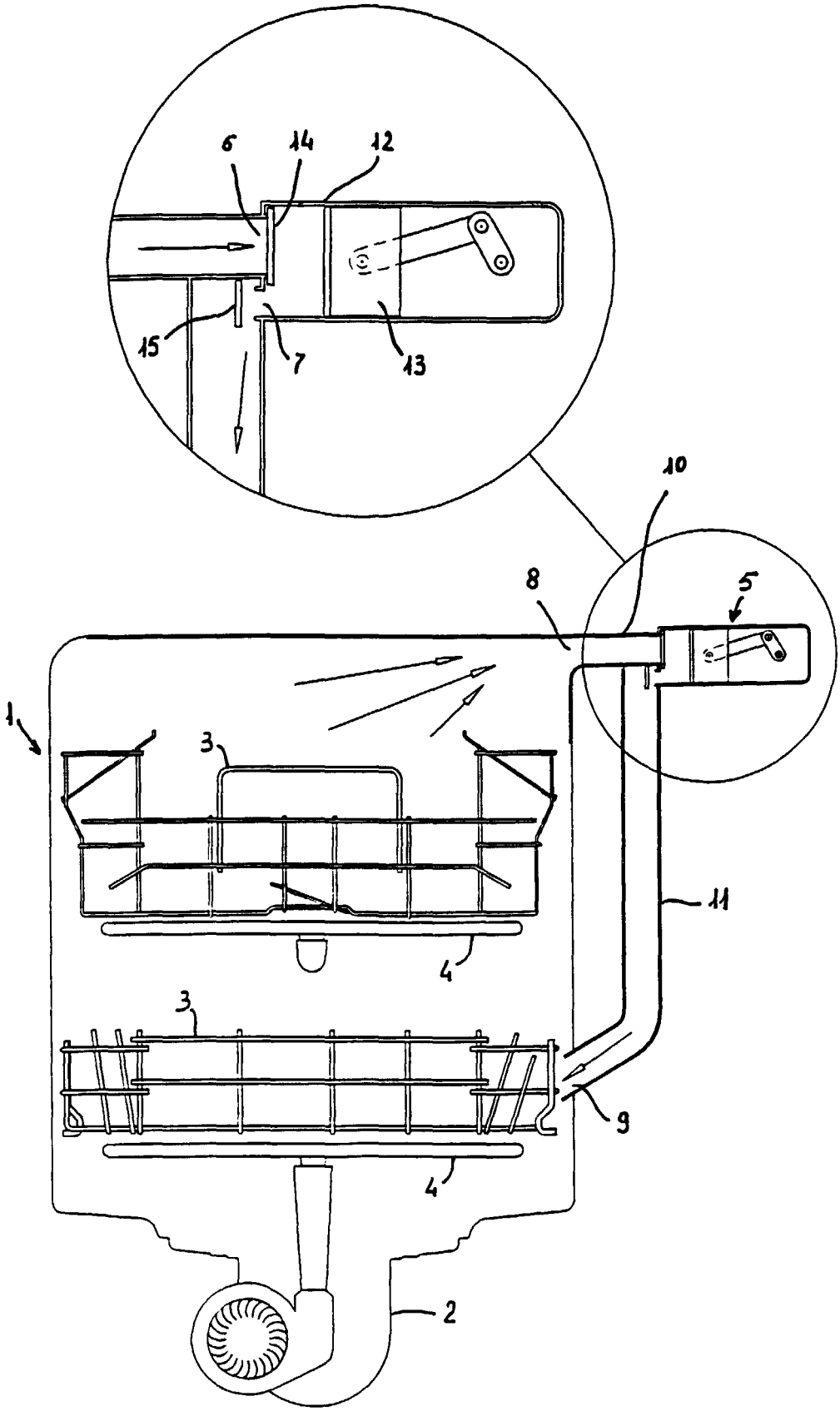
1. Washing machine comprising a washing vessel in which water vapour is present at the beginning of a drying phase of the washload items accomodated in the same vessel, characterized in that it further comprises compressor means (5) having a chamber (12) with at least an inlet (6) and at least an outlet (7) that are connected to an aperture (8) of the washing vessel (1) and an outlet conduit (11), respectively, said compressor means being adapted to take in the water vapour from the vessel through said inlet (6), to compress the so taken-in water vapour in order to cause it to substantially condense, and to convey it towards said outlet conduit (11).

2. Washing machine according to claim 1, characterized in that said outlet conduit (11) communicates with a further aperture (9) of the vessel so that said vessel (1), the compressor means (5) and said conduits (10, 11) form a closed-loop drying system along which said water vapour is capable of being circulated, the resulting condensate collecting into the vessel.

3. Washing machine according to claim 2, characterized in that said inlet (6) and said outlet (7) of the compressor means (5) are associated to respective non-return valves (14, 15) so that the water vapour is circulated in said closed-loop circuit in a single direction only.

4. Washing machine according to claim 1, characterized in that the inlet (6) of said chamber (12) of the compressor means (5) has a larger cross-section area than the outlet (7) of the same chamber.

5. Washing machine according to claim 1, characterized in that said chamber (12) of the compressor means (5) is at least partially in a heat-exchange relation with the ambient on the outside of the washing vessel (1) so as to promote the condensation of the water vapour being compressed inside the same chamber.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EUROPEAN SEARCH REPORT

Application Number
EP 99 11 8971

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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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A,D	US 5 056 543 A (AKTIEBOLAGET ELECTROLUX) 8 August 1990 (1990-08-08) * the whole document *	1	
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A,D	EP 0 800 786 A (ELECTROLUX ZANUSSI ELETTRODOMESTICI S.P.A.) 15 October 1997 (1997-10-15) * column 4, line 56 - column 5, line 15; figure 2 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 April 2000	Courrier, G

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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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