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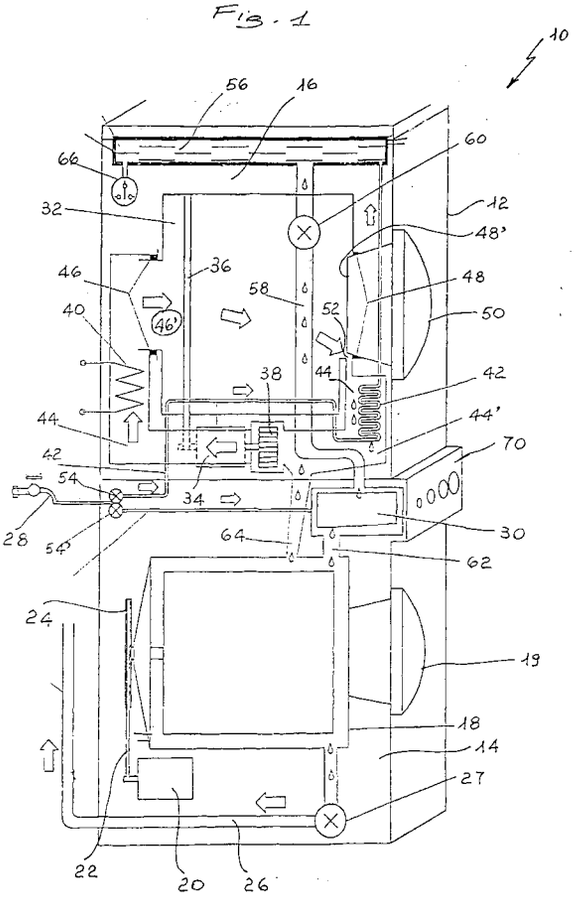
(54) Combined washing machine

(57) A combined washing machine (10), that comprises a washing apparatus defining a space (14) wherein there are contained a tub (18) with the associated rotary drum and access door (19), a motor (20) driving said drum, a pump (27), a mains water feeding and emptying hose (26) and a box (30) for the cleansing agents, characterized in that said washing apparatus is associated with a drying machine having in a space (16) a condenser or heat exchanger (42) with at least one coil, connected on the one side to said water hose (28) and on the other side to the washing hub (18) or the accumulation tank (56) integral with the machine (10) or external to the same, and one or more fans (38) for the creation of a flow of heated air through at least one or more heating elements (40), wherein said flow circulates in a duct (44) that incorporates said at least one coil of the heat exchanger (42) and develops around the perimeter of a perforated drum (32).

Fig. 1



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Description

[0001] The present invention relates to a combined washing machine.

[0002] More particularly, the present invention relates to a machine especially suitable for laundering linen and of the type used as household appliance, comprising an apparatus intended for drying what has already been laundered.

[0003] There have been known from years domestic appliances through which it is possible to carry out, according to an automatic cycle, the launder of linen, underwear and clothing; these machines, traditionally called washing machines, carry out also, at the end of the laundering, the centrifugation of what has been laundered, to prevent dripping and to accelerate drying.

[0004] Linen is then removed in these conditions from the drum of the washing machine and hanged out to dry.

[0005] Other known washing machines are provided with ventilation means that are activated after the washing and the centrifugation to let hot air into the drum and to remove a part of the humidity which still soaks linen. This solution solves the problem of the drying of linen, which needs not being then hanged out, but the subsequent ironing is more difficult because of the folds that form in the fabrics in the inside of the drum, whose capacity is adequate only for the washing step. Therefore, drying is usually carried out in two times, with very long cycles and a high consumption of water and power. Besides, the result of the drying is not homogeneous.

[0006] To carry out, after the washing and the centrifugation a forced drying, complete and homogeneous, one must therefore have recourse to another specific apparatus, which has a structure similar to that of the washing machine. Such apparatus or drying machine, in fact, is constituted by a structure having a parallelepiped shape wherein there is rotatably contained a drum, having a volume much greater than that of the washing drums, suitable to house the linen to be dried in one only cycle. In the inside of the bearing cabinet the drying means are housed, constituted for instance by air or water condensers, fans and heating elements; the drum is autonomously moved through a conventional motor and the related drive gears. The drying machine must also be provided with devices for activating and controlling the work cycles, humidity condensation systems and the related water drain.

[0007] It is, therefore a complicated and expensive apparatus, which, besides, has sometimes a size greater than that of the washing machine. Further to the above drawbacks, the one adds that refers to use consumption, which is high because of the constant and long-lasting absorption of electric energy, necessary for the heating and diffusion of drying air. A great part of the calories developed for heating the drying air flow disperses in the environment, without any recovery possibility; if the drying machine is located, as often happens, in small service rooms, the dispersed heat progressively heats the environment, and the drying times therefore becomes longer, as the heat exchange between the over-heated air of the machine and the ambient air reduces, the latter being utilized for the condensation process.

[0008] Object of this invention is to obviate the aforesaid drawbacks.

[0009] More particularly, object of this invention is to realize a combined washing machine, especially utilized as household appliance to launder linen, clothing, and the like, incorporating a part suitable to carry out the homogeneous and complete drying of said articles.

[0010] A further object of the invention is to realize a combined washing machine having compact dimensions, wherein there is used for drying a relevant part of the existing structural and functional elements of the washing machine.

[0011] A further object of the invention is to realize a washing machine as defined above, suitable to allow the substantial recovery of the calories developed for the drying step, and therefore suitable to markedly reduce the running costs.

[0012] A further object of the invention is to provide users with a combined washing machine able to ensure a high level of resistance and reliability in the time, and also such as to be easily and economically realized.

[0013] These and still other objects are achieved by a combined washing machine according to the present invention, which comprises a washing apparatus which defines a space wherein there are contained a tub with the associated rotary drum and access door (19), a motor driving said drum, a pump, a mains water feeding and emptying hose and a box (for the cleansing agents), characterized in that said washing apparatus is associated with a drying machine having in a space a condenser or heat exchanger with at least one coil, connected on the one side to said water hose and on the other side to the washing hub or accumulation tank integral with the machine or external to the same, and one or more fans for the creation of a flow of heated air through at least one or more heating elements, wherein said flow circulates in a duct that incorporates said at least one coil of the heat exchanger and develops around the perimeter of a perforated drum.

[0014] The constructive and functional characteristics of the combined washing machine of the present invention will be better understood thanks to the following description, wherein reference is made to the attached drawings which represent a preferred non limiting example and wherein:

Figure 1 shows schematically, in perspective view, the combined washing machine of the present invention;

Figure 2 shows schematically, in front view, a detail of the preceding figure, referred to the box for the distribution of the cleansing agents;

Figure 3 shows schematically a side view of the

conveyance of heated water from one to another operating zone of the combined washing machine.

[0015] With starting reference to Figure 1, the combined washing machine of the present invention, indicated as a whole by 10, is basically constituted by a load-bearing cabinet (12), having by way of example a vertically developed parallelepiped form, wherein two zones or spaces 14, 16 are defined, superposed to one another which house the washing means and devices, respectively the ones intended for the drying of linen, clothing and the like. In the preferred embodiment of the aforementioned figure, the washing zone is located at the lower level of cabinet 12 and comprises conventional parts that are specific of a washing or laundering machine and that, therefore, will not be described in detail, being substantially well known. Solely by way of example, there are indicated, relatively to said washing zone, tub 18 that houses the rotary drum (not shown) and the related door 19, motor 20 with the associated belt 22, pump 27 and the washing water emptying hose 26, the mains water inlet hose 28, and the cleansing agent distribution box 30. At least some of the aforementioned components, specific of the washing zone defined by space 14, interact with the means and devices included in the superposed zone or space 16 intended for drying, as will be specified later on.

[0016] Said drying zone 16 basically comprises a rotary drum 32, driven by an electric motor 34 or the like though a belt 36, a fan 38 associated to said motor, suitable to create an air flow around drum 32, heating means (40) for the air flow developed by fan 38 and a condenser or heat exchanger 42. The rotary drum 32 is supported by known means in space 16 and is circumscribed by a perimetric duct 44 along which the air flow circulates that is created by fan 38 and heated by said means 40, advantageously constituted by electric wires located in suitable positions. The perimetric duct 44 is formed, for instance, by pre-shaped panels from plastic material. Drum 32, suitably perforated to allow the inlet and outlet of the heated air flow, rotates in the inside of duct 44, which is provided with suitable sealing gaskets, to form a closed circuit; In particular, according to the preferred embodiment of Figure 1, said gaskets are indicated by 46, 48 and are respectively located in correspondence of opposite mouths 46' and 48' of drum 32. One of said mouths, for instance the one indicated by 46', constitutes the heated air inflow front to drum 32, while the opposite mouth 48' circumscribes a conventional opening 50 through which the linen to be dried is let into said drum. Between opening 50 and the panels forming duct 44, a passage 52 is obtained for the air flow which is caused to pass, under the effect of fan 38, in a chamber 44'; said chamber, which is comprised, by way of example, between opening 50 and fan 38 and which is integral with the perimetric duct 44, houses said condenser or heat exchanger 42, advantageously but not critically constituted by at least one metal coil. Said coil, realized from high thermal exchange material such as copper or aluminum or from stainless steel, is connected, at the opposite free ends, respectively to the mains water inlet hose, through a double or double-acting valve 54, 54', and to an accumulation tank 56, installed for instance in the upper part of space 16 above the rotary drum 32. Said tank 56 is connected in its turn, through a tubular body 58 or the like, to the upper part of box 30 of the cleansing agents, with the interposition of a one-way valve 60; said box 30 communicates with the washing tub wherein the drum for the linen to be washed is located.

[0017] The accumulation tank 56 is provided with a device 66, for instance a pressure switch, suitable to detect the presence of water in its inside.

[0018] The two-section double or double-acting valve 54, 54', located on the mains water hose 28, controls the alternative direction of said water, conveying the same, according to need, directly to the cleansing agent distribution box 30 or the heat exchanger 42; as concerns water inlet, such alternative is determined through conventional means for the activation of the functions of the combined washing machine 10, said means being located on one only control panel, indicated by 70 in Figure 1. Section 54' of said valve is activated to send water directly into the cleansing agent box 30, while the other section 54 is activated to send water to exchanger 42 and, therefore, to the accumulation tank 56. In the first case, the water enters the washing tub 18 after having removed the cleansing agent from box 30, allowing to perform a conventional laundering or laundering step; in the second case, the water enters the circuit of exchanger 42 to create the conditions suitable for the drying in the upper zone or space 16 of the combined washing machine. Said valve sections 54, 54' have different capacities; in particular, for the entry of washing water from hose 28, the capacity is sufficiently high and constant, to ensure short loading times, while for the feeding of exchanger 42, the capacity is minimum and continuous, for instance comprised between 0.20 and 0.30 l/min, so as to optimize the heat exchange necessary for the condensation.

[0019] In the traditional and various steps for laundering linen clothing articles and the like, specific cleansing agents are used, for instance cleansing agents, scours, softeners and possibly bleachers. For this purpose, in order to remove from the box the detergent corresponding to the laundering step in progress, a cam selective distributor 74 of the known type, schematized in Figure 2, is located in said box. As also water coming from the accumulation tank 56 flows into the cleansing agent box, as will be specified later on with regard to the working of the combined machine 10, a plurality of variously oriented and/or shaped perforated plates 76 is associated to said box 30, which plates allow the selective passage of water coming from said tubular body 58 and suitably conveyed with known means.

[0020] The working of the combined machine of the

present invention can be easily inferred from the above description, which machine may work as a traditional washing machine, being at the same time provided with a drying sector connected to the washing tub; by carrying on a drying cycle, the result is obtained of heating a high quantity of water that has accumulated in tank 56 and that can be utilized afterwards for the subsequent washing cycle.

[0021] In detail, the hypothesis is first of all made of utilizing the combined machine 10 for the first time for washing purposes, or to utilize the same without having previously carried out a drying cycle. The linen to be laundered it put in the rotary drum of tub 18, i.e. in the lower zone or space 14, and the washing cycle is set traditionally with the controls of panel 70; the mains water enters into said tub, on prior removal from box 30 of the detergents corresponding to the specific operating steps, and is heated, if necessary, with the known and traditional procedures that are characteristic of the washing machines.

[0022] The selective control knob activates valve 54' that allows to feed with a direct flow into tub 18 the mains water. The washing cycle conventionally concludes with the centrifugation step, following which linen is wet but does not drip.

[0023] Now, there may be a drying cycle, and therefore the same linen is put in the upper zone 16 of the combined machine through door 50 that lets into the rotary drum 32. The start and the running of said drying cycle are controlled by known means, such as a timer and the like, located on the same panel 70. The mains water distributes, with a minimum and continuous capacity, through valve section 54 in exchanger 42, wherein it is invested by a flow of hot air circulating along the perimetric duct 44.

[0024] The air flow is created by fan 38 and its heating takes place thanks to the heating elements 40 located along the set way of said flow. At the same time, motor 34 causes, through belt 36, drum 32 containing the linen to rotate.

[0025] The hot air that circulates in a closed space, circumscribed by the perimetric duct 44, reaches a temperature comprised, by way of indication, between 60 and 90°C, penetrates in drum 32 through the holes obtained in the same, and exits after having invested the linen being moved; therefore, the hot air is loaded with humidity particles that are condensed following the contact with the coil of exchanger 42, within which water circulates at the temperature of the mains, i.e. generally comprised between 5 and 20°C, according to the climatic and geographic conditions. The contact between the hot air and the coil of exchanger 42 determines the formation of water drops that collect at the base of duct 44, whose inclination is suitably conformed, and descend into the washing tub 18 through offtake 64. This quantity of water is then evacuated through the emptying hose 26 contained in the lower washing zone 14 of the combined machine 10. The heat exchange that takes place between the hot air and exchanger 42 causes the heating of the water that continuously circulates in the coil of said exchanger; this quantity absorbs therefore the exchanger heat and flows progressively into the accumulation tank 56. The latter, that may possibly be insulated, is preferably so sized as to contain a quantity of water comprised between 25 and 35 liters; once it is completely full, which happens upon conclusion of the drying cycle depending on the water quantity that goes to exchanger 42, the water it contains has, by way of example, an average temperature comprised between 30 and 40°C, according to the experimental checks carried out by the applicant.

[0026] This quantity of air heated by heat exchange is kept in the accumulation tank 56, wherefrom it cannot flow downwards because of the action of one-direction valve 60.

[0027] At the end of the drying cycle, whose duration is comprised, by way of indication, between 60 and 120 minutes, the accumulation tank 56 is therefore full of clean water, i.e. mains water, at an average temperature not lower than 30-40°C. This quantity of water is advantageously utilized for a subsequent washing and is sufficient for a great part of the cycle; also even it is not utilized within a shot time, the water of tank 56 remains at a temperature higher than that of the mains.

[0028] After 10-15 hours from the conclusion of the drying cycle, its temperature is still of about 35°C, which temperature cannot, in any case, be higher in the presence of an adequate insulation of the accumulation tank 56. Even in boundary conditions, the temperature of the water contained in said tank cannot lower under the ambient temperature, i.e. 18-20°C at least.

[0029] As a consequence, on the start of the subsequent washing cycle, the combined machine 10 of the present invention has at its disposal a quantity of water at a temperature much higher than that of the mains, which causes a relevant reduction in heating time and the associated consumption necessary to heat the water at a washing temperature, i.e. about 60°C for standard washing programs.

[0030] The quantity of water contained in the accumulation tank 56 may be indifferently utilized for the prewashing, washing and rinsing steps through conventional means for the activation of the one-direction valve 60 which, once opened, allows water to flow along the tubular body 58 that connects said tank 56 to the cleansing agent box 30 and afterwards to the washing tub 18. During the washing cycle, carried out with the recovery of the hot water present in said tank, section 54' of the mains water inlet valve is preferably closed; however, it is possible to provide for said section 54' to be opened for fixed times or in specific steps of the washing cycle, in order to mix the hot water of tank 56, reducing thereby its temperature. When water going down from said tank reaches the cleansing agent box 30, it gets in touch with the perforated plates 76 that convey water to one of the sectors of said box containing the cleansing agent suit-

able for the washing step to be carried out.

[0031] Tank 56 is provided with a drain or overflow (not shown), connected through known means to the emptying hose 26 of the washing zone 14; said device activates when two drying cycles are carried out after one another, the second of which for linen washed, for instance, by hand. In this case, the accumulation tank 56 must be, in fact, previously emptied.

[0032] As can be inferred from the above description, the advantages provided by the invention are evident.

[0033] The combined machine of the present invention allows to exploit completely the energy utilized to create the flow of the drying hot water, as it heats simultaneously a high quantity of water to be utilized for the subsequent washing. In this way the energy consumption during the washing step drastically reduces, without increasing that of the drying step. Besides, the linen laundering is more effective, as it is carried out with water already heated since the beginning, and the specific cleansing agents are better utilized.

[0034] Besides, the combined machine of the present invention is extremely compact, as the superposed washing 14 and drying zones 16 are superposed, communicating with each other and contained in one only cabinet.

[0035] Also the economic aspect of the production costs should not be overlooked, as they are sharply reduced, especially thanks to the possibility of comprising in one only cabinet the washing and the drying apparatuses, and the possibility of having one only control panel 70 for all the functions. Other components, such as timer, control panel, and upper panel or top are present individually, while being utilized for both apparatuses, providing further high reductions in the production costs. Another advantage lies in that it is possible to exclude the presence of a special basin for the collection of the condensate with the associated control and safety systems, as said condensate is sent to the washing tub and eliminated through the relative pump.

[0036] Besides, the water-based heat exchanger involves lower costs with respect to the use of an air-based exchanger and less construction difficulties for the sealing between vapor and water circuits.

[0037] However, the invention, as described hereabove and claimed hereafter, has been solely proposed by way of non critical example, meaning that the same may be susceptible of many modifications and variants, all of which fall within the scope of the inventive concept.

[0038] For instance, the arrangement of the washing and drying apparatuses or the respective components may be different with respect to what has been described and illustrated; besides, the drying apparatus may be constituted by an autonomous cabinet, associated in any way whatever to the washing apparatus for the recovery of the water heated during the drying step and contained in the accumulation tank.

[0039] Even though the preferred embodiment as described above provides for the recovery of the water heated by heat exchange for a subsequent washing cycle, other advantageous realization hypotheses are not to be excluded. In particular, the water heated by heat exchange may be eliminated instead of being accumulated; in this case, the advantages achieved by the invention are associated especially to the construction economy of the combined machine thanks to the reduced number of components, many of which are common to the two washing and drying apparatuses.

[0040] According to a further alternative, the water heated by heat exchange may be conveyed and accumulated in a tank external to the combined machine and utilized for any purpose whatever.

[0041] Lastly, the water heated by heat exchange and possibly also the condensate water may be utilized directly for a cycle started simultaneously or little after the start of a drying cycle; this hypothesis is validly practicable especially if at least a traditional washing machine is running by side of the combined machine of the present invention.

Claims

1. A combined washing machine (10), that comprises a washing apparatus defining a space (14) wherein there are contained a tub (18) with the associated rotary drum and access door (19), a motor (20) driving said drum, a pump (27), a mains water feeding and emptying hose (26) and a box (30) for the cleansing agents, characterized in that said washing apparatus is associated with a tumble drying machine having in a space (16) a condenser or heat exchanger (42) with at least one coil, connected on the one side to said water hose (28) and on the other side to the washing hub (18) or the accumulation tank (56) integral with the machine (10) or external to the same, and one or more fans (38) for the creation of a flow of heated air through at least one or more heating elements (40), wherein said flow circulates in a duct (44) that incorporates said at least one coil of the heat exchanger (42) and develops around the perimeter of a perforated drum (32).

2. The combined washing machine according to claim 1, characterized in that said washing and drying apparatuses, arranged respectively in spaces (14), (16) are superposed to each other and contained in one only bearing cabinet (12), provided with a control panel (70) for the alternated activation of the washing and drying cycles.

3. The combined washing machine according to any of the preceding claims, characterized in that said accumulation tank (56) of the drying apparatus is connected, through a tubular body (58) to the cleansing agent box (30) of the washing apparatus with the interposition of one or more one-direction

valves (60).

4. The combined washing machine according to any of the preceding claims, characterized in that said duct (44) of the drying apparatus is constituted by pre-shaped panels from plastic material.

5. The combined washing machine according to any of the preceding claims, characterized in that an electric motor (34) that drives the perforated drum (32) is connected through a belt (36) or the like to fan (38) of the drying apparatus.

6. The combined washing machine according to any of the preceding claims, characterized in that duct 44 of the drying apparatus is connected, through an offtake (64), to tub (18) of the washing apparatus.

7. The combined washing machine according to any of the preceding claims, characterized in that the water feeding hose (28) is provided with a two-section valve (54, 54') respectively connected to exchanger (42) of the drying apparatus and to the cleansing agent box (30) of the washing apparatus.

8. The combined washing machine according to any of the preceding claims, characterized in that said sections (54, 54') of the hose valve (28) have different capacities.

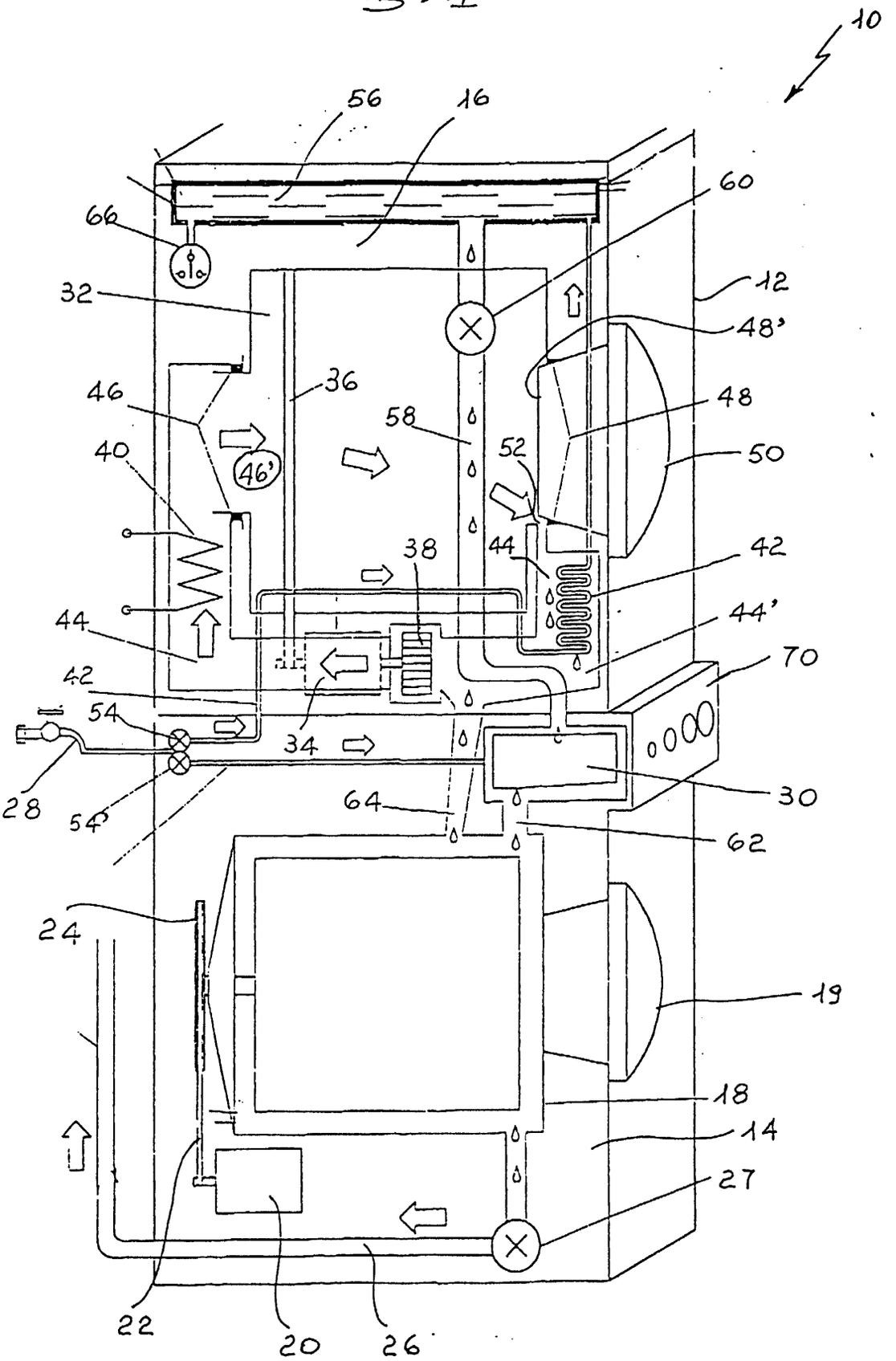
9. The combined washing machine according to any of the preceding claims, characterized in that the accumulation tank (56) of the drying apparatus is insulated and provided with a pressure switch (66) or the like for the detection of the presence of water in its inside.

10. The combined washing machine according to any of the preceding claims, characterized in that to the cleansing agent box (30) of the washing apparatus a plurality of perforated plates (76) is associated for the selective distribution in said box of the water coming from the accumulation tank (55) of the drying apparatus.

11. The combined washing machine according to any of the preceding claims, characterized in that the heating element or elements (40) of the drying apparatus are of the wire type.

12. The combined washing machine according to any of the preceding claims, characterized in that the accumulation tank (55) of the drying apparatus is provided with an overflow device.

Fig. 1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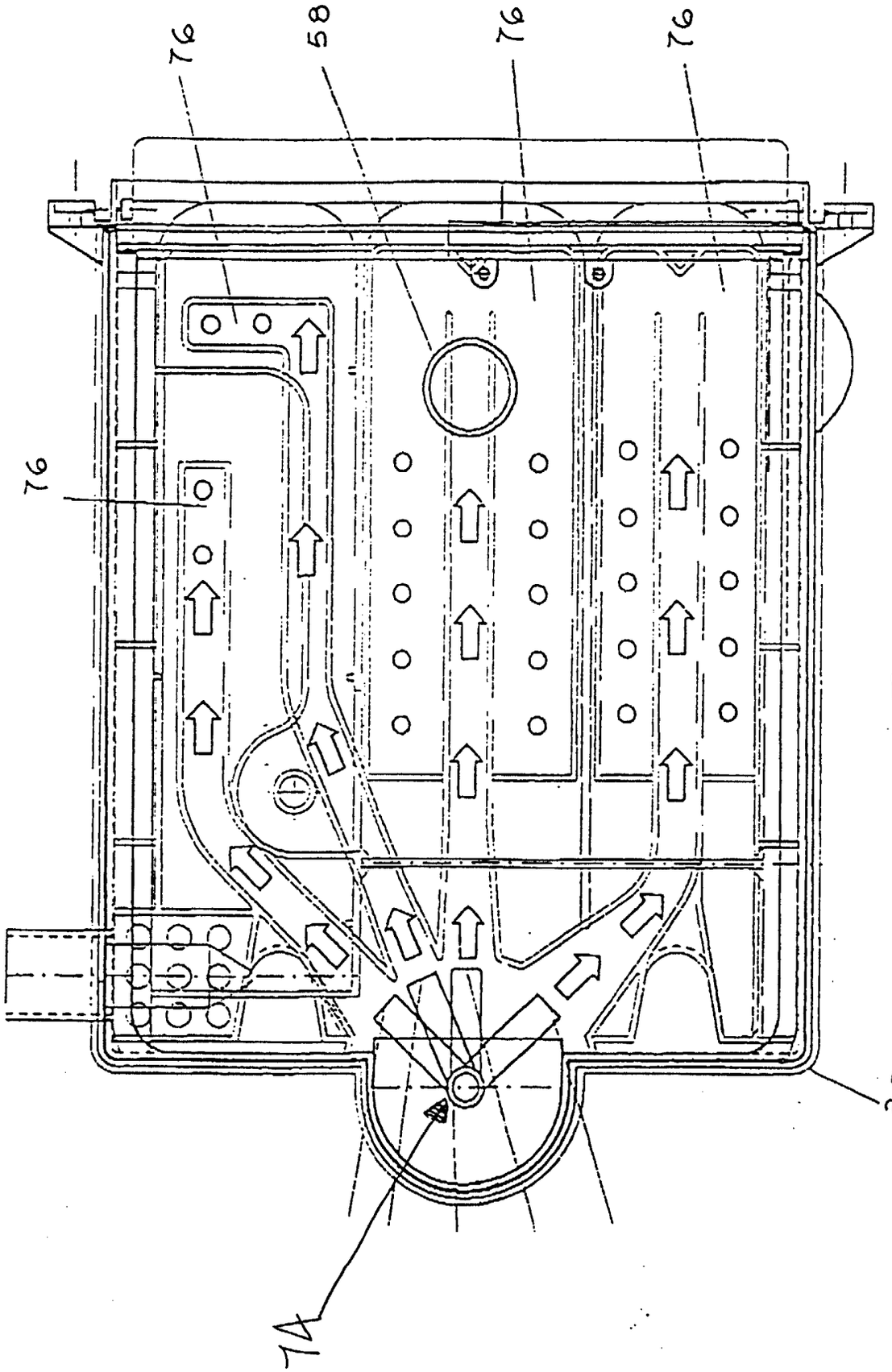

Fig. 2

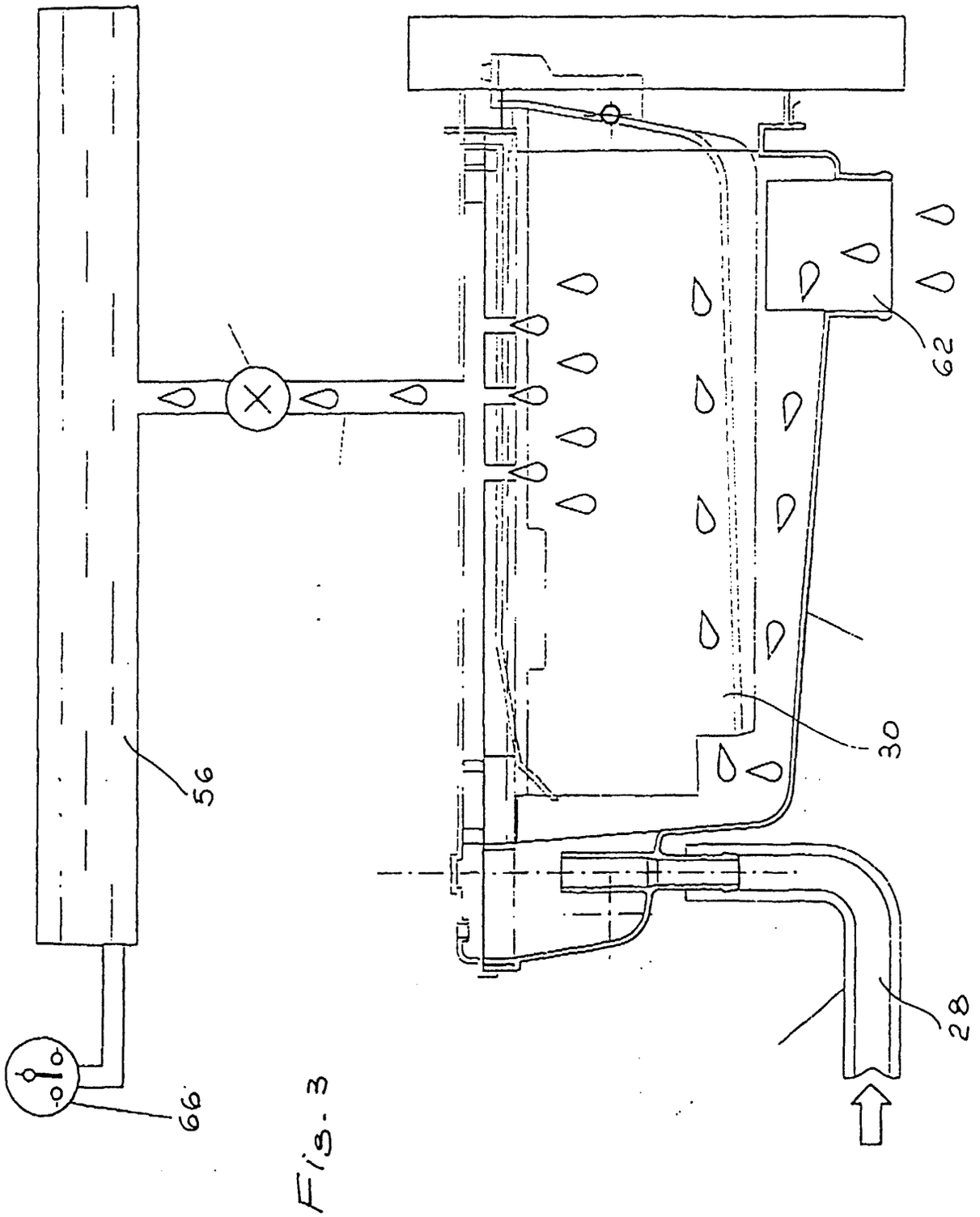

Fig. 3