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(54) Condenser-type clothes drying machine provided with a water failure safety arrangement

(57) Clothes drying machine comprising an arrangement provided for condensing the moisture out of the drying air, said arrangement being provided with at least a spray nozzle (7) ejecting a jet of atomized water that intercepts the flow of hot drying air passing through said condensing arrangement, the latter being also provided with means adapted to detect a failure in the inflow of the water required for condensation.

In a preferred manner, the clothes drying machine is provided with pressure switch means (8) capable of measuring the pressure that builds up at a point (9) located below the lowest portion of the vessel, and is arranged so as to be capable of detecting two successive values of the pressure building up at said lowest point during a pre-established period of time, so as to compare said two pressure values and generate a corresponding signal in the case that the second pressure value detected at the end of said period exceeds the first pressure value detected at the beginning of said period by an extent that is greater than a pre-established value.

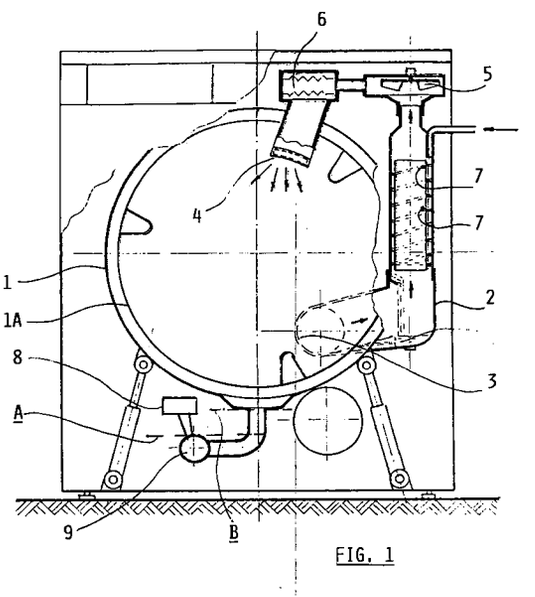

FIG. 1

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Description

The present invention refers to an improved type of clothes drying machine, or combined clothes washing and drying machine, wherein the clothes drying process is performed by condensing the moisture contained in the hot air being forced through the clothes by ventilation, said machine comprising an arrangement that makes the operation thereof particularly safe and reliable.

Clothes drying machines are known in the art which operate by the condensation of a flow of hot air which is blown through the drum of the machine, thereby removing the moisture contained in the clothes. Such machines are generally known to be made by installing a ventilation system, generally a blower consisting of a fan and associated electric driving motor, which causes the air to circulate in a closed-loop through a conduit, heats it up and blows it into the drum containing the clothes to be dried.

A heating element is installed inside said conduit which, when appropriately energized, heats up the air forced by said blower to flow through said conduit past said heating element, so that air is let into the drum which is sufficiently hot to cause the moisture contained in the clothes to evaporate.

The moisture-laden hot air is then caused by suction to leave the drum and to flow through a condensation arrangement which is generally formed by a sprinkle of cold water taken in from the water supply mains to create a cold barrier against which said moisture-laden hot air is blown.

Owing to the difference of temperature, the moisture is condensed off the circulated hot air, whereas the condensate is conveyed on to the bottom of the tub, from where it is then easily exhausted.

This technique is generally known in the art and is recalled here to the mere purpose of making it simpler to understand the actual peculiarities of the present invention.

The above cited clothes drying machines are quite simple, economic and reliably operating machines. However, they are generally known to have a drawback in that their drying cycle depends on the water sprinkle to be actually present to ensure the condensation of the moisture off the drying air. It has on the other hand been noticed that the valve provided to let the cooling water from the mains into the machine, which is normally shut for safety reasons upon conclusion of the machine operation, is sometimes left inadvertently shut by the user who forgets to open it when the machine is being used again.

If the machine is a combined clothes washing and drying machine, and the requested operation is clothes washing, such an oversight would not give rise to any particular problem, since all washing machines are regularly provided with safety arrangements that prevent them from operating in the case of washing liquor failing to regularly flow into the tub.

If on the other hand the machine is a clothes drying machine, or a combined clothes washing and drying machine being used to only perform a drying cycle, then such a closed condition of the water shut-off valve governing the water inlet from the mains into the machine would not prevent the machine from operating, albeit under totally irregular conditions that become apparent mostly in the form of a practical absence of any drying effect and a progressively rising temperature of the circulated air up to values that may jeopardize the integrity of both the clothes and the machine. Furthermore, since the the course of the temperature during the initial phase of the process may be used to anticipate the actual course of the whole drying process so as to therefore cause the cycle to be automatically stopped when such a process is estimated to have completed its drying task, it will be readily appreciated that an irregular course of the temperature of the drying air would completely distort the procedure for automatically calculating the duration of the drying cycle.

It would therefore be desirable, and it is actually a main purpose of the present invention, to provide a clothes drying or combined clothes drying and washing machine that before starting its drying cycle is arranged to check the water for regularly arriving at the nozzle producing the water sprinkle used to condensate the moisture contained in the drying air, without any need arising to redesign the machine to any significant extent, while using readily available, inexpensive and reliable materials and techniques and excluding any immoderate complication of the same machine.

These and further aims are reached with the present invention which will more readily and clearly understood from the description which is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a symbolically schematized view of the ventilation, condensation and drying conduits, along with the component parts of a clothes drying machine according to the invention;

- Figure 2 is a diagrammatic view showing the curve followed by the temperature of the air in the presence or absence of water in a traditional machine;

- Figure 3 is a view of the simplified flow-chart of the functional phases of a machine according to the invention.

To purposes of better exemplification, reference will be made in the following description to a combined clothes washing and drying machine. It will however be appreciated that the same condiderations apply to drying-only machines as well.

Furthermore, the term "water" will be used to indistinctly mean both the cooling liquor and the liquor generated by the condensation of the moisture from the clothes. This simplification will not, however, affect to

any extent the full understandability of the description, owing to the context in which this term is each time used, as this will readily be appreciated by anyone skilled in the art.

The combined clothes washing and drying machine according to the present invention is provided with a vessel 1, possibly a rotating drum 1A holding the drying load if the machine doubles also as a washing machine, an air circulation, condensation and heating-up conduit 2, said air being taken in from the vessel at a suction zone 3 and, after having been dehumidified, being returned into the vessel through a return zone 4.

Said conduit comprises a motor-driven blowing fan 5, a resistance-type electric heating element 6 for heating up the circulating air, and a condensation arrangement for condensing the moisture off the air, said arrangement comprising at least a nozzle 7 from which a sprinkle of atomized or similarly sprayed water is issued to create a cold barrier through which the moisture-laden hot air is caused to pass by a suction effect. Due to the effect of such a cold barrier, the moisture contained in the hot air is condensed and its liquid fraction is conveyed by gravity into an appropriate chamber provided in the lower portion of said condensation arrangement, from which it is then exhausted with traditional means.

This, however, is well-known in the art so that it shall not be discussed here any further.

If no supply of condensation cold water happens for any reason whatsoever to arrive at the inlet of the nozzle 7, it is fully apparent that the afore mentioned cold barrier will not be able to be generated and, therefore, no condensation of the moisture contained in the air circulated therethrough will be able to take place. This gives rise to a number of negative consequences, mainly due to the fact that the air will be continuously heated up following the curve A shown in Figure 2, which can be seen to markedly deviate from the course followed by the curve B in the same Figure, which on the contrary corresponds to a regular course of the air temperature.

Such an overheating of the air gives in turn rise to risks of some materials to possibily catch fire or become charred, and can as well create conditions under which the clothes themselves may become damaged.

Furthermore, this brings in limitations in the effectiveness of the drying process, without mentioning other drawbacks connected with the actual self-programming abilities of the machine, which are generally depending on the course of the temperature of the drying air.

For such drawbacks to be prevented from occurring, the need arises to make each time sure that water actually arrives at the inlet of said nozzle to create the barrier-forming sprinkle. To this purposes, a short cycle is therefore performed for making sure of the presence of said water, said cycle being in a preferred manner started automatically before the actual drying cycle is started.

The invention lies in measuring the amount of water possibly issued by the sprinkle during a pre-determined period of time, as well as comparing the measured value with a previously determined and appropriately established reference value. Should such a measured amount of water turn out to be smaller than the predetermined reference value, this means that the nozzle is either failing to issue a water sprinkle at all or issuing water to an insufficient extent, so that either automatic or manual means will be activated to cause the drying cycle to stop and the irregular condition to be appropriately indicated.

An appropriate pressure switch 8 is provided to such a purpose, which is adapted to measure the pressure at a point 9 in the sump in which said condensation water collects. In the illustration appearing in Figure 1, such a sump is shown to be the chamber of the drain pump of the machine. In any case, it shall of course be situated below the arrangement holding the condenser, so that the outflowing water is able to collect therein by gravity.

The machine is arranged so as to be capable of performing a cycle aimed at verifying the presence of water sprinkling from said nozzle, said cycle consisting at the beginning of a pre-determined period of time in the measurement of the pressure existing at said point 9, in setting the conditions for activating the outlet of the water, if any, collecting on the bottom of said sump, and, at the end of said pre-determined period of time, in shutting off the inlet of water and measuring the pressure at the same point 9. It will clearly be appreciated that, if there has been no water inlet or such an inlet has been insufficient, the irregular condition can be measured and detected on the basis of the difference between the initial pressure and the final pressure measured at said point 9. Such a pressure difference can be recorded and compared with an approrpiate pre-set value, as this can on the other hand be done using means and methods commonly known in the art, wherein the more or less effective operation of the nozzle 7, ie. the greater or smaller effectiveness of the water sprinkle generated by it, can be readily inferred from the result of such a comparison.

An advantageous simplification can be further reached if the first pressure measurement is preceded by a short water discharge phase from said sump by means of the discharge pump of the machine. In this manner, after the de-energization of such a pump, the water head rearranges at a lower, substantially constant level, thereby making such a nozzle operation verification phase more constant and reliable in its outcome, as well as easier to perform.

Figure 3 illustrates a block diagram indicating the logical sequence of the phases included in said cycle performed to verify the presence of the water sprinkle issuing from the nozzle, in which the sump is preliminarily emptied and the difference between the lower level A and the higher level B reached by the water is finally calculated by measuring the respective pressure values.

It will of course be appreciated that it is within the ability of anyone skilled in the art to possibly find further technical and optimizing solutions in the use of the teaching of the present invention by having resort to readily available techniques and usual skills. As a consequence, although the present invention has been described using a generally known terminology, it should by no means be regarded as being limited by the examples given in the above description.

Claims

1. Clothes drying or combined clothes washing and drying machine comprising a vessel (1) containing the clothes to be dried, a conduit (2) for circulating, condensing and heating up the air that is taken in from said vessel at a suction zone (3) and is forced by a fan into the same vessel at a return zone (4) thereof, said conduit (2) comprising a motor-driven fan (5), at least a heating element (6) for heating up the air circulating inside said conduit, and a condensation arrangement for condensing the moisture off the air circulating in said conduit, said moisture condensation arrangement comprising at least a nozzle (7) ejecting a jet of atomized water that intercepts the flow of moisture-laden hot air passing through said condensation arrangement, **characterized in that** it is provided with an arrangement adapted to detect a possible failure in the water inflow supplying said jet of atomized water.

2. Machine according to claim 1, which is further provided with a pressure switch (8) adapted to measure the pressure existing at a point (9) located below said nozzle, **characterized in that** it is arranged so as to be capable of detecting two successive values of the pressure exisitng at said lower point at two successive moments separated by a pre-determined period of time, comparing said two measured pressure values with each other and generating corresponding signals that differ from each other depending on the value of the pressure measured on said second moment exceeding or not the value of the pressure measured on said first moment by an extent that is greater than a pre-established value.

3. Machine according to claim 2, and additionally capable of washing the clothes, **characterized in that** said lower point lies substantially in correspondence of the suction chamber of the drain pump used to discharge the liquor from the vessel.

4. Machine according to claim 2 or 3, **characterized in that** the drying cycle is preceded by a cycle performed to verify the presence of condensation water, said cycle consisting of:
   - a first phase involving the operation of the drain pump until the latter is emptied;
   - a second phase involving a first measurement of the pressure at said lower point;
   - a third phase involving water being supplied to said nozzle for as pre-determined period of time to sustain the jet of atomized water, said drain pump being de-energized;
   - a fourth phase involving a second measurement of the pressure at said lower point;
   - a fifth phase involving the difference between said first and second pressure measurements being calculated and then compared with a pre-determined reference value.

5. Machine according to claim 4, **characterized in that** depending on said difference between said two successively measured pressure values turning out to be smaller than said pre-determined reference value, the machine is enabled to go on operating according to the drying cycle selected.

6. Machine according to claim 4, **characterized in that** depending on said difference between said two successively measured pressure values being not found to be smaller than said pre-determined reference value, the operation of the machine is stopped.

7. Machine according to claim 6, **characterized in that** the interruption in the operation of the machine is accompanied by a visual and/or sound signal being issued to alert the user.

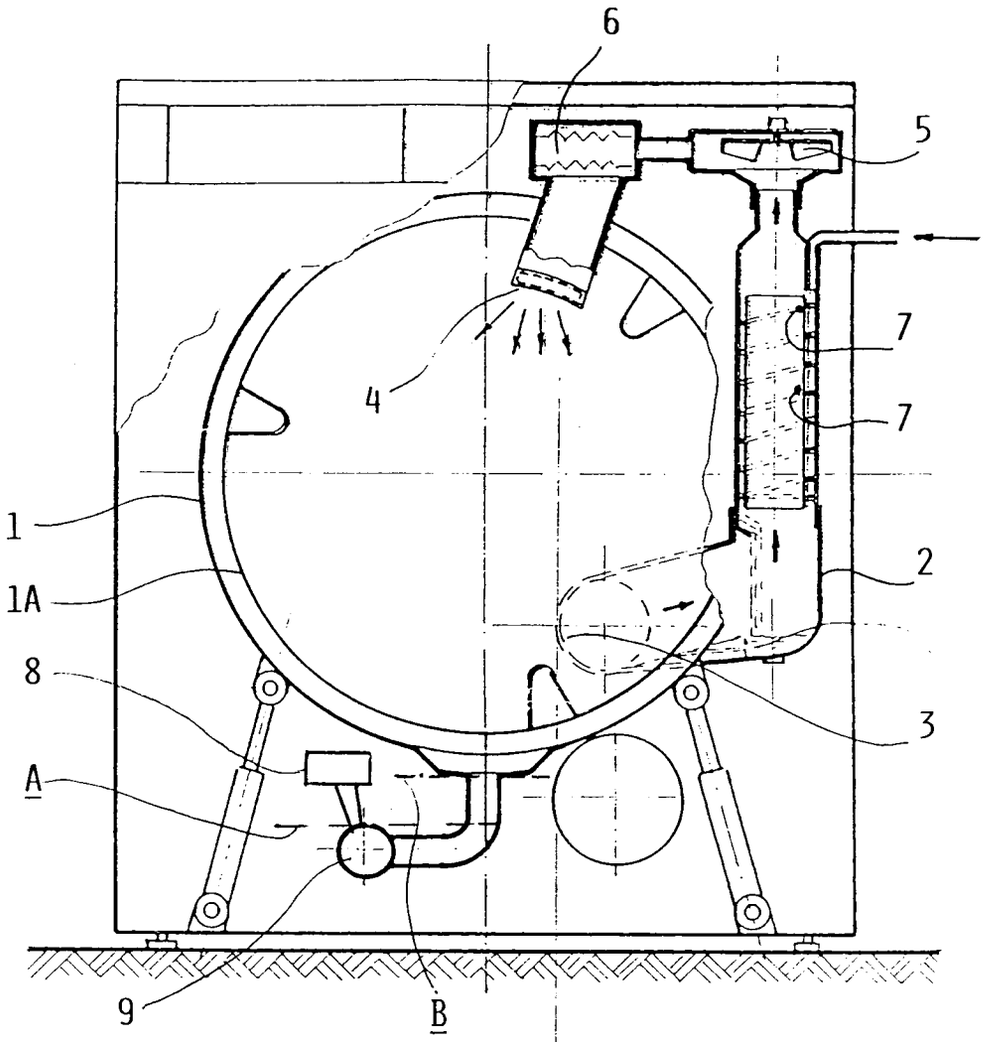

FIG. 1

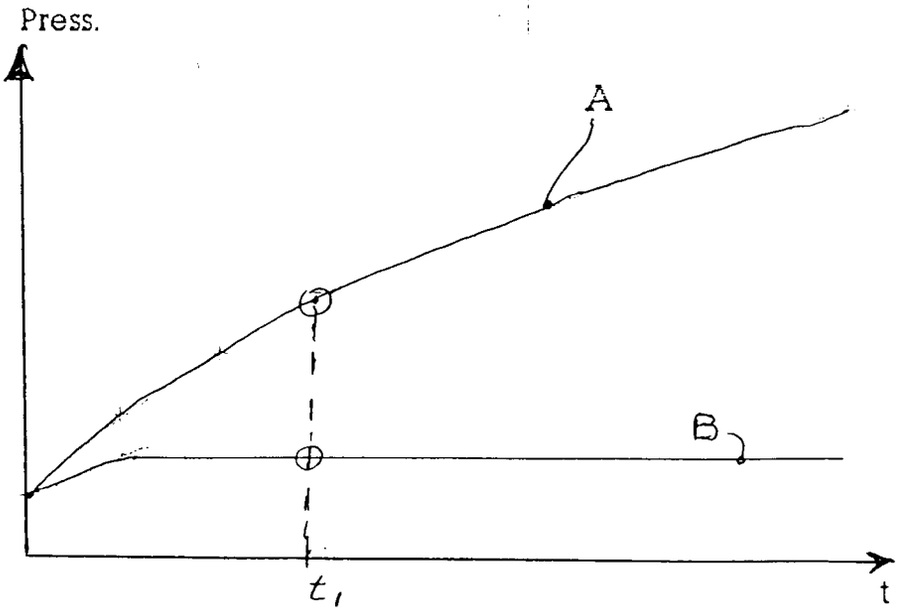

FIG. 2

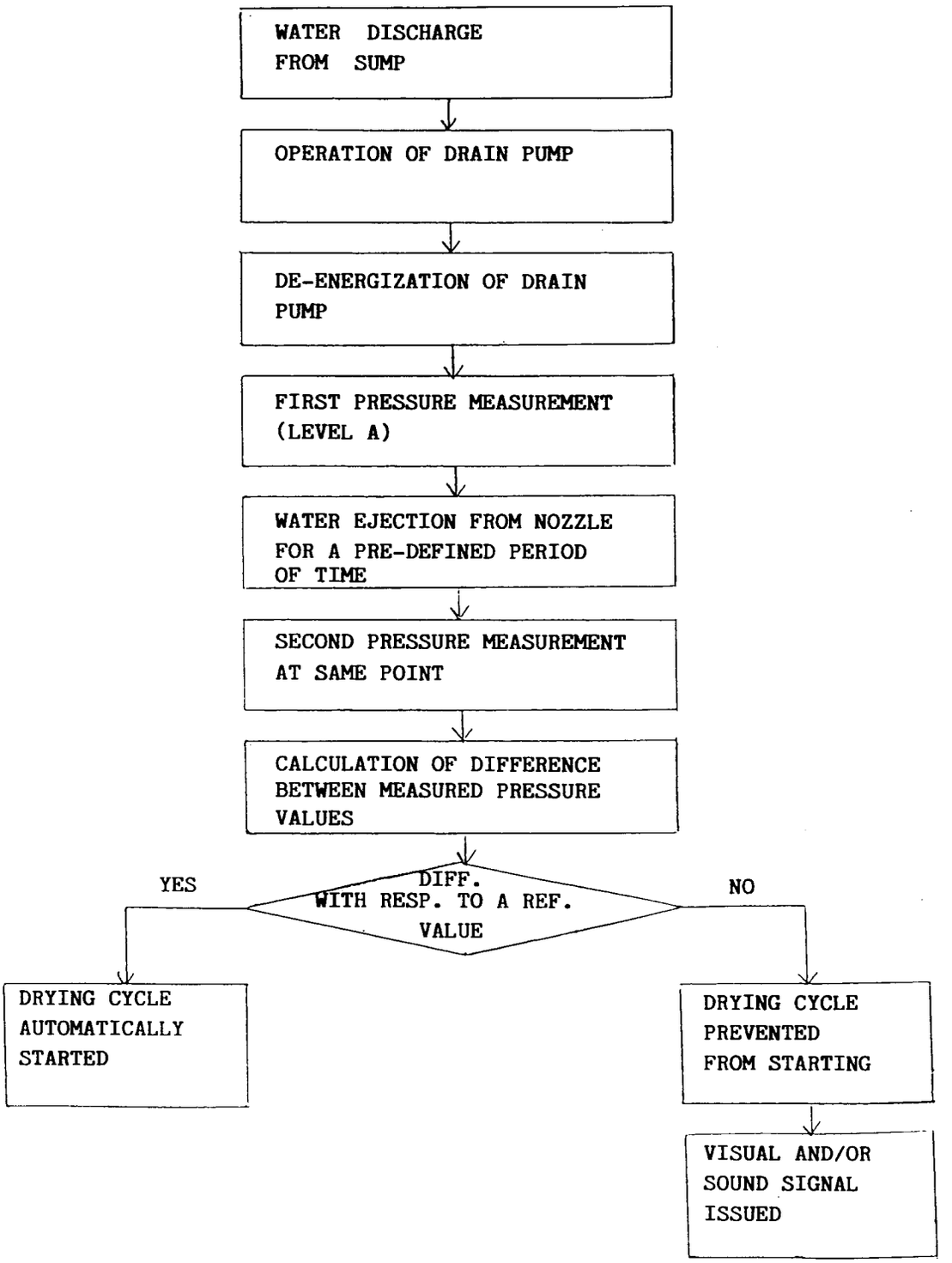
WATER DISCHARGE FROM SUMP
OPERATION OF DRAIN PUMP
DE-ENERGIZATION OF DRAIN PUMP
FIRST PRESSURE MEASUREMENT (LEVEL A)
WATER EJECTION FROM NOZZLE FOR A PRE-DEFINED PERIOD OF TIME
SECOND PRESSURE MEASUREMENT AT SAME POINT
CALCULATION OF DIFFERENCE BETWEEN MEASURED PRESSURE VALUES
DIFF. WITH RESP. TO A REF. VALUE
YES
NO
DRYING CYCLE AUTOMATICALLY STARTED
DRYING CYCLE PREVENTED FROM STARTING
VISUAL AND/OR SOUND SIGNAL ISSUED

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 6698

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-B-12 42 303 (SIEMENS-ELECTROGERÄTE GMBH) * the whole document *	1	D06F58/24
A	FR-A-2 332 360 (ESSWEIN S.A.) * page 2, line 30 - page 3, line 3 * * page 6, line 20 - line 23; figures *	1	
A	EP-A-0 552 842 (CANDY S.P.A.) * abstract; figure *	1,2	
A	US-A-2 695 460 (GENERAL ELECTRIC COMPANY) * column 5, line 36 - line 71; figures 1,3,4 *	1,2	
A	DE-A-24 29 078 (H.W. GESCHKA) * page 6, line 11 - line 15; figure *	2	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 September 1996	Courrier, G

CATEGORY OF CITED DOCUMENTS

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