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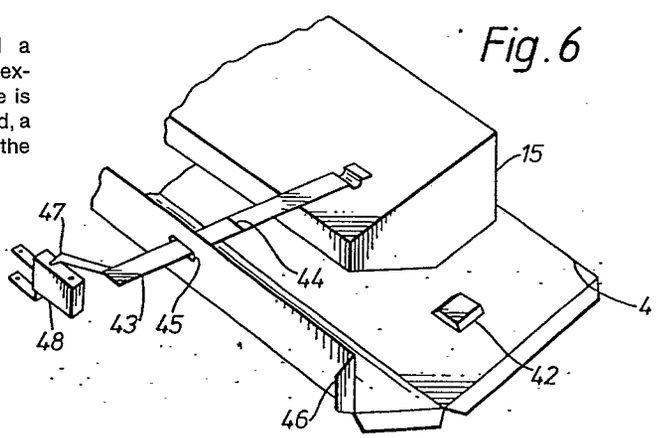
(54) Tumble driers.

(57) In a tumble drier having a heat exchanger and a re-circulating air path through the drum and the heat exchanger, a container 15 is provided into which condensate is pumped. To indicate when the container needs to be emptied, a pressure pad 42 is depressed by the weight of water in the container and a lever 43 operates a switch 48.

Fig. 6



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Description

Tumble Driers

This invention relates to tumble driers.

It is known to provide heat exchangers through which the air flow passes in a re-circulating path through the drum. It is also known to provide a container for water condensed out of the re-circulating path.

The invention provides a tumble drier which comprises a rotatable drum, a heat exchanger through which air flow passes in a re-circulating path through the drum in use, a container for receiving water condensed out of the re-circulating air, a pad underneath the container which is resiliently urged upwards against the container, and a switch linked to the upper surface of the container which is arranged to operate when the weight of water in the container is sufficient to depress the pad by a predetermined amount.

The use of a switch linked to the upper surface of the container in conjunction with a resiliently biased pad underneath provides the simple arrangement for ensuring that the container does not become over-filled. The switch may be coupled to an indicator, such as a warning buzzer or light, or may automatically switch the drier off.

The container can then be removed from the machine and emptied. A switch lying clear of the path of the container may be provided in conjunction with a pivotable lever linking the upper surface of the container with the switch.

A tumble drier constructed in accordance with the invention will now be described by way of example with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic perspective view of the tumble drier;

Fig. 2 is a top plan view of the tumble drier, but with components down to and including the drum not shown;

Fig. 3 is a side view of the tumble drier with a duct omitted for clarity;

Fig. 4 is a front view of the tumble drier;

Fig. 5 is an enlarged view of a fan and housing for re-circulating air flow; and

Fig. 6 is a schematic perspective view of the condensate container.

The tumble drier comprises a rotatable drum 1 housed in a cabinet 2, the drum being mounted on a bearing 3 at the front of the machine and a bearing (not shown) at the rear of the machine. A load is inserted into the tub through a door 4. The drum 1 is rotated by a motor 5 by a drive belt 6. The load is dried by means of an air flow heated by a heating element (not shown) in duct 7, which air flow circulates through the drum and through a condenser in the form of a heat exchanger indicated generally by the reference numeral 8 in a closed loop (see arrows 9 to 12). The heat exchanger is cooled by a flow of atmospheric air (arrows 13, 14). Condensed moisture is collected in container 15.

The layout of the motor and the fans for producing the air flows will now be described. The motor 5 has output shafts at each end. As well as driving the drum belt 6, the forward shaft 16 drive a fan 17 in a housing 18 in order to impel air through the drum. The rear shaft 19 drives a fan 20 in a housing 21 in order to impel atmospheric cooling air through the heat exchanger. The co-axially arranged motor and fans lie laterally with respect to the heat exchanger 8.

Referring to figure 5, the fan 17 consists of a rotatable fan wheel i.e. a wheel bearing curved blades 22 which is rotatable in a volute housing i.e. the outer periphery of the housing is in the shape of a scroll so that the clearance between the fan and the housing gradually increases towards the outlet 23, which is tangential to the fan wheel. The inlet is axially into the centre of the fan wheel. Such a fan has a high efficiency, i.e. a high air throughput, when the fan is rotated in the direction of the arrow, but a low throughput when the fan is rotated in the opposite direction. The fan 20 and its housing are identical to the fan 17 and its housing.

The heat exchanger 8 consists of a number of flat tubes 24 (through which the re-circulating air passes) which run longitudinally along the heat exchanger. At the front and rear ends the tubes are set into plastics panels 25, 26 which block the spaces between the tubes, and top and bottom panel 27, 28 have offset slots in them (the top one being shown at 38) for feeding the cooling air across the condenser tubes.

The heat exchanger 38 is housed in a chamber 30, with which the housing 18 communicates for the inlet to the heat exchanger (arrow 9). The re-circulating air flow is driven by the fan 17 through the tubes 24 and leaves the rear end 31 of the chamber (arrow 10), and enters the duct 7 which contains the heating element. The now heated re-circulating air enters the rear of the drum through a slot 32 and, after flowing through the drum, passes along a tapering duct 33 (arrow 12) and enters the fan housing 17 axially through an aperture 34. The heated and moist air is driven into the chamber 30 again. The front panel 35 of the chamber 30 can be opened (and a similar panel on the front of the cabinet 2 may be opened) in order to enable the heat exchanger 8 to be withdrawn longitudinally from the cabinet 14. Particles of fibre and of lint filters (not shown) will be entrained in the re-circulating air flow, and the heat exchanger should be periodically removed and cleaned to prevent it becoming clogged.

The cooling of the heat exchanger is effected by the fan 20. Cooling ambient air (arrow 13) from the atmosphere is drawn axially through inlet 35a into aperture 36 in the fan housing 21 and enters chamber 30 through slot 37 in the underside of the chamber. The air passes over the heat exchanger tubes 24 and leaves the chamber through slot 38 (arrow 14), which is offset relative to the slot 37 in order to cause turbulence in the cooling air flow and therefore promote better heat transfer. The air which has now been heated re-enters the atmosphere.

The side-by-side arrangement of the heat ex-

changer 8 on the one hand and the motor 5 and co-axial fans 17 and 20 on the other hand permits: the use of a single motor for the drum and two fans; an axial air entry into both fan housings; and accessibility of the heat exchanger from the front of the machine.

An electronic circuit is provided for periodically reversing the direction of rotation of the motor. Instead of providing equal periods of forward and reverse rotation as hitherto, the motor rotates the drums and fan in a repetitive cycle consisting of a forward rotation of five minutes and a reverse rotation of half a minute. In this way, the fans are operating in an efficient manner for around 90% of the time and in an inefficient manner only for around 10% of the time. Overall the air flow through the drum is effective for drying even though the air flow is subject to the impedance created by the condenser and the ducting of the re-circulating loop. Equally, the short reversal is effective for preventing tangling of the clothes, in the same way as equal length reversals were hitherto.

The use of unequal forward and reverse times permits the use of high efficiency fans but without the need for individual drive motors.

Referring to figure 3, the moisture from the re-circulating air leaving the drum condenses and runs from drains 39, 40 to the pump 40a (figure 1) which is powered by its own electric motor, and which pumps the liquid to a container 15. Referring to figure 6, the container is withdrawn by the user periodically to empty it and has means to prevent it being over filled.

Thus, container 15, when fully inserted, rests on spring-loaded pressure pad 42. An operating lever 43 pivoted at 44 passes through a slot 45 in support panel 46. One end rests on the upper surface of the container 15. The other end rests on a further lever 47 which, when depressed, operates a switch 48 which switches on the pump motor and the main motor as well.

When the container 41 becomes filled to a predetermined level, the weight is such that the pressure pad 42 is depressed by a predetermined amount. In turn, the end of the lever resting on the container is depressed and the other end raised, so that the switch 48 operates. The user then withdraws the container and empties it, and the switch remains in the off position. Only when the empty container has been re-inserted will the levers set the switch to the position in which the machine can restart.

Various modifications may of course be made to the embodiment described without departing from the scope of the invention, Thus, although the motor 5 is a two pole capacitor start and run induction motor, instead it could be a relay start motor, or indeed a four pole motor could be used. Equally, different forward and reverse periods in the reversing cycle of the motor are possible: thus, the ratio of forward to reverse for each cylinder could be from 5:1 to 20:1, and the cycle time could be between three minutes and ten minutes. Also, the points of entry to and exit from the heat exchanger could be changed. If desired the heat exchanges could be water cooled instead of air cooled.

Claims

1. A tumble drier which comprises a rotatable drum, a heat exchanger through which air flow passes in a re-circulating path through the drum in use, a container for receiving water condensed out of the re-circulating air, a pad underneath the container which is resiliently urged upwards against the container, and a switch linked to the upper surface of the container which is arranged to operate when the weight of water in the container is sufficient to depress the pad by a predetermined amount.

2. A tumble drier as claimed in claim 1, in which the container is removable from the tumble drier to allow it to be emptied.

3. A tumble drier as claimed in claim 2, in which the container is removable longitudinally through the front of the drier.

4. A tumble drier as claimed in claim 2 or claim 3, in which the switch lies clear of the path of the container, and a pivotable lever links the upper surface of the container and the switch.

5. A tumble drier as claimed in claim 4, in which the lever operates a switch via a further lever.

6. A tumble drier as claimed in any one of claims 1 to 5, in which the switch is arranged to switch the tumble drier off when the pad has been depressed by the predetermined amount.

7. A tumble drier substantially as herein described with reference to the accompanying drawings.

Fig.1

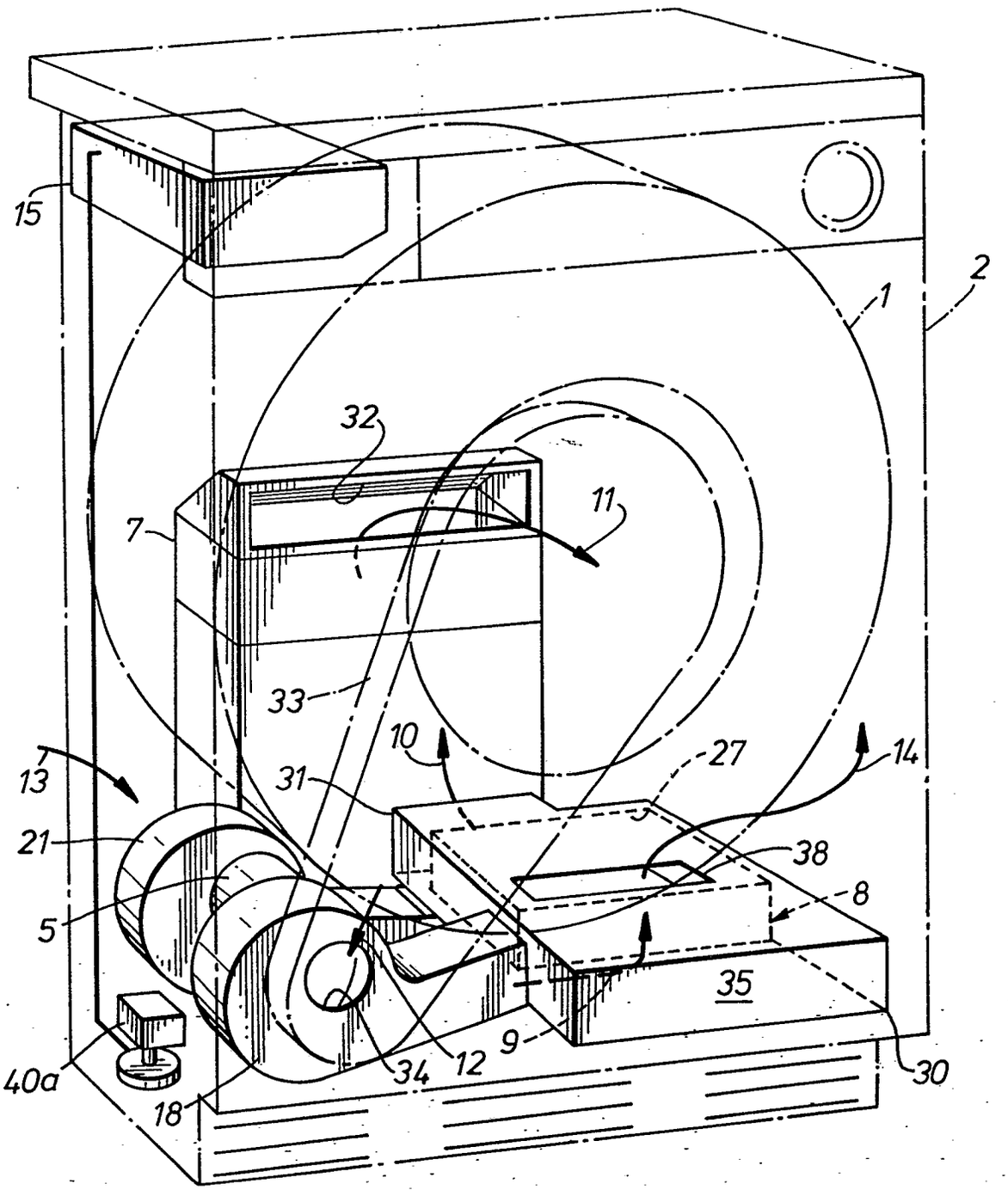


Fig. 2

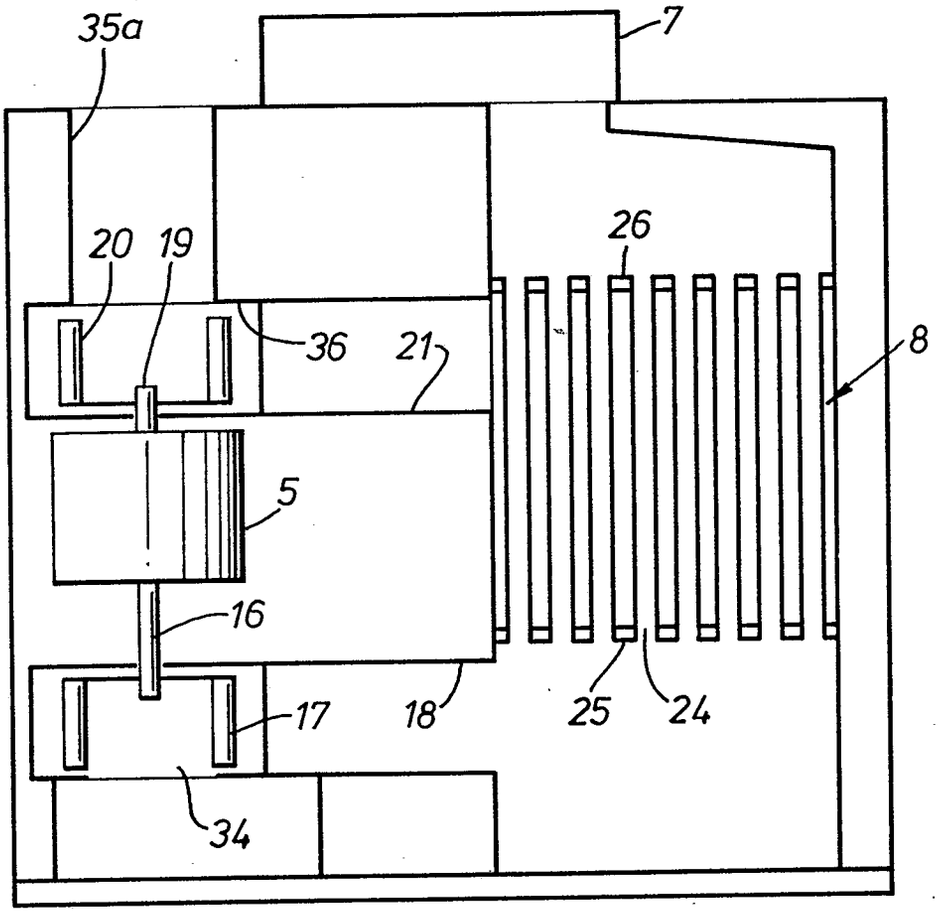


Fig. 3

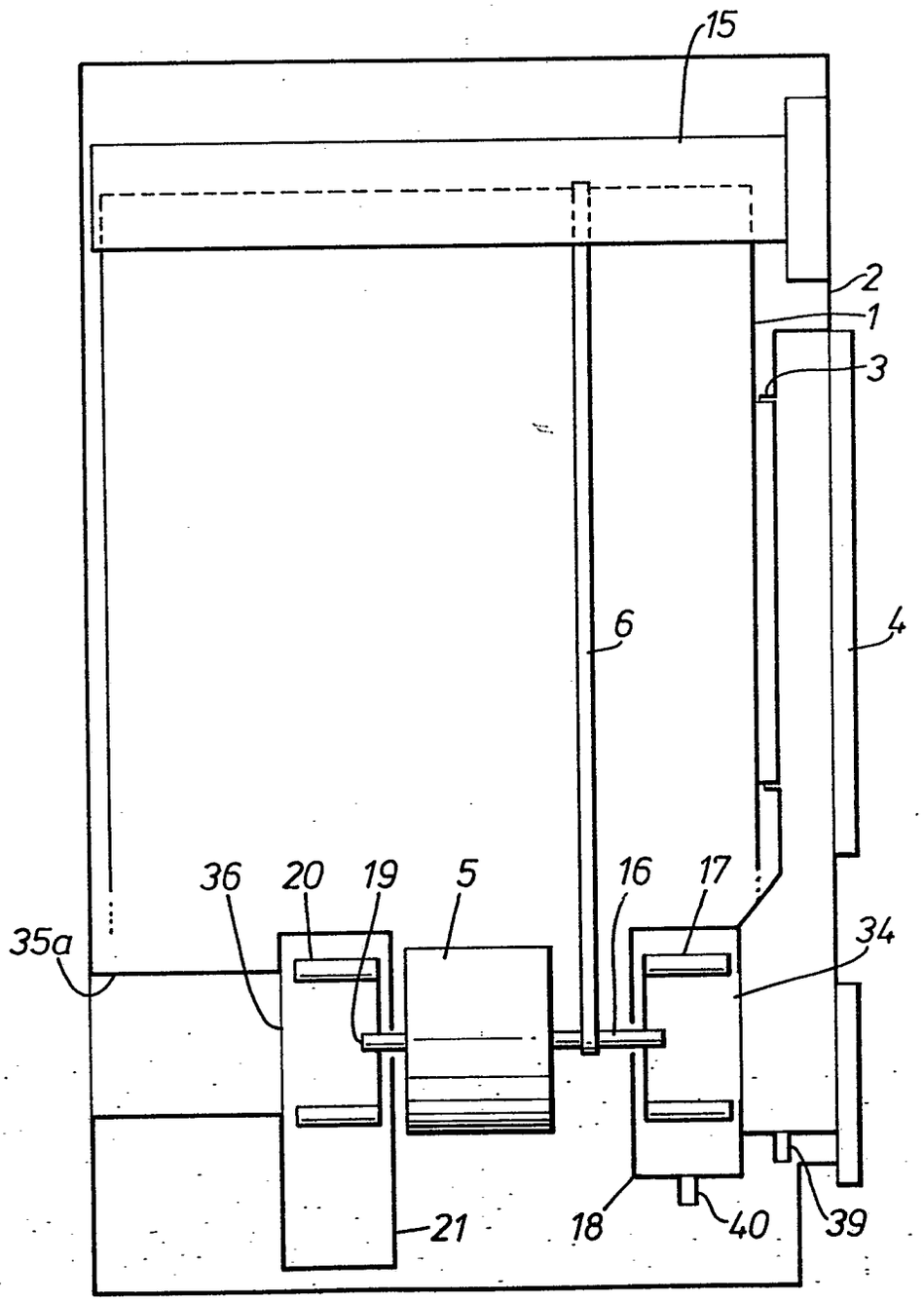


Fig. 4

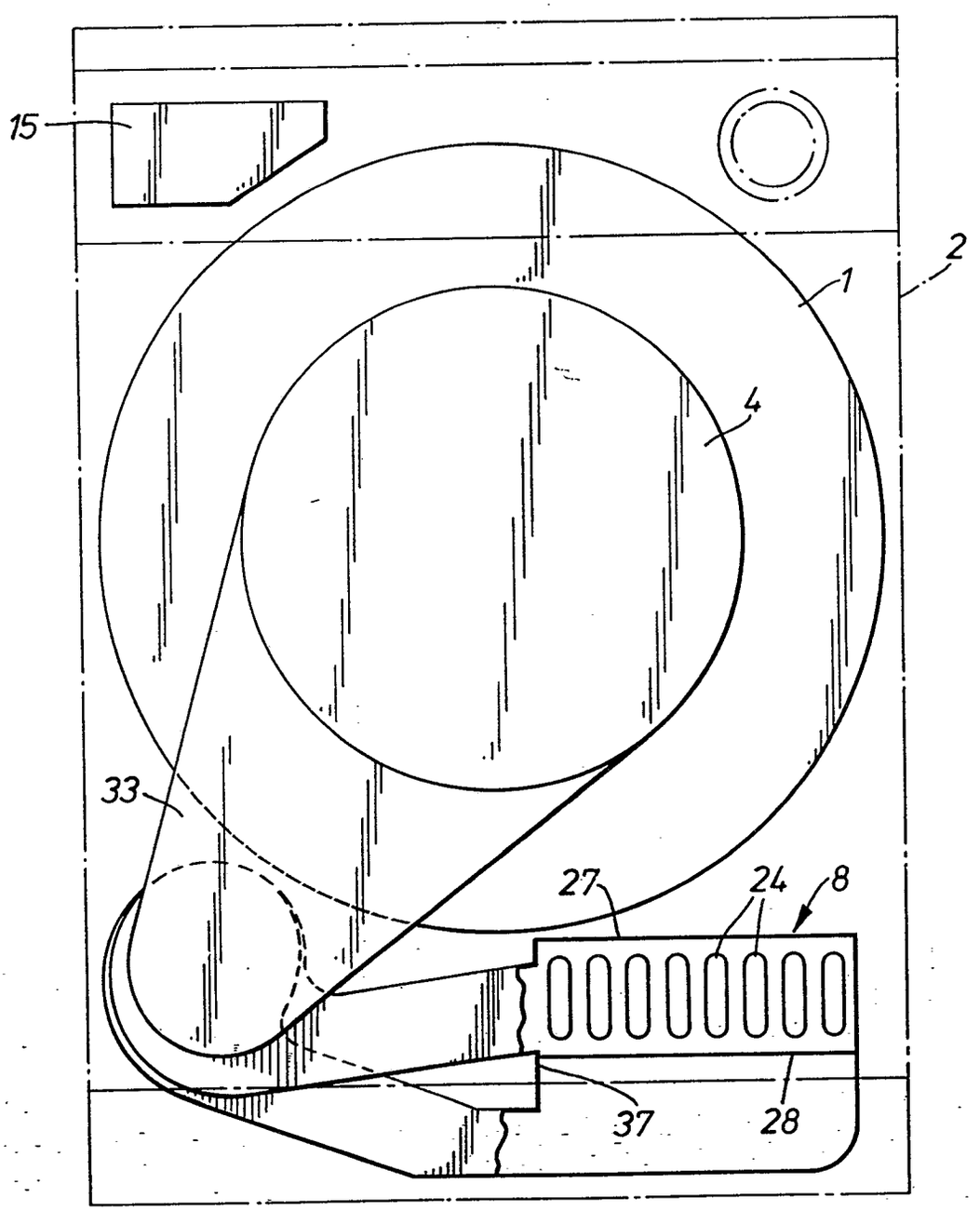


Fig.5

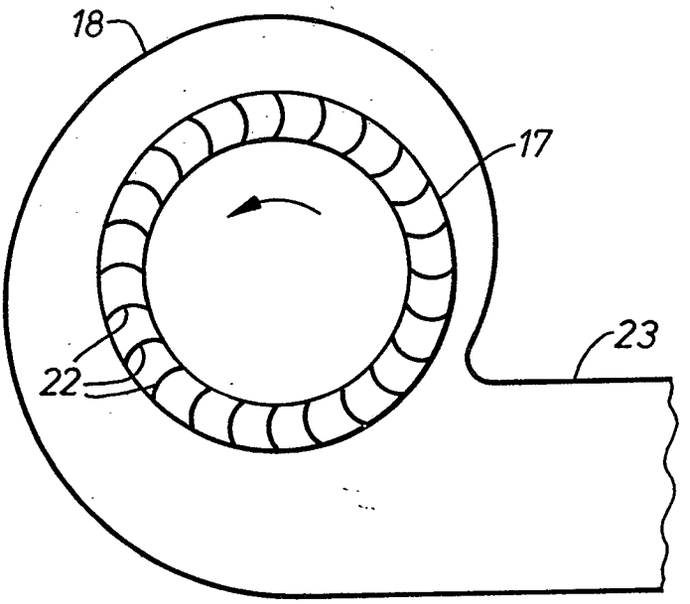
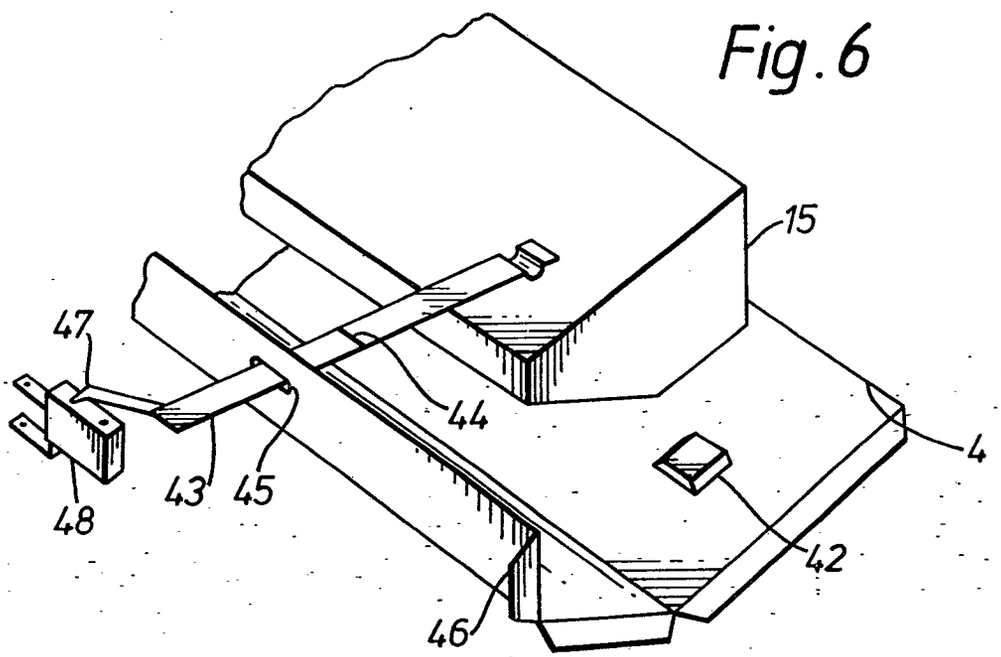


Fig.6



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 0344

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.4)
X	GB-A-1390901 (LICENTIA PATENT-VERWALTUNGS-GMBH) * the whole document *	1-7	D06F58/24
A	DE-A-3209555 (BOSCH-SIEMENS HAUSGERÄTE GMBH)		
A	DE-A-3131543 (G. BAUKNECHT GMBH)		
A	US-A-2956417 (W R LYMAN)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

D06F
F25D
F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 APRIL 1989	D HULSTER E.W.F.

CATEGORY OF CITED DOCUMENTS

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