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71 Applicant: **CREDA LIMITED**
Creda Works Blythe Bridge
Stoke-on-Trent Staffordshire, ST11 9LJ(GB)

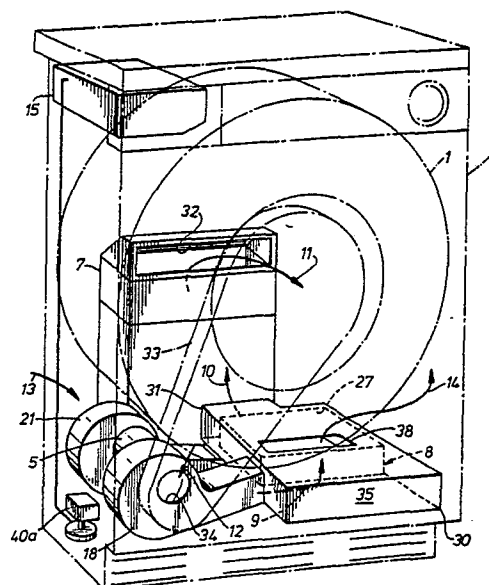
72 Inventor: **Rollason, Keith**
98 Badgeworth
Yate Bristol BS17 4YJ(GB)
Inventor: **Watts, Derek John**
12 River Road
Chipping Sodbury BS17 6HQ(GB)
Inventor: **Davies, John Garfield**
The Rocks 22 Midford Lane
Limpley Stoke Bath BA3 6JR(GB)

74 Representative: **Waters, Jeffrey et al**
The General Electric Company plc Central
Patent Department Marconi Research Centre
West Hanningfield Road
Great Baddow Chelmsford Essex CM2
8HN(GB)

54 Tumble driers.

57 In a tumble drier in which the drying air flow through the drum (1) is impelled by a fan (17) driven by the motor (5) which drives the drum (1), an efficient fan (17), such as one in a volute housing (18) is used. The drum (1) is periodically reversed in rotation to avoid tangling but, in accordance with the invention, the periods of forward rotation for which the fan (17) is acting efficiently are greater than the periods of backward rotation.

Fig. 1



Tumble Driers

This invention relates to tumble driers.

It is known to have a fan to direct air flow through the drum of a tumble drier to pick up moisture in the laundry items to be dried. Such fans are either driven by their own motor, or by the motor for driving the drum of the tumble drier. In the former case, relatively efficient fans in a specially designed volute housings can be used, but in the latter case, because the direction of rotation of the drum is periodically reversed to avoid tangling clothes, a fan that will produce an air flow whichever its direction of rotation is used, and such a fan is relatively inefficient.

The invention provides a tumble drier which comprises a rotatable drum, a fan in a housing for producing an air flow through the drum, a motor for driving both the drum and the fan, the output shaft of the motor being arranged to rotate alternately in a forward direction and in a reverse direction, the fan and the housing being such that the air flow delivered by the fan is greater in one direction of rotation than in the opposite direction, and the arrangement being such that the periods of rotation of the motor in the direction corresponding to greater air flow are longer than the periods of reverse rotation.

It has been discovered that, so long as the reverse rotation periods corresponding to lesser air flow are shorter than the forward rotation periods, an acceptable air flow through the drum is obtained over a period of time, enabling a relatively efficient fan to be used without the need for a separate motor.

Advantageously, the ratio of the periods of rotation in the direction corresponding to greater air flow to the periods in the direction corresponding to lesser air flow is greater than 2:1, preferably greater than 4:1, and preferably greater than 8:1.

Preferably, there is provided a heat exchanger through which the air flow through the drum passes in use before being re-circulated to the drum; the use of an efficient fan with a tangential outlet is particularly important in such a closed circuit system. Preferably, the fan and motor are arranged laterally with respect to the heat exchanger, which is preferably removable longitudinally through an opening in the front of the drier. Preferably, there is provided a second fan also driven by the motor arranged to pass cooling air from the atmosphere through the heat exchanger, and the motor may be arranged between the two fans.

A container may be provided for receiving water condensed out of the re-circulating path, and a pad underneath the container which is resiliently urged upwards against the containers may co-op-

erate with a switch linked to the upper surface of the container so that the switch operates when the weight of water in the container is sufficient to depress the pad by a predetermined amount. In this way, the machine can have an automatic cut-out when such a container for condensate becomes full.

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 drives 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 exchanger 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 enter 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 level 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 re-start.

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 ex-

changer 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 fan in a housing for producing an air flow through the drum, a motor for driving both the drum and the fan, the output shaft of the motor being arranged to rotate alternately in a forward direction and in a reverse direction, the fan and the housing being such that the air flow delivered by the fan is greater in one direction of rotation than in the opposite direction, and the arrangement being such that the periods of rotation of the motor in the direction corresponding to greater air flow are longer than the periods of reverse rotation. 10
2. A tumble drier as claimed in claim 1, in which the ratio of the periods of rotation in the direction corresponding to greater air flow to periods in the direction corresponding to lesser air flow is greater than 2:1. 15
3. A tumble drier as claimed in claim 2, in which the ratio is greater than 4:1. 20
4. A tumble drier as claimed in claim 3, in which the ratio is greater than 8:1. 25
5. A tumble drier as claimed in any one of claims 1 to 4, in which the fan housing has an outlet tangential to the path of rotation of the fan. 30
6. A tumble drier as claimed in claim 5, in which the fan housing is in the shape of a scroll.
7. A tumble drier as claimed in any one of claims 1 to 6, in which there is provided a heat exchanger through which the air flow through the drum passes before being re-circulated to the drum. 35
8. A tumble drier as claimed in claim 7, in which there is provided a second fan also driven by the motor, the second fan being arranged to pass cooling air from the atmosphere through the heat exchanger. 40
9. A tumble drier as claimed in claim 8, in which the motor is arranged between the two fans. 45
10. A tumble drier substantially as herein described with reference to the accompanying drawings.

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Fig. 1

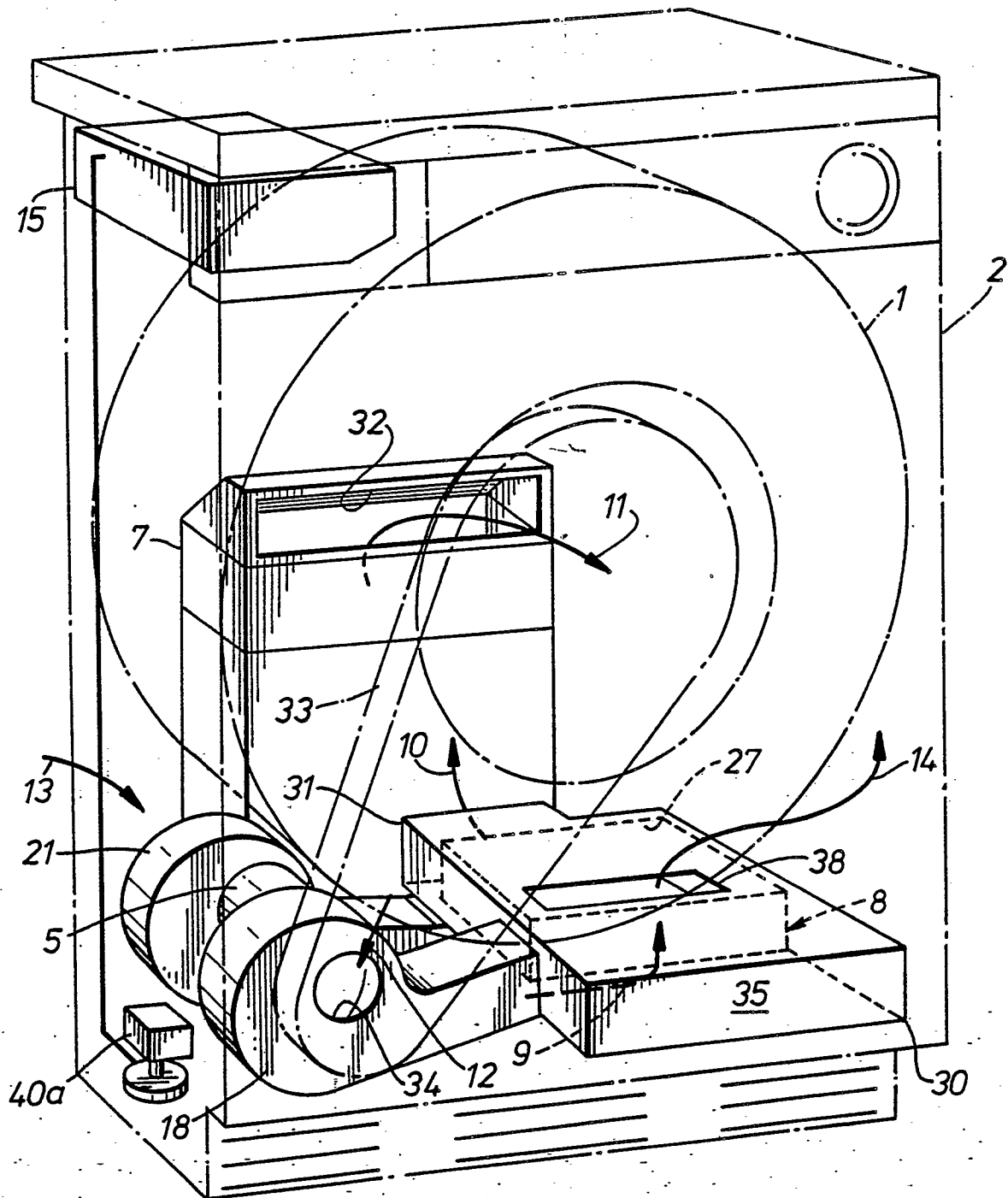


Fig. 2

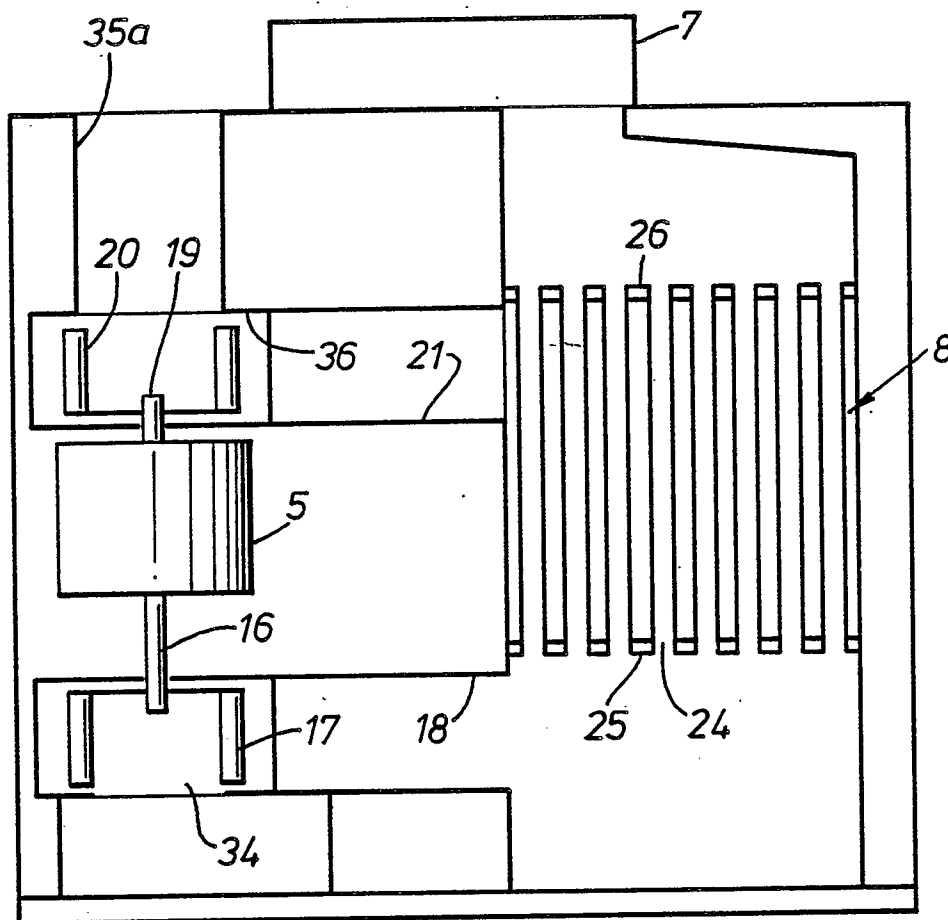


Fig. 3

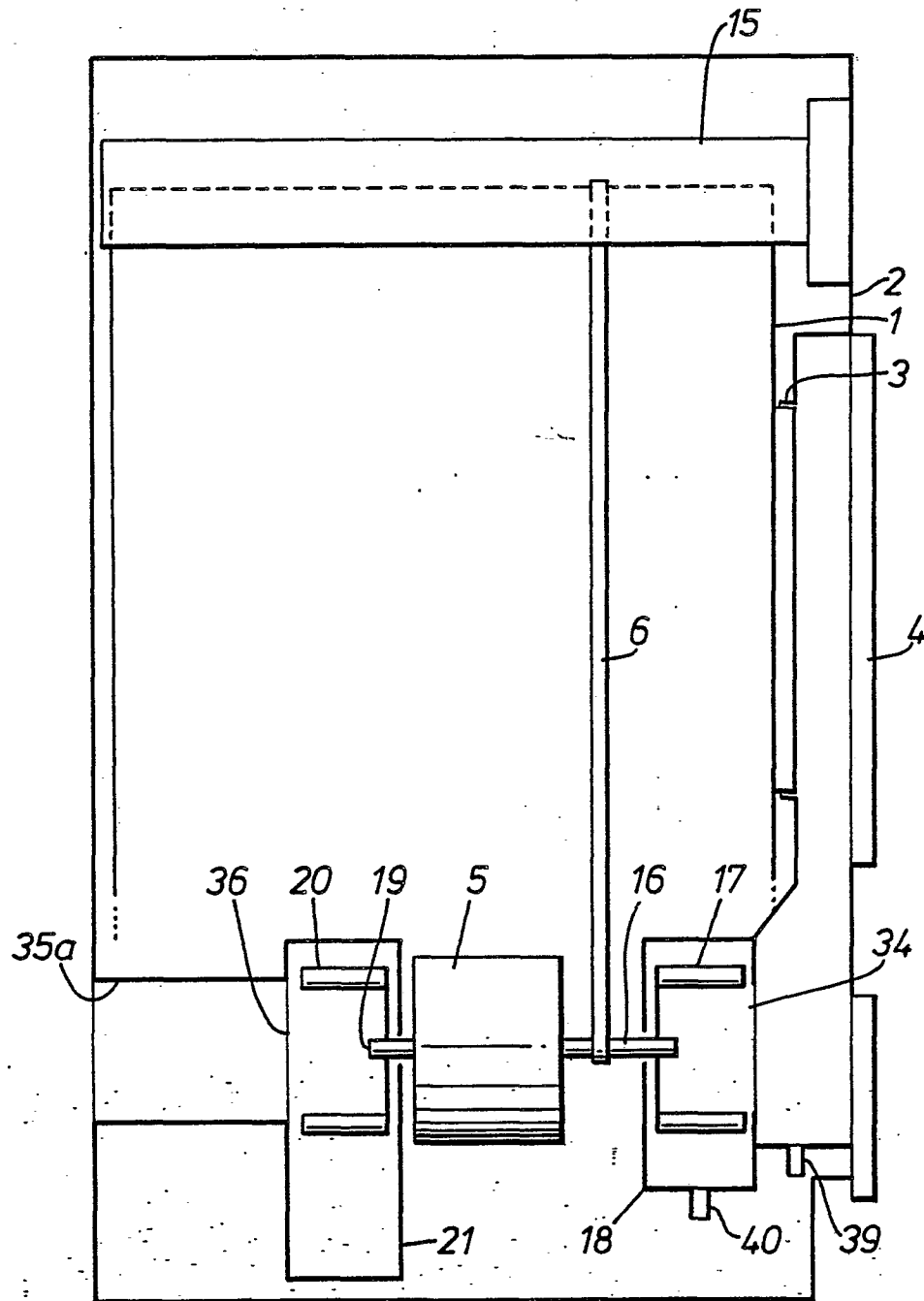


Fig. 4

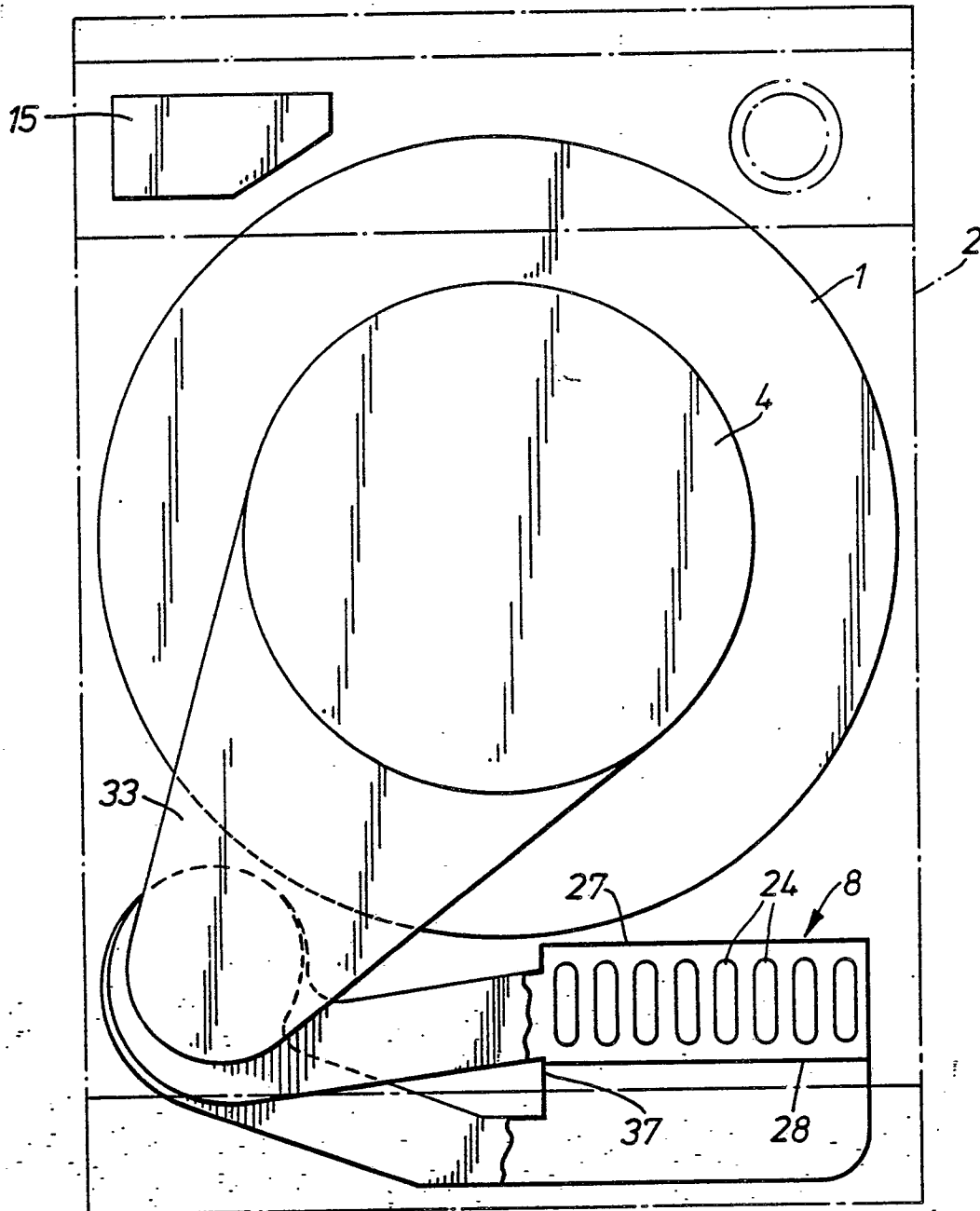


Fig. 5

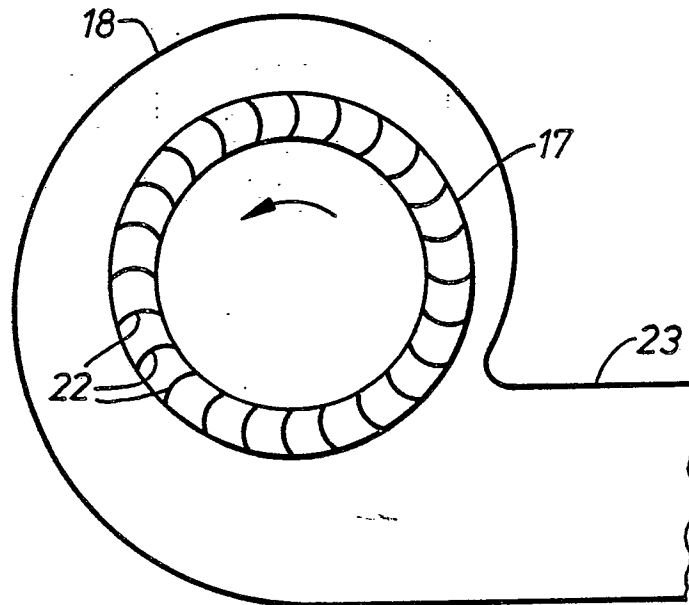
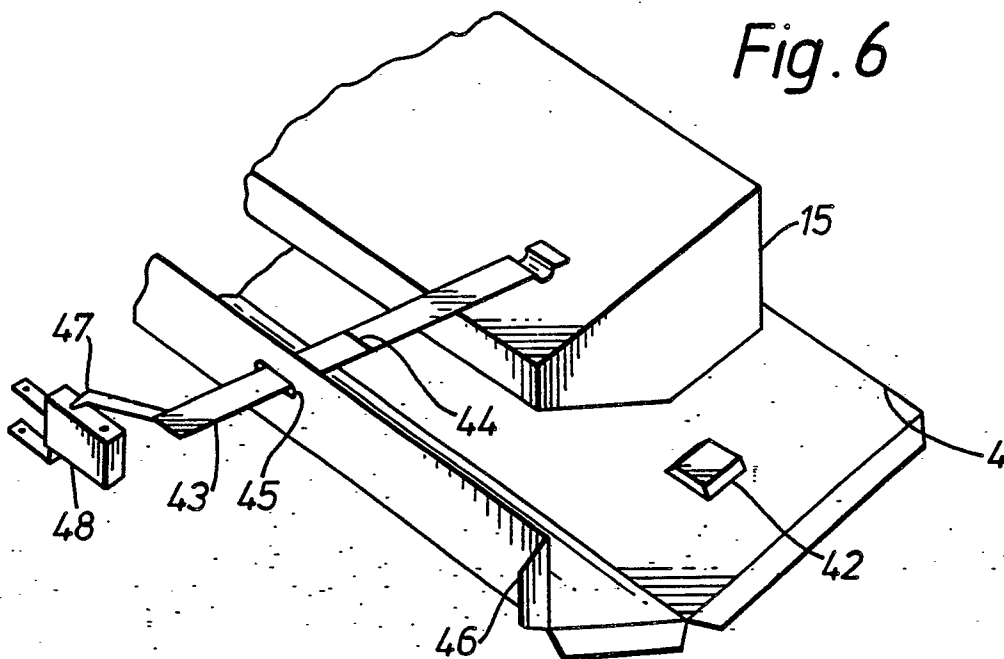


Fig. 6





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 0343

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)
Y	GB-A-1062258 (PHILCO CORPORATION) * page 1, line 15 - line 20 * * page 2, line 48 - line 89 * * page 2, line 98 - page 3, line 40 * * claims 1-15; figure 1 * ---	1-4, 7-10	D06F58/08 D06F58/28
Y	DE-A-1585938 (SIEMENS-ELECTROGERÄTE GMBH) * page 2, last paragraph - page 3, first paragraph * * page 3, five last lines * * claim 1; figures 1b, 2 * ---	1-4, 10	
Y	GB-A-2107839 (TOKYO SHIBAURA DENKI KK) * page 1, line 103 - page 4, line 16 * * figures 1-4 * ---	7-10	
A	US-A-3309783 (J. C. WORST) ---		
A	GB-A-2058316 (TOKYO SHIBAURA DENKI KK) ---		
A	US-A-2961776 (P. G. HUGHES) ---		TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	GB-A-2089952 (BOSCH SIEMENS HAUSGERÄTE GMBH) ---		
A	GB-A-2051330 (PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LTD) -----		D06F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 APRIL 1989	Examiner BOURSEAU A.M.
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			