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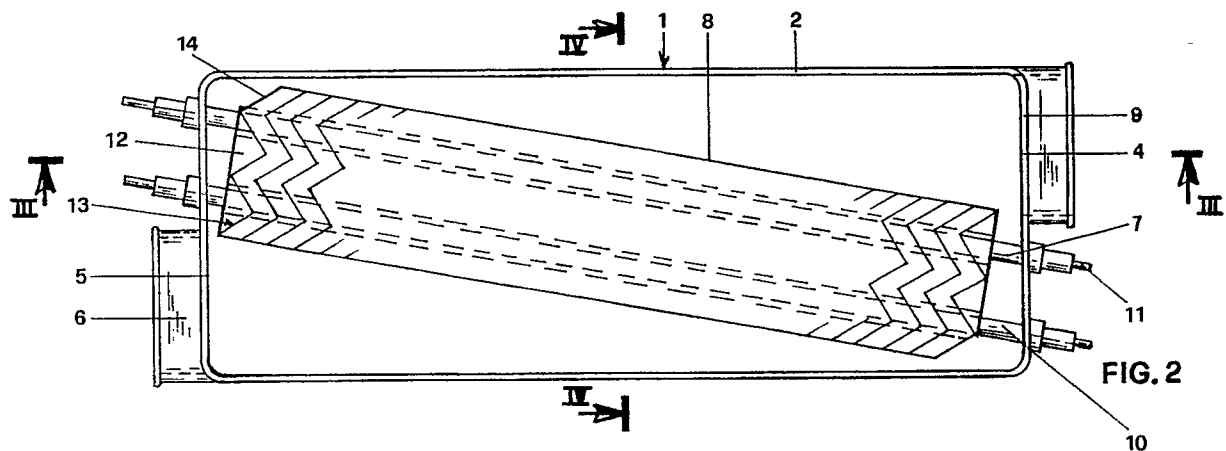
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(54) **Forced-convection air heater element for clothes dryers.**

(57) A forced-convection air heater element, particularly for clothes dryers, comprising a metal box casing (1) with at least one entry aperture (4) for the air to be heated and at least one exit aperture (5) for the heated air, and housing at least one armoured electrical resistance element (7) provided with a heat radiator (13), characterised in that the radiator (13) consists of a plurality of thermal diffusers (14,19,21)

thermally connected to the armoured resistance element (7) and spaced from the walls of said casing (1), said thermal diffusers (14,19,21) and said casing (1) being constructed of diecast aluminium alloy the connection between the electrical resistance element (7) and the walls of the casing being made only at the two ends of said resistance element.



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This invention relates to a forced-convection air heater element for clothes dryers.

Known clothes dryers comprise an external cabinet for containing the clothes to be dried by a hot air jet. This jet is obtained by passing an air stream through a feed duct containing a resistance heater element.

EP-A-O 320 966 describes a heater unit comprising one or more resistance elements completely embedded in a diecast aluminium block, preferably provided with radiant fins which are grazed by the air stream to be heated.

This known heater unit has proved satisfactory in that it offers a large heat transfer surface enabling a good heating effect to be obtained for a small overall size, and can moreover be produced in a single diecasting process. However the metal continuity between the electrical resistance element and the diecast alloy necessary to support the radiant element means that the cabinet to which the heater element is fixed reaches a high temperature.

This means on the one hand that the heater element must be insulated from the clothes dryer cabinet and on the other hand that a given temperature must not be exceeded as this would result in excessive heating of the cabinet.

The present invention provides a heater unit for air flows which is thermally insulated towards the outside and thus allows high-temperature operation, with a correspondingly reduced overall size.

This and further object which will be more apparent from the following description are attained according to the invention by a forced-convection air heater element for clothes dryers as described in claim 1.

The present invention is described hereinafter example with reference to the accompanying drawings in which:

- Figure 1
is a partial perspective view of a heater element according to the invention;
- Figure 2
is a plan view thereof;
- Figure 3
is a longitudinal section therethrough on the line III-III of Figure 2;
- Figure 4
is a cross-section therethrough on the line IV-IV of Figure 2;
- Figure 5
is a plan view of a second embodiment,
- Figure 6
is a plan view of a third embodiment,
- Figure 7
is a plan view of a fourth embodiment,
- Figure 8
is a plan view of a fifth embodiment,

Figure 9

is a plan view of a sixth embodiment, and
Figure 10 and 11

schematically show a seventh embodiment.

As can be seen from the figures the heater element according to the invention comprises a metal box casing 1 of essentially parallelepiped shape, with a perimetral wall 2 and two covers 3, 3'. In said perimetral wall 2 there are two apertures 4 and 5 for air entry and exit respectively, and provided with connection pieces 6 for connection to external ducts (not shown).

To the perimetral wall 2 there are fitted two armoured resistance elements 7 arranged parallel to each other and inclined to the larger sides 8 of said wall. The two resistance elements, the ends of which pass through the minor sides 9 of the wall 2, are traditional armoured resistance elements, ie provided with an outer sheath 10 and a coaxial resistor 11 insulated from said sheath by a dielectric.

A multiple radiator 13 is fitted to the two resistance elements 7, it consisting of a plurality of parallel zig-zag fins 14 of height slightly less than the wall 2.

To form the heater element according to the invention the two resistance elements 7 are placed in a mould with a cavity corresponding to the radiator 13 and the perimetral wall 2, and once enclosed within this mould a molten aluminium alloy is injected into the mould to form the diecast radiator incorporating the two resistance elements 7, and the perimetral wall 2, which is joined to said radiator by a plurality of feedheads. These are then removed by conventional methods during finishing, so that at the end of the process the radiator applied to the resistance element is joined to the perimetral wall 2 only at the ends of resistance elements.

Applying the two covers 3, 3' completes the construction of the heater element according to the invention.

The operation of such a heater element when applied to a clothes dryer is as follows: the air to be heated enters the casing 1 through the entry aperture 4, passes across the radiator 13 through the channels defined by its adjacent 14 fins to become hot and to then leave, thus heated, through the exit aperture 5.

As the ends of the armoured resistance elements 7, which represent the only connection between the radiator and the perimetral wall 2 and thus between the radiator and the outer casing, are not hot due to the fact that the internal resistor 11 generally does not extend as far as said end and that the stainless steel of which the sheath 10 is constructed is not a good conductor of heat, the high temperature of the electrical resistance ele-

ment 7 produces a substantially lower temperature at the casing 1, which is also kept continually cooled by the passage of air to be heated.

In addition, by virtue of particular configuration used, the air stream to be heated transverses the armoured resistance element 7 transversely, thus encountering a large flow cross-section. The resultant low pressure drop means that the radiator 13 can be formed with a large number of fins 14 and hence with a large heat transfer surface, which itself means that the working temperature of the resistance elements remains very high, enabling the overall dimensions of the entire heater element to be reduced for equal transmitted thermal energy.

In the embodiment shown in figure 5, in order to more reduce the temperature of the larger side 8 of the perimetral wall 2 which is struck by the heated air, this side is covered at the inside with a metal sheet screen 15 extending along the whole length of the side 8.

Also this covering screen 16 can be realized in diecast aluminium during the same moulding step when the radiator and the casing are prepared (see fig. 16).

In a further embodiment (see figure 7) the use of a baffle 17 is foreseen, bound to the ends of the radiator 13 and obtained during the same moulding step thereof.

Always in order to keep at a satisfactorily low value the larger side 8, it is foreseen to direct in a suitable way the fins 18 and also to partly lengthen the end portions 18 thereof so as to substantially form channels orientated toward the aperture 5 (see figure 8).

In the embodiment shown in figure 9, a plurality of little cylinders 19 are fitted to the support 12 of the resistance elements 7, even made of diecast aluminium, which forms a "devious" run for the air which transverses the resistance elements 7.

This embodiment allows to reduce the constructional costs thank to the lesser quantity of aluminium used, even increasing the heat exchange.

In the embodiment schematically shown in figures 10 and 11, the resistance elements 7 are parallel each other to and are embedded in a radiator formed by a plate 20 and a plurality of longitudinal vertical ribs 21, placed under and on the plate 20. This plate 20 divides the casing 1 into two superimposed zones 22,22', respectively communicating with the entry aperture 4 and the exit aperture 5. The plate 20 is provided with a plurality of apertures 23 for the passage of the air to be heated. Also in this embodiment the lower surface of the casing which is struck by the heated air is covered with a metal sheet plate.

Claims

1. A forced-convection air heater element, particularly for clothes dryers, comprising a metal box casing (1) with at least one entry aperture (4) for the air to be heated and at least one exit aperture (5) for the heated air, and housing at least one armoured electrical resistance element (7) provided with a heat radiator (13), characterised in that the radiator (13) consists of a plurality of thermal diffusers (14,19,21) thermally connected to the armoured resistance element (7) and spaced from the walls of said casing (1), said thermal diffusers (14,19,21) and said casing (1) being constructed of diecast aluminium alloy, the connection between the electrical resistance element (7) and the walls of the casing being made only at the two ends of said resistance element.
2. A heater element as claimed in claim 1 characterised in that the connection between the electrical resistance element (7) and the walls of the casing occurs in correspondance of the zone of the resistance not provided with the resistive wire.
3. A heater element as claimed in claim 1, characterised by comprising a pair of electrical resistance elements (7) arranged parallel each other to, the thermal diffusers (14,19,21) of said radiator (13) being fixed to both said resistance elements.
4. A heater element as claimed in claim 1, characterised in that the casing (1) is of flat parallelepiped form with the entry aperture (4) and exit aperture (5) positioned at two non-facing ends of the smaller side walls (9), the resistance element (7) being supported at the other two ends of said smaller side walls (9), said resistance element therefore being housed substantially diagonally within said casing (1) and being struck obliquely by the air stream to be heated.
5. A heater element as claimed in claim 4 characterised in that the larger side wall (8) struck by the heated air is covered with a metal sheet screen (15).
6. A heater element as claimed in claim 4 characterised in that the larger side wall (8) struck by the heated air is covered with a diecast aluminium screen (16), formed during the same moulding step of the casing.
7. A heater element as claimed in claim 4 charac-

terised in that the larger side wall (8) is protected with a deflector screen (17) placed parallel to it and connected to the radiator (13).

8. A heater unit as claimed in claim 1 characterised in that the thermal diffusers consist of small cylinders (19). 5

9. A heater element as claimed in claim 1 characterised in that the thermal diffusers consists of fins (14). 10

10. A heater element as claimed in claim 9, characterised in that the fins (14) of the radiator (13) are undulated. 15

11. A heater element as claimed in claims 1 and 9 characterised in that the ends (18) of the fins facing the larger side wall (8) struck by the heated air are directed towards the exit aperture (5). 20

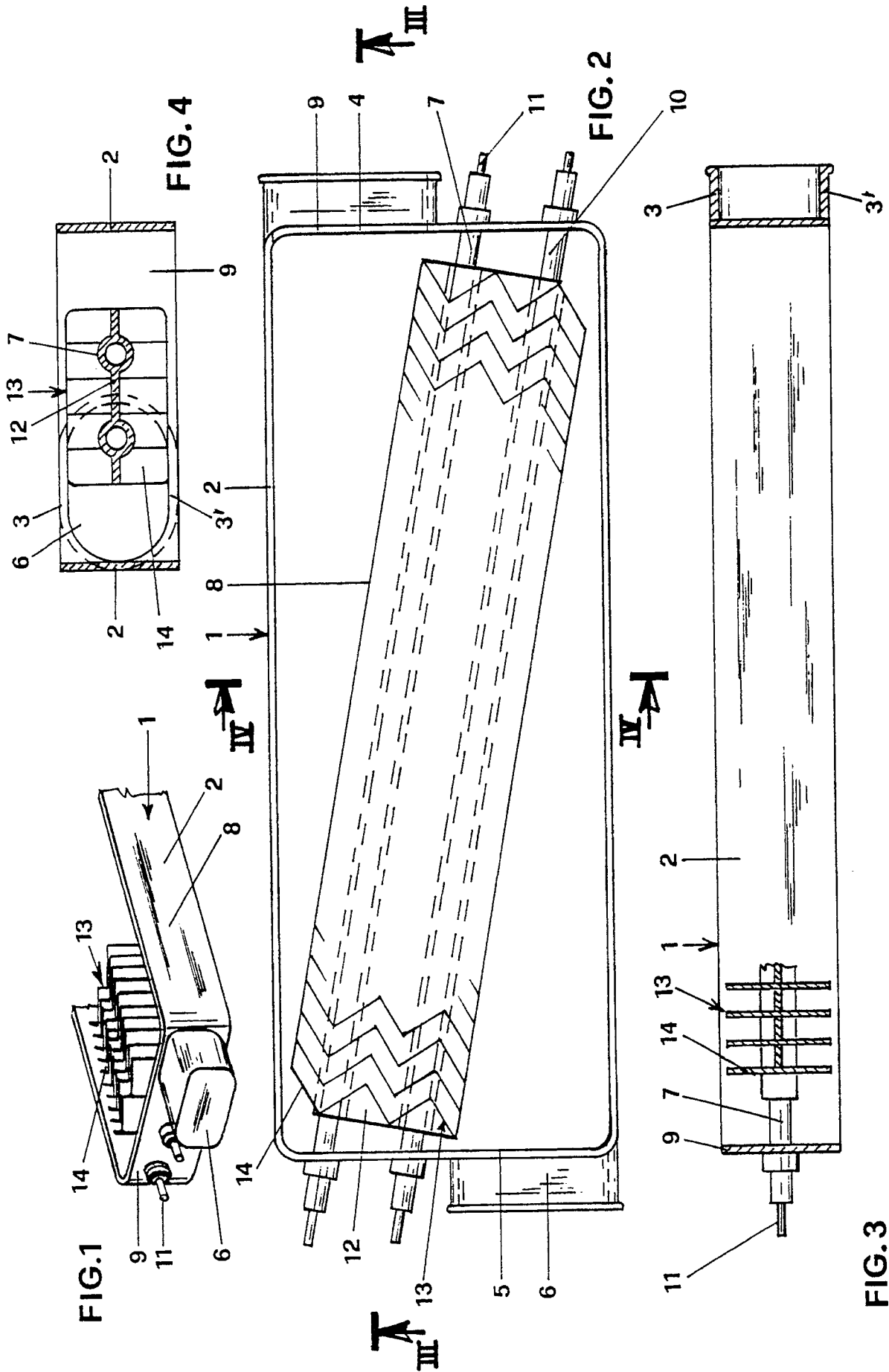
12. A heater element as claimed in claim 1 characterised in that the radiator consists of a plate (20), provided with a plurality of vertical longitudinal ribs (21) and supporting the resistance elements (7), said plate dividing the casing (1) into two superimposed zones (22,22') communicating respectively with the entry aperture (4) and the exit aperture (5), and being provided with a plurality of apertures (23) for the passage of the air to be heated. 25
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13. A heater element as claimed in claim 1, characterised in that the side walls (8, 9) of the casing (1) and the thermal diffusers (14,19,21) of the radiator (13) are constructed of diecast aluminium alloy and are joined together during their construction by feedheads which are removed during finishing. 35
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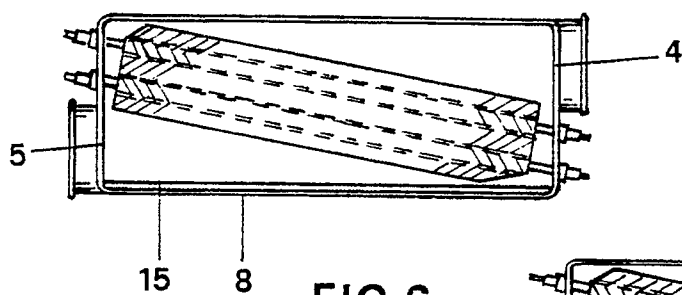


FIG. 5

FIG. 6

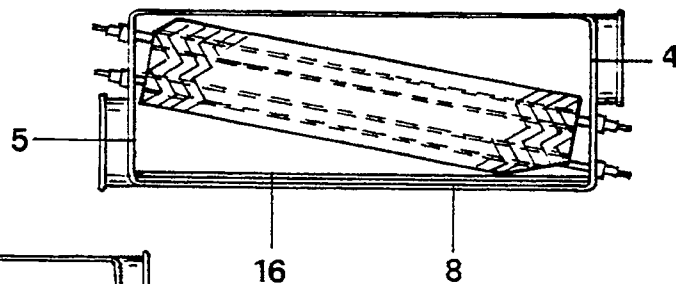


FIG. 7

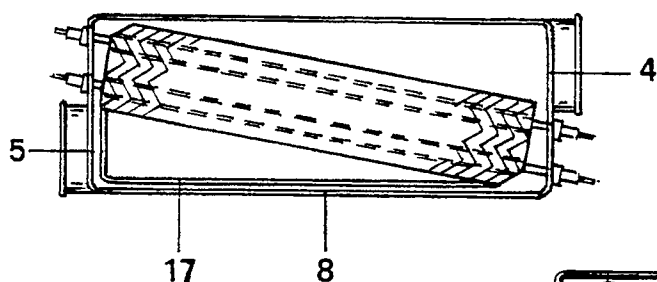


FIG. 8

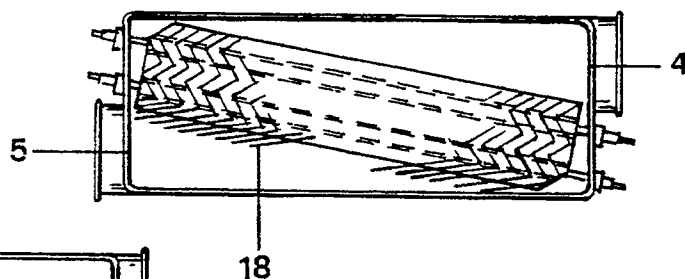


FIG. 9

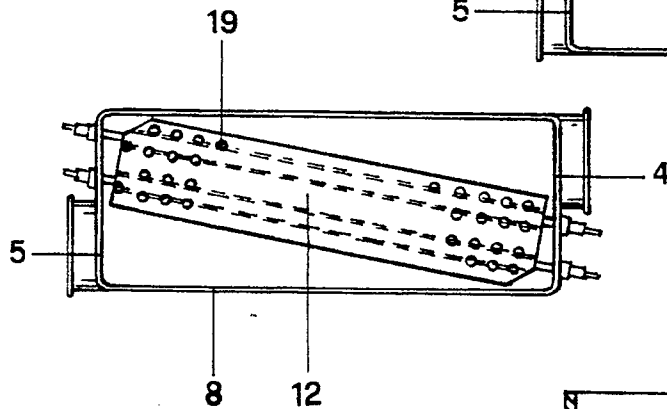


FIG. 10

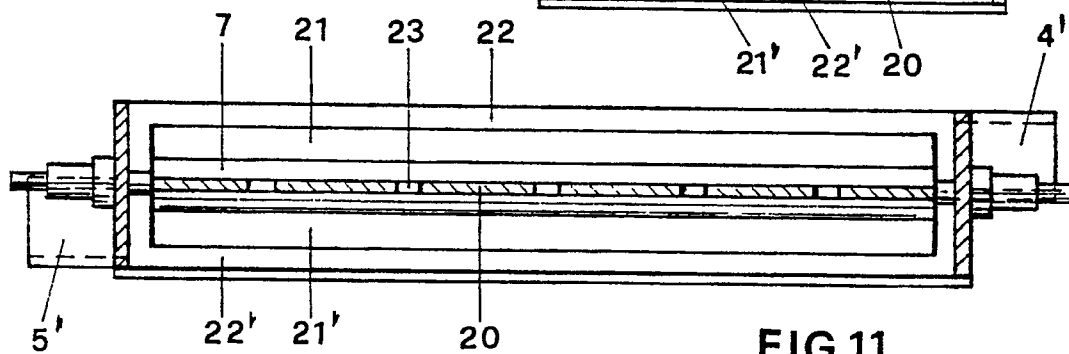
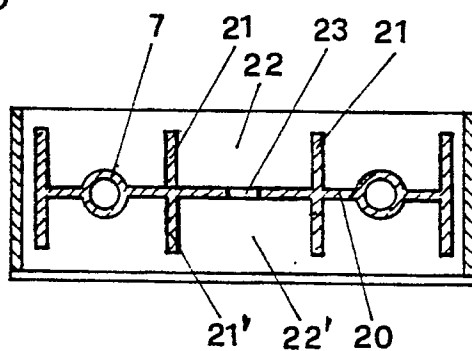


FIG. 11



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EUROPEAN SEARCH REPORT

Application Number

EP 91 10 7370

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.5)
A,D	EP-A-0 320 966 (I.R.C.A. S.P.A. INDUSTRIA RESISTENZE CORAZZATE E AFFINI) * claims ; figures 1-3 * - - -	1,3,9,12, 13	D 06 F 58/26 F 24 H 3/04 H 05 B 3/50
A	DE-A-3 340 313 (LICENTIA PATENT- VERWALTUNGS-GMBH) * figures * - - -	1,3,9,12	
A	DE-A-1 944 939 (INDUSTRIE A ZANUSSI S.P.A.) * figures * - - -	1,9,10	
A	FR-A-2 274 006 (FRANCE-AIR COMPAGNIE FRANCAISE DE L'AIR PULSE) * claims ; figure * - - -	1,3,9	
A	FR-A-2 292 396 (M. TOURE) * figures 2, 3 * - - -	3,9,10	
A	US-A-3 870 860 (EMERSON ELECTRIC CO.) * figures * PROFS - - - - -	1,3,9	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5) D 06 F F 24 H H 05 B
Place of search The Hague		Date of completion of search 22 August 91	Examiner COURRIER,G.L.A.
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			