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(54) Convertable combination refrigerator.

(57) A combination refrigerator (1) of forced-air circulation type comprises a cabinet presenting at least two compartments, namely a freezer compartment (4) and a refrigeration compartment (3), which are closed by respective doors (5,6), there are provided usual means (11) for generating the cold within the refrigerator and means (15) for generating a forced-air circulation within it, ducts for the forced circulation of the air opening at a wall of said compartments. In correspondence with the duct (26) which opens into the freezer compartment there are provided first shut-off means (31) for the air flow, at least one further communication duct (20) being provided between the refrigeration compartment (3) and the freezer compartment (4), there are provided in one of the two compartments in correspondence with at least one of the mouths (25A) of said communication duct (20) second shut-off means (47) for the air flow through said duct (20) in order to allow this air to pass when the first shut-off means (31) at least partially act on the duct which opens into the freezer compartment (4).

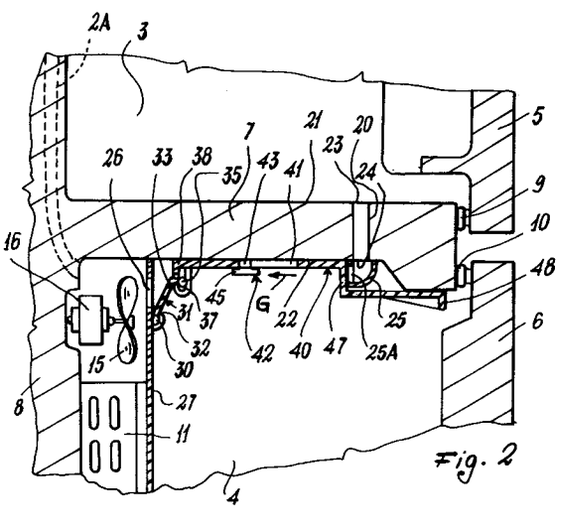

Fig. 2

EP 0 553 426 A1

This invention relates to a combination refrigerator of the forced-air circulation type comprising a cabinet presenting at least two compartments, namely a freezer compartment and a refrigeration compartment, which are closed by respective doors, there being provided therein usual cold generation means and means for generating a forced-air circulation, ducts for the forced circulation of the air opening at a wall of said compartments. In a refrigerator of the aforesaid type, at particular moments of its use, the freezer compartment may for example be oversized or indeed not be required for use. In this respect, requirements differ variously from season to season.

In such a case the freezer compartment of the refrigerator can be better used, depending on specific needs, as a refrigeration compartment if the user considers it more appropriate to his requirements.

An object of the invention is to provide a refrigerator which the user can adjust in such a manner as to provide an equal temperature in all compartments.

A particular object of the invention is to provide a refrigerator comprising simple means by which the freezer compartment can be made to attain and maintain the temperature of the refrigeration compartment.

A further object is to provide a refrigerator comprising reliable means for bringing both its compartments to the same temperature and maintaining them thereat.

A further object is to provide a refrigerator in which the fact that substantially the same temperature has been attained and is being maintained in its compartments can be displayed to the user external to the refrigerator.

These and further objects which will be apparent to the expert of the art are attained by a refrigerator of the stated type, characterised in that in correspondence with the duct which opens into the freezer compartment there are provided first shut-off means for the air flow, at least one further communication duct being provided between the refrigeration compartment and the freezer compartment, there being provided in one of the two compartments in correspondence with at least one of the mouths of said communication duct second shut-off means for the air flow through said duct in order to allow this air to pass at least when the first shut-off means act on the duct which opens into the freezer compartment.

The present invention will be more apparent from the accompanying drawing, which is provided by way of non-limiting example and in which:

Figure 1 is a schematic side view in cross-section of an upright refrigerator according to the invention;

Figure 2 is an enlarged view of the part indicated by A in Figure 1, the refrigerator being shown at a stage during its use;

Figure 3 is a view similar to that of Figure 2, but with the refrigerator at a different stage during its use;

Figure 4 shows a modified embodiment of the invention in a view similar to that of Figure 2; and

Figure 5 is a simplified block diagram of an electric control circuit for a refrigerator according to the invention.

With reference to said figures, a refrigerator according to the invention is indicated overall by 1 and comprises a cabinet 2 in which a freezer compartment 4 and a refrigeration compartment 3 positioned thereon are defined, both closed by their own door 5 and 6. Between the two compartments there is an interspace 7.

The cabinet is insulated with usual insulating material, such as expanded polyurethane 8. Usual seal gaskets 9 and 10 are associated with the doors 5 and 6.

The refrigerator 1 comprises a usual refrigeration circuit incorporating in particular a motor-compressor unit 10 and an evaporator 11. In correspondence with this latter there is provided at least one resistance element 14 for defrosting the evaporator.

The refrigerator operation is controlled for example by a usual control member 13 comprising at least one known thermostat and a known timer. The refrigerator is of the type comprising forced-air circulation obtained by a fan 15 positioned in correspondence with the evaporator 11 (as can be seen in Figures 1, 2 and 3).

The fan is associated with its own electric motor 16, the operation of which is controlled by the member 13. A usual duct 2A (shown only schematically) is provided within the cabinet 2 to enable the circulating air to pass from the evaporator to the compartment 3. A usual valve 2B is provided where said duct opens into this latter compartment.

With reference to Figures 1 to 3, a duct 20 connecting the refrigeration compartment 3 to the freezer compartment 4 is provided through the interspace 7. The duct 20 opens at one end, at 23, at the lower wall 21 of the compartment 3 and at the other end, at 24, at the roof 22 of the compartment 4.

In correspondence with this latter opening 24 a tubular elbow piece 25 is associated with said roof 22.

Another opening 26 is present in the rear wall 27 of the freezer compartment 4, said opening being provided in correspondence with the fan 15.

At least one pin 30 is provided on said wall 27 to act as a hinge for a movable flap 31 connected

to said pin at one of its ends 32.

The other end 33 of the flap supports at least one pin 35 arranged with its axis parallel to the plane in which the rear wall 27 of the compartment 3 lies and movable within a slotted guide 37 carried by the end 38 of a slidable element 40 secured to the roof 22 of said compartment. The element 40 comprises a slot 41 within which a pin 42 associated with the roof 22 moves relatively. This pin has its shank 43 passing through the slot 41 and its wider head 45 external to the slot. The pin 42 secures the element 40 to said roof 22 but enables it to move in correspondence therewith, this movement in the represented example being a trnslational movement along said roof.

The element 40 comprises a step 47 arranged to cooperate with the elbow piece 25 or rather with the mouth 25A of this latter.

Finally, the element 40 has its other end 48 bent to define a handgrip for moving the element along the roof 22 of the compartment 4 when the temperature of the compartments 3 and 4 is to be made equal (or vice versa different).

In this respect, it will be assumed that the temperature of the compartments 3 and 4 is to be equalized, these compartments having been previously used as a refrigeration compartment and as a freezer compartment respectively. In this situation, the flap 31 is in a position withdrawn from the opening 26 so that cold air can flow from this latter by the action of the fan 15. At the same time the step 47 of the element 40 is in correspondence with the mouth 25A of the elbow piece 25; advantageously a seal element (shown for greater clarity by dashed lines in Figure 3 and indicated by 50) is carried by the step 47 to seal this mouth. In this manner the air flow within the compartment 3 and within the compartment 4 are separated from each other, ie there is no (or at least no substantial) transfer of air between the refrigeration compartment and the freezer compartment through the duct 20.

To now equalize the temperature between the two compartments, the element 40 is shifted along the pin 42 by pushing said element towards the wall 27 of the compartment 4 (arrow G, Figure 2).

With this movement the step 47 is shifted from the mouth 25A of the piece 25 and the flap 31 closes against the opening in said wall 27. The flap rotates about the pin or hinge 30 to close said opening (Figure 3); during this movement the pin 35 moves within the guide 37.

This action interrupts the flow of cold air reaching the compartment 4 through the opening 26 and enables the relatively hotter air originating from the refrigeration compartment 3 to pass through the duct 20 and emerge through the mouth 25A of the piece 25. In this manner the temperature in the two compartments 3 and 4 is made equal, and both are used as a refrigeration evaporator.

Advantageously the usual thermostat (incorporated into the member 13 in the illustrated embodiment) provided in the compartment 4 and operating usually at a temperature between -30 °C and -18 °C is replaced with a thermostat operating between -30 °C and +5 °C. This is achieved by using a suitably modified thermostat of the capillary type.

In contrast, to produce different temperatures in the two evaporators (Figure 2), the element 40 is again shifted along the pin 42 to open the flap 31 (so releasing the opening 26) and close the mouth 25A of the elbow piece 25 (and hence the duct 20).

Because of the fact that in some types of refrigerator the reduced period of operation of the compressor 10 could make it impossible to achieve the same temperature in the compartments 3 and 4 with the element 40 arranged in the position shown in Figure 3, the usual refrigerator control circuit 60 (see Figure 5) is suitably modified.

The circuit 60 comprises a line switch 61, the control member 13 being connected to a power line 63 via a movable contactor 63 (connected to that part of the member 13 acting as a thermostat; the contactor can also be incorporated directly into said member); an indicator lamp 65 is connected to the line 62 to indicate usual operation of the refrigerator. A further indicator lamp 66 is connected to the line 62 via a usual movable contactor 67 which also operates on a line 68 terminating in the member 13; the indicator 66 indicates when the refrigerator is operating under rapid-freeze conditions, ie when it is required to achieve the desired temperature in the freezer compartment 4 within the shortest possible time.

The circuit 60 also comprises a usual return line 70 to which the indicator lamps 65, 66, the defrosting resistance element 14, the electrical part of the compressor 10 and the motor 16 for the fan 15 are connected.

An indicator lamp 71 is also provided in an electrical branch 72 connected to the line 62 and to the line 70. The branch 72 comprises a usual movable contactor 73 connected to the door 5 of the refrigeration compartment 3.

With a refrigerator according to the invention, whenever the operating time of the compressor 10 is reduced, the circuit 60, as stated, is modified by virtue of a switching member 80 which allows the fan 15 to operate continuously when equal temperatures in the compartments 3 and 4 are desired.

The member 13 detects this variation in the operating time of the compressor in known manner and causes a contactor 87 of the switching member to switch onto a fixed contact 86 connected to earth. The contactor 87 was previously connected

to a fixed contact 86A in a branch 86B connected to the line 62 so as to electrically power an electrical branch 88 containing an indicator lamp 89; this latter is activated when the compartment 4 functions as a normal freezer.

Simultaneously, the member 13 causes a movable contactor 90 (connecting a branch 91 from said member to a branch 92 containing the motor 16 of the fan 15) to switch onto a fixed contact 93 in order to connect the branch 92 to the branch 95 powered by the line 62. The branch 86B is also connected to the branch 95.

This switching of the contactors 87 and 90 results in deactivation of the indicator lamp 89 and continuous operation of the motor 16. Alternatively, if the circuit 60 comprises, in any known manner, a usual timer separate from a known thermostat, the contactors 87 and 90 can be switched (ie the switching member 80 operated) directly by the movement of the element 40. In this case, this latter cooperates with a microswitch 82 acting directly on the contactors 87 and 90. The circuit 60, for the part relative to the timer and thermostat, is similar to those already available commercially.

According to a different embodiment of the invention (shown in Figure 4 in which parts corresponding to those already described are indicated by the same reference numerals) the element 40 is operated by a mechanical actuator 97 (such as a double-acting pneumatic actuator) operating under the control of the member 13, which for this purpose is activated by a usual pushbutton 98 provided on the usual control panel for the refrigerator 1. This embodiment enables the element 40 to operate automatically without the need to open the door 6 of the compartment 4. In addition, as said element is controlled in its movement directly by the member 13, this latter can control its movement on the basis of the temperature and humidity (measured preferably by a usual humidity probe) within the compartment 4, for example to only partly close the mouth 25A and opening 26. In addition, in this manner having attained the desired temperature in the compartment 4, the control member 13 can interrupt the continuous operation of the fan 15, for example by operating a suitable contactor (not shown) provided in the branch 95 upstream of the contactor 90. This results in a reduction of energy cost during the use of the refrigerator.

Some embodiments of the invention have been described. Other embodiments are however possible, to be considered as falling within the scope of the present document.

Claims

1. A combination refrigerator of the forced-air circulation type comprising a cabinet presenting at least two compartments, namely a freezer compartment and a refrigeration compartment, which are closed by respective doors, there being provided usual means for generating cold within the refrigerator and means for generating a forced-air circulation therein, at a wall of said compartments there opening ducts for the forced circulation of the air, characterised in that in correspondence with the duct which opens (at 26) into the freezer compartment (4) there are provided first shut-off means (31) for the air flow, at least one further communication duct (20) being provided between the refrigeration compartment (3) and the freezer compartment (4), there being provided in one of the two compartments (3, 4) in correspondence with at least one of the mouths of said communication duct (20) second shut-off means (47) for the air flow through said duct, in order to allow this air to pass at least when the first shut-off means (31) at least partially act on the duct which opens (at 26) into the freezer compartment (4).

2. A refrigerator as claimed in claim 1, characterised in that the first shut-off means are a flap (31) movable relative to the wall (27) of the freezer compartment (4) in that position in which the duct for the forced circulation of the air opens (at 26), said flap (31) being connected to actuator means (40) for its movement.

3. A refrigerator as claimed in claim 2, characterised in that the flap (31) is hinged (at 30) to the wall (27) in that position in which the duct for the forced circulation of the air opens (at 26), said flap (31) carrying at its free end (33) an element (35) movable within a guide (37) forming part of the actuator means (40).

4. A refrigerator as claimed in claim 2 or 3, characterised in that the actuator means (40) are an element movable along a wall (22) of the freezer compartment (4).

5. A refrigerator as claimed in claims 1 and 4, characterised in that the second shut-off means are a portion (47) of the actuator means (40) for the first shut-off means (31).

6. A refrigerator as claimed in claim 5, characterised in that the actuator means (40) comprise a step portion (47) arranged to cooperate

with the mouth (25A) of a tubular elbow piece (25) associated with the opening (24) via which the duct (20) connecting the freezer compartment (4) to the refrigeration compartment (3) opens into the freezer compartment (4).

7. A refrigerator as claimed in claim 4, characterised in that the movable element (40) is associated with the roof (22) of the freezer compartment (4) and comprises an elongate slot (41) within which a pin (42) secured to said roof moves relatively.

8. A refrigerator as claimed in claim 7, characterised in that the movable element (40) has an end (48) defining a handgrip for its manual movement.

9. A refrigerator as claimed in claim 7, characterised in that the movable element (40) is associated with drive means (97).

10. A refrigerator as claimed in claim 9, characterised in that the drive means are controlled by the usual control member (13) which controls the operation of the refrigerator (1).

11. A refrigerator as claimed in claim 9, characterised in that the drive means (97) can be activated by a control member (98) provided on the usual refrigerator control panel.

12. A refrigerator as claimed in claims 1 and 10 comprising a usual electrical circuit (60) which controls the motor-compressor unit (10), the usual evaporator defrosting resistance heater element (14), and the usual indicator lamps (65, 66, 71) relating to the operation of the refrigerator (1) and the opening of at least one (5) of its doors, said circuit (60) comprising a usual thermostat and a known timer, characterised in that said control circuit (60) comprises visual indicator means (89) for indicating when the refrigerator is operating with its compartments (3, 4) maintained substantially at the same temperature, and control means which enable the fan (15) generating the forced-air circulation to also operate when said compartments (3, 4) are maintained at the same temperature.

13. A refrigerator as claimed in claim 12, characterised by comprising movable contactors (87, 90) arranged to connect said indicator means (89) and the motor (16) of the fan (15) to a known power line (62) for the control circuit (60).

14. A refrigerator as claimed in claim 12, characterised in that the movable contactors (87, 90) are controlled by the thermostat and/or timer.

15. A refrigerator as claimed in claim 12, characterised in that the movable contactors (87, 90) are controlled at least by the first shut-off means.

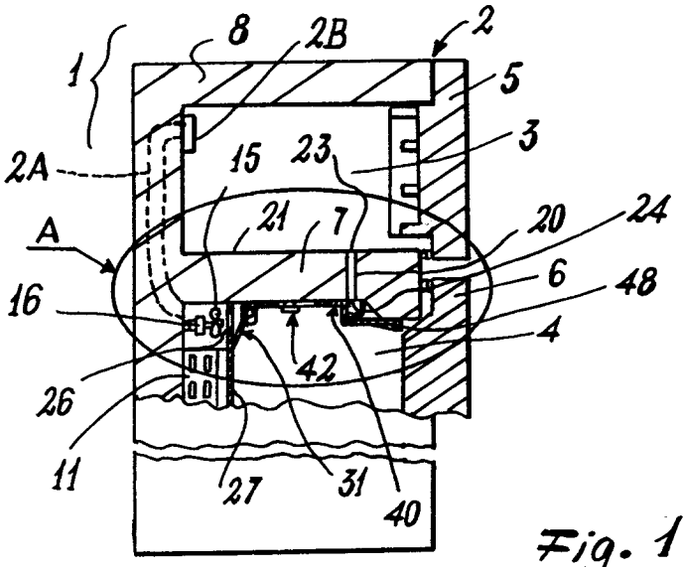
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Fig. 1

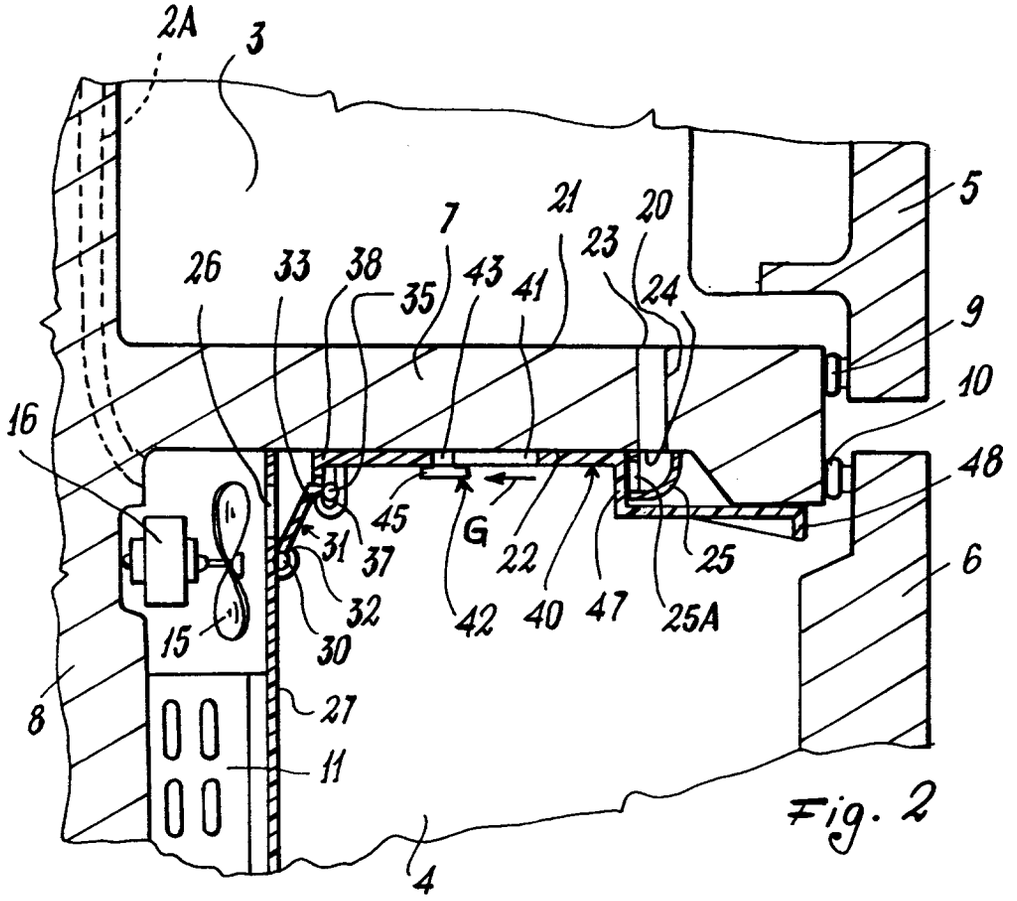
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Fig. 2

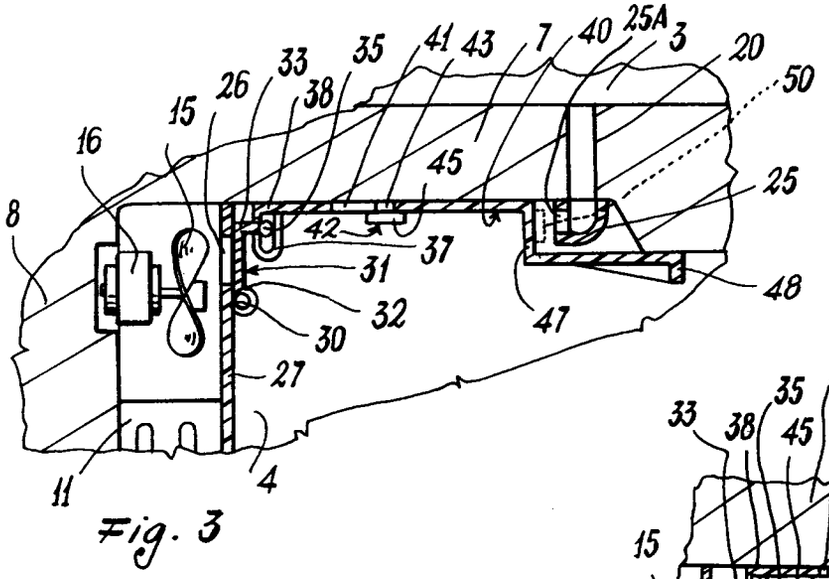

Fig. 3

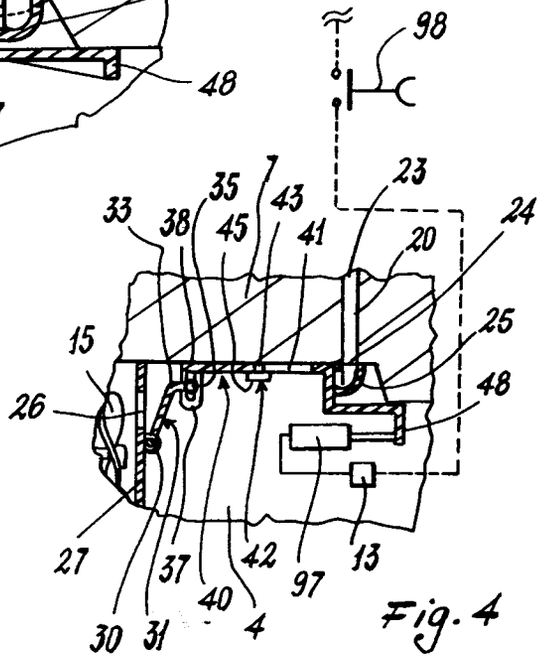

Fig. 4

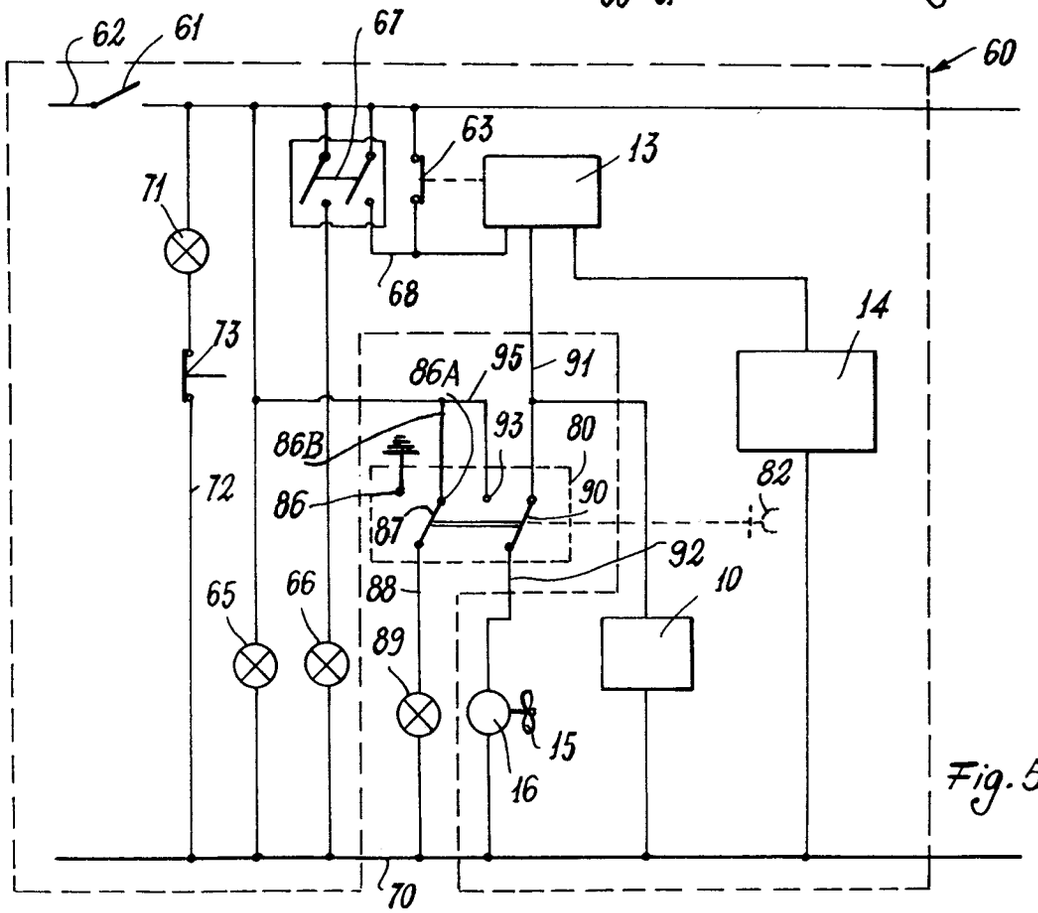

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number

EP 92 12 0059

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)
X Y	US-A-3 638 717 (HARBOUR ET AL.) * column 2 - column 5, line 12; figures 2,3,8-10 *	1-5 7-15	F25D17/06
Y	EP-A-0 181 781 (TOSHIBA) * page 17, line 12 - page 18; figures 5,6,8 *	7-15	
A	US-A-3 590 911 (HORVAY) * the whole document *	1,2	
A	US-A-2 543 494 (HARTMAN) * column 3, line 36 - column 7, line 78; figures 1,6-8 *	1-5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 MARCH 1993	BAECKLUND O.A.

CATEGORY OF CITED DOCUMENTS

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