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(71) Applicant: **WHIRLPOOL CORPORATION**
Benton Harbor
Michigan 49022 (US)

(72) Inventor: **Jagtap, Gajanan**
21025 Comerio (IT)

(74) Representative: **Guerci, Alessandro**
Whirlpool Europe S.r.l.
Patent Department
Viale G. Borghi 27
21025 Comerio (VA) (IT)

(54) **Refrigerator comprising a convertible compartment and method for adjusting temperature therein**

(57) A refrigerator comprises a convertible compartment in which a flow of cold air is fed and a damper system for adjusting such flow in order to regulate temperature in said compartment. The convertible compartment comprises at least two sub-compartments and the damper system comprises two rotating flow distributors driven by a single motor.

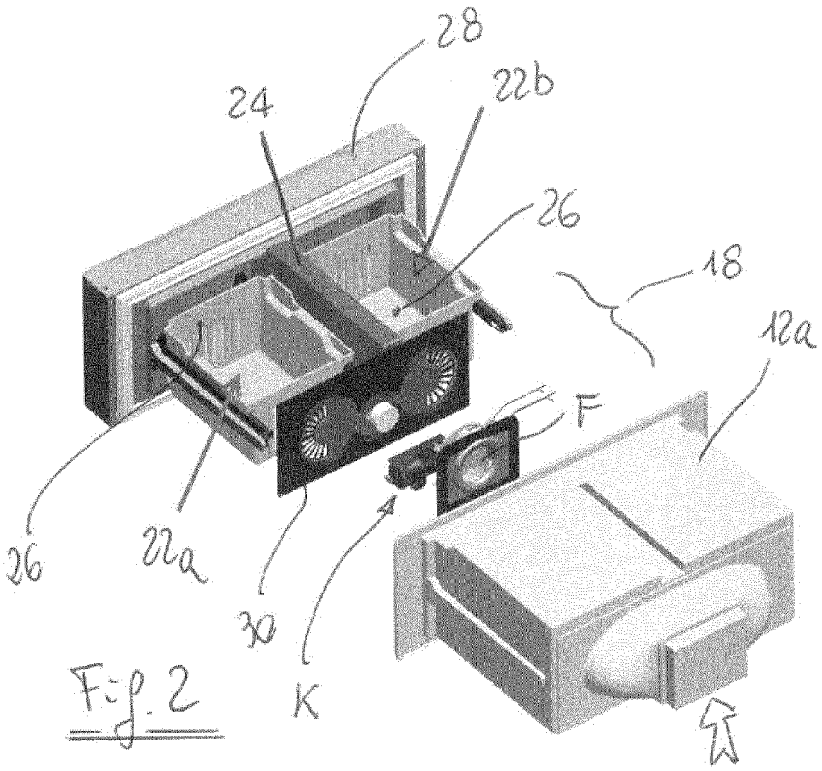

Fig. 2

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Description

[0001] The present invention relates to a refrigerator comprising a convertible compartment in which a flow of cold air is fed and a damper system for adjusting such flow in order to regulate temperature in said convertible compartment.

[0002] The above refrigerators and related convertible compartments are well known in the art of domestic refrigeration appliances. Such compartment can be customized by the user in order to adapt a certain compartment of the refrigerator, in addition to traditional fresh food and freezer compartment, to a certain kind of food to be stored. Usually the cold air is flown by the freezer compartment by means of a conduit and related fan.

[0003] In order to increase the flexibility of the convertible compartment, it is possible to envisage a compartment in which two different temperatures can be maintained. Such solution has not implemented up to now since it would imply the use of multiple dampers and motors therefore increasing the complexity and cost of the refrigerator.

[0004] It is therefore an object of the present invention to increase the flexibility of use of a convertible compartment by allowing the user to maintain two different temperatures therein, minimizing the components and reducing the overall cost.

[0005] According to the invention, the above object is reached thanks to the features listed in the appended claims.

[0006] According to the invention, the convertible compartment presents a cold air flow distributor with a single motor and gear mechanism to control air flow in the two regions. The gear mechanism rotates two rotary valves at different rates which cooperate with two openings thereby allowing controlling actual area for air passage on each side of the compartment independently.

[0007] Of course other kind of transmission from the single motor to the two rotary valves can be adopted, for instance by means of belts and pulleys. Moreover it is possible to divide the convertible compartment in more than two sub-compartments.

[0008] Further features and advantages of a refrigerator according to the present invention will be clear from the following description, with reference to the attached drawing in which:

- Figure 1 is a schematic cross section view of part of a refrigerator having a convertible compartment according to the invention;
- Figure 2 is a perspective exploded view of the compartment of figure 1;
- Figure 3 is a perspective exploded view of a component of figure 2;
- Figure 4 is a diagram showing the percentage of opening area of the flow distributor used in the compartment of figures 1-3 vs. angle of rotation; and
- Figures 5 - 10 are schematic views showing different configurations of the flow distributor.

[0009] With reference to the drawings, a refrigerator 10 comprises a fresh food compartment RC, a freezer compartment FC and a convertible compartment 12 placed between the fresh food compartment RC and the freezer compartment FC. The convertible compartment 12 has an inner liner 12a provided with a back aperture 14 for allowing the inflow of cold air from the freezer compartment FC though a conduit 16.

[0010] In the rear portion of the convertible compartment 12 it is placed a flow distributor 18 which divides the compartment in an air plenum 20 and in a storing chamber 22 which is divided in two sub-chambers 22a and 22b by means of a vertical separator 24. In each sub-chamber it is placed a bin 26 which can be extracted from the chamber 22 when a door 28 is pulled by the user.

[0011] With reference to figure 3, the flow distributor 18 comprises a wall 30 which is fixed in an air tight manner within the inner liner 12a and a shaped cover 32. The wall 30 and the cover 32 have each two openings 34 and 36 respectively shaped as parts of circle rings. Between the wall 30 and the cover 32 is defined a thin space where two rotating discs 38 and 40 are placed, each disc having an opening 42 corresponding to the shape of the openings 34 and 36 of the wall 30 and of the cover 32 respectively. Each disc has a geared edge G in order to cooperate with a gear mechanism comprising a motor gear 44, a compound gear 46 and an idle gear 48. The motor gear 44 is driven by an electric motor 50 supported by the wall 30 and by the cover 32.

[0012] By choosing the number of teeth of each gear element, it is possible to have a different speed of rotation of the discs 38 and 40 (which act as rotating valves) and therefore reach different combinations of opening/closing percentage of the openings 34 and 36 in order to reach the desired temperature in the left and right sub-compartments 22a and 22b, which may be as follows:

Right side (sub-compartment 22a)	Left side (sub-compartment 22b)
-18°C	-18°C
-18°C	-13°C

(continued)

Right side (sub-compartment 22a)	Left side (sub-compartment 22b)
0°C	+2°C
+2°C	+2°C
+2°C	+10°C

[0013] Various levels of relative openings between left & right can be achieved based on the requirement by changing the gear ratios. This concept can be extended to multiple openings also with a single prime mover. Very precise control of openings is possible by reducing the module of the gears also. By choosing a certain gear ratio (3.25:1 for slower rotation-right opening & gear ratio of 0.65:1 for faster rotation-left opening), it is possible to obtain the following % of opening for different motor gear 44 rotation angle positions:

Motor gear rotation angle	% right opening	%left opening
0°	1	1
78°	0.976	0.5
156°	0.905	0
234°	0.794	0.5
312°	0.655	1
1 turn 30°	0.5	0.5
1 turn 108°	0.345	0
1 turn 186°	0.206	0.5
1 turn 264°	0.095	1
1 turn 342°	0.024	0.5
2 turns 60°	0	0
2 turns 138°	0.024	0.5
2 turns 216°	0.095	1
2 turns 294°	0.206	0.5
3 turns 12°	0.345	0
3 turns 90°	0.5	0.5
3 turns 168°	0.655	1
3 turns 248°	0.794	0.5
3 turns 324°	0.905	0
4 turns 42°	0.976	0.5
4 turns 120°	1	1

[0014] The above % opening vs. angle is shown also in figure 4.

[0015] By stopping the motor 50 at a certain time (and by optionally using an angle of rotation sensor), it is possible to obtain the following basic air configuration table:

Right side opening	Left side opening	Time/angle
OPEN	OPEN	0,4 turn 120°
OPEN	PARTIALLY OPEN	78°, 4 turns 42°
OPEN	CLOSE	156°, 3 turns 324°

(continued)

Right side opening	Left side opening	Time/angle
CLOSE	CLOSE	1 turn 264°, 2 turns 216°
PARTIALLY OPEN	CLOSE	1 turn 108°, 3 turns 12°
PARTIALLY OPEN	OPEN	312°, 3 turns 168°
CLOSE	PARTIALLY OPEN	2 turns 168°, 1 turn 342°
PARTIALLY OPEN	PARTIALLY OPEN	1 turn 30°, 3 turns 90°

[0016] Where right and left side are referred to the sub-compartments 22a and 22b as seen by the user, and "partially open" means 50% of opening.

[0017] Figures 5 to 10 show certain configurations of the flow distributor according to the invention, as seen from direction Z (figure 3). In this view the "right" disc 40 rotates at a higher speed than the "left" disc 38 (where right and left are opposite to the above definition).

[0018] Figure 5 shows an open-open configuration corresponding to 0° or 4turns + 120°.

[0019] Figure 6 shows an open-partially open configuration corresponding to 78°.

[0020] Figure 7 shows an open-close configuration corresponding to 156°.

[0021] Figure 8 shows a close-open configuration corresponding to 1 turn + 264°.

[0022] Figure 9 shows a partially open - close configuration corresponding to 1 turn + 108°.

[0023] Figure 10 shows a partially open-open configuration corresponding to 312°.

[0024] Of course the actual temperature in the sub-compartments 22a and 22b depends on the actual temperature in the freezer compartment FC, on the dimension of the conduit 16, on the actual flow rate driven by the fan F (depending also on the dimension of the return conduit , not shown), and on the insulation of the convertible compartment 22 as well. A designer can therefore establish the actual link between the percentage of the openings and the actual temperature in the sub-compartments by carrying out experimental test. Once such relationship is established, the designer will program the control unit of the refrigerator, and particularly the control unit associated with the flow distributor 18 (indicated with reference K in figure 2), accordingly.

Claims

1. Refrigerator (10) comprising a convertible compartment (22) in which a flow of cold air is fed and a damper system (18) for adjusting such flow in order to regulate temperature in said convertible compartment (22); **characterized in that** the convertible compartment (22) comprises at least two sub-compartments (22a, 22b) and wherein the damper system (18) comprises two rotating flow distributors (38, 40).

2. Refrigerator according to claim 1, wherein the two rotating distributors (38, 40) are driven by a single motor (50).

3. Refrigerator according to claim 2, wherein the two rotating distributors (38, 40) are driven by means of a gear transmission (44, 46, 48, G).

4. Refrigerator according to claim 3, wherein the flow distributor (18) comprises a fixed screen (30, 32) having two openings (34, 36) shaped as parts of circle rings, and two rotating disc (38, 40) having openings with a shape corresponding to the openings (34, 36) of the screen (30, 32).

5. Refrigerator according to claim 4, wherein the two rotating disc (38, 40) have a geared edge (G) cooperating with the gear transmission (44, 46, 48).

6. Method for regulating the temperature in a convertible compartment (22) of a refrigerator (10) having at least two sub-compartments (22a, 22b), **characterized in that** it comprises adjusting the flow rate of cold air coming from another compartment (FC) of the refrigerator (10) by rotating step-wise two rotating valves (38, 40) in order to change the actual area of air passage towards the two sub-compartments (22a, 22b).

7. Method according to claim 6, wherein the two rotating valves (38, 40) are driven by a single motor (50).

8. Method according to claim 7, wherein the two rotating valves (38, 40) are driven by the single motor (50) through a gear transmission (44, 46, 48, G).

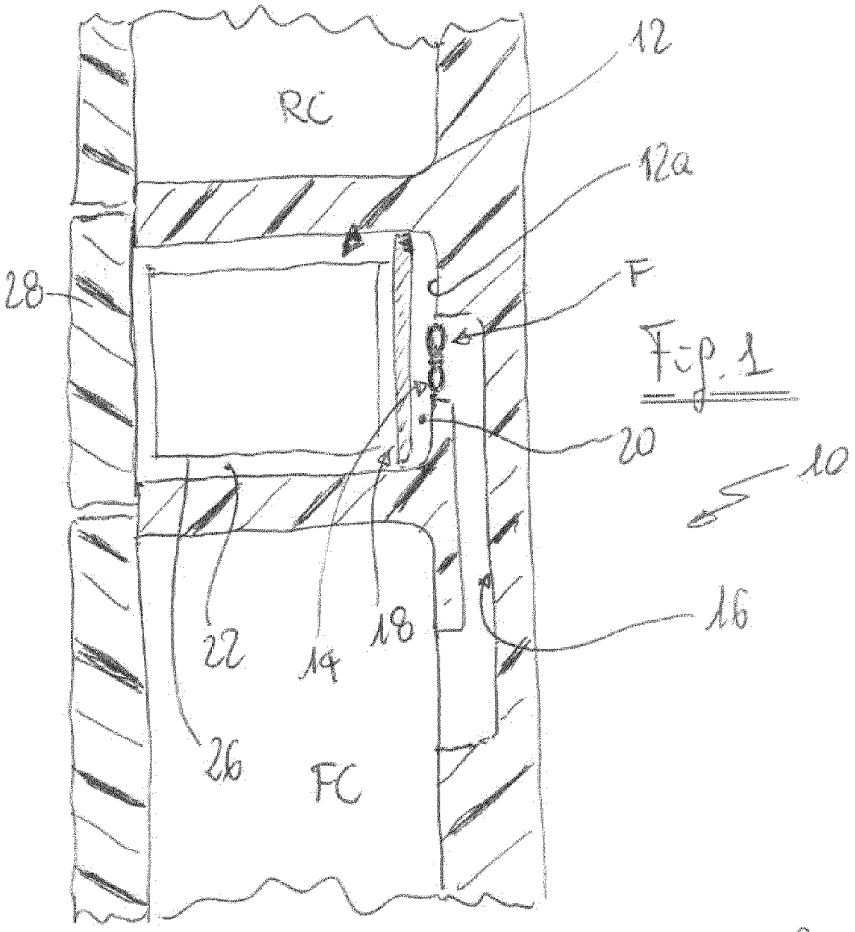

Fig. 1

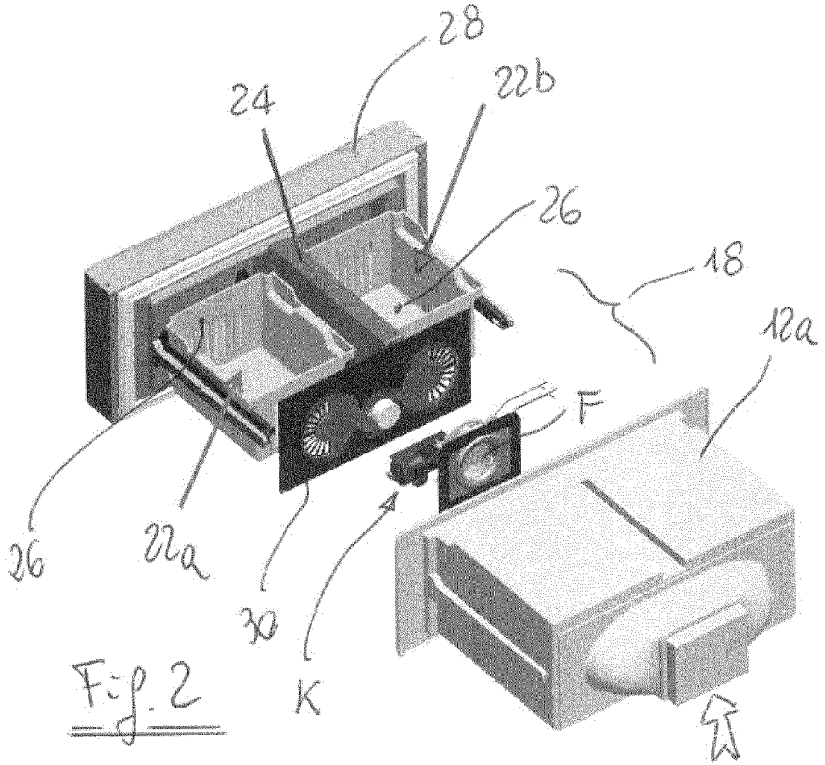

Fig. 2

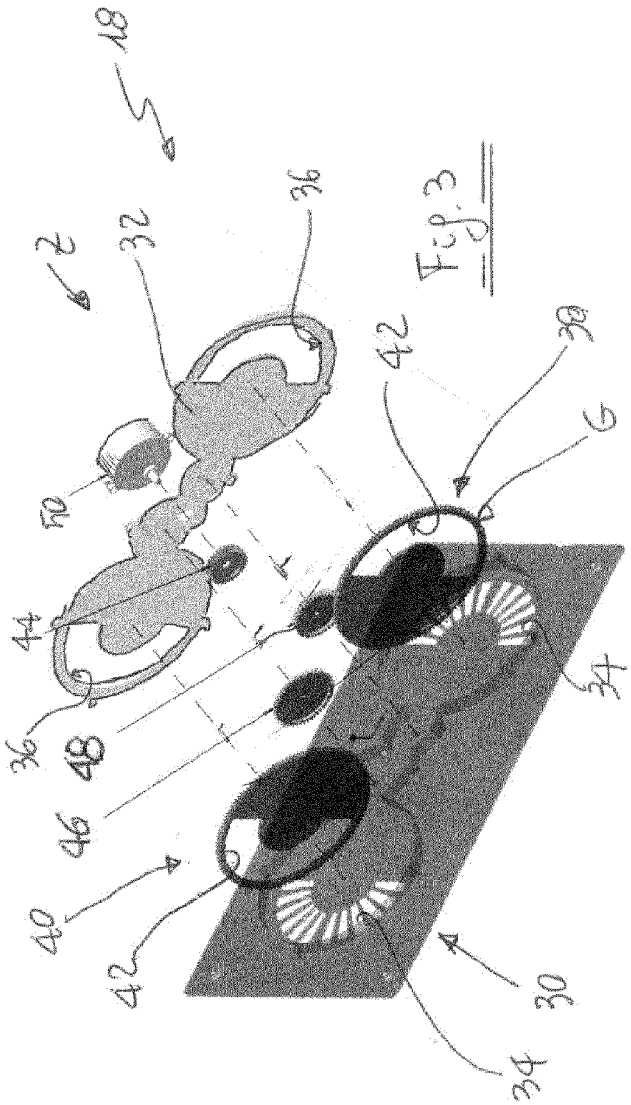
18
2
32
36
50
44
36
48
46
40
42
34
30
42
38
G
34

Fig. 3

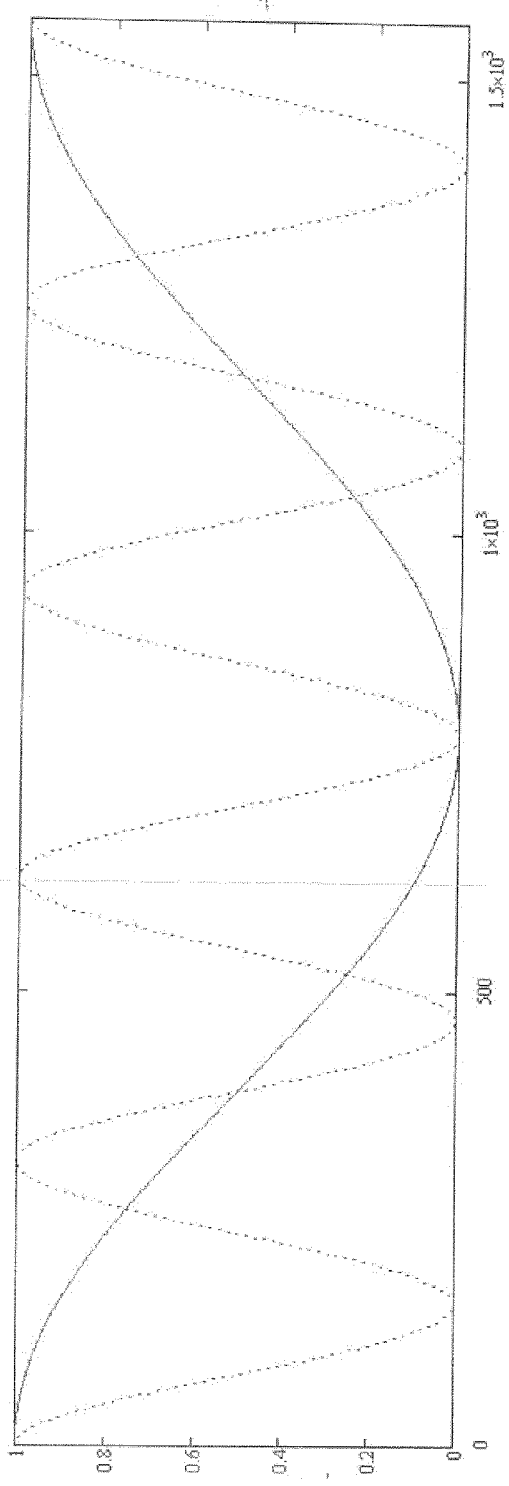
1.5×10³
1×10³
500
0
1
0.8
0.6
0.4
0.2
0

Fig. 4

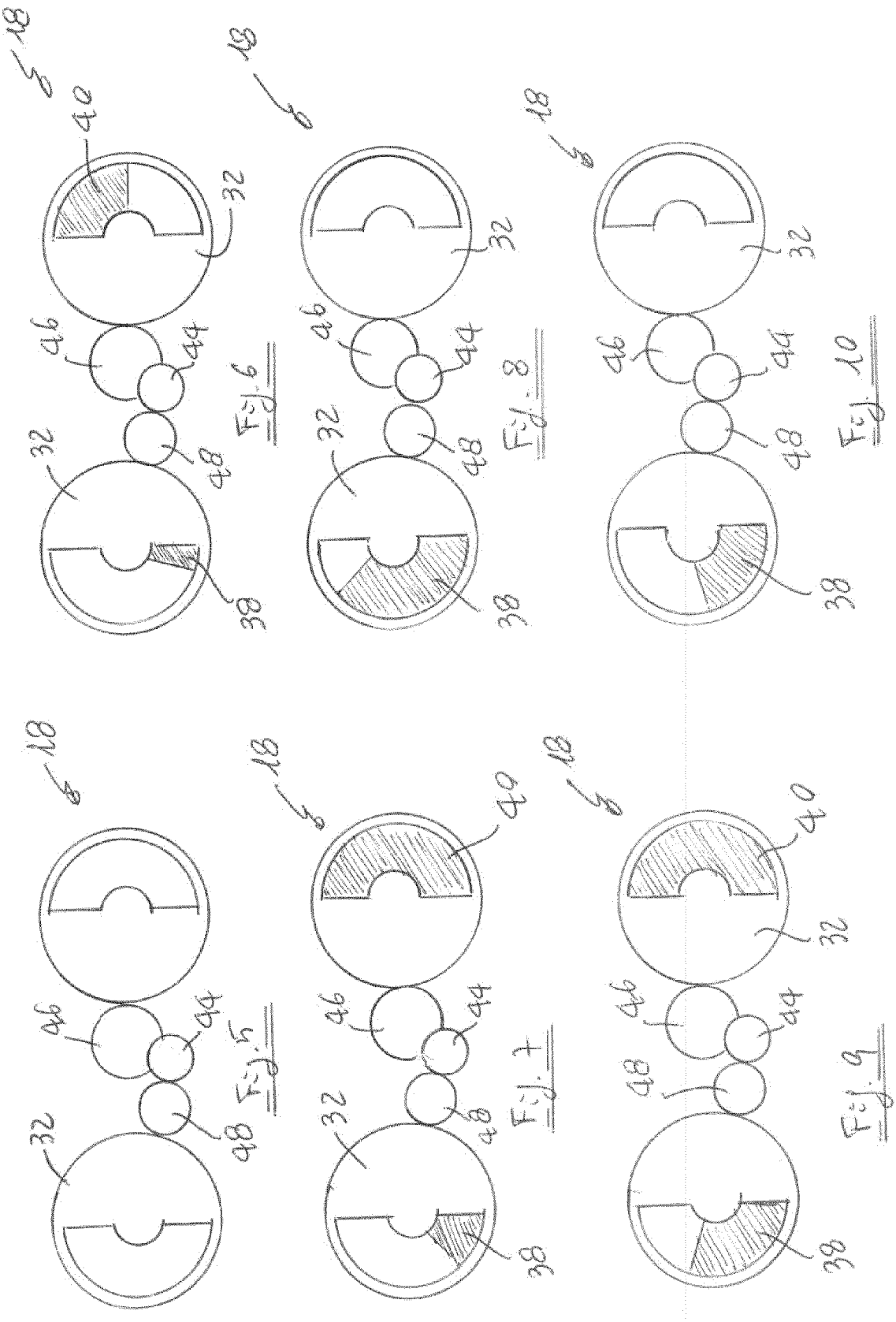

Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9 Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 2983

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 July 2013	Correia dos Reis, I

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