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(54) LOW TURBULENCE CENTRIFUGAL PUMP IMPELLER WHEREIN THE DOWNSTREAM PART OF THE BLADES EXTENDS CIRCUMFERENTIALLY

(57) A low-turbulence impeller for a fluid pump comprises a first base wall (2), a second base wall (3), multiple guiding blades (4), multiple back-up plates (5), and multiple runners (6). The second base wall (3) has an inlet (33) formed through the second base wall (3). Each runner (6) is formed between two adjacent guiding blades (4). Each runner (6) has an outlet (60) formed between two adjacent back-up plates (5), a laminar zone (61) communicating with a corresponding outlet (60) and a turbulent zone (62) aligning with the corresponding back-up plate (5). The fluid can only be flowed out of the outlet (60) from the laminar zone (61), such that the fluid through the outlet (60) of each runner (6) is in low-turbulence condition. The cavitation corrosion is greatly reduced. The rotational velocity is enhanced to promote the fluid-draining efficiency.

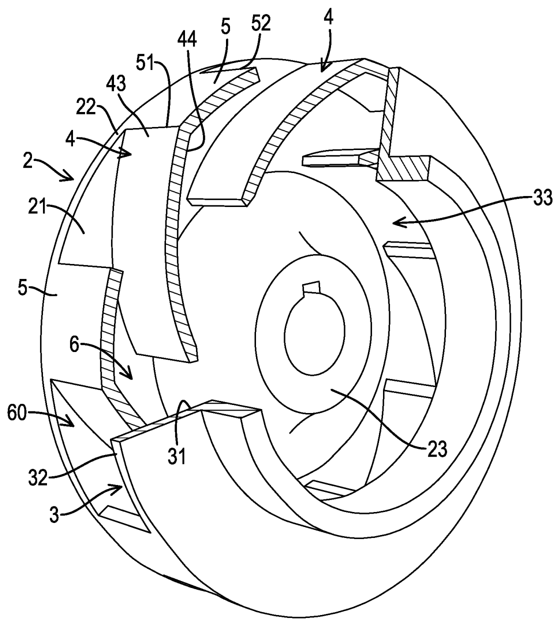

FIG.1

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Description

1. Field of the Invention

[0001] The present invention relates to a pump impeller, especially a low-turbulence impeller for a centrifugal fluid pump.

2. Description of the Prior Arts

[0002] With reference to Figs. 8 and 9, a conventional centrifugal pump impeller 1 has a first base wall 11, a second base wall 12 spaced apart from the first base wall 11, multiple blades 13 mounted between the first base wall 11 and the second base wall 12, and multiple runners 14. The second base wall 12 has an inlet 121 formed in a center of the second base wall 12. The blades 13 are curved and are spaced apart from each other. Each blade 13 has a first blade surface 131 and a second blade surface 132. Each one of the runners 14 is formed between a first blade surface 131 and a second blade surface 132 of two adjacent blades 13 for the flowing of fluid. A width of each blade 13 is constant. A width of each runner 14 is gradually increased from an interior to a periphery of the pump impeller 1.

[0003] When a motor drives the pump impeller 1 to turn along the direction R by a transmission shaft, the fluid is flowed into the pump impeller through the inlet 121, and then the fluid is flowed out of outlets 140 of the runners 14 by centrifugal forces. Since a width of each runner 14 is gradually increased from the interior to the periphery of the pump impeller 1, each runner 14 has a laminar zone 141 near the first blade surface 131, a turbulent zone 142 near the second blade surface 132, and a transition zone 143 located between the laminar zone 141 and the turbulent zone 142. The laminar zone 141, the turbulent zone 142, and the transition zone 143 of the runner 14 correspond and communicate with the outlet 140. When the fluid is flowed into each runner 14, part of the fluid is flowed out from the laminar zone 141 along the direction of arrow D, part of the fluid forms multiple reversely-rotating vortexes V in the turbulent zone 142, and then the vortexes V flow out of the outlet 140. The vortexes V make the fluid flowed out from the outlet 140 highly turbulent. Thus, the fluid will flow inversely due to negative pressures produced by the vortexes V. Further, cavitation corrosion of the fluid easily occurs and damages the blades 13. When the rotational velocity of the pump impeller 1 is increased, the cavitation corrosion might be more severe. As the conventional pump impeller 1 could not increase the rotational velocity in operating condition, the fluid-draining efficiency of the pump impeller 1 is insufficient.

[0004] To overcome the shortcomings, the present invention provides a low-turbulence impeller for a fluid pump to mitigate or obviate the aforementioned problems.

[0005] The main objective of the present invention is to provide a low-turbulence impeller for a fluid pump that can eliminate cavitation corrosion of the fluid to reduce energy consumption and promote fluid-draining efficiency.

[0006] The low-turbulence impeller for a fluid pump comprises a first base wall, a second base wall, multiple guiding blades, multiple back-up plates, and multiple runners.

[0007] The first base wall has a first inner surface and a first periphery. The second base wall is spaced apart from the first base wall. The second base wall has a second inner surface facing the first inner surface, a second periphery, and an inlet. The inlet is formed through the second base wall. The guiding blades are connected to the first inner surface and the second inner surface. The guiding blades are curved and are spaced apart from each other. Each one of the guiding blades has an inner end, an outer end, a first blade surface, and a second blade surface. The multiple back-up plates are respectively mounted on the first periphery of the first base wall and the second periphery of the second base wall. The back-up plates are annularly spaced apart from each other. Each one of the back-up plates is intrgratedly connected to the outer end of a corresponding guiding blade. Each one of the runners is formed between two adjacent guiding blades. Each one of the runners has an outlet. The outlet is formed between two adjacent back-up plates. Each one of the runners has a laminar zone and a turbulent zone. The laminar zone is near the first blade surface of one of the two adjacent guiding blades and communicates with a corresponding outlet. The turbulent zone is near the second blade surface of the other guiding and aligns with the corresponding back-up plate.

[0008] Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

IN THE DRAWINGS:

[0009]

Fig. 1 is a sectional perspective view of a first preferred embodiment of a low-turbulence impeller for a fluid pump in accordance to the present invention, showing the connection of a first base wall, a second base wall, a guiding blade, and a back-up plate;

Fig. 2 is a schematically side-sectional view of the first preferred embodiment of the low-turbulence impeller for a fluid pump in Fig. 1;

Fig. 3 is a schematically front-sectional view of the low-turbulence impeller for a fluid pump in Fig. 3, showing part of the fluids in the laminar zone flowing out of an inlet, and part of the fluids in the turbulent zone and transition zone obstructed by a blocking surface of a back-up plate;

Fig. 4 is a sectional and perspective view of a second preferred embodiment of a low-turbulence impeller for a fluid pump in accordance with the present invention;

Fig. 5 is a schematically front-sectional view of the low-turbulence impeller for a fluid pump in Fig. 4, showing part of the fluids in the laminar zone flowing out of an inlet, and part of the fluids in the turbulent zone and transition zone obstructed by a blocking surface of a back-up plate;

Fig. 6 is a perspective view of a third preferred embodiment of a low-turbulence impeller for a fluid pump in accordance with the present invention;

Fig. 7 is a schematically front-sectional view of the low-turbulence impeller for a fluid pump in Fig. 6;

Fig. 8 is a sectional and perspective view of a conventional centrifugal pump impeller; and

Fig. 9 is a schematically front-sectional view of the conventional centrifugal pump impeller in Fig. 8, showing the flowing route of the fluid.

[0010] With reference to Fig. 1, a first preferred embodiment of a low-turbulence impeller for a fluid pump in accordance with the present invention is mounted in a casing of a centrifugal pump (not shown in figures). The centrifugal pump rotates the low-turbulence impeller.

[0011] With reference to Figs. 1 to 3, the low-turbulence impeller for a fluid pump comprises a first base wall 2, a second base wall 3, multiple guiding blades 4, multiple back-up plates 5, and multiple runners 6.

[0012] The first base wall 2 is circular and has a first inner surface 21, a first periphery 22, and a coupling portion 23. The coupling portion 23 is connected to a transmission shaft of a motor and is rotated by the motor. The second base wall 3 is spaced apart from and parallel to the first base wall 2. The second base wall 3 is circular and has a second inner surface 31 facing the first inner surface 21, a second periphery 32, and an inlet 33. The inlet 33 is formed through the second base wall 2 to allow fluid such as air or liquid to enter. The guiding blades 4 are connected to the first inner surface 21 and the second inner surface 31. The guiding blades 4 are curved and are spaced apart from each other. Each one of the guiding blades 4 is arched and has an inner end 41, an outer end 42, a first blade surface 43, and a second blade surface 44. The inner end 41 and the outer end 42 are disposed opposite to each other. The first blade surface 43 is disposed between the inner end 41 and the outer end 42. The second blade surface 44 is disposed opposite to the first blade surface 43.

[0013] The multiple back-up plates 5 are mounted between the first periphery 22 of the first base wall 2 and the second periphery 32 of the second base wall 3. In the first preferred embodiment, the back-up plates 5 are connected to the first inner surface 21 of the first base wall 2 and the second inner surface 31 of the second base wall 3. The back-up plates 5 are annularly spaced apart from each other. Each one of the back-up plates 5 is integratedly connected to the outer end 42 of a corresponding guiding blade 4 to block the fluid.

[0014] Each one of the runners 6 is formed between two adjacent guiding blades 4 and two adjacent back-up plates 5 connected to said two adjacent guiding blades 4. Each one of the runners 6 has an outlet 60. The outlet 60 is formed between said two adjacent back-up plates 5. Each one of the runners 6 has a laminar zone 61, a turbulent zone 62, and a transition zone 63. The laminar zone 61 is near the first blade surface 43 of one of the two adjacent guiding blades 4 and communicates with a corresponding outlet 60. The turbulent zone 62 is near the second blade surface 44 of the other guiding blade 4 and aligns with the corresponding back-up plate 5. The transition zone 63 is located between the laminar zone 61 and the turbulent zone 62 and aligns with the corresponding back-up plate 5.

[0015] Specifically, each back-up plate 5 has a connecting end 5 land a terminal end 52. The connecting end 51 is connected to the outer end 42 of a corresponding guiding blade 4. The terminal end 52 is disposed opposite to the connecting end 51 of the back-up plate 5. The connecting end 51 of each back-up plate 5 is integrated with the outer end 42 of the corresponding guiding blade 4 to prevent the fluid from flowing out between the back-up plate 5 and the guiding blade 4.

[0016] In addition, each back-up plate 5 has a blocking surface 53 formed between the connecting end 51 and the terminal end 52. The blocking surface 53 is used to block the flowing fluid. The blocking surface 53 of each back-up plate 5 and the second blade surface 44 of a corresponding guiding blade 4 are connected to each other and have an included angle A. The included angle A is an obtuse angle and is adjustable based on an actual design requirement.

[0017] When the motor drives the low-turbulence impeller for a fluid pump to rotate along a direction R by the transmission shaft, the fluid is flowed into the low-turbulence impeller through the inlet 33, and then the fluid is flowed into each one of the runners 6 by centrifugal forces. Part of the fluid is flowed out of the laminar zone 61 along a direction of arrow D through the outlet 60, and part of the fluid in the turbulent zone 62 and transition zone 63 is blocked by the blocking surfaces 53 of the back-up plates 5. So multiple counterclockwise vortexes V formed by the fluid in the turbulent zone 62 are blocked by the blocking surface 53 and do not flow out of the low-turbulence impeller, and the flowing fluid through the outlet 60 of each runner 6 is in low-turbulence condition. The phenomenon of inverse flow caused by negative pressures and cavitation corrosion caused by turbulent flow is reduced to prevent the guiding blades 4 from damage. Further, the rotational velocity of the low-turbulence impeller for a fluid pump is enhanced to promote the fluid-draining efficiency.

[0018] In the first preferred embodiment, a length of each back-up plate 5 is designed according to an area of the outlet 60. The area of the outlet 60 is calculated by an area of the inlet 33, a flowing velocity of the fluid flowing out the inlet 33, and a flowing velocity of the fluid flowing out of the outlet 60. A reduction ratio of the outlet 60 is determined by the flowing velocity of the fluid flowing out the inlet 33 divided by the flowing velocity of the fluid flowing out of the outlet 60. With reference to Figs. 4 and 5, a second preferred embodiment of a low-turbulence impeller for a fluid pump in accordance with the present invention is shown. The structure and operation of the second preferred embodiment are approximately the same as the first preferred embodiment. The low-turbulence impeller for a fluid pump has a ring member 50B.

[0019] The ring member 50B is securely mounted around the first periphery 22 of the first base wall 2 and the second periphery 32 of the second base wall 3. The ring member 50 is mounted securely on the first base wall 2 and the second base wall 3 by soldering or screwing. The ring member 50B has two rings 54B and multiple back-up plates 55B. The rings 54B are spaced apart from each other. The back-up plates 55B are formed between the rings 54B.

[0020] With reference to Figs. 6 and 7, a third preferred embodiment of a low-turbulence impeller for a fluid pump in accordance with the present invention is shown. The structure and operation of the third preferred embodiment are approximately the same as the first preferred embodiment. The low-turbulence impeller for a fluid pump has multiple guiding blades 4C. Each one of the guiding blades 4C has an inner end 41C. The inner end 41C is cambered relative to the inner end 41 of the guiding blades 4.

[0021] The low-turbulence impeller for a fluid pump is applied to fluid that has a specific weight less than 1, such as air.

[0022] Every preferred embodiment of the low-turbulence impeller for a fluid pump has multiple back-up plates 5, 55B mounted in the runners 6. So the fluid can only be flowed out of the outlets 60 from the laminar zone 61. Thereby, the fluid through each outlet 60 is in low-turbulence condition. The phenomenon of inverse flow caused by negative pressures and cavitation corrosion caused by turbulent flow is greatly reduced to avoid damaging the guiding blades 4,4C. The rotational velocity of the low-turbulence impeller is enhanced in operational condition to promote the fluid-draining efficiency.

[0023] Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and features of the invention, the disclosure is illustrative only. Changes may be made in the details, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

Claims

1. A low-turbulence impeller for a fluid pump **characterized in that** the low-turbulence impeller comprises:

    a first base wall (2) having
    a first inner surface (21); and
    a first periphery (22);
    a second base wall (3) spaced apart from the first base wall (2) and having
    a second inner surface (31) facing the first inner surface (21);
    a second periphery (32); and
    an inlet (33) formed through the second base wall (3);
    multiple guiding blades (4) connected to the first inner surface (21) and the second inner surface (31), the guiding blades (4) being curved and spaced apart from each other; each one of the guiding blades (4) having
    an inner end (41);
    an outer end (42) disposed opposite to the inner end (41);
    a first blade surface (43); and
    a second blade surface (44) disposed opposite to the first blade surface (43);
    multiple back-up plates (5) mounted on the first periphery (22) of the first base wall (2) and the second periphery (32) of the second base wall (3), and annularly spaced apart from each other; each one of the back-up plates (5) connected to the outer end (42) of a corresponding guiding blade (4); and
    multiple runners (6), each one of the runners (6) formed between two adjacent guiding blades (4) and two adjacent back-up plates (5) connected to said two adjacent guiding blades (4), and each one of the runners (6) having
    an outlet (60) formed between said two adjacent back-up plates (5);
    a laminar zone (61) being near the first blade surface (43) of one of the two adjacent guiding blades (4) and communicating with the outlet (60) of the runner (6); and
    a turbulent zone (62) being near the second blade surface (44) of the other guiding blade (4) and aligning with the corresponding back-up plate (5).

2. The low-turbulence impeller as claimed in claim 1, wherein
    each one of the runners (6) has
    a transition zone (63) located between the laminar zone (61) and the turbulent zone (62) and aligning with one of the back-up plates (5).

3. The low-turbulence impeller as claimed in claim 1 or 2, wherein
    each one of the back-up plates (5) has
    a connecting end (51) connected to the outer end (42) of the corresponding guiding blade (4); and

a terminal end (52) disposed opposite to the connecting end (51) of the back-up plate (5).

4. The low-turbulence impeller as claimed in claim 1 to 3, wherein
each back-up plate (5) has
a blocking surface (53) formed between the connecting end (51) and the terminal end (52), and connected to the second blade surface (44) of the corresponding guiding blade (4);
wherein an included angle between the blocking surface (53) and the second blade surface (44) is an obtuse angle.

5. The low-turbulence impeller as claimed in claim 1 to 4, wherein
the back-up plates (5) are respectively mounted between the first periphery (22) of the first base wall (2) and the second periphery (32) of the second base wall (3);
each one of the back-up plates (5) is integratedly connected to the outer end (42) of the corresponding guiding blade (4).

6. The low-turbulence impeller as claimed in claim 1 to 4 further comprising:

a ring member (50B) securely mounted around the first periphery (22) of the first base wall (2) and the second periphery (32) of the second base wall (3), and having
two rings (54B) spaced apart from each other; and
multiple back-up plates (55B) formed between the rings (54B).

7. The low-turbulence impeller as claimed in claim 1 to 6, wherein each one of the guiding blades (4C) has an inner end (41C) in a cambered shape.

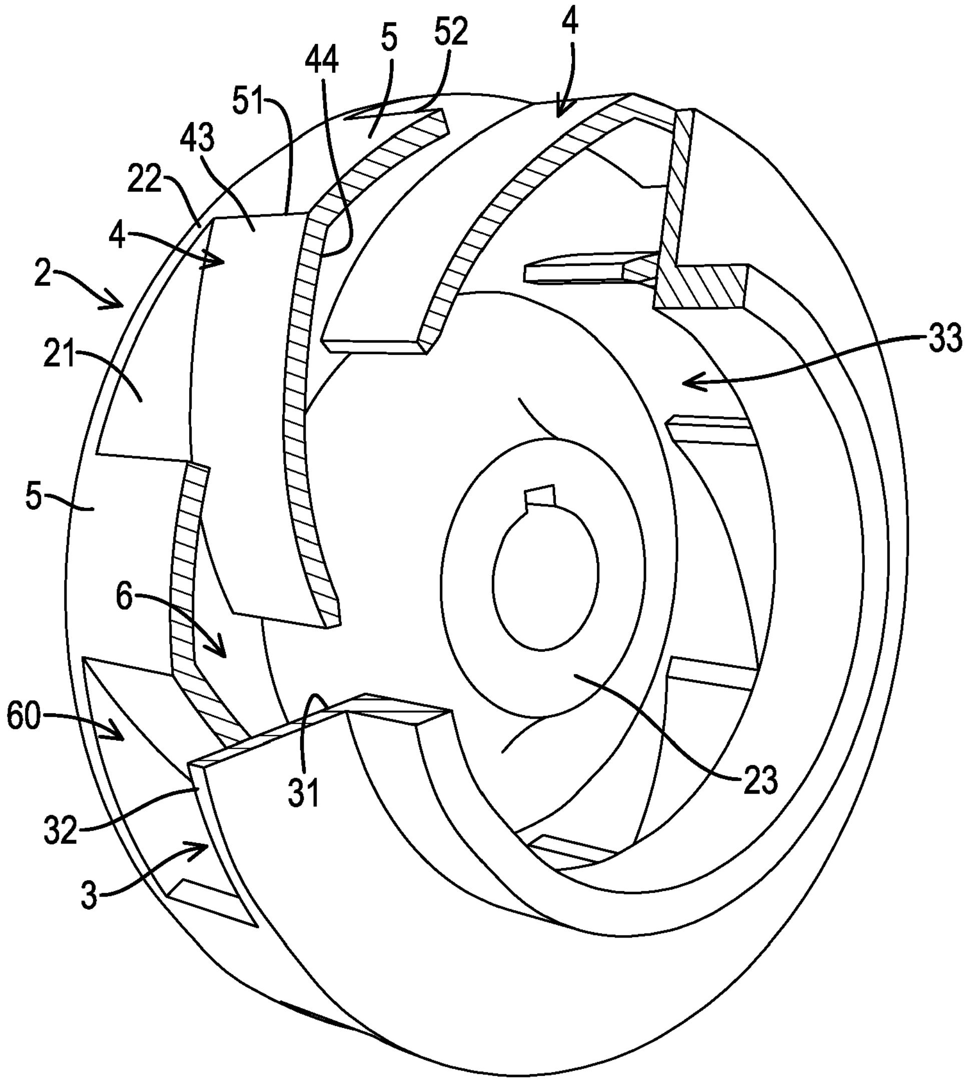

FIG.1

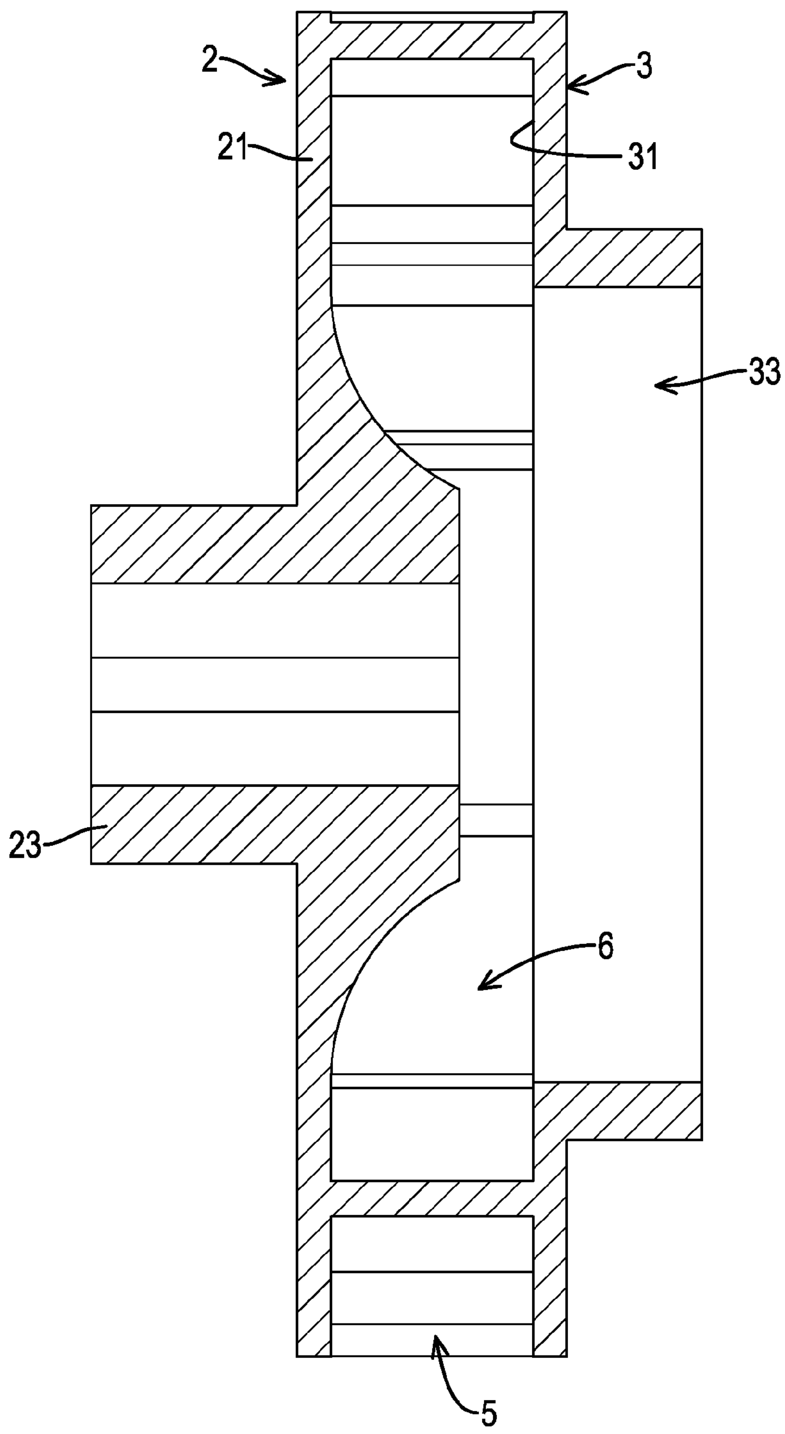

FIG.2

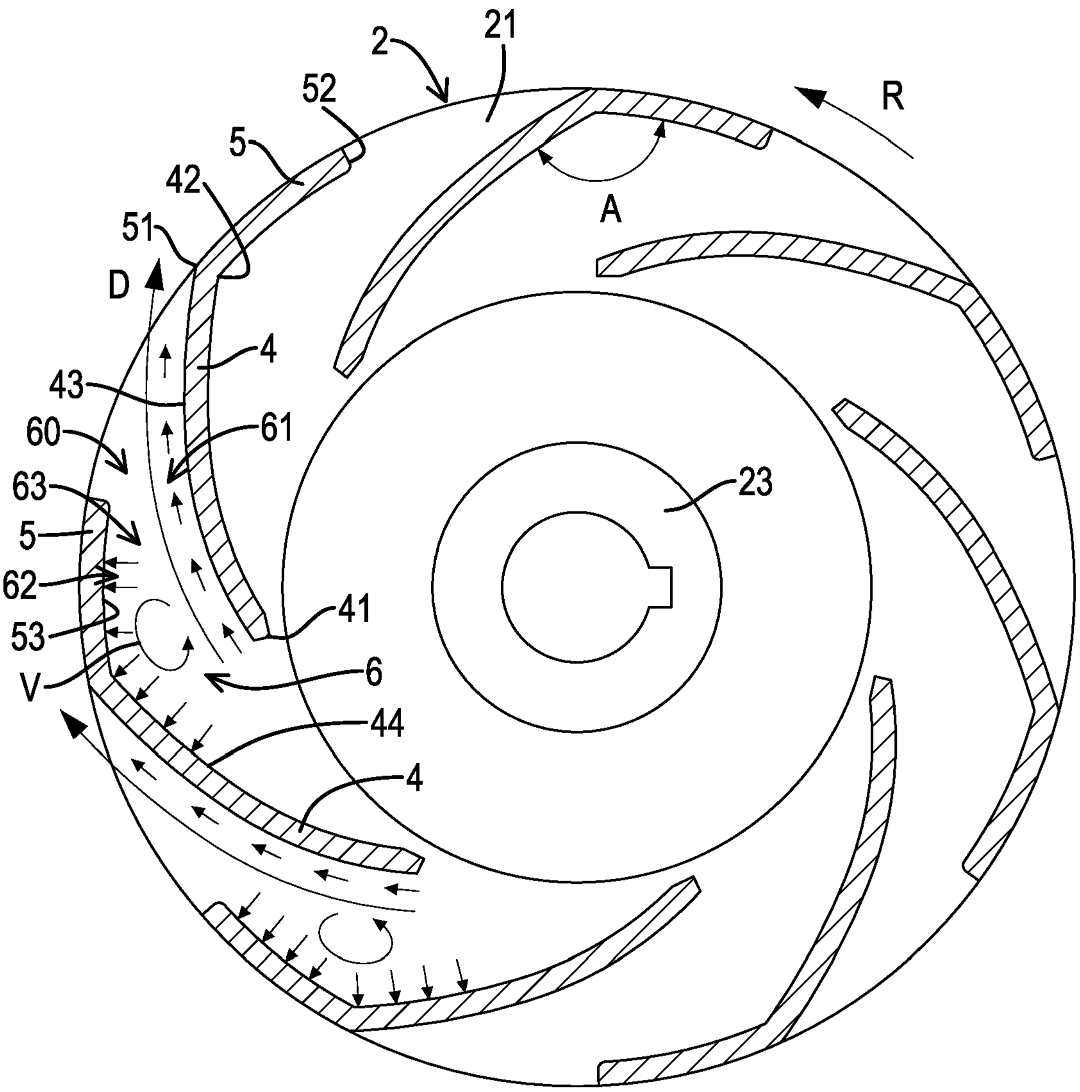

FIG.3

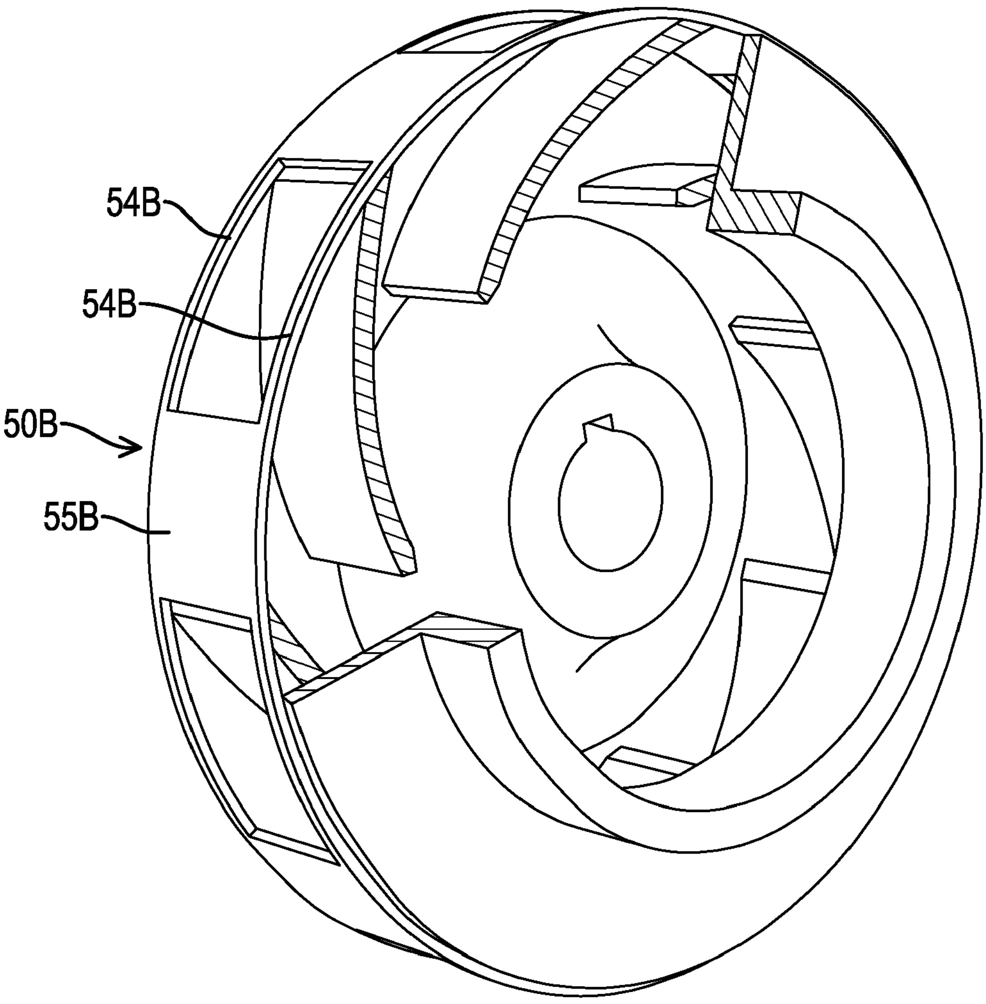

FIG.4

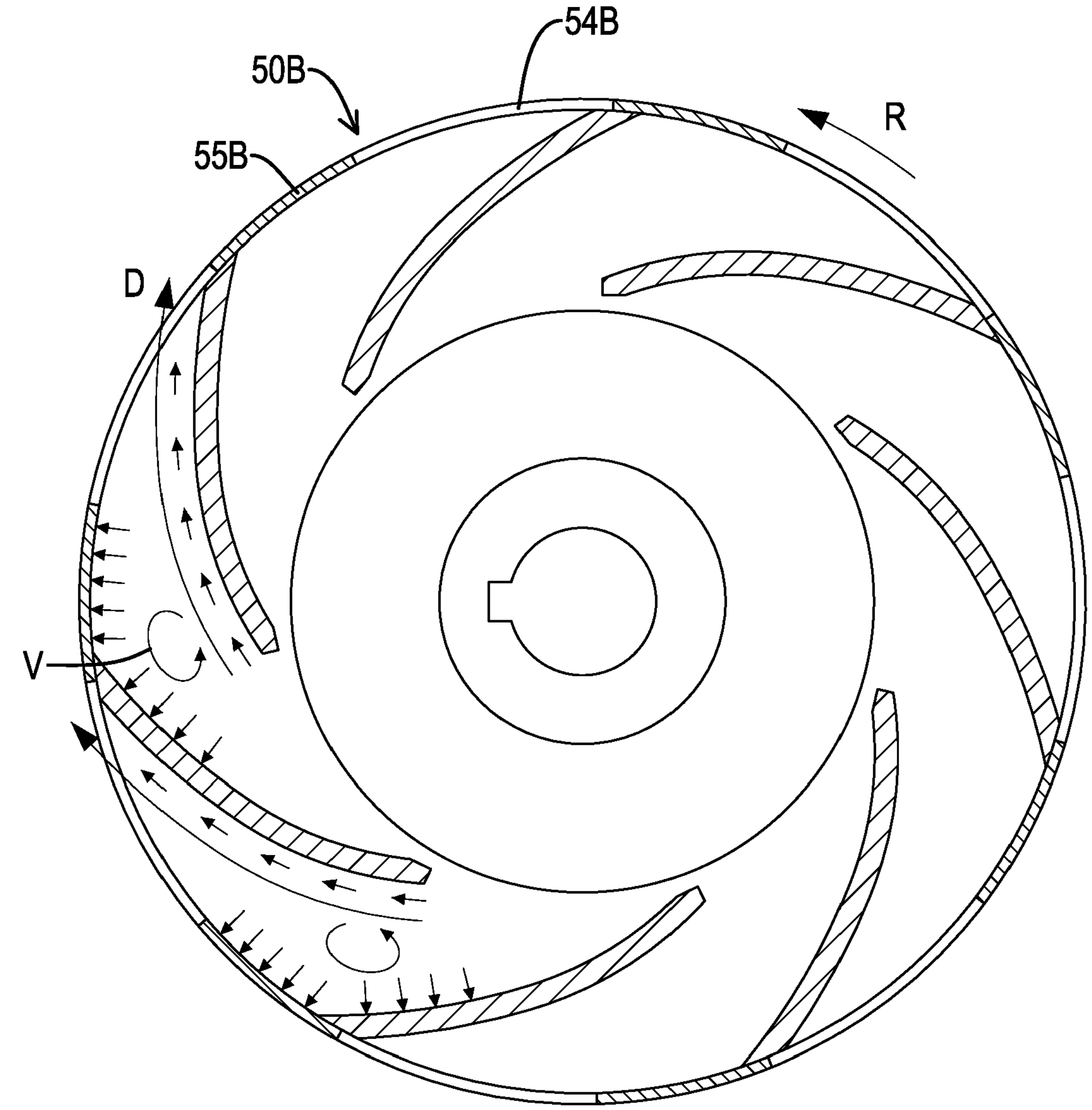

FIG.5

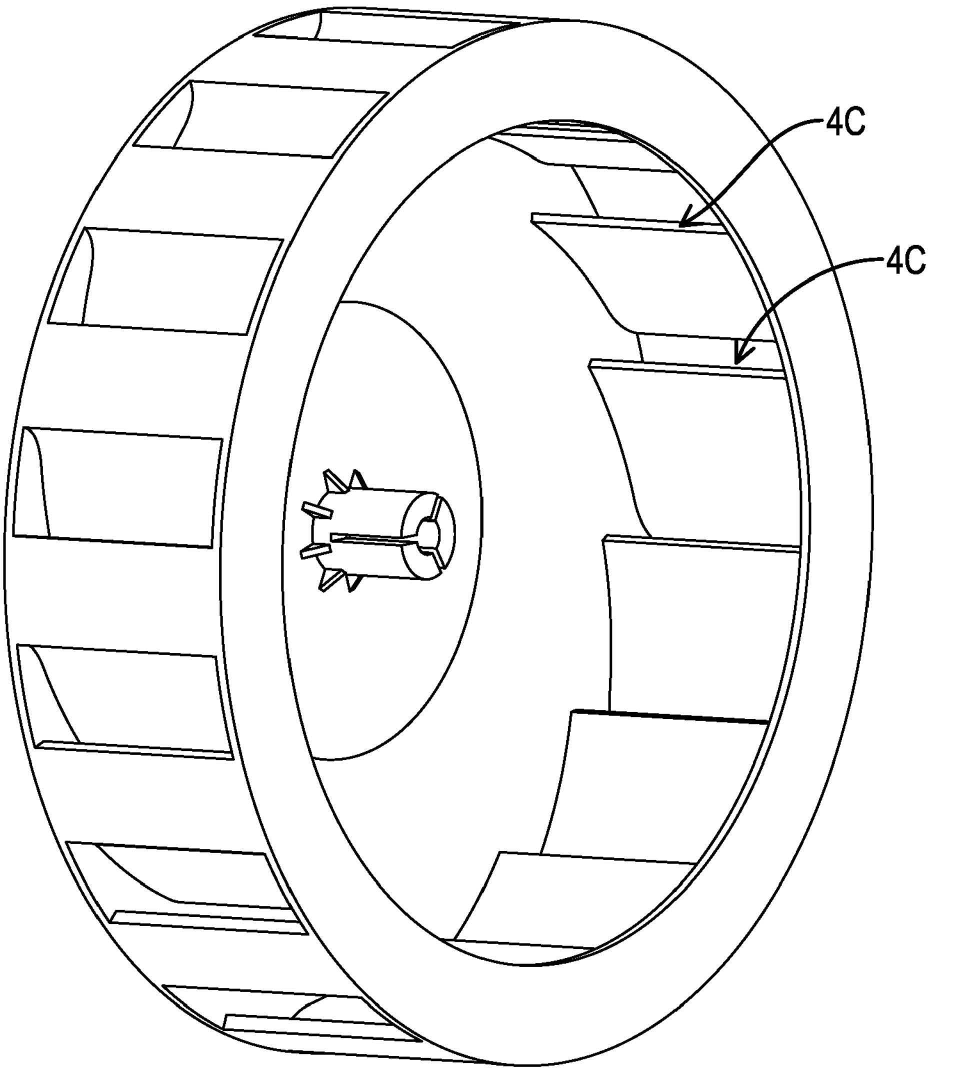

FIG.6

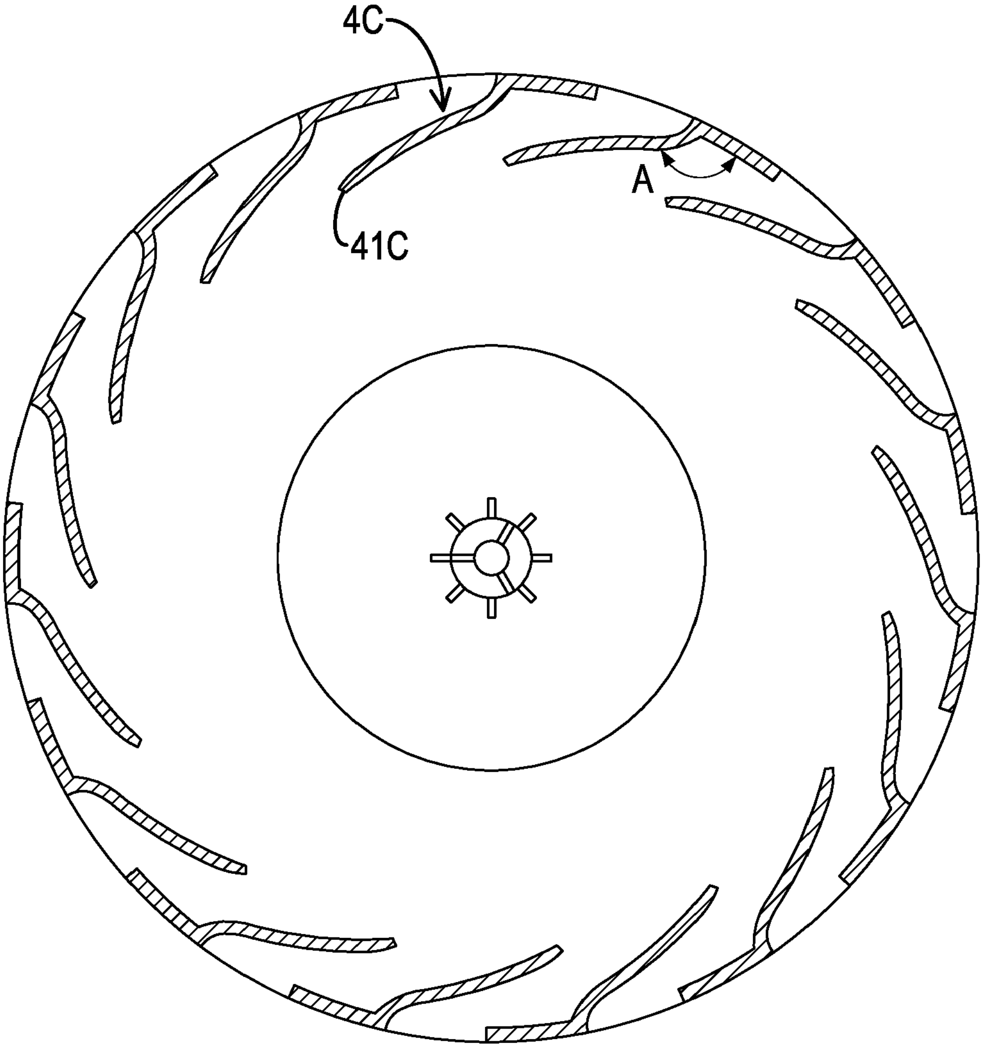

FIG.7

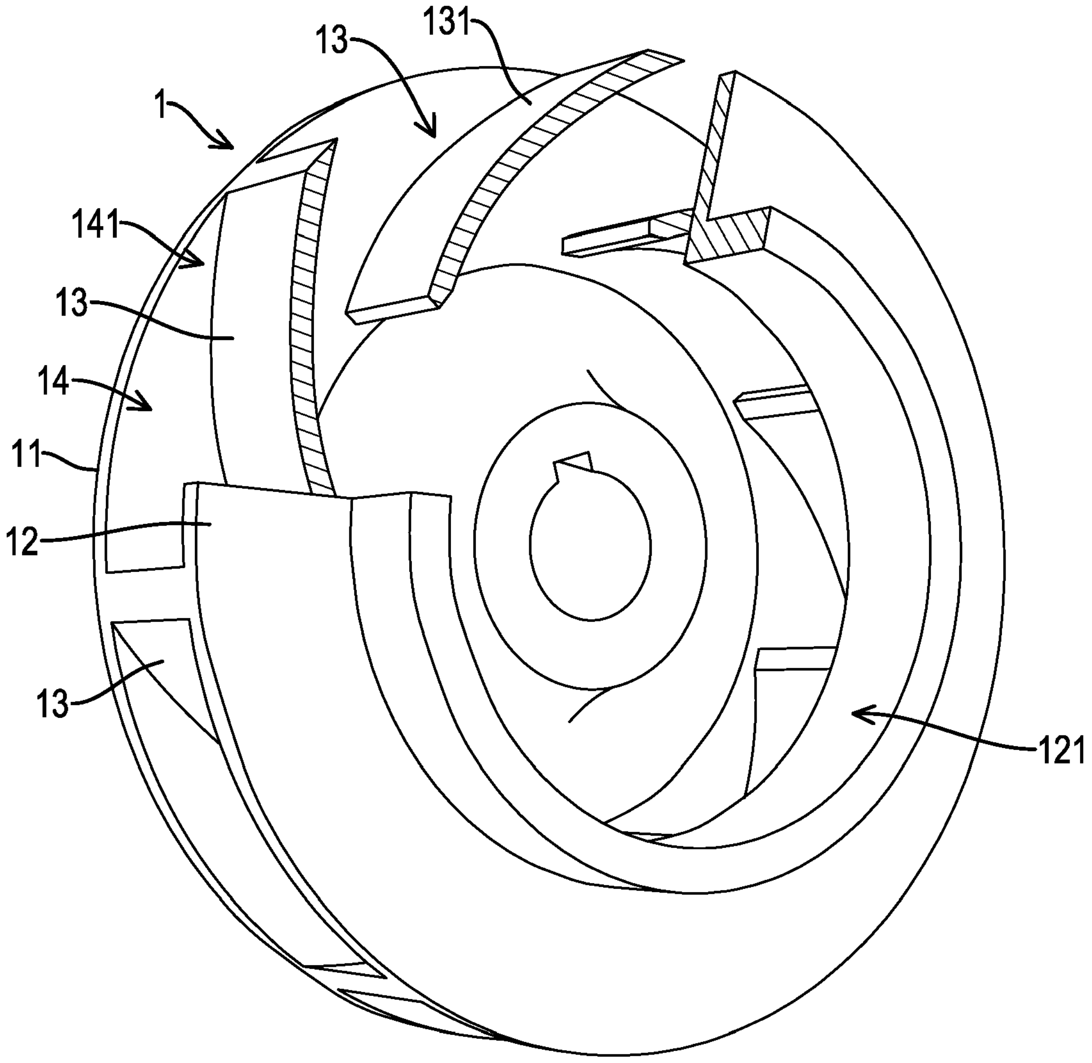

FIG.8
PRIOR ART

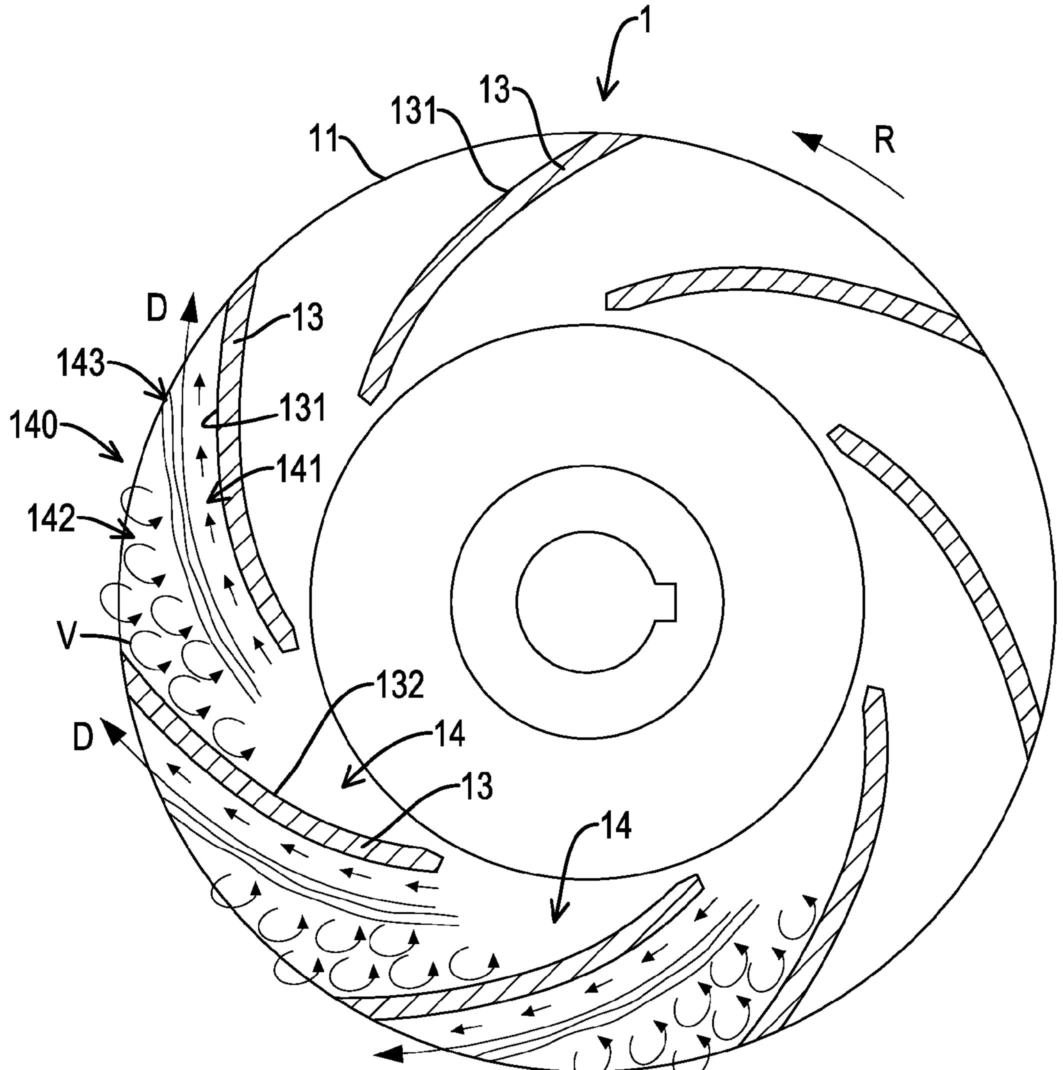

FIG.9
PRIOR ART

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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 8591

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 11 52 887 B (ROTH CO ROY E) 14 August 1963 (1963-08-14) * figures 1, 3 * -----	1-3,5,7	INV. F04D29/22 F04D29/24 F04D29/66
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Y	US 1 030 561 A (BLACKMER ERNEST E [US] ET AL) 25 June 1912 (1912-06-25) * figure 4 * -----	6	
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			TECHNICAL FIELDS SEARCHED (IPC)
			F04D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	9 October 2015	Brouillet, Bernard

CATEGORY OF CITED DOCUMENTS

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