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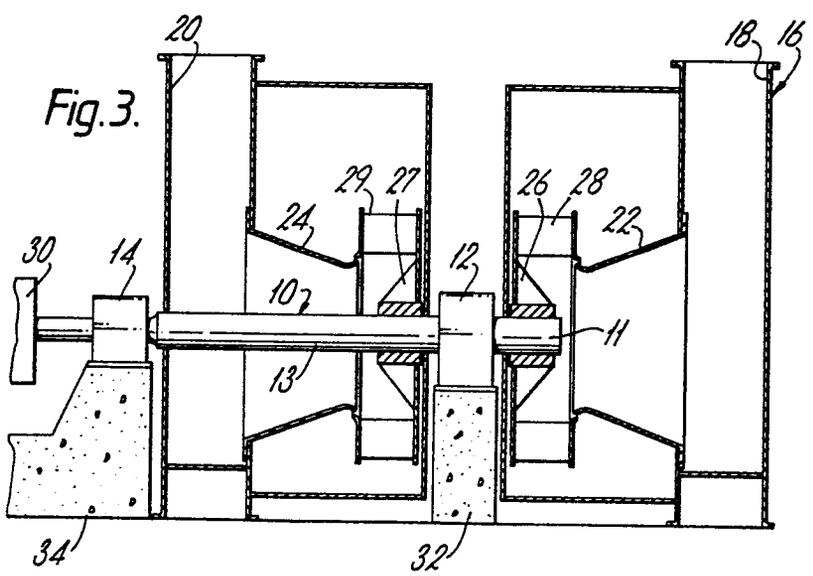
(54) **Centrifugal fans and blowers.**

(57) A centrifugal fan in which a shaft (10, 11, 13) is rotatable about its axis in a main bearing (12) and carries two single inlet centrifugal fan impellers (26, 27) for rotation therewith, the main bearing (12) being located between said impellers and taking a major portion of the bearing load of said impellers.

Fig.3.



EP 0 219 578 A1

"CENTRIFUGAL FANS AND BLOWERS"

The present invention relates to centrifugal fans or blowers.

Conventional heavy duty double suction centrifugal fans and blowers basically consist of a bearing arrangement, a shaft rotatable about its axis in said bearing arrangement, two single inlet centrifugal fan impellers mounted on said shaft and rotatable therewith, a fan casing surrounding the impellers and drive means for rotating the shaft. While such designs are well proven in service, they do have significant disadvantages in very large size fans, due to scale effects on the basic geometry of the rotor.

The problems of such heavy duty fans are discussed later in this specification with reference to Figures 1 and 2.

The present invention aims to overcome the major problems resulting from the scale effect, by providing the bearing arrangement so that it includes a main bearing which is located between the impellers, this main bearing taking a major portion of the bearing load of the impellers.

With such an arrangement because the actual load bearing portion of the shaft can be relatively short, the diameter of the shaft can be significantly reduced and it is determined largely by the torque which the remainder of the shaft has to transmit from the drive source, such as an electric motor. It is also possible very significantly to reduce the impeller hub weight and therefore its cost.

The drive means may be connected to the shaft at a location between the impellers, for example either by mounting a drive motor between the impellers or by providing a belt or chain drive or gearbox drive.

Preferably, however, the bearing assembly includes a second bearing at a location spaced along the shaft from the main bearing, the drive means being positioned adjacent the second bearing. There will be a much reduced load on the outer bearing which will allow the size of this bearing to be greatly reduced. Because of the very much reduced total rotor weight, there will be easier handling, less starting torque and reduced foundation loads.

Because the shaft can be made of lesser diameter than hitherto, and when the second portion of smaller diameter is provided, the shaft blockage of the flow of air to the inlet of the impellers will be greatly reduced on one side and will totally eliminated on the other side from that on which the drive motor will be provided. The other side, of course, will only be an overhung portion cantilevered out from the main bearing.

The main portion of the shaft may be detachably connected to the second portion of the shaft and the casing may include slots and removable cover panels, so that when cover panels are removed and the main shaft portions are disconnected from the second shaft portion, the impellers can be rolled out of the casing.

The two fan impellers and their volutes may be of a different size and/or design.

Furthermore, the impeller or impellers which are mounted in overhung relation to the main bearing may be provided with a simple disc flow control.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings, in which:-

Figure 1 is a schematic, broken away side elevation of one known form of large capacity double centrifugal fan or blower;

Figure 2 is a view similar to Figure 1 of a second known form of such apparatus;

Figures 3, 4, 5, 6 and 7 are similar views of five different embodiments of large capacity double centrifugal fans or blowers according to the present invention; and

Figure 8 is an end elevation of the arrangement of Figure 3.

Referring first to Figure 1, the assembly illustrated therein includes a horizontal axis large diameter shaft 10 mounted between two bearings 12 and 14. The shaft passes through a casing indicated by the general reference numeral 16 and including first and second inlet ducts 18, 20 located just inwardly of the bearing 12, 14. The inlet ducts 18 have laterally extending inlet frusto-conical portions 22, 24 substantially coaxial with the shaft 10. Mounted centrally on the shaft 10 is a double inlet impeller 26, 27 which is surrounded by volute portions 28, 29, respectively, of the fan casing.

The two bearings 12 and 14 are spaced apart from one another by a substantial distance and the shaft 10 will need to have a fairly large diameter to enable it to support a heavy duty double inlet impeller 26, 27. The shaft is driven by a motor indicated schematically at 30 positioned to the left of the bearing 14.

Problems arise with the construction of Figure 1 mainly from the fact that, in order to maintain an acceptable critical speed for the rotor, the ratio of shaft to impeller weight is size dependent and, in very large fans, the shaft weight can be of the order of 3 times the impeller weight. A most obvious disadvantage of this is the total rotor weight can become excessive resulting in very high loads

on the foundations 32, 34 carrying the bearings 12, 14. Similarly it will require very large bearings to support the rotating weight and the shaft forging costs can become disproportionally large and can approach the order of one third of the total manufacturing cost. Because the shaft 10 is of a relatively large diameter it also provides a substantial blockage on the in flowing air through the frusto-conical portions 22, 24, thus reducing the efficiency of the fan or blower.

Figure 2 shows an alternative known arrangement in which like parts have been indicated by like reference numerals. This construction differs from that of Figure 1 in that there is only a single inlet 18 mounted centrally of the assembly and the two impellers 26, 27 are mounted adjacent the bearings 12, 14. Thus there are two single inlet impellers on the common shaft, each located adjacent a separate one of the bearings. This design results in a significant reduction in shaft diameter compared to that shown in Figure 1, with all the advantages that this will bring. It does, however, present considerable practical problems with regard to flow control in the common inlet 18 and in some applications the additional complexity resulting from this is unlikely to be offset by the cost savings resulting from the reduced shaft size.

Figure 3 illustrates a construction according to the present invention which obviates many of the disadvantages of the arrangements of Figures 1 and 2, and like parts have again been indicated by like reference numerals. The structure is very similar to Figure 1 in that there are two inlets 18, 20, to frusto-conical portions 22, 24 and two outlet volutes 28, 29.

In this construction, however, the two inlet impellers 26, 27 are formed as single inlet impellers mounted on the common shaft 10 and a main bearing 12 is mounted between them and bears most of the weight load of the shaft 10 and of the impellers 26, 27. An overhung portion 11 of the shaft 10 extends to the right of the main bearing 12 as seen in Figures 3, and the first single inlet impeller 26 is mounted thereon. The remaining portion 13 of the shaft 10 carries the second single inlet impeller 27 and extends to the second bearing 14 and from there to a drive motor 30.

Because the main bearing 12 carries most of the weight load, and because the overhung portion 11 and the corresponding part of the portion 13 of the shaft 10 are relatively short, the diameter of the shaft 10 can be made significantly smaller than in the structure of Figure 1. This means that the restriction to flow of air into the impeller 27 is greatly reduced, thus increasing the efficiency of that fan. Furthermore, because all of the parts can be made much lighter, the construction of the foundations 32, 34 can be reduced for a fan of the same size. Alternatively, of course, using conventional size parts, the size of the fan can be increased.

Figure 4 illustrates a similar construction to that in Figure 3 and again like parts have been indicated by like reference numerals. Here it can be seen that the fan constituted by the impeller 26 and the volute 28 is different from that constituted by the impeller 27 and the volute 29.

The construction of Figure 5 is again similar but here the fan constituted by the impeller 26 and the volute 28 is much smaller than that constituted by the impeller 27 and the volute 29.

Figure 6 is a further modification. The two fans are themselves substantially identical, but a disc type flow control is provided by a shaft 36 mounted in a first slide bearing 38 in the housing 16 and the second slide bearing 40 carried on a spider 41. On the end of the shaft 36 is formed a frusto-conical disc flow control. Movement of the shaft in the direction indicated by the arrows will affect the flow of air through the fan.

The structure of Figure 7 differs from that of Figure 3 in that the shaft 10 includes not only the overhung portion 11, but a further overhung portion 13 of about the same length as the portion 11, and of a fairly robust diameter, and it is connected to a smaller diameter drive shaft 15 by a simple coupling 17. A pin (not shown) can pass through the coupling 17 and the shaft 15.

The advantage of this construction is that panels 44 can be removed, the pin passing through the connector 17 and the shaft 15 can be disengaged, and if the bearing 12 is opened up, the impellers 26, 27 can be moved out bodily with their supporting shaft portions 11, 13, these passing through horizontal slots 50 provided in the vertical facing walls 51, 52 of the volutes 28, 29.

Claims

1. A centrifugal fan comprising a bearing arrangement (12, 14), a shaft (10) rotatable about its axis in said bearing arrangement (12, 14) two single inlet centrifugal fan impellers (26, 27) mounted on said shaft for rotation therewith and a fan casing (16) surrounding said impellers and drive means - (30) for rotating said shaft, characterised in that said bearing arrangement includes a main bearing - (12) located between said impellers (26, 27) said main bearing taking a major portion of the bearing load of said impellers.

2. A fan according to claim 1, characterised in that said drive means (30) is connected to said shaft (10) at a location between said impellers (26, 27)

3. A fan according to claim 1, characterised in that said bearing assembly includes a second bearing (14) at a location spaced along the shaft from said main bearing (12) and in that the drive means is positioned adjacent the second bearing (30).

4. A fan according to claim 3, characterised in that the shaft includes a main shaft portion (11, 13) mounted on said main bearing (12) and carrying said two impellers (26,27) and a second portion - (15) of smaller diameter connected to said main portion (11, 13) and said drive means (30) and being mounted in said second bearing (14).

5. A fan according to claim 4, characterized in that said main portion (11, 13) of the shaft (10) is detachably connected to the second portion (15) of the shaft.

6. A fan according to claim 5, characterised in that the casing includes slots and removable cover panels (44), so that when said cover panels are removed and said main shaft portions (11, 13) is disconnected from said second shaft portion (15), said impellers (26, 27) can be rolled out of the casing (16).

7. A fan according to any proceeding claim, characterised in that the two fan impellers (26, 27) are of a different size and/or design.

8. A fan according to any proceeding claim, wherein the impeller or impellers which are mounted in overhung relation to the main bearing (12) is/are provided with a simple disc flow control (36 to 42).

Fig.1.

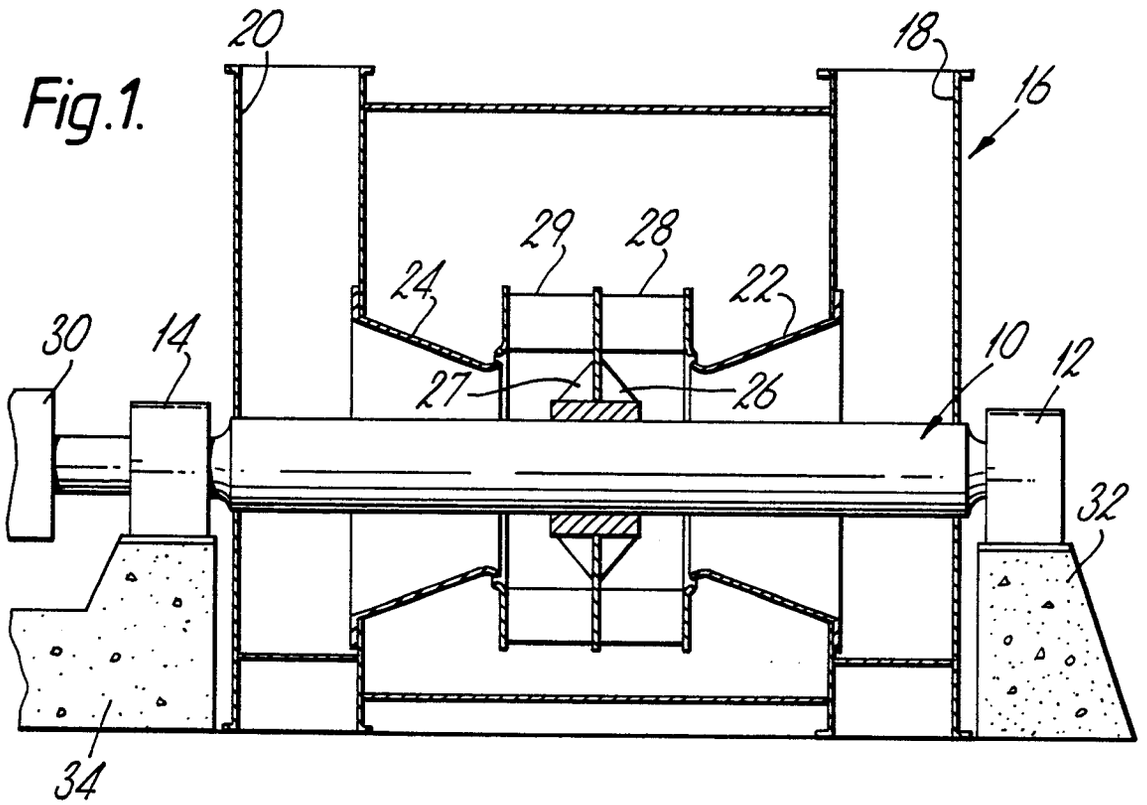

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Fig.2.

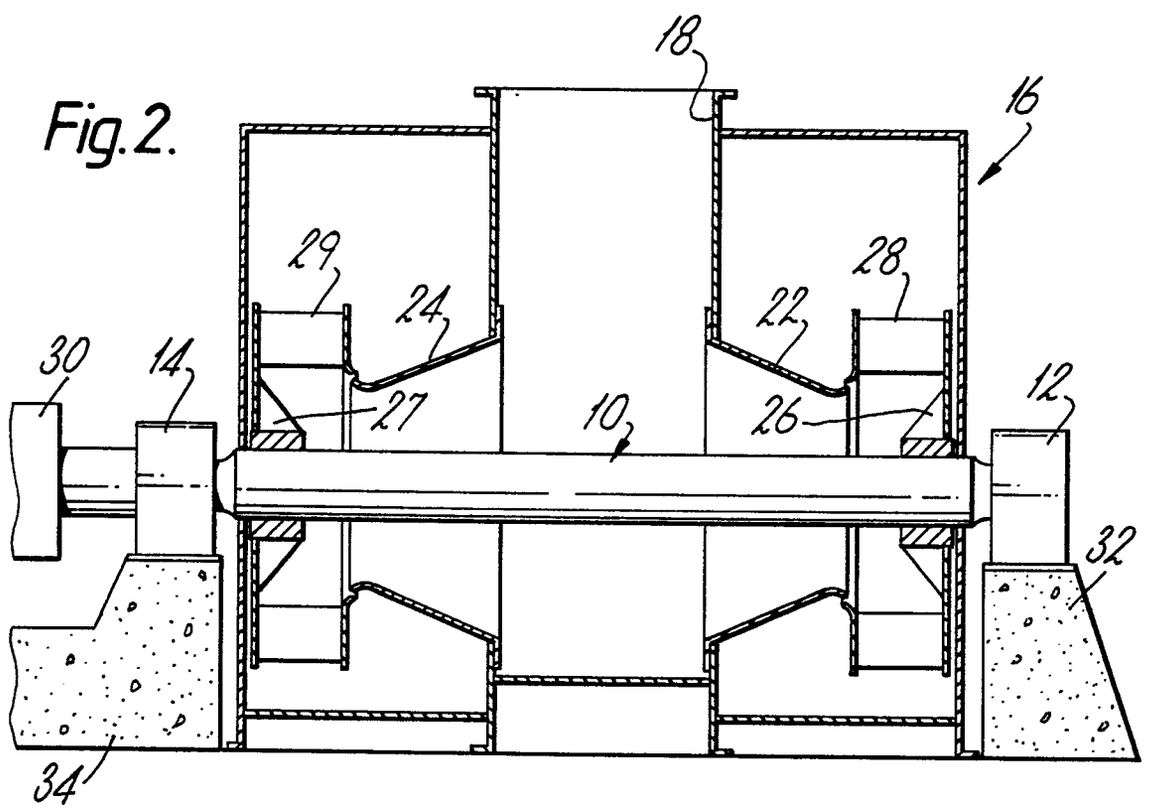
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Fig.3.

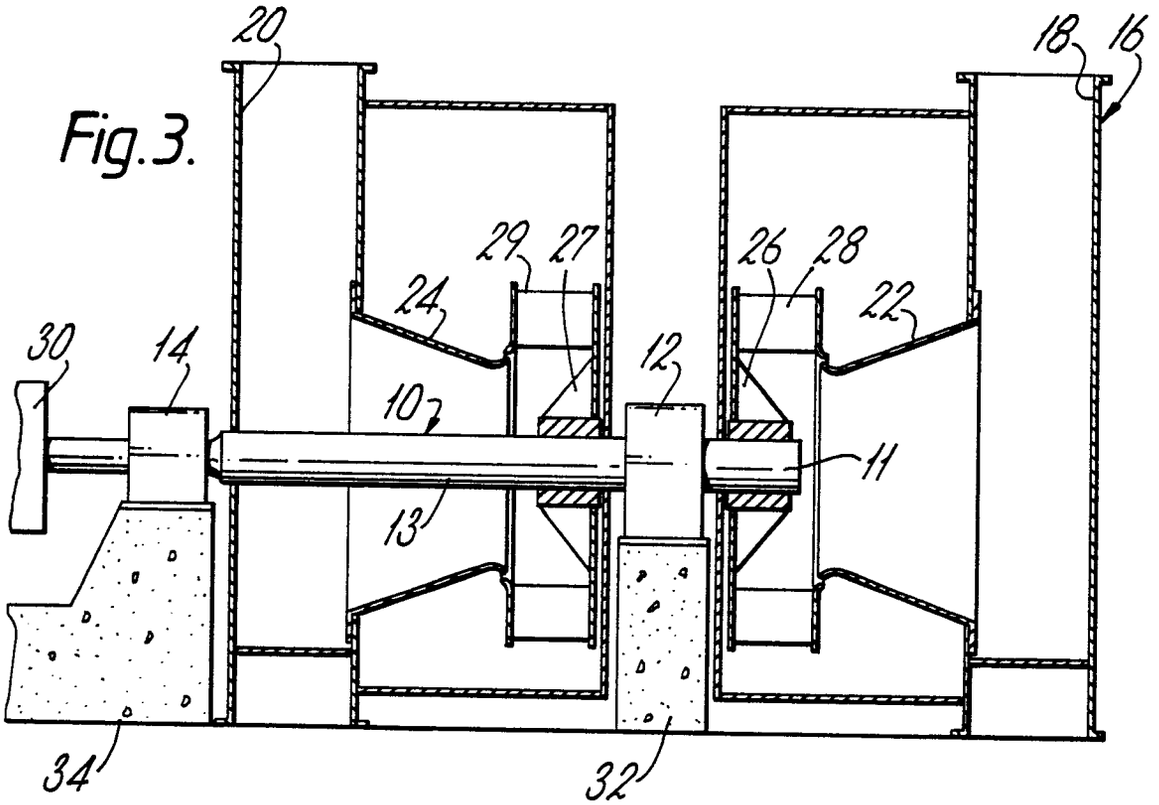
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Fig.4.

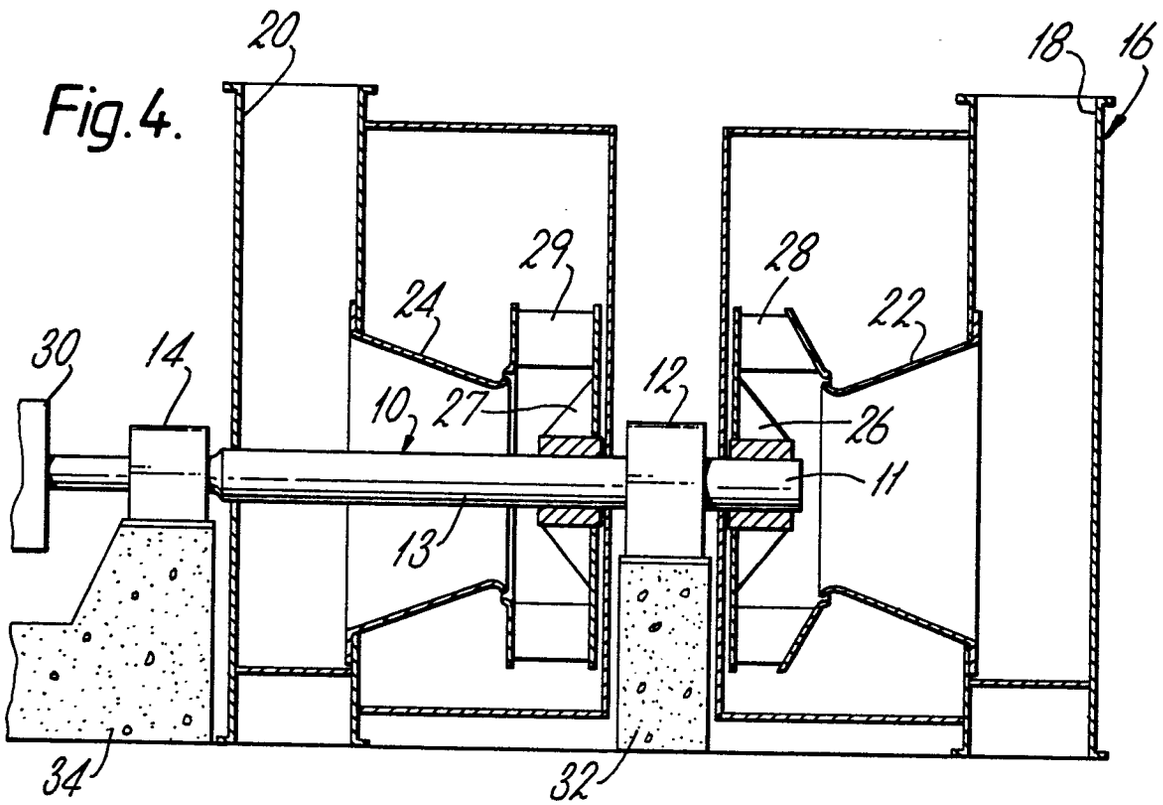
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Fig.5.

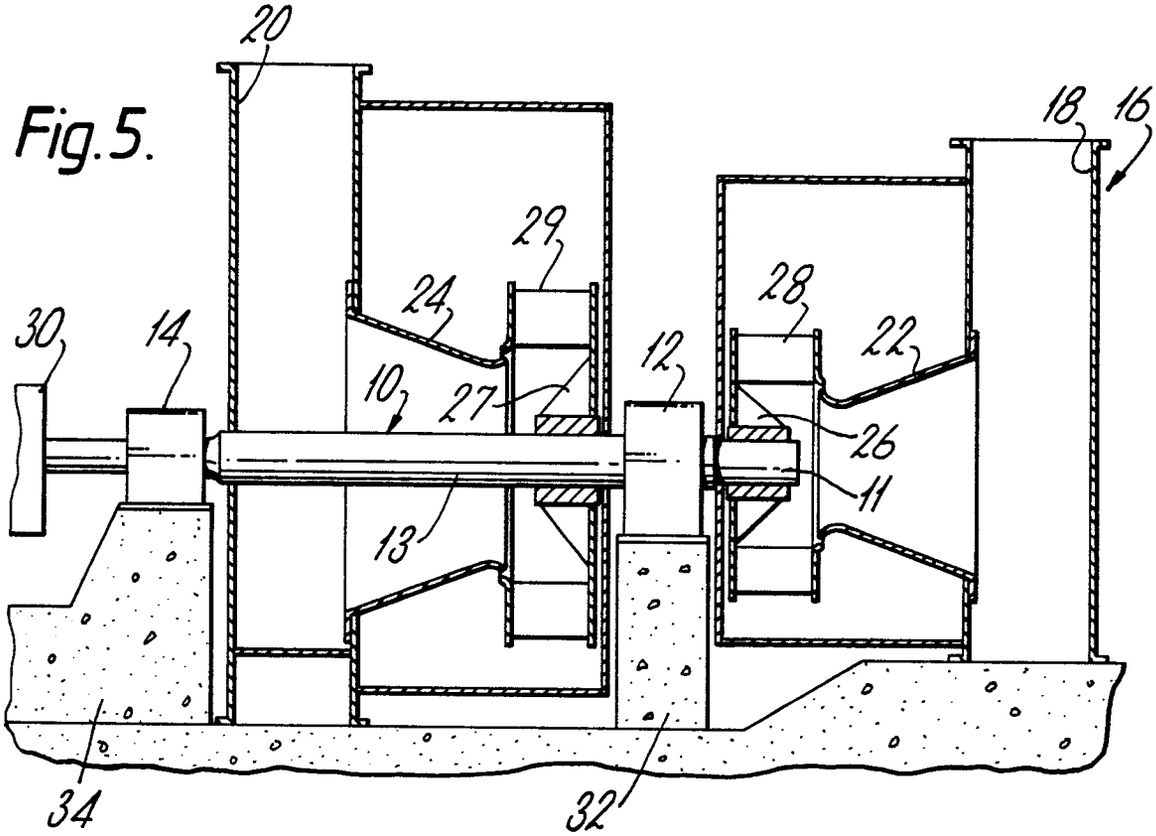
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Fig.6.

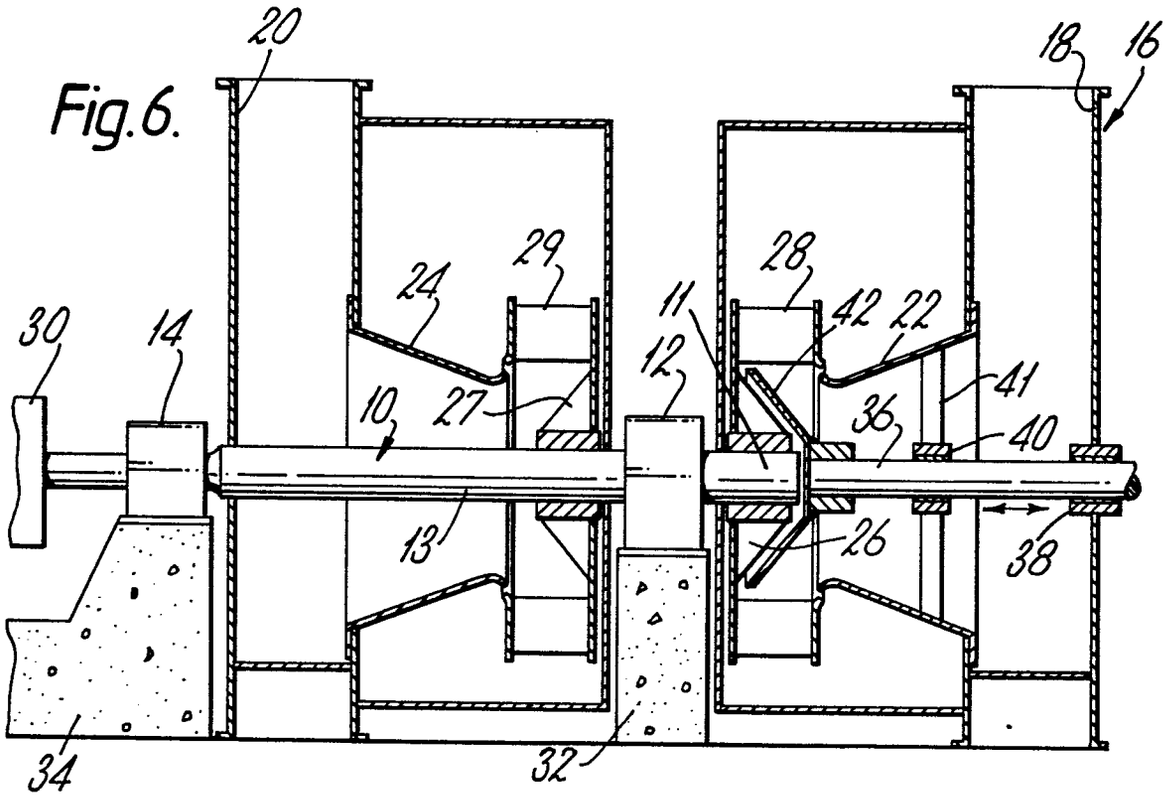
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Fig.7.

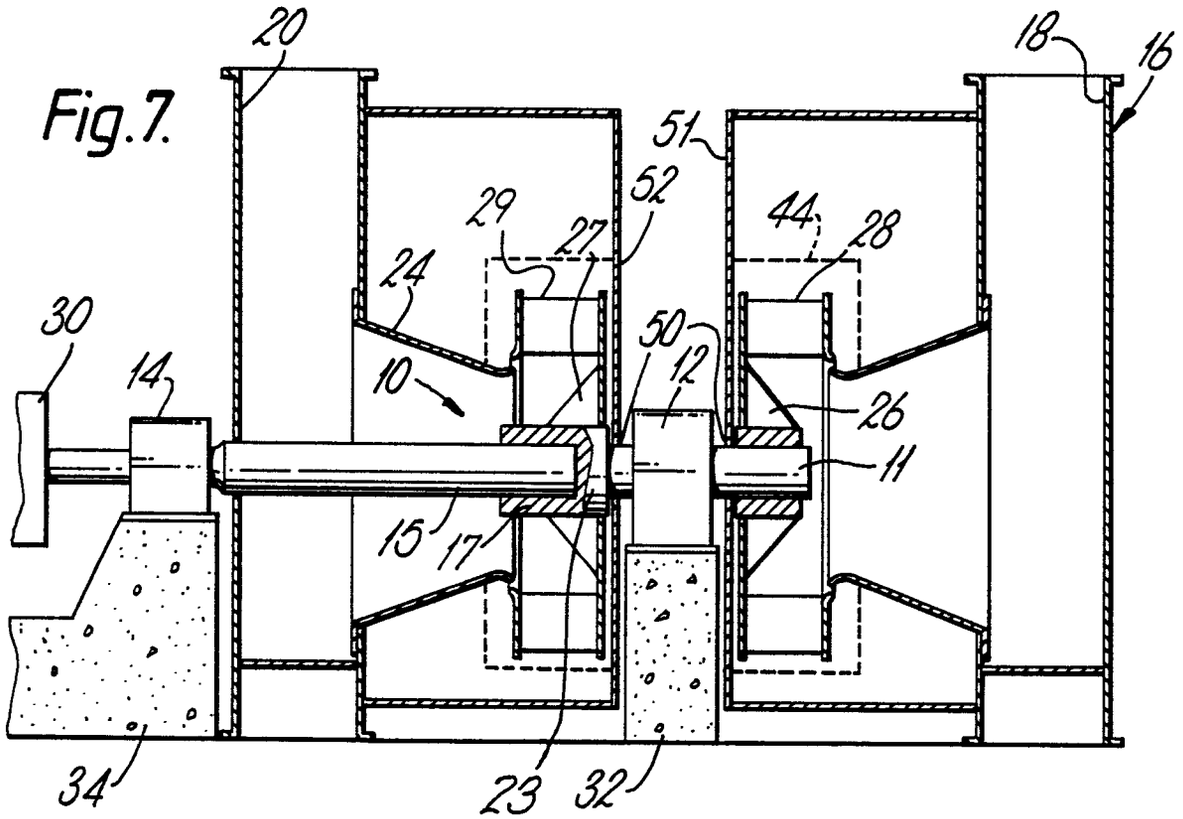
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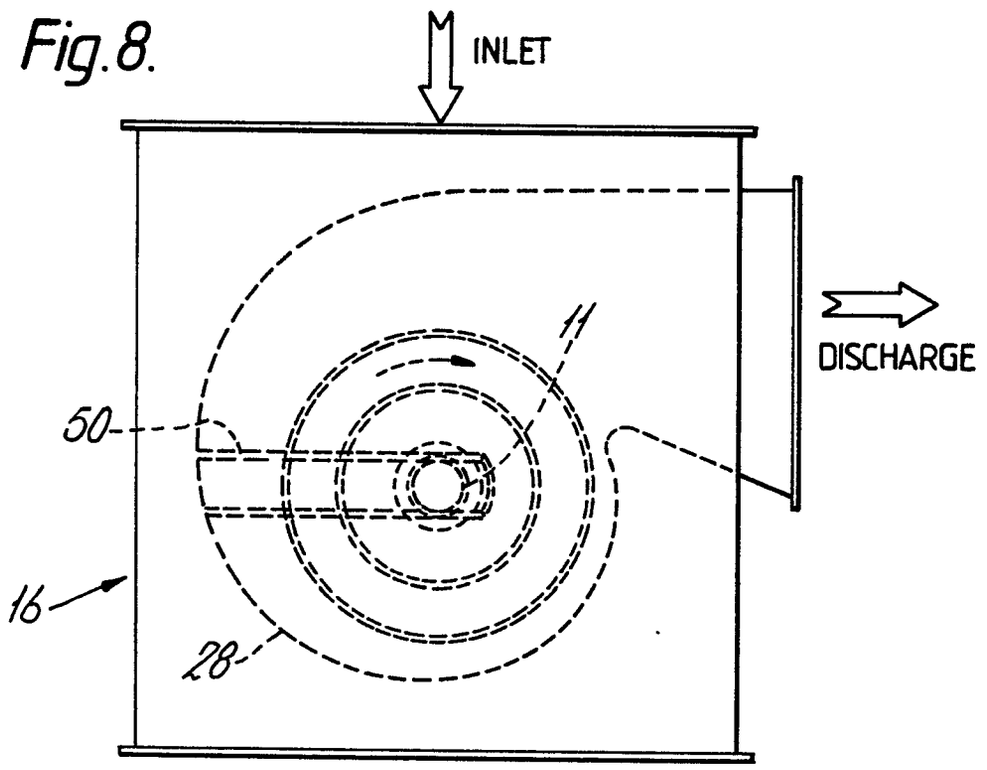
Fig.8.


INLET
DISCHARGE
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16
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EUROPEAN SEARCH REPORT

Application number

EP 85 30 6321

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)
X	GB-A- 11 029 (STOTT)(A.D. 1914) * Page 1, lines 5-16 and line 43 - page 3, line 2; page 3, lines 13-15; figure 1 *	1,3,7	F 04 D 25/16 F 04 D 29/04 F 04 D 29/62
Y		2,4,5, 8	

Y	ZEITSCHRIFT DES VEREINES DEUTSCHER INGENIEURE, vol. 95, January 1953, pages 55,56, Düsseldorf, DE; E. SIEGWART: "Luftgekühlte Lager für Radial- und Axialheissgasgebläse" * Figure 7 *	4,5	

Y	DE-B-1 266 133 (LOEWE) * Column 2, line 45 - column 3, line 6; figure *	4,5	TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A	US-A-1 646 319 (SLOTT) * Page 1, lines 1-33, 64-101; figures 1-6 *	6	F 04 D

A	US-A-3 182 899 (HAMES) * Column 1, lines 13-15; column 5, lines 41-66; figures 1,3,5 *	6	
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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	13-05-1986	WALVOORT B.W.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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)
A	FR-A-1 279 221 (COURTIAL) * Page 1, right-hand column, lines 19-37; page 2 , right-hand column, lines 9-25; figures 1-6 *	6	
Y	DE-B-1 106 918 (ECK) * Whole document *	8	
Y	US-A-2 652 816 (DODGE) * Column 1, lines 10-16; column 2, lines 26-43; figure 2 *	2	
Y	US-A-2 450 708 (ANDERSON) * Column 1, lines 1-4, 30-43; figures 1,2 *	2	
A	DE-A-1 901 361 (BAUMAN) * Figure 1 *	2	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	GB-A-1 079 331 (HOWDEN) * Page 1, lines 9-12, 61-67; figures 1,2 *	1	

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