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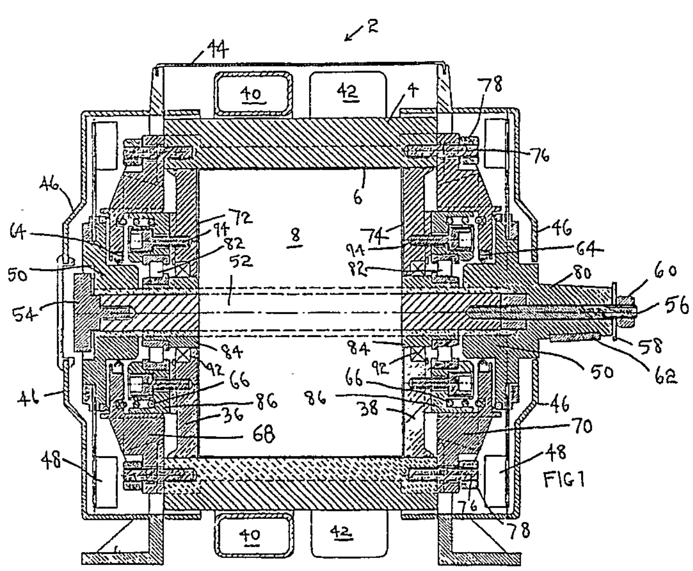
(54) **A rotary vane compressor.**

(57) A rotary vane compressor (2) comprising a body (4), a bore (6) in the body (4), a rotor (8) mounted for rotation in the bore (6), and a plurality of sliding vanes (10) which are slideably mounted in slots (12) in the rotor (8) such that the sliding vanes (10) are extendible at a radial angle with respect to the rotor (8), the bore (6) being such that it has a central portion (14) and a pair of lobe portions (16, 18) which are positioned one on either side of the central portion (14), the rotor (8) being mounted for rotation in the central portion (14) such that the lobe portions (16, 18) form a pair of compression chambers during use of the rotary vane compressor (2), and the central portion (14) and the lobe portions (16, 18) together having a bore wall (20) which is such that during use of the rotary vane compressor (2) the outer ends (22) of the vanes (10) are always in contact with the bore wall (20).



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A ROTARY VANE COMPRESSOR

This invention relates to a rotary vane compressor.

Rotary vane compressors are well known. They usually comprise a body, a bore in the body, a rotor mounted for rotation in the bore, and a plurality of sliding vanes which are slideably mounted in slots in the rotor. During operation, the rotary vane compressors generate heat such that one side of the compressor is hot and the other side of the compressor is relatively cold. The generated heat causes expansion within the rotary vane compressor and this expansion can cause the compressor to malfunction. More specifically, in one known type of rotary vane compressor, the rotor rotates between fixed side plates. The side plates are positioned such that the rotor floats between the side plates in order to cater for expansion during operation of the rotary vane compressor. Often the body of the compressor is made of a metal alloy, whilst the rotor is made of steel. Differential expansion rates tend to cause the rotor to engage the side plates if the rotary vane compressor has been operating for a time sufficient to get a substantial build-up,and is then stopped and restarted too soon. Another type of known rotary vane compressor attempts to overcome this problem of the rotor engaging the side plates by using floating side plates. The floating side plates thus operate inside the bore and it is not then necessary for the piston to float between the side plates. However, as the rotary vane compressor operates, the side plates are subjected to pressure and suction and this can cause them to lie at an angle on a mounting shaft, which in turn can lead to the angled side plates trapping the rotor and/or allowing air to pass through the side plates. In both of the stated known types of compressors, a further problem is that the heat generated during operation of the compressors causes the bodies to distort and become curved.

It is an aim of the present invention to obviate or reduce the above mentioned problems.

Accordingly, this invention provides a rotary vane compressor comprising a body, a bore in the body, a rotor mounted for rotation in the bore, and a plurality of sliding vanes which are slideably mounted in the slots in the rotor such that the sliding vanes are extendible at a radial angle with respect to the rotor, the bore being such that it has a central portion and a pair of lobe portions which are positioned one on either side of the central portion, the rotor being mounted for rotation in the central portion such that the lobe portions form a pair of compression chambers during use of the rotary vane compressor, and the central portion and the lobe portions together having a bore wall which is such that during use of the rotary vane compressor the outer ends of the vanes are always in contact with the bore wall.

Because the vanes extend at an angle, they are more resistant to breaking under the back pressure that occurs during operation of the rotary vane compressor. The two lobe portions give two of the compression-chambers during operation of the compressor so that two pressure sides exist which tend to equalize out each other, thereby preventing distortion of the body of the compressor into the above mentioned curved shape. The use of the two pressure sides also helps to prevent tilting of side plates if floating side plates are employed. Because the outer ends of the blades are always in contact with the bore wall, the rotary vane compressor operates in an especially efficient manner with the high pressure and the low pressure sides of the compressor always being isolated and this in turn helps to prevent the transfer of heat from one side of the compressor to the other. By preventing the transfer of heat from one side of the compressor to the other, the rotary vane compressor is prevented from operating at ever increasing temperatures, which is a defect of known rotary vane compressors and is often referred to as a carry-over effect.

The bore wall may define the general shape of an ellipse but not a pure ellipse since a pure ellipse is such that during operation of the rotary vane compressor, the ends of the vane would miss parts of the bore wall sand they would then not always be in contact with the bore wall.

Preferably, the bore wall defines the general shape of an ellipse by having a first part-circular portion for the central portion of the bore, and second and third part-circular portions for each of the lobe portions, the central portion and the lobe portions being connected together by fourth part-circular portions, and the fourth part-circular portions being such as to have a larger radius than the first, second and third part-circular portions.

If the first part-circular portion has a radius which is regarded as 100%, then the second part-circular portion may have a radius which is 68.75%, the third part-circular portion may have a radius which is 118.23%, and the fourth part-circular portion may have a radius which is 190.55%, with the third part-circular portion having the centre of its radius at a distance of 56% from the centre of the radius of the first part-circular portion. Larger or smaller percentage values may be employed if desired.

The radial angle of the sliding vanes may be an angle of 10-25° to the radius of the perimeter of the rotor. A larger or smaller radial angle may however be employed. A presently preferred angle is 15° to the radius at the perimeter of the rotor.

Preferably, the rotary vane compressor is one in which there are twelve vanes. The compressor may have more or less vanes if desired but the twelve vanes give good operation and may be contrasted to known rotary vane compressors which normally have only six vanes.

Preferably, the rotary vane compressor has floating side plates. Floating side plates may assist in stopping vane breakages in the event that the rotary compressor should operate above its designed pressure. If desired however the rotary vane compressor may use fixed side plates.

Preferably, the bore is short in length compared to existing bores in known rotary vane compressors. This is because the body of the compressor is made of a metal and it is difficult to cut the bore out of the metal. With long bores, the boring tool tends to deflect, and a short bore obviates this problem.

The rotary vane compressor may include coupling means for coupling two or more of the rotary vane compressors together. Preferably, the coupling means is a flexible coupling means.

The present invention also extends to a rotary vane compressor arrangement comprising two or more of the rotary vane compressors.

Embodiments of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

Figure 1 is a cross section of a rotary vane compressor;

Figure 2 is a side view of the rotary vane compressor as shown in Figure 1;

Figure 3 illustrates the shape of the bore;

Figure 4 illustrates the operation of the rotary vane compressor;

Figure 5 shows a rotary vane compressor arrangement comprising two of the rotary vane compressors;

Figure 6 shows a rotary vane compressor arrangement comprising three of the rotary vane compressors; and

Figure 7 is a side view of the rotary vane compressor arrangment shown in Figure 6.

Referring to Figures 1-4, there is shown a dual chamber rotary vane compressor 2 comprising a body 4 and a bore 6 in the body 4. A rotor 8 is mounted for rotation in the bore 6. A plurality of sliding vanes 10 are slideably mounted in slots 12 in the rotor 8. The sliding vanes 10 are so mounted that they are extendible at the radial angle with respect to the rotor 8 as shown in Figure 4. Also as shown in Figure 4, the bore 6 has a central portion 14 and a pair of lobe portions 16, 18 which are positioned one on either side of the central portion 14. The rotor 8 is mounted for rotation in the central portion 14 such that the lobe portions 16, 18 form a pair of compression chambers during use of the compressor 2.

As shown most clearly in Figure 3, the central portion 14 and the lobe portions 16, 18 together have a bore wall 20 which is such that during use of the compressor 2, the outer ends 22 of the vanes 10 are always in contact with the bore wall 20. As can be seen from Figure 4, the outer ends 22 of the vanes 10 are in the form of angled or chamferred tips.

As can be seen from Figures 3 and 4, the bore wall 20 defines the general shape of an ellipse but not a pure ellipse since a pure ellipse is such that during operation of the compressor 2, the outer ends 22 of the vanes 10 would miss parts of the bore wall, and the outer ends 22 of the vanes 10 would then not always be in contact with the bore wall 20. The bore wall 20 defines the general shape of an ellipse by having a first part-circular portion 24 for the central portion 14 of the bore 6, a second part-circular portion 26, and a third part-circular portion 28. The second and third part-circular portions 26, 28 together make up one of the lobe portions 16, 18. The central portion 14 and the lobe portions 16, 18 are connected together by a fourth part-circular portion 30, and the fourth part-circular portion 30 is substantially less curved than the other part-circular portions 24, 26, 28. Thus the fourth part-circular portion 30 has a larger radius than the first, second and third part-circular portions 24, 26, 28. As can be seen from Figure 3, the third part circular portion 28 connects to the first part circular portion 24 by a tangent T.

Still referring to Figure 3, the compressor 2 is such that if the first part-circular portion 24 has a radius r2 which is regarded as 100%, then the second part-circular portion 26 has a radius r4 which is 68.75%, the third part-circular portion 28 has a radius r3 which is 118.23%, and the fourth part-circular portion 30 has a radius r1 which is 190.55%, with the third part-circular portion 28 having the centre 32 of its radius r3 at a distance of 56% from the centre 34 of the radius r2 of the first part-circular portion 24.

Referring now again to Figure 4, it will be seen that the compressor 2 has twelve of the vanes 10. The vanes 10 may be at an angle of 10-25° to the radius at the perimeter of the rotor 8. A preferred angle is 15°.

As can be seen from Figures 1 and 2, the compressor 2 has floating side plates 36, 38. As can also be seen from Figure 1, the bore 6 is relatively short in length compared with existing bores in known rotary vane compressors. The short bore 6 is advantageous in manufacture of the compressor 2 in that the bore 6 can be bored out without the boring tool tending to deflect too much.

The compressor 2 further comprises manifolds 40, 42. Either manifold 40, 42 can be an inlet manifold, and the other manifold will then be an outlet manifold. A cover 44 covers the manifolds 40, 42 as shown. The cover 44 locates on a fan housing 46 as shown. The fan housing 46 covers a pair of fans 48 as shown. Each fan 48 is mounted on a fan boss 50.

An axle 52 passes through the fan bosses 50. The rotor 8 is mounted on the axle 52. As shown in Figure 1, the left hand end of the axle 52 is held in position by a nut 54. The right hand end of the axle 52 is held in position by a holding stud 56, a washer 58 and a locking nut 60. A woodruf key 62 is also employed.

The compressor 2 further comprises grease seals 64 and springs 66. The springs 66 act on fixed outer side plates 68, 70 and bias the inner floating side plates 36, 38 inwardly to give fixed clearance gaps 72, 74.

The fixed outer side plates 68, 70 are held in position by studs 76 and locking nuts 78.

A tapered drive flange 80 is mounted on the axle 52 and held in position by the holding stud 56, the washer 58 and the locking nut 60. The axle 52 rotates in bearings 82 and the bearings are held in bearing collars 84. The bearings 82 are also held in position by bearing housings 86.

As can be seen from Figure 2, the cover 44 fits around a part of the manifold 40 and a flange 88 is provided with holes 90 for enabling the flange 88 to be bolted to an appropriate piece of equipment.

As the compressor 2 operates, labyrinth seals 92 act to isolate the rotor 8 from the fixed outer side plates 68, 70. Studs 94 help to mount the inner floating side plates 36, 38 in respect to the springs 66.

Referring now to Figure 5, there is shown a rotary vane compressor arrangement 96 comprising two compressors 2. Manifold ducting 98 for the manifolds 40, 42 is shown. Also shown in Figure 5 is a connecting flange 100 for connecting over the woodruf key 62.

Figures 6 and 7 show a rotary vane compressor arrangement 98 in which three of the compressors 2 are connected together. The compressors 2 shown in Figure 6 are connected together by coupling means in the form of flexible couplings 102.

It is to be appreciated that the embodiments of the invention described above with reference to the accompanying drawings have been given by way of example only and that modifications may be effected. Thus, for example, in Figure 5, distance pieces 104 are employed to keep the two compressors 2 apart but the shape of these distance pieces 104 may be varied as may be desired.

Claims

1. A rotary vane compressor comprising a body, a bore in the body, a rotor mounted for rotation in the bore, and a plurality of sliding vanes which are slideably mounted in the slots in the rotor such that the sliding vanes are extendible at a radial angle with respect to the rotor, the bore being such that it has a central portion and a pair of lobe portions which are positioned one on either side of the central portion, the rotor being mounted for rotation in the central portion such that the lobe portions form a pair of compression chambers during use of the rotary vane compressor, and the central portion and the lobe portions together having a bore wall which is such that during use of the rotary vane compressor the ends of the vanes are always in contact with the bore wall.

2. A rotary vane compressor according to claim 1 in which the bore wall defines the general shape of an elipse.

3. A rotary vane compressor according to claim 2 in which the bore wall defines the general shape of an elipse by having a first part-circular portion for the central portion of the bore, and second and third part -circular portions for each of the lobe portions, the central portion and the lobe portions being connected together by fourth part-circular portions, and sthe fourth part-circular portions being such as to have a larger radius than the first, second and third part-circular portions.

4. A rotary vane compressor according to claim 3 in which, if the first part-circular portion has a radius which is regarded as 100%, then the second part-circular portion has a radius which is 68.75%, the third part-circular portion has a radius which is 118.23%, and the fourth part-circular portion has a radius which is 190.55%, with the third part-circular portion having the centre of its radius at a distance of 56% from the centre of the radius of the first part-circular portion.

5. A rotary vane compressor according to any one of the preceding claims in which the radial angle of the sliding vanes is an angle of 10-25° to the radius at the perimeter of the rotor.

6. A rotary vane compressor according to claim 5 in which the radial angle of the sliding vanes is 15° to the radius at the perimeter of the rotor.

7. A rotary vane compressor according to any one of the preceding claims in which there are twelve vanes.

8. A rotary vane compressor according to any one of the preceding claims and including floating side plates.

9. A rotary vane compressor according to any one of the preceding claims and including coupling means for coupling, two or more of the rotary vane compressors together.

10. A rotary vane compressor according to claim 9 in which the coupling means is a flexible coupling means.

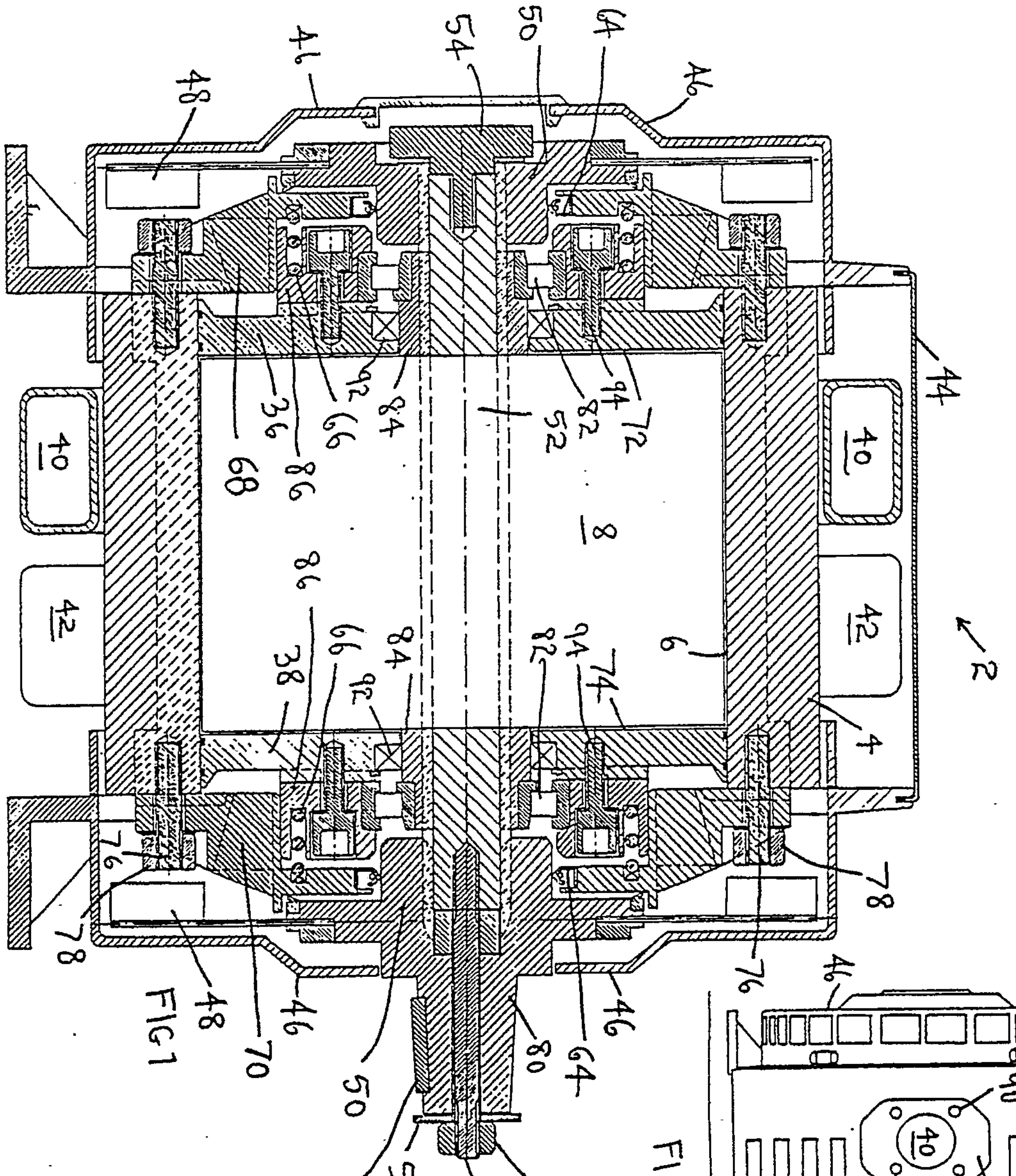

FIG 1

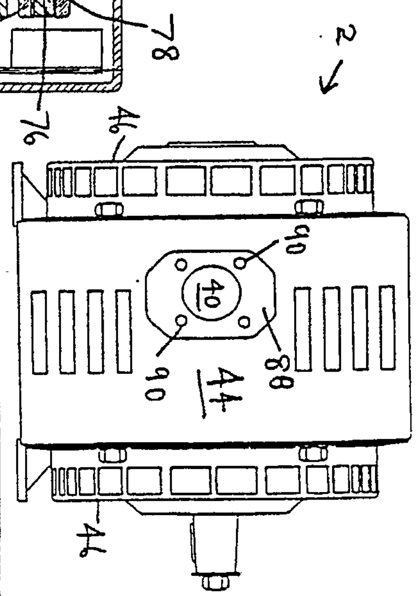

FIG 2

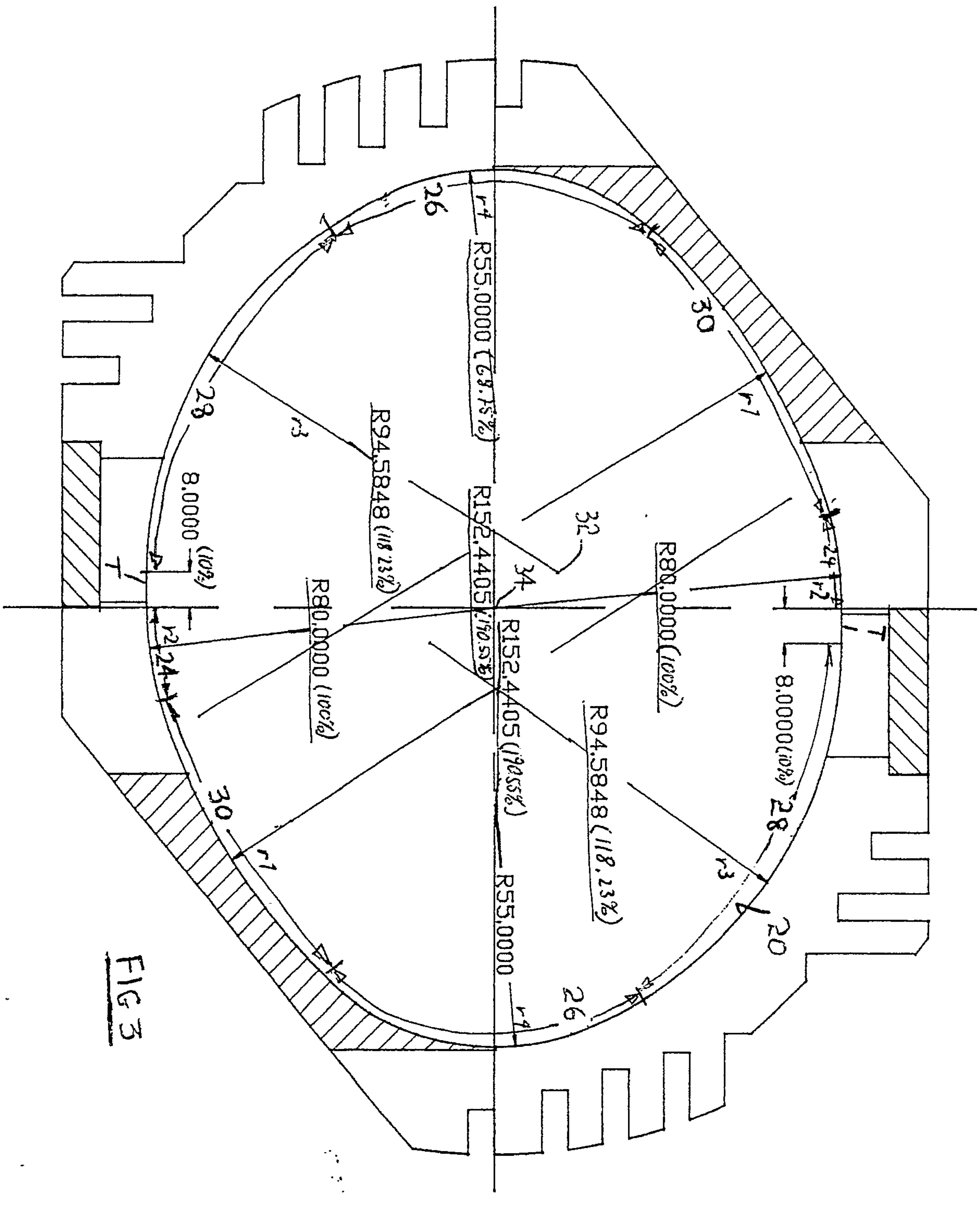
R55.0000
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FIG 3

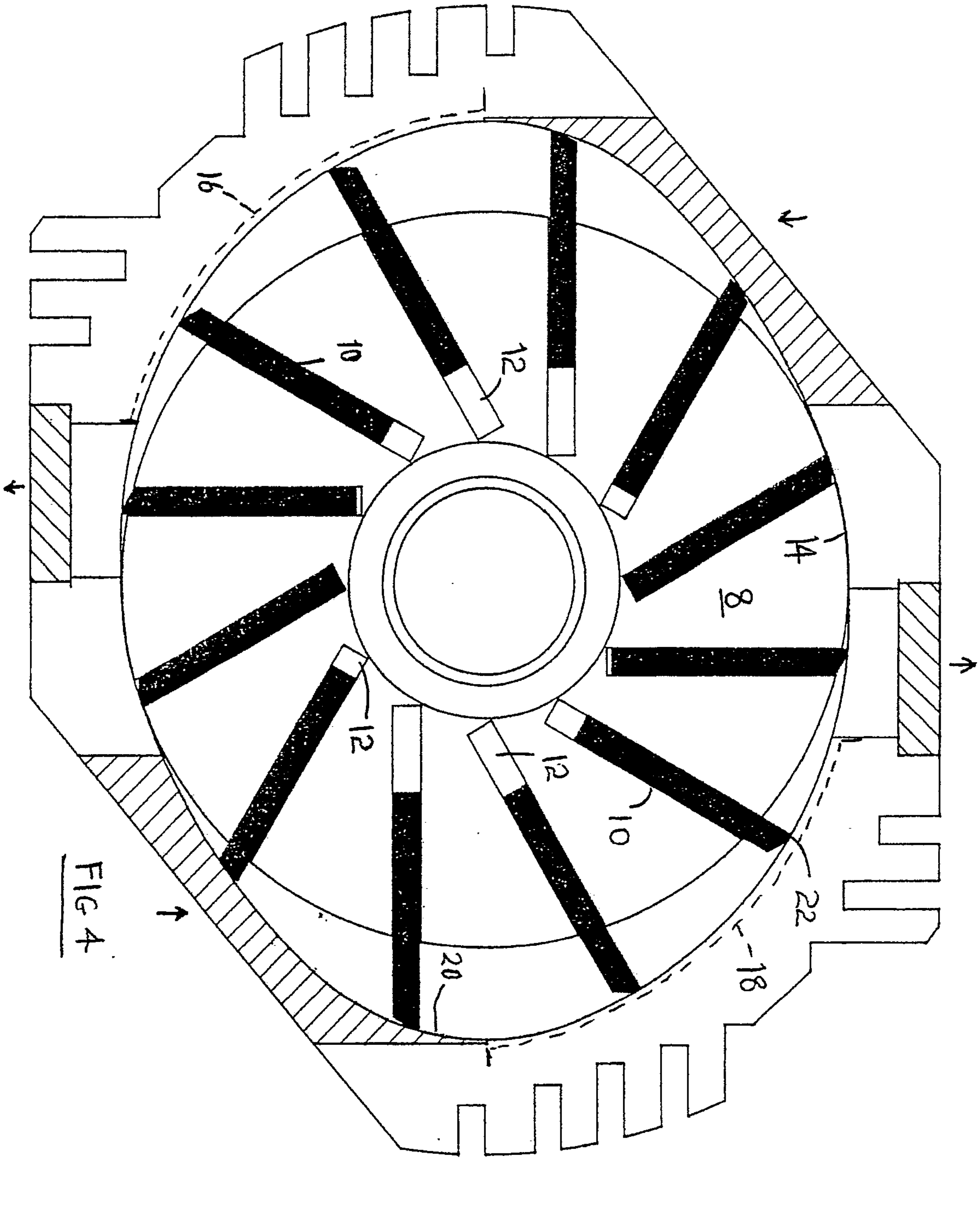

FIG 4

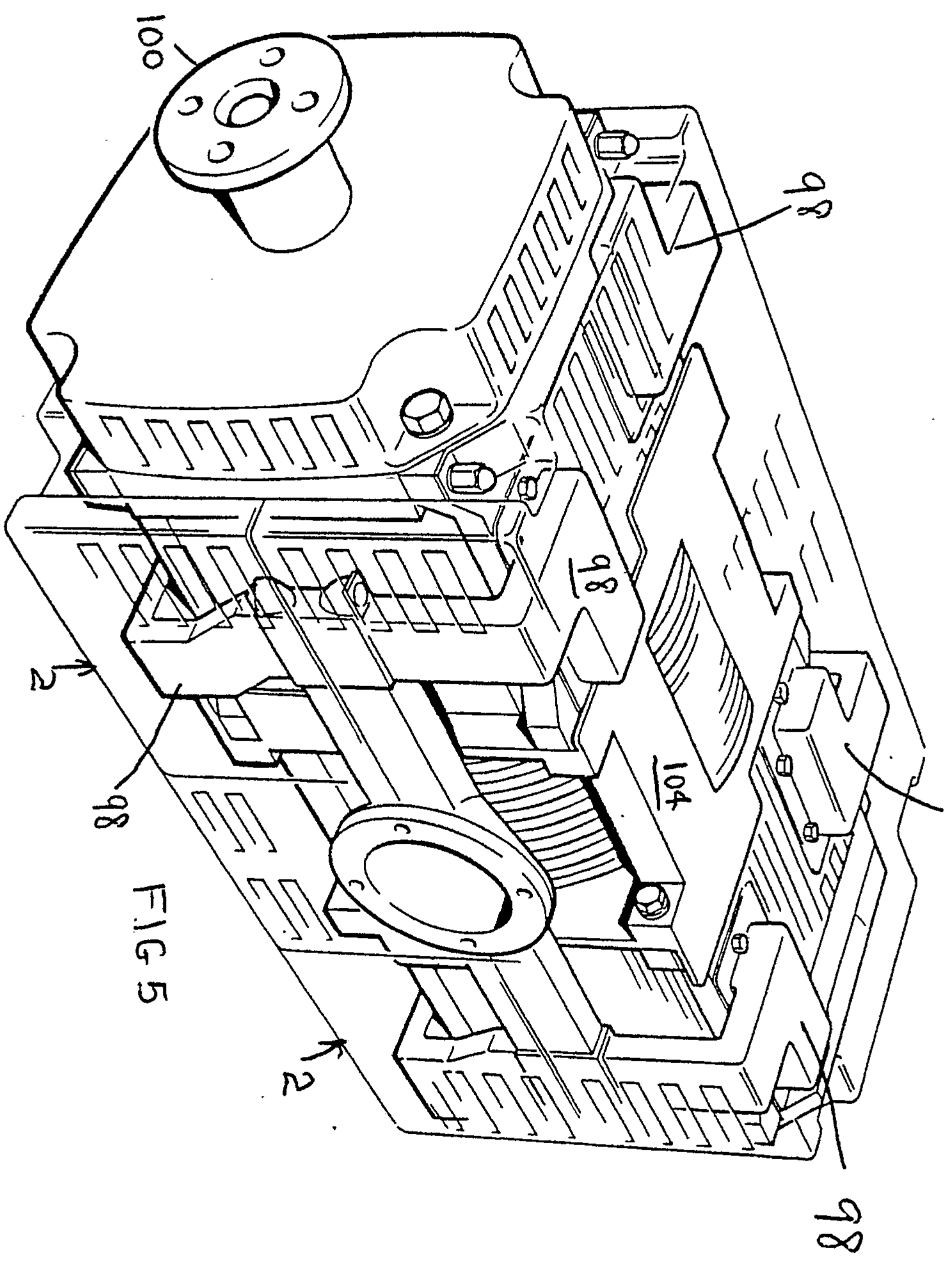

FIG 5

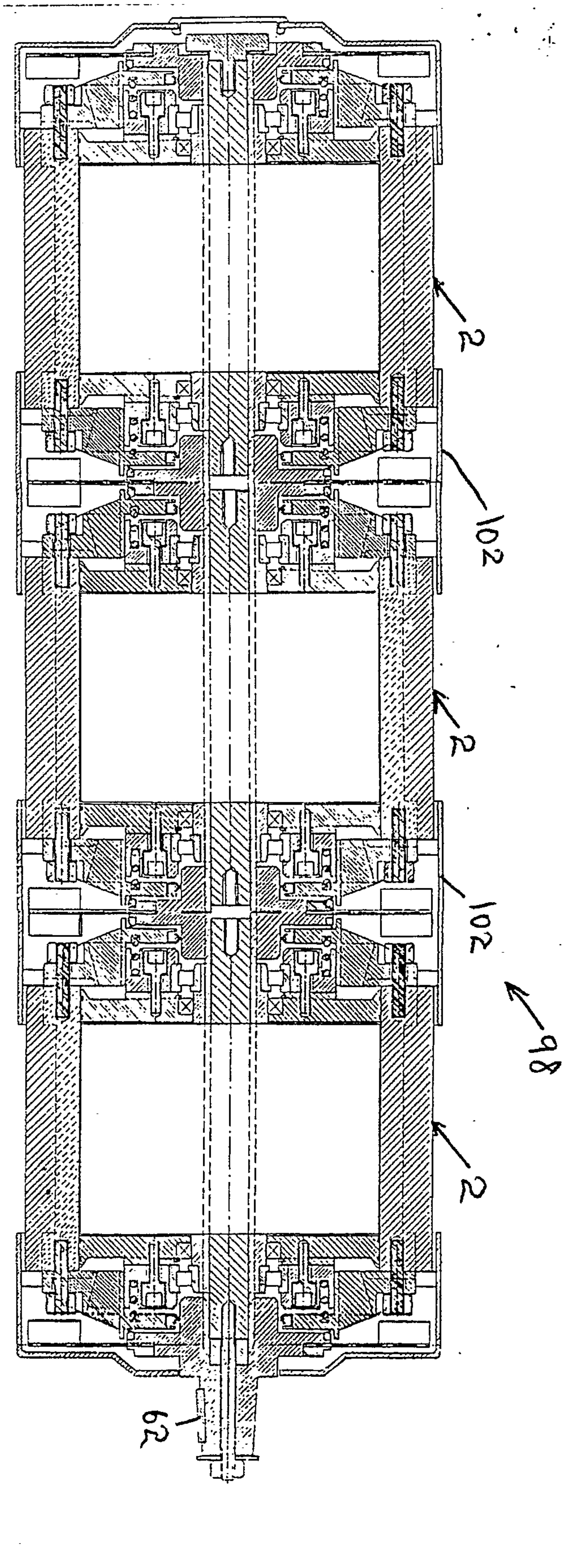

FIG 6

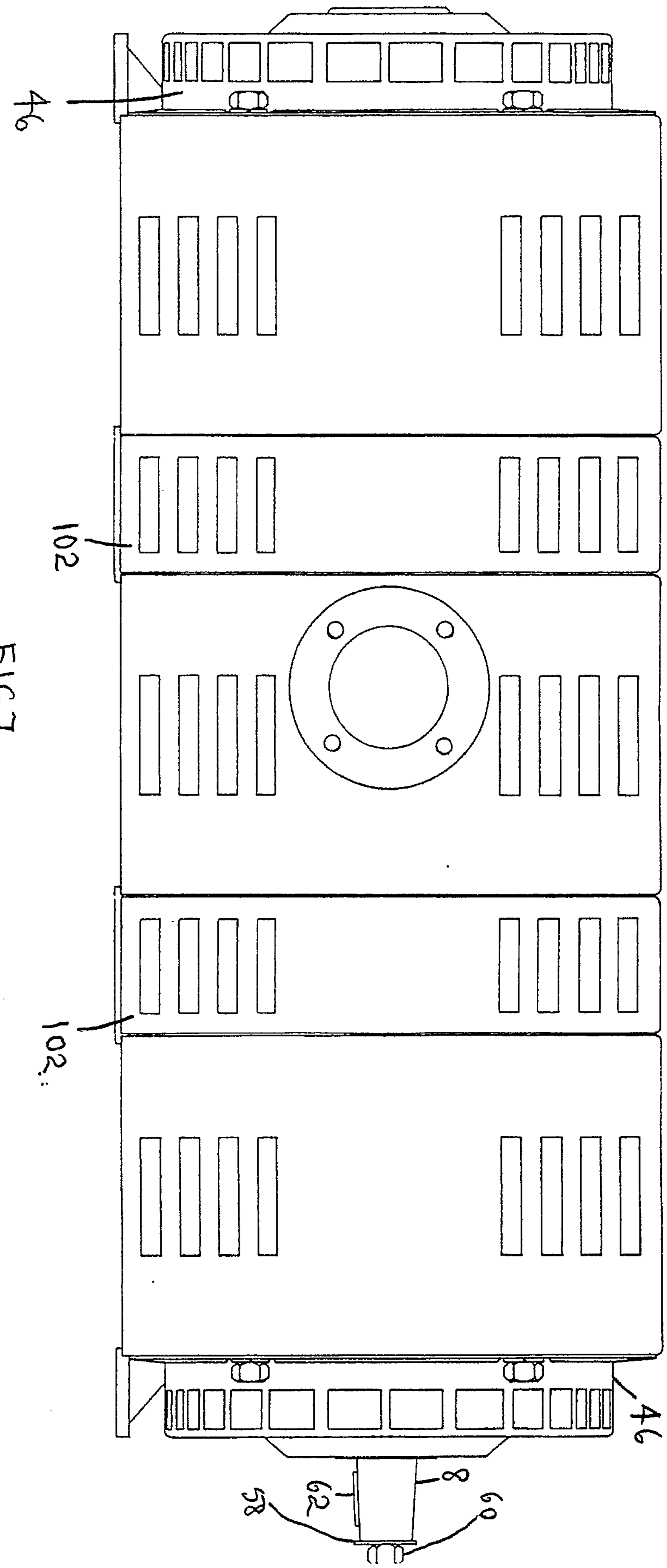

FIG 7