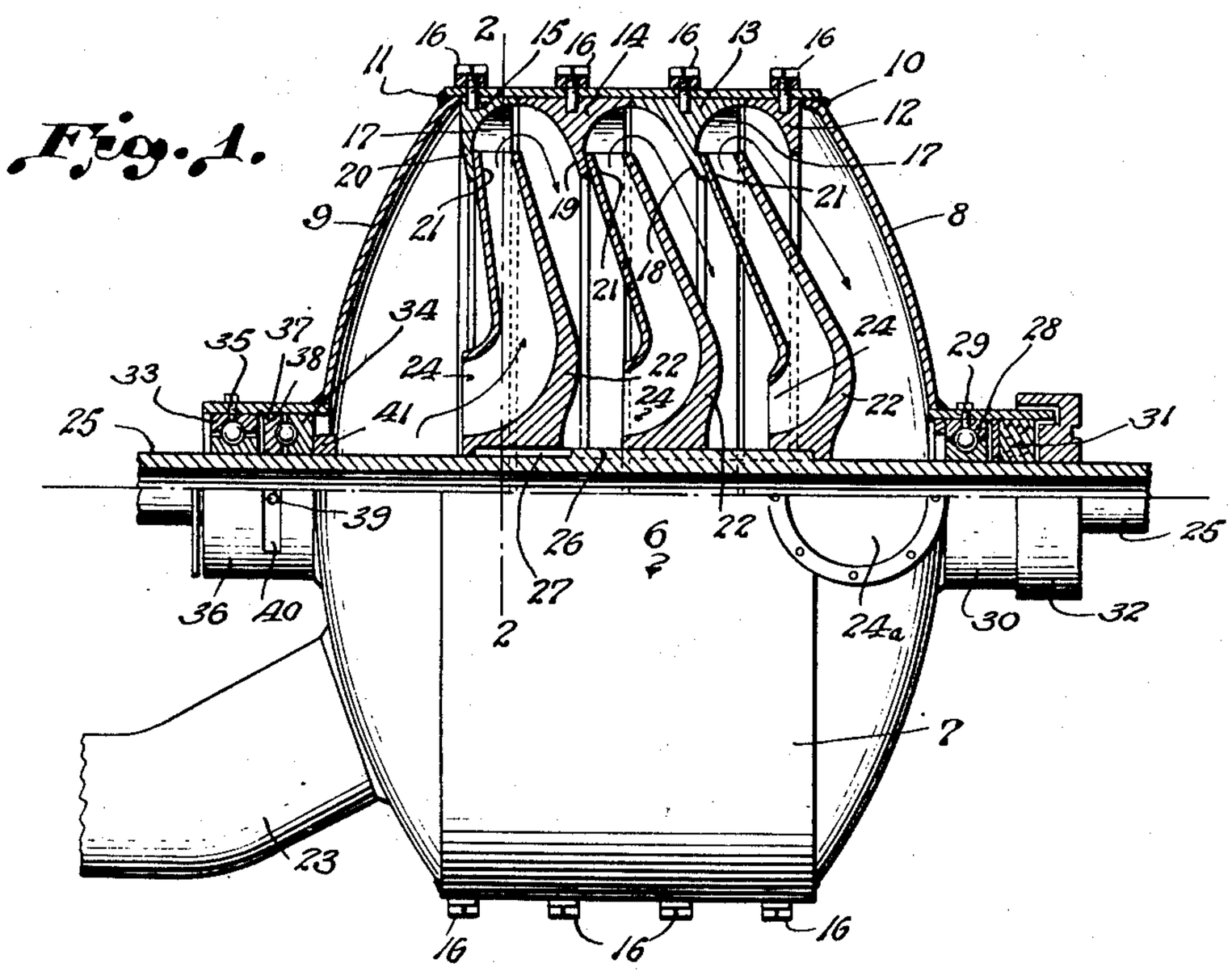
March 6, 1951 W. T. MIXSELL 2,543,923

RADIAL AIR COMPRESSOR

Filed April 13, 1948

Fig. 1.



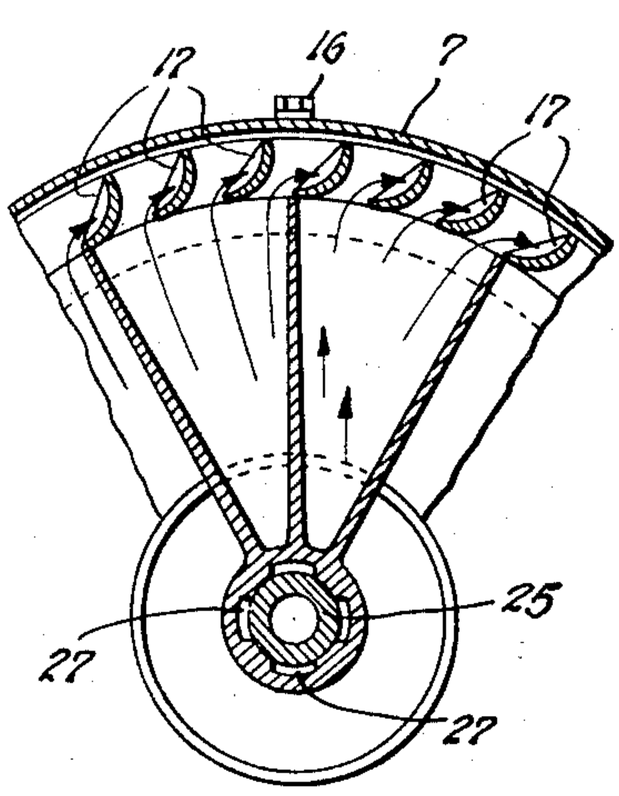


Fig. 2.

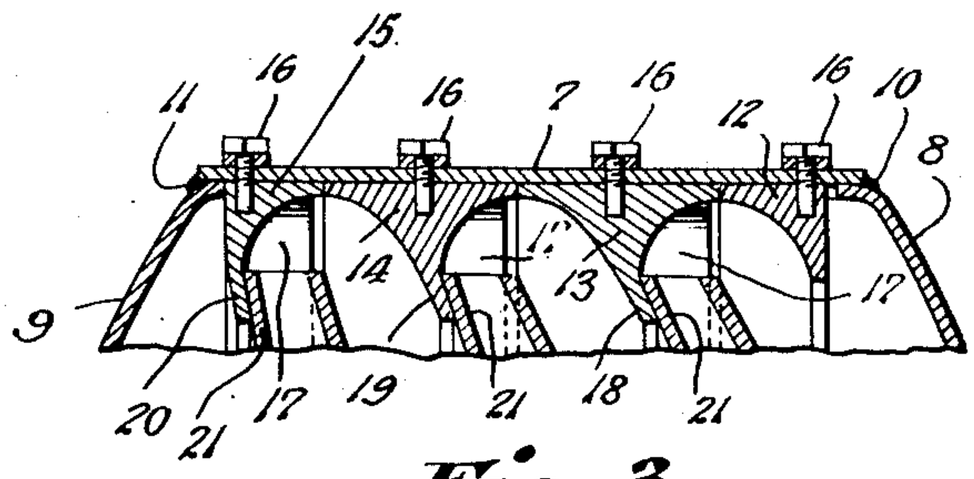


Fig. 3.

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RADIAL AIR COMPRESSOR

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2 Claims. (Cl. 230—130)

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This invention relates to improvements in radial air compressors or pumps such as of a type which may be used for supplying compressed air to gas turbines for aeronautical services and in other environments in which such radial air compressors are adapted to be used.

Radial air compressors at present are generally of two types, first, the free flow type in which air is moved by the impellers and is discharged into a circular chamber and in the case of multi-stage machines from the chamber to the inlet of the succeeding set of impellers, or secondly, the air is discharged from the impellers against vanes, whereby the flow is partially reversed, thereby converting the kinetic energy into static pressure, this type being much more efficient, when operating a full volume capacity, and designed pressure, but unlike the free flow type, if the delivery volume is reduced higher pressures occur which react against the flow from the impellers thereby setting up pulsations and vibrations, which are harmful to the compressor and driving member.

My invention is directed to improvements in radial compressors of the free flow type, with a variable volume delivery, said compressor containing means to arrest the circulatory motion of air being discharged, thus converting the same into static pressure. Thus, the compressor is provided with diverters to direct the air tangentially and thereby stop the circular or rotary motion of the air, and further the compressor is provided with deflectors to redirect the flow of air toward the inlet of the succeeding impeller, so that the mass is brought to a practical state of rest and a higher pressure obtains at that area, and thereby permits volumetric variations, without back pressure reactions. Also by discharging the air tangentially, I eliminate the outer space surrounding the vanes, such a space being common in compressors of this type, and can thereby reduce the outer diameter of the compressor by twice that space, with a corresponding reduction in weight.

In order to reduce the overall length of the compressor, I turn the impeller outlets back upon themselves, while still retaining ample space for air to enter the same, so that it will be possible to use four or five stages in the same length where it was heretofore required to be able to use only three or four stages, thereby reducing the pressure rise in each stage, which will increase the efficiency, and also reduce the required diameter of the impellers and the entire machine.

A further improvement is in the method of

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constructing the entire unit. Usually multi-stage pumps and compressors are built split horizontally, being made from two castings and held together by flanges and a plurality of bolts, whereas I use a cylinder of high tensile material, as for example a shell, provided with separator rings, said rings subdividing the chambers, and the rings can be made of cast aluminum machined to fit in the cylinder, the same having a flange in close running contact with the shroud of the impeller to prevent air leakage, the diverters and deflectors are a part of the same ring and can be of one casting, the ring being held in proper position by dowels or set screws. The heads preferably are made of pressed steel and are identical, and can be welded to the cylindrical shell.

Another improvement is in the shaft carrying the impellers which is preferably made hollow, thereby to pass cold air through the same to cool the bearings in which the shaft is mounted, if desired.

A further object is to provide at the discharge end of the compressor a bearing which carries the shaft and also a packing gland outside of the bearing thus preventing air and oil leakage, the packing also being lubricated by the oil in the reservoir. At the inlet end a bearing carries the shaft and then another bearing which takes the pressure thrust against the impellers, this bearing having an adjustable member to regulate the clearance between the rotating impellers, and the flanges of the separators.

The invention is not intended to be limited to the exact construction shown, but is capable of various modifications and forms, the accompanying drawings and illustrations disclosing a preferred construction.

In the drawings:

Fig. 1 is an elevational view partly in section;

Fig. 2 is a section taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view of a part of the outer portion of the compressor showing the outer shell, the separator rings, air deflectors and impeller shrouds.

Referring specifically to the drawings in which like numerals indicate similar parts throughout the various views, the compressor is indicated generally at 6, the same comprising a cylinder or shell 7 of a high tensile strength material and having identical head members 8 and 9, said members being welded as at 10 and 11 to the cylinder 7 when the various units of the compressor are finally assembled. The cylinder or

shell 7 is further provided adjacent its inner surface with a plurality of cast deflector members or separators 12, 13, 14 and 15 thereby dividing the interior of the compressor into respective chambers, the separators being machined to fit in the cylinder and held in place as by dowels or set screws 16. The cast deflector members are further provided with air diverters 17 which are formed as a part of the separator rings. The separator rings are provided with downwardly extending flange portions 18, 19 and 20 which form a portion which is in close running contact with the shroud parts 21 of the respective impellers 22 of the compressor.

As will be seen the end portion 9 of the compressor has an air inlet 23 and the respective impeller blades have air inlet openings 24 which openings conduct air through the impeller blades, pellers, the blades being turned back upon themselves and discharging air against the deflectors 12, 13, 14 and 15 and also against the air diverters 17, the air traveling from the respective chambers to the next succeeding impeller inlet and finally to the air outlet 24*a*.

Thus it will be seen that by having the respective impeller blades turn back upon themselves that the compressor can be made much smaller than those of known construction, and further the outer diameter of the compressor is much reduced in size because of the arrangement of the air deflectors and diverters, and because of which the air space can be greatly reduced in size.

The impellers are made as separate units and are mounted on a hollow shaft 25, the shaft being provided with splines 26 which receive complementary recesses or key ways 27 formed in the hubs of the impellers. The rotary shaft 25 carrying the impeller blades at its rear end is mounted in a bearing 28 held in place by a stud 29 extending through a flanged portion 30 which is welded to the end 8. Adjacent the bearing 28 is a packing gland 31 to prevent oil and air leakage, the gland 31 being held in place as by a retaining member 32. At the other end the shaft 25 is mounted in two bearings 33 and 34, the bearing 33 being a roller bearing and being held in place by a stud 35 extending through an extension 36 welded to the head 9. The other bearing 34, a thrust bearing, is threaded as at 37 said threads engaging with threads 38 on the inner surface of the extension 36. The bearing 34 is provided with a key or tool socket 39 and the extension 36 is provided with a slot 40 whereby access may be had to the socket 39 to engage the same by a tool to move the bearing 34 toward and from a shoulder 41 said shoulder being a part of the shaft 25, whereby the shaft, containing the respective impellers can be moved longitudinally to some extent, thus moving the impellers to thereby vary the distance between

the flanges 20 of the air deflectors and the portions 21 of the impeller shrouds.

In the assembly of the compressor the shell 7 and the head 9 thereof are first assembled, the head 9 of course carrying the bearings 33 and 34. The shaft 25 is taken and the first separator ring 15 moved over the shaft after which the first impeller is driven onto the shaft in tight fit therewith, and successively each of the separator rings and its associated impeller is mounted on the shaft, this of course being done while the shaft and the respective elements are removed from the shell 17. Thus we have the shaft 25 with the respective units mounted thereabout. After this, the shaft with its impellers and separator rings are pushed into the shell 7 whereupon the studs 16 are engaged in the complementary recesses in the respective rings to hold the same in place. The head 8 with its bearing and stuffing box is then attached to the shell 7 thereby completing the assembly.

The invention is not limited to the exact construction shown, but is capable of variation within the scope of the following claims.

I claim:

1. In a radial compressor, the combination comprising a shell, heads on said shell, air inlet and discharge ports, bearings in the heads, a shaft mounted in the bearings, shrouded impellers mounted on the shaft, separator rings mounted within the shell and having downwardly extending flanged portions being spaced in close proximity to the shrouds of the impellers to form separate air pressure chambers, deflector blades mounted on the separator rings, the surfaces of the separator rings and the deflector blades tending to change the radial and circular flow of air from the shrouded impellers and directing the same tangentially into the surrounding space.

2. In a radial compressor, the combination comprising a shell, heads on said shell, air inlet and discharge ports, bearings in the heads, a shaft mounted in the bearings, shrouded impellers mounted on the shaft, separator rings mounted within the shell, said rings having flanges extending downwardly within the air space and spaced in close proximity to the shrouds of the impellers to thereby form separate pressure chambers, and deflector blades mounted on the separator rings and extending inwardly in close proximity to the outer ends of the impellers.

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