Nov. 1, 1955 W. A. LEDWITH ET AL 2,722,373

COMPRESSOR CASING AND STATOR ASSEMBLY

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Fig. 1.

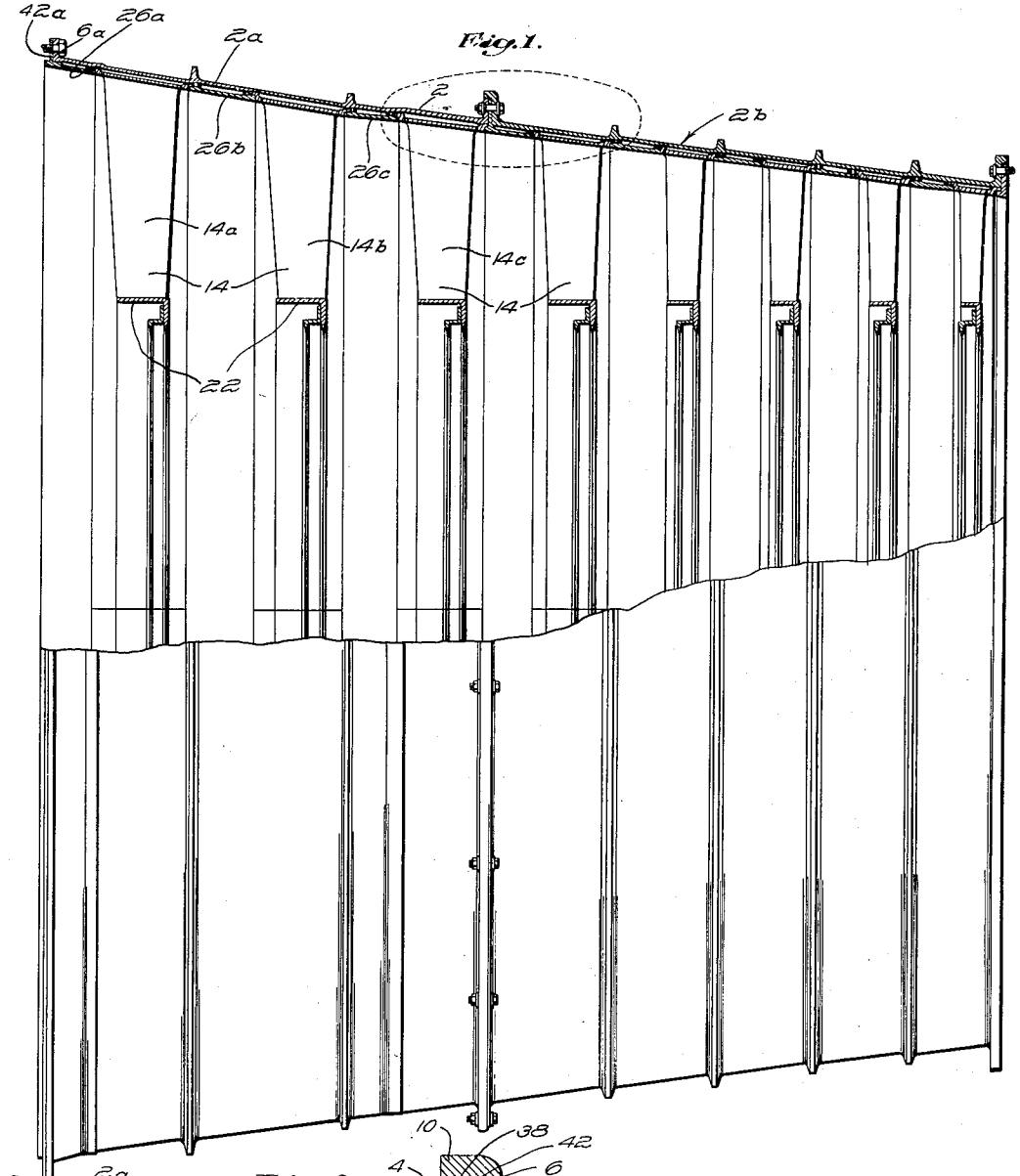
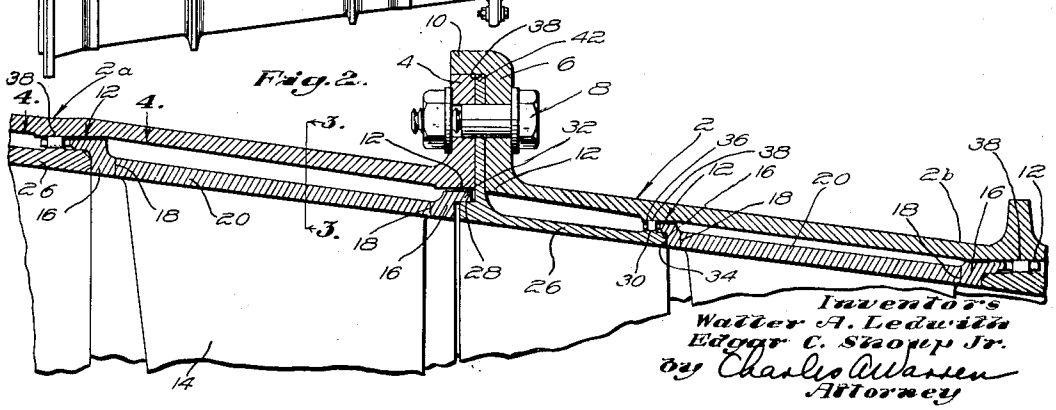


Fig. 2.



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Fig. 3.

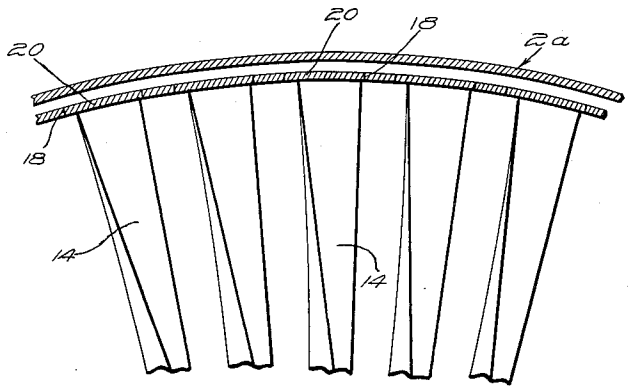


Fig. 4.

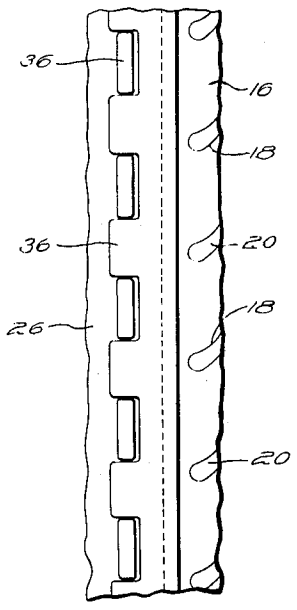
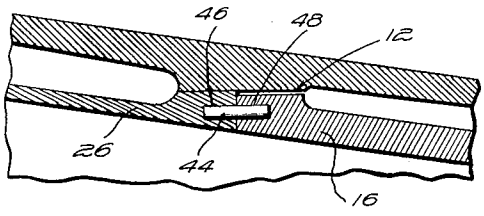


Fig. 5.



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COMPRESSOR CASING AND STATOR ASSEMBLY

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Application February 6, 1951, Serial No. 209,556

9 Claims. (Cl. 230—133)

This invention relates to a compressor and particularly to the arrangement of the casing and the stator vanes carried by the casing in a multistage axial flow compressor.

Where weight is a serious problem, as in aircraft power plants, an annular casing with no longitudinal splits provides a lighter construction with the rows of stator vanes being assembled by insertion axially into the casing. A feature of this invention is an annular casing within which the rows of stator vanes may be positioned, with the rows of vanes being split and the casing serving to hold the rows of vanes in assembled relation. Another feature is the interposition of spacer rings between adjacent rows of stator vanes for maintaining the spacing between the vanes and for locking the rows of vanes against rotation within the casing. Another feature is the arrangement of the casing such that its inner surface diminishes in diameter from one end to the other to facilitate the positioning of the casing over the assembled stator vanes and spacer rings.

One feature of the invention is an arrangement by which to secure the several rows of stator vanes against rotation within the casing without the necessity for a securing means between the casing and each separate row of vanes. Another feature is the attachment of one of a group of rows of vanes to the casing and the provision of inter-engaging lugs on the other rows of the group to prevent relative rotation.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a side elevation partly in section of the compressor casing.

Fig. 2 is a fragmentary sectional view on a larger scale of the section delineated by the dotted lines of Fig. 1.

Fig. 3 is a fragmentary sectional view substantially on line 3—3 of Fig. 2.

Fig. 4 is a fragmentary developed view substantially on line 4—4 of Fig. 2.

Fig. 5 is a fragmentary longitudinal sectional view of a modification.

The invention is shown in a multistage axial flow compressor construction in which the casing **2** is unsplit in a longitudinal direction such that there is no need for bolting flanges or the like thereby reducing the weight of this element. This construction also permits the contours of the casing to be produced by turning operations, to give accurate control of wall thickness. The casing may be made up of a number of separate circumferentially continuous rings **2***a* and **2***b*, in which event the adjacent edges of the rings may have complementary flanges **4** and **6** (Fig. 2) by which the casing rings may be held together as by bolts **8**. For piloting the adjacent casing rings it may be advantageous to have one of the flanges (flange **6** in the arrangement shown) provided with a cylindrical flange **10** at its periphery of such a dimension as to receive and fit closely around the peripheral surface of the

cooperating flange **4**, thus piloting the ring **2***a* with respect to ring **2***b*.

The casing preferably decreases in diameter from one end to the other and the inner surface may be provided with a number of axially spaced piloting surfaces **12** each of which is preferably smaller in diameter than the adjacent piloting surface for ease of assembly as will hereinafter appear. As best shown in Fig. 2, the piloting surfaces **12** are substantially cylindrical and they are joined by sections having frusto-conical inner surfaces.

The casing supports spaced rows **14** of stator vanes which when the compressor is completely assembled alternate with cooperating rows of moving blades, not shown. The individual vanes making up any one of the rows of vanes **14** are supported at their outer ends by a shroud ring **16** which may be axially tapered or frusto-conical and which, in the arrangement shown, is provided with openings **18** to receive the individual shroud piece **20** on each individual vane. The shroud pieces may be welded or brazed or otherwise positively held in the shroud ring **16**. The inner ends of the vanes may be secured in position as by an inner shroud ring **22**, Fig. 1.

For the purpose of maintaining the proper spacing between adjacent vane shrouds, spacer rings **26** are positioned between adjacent shroud rings and are preferably notched to form radially extending lugs at opposite edges as at **28** and **30** to cooperate with similar notches **32** and **34** in the edges of the shroud rings. The spacer rings **26** and the adjacent shroud rings preferably have integral inter-engaging means in the form of interlocking detents **36**, Fig. 4, which serve to prevent relative rotation between the spacer rings and the adjacent shroud rings. It will be noted that the spacer rings have piloting surfaces **38** which may be on the detents **36** and which engage the surfaces **12** to position the spacers accurately within the casing. The surfaces **38** are preferably located adjacent to the edges of the spacer ring.

For the purpose of preventing rotation of the rows of vanes within the casing, one of the centrally located spacer rings out of a group of interlocked spacer rings and shroud rings has a radially extending flange **42** which is positioned between the flanges **4** and **6** of the casing and is prevented from rotation with respect to the casing by the same bolts **8** that hold the casing rings together. The flange **42** is preferably located on the endmost ring of the group such that the clamping of the flange serves to hold the rings axially in position within the casing. Pilot surface **38** on the flange end of this spacer ring is shown as located on the periphery of flange **42**.

For ease of assembly of the casing and stator vane assemblies around the compressor rotor it is desirable to have the shroud rings for the stator vanes split as shown so that the stator vanes may be positioned between adjacent rows of blades on a completely assembled rotor. Thus, in assembling the device, each of the stator rings in the form of 2 halves is assembled around the rotor with the spacer rings appropriately positioned between adjacent shroud rings until at least one group, as above described, of inter-engaging spacer and shroud rings are assembled as, for example, the first three rows of stator vanes **14***a*, **14***b*, and **14***c* and the inter-engaging spacer rings **26***a*, **26***b*, and **26***c*. When these are in position around the rotor it will be apparent that the casing ring **2***a* may then be positioned around the assembled structure by movement from right to left in Fig. 1 until the radially projecting flange **42***a* on the spacer ring **26***a* is engaged with the radial flange **6***a* on the casing ring. It will be apparent that the spaced piloting surfaces **12** on the casing ring engage the appropriate piloting surfaces **38** on the spacer rings. In a similar manner the shroud rings and spacer rings enclosed within the casing ring **2***b* may be assembled around the rotor and then the casing

ring may be positioned in a manner similar to that above described in connection with the casing ring *2a*. The final result is a very light weight casing and stator vane assembly which is sufficiently strong to withstand the loads applied to it and which also permits the rows of vanes to be split without a corresponding split in the supporting casing. The splits in adjacent vane rings may be staggered circumferentially to eliminate any general plane of flexibility in the assembled structure. It may be further noted that no fastening means are provided between the casing and each individual shroud ring or spacer ring since the inter-engaging lugs between adjacent shroud rings and spacer rings will function to prevent rotation of the parts within the casing.

In the modification of Fig. 5 the interlocking detents which align the spacers and shroud rings may be replaced by axial pins **44** which are received in bores **46** in the spacer **26** and other bores **48** in the shroud ring **16**. It will be obvious that these pins will transmit the torque between adjacent shroud rings and will also serve to pilot the shroud rings and spacers so that a group of shroud rings and spacers may be assembled without any extraneous supporting means prior to the positioning of the surrounding casing. Also in this modification, as in the arrangement of Figs. 1–4, a clearance surface is provided between the piloting surface **12** on the casing and the shroud ring **16** such that the spacer rings are the piloting elements between the outer casing and the shroud rings.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

We claim:

1. In a compressor construction, an annular casing the inner surface of which decreases in diameter from one end to the other, axially spaced rows of vanes positioned within the casing, each row of vanes having a shroud ring engaging with and supporting the outer ends of a number of the vanes in the row, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes, said spacer rings having piloting means thereon for engagement with the inner surfaces of the casing to maintain the concentricity of the spacer rings with respect to the casing, and said shroud rings and said spacer rings having interengaging piloting means to maintain concentricity between the spacer and shroud rings, a group of said spacer rings and shroud rings having inter-engaging means thereon by which to prevent relative rotation, and one of the centrally located rings of said group having a radially extending flange engaging with a flange of said casing and held against rotation relative thereto.

2. In a compressor construction, an annular casing the inner surface of which decreases in diameter from one end to the other, one end of the casing having a radially extending attaching flange, axially spaced rows of vanes positioned within the casing, each row having a shroud ring engaging with and supporting the outer ends of a number of the vanes in the row, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes, one of said spacer rings having a radially extending flange projecting over and secured to the attaching flange on the casing such that the spacer ring is located axially within the casing and prevented from turning therein.

3. In a compressor construction, an annular casing the inner surface of which decreases in diameter from one end to the other, one end of the casing having a radially extending attaching flange, axially spaced rows of vanes positioned within the casing, each row having a shroud ring engaging with and supporting the outer ends of a number of the vanes in the row, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes, one of said spacer rings having a radially extending flange projecting over and secured to the attaching flange on the casing such that the spacer ring is located axially within the casing and prevented from turning therein, said spacer ring and a group of shroud rings and spacer rings adjacent thereto having inter-engaging means thereon by which to prevent relative rotation.

4. In a compressor construction, an annular circumferentially continuous casing the inner surface of which decreases in diameter from one end to the other, axially spaced rows of vanes positioned within the casing, each row having a shroud ring engaging with and supporting the outer ends of a number of the vanes of the row, said shroud ring being split longitudinally, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes, said spacer rings being circumferentially continuous and having piloting means thereon for engagement with the inner surface of the casing to maintain the concentricity of the spacer rings and the adjacent shroud rings with respect to the casing, said spacer rings and the adjacent shroud rings having inter-engaging notches by which to maintain the adjacent rings in concentricity with each other.

5. In a compressor construction, a casing having a number of concentric spaced surfaces on the inside thereof, axially spaced rows of vanes within said compressor, each row of vanes having a supporting shroud ring to which the outer ends of the vanes of the row are rigidly secured, and spacers between the shroud rings of axially adjacent rows of vanes, said spacers having means thereon for engagement with the concentric surfaces on the casing for piloting the spacers and the shroud rings within the casing, said spacers and said shroud rings having inter-engaging detents to prevent relative rotation.

6. In a compressor construction, a casing having a number of concentric spaced surfaces on the inside thereof and also having a radial surface thereon, axially spaced rows of vanes within said compressor, each row of vanes having a supporting shroud ring to which the outer ends of the vanes of the row are rigidly secured, and spacers between the shroud rings of axially adjacent rows of vanes, said spacers having means thereon for engagement with the concentric surfaces on the casing for piloting the spacers and the shrouds within the casing, said spacers and said shroud rings having interengaging detents to prevent relative rotation, one of said spacers having a radially extending flange engaging with the radial surface on, and attached to, the casing.

7. In a compressor construction, an annular casing having a plurality of axially spaced cylindrical inner surfaces, with each succeeding cylindrical inner surface of less diameter than the previous cylindrical inner surface and further having sections of frusto-conical inner surface joining adjacent cylindrical inner surfaces, axially spaced rows of vanes positioned within the casing, each row of vanes having a frusto-conical shroud ring engaging with and supporting the outer ends of a number of the vanes in the row, spacer rings located between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes such that each shroud ring is positioned within one of said frusto-conical inner surfaces of said casing, each of said shroud rings being of less outer diameter than the inner diameter of said frusto-conical inner surface within which it is positioned so that a substantial clearance exists therebetween, said spacer rings having piloting means at each end for engagement with the cylindrical inner surfaces of the casing to maintain the concentricity of the spacer rings with respect to the casing, means connecting said shroud rings and said spacer rings to maintain concentricity and to transmit torque and to prevent relative rotation between the spacer and shroud rings, and interlocking means joining said spacers and shroud rings with said casing to prevent relative rotation therebetween.

8. In a compressor construction, an annular circumferentially continuous casing having a plurality of axially

spaced cylindrical inner surfaces with each succeeding cylindrical inner surface of less diameter than the previous cylindrical inner surface and further having sections of frusto-conical inner surface joining adjacent cylindrical inner surfaces, axially spaced rows of vanes positioned within the casing, each row having a frusto-conical shroud ring engaging with and supporting the outer ends of the vanes of the row, said shroud ring being split substantially diametrically, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes such that each shroud ring is positioned within one of said frusto-conical inner surfaces of said casing, each of said shroud rings being of less outer diameter than the inner diameter of said frusto-conical inner surface within which it is positioned so that a substantial clearance exists therebetween, said spacer rings being circumferentially continuous and having piloting means for engagement with the inner cylindrical surfaces of the casing to maintain the concentricity of the spacer rings and means interlocking said spacer rings with said shroud rings to prevent relative rotation therebetween and to maintain concentricity therebetween.

9. In a compressor construction, an annular circumferentially continuous casing having a plurality of axially spaced cylindrical inner surfaces with each succeeding cylindrical inner surface of less diameter than the previous cylindrical inner surface and further having sections of frusto-conical inner surface joining adjacent cylindrical inner surfaces, axially spaced rows of vanes positioned within the casing, each row having a frusto-conical shroud

ring engaging with and supporting the outer ends of the vanes of the row, said shroud ring being split substantially diametrically, and spacer rings between axially adjacent shroud rings to maintain the required axial spacing between the rows of vanes such that each shroud ring is positioned within one of said frusto-conical inner surfaces of said casing, each of said shroud rings being of less outer diameter than the inner diameter of said frusto-conical inner surface within which it is positioned so that a substantial clearance exists therebetween, said spacer rings being circumferentially continuous and having piloting means at each end engaging adjacent inner cylindrical surfaces of the casing to maintain the concentricity of the spacer rings and means interlocking said spacer rings with said shroud rings to prevent relative rotation therebetween and to maintain concentricity therebetween, and interlocking means joining said spacers and shroud rings with said casing to prevent relative rotation therebetween.

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