

Dec. 11, 1962

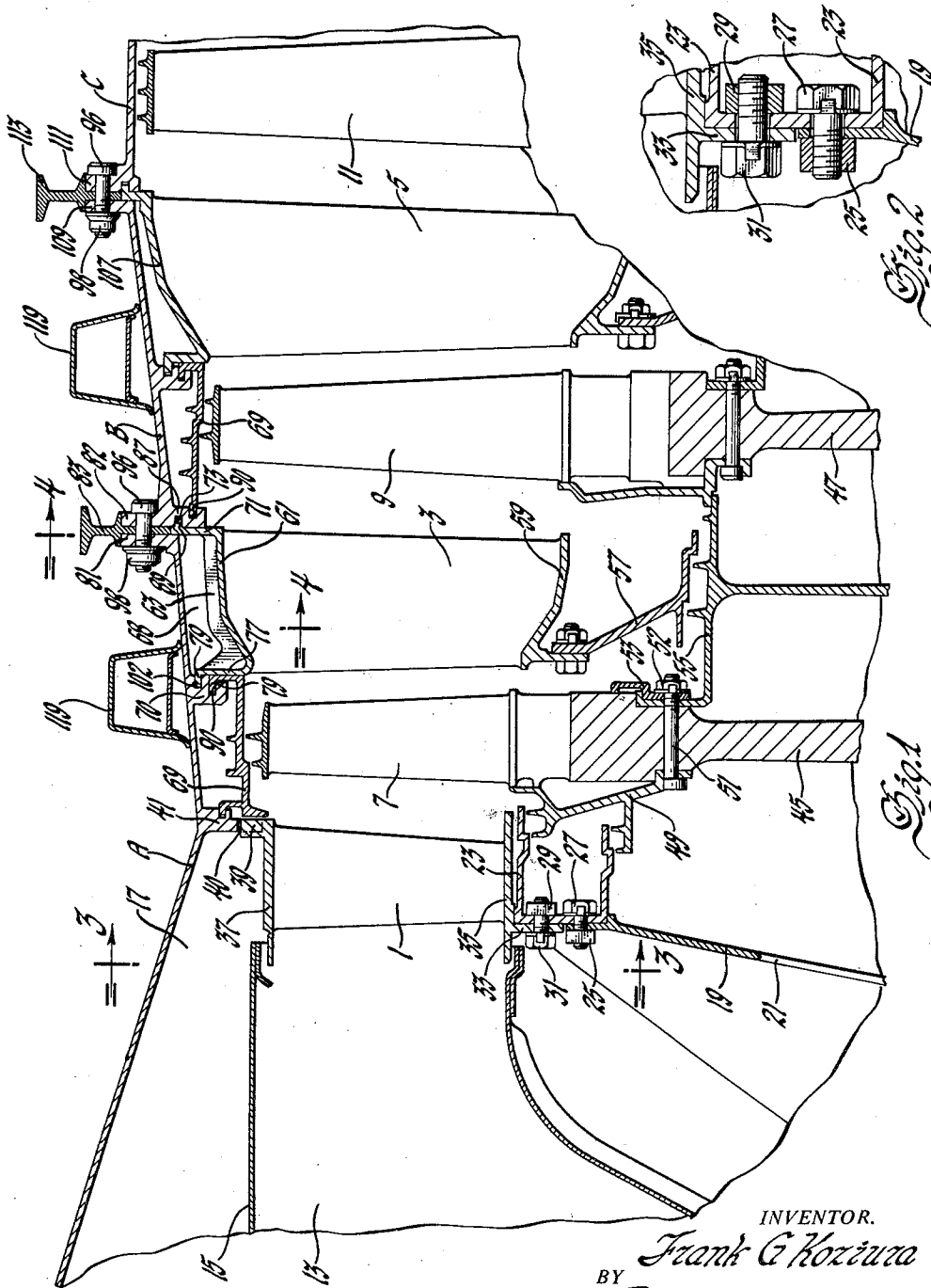
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3,067,983

TURBINE MOUNTING CONSTRUCTION

Filed July 1, 1958

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

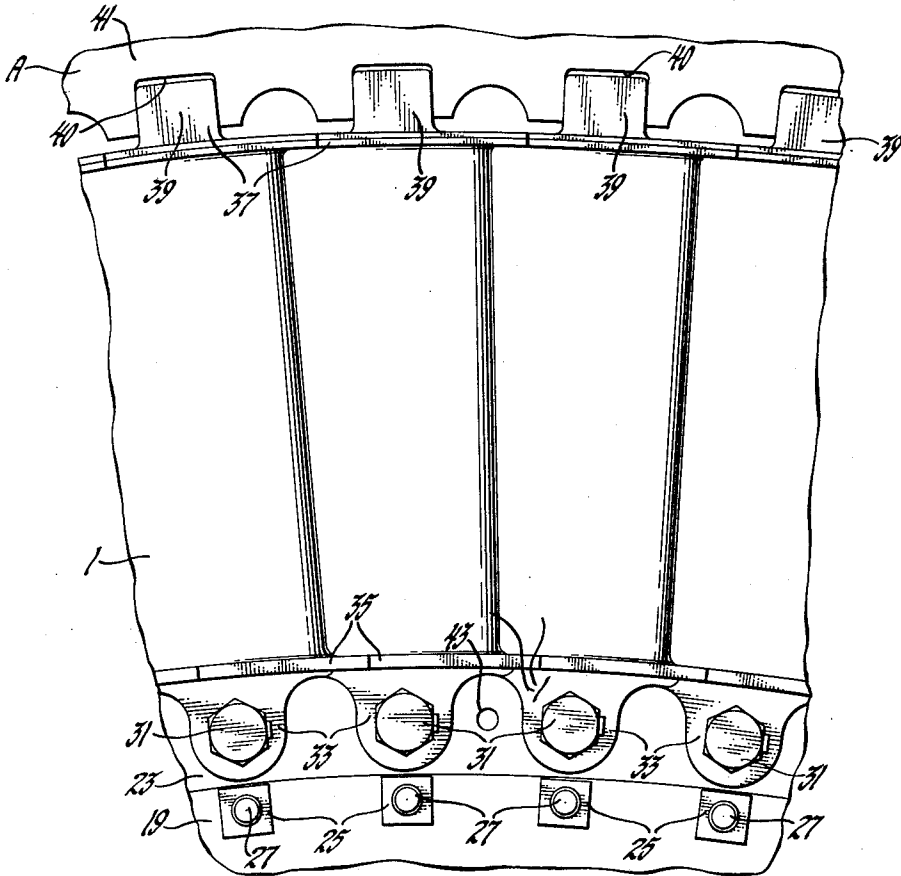


Fig. 3

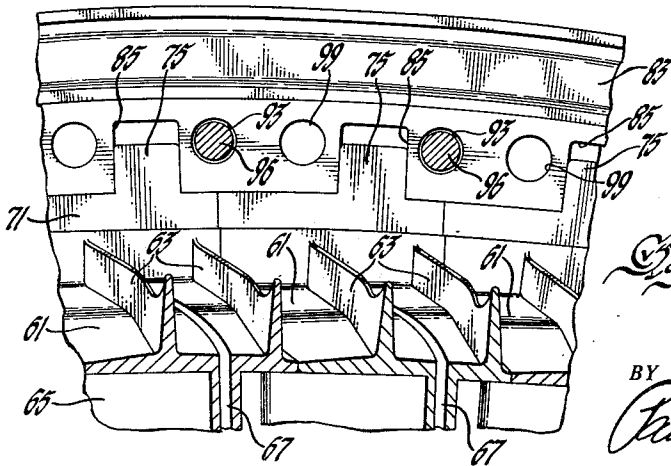


Fig. 4

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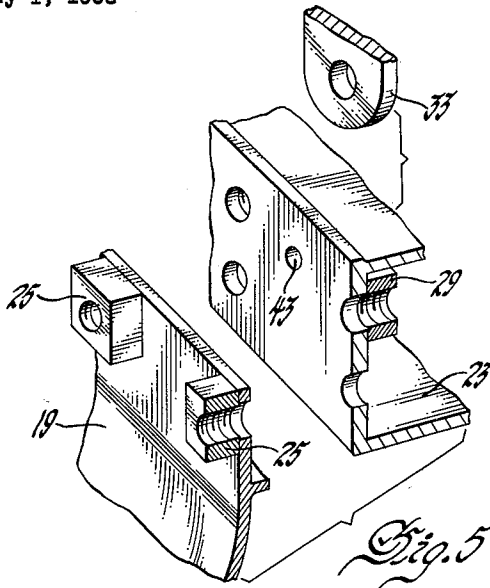
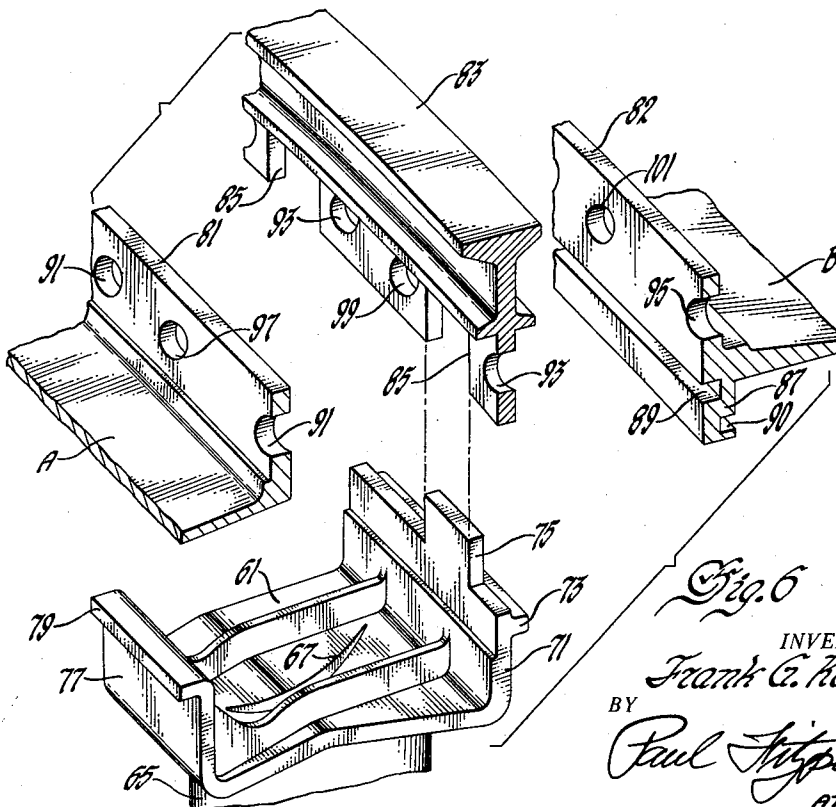
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TURBINE MOUNTING CONSTRUCTION

Filed July 1, 1958

3 Sheets-Sheet 3



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3,067,983

TURBINE MOUNTING CONSTRUCTION

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Filed July 1, 1958, Ser. No. 746,051

2 Claims. (Cl. 253-78)

This invention relates to gas turbine blade and vane mounting, and more particularly to the mounting of turbine stator vanes and turbine rotor buckets.

In the operation of gas turbine engines, periodic inspection and replacement of individual turbine vanes is necessary, so that it is desirable that the vanes be mounted so as to permit easy inspection of the vanes and replacement of individual vanes without having to remove all of the vanes in a turbine stage. At the same time it is desirable that it be possible to install and remove the whole stage of vanes at the same time.

In order to reduce the weight of gas turbine engines, especially those used in aircraft, it has become necessary to utilize relatively thin casing members and in order to maintain proper structural strength of the engine it is necessary to provide additional stiffening and strengthening members. It would be advantageous if the strengthening members perform a dual function such as also providing vane mounting structure.

It is therefore an object of the invention to provide a turbine vane mounting construction wherein individual vanes may be easily installed and removed, or the whole stage of vanes may be installed and removed simultaneously.

It is a further object of the invention to provide a turbine vane mounting construction wherein turbine vanes may be removed from either fore or aft of the turbine stage.

It is still a further object to provide a stator vane mounting construction which provides for simple and easy assembly and which adds structural rigidity to the engine.

These and other objects, features and advantages will be apparent from the following description; reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

FIGURE 1 is a longitudinal sectional view of part of a turbine section of a gas turbine engine.

FIGURE 2 is an enlarged view showing details of the turbine vane mounting structure.

FIGURE 3 is an enlarged view taken on the line 3-3 of FIGURE 1.

FIGURE 4 is an enlarged sectional view taken on the line 4-4 of FIGURE 1.

FIGURE 5 is an exploded view of certain parts of the turbine vane mounting construction with parts partially broken away.

FIGURE 6 is another exploded view of other parts of the turbine vane mounting construction with parts broken away.

FIGURE 1 shows a portion of the turbine section of a gas turbine engine having outer case sections A, B and C acting to enclose the turbine section. The turbine assembly includes a plurality of stages of stator and rotor vanes, there being three such stages shown in FIGURE 1. The first turbine stage includes stator vanes 1 and rotor blades 7, the second stage includes stator vanes 3 and rotor blades or buckets 9, and the third stage includes stator vanes 5 and rotor blades 11. This construction is conventional, and the rotor vanes 7, 9 and 11 may be attached in known manner to a common power shaft or may be connected to a plurality of power shafts as would be the case in a dual spool gas turbine engine.

The turbines are supplied with hot gases from combustion chambers which may be of any form and which conventionally are a group of circumferentially arranged cans having transition sections 13 formed by sheet metal members 15. A cooling air manifold 17 is formed by the space between outer case section A and the combustion can 15 to supply air for cooling the turbine vanes. A bulkhead section 19 connected on its radially inner end to a turbine shaft bearing, not shown, provides a support for the first stage turbine vanes. Referring to FIGURES 1, 2, 3 and 5, it will be seen that there is a channel section ring 23 bolted to the outer portion of the bulkhead 19 which has one or more passages 21 formed therein for supplying cooling air to the interior cavity of the turbine section. The ring 23 has a trifold function. It acts as a support for the first stage turbine vanes, acts as the stationary portion of a double labyrinth seal, and also provides a manifold passage for cooling air. The ring 23 is secured to the bulkhead 19 by bolts 27 which pass through holes formed in the ring 23 and are threaded into nuts 25 welded or otherwise secured to the forward face of the bulkhead 19. The individual turbine vanes 1 extend from inner blade vane platforms 35 that have radially extending flanges 33 that act to secure the vanes 1 to the ring 23. Each vane is held to the ring 23 by a bolt 31 which passes through an aperture in the flange 33 and is threaded into nut 29 secured to the inner surface of the ring 23. It will be seen that the first stage turbine vanes 1 may be assembled to the ring 23 and the whole assembly of vanes and the ring may then be installed in the engine and held to the bulkhead 19 by the bolts 27. If the combustion cans 15 are removed from the engine it is possible to inspect the vanes 1, and individual vanes may be removed and replaced simply by removing the bolt 31 that secures the particular vane to be removed to the ring 23. This eliminates the necessity for splitting the engine or removing many additional components merely to inspect and replace individual turbine vanes. Since the first stage turbine vanes are subject to the highest temperatures and pressures, it is most important that these vanes be readily accessible. If it is desired to remove the whole first stage vane section, this can be accomplished from the rear of the engine by splitting the same to the rear of the first stage turbine assembly and by removing the ring 23 from the bulkhead 19 by removing bolts 27. It may be noted that the ring 23 may be a continuous annular ring or it may be formed of two semi-circular rings or three or more ring segments to form a circular turbine vane support. As seen in FIGURE 3 the turbine vanes 1 and outer platform 37 have radially extending tongue members 39 that engage in slots 40 formed in an annular flange 41 on the case section A. This construction allows the vane assembly and the outer case A to move radially relative to each other through thermal expansion, etc. As seen in FIGURES 3 and 5 the ring member 23 has a plurality of small apertures 43 which provide for the entrance of cooling air into the manifold formed by the ring 23. The cooling of the turbine vanes and other associated parts forms no part of the invention and is fully shown and described in the co-pending application Serial No. 742,466 filed June 12, 1958, now Patent No. 3,034,291, filed May 15, 1962, entitled "Turbine Cooling System" of Harlan V. White. The first stage rotor blades 7 are supported on a rotor wheel 45 by any suitable means, not shown, and the second stage rotor blades 9 are supported on a rotor wheel 47, both rotor wheels 45 and 47 being connected to a turbine power shaft (not illustrated). The rotor wheel 45 carries an annular rotating seal member 49 having ribs thereon which cooperate with the inner and outer edges of the ring 23 to form a double labyrinth seal to prevent leakage of hot gases from the turbine into the inner turbine

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tion chambers which may be of any form and which conventionally are a group of circumferentially arranged cans having transition sections 13 formed by sheet metal members 15. A cooling air manifold 17 is formed by the space between outer case section A and the combustion can 15 to supply air for cooling the turbine vanes. A bulkhead section 19 connected on its radially inner end to a turbine shaft bearing, not shown, provides a support for the first stage turbine vanes. Referring to FIGURES 1, 2, 3 and 5, it will be seen that there is a channel section ring 23 bolted to the outer portion of the bulkhead 19 which has one or more passages 21 formed therein for supplying cooling air to the interior cavity of the turbine section. The ring 23 has a trifold function. It acts as a support for the first stage turbine vanes, acts as the stationary portion of a double labyrinth seal, and also provides a manifold passage for cooling air. The ring 23 is secured to the bulkhead 19 by bolts 27 which pass through holes formed in the ring 23 and are threaded into nuts 25 welded or otherwise secured to the forward face of the bulkhead 19. The individual turbine vanes 1 extend from inner blade vane platforms 35 that have radially extending flanges 33 that act to secure the vanes 1 to the ring 23. Each vane is held to the ring 23 by a bolt 31 which passes through an aperture in the flange 33 and is threaded into nut 29 secured to the inner surface of the ring 23.

It will be seen that the first stage turbine vanes 1 may be assembled to the ring 23 and the whole assembly of vanes and the ring may then be installed in the engine and held to the bulkhead 19 by the bolts 27. If the combustion cans 15 are removed from the engine it is possible to inspect the vanes 1, and individual vanes may be removed and replaced simply by removing the bolt 31 that secures the particular vane to be removed to the ring 23. This eliminates the necessity for splitting the engine or removing many additional components merely to inspect and replace individual turbine vanes. Since the first stage turbine vanes are subject to the highest temperatures and pressures, it is most important that these vanes be readily accessible.

If it is desired to remove the whole first stage vane section, this can be accomplished from the rear of the engine by splitting the same to the rear of the first stage turbine assembly and by removing the ring 23 from the bulkhead 19 by removing bolts 27. It may be noted that the ring 23 may be a continuous annular ring or it may be formed of two semi-circular rings or three or more ring segments to form a circular turbine vane support.

As seen in FIGURE 3 the turbine vanes 1 and outer platform 37 have radially extending tongue members 39 that engage in slots 40 formed in an annular flange 41 on the case section A. This construction allows the vane assembly and the outer case A to move radially relative to each other through thermal expansion, etc. As seen in FIGURES 3 and 5 the ring member 23 has a plurality of small apertures 43 which provide for the entrance of cooling air into the manifold formed by the ring 23. The cooling of the turbine vanes and other associated parts forms no part of the invention and is fully shown and described in the co-pending application Serial No. 742,466 filed June 12, 1958, now Patent No. 3,034,291, filed May 15, 1962, entitled "Turbine Cooling System" of Harlan V. White.

The first stage rotor blades 7 are supported on a rotor wheel 45 by any suitable means, not shown, and the second stage rotor blades 9 are supported on a rotor wheel 47, both rotor wheels 45 and 47 being connected to a turbine power shaft (not illustrated). The rotor wheel 45 carries an annular rotating seal member 49 having ribs thereon which cooperate with the inner and outer edges of the ring 23 to form a double labyrinth seal to prevent leakage of hot gases from the turbine into the inner turbine

cavity. Cooling air introduced through the apertures 43 acts to pressurize the manifold formed by the ring 23 and the seal member 49 and aids in cooling the seal as well as in preventing gas leakage past the seals.

The rotating seal member 49 is fixed to the rotor wheel 45 by a plurality of bolts 51 and nuts 52 which also fix an inner shroud ring 55 and a retaining ring 53 to the wheel 45. The shroud ring 55 cooperates with a continuous seal ring 57 that is bolted to the inner platforms 59 on the inner end of the second stage turbine vanes 3 to provide a labyrinth seal. These turbine vanes 3 have outer platforms 61 that joint to form a continuous shroud (FIGURE 4).

The second stage stator vane assemblies including the vanes 3 are supported in the engine by outer platform members 61. This structure is best seen in FIGURES 1, 4 and 6. Each platform 61 has a pair of stiffening ribs 63 that connect radially extending flange portions 71 and 77. The outer platform 61, inner platform 59 and the interposed vanes 3 provide a passage 67 for flow of cooling air from the chamber 68 through the vane to cool the vane. The flange 71 has a ridge 73 formed thereon as well as an extension tongue 75. Flange 77 has a forwardly extending flange portion 79.

Formed in any suitable manner on the forward case section A is an annular flange 81 and a similar flange 82 is formed on the case section B. Between flanges 81 and 82 is a stiffener ring member 83. The ring 83 has slots 85 that receive the tongues 75 on the vanes to prevent circumferential movement of the vanes. An inwardly extending flange 87 on section B has a groove 89 receiving ridge 73 on the vane 3 which acts to prevent radial movement of the vane. A similar groove 90 receives the outer shroud 69 of the second rotor stage. Bolt holes 91, 93 and 95 are formed in flange 81, ring 83, and flange 82, respectively, through which bolts 96 extend. Nuts 98 are threaded on bolts 96 to secure the flanges 81 and 82 together with the stiffener ring 83 and flange 71 of the vane both held between the flanges 81 and 82.

Flange 81, ring 83 and flange 82 have additional holes 97, 99, and 101, respectively, for passage of cooling air between adjacent sections A and B. The forward end of the platform 61 is held by the ridges 79 engaging in grooves 102 formed in the annular flanges 70 on section A.

As seen in FIGURE 1 the third stage stator vanes 5 have outer platform members 107 that are held between a flange portion 109 on the rear edge of case section B and a flange portion 111 formed on the forward edge of case section C. This construction including a stiffener ring 113 is the same as that used in holding the vanes 3 between sections A and B.

Welded or otherwise secured to each case section is a hat-shaped stiffener ring 119 to add further rigidity to the case structure.

The turbine stator vane mounting construction described provides for easy assembly and disassembly of the parts with the vane mounting adding structural strength and rigidity to the engine.

Furthermore the vanes are not bolted in place and hence are not subject to the stresses that usually are present where the vanes are bolted.

It will readily be seen that the vane supporting structure may be used for supporting compressor stator vanes or other stationary vane members. It will also be apparent to those skilled in the art that many modifications of the parts and assembly may be made without departing from the spirit of the invention which is limited only by the following claims.

What is claimed is:

1. A stator vane structure for a gas turbine or the like comprising a fixed outer casing, a radially extending inner support member, an annular ring member having a radial face adjacent to one side of said support member, a plurality of radially extending, circumferentially spaced vanes between said outer casing and said ring member, said vanes having surfaces adjacent to said one side of said ring member, means securing said ring member to said support member from one side of the radial face of said ring member, and means individually securing said vanes to said ring member from the other side of said radial face, whereby said ring member may be detached from said support member on one side thereof and said vanes detached from said ring member from the other side of said support member.

2. A stator structure for a gas turbine or the like having a longitudinal axis of rotation comprising a fixed outer casing, a fixed circular inner support member having a portion radially extending from the axis of rotation of the turbine, a U-shaped ring member having a pair of axially extending portions joined by a radially extending portion, said ring member located on one side of said support member and having its radially extending portion secured from the inside of the U to the radially extending portion on said support member, a plurality of radially extending circumferentially spaced vanes having radially extending portions, said radially extending vane portions located adjacent the radially extending portion of said ring member on the outside of said U and securing means individually securing each of said vanes to said ring member from the outside of said U-shaped member for independent removal of said vanes from said ring member while said ring member is secured to said support member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,067,983

December 11, 1962

Frank G. Koziura

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 61, for "Patent No. 3,034,291, filed" read
-- Patent No. 3,034,298, issued --.

Signed and sealed this 28th day of May 1963.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents