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(54) **A sideplate for turbine disk.**

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(56) References cited :
**FR-A- 2 290 570**
**FR-A- 2 324 873**
**GB-A- 2 058 945**
**US-A- 3 010 696**
**US-A- 3 295 825**

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## Description

The invention is a combination seal and sideplate for attachment to a turbine disk and serves as a spaced seal element, a sideplate for the disk to hold the blades in position and to direct cooling air into the blade roots and has its own fastening means to eliminate the need for any bolt attachments of the device to the disk.

The prior art has generally been an annular seal element carrying several knife-edge seals and bolted to the turbine disk as one element, and a separate plate also bolted to the disk to serve as the sideplate for holding the blades in axial position in the disk and for directing cooling air into the grooves for the blade roots. It has also been necessary to provide additional devices to guide cooling air from the seal element to the separate side plate. This has necessitated another annular device in addition to the many bolts and nuts necessary for holding the several plate elements in position. It is well known that bolt holes create stress concentrations and are undesirable in a high speed device like a turbine disk. The elimination of any bolt holes and bolts as retaining means is a desirable result. The necessity for attaching several plates each by a number of bolts and nuts also increases the cost of assembling the device as well as the number of parts used in creating the finished product. A turbine rotor assembly having a first annular seal plate and a second cooling fluid distribution and blade root retaining plate is disclosed in US-A-3 010 696.

Reference is also made to GB-A-2 058 945, which discloses a turbine rotor assembly according to the precharacterizing portion of claim 1 consisting of a single annular plate for use against the side of the turbine disk having the necessary seal elements near its inner periphery and serving as a sideplate for preventing axial movement of the blade roots within a disk, and also having a means for guiding the cooling air from a point near the axis of the disk outwardly to and into the cooling spaces at the roots of the blades. Also, with the known side plate, the attachment to the disk by a bayonet form of mount integral with the disk and plate avoids any bolting attachment eliminating the necessity for bolt holes in either disk or plate.

The turbine rotor assembly according to the invention is characterized by the features recited in the characterizing portion of claim 1.

The use of a double snap fit between the plate and disk tailors the load split between the two snap fits accounting for different thermal expansion of the parts during operation.

The arrangement is also such that the side plate serves as a pump in increasing the cooling air pressure from the point where it is delivered to the side plate near the axis of the disk to the point where it enters the blade roots near to the periphery thereby increasing the flow of air through the bases of the slots in the disk.

Other advantageous features of the turbine rotor assembly are recited in the dependent claims.

The turbine rotor assembly will now be described in greater detail with reference to the accompanying drawings, wherein :

Fig. 1 is a sectional view through a turbine disk and the plate thereon to show the cooperating structures and the method of attachment of the plate to the disk.

Fig. 2 is a sectional view taken substantially along the line 2-2 of Fig. 1.

Fig. 3 is a fragmentary perspective view of a modification.

The turbine rotor assembly is shown in conjunction with the first stage disk 10 of a multistage turbine rotor, and this disk has an annular attachment flange 12 extending forwardly and laterally therefrom near or at its center for attachment to the remainder of the rotor. Radially outward from the center of the disk is another lateral flange 14 to support a ring 16 carrying a plurality of knife-edge seals 17 cooperating with a fixed seal ring 18. The ring 18 is supported by a fixed structure 20. The structure 20 also carries one or more tubes 22 through which cooling air is admitted to the space 24 radially outward from the ring 16 and flange 14. The structure 20 also carries another annular seal ring 25 surrounding and in spaced relation to the seal ring 18. The ring 16 is secured to the flange 14 by suitable bolts 26.

Outwardly beyond the flange 14 the disk has another axially extending flange 27 with an inturned rib 28 on the outer end. This inturned rib is notched at 29 so that the rib has evenly spaced elements of projections 30 between the notches and forming part of a bayonet attachment by which to hold a sideplate 32 in position on the disk. The plate 32 has an outwardly extending flange 33 to cooperate with the inturned rib, and this outwardly extending flange has a recess 34 to receive the rib 28. The flange 33 has notches 36 therein corresponding in dimension to the projection 30 between the notches 29 on the rib 28. The notches 36 are spaced apart by projections 38 on the flange 33.

With this arrangement the plate is held against the disk by the bayonet at attachment which is activated by placing the plate with the projection 38 aligned with the notches 29, moving the plate axially against the disk and then turning the plate to align the notches in the disk and plate thereby placing the projections 38 in alignment with the projections 30 formed by the notches in the flange 27.

The inner diameter of the rib 28 is the same as the diameter of the bottom of the recess 34 so that there is a tight fit at this location to provide for piloting the plate on the disk and holding these parts in concentric relation. The notches 28 are cut deeply into the flange 27, as shown at 42, and the notches 36 are cut to the surface 44, as shown, so that cooling air may pass through the

aligned notches to flow along the surface of the disk from the chamber 24 to a chamber 45 radially outward of the flange 27.

Radially inward of the flange 33 on the plate, the latter has an inner peripheral extension 46 that extends laterally out of the general plane of the plate and carriers several outwardly extending spaced ribs 48 having on their outer ends knife-edge elements 50 to cooperate with the seal ring 25 above described to minimize air leakage from the chamber 24 at this location.

Radially outward from the bayonet connection, the disk 10 has an increasing thickness near its periphery to provide adequate dimension for the formation of slots 52 to receive the blade roots 54 therein as in conventional disk constructions. Where the disk becomes thicker, there is an axially extending flange 55 having an inwardly facing axial surface 56, and this axial surface cooperates with another axial surface 58 on a lateral flange 59 on the plate. These cooperating surfaces are nearly the same dimension radially to provide a second pilot for the plate on the disk. The preferable embodiment is to have the first pilot at the bayonet connection tight to maintain concentricity between plate and disk and then to adjust the dimension at this outer pilot to tailor the load split between these two locations under different conditions of operation. This is particularly desirable because of the thermal differences between plate and disk during operation, and the significant thermal dimension changes in the respective parts.

The flanges 55 and 59 have spaced notches 60 and 62 therethrough to allow for a flow of air past these flanges radially outward for cooling the blade roots.

The plate 32 extends radially outward beyond the flange 59 to overlie the disk between the flange and the blade roots and define a chamber 63 between it and the disk in this area. The plate then has a conical portion 64, and the outer periphery of the plate terminates in a radially extending portion 66 that overlies and is held against the surface of the plate and the blade root ends to prevent axial movement of the roots within the disk. This radial portion begins is contact with the disk at the outer edge of the conical portion at the point radially outward of the cooling air passages 67 provided at the base of each slot and located at the bottom of the blade root. These passages accept cooling air from the chamber 63 and serve for cooling the disk and the blade root by the flow of the cooling air through the disk.

Because of the arrangement of the air passages in the flanges 27 and 33 and also the flanges 55 and 59, they act as centrifugal pumps and raise the pressure of the air between the chambers 24 and 63 significantly to increase the cooling air flow through the disk.

The plate 32 has another axial flange 68 on the side remote from the disk and near the conical portion. This flange carries at its outer end an outwardly extending rib 70 cooperating with a fixed seal ring 72 adjacent to the disk.

The plate may have seal grooves 74 and 76 at opposite edges of the radial portion 66 to receive sealing wires 78 and 80. This will provide a tight seal between the plate and disk at these locations and prevent the escape of cooling air past this radial portion of the plate.

A modification shown in Fig. 3 may have vanes 82 mounted thereon adjacent to and on the side of the flange 33', and these vanes will serve to increase the pressure rise in the flow of air outwardly between plate and disk to increase the cooling effect on the periphery of the disk. These vanes may be integral with the plate, being machined therein, or may be attached thereto if desired. In many installations these vanes are unneccessary, but in particularly high performance turbines they may have added functions in further increasing the pressure of the cooling air as it reaches the slots in a disk.

The side plate may be locked against turning on the side of the disk by a plurality of slots 84, Fig. 2, in the periphery of the disk or plate 32. These slots are in a position to be engaged by tangs 86 on the blade roots. The tangs and slots are so located that when the tangs engage the slots the projections 30 and 38 are in alignment axially and the slots 60 and 62 are also in alignment. This will assure retention of the side plate securely on the disk.

It should be understood that the invention is not limited to the particular embodiments shown and described herein, but that various changes and modifications may be made without departing from the scope of this novel concept as defined by the following claims.

## Claims

1. A turbine rotor assembly having a disk (10) provided with a row of slots (52) in its periphery, and blade roots (54) in said slots (52), and an annular plate (32) secured to one side of the disk (10), said plate having a slotted radially extending first flange (33 ; 33') cooperating with a slotted axially extending first flange (27) having a radial rib (30) on the disk (10) to provide a bayonet attachment of the plate (32) to the disk (10), said plate also having a second flange (59) radially outward from said slotted flange (28) cooperating with a second flange (55) on the disk (10), said second flanges (59, 55) having cooperating surfaces (56, 58) providing a first piloting location between the plate (32) and the disk (10), said plate further having an outer radial portion (66) to overlie the portion of the disk (10) having the slots (52) therein to guide air from a space (63) between the plate (32) and disk (10) into the slots (52) and to retain the blade roots (54) in position in the slots (52), characterized in that the first flange (33 ; 33') of said plate (32) is formed on one side of the plate (32) between the edges thereof and that said slotted first flanges (33 ; 33', 27) have cooperating axially extending surfaces in contact

with one another providing a second piloting location between disk (10) and plate (32) to maintain contact concentricity of the plate (32) and disk (10).

2. The rotor assembly according to claim 1, characterized in that said plate (32) also has a plurality of knife-edge (48, 50) near the inner periphery on the side opposite to the flanges (33 ; 33', 59) to provide a seal for the air adjacent the disk (10).

3. The rotor assembly according to claim 1, characterized in that the slots (29, 36) in the slotted flanges (33 ; 33' ; 27) are deep enough when plate (32) and disk (10) are assembled to permit air flow past said flanges (33 ; 33' ; 27) and to provide action on the air.

4. The rotor assembly according to claim 1, characterized in that the second cooperating flanges (55, 59) radially outward from the bayonet attachment are slotted for the passage of air therethrough and to cause a pumping action on the air.

5. The rotor assembly according to claim 1, characterized in that said plate (32) has a conical portion (64) adjacent the outer radial portion (66) to form the space (63) for cooling air between the plate (32) and disk (10) and to direct cooling air into the slots (52).

6. The rotor assembly according to claim 1, characterized in that the plate (32) has a plurality of slots (84) on the side of the disk (10), said slots being engaged by tangs (86) on the blade roots (54) to lock the plate (32) against turning.

**Patentansprüche**

1. Turbinenrotorbaugruppe mit einer Scheibe (10), die mit einer Reihe von Schlitzen (52) in ihrem Umfang und mit Schlaufelfüßen (54) in den Schlitzen (52) versehen ist, und mit einer kreisringförmigen Platte (32), die auf einer Seite der Scheibe (10) befestigt ist, wobei die Platte einen geschlitzten, sich radial erstreckenden ersten Flansch (33 ; 33') hat, der mit einem geschlitzten, sich axial erstreckenden ersten Flansch (27), welcher eine radiale Rippe (30) hat, an der Scheibe (10) zusammenwirkt, um eine Bajonettbefestigung der Platte (32) an der Scheibe (10) zu schaffen ; wobei die Platte außerdem einen zweiten Flansch (59) radial außerhalb von dem geschlitzten Flansch (28) hat, der mit einem zweiten Flansch (55) an der Scheibe (10) zusammenwirkt, wobei die zweiten Flansche (59, 55) zusammenwirkende Oberflächen (56, 58) haben, die eine erste Führungsstelle zwischen der Platte (32) und der Scheibe (10) bilden, und wobei die Platte weiter einen äußeren radialen Teil (66) hat, der dem Teil der Scheibe (10) überlagert ist, welcher die Schlitze (52) aufweist, um Luft aus einem Raum (63) zwischen der Platte (32) und der Scheibe (10) in die Schlitze (52) zu leiten und die Schaufelfüße (54) in den Schlitzen (52) in ihrer Position zu halten, dadurch gekennzeichnet, daß der erste Flansch (33 ; 33') der Platte (32) auf einer Seite der Platte (32) zwischen deren Rändern gebildet ist, und daß die geschlitzten ersten Flansche (33 ; 33', 27) zusammenwirkende, sich axial erstreckende Oberflächen haben, die miteinander in Kontakt sind und eine zweite Führungsstelle zwischen der Scheibe (10) und der Platte (32) bilden, um Kontaktkonzentrizität der Platte (32) und der Scheibe (10) aufrechtzuerhalten.

2. Rotorbaugruppe nach Anspruch 1, dadurch gekennzeichnet, daß die Platte (32) außerdem mehrere Messerkantenrippen (48, 50) nahe dem inneren Umfang auf der zu den Flanschen (33 ; 33', 59) entgegengesetzten Seite hat, um eine Dichtung für die Luft an der Scheibe (10) zu schaffen.

3. Rotorbaugruppe nach Anspruch 1, dadurch gekennzeichnet, daß die Schlitze (29, 36) in den geschlitzten Flanschen (33 ; 33', 27) tief genug sind, um, wenn die Platte (32) und die Scheibe (10) zusammengebaut sind, eine Luftströmung vorbei an den Flanschen (33 ; 33', 27) zu gestatten und eine Pumpwirkung auf die Luft auszuüben.

4. Rotorbaugruppe nach Anspruch 1, dadurch gekennzeichnet, daß die zweiten zusammenwirkenden Flansche (55, 59) radial außerhalb von der Bajonettbefestigung für den Durchtritt von Luft und zum Ausüben einer Pumpwirkung auf die Luft geschlitzt sind.

5. Rotorbaugruppe nach Anspruch 1, dadurch gekennzeichnet, daß die Platte (32) einen konischen Teil (64) an dem äußeren radialen Teil (66) hat, um den Raum (63) für Kühlluft zwischen der Platte (32) und der Scheibe (10) zu schaffen und Kühlluft in die Schlitze (52) zu leiten.

6. Rotorbaugruppe nach Anspruch 1, dadurch gekennzeichnet, daß die die Platte (32) mehrere Schlitze (84) auf der Seite der Scheibe (10) hat, wobei die Schlitze durch Lappen (86) an den Schaufelfüßen (54) erfaßt werden, um die Platte (32) gegen Drehen zu verriegeln.

**Revendications**

1. Ensemble de rotor de turbine comprenant un disque (10) dont la périphérie présente une rangée de gorges (52), des pieds d'aubes (54) ajustés dans ces gorges (52), ainsi qu'une plaque annulaire latérale (32) fixée sur une face au disque (10) et comportant un premier rebord (33, 33') muni de créneaux (36) et d'une cavité (34), et orienté radialement, ce rebord (33, 33') coopérant avec une première bride saillante (27) munie de tenons radiaux (30) et formée sur le disque (10) afin de constituer un montage à baïonnette pour verrouiller la plaque (32) sur le disque (10), cette plaque (32) comportant également un second rebord (59) orienté radialement vers l'extérieur et muni de surfaces coopérantes (56, 58) assurant un premier positionnement par guidage entre la plaque (32) et le disque (10), cette plaque (32) comprenant par ailleurs une partie radiale externe (66) qui s'applique contre la partie du disque (10) dans laquelle sont formées les gorges (52), afin de guider l'air provenant d'un espace (63) situé

entre la plaque (32) et le disque (10) vers l'intérieur des gorges (52), et de maintenir les pieds (54) des aubes en position correcte dans leurs gorges (52), cet ensemble étant caractérisé en ce que le premier rebord (33, 33') de la plaque (32) est formé sur un côté de la plaque entre les bords de celle-ci, et que lesdits premiers rebords (33, 33', 27) présentent des surfaces coopérantes à orientation axiale qui sont maintenues en contact entre elles de façon à réaliser un second positionnement de guidage entre le disque (10) et la plaque (32), et à préserver la concentricité du contact entre la plaque (32) et le disque (10).

2. Ensemble de rotor selon la Revendication 1, caractérisé en ce que ladite plaque (32) présente également à proximité de sa périphérie interne, plusieurs nervures effilées (48, 50), sur le côté opposé aux rebords (33, 33', 59) afin de réaliser un joint étanche aux fuites d'air de refroidissement à proximité du disque (10).

3. Ensemble de rotor selon la Revendication 1, caractérisé en ce que les créneaux (29, 36) prévus dans les rebords (33, 33', 27) sont suffisamment profonds pour que, lorsque la plaque (32) et le disque (10) sont assemblés, l'air puisse circuler au-delà de ces rebords (33, 33', 27) et produire un effet de pompage sur cet air.

4. Ensemble de rotor selon la Revendication 1, caractérisé en ce que les seconds rebords saillants coopérants (55, 59) situés radialement à l'extérieur du montage à baïonnette sont pourvus de passages (57) pour permettre l'écoulement de l'air à travers ces rebords et produire un effet de pompage sur cet air.

5. Ensemble de rotor selon la Revendication 1, caractérisé en ce que ladite plaque (32) présente une partie conique (64) à proximité de la partie radiale externe (66) pour former un espace (63) pour l'air de refroidissement entre la plaque (32) et le disque (10) et pour diriger l'air de refroidissement vers l'intérieur des encoches (52).

6. Ensemble de rotor selon la Revendication 1, caractérisé en ce que la plaque (32) présente plusieurs créneaux (84) du côté disque, ces créneaux étant destinés à recevoir des tenons (86) prévus sur les pieds (54) des aubes afin de verrouiller la plaque (32) contre tout mouvement de rotation.

FIG. 1

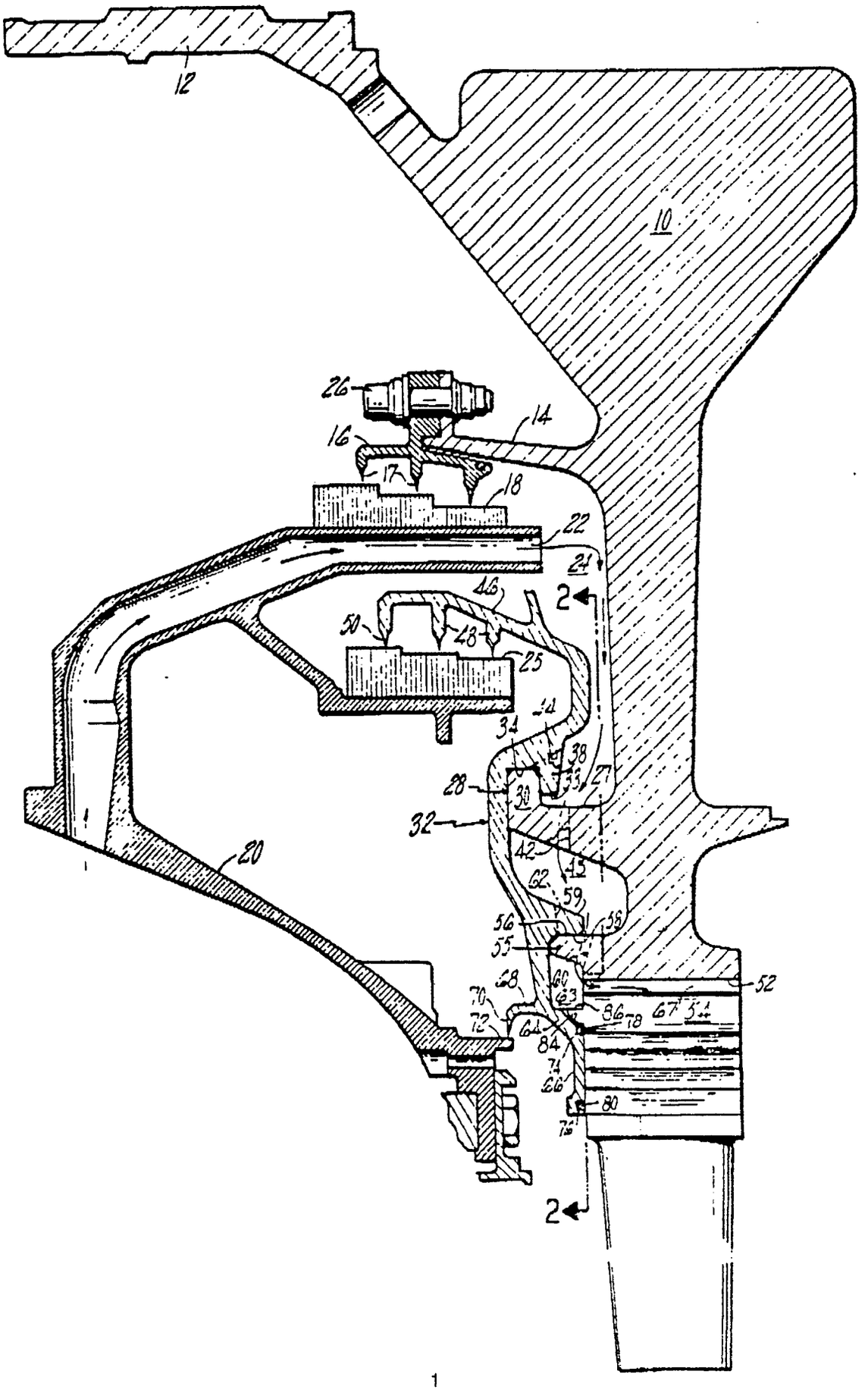
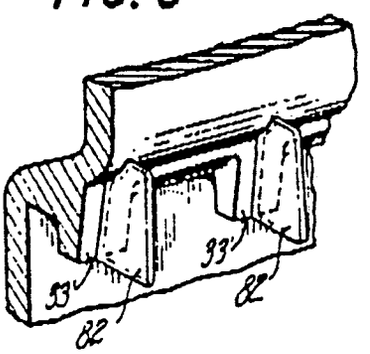

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FIG. 3


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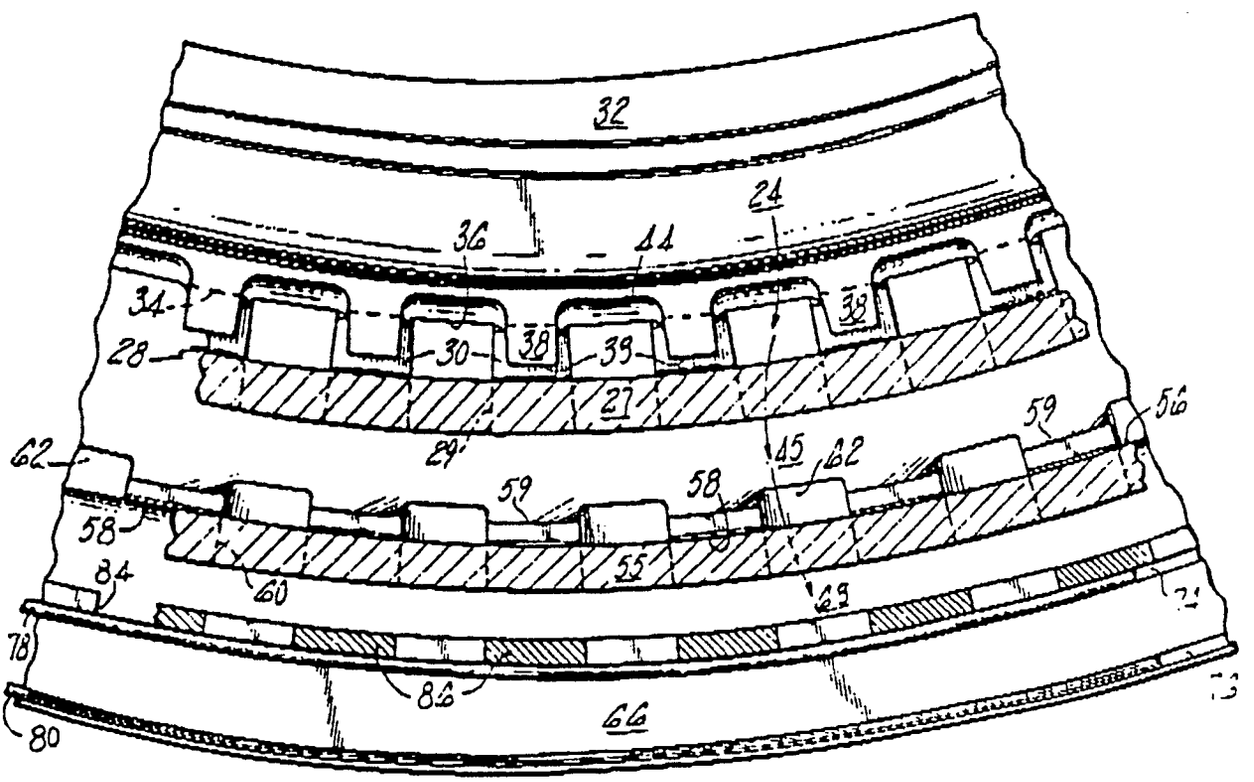

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FIG. 2