Sept. 1, 1959 D. G. RICH 2,902,267

ROTARY REGENERATOR SEALS

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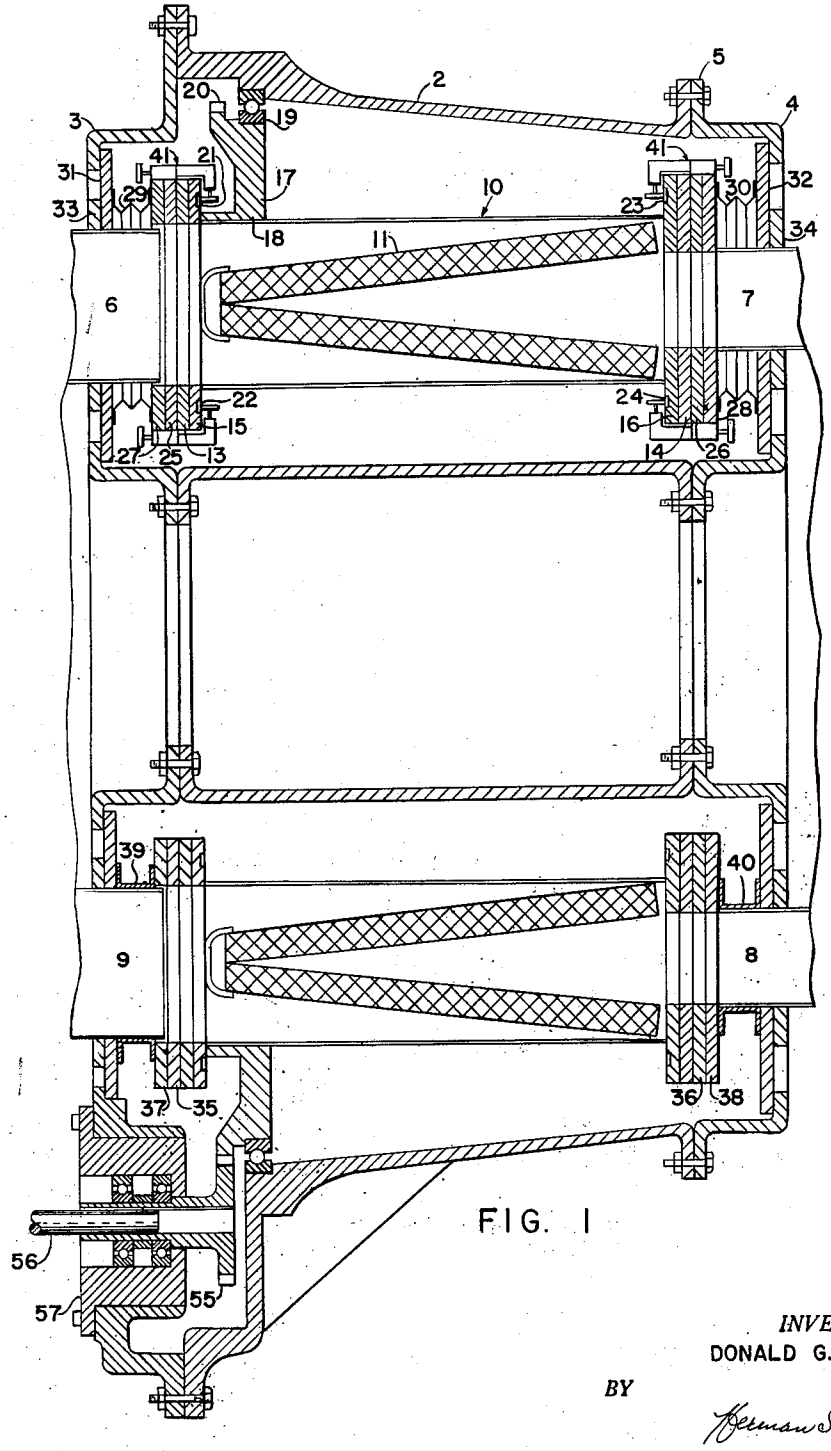


FIG. 1

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FIG. 3

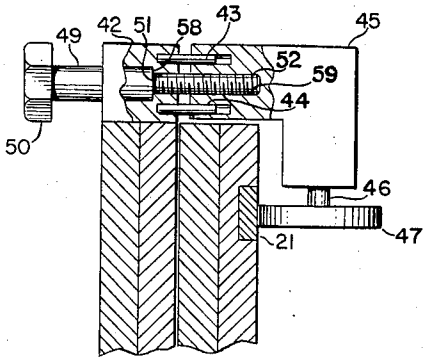
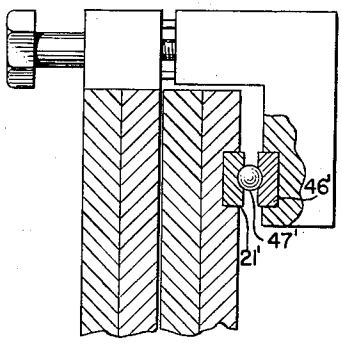


FIG. 4



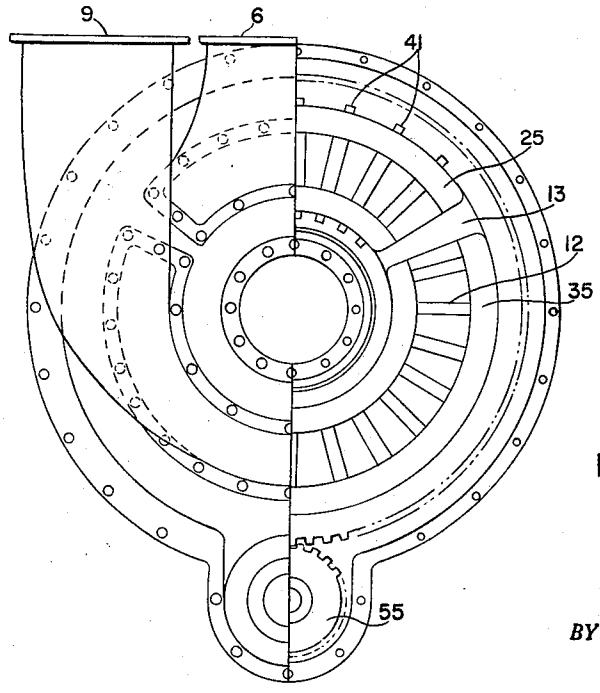


FIG. 2

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ROTARY REGENERATOR SEALS

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4 Claims. (Cl. 257—269)

This invention relates to seals, particularly to seals for use between the rotor and the enclosing housing in rotary regenerators in which the heat exchange medium or matrix rotates about an axis traversing in turn two fluid streams flowing through the regenerator. In this type regenerator the two fluid streams are at different temperatures and pressures. A portion of the matrix passes through the warm gas stream which is at a low pressure. During this interval the matrix absorbs heat. As the matrix continues to rotate it passes into the cold high pressure gas stream where the heat absorbed by the matrix is given up to the gas stream. This cycle operates continually due to the continual matrix rotation.

The principal problems connected with this type of regenerator are those of leakage through the seal from the high pressure duct to the low pressure duct and of carry-over gas trapped within the matrix. These two problems sufficiently decrease the efficiency of this type heat exchanger to the extent where its feasibility has become questionable. The present invention satisfactorily solves the problem of leakage through the seal from the high pressure duct by providing means to insure adequate facial contact between the sealing members comprising the seal.

The chief object of this invention is to provide a seal which will keep leakage through the seal to a minimum.

A further object is to provide a high pressure seal which comprises means for positively maintaining the seal plates in sealing contact. Other objects of the invention will be readily perceived from the following description.

This invention relates to a seal for a regenerator, the regenerator comprising an annular rotor having inner and outer concentric walls, a matrix member disposed in the rotor, and two annular shaped seal members concentrically mounted at the ends of said rotor. A kidney shaped stationary seal member capable of slight axial movement has mounted thereon an adjustable clamping means adapted to rotatable engage the back portion of each seal member mounted on the rotor in such a manner as to urge the faces of both the seal members into sealing contact.

The attached drawings illustrate a preferred embodiment of my invention, in which:

Figure 1 is a view in section indicating the high pressure and low pressure sections of the regenerator embodying the present invention;

Figure 2 is a view partly in elevation and partly in section of an end section of the regenerator;

Figure 3 is a fragmentary view of the clamping means comprising the present invention; and

Figure 4 is a fragmentary view of a modification of this invention.

Referring to the drawings, there is shown in Figure 1 a sectional view of a rotary regenerator embodying the present invention. There is shown a housing 2 which comprises an annular shaped member having outer and

inner concentric walls. On each end of the housing is mounted the end covers 3 and 4. These end covers are attached to the housing by means of flanged connections 5. Cold high pressure gases pass into the housing 2 through inlet 6, through the rotor 10 in the housing, and then out through outlet 7. Simultaneously hot low pressure gas is introduced through inlet 8, passed through the rotor and then removed through outlet 9.

The rotor 10 has an annular shape and comprises an inner and outer concentric wall within which is mounted a matrix adapted to absorb the heat from the hot gases passing therethrough. This matrix normally consists of a series of sections 12 within which the matrix material is located. These sections 12 are normally of a box shape having a general trapezoidal cross section. A preferred type of matrix housing is illustrated in the application of W. S. Misener, Serial No. 361,215, filed June 12, 1953.

Concentrically mounted on each end of this rotor are end seal plates 13 and 14. These rotary seal plates are of annular shape and have located therein a series of trapezoidal openings permitting the passage of gas through the seal plates into the individual matrix sections 12 and then out of the rotor structure. Copper backing plates 15 and 16 are mounted behind these rotary seal plates 13 and 14 so that heat will be evenly distributed to these rotary seal plates and thereby insure uniform expansion of the seal plates.

Mounted directly behind the copper backing plate 15 is the ring 17. This ring includes a flanged section 18 which mounts concentrically upon the outer surface of the rotor 10. Extending outwardly from this flanged section 18 is a bearing 19 which may be of an anti-friction type such as roller or ball bearings. Adjacent this bearing portion are means for rotating the rotor, namely, the ring gear 20. In each copper backing plate there are located the annular races 21, 22, 23 and 24. As will be noted these races are located behind the copper plate adjacent the inner and outer peripheries of the rotor. The purpose of these races will be described hereinafter.

Connected to the housing 2 are two stationary seal plates having the shape of substantially the sector of an annulus. These plates 25 and 26 comprise the high pressure stationary seal plate of the present invention. Behind these stationary plates 25 and 26 are the copper backing plates 27 and 28, the function of which again is to distribute heat evenly over the stationary plates to assure uniform expansion. The backing plates 27 and 28 are directly connected to the bellows 29 and 30. These bellows are also attached to the annular plates 31 and 32. The plate 31 is rigidly attached to the end cover 3 and the plate 32 is attached to the end cover 4. In order to provide a sealed passage from the inlet 6 into the housing 2 and from the housing 2 to the outlet 7 there are mounted upon the inlet 6 and outlet 7 flange plates 33 and 34 which are bolted (not shown) to the plates 31 and 32 thereby preventing high pressure gas from escaping from the housing.

Referring to the low pressure section of the regenerator, the low pressure stationary plates 35 and 36 are substantially fixed in sealing relation to the annular rotary seal plates 13 and 14 by the members 39 and 40. Referring to Figure 2 it will be seen that the circumferential length of the low pressure inlet and outlet 8 and 9 are substantially greater than the high pressure inlet and outlet 6 and 7. It will also be noted that this geometry is carried through on the relative sizes of the stationary seal plates. To prevent warping of the stationary plates 35 and 36 suitable copper backing plates 37 and 38 are provided.

It will be noted that an exemplary rotary regenerator structure has been presented and there is fully illustrated a housing, a rotor and housing means between said hous-

ing and rotor. In order to impart rotation to the rotor there is provided a gear 55 suitably attached to a shaft 56 which is attached to some motive means such as an electric motor or a turbine. The gear 55 is mounted into the pillow block 57 which has a flanged connection for attachment to the end plate 3. Within this pillow block are provided suitable anti-friction bearing means for the gear 55.

The stationary seal plates 25 and 26 are urged into sealing contact by the clamps 41. Figure 3 shows an enlarged view of the construction of typical clamp 41. A boss 42 is mounted upon the stationary seal member. This boss has a hole therethrough with a shoulder 58. This hole is adapted to journal the bolt 49 which comprises a hexagonal head 50, a shoulder 51 and a threaded portion 52. The shoulder 51 coacts with the shoulder in the boss 42. The threaded portion of the bolt is adapted to coact with the L-shaped member 45 which has an internal thread 59. The boss 42 has affixed thereto two pin members 43 and 44 which coact with the two holes in the L-shaped member 45 for the purpose of preventing relative rotation between the L-shaped member 45 and the boss 42 about the axis of the bolt 49. The bolt member 49 adjustably engages the L-shaped member 45 in such a way as to permit variance of the distance between the members 42 and 45. A shaft member 46 extends from the lower leg of the member 45. Journaled upon this shaft member is a wheel 47. This wheel coacts with a race 21 which is a hardened steel ring embedded in the copper plate member which backs up the rotatable seal member. It can be readily seen that this wheel constitutes an anti-friction means between the clamp member 41 and the rotatable seal member thereby permitting rotation of the rotatable seal member with a minimum of friction. The present construction presents a clamping means which is capable of exerting a direct biasing force between two relatively moving seal members.

Referring to Figure 4 there is shown a similar clamp construction employing alternate anti-friction means. This clamp utilizes ball bearings instead of the roller construction in Figure 3. The race 21' is provided with a groove to accommodate the ball 47' and there is provided a cage member 46' for restraining relative orbital movement of the ball 47'.

The present invention provides a positive means for isolating the high pressure gas stream as it passes through the matrix of the rotary regenerator. This positive means comprises a clamp member which is adapted to urge the rotating seal member into facial contact with the stationary seal member. This construction has the advantage of being postitively attached to one member and being able to directly apply a biasing force against the other member thereby urging both sealing surfaces into facial contact.

While I have described a preferred embodiment of my invention, it will be understood that my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. A rotary regenerator adapted to condition a second stream of fluid with the properties of a first stream of fluid comprising a housing, a plurality of ducts leading to and from said housing for conducting said streams of fluid, a rotor mounted in said housing, a plurality of chambers annularly disposed within said rotor to provide paths through said regenerator for said streams of fluid, motor means coupled to said rotor to rotate said rotor thereby causing each of said chambers to be alternately presented to said first and second streams of fluid passing through said regenerator, a matrix positioned in each of said chambers to be conditioned by said first stream of fluid and to impart said conditioning to said second stream of fluid, said rotor having an annular rotating seal member with a sealing surface, said rotating seal member having a larger diameter than said annularly disposed chambers, a stationary seal member having a passage therethrough in alignment with said ducts and for alignment with the chambers, said stationary seal member having the shape of substantially the sector of an annulus, a plurality of bosses mounted along the inner and outer arcuate edges of said stationary seal member, a plurality of clamp members having anti-friction means engaging areas adjacent the edge portion of the annular rotating seal member to urge said stationary and rotating seal members into sealing engagement, adjustment means associated with each of said bosses for adjustably biasing said seal members into sealing engagement.

2. A rotary regenerator according to claim 1 in which at least one of the clamp members having said anti-friction means engages the rotating sealing member at a diameter greater than the annularly disposed chambers.

3. A rotary regenerator according to claim 2 in which the anti-friction means comprises wheels rotatably mounted on said clamping means and having their periphery in rolling engagement with a surface of the rotating seal member opposite from the sealing surface.

4. A rotary regenerator according to claim 2 in which the anti-friction means comprises balls in rolling engagement with a surface of the rotating seal member opposite the sealing surface.

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