May 12, 1970 H. J. CLIFFORD ET AL 3,511,309

ROTARY REGENERATOR

Filed Nov. 20, 1968

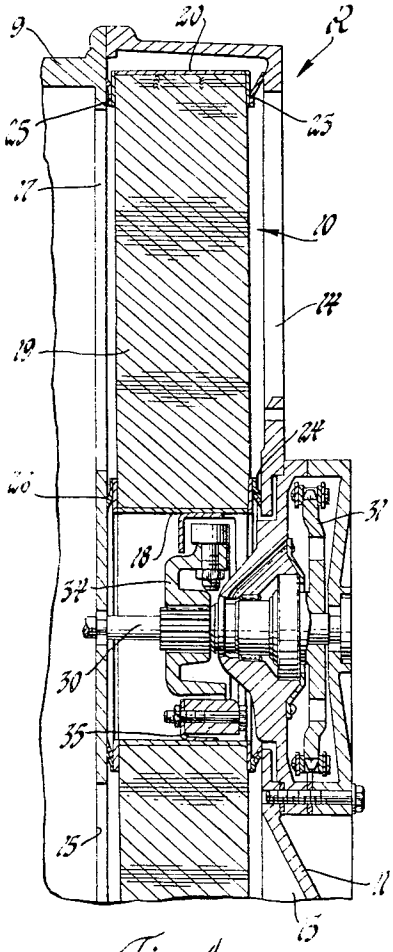


Fig. 1

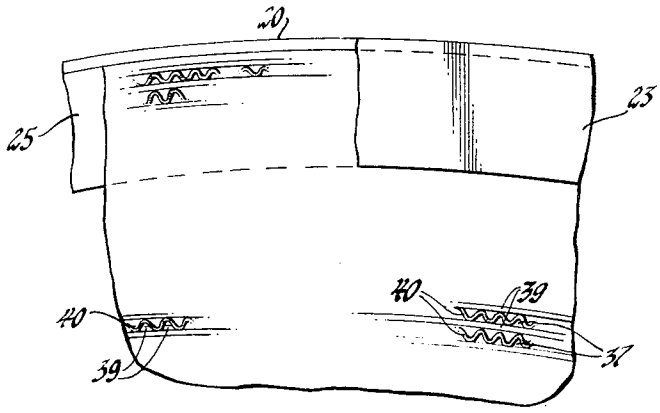


Fig. 2

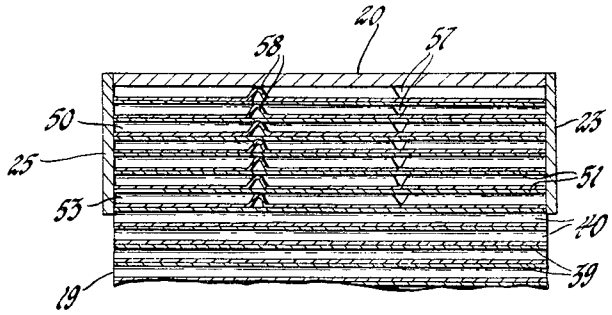


Fig. 3

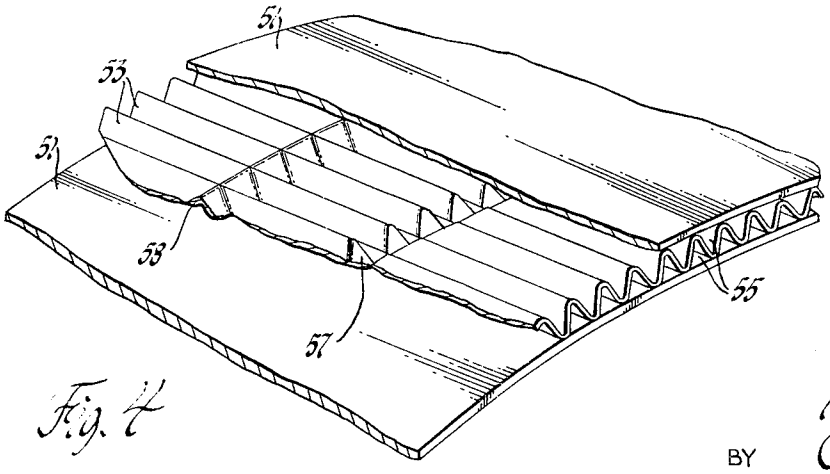


Fig. 4

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ROTARY REGENERATOR

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U.S. Cl. 165—9 2 Claims

ABSTRACT OF THE DISCLOSURE

An annular matrix in an axial-flow regenerator which cooperates with circumferential seals bearing against the faces of the matrix at the outer rim has an impervious ring in the matrix structure blocking communication of pressure from one face of the matrix to the matrix-engaging face of the seal at the other face. The blockage is produced by a circumferential corrugation or crimp in the sheets of the matrix which have corrugations extending axially of the matrix.

Our invention relates to rotary regenerators, particularly those of the axial-flow type. Such regenerators include a matrix which is a disk or drum of material pervious to flow through it in an axial direction, the matrix being rotated about its axis so as to cause each element of the matrix to pass alternatively through passages conveying fluids at different temperatures. Heat is stored in the matrix while exposed to one fluid and is delivered to the other fluid when it passes through it. It is customary to provide seals at the rims of the matrix to prevent flow around the matrix rather than through it. Such seals may extend entirely around the matrix on each side or may extend only part way around the matrix on one of the two sides. It is important that these seals bear lightly against the matrix to minimize friction and wear but that they be in contact to minimize leakage.

Communication of pressure between the two faces of the matrix upsets the action of the seals. If the pressures can be communicated from face to face through the matrix to the seals, the effect is to provide communication through a connecting passage such that the pressure distribution exerted on the matrix-engaging face of the inner seal is no longer independent of the pressure distribution exerted against the matrix-engaging face of the outer seal.

According to an invention of Bracken and Hubble disclosed in U.S. patent application Ser. No. 671,267 for Rotary Regenerator, filed Sept. 28, 1967 (Pat. No. 3,482,-622) this difficulty is cured by providing a structure in the matrix which renders those portions of the matrix which contact the by-pass seal at the outer margin of the matrix impervious to fluid flow or transmission of pressure from one face to the other. In their preferred structure, the matrix is of a ceramic type and the blockage is effected by cutting a channel into the outer circumferential portion of the matrix between the faces, which channel is filled with a ceramic material which is fired and hardened to form a barrier impenetrable to fluid between the faces of the matrix.

Our invention provides for such blockage in a regenerator matrix of metal construction embodying metal sheets some of which have corrugations extending axially of the matrix.

Our invention is illustrated here as embodied in a rotary regenerator of the type to which U.S. Pat. No. 3,368,611 of Bracken and Zeek for Regenerator Seals, Feb. 13, 1968, and Bracken and Hubble application Ser. No. 661,075, filed Aug. 16, 1967, for Rotary Regenerator Matrix Mount and Drive (Pat. No. 3,476,173) are directed.

The principal objects of our invention are to improve the performance of rotary regenerators, to provide more precise and effective control over the contact forces of seals for such regenerators, to improve durability and minimize leakage in regenerators, and to provide a simple and effective means for eliminating imposition of static pressure from one face of a matrix on a seal which bears against the opposite face. While the principles of the invention may be applied to radial-flow regenerators, it is more readily applied to and more likely to find useful application in axial-flow regenerators, and is so shown.

The nature of our invention and its advantages will be clear to those skilled in the art from the succeeding detailed description of the preferred embodiment of the invention and the accompanying drawings thereof.

FIG. 1 is a sectional view of a rotary regenerator taken in a plane containing the axis of rotation thereof.

FIG. 2 is a fragmentary elevation view of one face of a matrix, with parts cut away.

FIG. 3 is a fragmentary enlargement of FIG. 1.

FIG. 4 is a fragmentary axonometric view of a matrix.

Referring first to FIG. 1, a gas turbine engine may include an engine block or housing **9** which supports the rotating parts and combustion chamber of the engine (not illustrated) and which also supports a rotary regenerator R including an axial-flow matrix **10**. The matrix is mounted for rotation about a horizontal axis, as illustrated, at a side face of the block **9**. The matrix is enclosed by the block **9** and a regenerator cover **11** fixed to the block, these two constituting a housing for the matrix. The regenerator cover defines a cool air inlet **13** and an exhaust outlet **14**. The block **9** defines a hot air outlet **15** opposite to the inlet **13** and a hot gas inlet **17** opposite to the exhaust outlet **14**.

The matrix **10** is of known type embodying a hub or inner ring **18** by which it is driven, an annulus **19** of heat exchange material defining passages extending generally parallel to the axis from face to face of the matrix, and an outer ring or outer rim **20**. The heat exchange material **19** is fixed to the hub **18**. Seals cooperating with the matrix include an outer side rim seal **23** engaging the matrix adjacent the rim, an outer side hub seal **24** engaging the hub, an inner side rim seal **25** opposite to seal **23**, and an inner side hub seal **26** opposite to seal **24**. The sealing structure also includes radial crossarm seals extending from the hub to the outer margin of the matrix (not illustrated) to block flow from one fluid passage to the other across the face of the matrix. These seals may be as described in Pat. No. 3,368,611.

The means for driving and supporting the matrix illustrated is the same as one form shown in the prior application referred to above. It includes a shaft **30** rotatably mounted in the housing driven by a sprocket **31**. An inner coupling member **34** fixed on the shaft is coupled by a flexible connection to an outer coupling member **35** which connects the shaft to the hub **18** of the matrix.

The sheet metal matrix is of such a nature as to provide numerous small passages or pores **37** extending parallel to the axis of the matrix. Generally speaking, this structure is made by laying up alternate spirals **39** of flat sheet metal and **40** of corrugated sheet metal, which are then bonded together by brazing.

The means for blocking transmission of pressure from face to face of the matrix through the marginal part engaged by the rim seals is shown particularly in FIGS. 3 and 4. The radially outer portion **50** of the matrix between seals such as **23** and **25** embodies alternating flat sheets **51** and corrugated sheets **53**. The corrugated sheets may be similar to those in the main portion **19**

of the matrix but, in general, the corrugations in the blocked outer portion are shallow while those in the inner portion may not be.

To block flow through the passages **55** which would otherwise be defined between the flat and corrugated sheets, the corrugated sheets **53** are provided with two ridges or corrugations **57** and **58** extending lengthwise of the corrugated strip and circumferentially of the matrix, crossing the normal corrugations of the strip which extend axially of the matrix. The circumferentially extending ridges **57** and **58**, as can clearly be seen, cut off or block the passages which otherwise would exist between adjacent flat sheets **51**. When the assembly of the matrix is completed, the peaks of outward extending ridge **58** bear tightly against and are brazed to the next adjacent flat sheet **51** outward of the corrugated sheet and the peaks of corrugations of ridge **57** similarly bear against the next inner flat sheet **51**. Thus, the two ridges block the otherwise existing flow passages on both the outer and inner sides of the corrugated sheet **53**.

The ridges **57** and **58** may be provided during the rolling to provide the normal corrugations of the sheet or may be added by a subsequent rolling operation.

Precise control of the action of the seal and accurate response of the seal engaging force to the varying pressures which may exist in different conditions of regenerator operation are assured by presence of the barrier defined by ridges **57** and **58**.

The detailed description of the preferred embodiment of our invention for the purpose of explaining the principles thereof is not to be considered as limiting or restricting the invention, since many modifications may be made by the exercise of skill in the art without departing from the scope of the invention.

What is claimed is:

1. A rotary regenerator comprising, in combination, a housing, an axial-flow matrix having radial faces and an outer circumferential surface, the matrix including heat-exchange material defining multifarious distinct generally parallel passages from face to face of the matrix, means mounting the matrix rotatably in the housing, and seal means mounted on the housing engaging at least one face of the matrix adjacent the outer surface of the matrix; the matrix including a peripheral annular zone cooperating with the said seal means, the said peripheral zone comprising alternating smooth and corrugated metal strips with the corrugated strips spacing the metal strips and defining passages across the matrix, the corrugated strips in the said zone having oppositely directed circumferential ridges blocking the said passages so as to isolate the matrix-engaging surface of the seal means from exposure to pressure communicated through the matrix from the remote face of the matrix.

2. A regenerator as recited in claim **1** in which the ridges are spaced inwardly from the faces of the matrix.

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U.S. Cl. X.R.

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