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REGENERATIVE HEAT EXCHANGER

2,579,211

Original Filed Aug. 23, 1948

2 SHEETS—SHEET 1

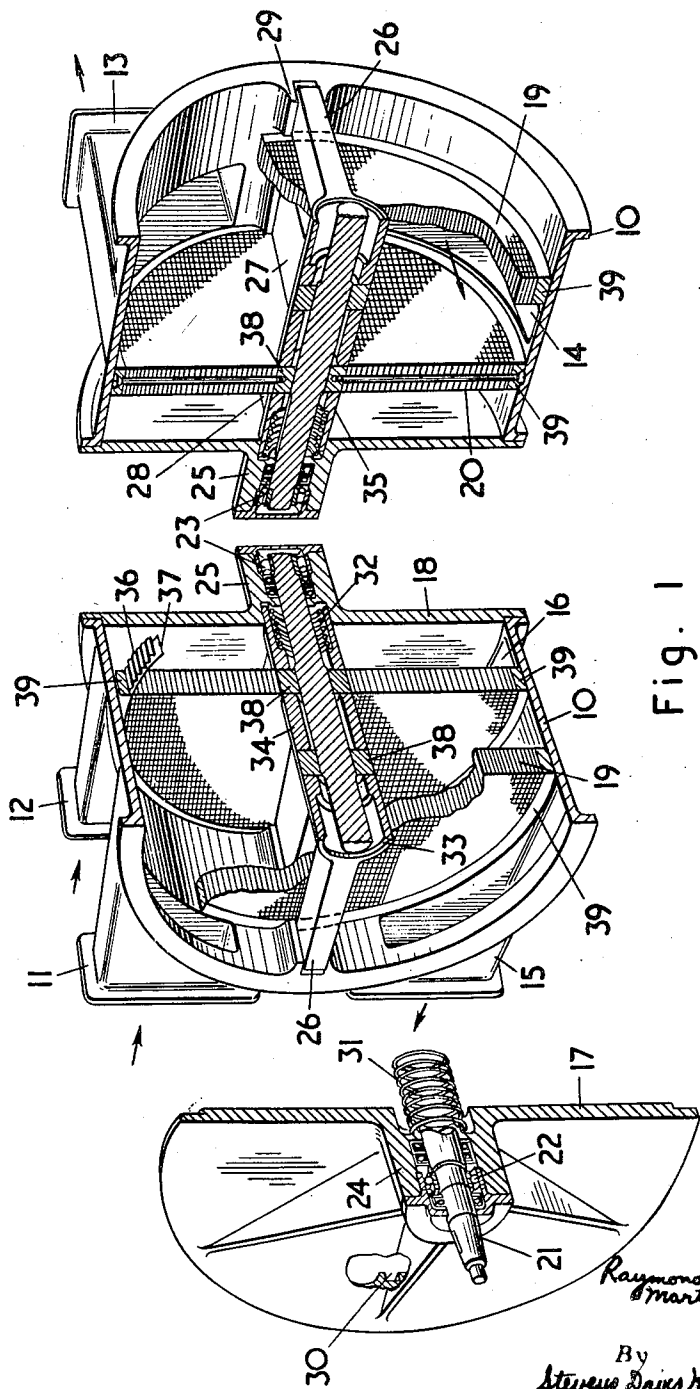


Fig. 1

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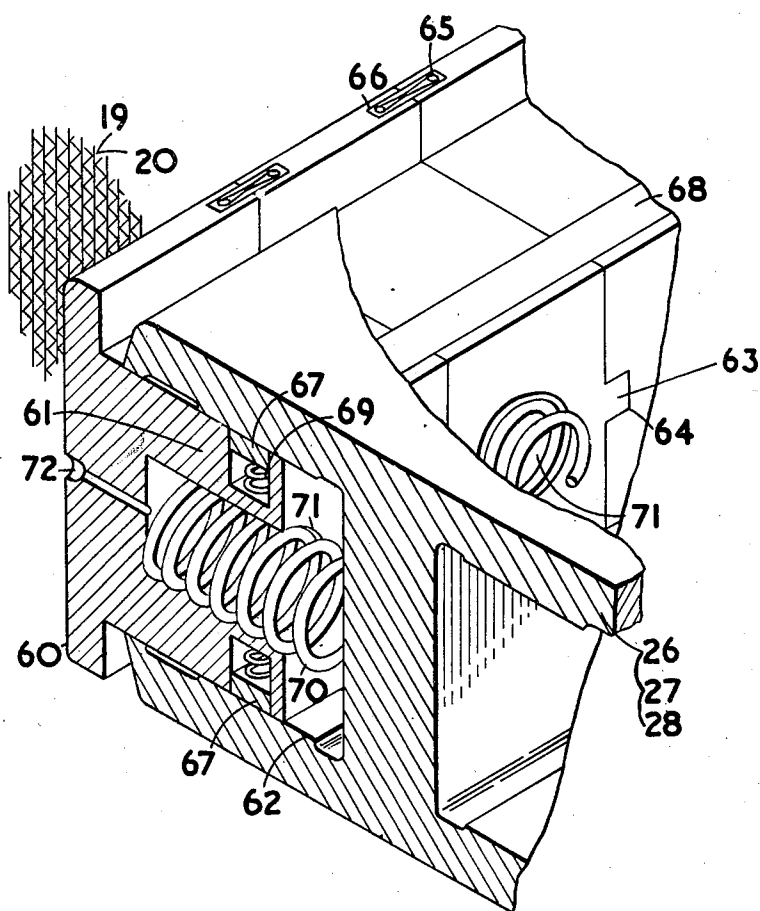


Fig. 2

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UNITED STATES PATENT OFFICE

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REGENERATIVE HEAT EXCHANGER

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5 Claims. (Cl. 257—6)

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This application is a division of prior copending application Serial No. 45,756, filed August 23, 1948, entitled Regenerative Heat Exchangers, and also relates to regenerative heat exchangers of the kind wherein heat absorbing and heat transmitting matrix members are rotatable in a casing partitioned by dividing members extending across the face of the matrix members into fluid paths for a fluid at a high temperature and a fluid at a lower temperature so that the members as they rotate absorb heat from the high temperature fluid and transmit the heat to the lower temperature fluid and in which the dividing members are each provided with movable sealing contact members extending longitudinally thereof in grooves therein for movement towards and away from the face of the matrix members and biased to contact the face to limit the loss between the two fluid streams.

In the regenerative heat exchanger as described above the velocity of flow of the two fluids, which may be, for example, the products of combustion from a furnace and the combustion air for the furnace, is generally low and the pressure difference and the temperature difference between the two fluids is never very great so that the provision of an effective seal between the two fluid flows is a comparatively simple matter.

When, however, the pressure difference and the temperature difference and the velocity of flow are much greater, such for example, as between the compressed combustion air and the hot exhaust gases of a gas turbine plant the provision of an effective seal is much more difficult and the seals devised so far are not effective.

According to the present invention a sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure difference between the two fluids is great is made up of a plurality of sealing contact elements slidably positioned in the groove of the dividing member in closely abutting formation to provide a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face and each being spring biased sufficiently to maintain it in contact with the matrix face and each being provided with a fluid passage extending therethrough from the sealing contact face to the rear surface within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the rear surface in the groove to load it and urge the element into contact with the matrix face. The

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opening of the fluid in the sealing contact face of the element may be positioned at a distance from the side of the element adjacent the high pressure fluid in accordance with the pressure drop across the sealing contact face of the element. The abutting interfaces of the elements may be provided with sealing means to prevent leakage of the high pressure fluid between them. For example the abutting elements may be tongued and grooved or the abutting elements may be provided with abutting grooves and a dumbbell sectioned sealing element positioned with the bell ends in the grooves. The faces of each element contacting the sides of the grooves may also be provided with sealing means to prevent the high pressure leaking into the groove.

The invention will now be described by way of example only with reference to the accompany drawing in which:

Figure 1 is a divided and sectioned perspective view of a regenerative heat exchanger with dividing members or plates and rotatable matrix discs according to the aforesaid copending application Serial No. 45,756.

Figure 2 is a sectioned perspective fragmentary view showing the sealing contact elements of the dividing plates in yieldable sections.

In Figure 1 a regenerative heat exchanger has an outer cylindrical casing 10 with tangentially arranged fluid inlet and outlet connections; two inlets 11 and 12 and one outlet 13 for the cold high pressure fluid and one inlet 14 and two outlets 15 and 16 for the hot low pressure fluid. The cylindrical casing is provided with removable end covers 17 and 18.

Two similar porous matrix members 19 and 20 of disc form are mounted for rotation within the casing 10 on a shaft 21. The, are splined to the shaft 21 (splines not shown) and are capable of relative axial movement on the splines. The disc members 19 and 20 divide the casing 10 into three chambers and each chamber is divided diametrically by dividing members or plates 26, 27 and 28 which are supported in grooves or slots 29 or 30 formed respectively in the casing 10 and covers 17 and 18. The two dividing plates 26 and 28 adjacent the covers 17 and 18 are spring urged towards one another by compression springs 31 and 32 arranged around the shaft 21 between the covers 17 and 18 and the plates 26 and 28 respectively. The two matrix discs 19 and 20 are sandwiched between the central dividing plate 27 and the two dividing plates 26 and 27. Hollow bosses 33, 34 and 35 are formed respectively on the dividing plates 26, 27 and 28 through

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which the shaft 21 passes. The bosses 33, 34 and 35 closely engage the matrix discs and the end covers 17 and 18 to prevent any leakage between the high and low pressure chambers. The bosses 33 and 35 are arranged to receive the springs 31 and 32 respectively.

The matrix discs 19 and 20 are each formed of a corrugated strip 36 and a plain strip 37 of metal wound in a spiral on a central boss 38. A rim member 39 is placed around the spirally arranged strips 36 and 37. A labyrinth gland (not shown) may be machined on the outer surface of the rim 39. The dividing plates 26, 27 and 28 may be arranged to rub against the matrix discs 19 and 20 to form the diametrical seal.

In Figure 2 of the drawings the dividing member or plate 26 is shown which is provided in the region adjacent to a face of a rotating matrix disc 19 or 20 with a number of sealing elements 60 abutting against one another and arranged diametrically across the face of the disc 19 or 20. The elements 60 are preferably arranged for rubbing contact with the discs and the centrally located element or elements may be provided with an aperture for the shaft (not shown) on which the matrix discs are mounted. The elements 60 are made comparatively short relative to the diameter of the discs so that the seal as a whole is locally yieldable and can, therefore, adjust itself to any distortion of the matrix face. Each element 60 is provided with an axially extending tongue 61 arranged to slide freely in a groove 62 formed in the dividing member 26. Adjacent elements 60 are also provided with sealing means 63, 64 and 65 between their interfaces to prevent high pressure fluid passing between them. For this purpose each element 60 may be formed for tongue and groove sealing 63, 64, in one plane (e. g. the horizontal plane) and another form of sealing in another plane (e. g. the vertical plane) which may consist of a dumbbell shaped element 65 arranged half in one element 60 and half in another element 60 in slots 66.

It may be necessary to form seals between the tongues 61 of the sealing sections 60 sliding in the grooves 62 in the dividing members 26, 27 or 28. Packing strips 67 arranged in grooves 68 formed in the tongue 61 of each element 60 will suffice. The strips 67 are spring loaded by springs 69.

The sealing elements 60 are forced against the face of the matrix disc by fluid pressure applied to the groove 62 behind the elements 60. Springs 70 may be arranged between the end of the tongue 61 and the end of the groove 62 to give an initial loading to each element 60. The ends of the springs 70 may be arranged in circular recesses 71 formed in the tongue 61 (as shown in Figure 2 of the drawing) or in the dividing plate 26 to hold them in position.

The fluid pressure which is used to force the elements 60 against the face of the matrix disc 19 or 20 may be obtained from the high pressure fluid stream passing through the heat exchanger. For this purpose a bleed duct or passage 72 is provided in one or more of the elements 60 extending through the element from the front thereof (i. e. from the rubbing face of the disc) to the rear thereof, the function of this duct 72 being to maintain the pressure existing in the groove 62 at the rear of the elements 60 and urging said element 60 towards the rubbing face at a value equal to that existing at a suitable point on the front of the sealing element

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60 where it abuts against or is very close to the matrix face, for varying rotational speeds and pressure differences between the two fluid streams.

The position of the duct 72 from the high pressure side of the element may be selected to give the necessary pressure loading required to hold the element 60 against the matrix face (i. e. according to the pressure drop across the face of the element 60.)

Sealing elements constructed in the above described manner can conform fairly closely to any distortion of the matrix face and thereby limit leakage.

It will be understood that when the matrix is in the form of a drum, through the wall of which the gases pass in the radial direction, the seal will lie along the cylindrical surface of the drum and its local yielding will take place in the radial direction.

We claim:

1. A sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure difference between the two fluids is great, comprising a plurality of sealing contact elements slidably positioned in the groove of the dividing member in closely abutting formation to provide a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face and each being spring biased sufficiently to maintain it in contact with the matrix face and each being provided with a fluid passage extending therethrough from the sealing contact face to the face within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the face in the groove to load the element and urge it into contact with the matrix face.

2. A sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure difference between the two fluids is great, comprising a plurality of sealing contact elements slidably positioned in the groove of the dividing member in closely abutting formation to provide a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face and each being spring biased sufficiently to maintain it in contact with the matrix face and each being provided with a fluid passage extending therethrough from the sealing contact face to the face within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the rear surface in the groove to load the element and urge it into contact with the matrix face, and sealing means between the abutting faces of the elements to prevent high pressure fluid passing between said elements.

3. A sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure difference between the two fluids is great, comprising a plurality of sealing contact elements slidably positioned in the groove of the dividing member in closely abutting formation to provide a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face and each being spring biased sufficiently to maintain it in contact with the matrix

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face and each being provided with a fluid passage extending therethrough from the sealing contact face to the face within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the rear surface in the groove to load the element and urge it into contact with the matrix face, and sealing means between the abutting faces of the elements to prevent high pressure fluid passing between said elements comprising a tongue in one element, and a groove in an adjacent element to receive the tongue, the tongue and groove being arranged to allow each element to move relatively to another towards and away from the matrix face.

4. A sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure difference between the two fluids is great, comprising a plurality of sealing contact elements slidably positioned in the groove of the dividing member in closely abutting formation to provide a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face and each being spring biased sufficiently to maintain it in contact with the matrix face and each being provided with a fluid passage extending therethrough from the sealing contact face to the face within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the rear surface in the groove to load the element and urge it into contact with the matrix face, and sealing means between the abutting faces of the elements to prevent high pressure fluid passing between said elements comprising a channel slot in each abutting face of adjacent elements arranged to cooperate together to form a passage between adjacent elements and a dumbbell-sectioned element in said passage with a bell end in each channel slot to form a seal.

5. A sealing contact member of a dividing member of a regenerative heat exchanger of the kind described and in which the pressure differ-

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ence between the two fluids is great comprising a plurality of sealing contact elements, each having a sealing contact face for contacting the matrix face and a tongue projecting into the groove of the dividing member, said elements being positioned in closely abutting formation to provide with their sealing contact faces a continuous seal against the matrix face and a flush rear surface in the groove, each element being individually movable towards and away from the matrix face slidably on its tongue in said groove and each spring biased sufficiently to maintain it with its sealing contact face in contact with the matrix face and each provided with a fluid passage extending therethrough from the sealing contact face to the rear surface of the tongue within the groove to collect high pressure fluid leaking past the sealing contact face and to lead it to the rear surface of the tongue in the groove to load the element and urge it into contact with the matrix face and sealing means between said tongue and said groove to prevent high pressure fluid leaking between said tongue and groove.

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