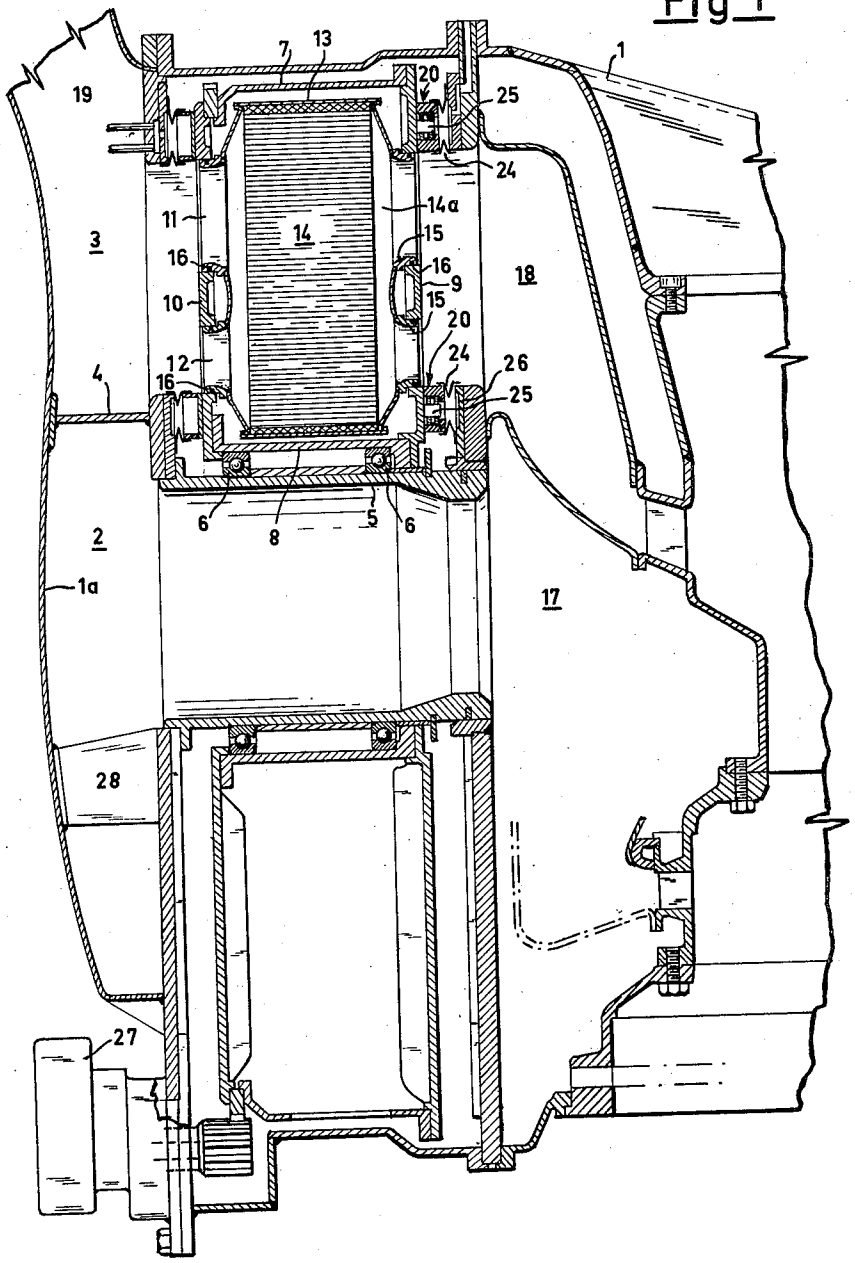
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REGENERATIVE HEAT EXCHANGER

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Fig 1

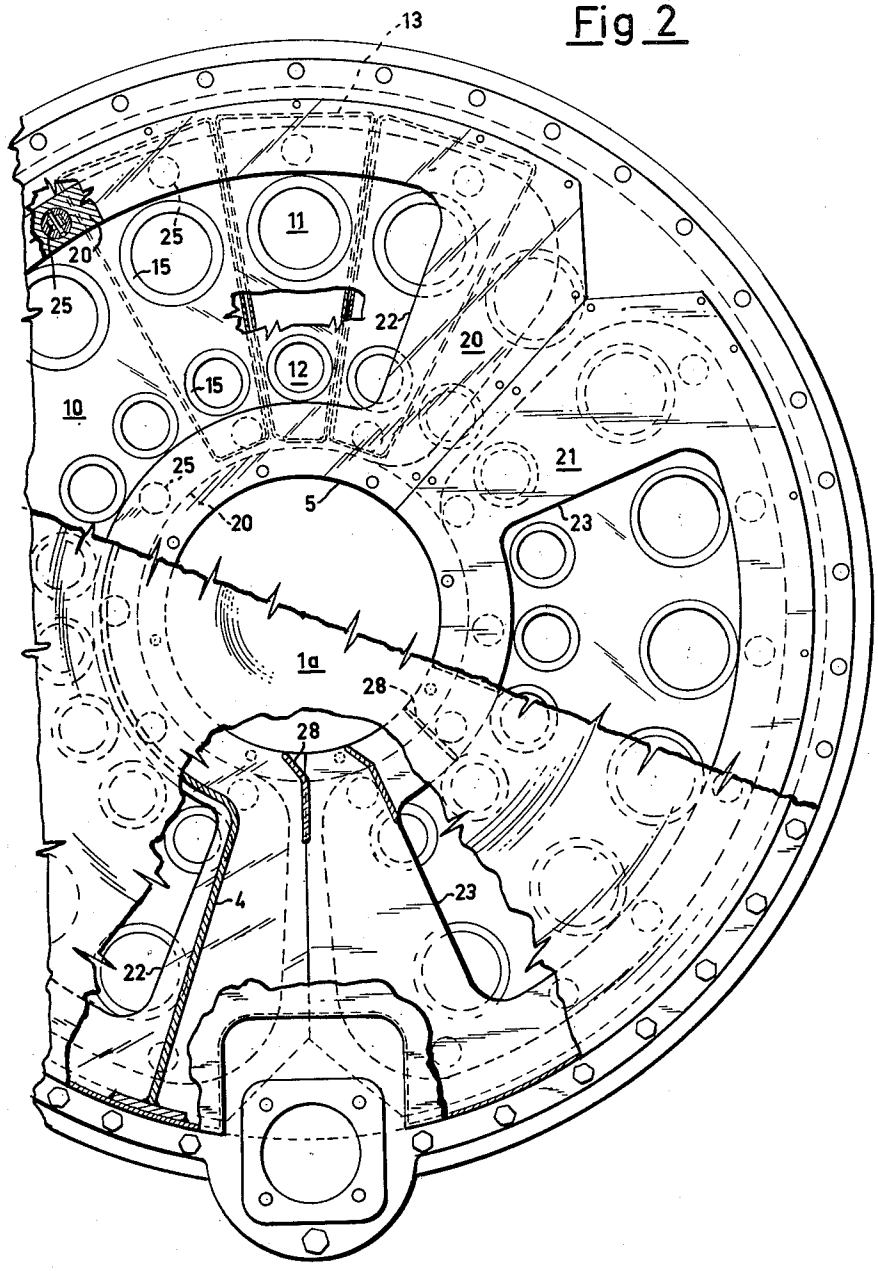


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Fig 2



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REGENERATIVE HEAT EXCHANGER

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3 Claims. (Cl. 165—9)

This invention relates to a rotary regenerative heat exchanger, particularly for gas turbine power plants, comprising a housing having an inlet and an outlet for a heating and a heated elastic fluid, and a heat exchange member mounted for rotation in said housing and divided into a plurality of sections.

In gas turbine power plants for automotive purposes it is highly important to minimize the dimensions of the components of the plant. The heat exchanger is usually the largest one of these components.

In order to keep the dimensions of a heat exchanger as small as possible it is obviously desirable to utilize a heat exchange medium having a high heat capacity per unit volume. However, in addition to this, it as also necessary to utilize this medium to its maximum capabilities.

In accordance with this invention, the sections of the heat exchange member are in the form of substantially wedge-shaped chambers having apertures for the supply and discharge of the fluids, said chambers being filled with a heat-absorbing material and arranged circularly around the axis of rotation with the apertures orientated in the direction of said axis, the annular zone of the part of the heat exchange member confronting the apertures extending radially over 50 to 90% of the radial extent of said sections. Due to the comparatively great radial extent of the part of the heat exchange member confronting the apertures there is obtained a very uniform distribution of the fluid over the end surface of the heat absorbing material even if this end surface be located at a relatively short distance within the plane of the apertures.

The invention is described hereinbelow with reference to an embodiment illustrated in the annexed drawing. FIG. 1 is an axial sectional view of a regenerative heat exchanger according to the invention and FIG. 2 is a partial sectional end view of this heat exchanger.

The heat exchanger illustrated in the drawing is intended for a gas turbine power plant in which the residual heat of the exhaust gases from the turbine is to be recovered and used for preheating the combustion air. The heat exchanger comprises a housing 1 and a cover 1*a* having a distributor chamber 2 for the air and a collecting chamber 3 for the exhaust gas, said chambers being separated from each other by means of a partition 4.

The cover 1*a* carries a central inlet duct 5 on which the heat exchange member is mounted for rotation by means of ball bearings 6.

The heat exchange member comprises an annular case having an outer wall 7 and an inner wall 8. The case also has end walls 9 and 10 which are flat at their outsides and have two sets of circular apertures 11 and 12, the apertures 11 being of larger diameter and located radially outwards of the apertures 12.

Inserted between the end walls 9 and 10 are sheet metal receptacles defining chambers 13 for a heat absorbing material 14. As will be seen from FIG. 2, the chambers are substanially wedge-shaped and provided with openings corresponding to the apertures 11 and 12. The end walls of the chambers 13 are conically pressed outwards around the openings and carry cylindrical collars 15 which

are guided in the openings in the end walls of the case 7 and provided with sealing piston rings 16. Due to this arrangement the chambers 13 have a certain freedom of motion relative to the case 7, whereby to avoid detrimental thermal stresses.

The air arriving from the compressor of the turbine power plant passes via a space 17 in the housing 1 of the heat exchanger and through the inlet duct 5 to the distributor chamber 2 and hence passes through the heat exchange member from the left to the right, as viewed in FIG. 1. The exhaust gas from the turbine enters a distributor chamber 18 in the housing 1 of the heat exchanger and passes through the heat exchange member from the right to the left in FIG. 1. The gas leaves the collecting chamber 3 through a diagrammatically indicated outlet 19.

In order to prevent air from flowing over to the gas section of the heat exchanger, sealing members 20 and 21 are provided on either side of the heat exchange member. The sealing members have arc-shaped openings the edges of which are denoted at 22 and 23, respectively, in FIG. 2. The sealing members 20 and 21 are carried by bellows 24, FIG. 1, to which air under pressure is supplied so that the sealing members are forced against the flat end walls 9 and 10. The thrust can be chosen such as to relieve the ball bearings 6 from axial forces.

Mounted in recesses in the sealing members 21 are support rollers 25 which initially may be located entirely inside the surface of the sealing element but upon a certain wear of the sealing element come into contact with flat end walls 9 and 10. The support rollers take the main thrust such that the sealing surfaces only just come into contact with each other. Consequently, the sealing surfaces will be subject to moderate wear. The air supplied to the bellows 24 leaks past the rollers and cools the rollers as well as the sealing surfaces.

The sealing members and bellows are secured to plates 26 which are bolted to the housing 1 and the cover 1*a*, respectively. The regenerator material 14 consists advantageously of a corrugated foil-shaped material of the ceramic type. These foils are arranged in the chamber 13 such that parallel narrow ducts formed by the corrugations extend through the heat exchange member, as will be seen from FIG. 1. The ceramic material is light and has a very large surface with resulting high capacity in spite of the fact that the thermal conductivity of the material is low. The last-named property is advantageous from the point of view of minimizing the transport of heat from the hot end to the cold end of the material. It is true that this material is very brittle, but since it is divided in a plurality of small sections provided in individual chambers, the material will not be subjected to considerable mechanical stresses. In case of damage individual sections can be exchanged. It may happen that a heat exchanger takes fire. In the heat exchanger described the fire is not likely to spread over the entire heat exchange member, and since the ceramic material is highly heat-resistant, it is not likely to be damaged.

Although not shown in the drawing, the converging lateral surfaces of the chamber 13 are corrugated to increase the stiffness thereof. The corrugations are displaced relative each other such that the corrugations of one element project into the corrugations of an adjacent element in the assembly.

Said corrugations of the walls of the chamber do not extend throughout the entire height of the walls. At the ends of the walls there are provided flat wall portions. Between these flat portions and the heat absorbing material there are inserted sealing rings in conformity with the wedge-shape of the chamber, said sealing rings preventing the fluids from passing between the walls of the chamber and the heat absorbing filling material. The

sealing rings may be V-shaped in cross section so as to be resilient, one limb of the V bearing upon the inside of the wall of the chamber and the other one bearing upon the filling material. The two contacting edges may be provided with outwardly bent flaps which are received in the filling material and in the recesses in the wall of the chamber, respectively, such as to localize the filling material in its position in the chamber. These sealing rings which may be replaced by separate strips serve three purposes. They act as sealing members, they retain the filling material elastically to prevent damage by thermal expansion of the chamber, and they lock the filling material axially of the chamber.

In accordance with the invention, the annular zone of the part of the heat exchange member confronting the apertures **11** and **12** extends radially over 50 to 90% of the radial extent of the chambers **13**. As a result thereof, the fluids are able to distribute themselves over the entire end surface of the filling material which consequently will be uniformly utilized even in case of a relatively small distance between the end surface of the filling material and the plane of the apertures. In addition, the axial extension of the case **7** may be small, resulting in a low weight of the heat exchanger. In order to minimize the axial extent of the heat exchange member special measures may be taken to spread the fluids. For example, a conical perforated screen, such as a conical netting, may be provided immediately inside the apertures **11** and **12** such as to guide part of the fluid outwards toward the walls of the container **13**. A similar effect can be obtained if the end surface of the filling material which confronts the apertures **11** and **12** is provided with an additional lining of steel wool, mineral wool or the like which is retained in place by a suitable netting. As a result of this measure, the resistance to flow will be increased just at these parts of the filling material which are indicated at **14***a* in FIG. 1, the result being a balanced fluid flow. It should be noted that these additional linings also take part in the exchange of heat. Instead of the provision of special linings the filling material itself may be profiled in a corresponding manner.

While two circular apertures of different sizes are shown in the drawing, the invention is not limited to this shape and number of apertures. For example, the two apertures may be replaced by a single aperture conforming to the shape of the chamber. In this case, packings, O-rings or similar members have to be provided for effecting a seal between the apertures of the chambers and the end walls **9** and **10** of the case **7**, and the chambers have to be provided with bellows-like collars around the apertures such that the edges of the apertures are kept in resilient engagement with the sealing material.

In the embodiment exemplified the heat exchange member is driven by a hydraulic motor **27**.

As will be seen from FIG. 2, the opening **22** in the sealing member **20** for the gas section extends through a considerably greater angle than the openings **23** in the sealing member **21** for the air section. However, the

partition **4** in the cover **1***a* is located such that the chambers **2** and **3** extend substantially through an angle of 180°. Inserted in the cover are guide vanes **28** which deflect the air from the inlet duct **5** also to the ends of the chamber **2** so as to contribute to a uniform inflow through the openings **23** and to cool a comparatively large portion of the outside of the cover **1**.

The invention is not limited to the illustrated and described embodiment and can be modified as to the details thereof, within the scope of the annexed claims. For example, the outer wall **7** and the inner wall **8** of the case of the heat exchange member may be recessed, such as in the form of lattices, in order to reduce their weight. If desired, the sealing members **20** and **21** may be replaced by a single one. Even other modifications are conceivable and need not be described.

What is claimed is:

1. A rotary regenerative heat exchanger of the axial flow type, particularly for gas turbine power plants, comprising a stationary housing, an annular heat exchange member mounted for rotation in said housing and having radial end walls, driving means for said heat exchange member, said housing being provided with an inlet and an outlet for a heat emitting elastic fluid and an inlet and an outlet for an elastic fluid to be heated and a cover comprising a distributing chamber and a collecting chamber for the fluid to be heated and the heat emitting fluid, respectively, a plurality of receptacles in said heat exchange member, said receptacles being filled with a heat exchange material and arranged circularly around the axis of rotation of the heat exchange member, sealing means between said radial end walls and said housing, and an inlet duct for said fluid to be heated extending axially through the center of said annular heat exchange member to said distributing chamber, said duct supporting bearings for said rotatable heat exchange member.

2. A regenerative heat exchanger as claimed in claim **1**, and which further includes guide vanes in said distributing chamber for deflecting fluid from said inlet duct evenly to the receptacles of said heat exchange member.

3. A regenerative heat exchanger as claimed in claim **1** and which further includes bellow members filled with a fluid under pressure and forcing said sealing means into contact with said radial end walls of said annular heat exchange member.

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