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(71) Applicant: BURMEISTER & WAIN ENERGI A/S [DK/DK]; Teknikerbyen 23, DK-2830 Virum (DK).

(72) Inventor: MADSEN, Bjarne, Nygaard ; Harekrogen, DK-2740 SKovlunde (DK).

(74) Agents: JESSEN, Ivar, Bergishagen et al.; Internationalt Patent-Bureau, 23 Høje Taastrup Boulevard, DK-2630 Taastrup (DK).

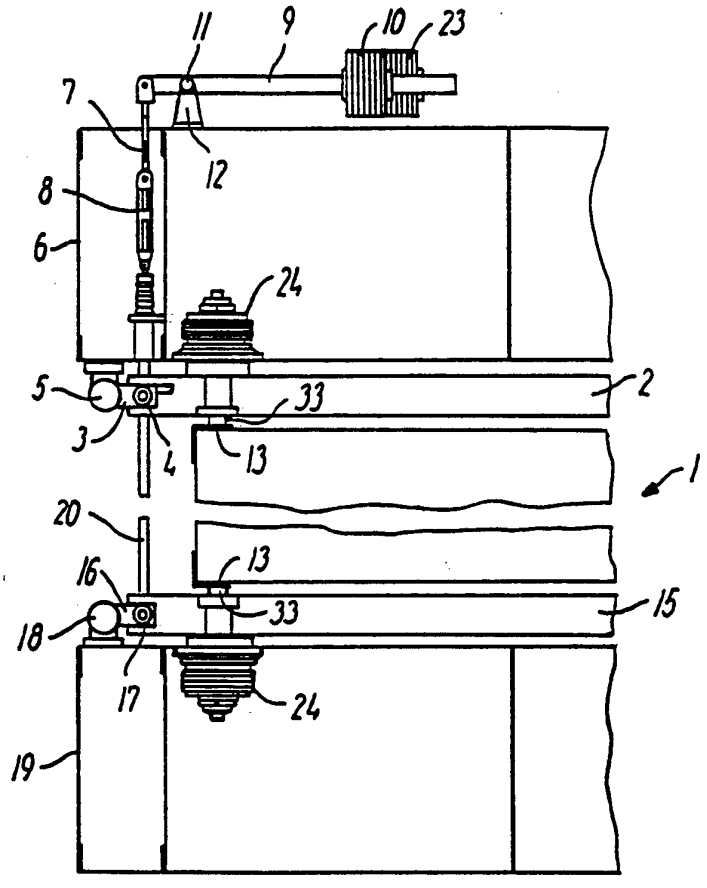
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(54) Title: REGENERATIVE HEAT EXCHANGER

(57) Abstract

The heat exchanger (1) has a rotor (1) with radial sealing devices (2, 15) which by means of counterweight (10, 23) over link connections are kept against the rotor. A spacing device (24) comprises an adjustable spindle carrying a slide shoe (33) made of carbon which slides against a smooth face (13) of the rotor, thereby determining the gap between the radial sealing device and the rotor.



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REGENERATIVE HEAT EXCHANGER

The invention relates to a renegerative heat exchanger comprising a heat exchanger matrix in form of a rotor having at each end a smooth, axial face at the periphery, and at each end a radial sealing device which by means of a counterweight over a link connection is kept against the rotor, as well as a spacing device for controlling the axial distance between the radial sealing device and the rotor.

From DE published specification no. 1 035 843 a heat exchanger of the above type is known, in which the spacing device is a roller pivotally suspended in the radial sealing device and running on an annular rail at the end face of the rotor. It is stated that the operation of the rollers is impeded on account of a high content of dust in the gas flowing through the heat exchanger, and various combinations of sizes and materials for the roller and its axle bolt are suggested to overcome these difficulties. In DE Patent No. 1 133 850 a similar arrangement is disclosed, and it is stated that the wear on the roller on account of the big forces and the influence from dust and high temperature is so considerable that the life of the roller becomes short, and it is advised to find another solution which is not based on mechanical contact between the radial sealing device and the rotor.

The object of the invention is to provide a regenerative heat exchanger, in which the size of the gap is controlled in a simple way without the occurence of the drawbacks described above.

According to the invention this is achieved by the spacing means comprising a slide shoe of carbon which protrudes from the radial sealing and bears against the smooth axial face of the rotor, and by the protrusion of the slide shoe being adjustable relative to the housing.

By adjusting the counterweight in such a way that the slide shoe bears against the smooth axial face at the periphery of the rotor and then adjusting the protrusion of the

slide shoe relative to the housing, the desired gap size can be determined. This gap size will be maintained irrespectively of possible changes in the geometry of the rotor due to temperature changes in the gases flowing through the rotor, as long as the counterweight keeps the slide shoe against the smooth axial face of the rotor.

Tests have surprisingly shown that it is possible to use a slide shoe made from carbon as a spacing element between the radial sealing device and the rotor without the occurence of heavy wear of the slide shoe. This is due to the fact that the carbon is substantially not influenced by the prevailing high temperatures and corrosive gases. At the same time the carbon is self-lubricating, a low friction between the radial sealing device and the rotor being thus achieved. It has been found that part of the carbon of the slide shoe, after some time of operation, is embedded in the smooth axial face of the rotor, the friction thus stabilizing after some time on a low value.

In a preferred embodiment the slide shoe is during operation fixed against turning relative to the rotor. Hereby, a better adaptation of the slide shoe to the smooth face of the rotor is attained, which results in reduced friction and reduced wear.

A second embodiment of the heat exchanger according to the invention is characteristic in that the force, by which a slide shoe is urged against the smooth face of the rotor is less than 50 kg. The force, by which the slide shoe is urged towards the rotor, is to be of a size sufficient to ensure a permanent bearing of the slide shoe against the rotor irrespective of the variations of the geometry of the rotor caused by temperature variations.

A third embodiment of the regenerative heat exchanger according to the invention is characteristic in that the spacing device comprises a housing mounted on the face of the radial sealing device opposite the axial face of the rotor, that the radial sealing device is provided with an opening, through which the slide shoe protrudes, that the slide shoe is mounted at one end of a spindle which is

axially movable in the housing and which at its other end has a thread engaging a corresponding thread in the housing, and in that the threaded end of the spindle is adapted to engage an adjustment tool and is provided with a thread for a counternut for locking the position of the spindle.

In this embodiment the gap is adjusted manually by screwing the spindle with the slide shoe more or less forward towards the smooth axial face of the rotor, after which the spindle is locked by means of a counternut. It will then normally only be necessary, after a longer operation period, to make a manual readjustment on account of wear of the slide shoe. The need for electric or electromagnetic controlling devices, cables, signal devices, etc. therefore does not exist, the result being lower production and maintenance costs of the heat exchanger.

The invention will now be explained in detail by means of an embodiment and with reference to the drawing, in which

Fig. 1 shows somewhat schematically a section in a plane parallel with the rotor axis in a regenerative heat exchanger according to the invention,

Fig. 2 is a plan view of the arrangement shown in Fig. 1, and

Fig. 3 is a detailed section of the spacing device shown in Figs. 1 and 2.

Fig. 1 shows a heat exchanger matrix 1 in form of a rotor. For the sake of clarity only the areas at the end faces of the rotor are shown. Opposite the upper (in the drawing) end face of the rotor a radial sealing device 2 is provided which at the centre is supported in a manner not shown in detail and which at each end rests on a supporting arm 3 engaging a slot 4 in the end of the radial sealing device. The supporting arm 3 is connected to a horizontal shaft 5 mounted on a supporting beam 6 which is a part of the supporting construction of the heat exchanger and which in a manner not shown in detail also carries the upper bearing of the rotor.

The supporting arm 3 is connected with a rod 7, in

which a shroud screw 8 is inserted in such a way that the length of the rod 7 is adjustable. The upper end 7 of the rod is pivotally connected with the one end of a lever arm 9, the other end of which carries a counterweight 10. The lever arm 9 pivots about a shaft 11 supported by bearing brackets 12.

At the lower end face of the rotor a similar arrangement is provided, viz. a radial sealing device 15, the end of which is carrying a supporting arm 16 which is in engagement with a slot 17 in the radial sealing device 15 and which is pivotable about a shaft 18. The supporting arm 16 is connected with the lower end of a rod 20, the length of which is adjustable in the same way as described in respect of the rod 7. The rod 20 is at its upper end connected to one end of a lever arm 22, the other end of which carries a counterweight 23. The lever arm 22 pivots about a shaft 11 supported by bearing brackets 12.

Each radial sealing device is at its free ends provided with a spacing device 24 which will be described in detail in the following with reference to Fig. 3.

The spacing device 24 comprises a tubular housing 25, which at one end has a flange 26 fastened by means of pin bolts 27 to the side of the radial sealing device 2 opposite the rotor 2. In the housing 25 a displaceable spindle 28 is arranged, said spindle carrying at one end a thread 29 engaging a corresponding thread in the housing 25. The spindle has at its free ends a spigot 30 with faces for a spanner.

The other end of the spindle carries a bottom plate 32, in which a slide shoe 33 of carbon is fixed against rotation by means of a retaining screw 34. The slide shoe 33 protruding from the housing through an opening 38 in the radial sealing device is shown bearing against the smooth axial face 13 of the rotor which is here constituted by one of the flanges of an angle bar 36 connected to the periphery of the rotor.

By screwing the spindle 28 towards the rotor 1 by means of a spanner engaging the spigot 30 the gap 37 between the radial sealing device 2 and the rotor face 13 may be set

at a desired value. The associated counterweight 10 and the rod 7 are adjusted in such a way that it is ensured that the slide shoe during operation always bears against the face 13 irrespective of whether during operation of the heat exchanger deformations of the geometry of the rotor occur due to variatons of the operation temperature of the rotor.

It will be seen from Fig. 3 that the spacing device 24 extends upwards through an opening in the carrier beam 6. To avoid leakage of gases from the area just above the radial sealing device 2 a cylindrical bellows 41 is provided as sealing element between the housing 25 and the supporting beam 6.

C L A I M S

1. A renegerative heat exchanger comprising a heat exchanger matrix (1) in form of a rotor having at each end a smooth, axial face (13) at the periphery, and at each end a radial sealing device (2;15) which by means of a counterweight (10,23) over a link connection (7,20) is kept against the rotor, as well as a spacing device (24) for controlling the axial distance between the radial sealing device and the rotor,
c h a r a c t e r i z e d in that the spacing device comprises a slide shoe (33) of carbon which protrudes from the radial sealing device and bears against the smooth axial face of the rotor, and in that the protrusion of the slide shoe relative to the housing is adjustable.

2. A regenerative heat exchanger according to claim 1, c h a r a c t e r i z e d in that the slide shoe (33) during operation is fixed against against turning relative to the rotor.

3. A regenerative heat exchanger according to claim 1 or 2, c h a r a c t e r i z e d in that the force, by which a slide shoe (33) is urged against the smooth face (13) of the rotor (1) is less than 50 kg.

4. A regenerative heat exchanger according to any of the preceding claims, c h a r a c t e r i z e d in that the spacing device (24) comprises a housing (25) mounted on the face of the radial sealing device (2;15) opposite the axial face (13) of the rotor (1), that the radial sealing device is provided with an opening, through which the slide shoe (33) protrudes, that the slide shoe is mounted at one end of a spindle (28) which is axially movable in the housing and which at its other end has a thread (2) engaging a corresponding thread in the housing, and in that the threaded end of the spindle is adapted to engage an adjustment tool and is provided with a thread for a counternut (31) for locking the position of the spindle.

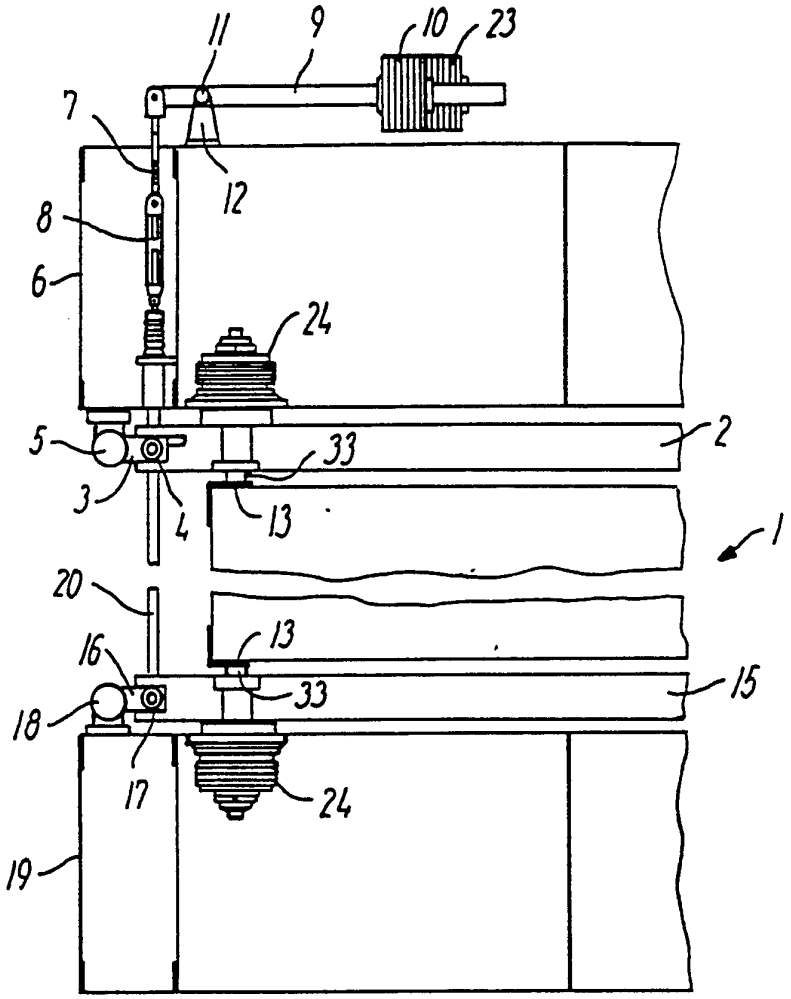

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FIG. 1

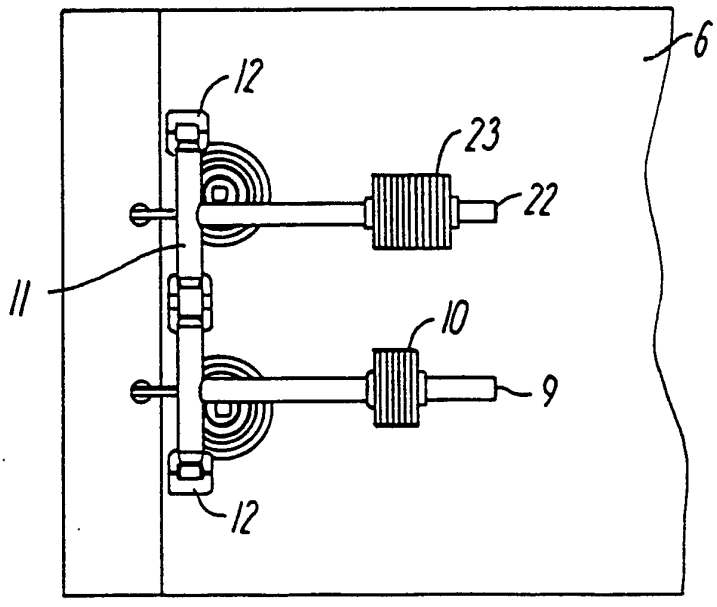

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FIG. 2

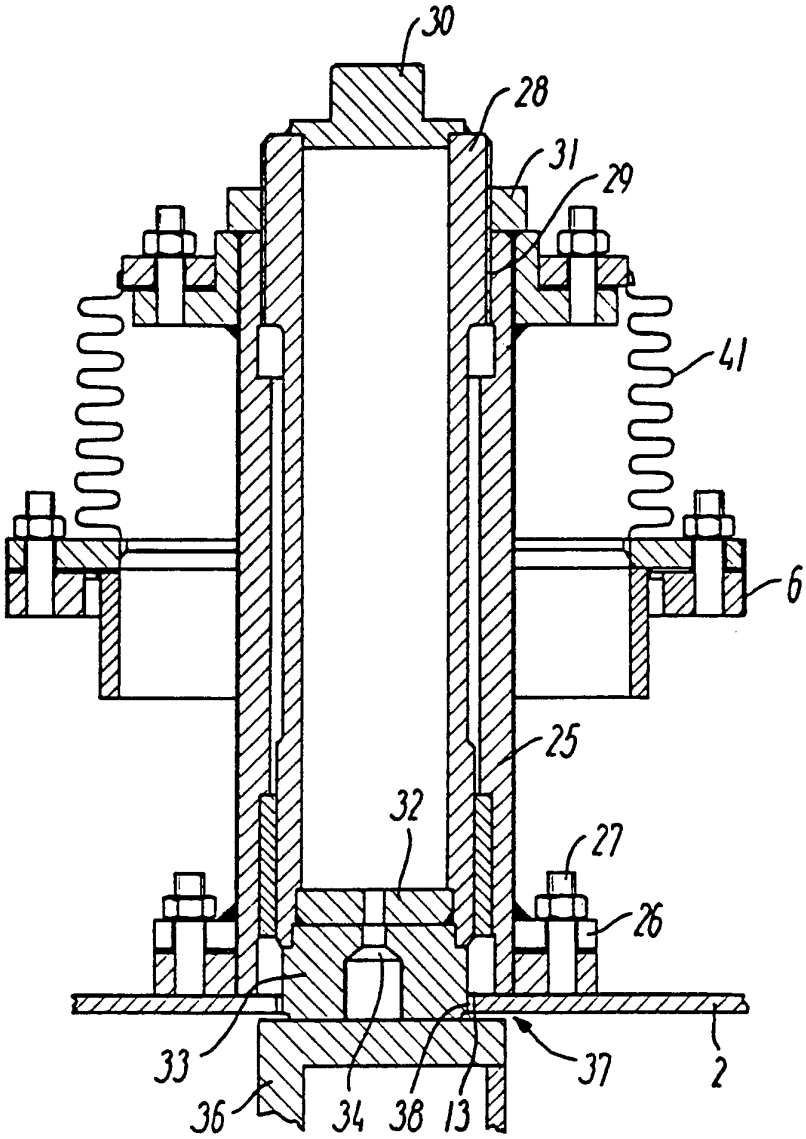


FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 93/00228

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F28D 19/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: F28D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3246686 (G. KALBFLEISCH ET AL), 19 April 1966 (19.04.66) --	
A	DE, A, 1133850 (KRAFTANLAGEN AKTIENGESELLSCHAFT), 26 July 1962 (26.07.62) --	
A	DE, A, 1035843 (KRAFTANLAGEN AKTIENGESELLSCHAFT), 7 August 1958 (07.08.58) --	
A	DE, A, 1015568 (KRAFTANLAGEN AKTIENGESELLSCHAFT), 12 Sept 1957 (12.09.57) --	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4024907 (BRZYTWA), 24 May 1977 (24.05.77), adjustable sector plates (36) and edge seals (42) --	
A	US, A, 3939903 (SAKAKI ET AL), 24 February 1976 (24.02.76), example of carbon seal --	

INTERNATIONAL SEARCH REPORT

Information on patent family members

26/08/93

International application No.
PCT/DK 93/00228

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3246686	19/04/66	NONE	
DE-A- 1133850	26/07/62	FR-A- 1315597	00/00/00
		OA-A- 1082	07/08/68
DE-A- 1035843	07/08/58	NONE	
DE-A- 1015568	12/09/57	NONE	
US-A- 4024907	24/05/77	AU-B- 500465	24/05/79
		AU-A- 2110677	13/07/78
		CA-A- 1050007	06/03/79
		FR-A,B- 2337865	05/08/77
		JP-C- 1039067	31/03/81
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