

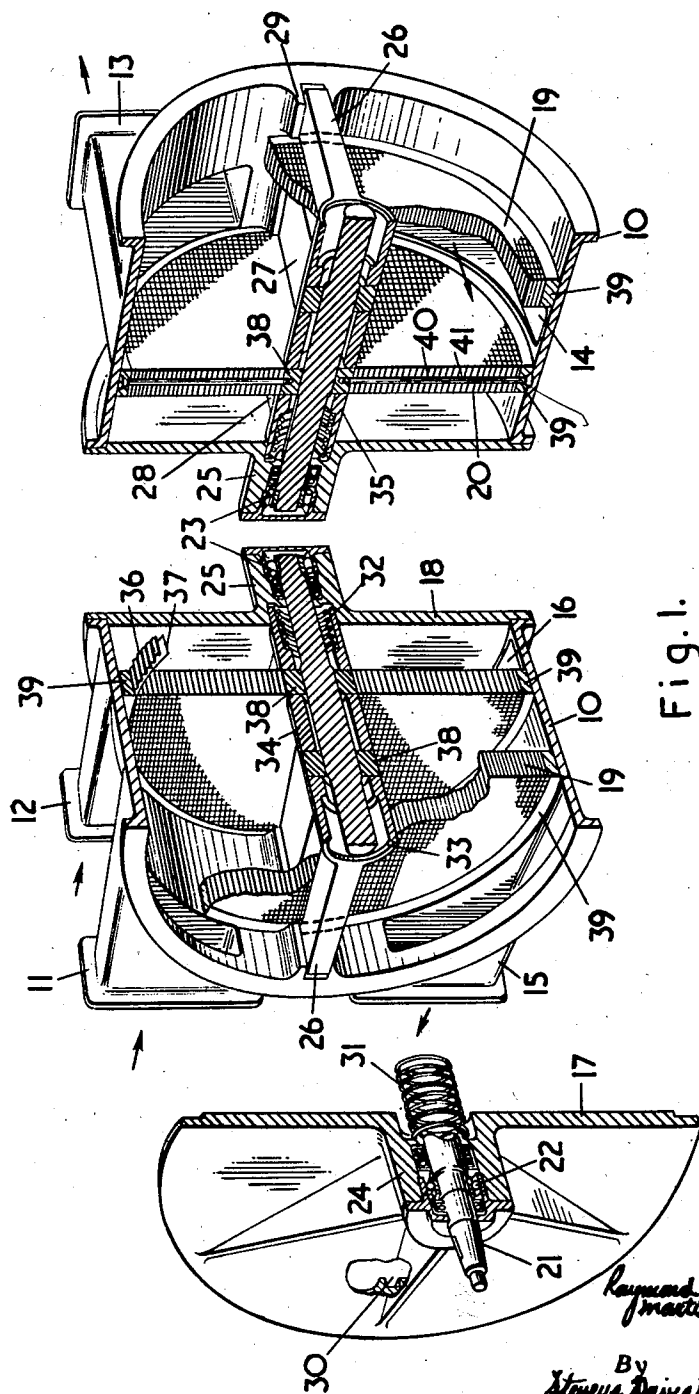
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R. K. P. STEVENS ET AL
HEAT EXCHANGER

2,579,212

Original Filed Aug. 23, 1948

3 Sheets-Sheet 1



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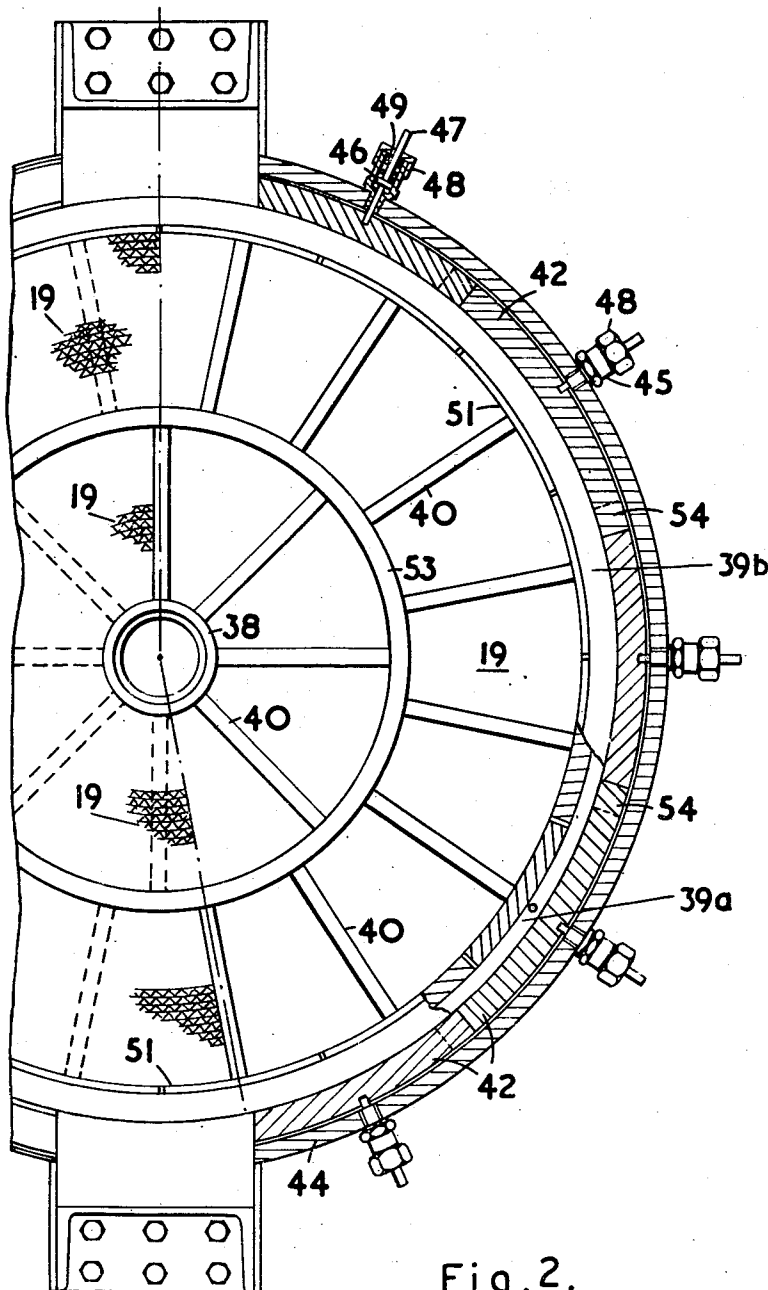


Fig. 2.

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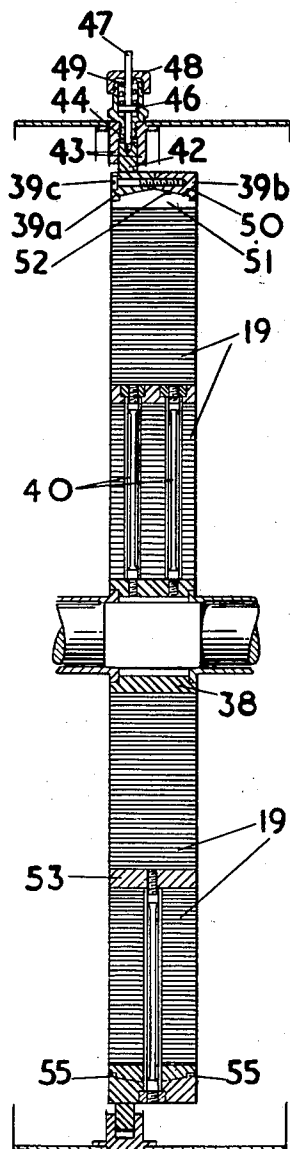


Fig. 3.

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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

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6 Claims. (Cl. 257-6)

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This application is a division of co-pending application Serial No. 45,756, filed August 23, 1948, entitled Regenerative Heat Exchanger, and relates to regenerative heat exchangers of the kind wherein a heat absorbing and transmitting matrix member whose axial depth is small compared with its radius is rotatable in a casing partitioned by dividing and sealing members into fluid paths for a fluid at a high temperature and a fluid at a lower temperature so that the matrix member as it rotates absorbs heat from the high temperature fluid and delivers it to the lower temperature fluid.

It has been proposed to construct the matrix discs of a strip of corrugated or crimped metal and a strip of plain metal wound together round a central boss to the diameter required and mounted in a wheel shaped frame.

According to the present invention in a regenerative heat exchanger of the kind described having a matrix disc composed of elements arranged around a central boss, the matrix is provided with a rim and a suitable number of spokes extending from the rim to the central boss through holes in the matrix to strengthen the disc. The rim may comprise two ring members, each being provided with an internal conical surface which when the two members are secured together form a shallow V-shaped groove, and a plurality of felloes forming a complete ring, each felloe being provided with an external conical surface to mate with the conical or V-shaped groove of the rim so that when the two ring members are secured together, their internal conical surfaces slide over the external conical surface of the felloes causing them to press inwardly in a radial direction and grip the elements comprising the matrix tightly. An intermediate ring may be arranged between the rim and the boss and coupled to both by spokes and the ring may be constructed in a similar manner to the composite rim set out above. The rim of the matrix disc may be provided with a labyrinth ring machined to the outer surface to co-operate with the casing in which the matrix disc rotates to form a seal. The rim may, however, be provided with sealing means comprising curved sealing elements, each tongued and grooved for interlocking together to form a complete ring contacting the rim and guided in a

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circumferential channel sectioned ring element attached to the casing, each curved sealing element being provided with at least one loading means for pressing it on to the rim. The loading may be applied by fluid pressure or by a spring or springs.

The invention will now be described by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a divided and sectioned perspective view of a regenerative heat exchanger, according to the aforesaid co-pending application Serial No. 45,756.

Figure 2 is a side view of a matrix disc.

Figure 3 is a cross-section of the matrix disc shown in Figure 2.

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. They 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 sealing or 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 sealing or 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 sealing or dividing plates 26 and 27. Hollow bosses 33, 34 and 35 are formed respectively on the sealing or dividing plates 26, 27 and 28 through 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 and a number of spokes 40 inserted in holes 41 drilled in the strips 36 and 37 and screwed into the boss 38. A labyrinth gland (not shown) may be machined on the outer surface of the rim 39. The sealing or dividing plates 26, 27 and 28 may be arranged to rub against the matrix discs 19 and 20 to form the diametrical seal. The rollers 9 are arranged to be slightly proud of the face of the sealing or dividing plates 26, 27 and 28 so that a minute clearance is maintained between the face of the discs and the face of the sealing or dividing plates.

In the construction of the matrix disc 19 (see Figures 2 and 3) the rim 39 is made in two members 39a and 39b bolted or screwed together by bolts or screws 39c. Each part 39a and 39b is provided with a coned internal surface 50 which when the two parts 39a and 39b are secured together form a shallow V-shaped groove. Between the rim 39 and the wound matrix strips 36 and 37, there are arranged a number of separate curved members or felloes 51, forming a complete ring. Each curved member or felloe 51 is provided with a coned external surface 52 to mate with the coned internal surfaces 50 forming together the shallow V-shaped groove of the rim 39. In building up a matrix disc, the felloes 51 are arranged in position round the wound matrix strips 36 and 37 and the rim members 39a and 39b placed on either side and drawn together by the bolts or screws 39c. The coned surfaces 50 of the rim members 39a and 39b of the rim 39 slide over the coned mating surfaces 52 of the curved members or felloes 51 pressing them inwardly to grip the wound matrix strips 36 and 37 tightly. The discs 19 and 20 are strengthened by inserting spokes 40 extending from the rim 39 to the central boss 38 or if greater strength is required an intermediate ring 53 (see Figure 3) is provided. Spokes 40 are then arranged as shown in Figure 2. It is preferable for two spokes 40 of small cross-section area to be arranged as shown in Figure 3 as less useful heat exchange surface area of the matrix 19 and 20 is wasted.

The felloes 51 are not tongued and grooved at their ends to interlock as the rim members 39a and 39b are provided with inwardly projecting flanges 55 to hold them circumferentially.

A number of curved sealing elements 42 (see Figures 2 and 3) may be arranged around the circumference of the rim 39. The elements 42 are arranged between two guide members 43 of a channel sectional ring element 44. At intervals around the element 44 there are arranged a number of cylindrical plunger bodies 45 each containing a plunger 46 connected by a rod 47 to the element 42. Each body 45 is provided with a screw cap 48 and a compression spring 49 is arranged between the plunger 46 and the cap 48 to press the element 42 on to the rim 39. The elements 42 are tongued and grooved as indicated at 54 to interlock at their ends to form a ring seal (see Figure 2).

The plungers 46 in the bodies 45 may be fluid pressure loaded instead of being spring loaded as shown.

We claim:

1. In a regenerative heat exchanger of the

kind described a matrix disc comprising a central boss with an aperture for a supporting shaft, elements forming a porous heat exchange mass around said boss, a rim around said elements to hold them in position and a plurality of insertable and removable rod-like spokes passing through holes in said elements and extending between said rim and boss and secured thereto to strengthen said disc.

2. In a regenerative heat exchanger of the kind described a matrix disc comprising a central boss with an aperture for a supporting shaft, an element formed of a strip of plain metal and a strip of crimped metal wound together on the central boss, a rim arranged around said wound element to hold it in position and a plurality of insertable and removable rod-like spokes passing through holes in said element and extending between said rim and boss and secured thereto to strengthen said disc.

3. In a regenerative heat exchanger of the kind described a matrix disc comprising a central boss with an aperture for a supporting shaft, an element formed of a strip of plain metal and a strip of crimped metal wound together on the central boss, a rim composed of a pair of ring members, each having an internal conical surface which when the two members are secured together form a shallow coned groove, a plurality of felloes forming a complete ring around said element, each being provided with an external conical surface to mate with the coned groove of the rim so that when the two rim members are secured together their internal conical surfaces slide over the external conical surfaces of the said felloes causing them to press inwardly in a radial direction and grip the element, means securing said rim members together and a plurality of insertable and removable rod-like spokes passing through holes in said felloes and said element and extending between said rim and said boss and secured thereto to strengthen said disc.

4. In a regenerative heat exchanger of the kind described, a matrix disc comprising a central boss with an aperture for a supporting shaft, an inner element formed of a strip of plain metal and a strip of crimped metal wound together around said element, an outer element formed of a strip of plain metal and a strip of crimped metal wound together around said ring, a rim around said outer element to hold it in position, and a plurality of insertable and removable rod-like spokes passing through holes in said elements extending between said ring and boss and between said rim and ring and secured thereto to strengthen said disc.

5. In a regenerative heat exchanger of the kind described, a matrix disc comprising a central boss with an aperture for a supporting shaft, an inner element formed of a strip of plain metal and a strip of crimped metal wound together, an intermediate ring member around said element and an outer element formed of a strip of plain metal and a strip of crimped metal wound together around said ring, a rim composed of a pair of ring members, each having an internal conical surface which when the two members are secured together form a shallow coned groove, a plurality of felloes forming a complete ring around said outer element, each being provided with an external conical surface to mate with the coned groove so that when the two rim members are secured together their internal conical surfaces slide over the external conical surfaces of said felloes causing them to press inwardly in a radial

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direction and grip the element, means securing said rim members together and a plurality of insertable and removable rod-like spokes passing through holes in said felloes and said elements and extending between said ring and boss and rim and ring and secured thereto to strengthen said disc.

6. In a regenerative heat exchanger of the kind described as claimed in claim 5 wherein said intermediate ring is composed of ring members and felloes in a similar manner to said outer rim.

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