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ROTARY CONVERTER SEALING DEVICES

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Fig. 1

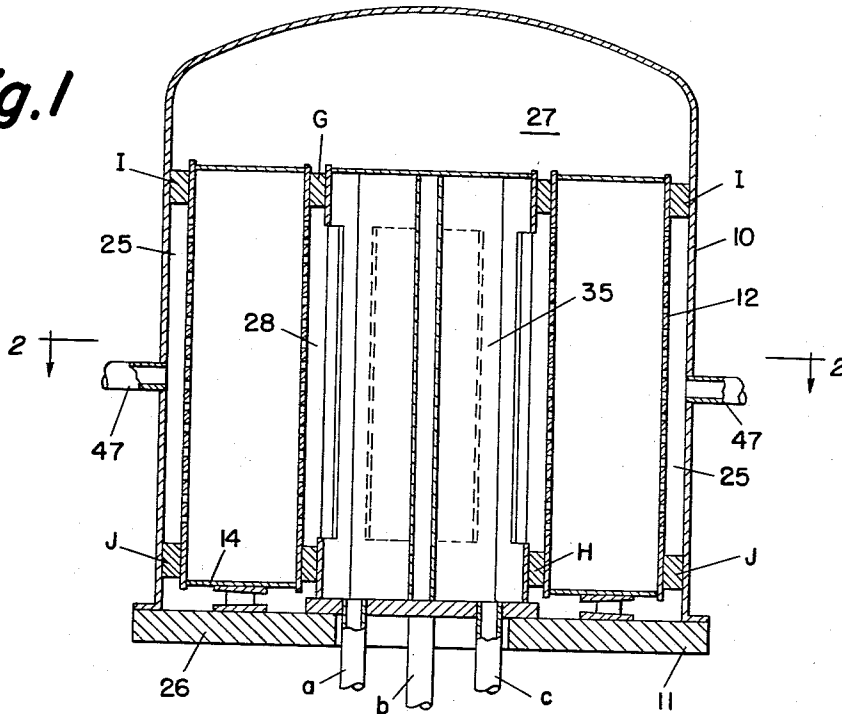
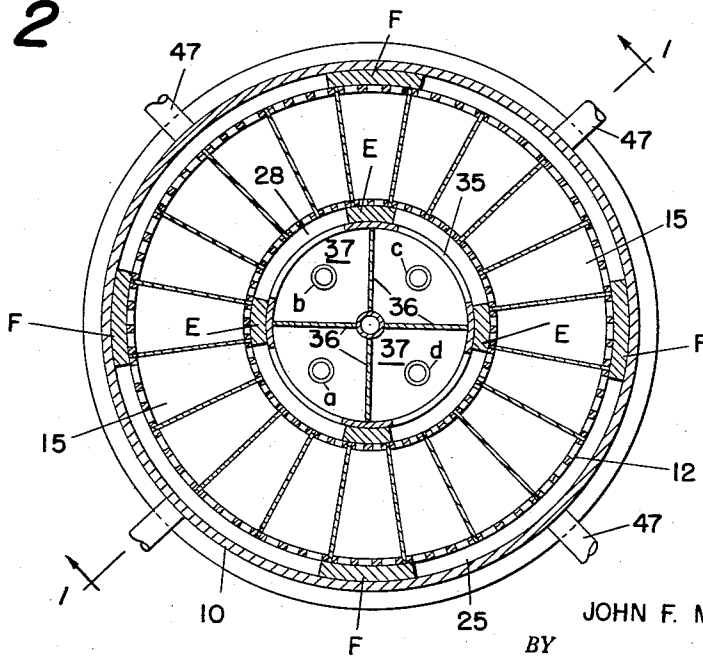


Fig. 2



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ROTARY CONVERTER SEALING DEVICES

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12 Claims. (Cl. 23—288)

In an application filed by Clarence H. Thayer September 14, 1953, Serial No. 380,027, later allowed, and issued March 22, 1955, as Patent No. 2,704,741, there is shown and described a converter in which different fluids are passed successively through contact material, typically a catalyst, from which effluent products are successively removed. The converter comprises fixed inner and outer cylindrical casings, and an annular rotatable reaction vessel between such casings and spaced from both to form inner and outer circumferential spaces each of which is enclosed, top and bottom, by circumferentially extending sealing devices, and each of which is divided by vertically extending sealing devices into independent arcuate spaces or compartments. One of said casings, preferably the inner casing, is divided into compartments, equal in number to said arcuate spaces, into which the different fluids to be passed into the contact material are conveyed and from which such fluids continuously flow into the corresponding arcuate spaces and thence into radially extending catalyst containers communicating at opposite ends with said inner and outer circumferential spaces, which containers, in the rotation of the reaction vessel, are brought into communication one after another with the several arcuate spaces. The vertically extending sealing devices carried by the two casings are arranged in pairs, one carried by each casing, so that at any given time in the rotation of the reaction vessel the same set of catalyst-containing containers communicates with corresponding inner and outer arcuate spaces.

It is of importance that these seals shall be as fluid-tight as possible in order to avoid leakage from one arcuate compartment to another; also to prevent such leakage in case of any departure from perfect fluid-tightness.

In the drawings:

Figure 1 is a sectional elevation of the converter showing only such features thereof as are necessary to embody the invention.

Figure 2 is a cross-sectional view of the converter.

Figure 3 is a cross-sectional view in detail of one of the seals, the seal selected for illustration being one of the vertically extending seals between the outer casing and the reaction vessel.

Figure 4 is a view in elevation of a vertically extending seal and a circumferentially extending seal and parts adjacent thereto.

The main features of construction of the converter, disclosed in more detail in said prior application and to which the improved sealing devices are applied, will first be briefly described, reference being made more particularly to Figures 1 and 2.

10 is an outer cylindrical casing which is fixed to a supporting base 11. The casing 10 is made pressure-tight and encloses the reaction vessel 12 containing the catalyst.

The reaction vessel 12 is annular in shape, being formed by an outer cylindrical wall and an inner cylindrical wall connected by upper and lower annular plates.

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The reaction vessel 12 contains a multiplicity of similarly shaped catalyst chambers 15 arranged around the vessel's circumference, each chamber also extending vertically from at or near the top to at or near the bottom of the reaction chamber. These chambers may assume different forms, another form being disclosed in said prior application; but the simplified form shown is adequate to illustrate the application of the invention to any arrangement of catalyst-containing chambers. Each chamber contains catalyst of a type and activity suitable for the desired hydrocarbon reaction.

The reaction vessel 12 is disposed within the casing 10 to provide an outer annular space 25 between the casing and the outer wall of the reaction vessel, a lower space 26 between the base 11 and the lower wall 14 of the reaction vessel and an enlarged space 27 above the upper wall of the reaction vessel. The reaction vessel is rotatable by means not shown.

Within and spaced from the reaction vessel is an inner stationary casing 35 forming between it and the inner wall of the reaction vessel an annular space 28. The inner casing is divided by a number of walls or partitions 36 into four (preferably sector-shaped) compartments 37 into which are fed, respectively: the hydrocarbons to be reacted; purging fluid, such as steam; a regenerating medium, such as air, to remove carbon deposited on the catalyst in the first step; and a second purging to remove regenerating products formed during the third step. Three of the four supply conduits, lettered *a*, *b* and *c*, that supply three of the above specified fluids to their respective sectors are shown in Fig. 1. From the several compartments 37 of the casing 35 the several specified fluids flow into the several arcuate spaces or compartments into which the annular space 28 is divided by the vertically extending seals *E*, and from such arcuate spaces into the catalyst-containing chambers 15. These arcuate spaces are four in number, corresponding in number to the compartments 37, and the seals *E* align vertically with the partitions 36 that divide the inner casing into such compartments 37. Each arcuate space thus constantly receives one of the supply fluids.

The annular space 28 is sealed at the top by a circumferentially extending seal, or series of seals *G*, and at the bottom by a circumferentially extending seal or series of seals, *H*.

The annular space 25 between the reaction vessel 12 and the outer cylindrical casing 10 is sealed at the top by circumferentially extending seals *I* and at the bottom by circumferentially extending seals *J*. The outer vertically extending seals *F* are paired with the inner vertically extending seals *E*, so that, at any given time in the rotation of the reaction vessel, the same set of catalyst-containing chambers 15 communicates with the corresponding or paired arcuate spaces inside and outside the reaction vessel 12.

This description, so far as it has proceeded, discloses no feature of construction which is essentially different from what is disclosed in said prior application. Many features of such construction, not essential to a full disclosure of the invention herein sought to be patented, are omitted, and the seals, hereinafter described in detail, are shown only diagrammatically. It may be desirable, however, to briefly describe the operation common to said prior application and the present disclosure. As the reaction vessel 12 rotates, each catalyst-containing chamber 15 registers successively with the several arcuate spaces, between the reaction vessel 12 and the inner casing 35, into which the circumferential spaces are divided by the seals *E*. Each catalyst-containing chamber 15 thus receives successively the several fluids supplied to the several arcuate spaces from the respective compartments 37 within the inner casing 15. At any given moment a

considerable number of these compartments 15 receives the same fluid. The vertical seals E that determine the lengths, measured arcuately, of the several arcuate spaces between the inner casing 35 and the rotating reaction vessel 12 are of sufficient width to each overlap the inlet to any one catalyst-containing chamber 15. The same description applies to the arcuate spaces between the rotating reaction vessel and the outer casing 12. Thus at any given moment one set of catalyst-containing chambers 15 is receiving, from one of the inner arcuate spaces, the same hydrocarbon reactant or the same purging fluid and is discharging the products of reaction or purging into the corresponding outer arcuate space, from each of which outer arcuate spaces the products of reaction or purging are removed through a common conduit. The several discharge conduits 47 are shown in Fig. 2.

The sealing devices E, F, G, H, I, J, are designed for application to a converter of the type described and are illustrated in detail in Figures 1, 3 and 4, reference being made particularly to Figures 3 and 4. While Figure 3 shows one of the vertically extending seals F between the rotatable reaction vessel 12 and the stationary outer casing 10, all the seals, whether extending vertically or circumferentially, are or may be of the same specific construction and therefore require no separate specific descriptions. All are supported from one or the other of the fixed casings 10 and 35.

A vertically extending holder 40 is carried by means of side plates 41, by the casing 10, the ends of the plates being secured, by welding, to the casing and holder. Thus a sealed enclosure 50 is formed bounded by the casing, the holder and the side plates. Between the arms 40a of the holder 40, which give the holder a channel-bar shape, are two sealing blocks 42 having a slightly concaved outer face conforming to the curvature of the wall of the reaction chamber. The sealing blocks have side faces each conforming to the plane of the opposing inner face of the arms 40a. Preferably the planes of these faces slope obliquely outward toward the reaction vessel. By means of such shaping the sealing blocks have a wedge-like engagement with the arms of the bar 40.

Formed in the bar 40 are two recesses 43, respectively opposite, in a somewhat oblique direction, to two recesses 44 in the respective sealing blocks. Springs 45 extend between the bar 40 and the sealing blocks 42, opposite ends of each spring being seated in the opposing recesses in the bar 40 and one of the sealing blocks.

Formed in the opposing faces of the two holding blocks are opposing recesses 46, 46. A spring 47 extends between these sealing blocks, opposite ends of the spring being seated in these opposing recesses.

There will normally be a plurality of these spring connections along the length of the sealing device.

These springs wedge the sealing blocks 42 in the acute angles formed by the inner faces of the arms 40a of the holder and the outer wall of the reaction vessel.

The described construction may effectually prevent leakage of fluid from either of the arcuate spaces on opposite sides of the sealing device. However, I have provided supplemental means to further insure against such leakage. The casing is orificed for connection with a conduit 51 adapted for connection with a source of fluid maintained under a pressure greater than that of the pressure of the fluid in any of the arcuate spaces between the casing and the reaction vessel. Such pressure fluid is thus contained in the enclosure 50. The holder 40 is also provided with an orifice 52, affording fluid communication between the enclosure 50 and the enclosure 54 formed by the holder 40, the sealing block 42 and the exposed face of the wall of the reaction vessel, so that pressure fluid is always present in the enclosure 54. Any failure of the springs to maintain fluid-tight contact of the sealing blocks with the reaction vessel and holder can result only in leakage of the pressure fluid contained

in the sealing device into one or both of the adjacent arcuate spaces between the reaction vessel 12 and the casing 10. Such very limited leakage of steam is not objectionable.

There is no occasion to describe the vertically extending sealing devices located between the inner casing 35 and the rotary reaction vessel 12, or the circumferentially extending sealing devices between the rotatable reaction vessel 12 and each casing, as these need differ in no essential detail from the sealing device illustrated in Fig. 3.

The circumferentially extending sealing units G, H, I, J, may be overlapped by the ends of the vertically extending sealing units E and F. Any vertically extending sealing unit may, if desired, be made in sections, adjacent sections overlapping, and the end sections of a vertical row of sealing units may overlap adjacent circumferentially extending sealing units, which latter, also, may be made in sections. Pins 70, such as shown in Fig. 4, may extend through one of the overlapping sealing units and may make close to end contact with the adjacent sealing unit without impairing the efficiency and tightness of the sealing device. These features, shown and described in said prior application, are not herein shown in detail, since they constitute no feature of the sealing devices included in the claims.

It will be understood that while it is contemplated that seals such as shown and described shall be utilized as both the inner and outer vertically extending seals and as upper and lower circumferentially extending seals, it is within the scope of the invention to utilize such seals as either only vertically extending inner or outer seals or as upper or lower circumferentially extending seals and do not necessarily exclude the use of other types of seals at locations other than those to which the seals shown and described are applied.

What is claimed is:

1. In a converter in which different fluids are fed successively into catalyst containers and from which the different products are successively removed, the same comprising a fixed outer cylindrical casing, a fixed inner cylindrical casing, an annular revoluble reaction vessel containing a multiplicity of catalyst chambers arranged around the vessel's circumference and each extending generally radially within the vessel, said vessel being located between the inner and outer casings and spaced from both to form inner and outer circumferential spaces partitioned by vertically and circumferentially extending sealing devices to form sets of inner and outer arcuate spaces, the arcuate spaces of one set adapted to receive the respective fluids, and the arcuate spaces of the other set adapted to receive the effluent fluids; the improvement in any of said sealing devices which comprises a holder between the casing and the reaction vessel, the holder having side arms extending toward the reaction vessel and imparting to the holder a channel-bar shape, a pair of spaced-apart sealing blocks within the holder, the sealing blocks being shaped at their outer ends to engage said side arms and at their outer faces to engage the wall of the reaction vessel, springs between the holder and the sealing blocks pressing the latter against the wall of the reaction vessel, and a spring between the sealing blocks pressing the latter against the side arms of the holder.

2. The construction defined in claim 1 in which the end faces of the holder and the inner faces of the holder arms are inclined in a plane extending obliquely outward to afford a wedge-shaped engagement of the sealing blocks with the arms of the holder and the wall of the reaction vessel.

3. In a converter in which different fluids are fed successively into catalyst containers and from which the different products are successively removed, the same comprising a fixed outer cylindrical casing, a fixed inner cylindrical casing, an annular revoluble reaction vessel containing a multiplicity of catalyst chambers arranged

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around the vessel's circumference and each extending generally radially within the vessel, said vessel being located between the inner and outer casings and spaced from both to form inner and outer circumferential spaces partitioned by vertically and circumferentially extending sealing devices to form sets of inner and outer arcuate spaces, the arcuate spaces of one set adapted to receive the respective fluids, and the arcuate spaces of the other set adapted to receive the effluent fluids; the improvement in any of said sealing devices which comprises a holder, side plates on opposite sides of the holder the ends of which are secured to the casing and holder, the holder having side arms extending toward the reaction chamber and imparting to the holder a channel-bar shape, a pair of spaced-apart sealing blocks within the holder, the sealing blocks shaped at their outer ends to engage the side arms of the holder and at their outer faces to engage the wall of the reaction vessel, means for admission of pressure fluid, at a pressure higher than that of said fluid in the arcuate spaces on opposite sides of the sealing device, into the space between the holder and the reaction vessel, said pressure fluid thus acting upon the sealing blocks to maintain them in substantially fluid-tight contact with the said arms and the wall of the reaction vessel and blocking flow of fluid from either of the arcuate spaces on opposite sides of the holder.

4. The construction defined in claim 3 in which the end faces of the holder and the inner faces of the holder arms are inclined in a plane extending obliquely outward to afford a wedge-shaped engagement of the sealing blocks with the arms of the holder and the wall of the reaction vessel.

5. The construction defined in claim 1 comprising also means for admission of pressure fluid into the space between the holder and the reaction vessel, said springs and said pressure fluid cooperating to maintain a substantially fluid-tight contact with the said arms and the wall of the reaction vessel.

6. The construction defined in claim 5 in which the end faces of the holder and the inner faces of the holder arms are inclined in a plane extending obliquely outward to afford a wedge-shaped engagement of the sealing blocks with the arms of the holder and the wall of the reaction vessel.

7. In a converter in which different fluids are fed successively into catalyst containers and from which the different products are successively removed, the same comprising a fixed outer cylindrical casing, a fixed inner cylindrical casing, an annular revoluble reaction vessel containing a multiplicity of catalyst chambers arranged around the vessel's circumference and each extending generally radially within the vessel, said vessel being located between the inner and outer casings and spaced from both to form inner and outer circumferential spaces partitioned by vertically and circumferentially extending sealing devices to form sets of inner and outer arcuate spaces, the arcuate spaces of one set adapted to receive the respective fluids, and the arcuate spaces of the other set adapted to receive the effluent fluids; the improvement in any of said sealing devices which comprises a holder, side plates on opposite sides of the holder the ends of which are secured to the casing and holder and which form, with the casing and holder, an enclosure, the holder having side arms extending toward the reaction chamber and imparting to the holder a channel-bar shape, a pair of spaced apart sealing blocks within the holder and which, together with the holder and the exposed face of the reaction vessel between the holders, form a second enclosure, the sealing blocks being shaped at their outer ends to engage said side arms and at their outer faces to engage the wall of the reaction vessel, the holder being orificed to afford fluid communication between said enclosures, means adapted for connection of the first enclosure with a source of fluid pressure supply, said pressure fluid acting upon the sealing blocks to main-

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tain them in substantially fluid-tight contact with the said arms and the wall of the reaction vessel, such pressure fluid thus blocking flow of fluid from either of the arcuate spaces on opposite sides of the holder into the second enclosure, springs between the holder and the sealing blocks pressing the latter against the wall of the reaction vessel, and a spring between the sealing blocks pressing the latter against the side arms of the holder, the end faces of the holder and the inner faces of the holder arms being inclined in a plane extending obliquely outward to afford a wedge-like engagement of the sealing blocks with said arms and the wall of the reaction vessel.

8. The combination with a structure comprising a fixed cylindrical casing and a revoluble casing, having a multitude of substantially radially extending chambers, the casings forming between them a circumferentially extending space into which fluid is adapted to flow from one casing and out of which fluid is adapted to flow through the other casing, of a sealing device between the casings which extends for a limited arcuate distance within said circumferential space and prevents leakage of said fluid from the space ahead of and behind said sealing device into the casing into which said fluid would flow in the absence of a seal; said sealing device comprising a holder between said casings supported by one of the casings and having side arms extending toward the other casing and imparting to the holder a channel-bar shape, a pair of spaced apart sealing blocks within the holder, the sealing blocks being shaped at their outer ends to contact said arms and on their faces to contact the wall of the last named casing, springs between the holder and the sealing blocks pressing them against the wall of the last named casing, and a spring between the sealing blocks pressing them against the side arms of the holder.

9. The construction defined in claim 8 in which the end faces of the holder and the inner faces of the holder arms are inclined in a plane extending obliquely outward to afford a wedge-shaped engagement of the sealing blocks with the arms of the holder and the wall of the last named casing.

10. The combination with a structure comprising a fixed cylindrical casing and a revoluble casing, having a multitude of substantially radially extending chambers, the casings forming between them a circumferentially extending space into which fluid is adapted to flow from one casing and out of which fluid is adapted to flow through the other casing, of a sealing device between the casings which extends for a limited arcuate distance within said circumferential space and prevents leakage of said fluid from the space ahead of and behind said sealing device into the casing into which said fluid would flow in the absence of a seal; said sealing device comprising a holder, plates supporting said holder from one of the casings and forming with such casing and said plates an enclosure, means to admit pressure fluid to said enclosure, the holder having side arms extending toward the other casing and imparting to the holder a channel-bar shape, a pair of spaced apart sealing blocks within the holder, the sealing blocks at their outer ends engaging the side arms of the holder and at their outer faces engaging the wall of the last named casing, said holder, sealing blocks and the exposed face of the last named casing forming a second enclosure, the holder being orificed to provide a pressure fluid communication between the enclosures, said pressure fluid acting to maintain the sealing blocks in substantially fluid tight contact with the said arms and the wall of the last named casing and blocking flow of the first named fluid from either of the circumferentially extending spaces ahead of and behind the sealing blocks into said second enclosure.

11. The construction defined in claim 10 in which the end faces of the holder and the inner faces of the holder arms are inclined in a plane extending obliquely outward to afford a wedge-shaped engagement of the sealing

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blocks with the arms of the holder and the wall of the last named casing.

12. A sealing device as defined in claim 9 and embodying also the additional elements specified in claim 11.

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