Aug. 16, 1955 N. F. KING 2,715,570

ROTARY CONVERTER SEALING DEVICES

Filed June 3, 1954

2 Sheets-Sheet 1

Fig. 1

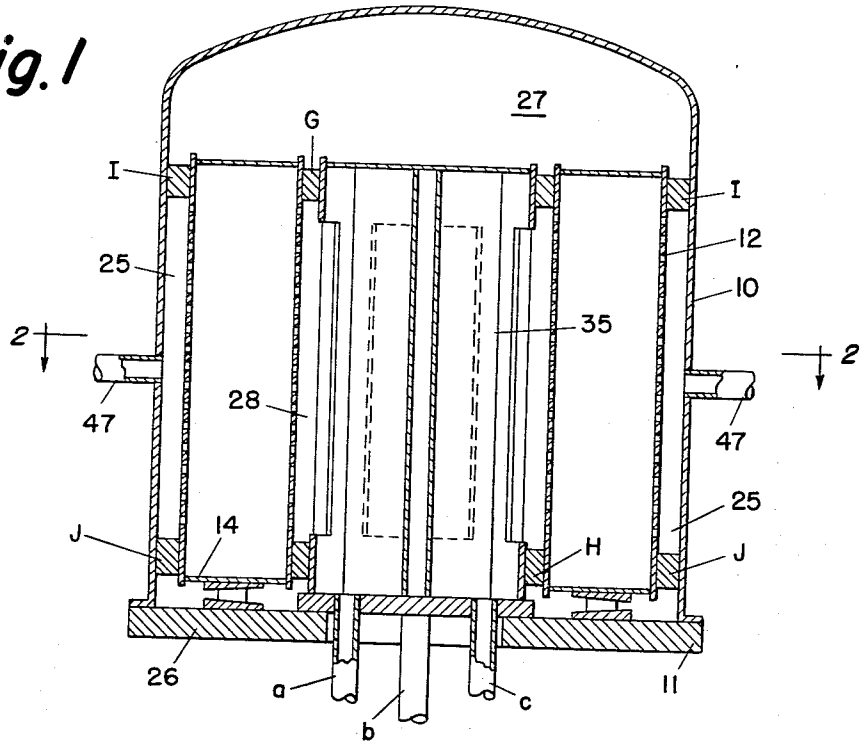
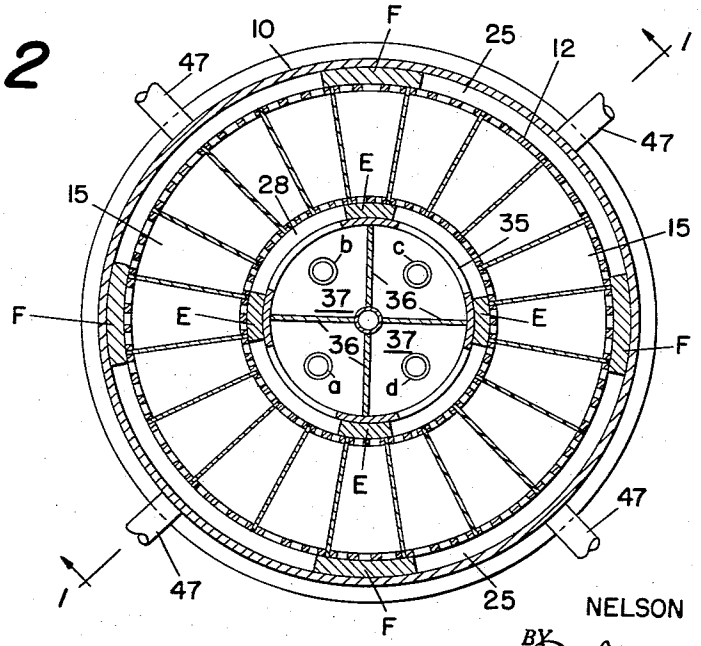


Fig. 2



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Fig. 3

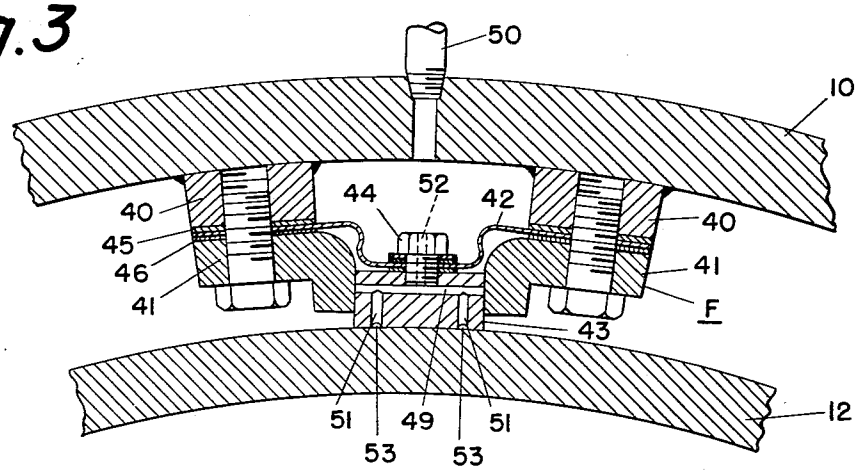
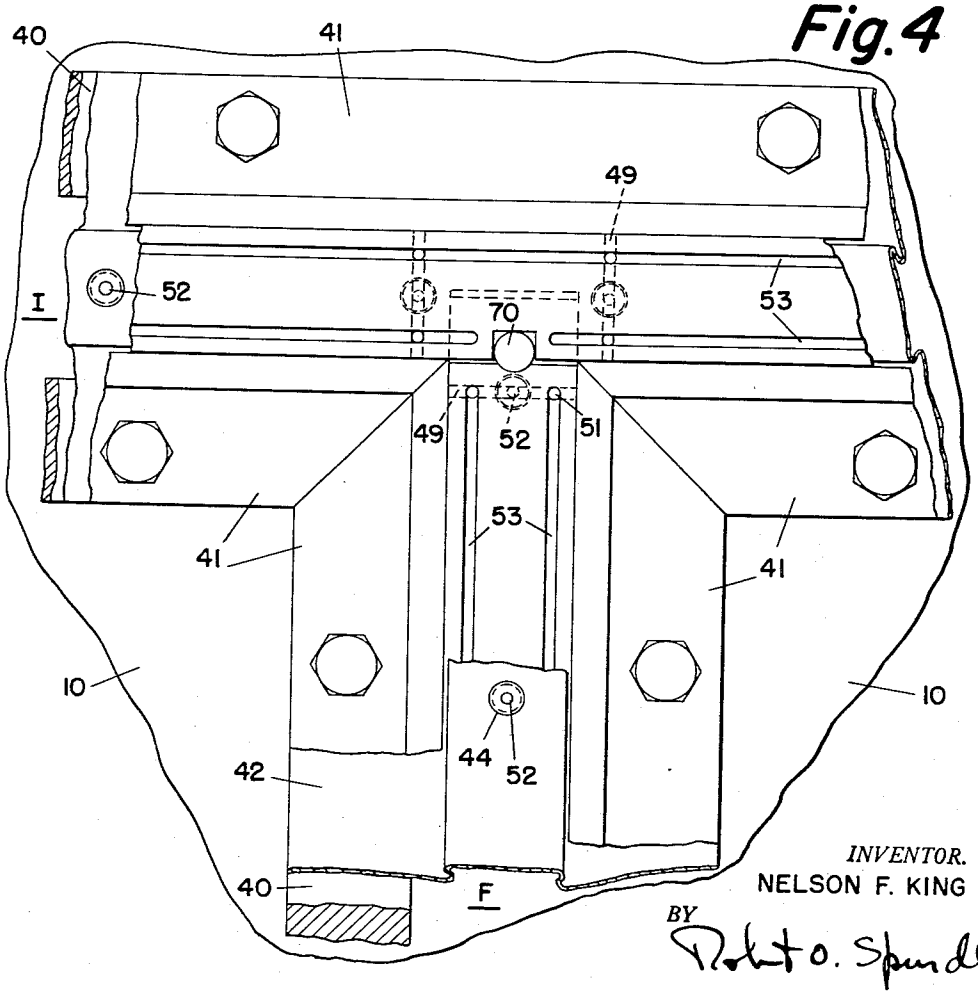


Fig. 4



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2,715,570

ROTARY CONVERTER SEALING DEVICES

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Application June 3, 1954, Serial No. 434,296

8 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.

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 give 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**.

Secured to the outer casing **10**, preferably by welding, are vertically extending bars **40** to which are bolted vertically extending holders **41**. Confined between each bar and holder is one end of a diaphragm **42** the central part of which is offset in a downward direction and by means of a bolt **44** is secured to and supports a vertically extending sealing block **43**. The diaphragm may be of spring metal and is so shaped as to press the block **43** against the outer wall of the rotatable reaction vessel. The width of the block **43** is such as to fit closely between the two holders **41**, while permitting radial movement of the block relative to the converter.

To insure a substantially tight fit between each bar **40** and its corresponding holder **41** a gasket **45** is confined between the diaphragm **42** and the bar **40** and a gasket **46** is confined between the diaphragm **42** and the holder **41**. A gasket **47** is confined between the central part of the diaphragm **42** and the sealing block **43**.

The construction so far described affords a seal that, if manufactured with great precision, may effectually prevent leakage of fluid from one arcuate space to another or reduce leakage to what might be deemed negligible. I prefer, however, to more effectively guard against such leakage. To this end the space enclosed by the elements **40**, **41**, **42** and **43** is connected through a conduit **50** with a source of supply fluid, say steam, under a pressure somewhat in excess of that which exists in the arcuate spaces on opposite sides of the sealing device. The sealing block **43** is provided with a cross-channel or channels **49** opposite ends of which extend to the face of the holder. Other channels **51**, communicating with channels **49**, communicate with vertically extending grooves **53**, which open against the wall of the reaction vessel. The bolt **44** is provided with a central passage **52** to connect channels **49**, **51** and **53** with the source of fluid pressure. It is clear that if the contacting faces of the stealing block **43** with the holder **41** and with the face of the rotatable reaction vessel are not absolutely fluid tight, there can be leakage only between these contacting surfaces into the adjacent arcuate spaces between the casing and the rotatable reaction vessel, which in minor amount is quite unobjectionable.

In the construction just described, the diaphragm **42** need not function to press the sealing block against the reaction vessel **12**, since the pressure fluid within the space enclosed by the members **40**, **41**, **42** and **43** may be relied upon to effect this contact.

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, extend through one of the overlapping sealing units and 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 application Ser. No. 412,230, filed February 24, 1954, 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 spaced-apart bars secured to one of the casings, spaced apart holders secured to the respective bars, a diaphragm each of its opposite ends being secured between a bar and the holder, a sealing block between and closely fitting the holders but slidable toward either casing, the central part of the diaphragm being secured to and carrying the sealing block, the latter contacting with the rotatable reaction vessel.

2. The construction specified in claim 1 comprising also a passage, for communication with a source of pressure fluid, opening into the space enclosed by the said bars, holders, diaphragm and sealing block.

3. The construction specified in claim 2 comprising also channels in the sealing block extending to the front and side faces of the sealing block, and a flow channel connecting said channels with said space.

4. The construction specified in claim 3 in which the means securing the central part of the sealing block to the central part of the diaphragm is a bolt, said bolt having an orifice extending therethrough and providing the flow channel connecting the channels with said space.

5. The combination with a structure comprising a fixed cylindrical casing and a revoluble casing having a number of substantially radially extending chambers, the casings forming between them a circumferential space into which fluid is adapted to flow through 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 cir-

cumferentially extending space and prevents leakage from the space ahead of and behind said sealing device into the last named casing into which said fluid would flow in the absence of a seal, said sealing device comprising spaced-apart bars secured to one of the casings, spaced-apart holders secured to the respective bars, a diaphragm each of its opposite ends being secured between a bar and its respective holder, a sealing block between and closely fitting the holders but slidable toward either casing, the central part of the diaphragm being secured to and carrying the holder.

6. The construction specified in claim 5 comprising also a passage, for communication with a source of pressure fluid, opening into the space enclosed by the said bars, holders, diaphragm and sealing block.

7. The construction specified in claim 6 comprising also channels in the sealing block extending to the front and side faces of the sealing block, and a flow channel connecting said channels with said space.

8. The construction specified in claim 7 in which the means securing the central part of the sealing block to the central part of the diaphragm is a bolt, said bolt having an orifice extending therethrough and providing the flow channel connecting the channels with said space.

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