Nov. 26, 1940. R. C. LASSIAT 2,222,623

APPARATUS FOR CONTROLLED TREATMENT OF FLUIDS

Filed March 8, 1937

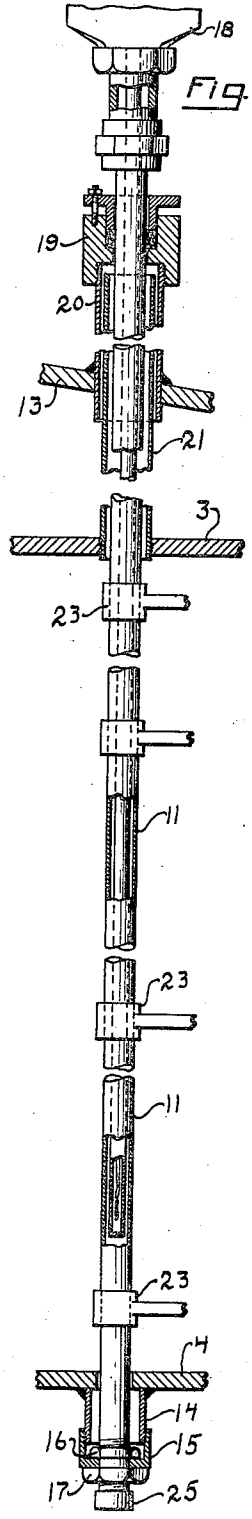


Fig. 2.

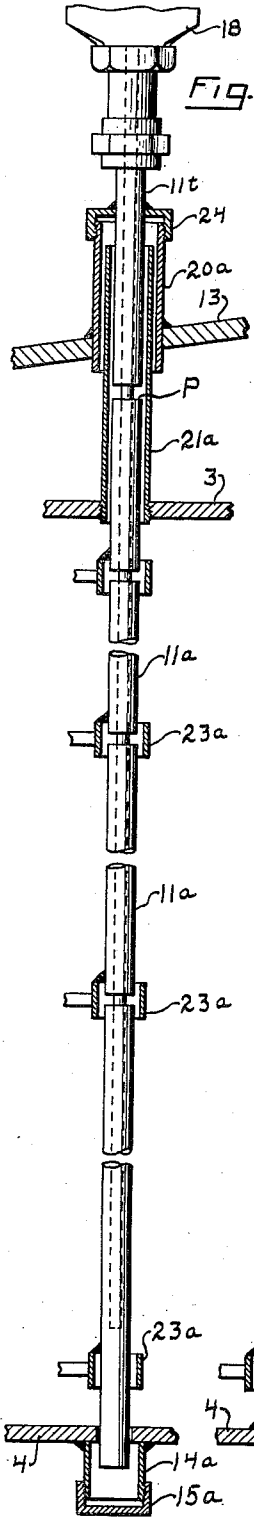


Fig. 3.

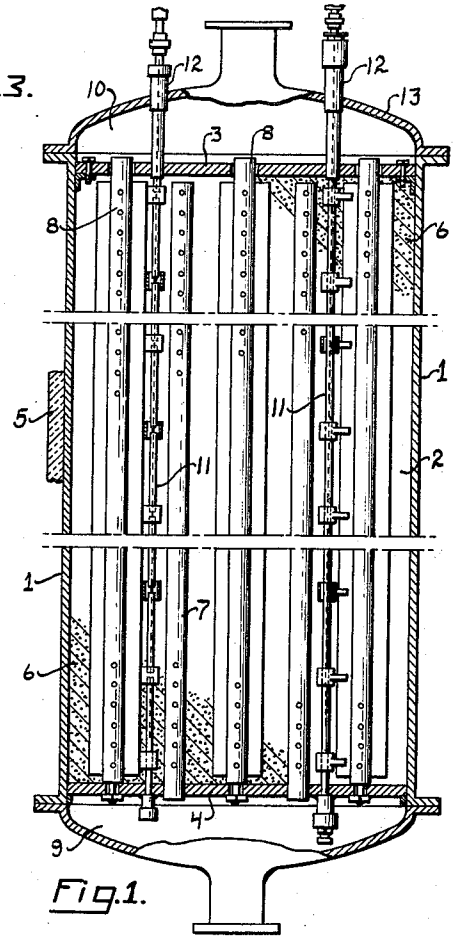


Fig. 1.

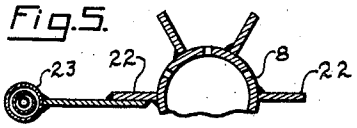


Fig. 5.

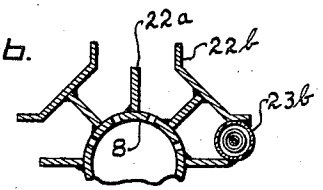


Fig. 6.

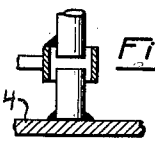


Fig. 4.

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APPARATUS FOR CONTROLLED TREATMENT OF FLUIDS

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3 Claims. (Cl. 23—288)

The present invention relates to the art of treating fluids and to apparatus therefor. It has particular application to apparatus and types of operations where a solid contact material or catalyst is employed in the separation, treatment, conversion or refining of fluids.

A structure, such as a hollow tubular member or well extending within the reaction or contacting chamber of a converter or other fluid treating apparatus and adapted to serve as a duct, or as a protector or guard for an elongate insert or other element in nested relation therewithin, constitutes an important feature of my invention. While such a structure may have various uses, one use for which it is particularly contemplated is as a shield or well for an elongate insert, which may be the impulse generating portions of temperature or pressure indicating apparatus such as a thermocouple, for example. Another specific use for which such structure may be employed is as a shield or well within which a heating or cooling element extends including a tube or nest of tubes for containing heat exchange fluid in circulating and/or stagnant state.

It is an object of this invention to provide a fluid treating apparatus having a well or the like which will be free or substantially free of any tendency to buckle or become distorted with temperature changes in the apparatus. Another object is to provide such a structure or well which will permit the ready insertion, to any desired depth, or removal, of any desired elongate element, such as a thermocouple, heat exchange element, or other member. Another object is to provide structure which is simple, can be easily assembled and will remain in good serviceable condition for long periods of time. A further object is to provide a well or tubular guard embedded in a contact material or mass and so mounted that during thermal expansion it will rise through the mass and overcome the resistance thereof while under compressional stress; but during thermal contraction will move downwardly through the mass and overcome the much greater resistance of the mass to movement through it in this direction while under tensional stress. In accomplishing the latter object it is also a purpose of this invention to provide for the introduction or withdrawal of a thermocouple or any other desired insert through the top of such well or tubular guard; and also to provide for mounting such an insert near the top of said well or at or near the top surface of the contact mass or of the converter or reaction apparatus in which it is contained so that the well and insert are free to move independently of each other and in opposite directions.

The structure or well, as above described, may be fastened or mounted at one of its ends and the insert or element which is to extend therewithin may be supported or mounted at a point adjacent or in proximity to the opposite end of such element or insert. For example, where such well is stationed in an upright or approximately upright position, as is often preferable, it may be joined near or adjacent its lower end to any suitable means or support. Where the structure or well extends to the lower end of the reaction chamber, it may be mounted on or near the wall or partition member which bounds the lower end of the reaction chamber, or it may be joined to a conduit or other element which may or may not be mounted on the last mentioned wall or partition, or it may be joined to other suitable element or structure. Where the well, tubular member, or the like, extends downwardly or into the reaction or contacting chamber from its top end (or one end) only to a point remote from its lower (or other) end, or to a point intermediate its two ends, such well or member may be joined or mounted at or near its lower (or other) end to any suitable portion of the apparatus possessing sufficient rigidity and strength.

The well structure or tubular member may, for example, consist of a continuous tube or of a plurality of separate sections.

Any insert, such as a thermocouple, which extends within such well structure may be supported at or near the end of the well structure remote from the end at or near which the latter is mounted or joined to a suitable support. Where the well structure is fastened near its lower end to a suitable support, any elongate element or member (e. g. a thermocouple) which extends therewithin may be supported on the upper end of the well, for example, or through suitable structure it may be mounted on the upper head of the converter or on other structure which, in turn, may or may not be joined to the upper head of the reaction chamber or converter or to the wall or partition member bounding the upper end of the reaction chamber. With this type of structure and assembly it will be seen that the well structure (e. g. the tubular member) and the nested elongate element, thermocouple or other insert will be free to move with respect to each other and in opposite directions during expansion and contraction thereof.

A quick general understanding of the invention can be facilitated by reference to the illustrative embodiments thereof shown in the accompanying drawing, in which:

Fig. 1 shows an elevational view of a fluid treating apparatus or converter partly in section;

Fig. 2 shows an enlarged detailed view of a portion of the apparatus shown in Fig. 1;

Fig. 3 shows a modified form of the type of structure illustrated in Fig. 2;

Fig. 4 illustrates a modification of a portion of the structure shown in Figs. 2 and 3;

Figs. 5 and 6 are transverse sectional views illustrating methods of supporting the structure shown in Figs. 2 and 3.

Referring more in detail to the drawing, in the several figures of which, like reference characters denote similar parts, 1 is a casing having a reaction chamber 2 located between upper partition member or wall 3 and lower partition member or wall 4. The casing 1 may be covered with insulation 5 and the reaction chamber 2 may contain contact or catalytic material 6, of any desired form or type. One or more series of conduits such as conduits 7 and 8, shown, may be imbedded in contact mass 6 for the purpose of distributing reactants through and/or removing reaction products from mass 6 as disclosed and claimed, for example, in U. S. Patent No. 2,042,468, issued to E. J. Houdry on June 2, 1936, and/or for the purpose of conducting a temperature control fluid in heat exchange relation with mass 6, as indicated in the copending application of E. J. Houdry and R. C. Lassiat, Serial No. 728,544 filed June 1, 1934 which issued on May 4, 1937 as Patent No. 2,178,947.

Considering conduits 7 as induction conduits, reactant fluids, which for the sake of a specific illustration may be considered as high boiling hydrocarbons in vaporous or atomized form, may be introduced into manifolding chamber 9 and pass from the latter into conduits 7, from whence they are distributed through contact material 6, which may for example, consist of an adsorptive blend of silica and alumina or any other suitable contact or catalytic material in the form of bits, fragments or molded pieces. Products of reaction may be withdrawn from the reaction chamber 2 through conduits 8 and then pass through manifolding chamber 10 in leaving the converter.

In the operation of apparatus of this general type, and especially when the operations for which it is to be used are predominantly or largely catalytic in nature, the temperature control of the reaction chamber and of the contact material contained therein is often of major importance. Consequently, it is important that accurate indication and/or recording of temperatures of localized portions of the contact mass be effected. To this end, a plurality of wells or tubular members 11 are provided, each containing one or more separate thermocouples 12 which are inserted to any suitable or desired depth. That is, a thermocouple may be inserted so that its lower end or hot junction is near the lower partition member 4 (when the lower end of the well is adjacent member 4), or is near the upper partition member 3, or is at any desired intermediate point.

The thermocouples 12 may be supported at a suitable point at the upper end of the converter 1. For example, the weight of the thermocouple may be supported on the upper end of the well 11 or on the upper head 13 of the converter, or on the upper partition member 3 thereof.

During heating or cooling of the reaction chamber the thermocouple element 12 and the tubular member or well 11 contract or expand freely and in opposite directions. The well or tubular member encounters less resistance from the mass or contact material when moving upwardly through it than when moving downwardly therethrough. However, when contracting downwardly through the mass, the stress set up in the well is one of tension and does not tend to make the well buckle or become distorted.

As shown in enlarged detail in Fig. 2, well 11 may consist of a continuous tubular member having a single fixed point at or adjacent its lower end being otherwise free to move with respect to other portions of the converter structure. It may extend in freely slidable relation through the lower partition member 4 of the converter and a nipple 14, joined to the lower surface of the partition member 4, may be provided with a removable cap 15 having an opening therethrough of sufficient size to permit the threaded end of well or tubular member 11 to extend therethrough. Nuts 16 and 17, above and below the end of the removable cap 15, serve to firmly hold the well in anchored position adjacent the lower partition member 4 and to provide for easy removal of the well for inspection, replacement, or repair. Well 11 is provided also with a removable cap 25 which permits inspection of the interior of the well without removing the latter from the converter.

Well 11 is shown extending in freely slidable relation through upper partition member 3 and the upper head 13 of the converter, and having a junction box 18 mounted on the upper end thereof. A stuffing box 19 containing packing material of any desired type and attached to the upper end 13 of the converter through tubular support 20, slidably receives well 11 and prevents leakage of fluid from the upper end of the converter. Sleeve 21, mounted in partition 3 and located within tubular support 20, stiffens the portions of well 11 located within chamber 10.

Supports 23, as can be clearly seen from the plan view of Fig. 5, loosely surround the well 11 so that the well is free to expand upwardly or downwardly independently of support 23. Support 23 may be joined, as by welding, to the fin 22 of conduit 8 at suitably spaced intervals between the upper partition member 3 and lower partition member 4. In place of being joined to the fins of one of conduits 8 or 7, these supports may be attached to any other suitable portion of the structure, as for example, to the side walls of the reaction chamber.

In place of being supported as shown in Fig. 5, the well or tubular member may, for example, be located relative to the fins of conduits 8 so as to permit the support or guide 23*a* to be directly attached to each fin, as shown in Fig. 6.

In place of being continuous, as shown in Fig. 2, the tubular member or well may be of the form illustrated in Fig. 3 and designated as 11*a*. Well 11*a* consists of a plurality of aligned but separated sections, each having a single fixed point at one of the supporting or guide members 23*a* and being otherwise free for limited movement with respect to other portions of the converter. Each section is shown rigidly attached at or adjacent its lower end to a guide member 23*a*, which in turn is attached to a suitable

portion of the converter such as fins **22**, to have a free upper end which may be located within and loosely or slidably received by the next adjacent guide member **23***a*. The uppermost section **11***a* within the reaction chamber may be slidably received by the wall bounding the reaction chamber to terminate, for example, within suitable guide means as at point P in stiffening member **21***a*. Thus, the relative movement of well **11***a* is fractionated and relatively great movement of upper portions of the well are avoided. Guide members **23***a* are preferably rather close fitting so as to avoid entrance of contact material **6** into the upper ends of sections **11***a*. With this type of well structure there is no necessity for a joint of the type provided by a stuffing box as indicated in Fig. 2. In Fig. 3 the uppermost section of the well designated as **11***t*, is shown rigidly attached to end **13** of the converter by sleeve **20***a* and removable cap **24** and extend into stiffening member **21***a* to have a free end therewithin. Thus junction box **18** is also rigidly attached to the converter shell. The lowermost section of well **11***a* is shown freely extending through a perforation in partition **4** to have a free end within nipple **14***a* provided with removable cap **15***a*.

While the well or tubular member of Fig. 3 is shown as consisting of a plurality of sections between partitions **3** and **4**, all other features of the structure as here shown are also contemplated when the portion of the well below point P, or below some equivalent point, consists of a single continuous tubular member.

From Fig. 4 it will be evident that the tubular member or well **11** or **11***a* need not necessarily extend through the lower partition member **4** but may, if desired, be mounted thereon. It may also be mounted on structure adjacent to the partition member without extending therethrough or it may terminate at a point intermediate partitions **3** and **4** and be supported by a number of either conduit series or from a side wall of the converter.

While this invention has been described to a large extent in connection with its use when the member or elongate element which is to be inserted within the well or tubular member **11** or **11***a*, or the like, consists of a thermocouple, yet it will be obvious from the whole specification that the invention is also applicable when the well or tubular member is employed in connection with heat exchange, or for other purposes. Also, while the invention is illustrated in connection with an upright converter, with the well or tubular member in an upright position, it is by no means restricted to such specific construction or particular arrangement.

Although the drawing illustrates distribution of fluid throughout the contact or catalytic material or mass by the use of perforated induction and eduction conduits, it will be understood that the invention is also applicable in fluid treating or contacting apparatus where perforated conduits are not employed and the flow of reactants is straight through or from end to end of the reaction chamber.

I claim as my invention:

1. A converter having side and end walls and transversely extending upper and lower partitions adjacent the end walls forming top and bottom manifolds and a central reaction chamber, a body of contact material in said reaction chamber, cooperating apertures in the upper end wall and upper partition, a guard assembly for elongated members comprising a plurality of aligned and spaced tubular sections, one of said sections extending through at least one of said cooperating apertures in freely moving relation therewith and being held in fixed position for expansion downwardly, other sections of said guard assembly extending through said body of contact material and being secured at their lower ends in the reaction chamber by cylindrical guide members permitting expansion upwardly through the contact material, said cylindrical guide members overlapping the upper ends of adjacent sections and being adapted to exclude contact material from the sections, sleeve means secured to said upper partition and end wall and having a free end extending outwardly of said end wall, said free end being sealed about said upper section of said guard assembly to prevent the escape of fluid from the reaction chamber.

2. A converter having side and end walls and transversely extending upper and lower partitions adjacent the end walls forming top and bottom manifolds and a central reaction chamber for containing a body of contact material, cooperating apertures in one end wall and its adjacent partition, a thermocouple well assembly having its upper end portion extending through said apertures in freely moving relation therewith, said well assembly including a plurality of aligned and spaced tubular sections, each of said sections being rigidly held adjacent its lower end by cylindrical guides within the reaction chamber to permit upward expansion of the sections through the contact material, said cylindrical guides overlapping the free ends of adjacent sections and being adapted to exclude the contact material from the well sections, a sleeve surrounding the upper end of the thermocouple well and spaced therefrom having one end secured in the transverse partition aperture and a free end disposed outwardly of the end wall, a second sleeve surrounding said first mentioned sleeve secured in the end wall aperture and having an open end disposed between said partition and end wall and its other end sealed around the upper section of the thermocouple well and enclosing the open end of said first mentioned sleeve, said sleeve construction providing an arrangement for preventing the leakage of fluid from the converter.

3. A converter having side and end walls and transversely extending upper and lower partitions adjacent the end walls forming therewith top and bottom manifolds and a central reaction chamber for containing a body of contact material, cooperating apertures in one end wall and its adjacent partition, a series of perforated conduits mounted in each of said partitions and extending toward the other partition, thermocouple well assemblies having their upper ends extending through said cooperating apertures in freely moving relation therewith, said well assemblies including a plurality of aligned and spaced tubular sections, each of said sections being rigidly held adjacent its lower end by cylindrical guides to permit upward expansion of the sections through the contact material, said cylindrical guides overlapping the free ends of adjacent sections, said cylindrical guides being secured to adjacent perforated conduits and adapted to exclude contact material from the well sections, sleeves surrounding the upper ends of the thermocouple wells and spaced therefrom having one end secured in the transverse parti-

tion apertures and a free end disposed outwardly of the end wall, a second set of sleeves surrounding said first mentioned sleeves secured in the end wall apertures and having open ends disposed between said partition and end wall and their other ends sealed around the upper sections of the thermocouple well assemblies and enclosing the open ends of said first mentioned sleeves, said sleeve constructions providing an arrangement for preventing the leakage of fluid from the converter.

RAYMOND C. LASSIAT.