April 21, 1970 C. E. BERTHOUD ET AL 3,507,628

RIGGING APPARATUS

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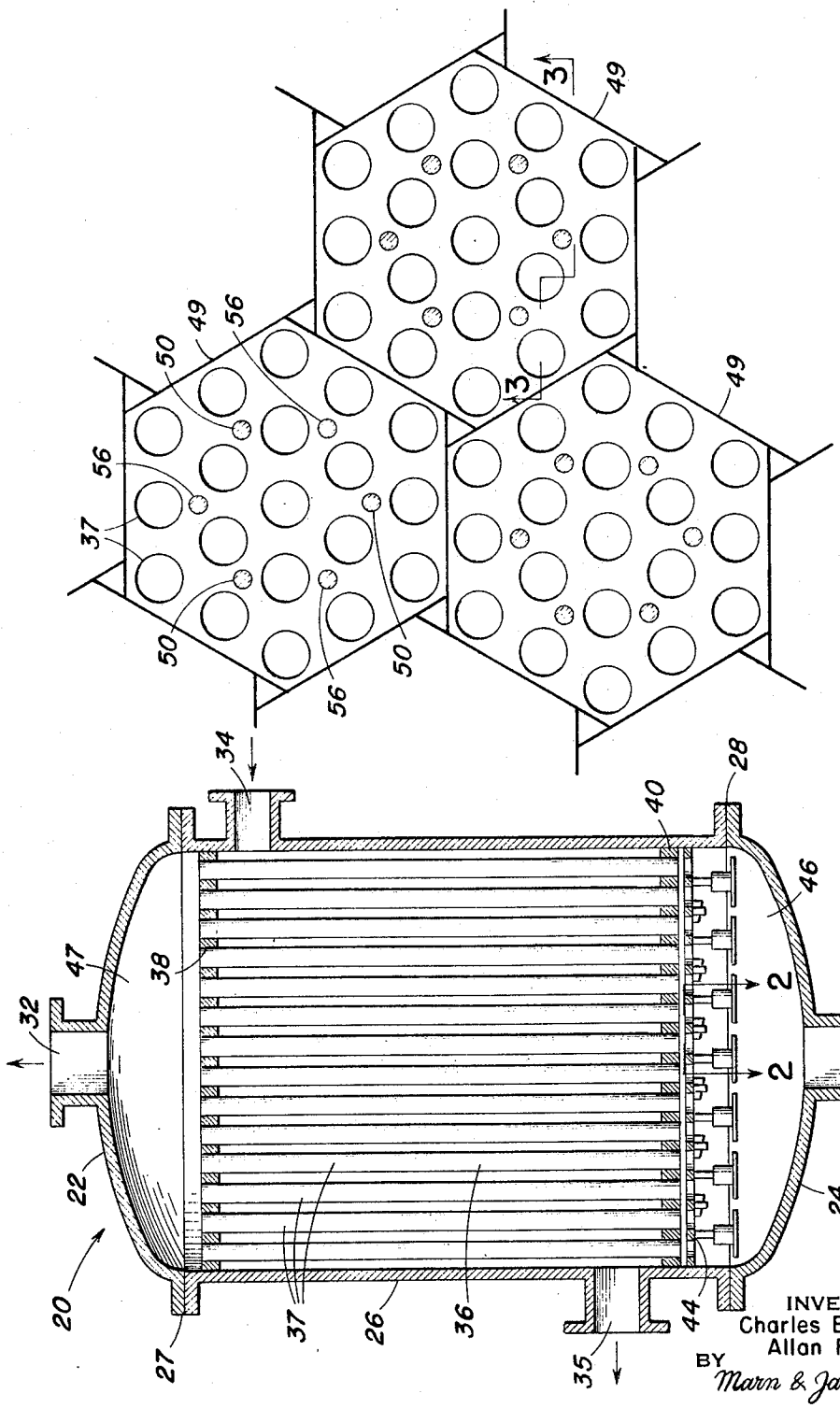


Fig. 2.

Fig. 1.

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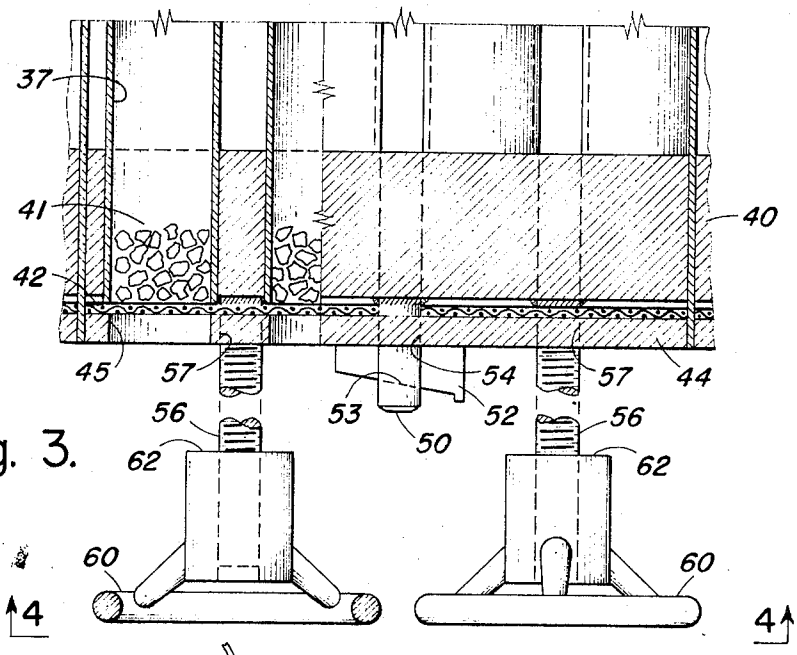


Fig. 3.

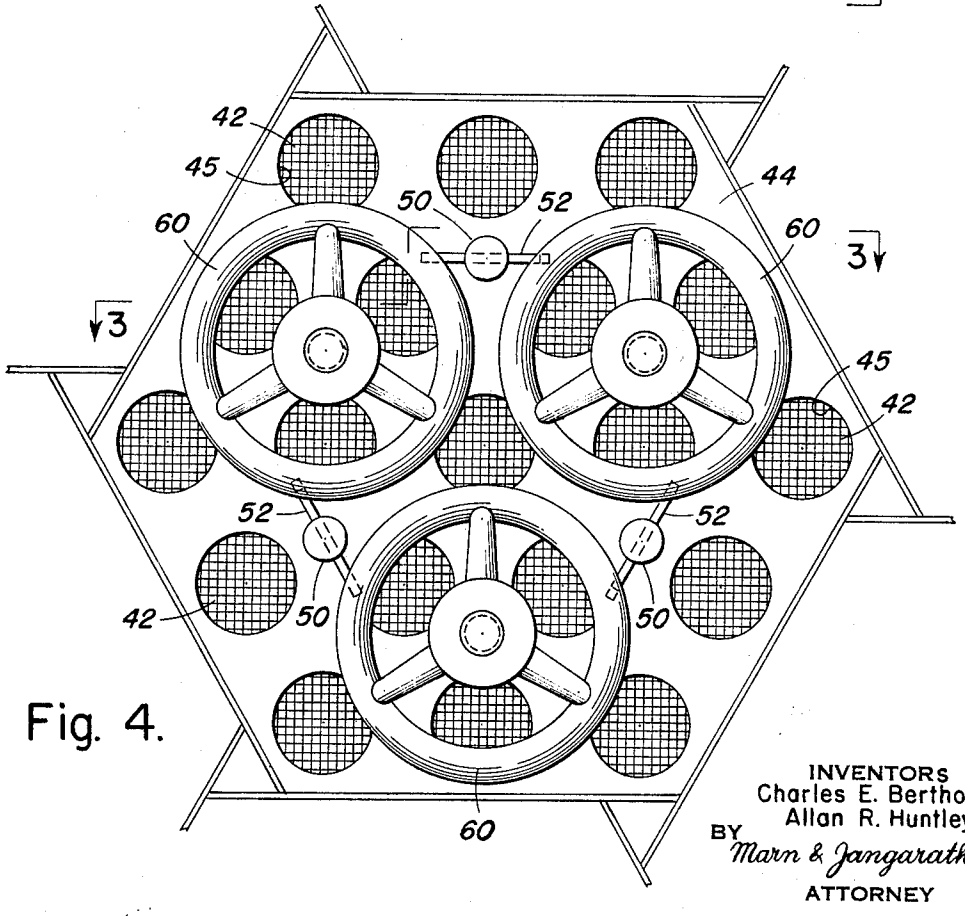


Fig. 4.

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RIGGING APPARATUS

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U.S. Cl. 23—288 10 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for lowering an underside cover or plate from a structural body, the operation of which requires only a single workman. The apparatus comprises a plurality of studs mounted through an underside cover on a structural body, and lifting devices such as handwheels mounted on the studs for carrying the cover during release from the body and for lowering the cover thereafter.

A recurring problem in the rigging art has been that of lowering an underside cover or plate from a structural body, particularly where the cover is large in size and/or extremely heavy. Ordinarily, the practice has been to use chain falls, or cables and windlasses, to support the cover during release from the structural body, and lower the plate or cover thereafter. More critical problems arise when a cover has to be closely guided during removal as in the situations of removing the lower half of a turbine casing with the rotor in place or of removing the lower portion of any machine housing where tolerances are close. In these instances, guide bars are used in addition to a plurality of chain falls or jacks so as to insure that the casing does not hit and damage the rotor during removal.

Known procedures for lowering underside plates and covers require a plurality of workmen and the availability of expensive equipment. Further, in many lowering situations, access to the plate to be lowered has had to be provided through the structure to which the plate or cover is secured, thus requiring disassembly for access to structure above the plate or cover. For example, the maintenance of a vertical tube reactor having a screen and screen mounting plate located under a lower tube sheet for maintaining catalyst material in the vertical tubes requires the periodic changing of catalyst material. Spent catalyst is usually removed by lowering the screen and screen mounting plate away from the bottom of the heat exchanger tubes and allowing the spent catalyst to run out.

Lowering had heretofore been accomplished in one of two ways, either chain falls were attached to pads mounted on the screen support plate which was then lowered, or the screen from one or more tubes was removed and cables were passed down through the empty heat exchange tubes from a windlass mounted on the upper tube sheet, the cables then being secured to the screen support plate which was thereafter lowered by the windlass. Obviously such lowering methods required a minimum of two workmen and often more. Further, there was a requirement for windlass or chain falls which might otherwise not be needed as well as communication apparatus for showing those engaged in the lowering to maintain in contact throughout the operation.

It is an object of the present invention, therefore, to provide an apparatus for lowering an underside cover or plate from a structure, the operation of which apparatus requires only one workman.

Another object of the present invention is the provision of apparatus for lowering an underside cover or plate from a structure, which apparatus is simple and relatively inexpensive.

Yet another object of the present invention is the provision of an apparatus for lowering underside covers or plates from a structure, which apparatus also guides the covers or plates as they are being lowered.

A still further object of the present invention is to provide an apparatus for lowering the catalyst retaining screen of a catalytic reactor, which apparatus provides for selective lowering so as to allow the controlled removal of spent catalyst from the reactor tubes.

These and other objects are accomplished by the apparatus of the present invention wherein one or more support devices, such as studs, are mounted on a structural body having an underside cover or cover plate releasably secured thereto, and wherein a lifting device such as a threaded handwheel is mounted on each of the support devices for carrying the cover or plate during release and lowering the cover or plate after release from the structural body.

A clearer understanding of the present invention may be had from a consideration of the following specification which describes the present invention, as incorporated in a vertical tube catalytic reactor to lower the catalyst screen support plate. The specification should be read in light of the appended drawings wherein:

FIG. 1 shows a front sectional elevational view of a vertical tube catalytic reactor having an apparatus according to the present invention provided therein;

FIG. 2 is a cross-sectional view, partially cut away, through plane 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view through the plane 3—3 of FIG. 2; and

FIG. 4 is a detailed view of a lowering apparatus according to the present invention, having the lowering handwheels in position on the lowering studs.

Referring now to FIG. 1, there can be seen a vertical tube catalytic reactor **20** having an upper head **22** and a lower head **24** secured to a cylindrical main shell **26** by flanged connections **27**, **28**, respectively. Lower head **24** is provided with an inlet opening **30** for allowing the entry of a feed stream of a fluid to be reacted. Upper head **22** is provided with a discharge opening **32** for allowing the exit of reacted fluids. The main shell **26** is provided with an inlet connection **34** and an outlet connection **35** for the passage of heat exchange fluid through a tube nest **36**.

The tube nest **36** comprises a plurality of vertically extending tubes **37** mounted at their respective ends in upper tube sheet **38** and lower tube sheet **40**. The upper tube sheet **38** is a horizontally disposed circular metal plate having a diameter substantially equal to the inside diameter of main shell **26** and secured, as by welding, to the inner surface of shell **26** just below flanged connection **27**. The tube sheet **38** is provided with a plurality of holes to receive tubes **37** therethrough. Lower tube sheet **40** is a horizontally disposed circular metal plate identical to upper tube sheet **38** and secured in shell **26** just above flanged connection **40**. The heat exchanger tubes **37** extend from the upper surface of upper tube sheet **38** to the lower surface of tube sheet **40**, and are secured at their respective ends to the respective tube sheets by rolling, welding, or other means known to those in the art. A screen **42** is maintained under and in surface to surface engagement with tube sheet **40** by a screen support plate **44**.

Screen support plate **44** comprises a plate, or a plurality of plates as will hereinafter be discussed, which extends horizontally across substantially the entire inner cross-sectional area of shell **26**. As is best seen in FIGS. 3 and 4, plate **44** supports screen **42** on its upper surface and is supported by a plurality of studs **50** which are rigidly secured to the underside of lower tube sheet **40**. The studs depend from tube sheet **40** and extend through

holes 54 provided therefore in support plate 44. Each stud 50 is provided with a vertically oriented through slot 53, the lower surface of which is beveled to accommodate a tapered wedge therethrough. Thus screen support plate 44 is suspended from tube sheet 40 by studs 50 and held rigidly upwardly against screen 42 by the action of tapered wedges 52 in slots 53.

In addition to holes 54 for accommodating studs 50, support plate 44 is provided with holes 45 of an equal diameter and in coaxial alignment with reactor tubes 37. Further, support plate 44 is provided with holes 57 for receiving threaded studs 56 therethrough as will be discussed more fully hereinafter.

The tubes 37 are filled with a catalyst 41 which is prevented from falling out of the tubes by screen 42 which extends under the tubes 37 and over the holes 45 in support plate 44. In this manner, the catalyst 41 is maintained in tubes 37 by the screen 42, but the passage of fluid to be reacted from the lower header chamber 46 into tubes 37 is not impeded.

In normal operation, fluid to be reacted is introduced into lower header chamber 46 through inlet opening 30, passed up through holes 45 and screen 42 into tubes 37, through catalyst 41 to upper header chamber 47 and out discharge opening 32. Heat exchange fluid for heating or cooling the tubes 37, and therewith the reacting fluid, is introduced through an inlet connection 34, passed through tube nest 36 and is discharged through outlet connection 35. Thus, as is well known in the art, a fluid may be catalytically reacted either endothermically or exothermically using a reactor of this type.

After certain periods of operation, it usually becomes necessary to replace the catalyst material. Removal of the spent catalyst is best accomplished by lowering screen support plate 44 and therewith screen 42 thus allowing the spent material to run out of tubes 37.

As was discussed above, screen support plate 44 may well be heavy and bulky. With this in mind, the present invention has been provided for reactor 20 so as to allow the removal of spent catalyst to be accomplished by a single workman. Screen supporting plate 42 is held in position by wedge pins 52 which are received in slots 53 of securing pins 50. Securing pins 50 extend through openings 54 in screen support plate 44 and are rigidly attached (as by welding) to lower tube sheet 40. In accordance with the present invention, a plurality of threaded lowering studs 56 are connected, such as by welding, at their one ends to the under surface of lower tube sheet 40, and extend downwardly vertically through openings 57 in screen support plate 44 into lower header chamber 46.

Depending upon the size of the reactor, it may be desirable to segment the screen 42 and the screen support plate 44 and to provide more than one lowering apparatus according to the present invention for each segment. Thus, as can be seen in FIGS. 2 and 4, the screen support plate of this reactor is formed of hexagonal segments 49 each having three symmetrically located lowering studs 56 and three securing pins 50 extending therethrough. With this arrangement, unless totally disassembled, each segment has at least three point support at all times.

In FIG. 3, there is shown a section of the lower tube sheet, one securing pin 50 and locking wedge 52, and two lowering studs 56 having handwheels 60 mounted thereon. Screen support plate 44 and catalyst retaining screen 42 are held rigidly in operating position by locking wedge 52 acting through securing pin 50. Handwheels 60 threadedly engage lowering studs 56 and, as shown, are not in operational position. When it is required to lower screen 42 and screen support plate 44 away from tubes 37 to allow catalyst 41 to be discharged, each handwheel 60 is run up studs 56 until shoulders 62 engage the underside of screen support plate 44. Handwheels 60 are then tightened further to tend to lift screen support plate 44 and thus relieve the weight of the plate from locking wedge 52. Locking wedge 52 is then removed to release screen support plate 44 which, with screen 42, is thereafter lowered by backing handwheels 60 down lowering stud 56 to the position which allows the desired rate of flow of catalyst from tubes 37. Spent catalyst 41 then tumbles from tubes 37 until the tubes are empty and ready to receive fresh catalyst. Thereafter, handwheels 60 are run up lowering studs 56 to lift screen support plate 44 and screen 42 back into operational position, locking wedge 52 is inserted in securing pin 50, and handwheels 60 are backed off lowering studs 56 to be used at another location.

It is to be recognized that the studs can be arranged differently from the arrangement shown in FIGS. 1 through 4. Thus, by placing studs 56 at the center of the triangular openings formed at each juncture of three adjacent segments 49, and, if required, by providing a washer or adequately large shoulder 62 on handwheels 60, each stud may be utilized in lowering each of three adjacent plate segments thus reducing the total number of studs required.

Thus, through the judicious use of permanently installed studs and portable handwheels, the present invention provides apparatus for economically and efficiently releasing and lowering a plate or cover from the underside of a structural body such as the aforedescribed vertical tube reactor. It is to be recognized, however, that it is not required that the lowering studs be permanently installed. In many applications, in fact, it is desirable that they be removable. For example, lowering studs according to the present invention may be screwed into the flange of the upper casing of a turbine, the bottom casing of which is to be lowered. The lowering studs are installed by positioning them in guide holes in the flange of the lower casing and screwing them into threaded coaxial holes in the upper casing. The lowering studs serve not only their support functions, but they also serve as casing guides to preclude accidental damage to the turbine rotor.

What is claimed is:

1. In a vessel having a body, a cover and securing means for releasably securing said cover to said body, the improvement comprising:
   - support means mounted on said body extending through said cover; and
   - means mounted on said support means for moving said cover along said support means, the movement of the cover along said support means in one direction permitting release of said securing means and movement of the cover in the opposite direction along said support means, after release of said securing means, permitting access to said vessel, said support means and means mounted on the support means supporting said cover after release of said securing means.

2. The apparatus as claimed in claim 1 wherein said support means mounted on said body is a stud.

3. The apparatus as claim in claim 2 wherein said means mounted on said stud is a handwheel.

4. In a catalytic reactor having a bank of catalyst containing, vertical heat exchanger tubes mounted between an upper tube sheet and a lower tube sheet, and a screen mounted on a screen support plate under said lower tube sheet, the improvement comprising:
   - support means mounted on said lower tube sheet; and
   - means mounted on said support means for lowering said screen and screen support plate away from said lower tube sheet.

5. The apparatus as claimed in claim 4 wherein said support means mounted on said lower tube sheet extend through said screen and screen support plate, said support means and means mounted on the support means supporting the screen and screen support plate upon lowering thereof.

6. The apparatus as claimed in claim 4 wherein said support means is a stud and said means mounted on said support means is a threaded member.

7. The apparatus as claimed in claim 6 wherein said threaded member is a handwheel.

8. In a catalytic reactor having a bank of catalyst containing vertical heat exchanger tubes mounted between an upper tube sheet and a lower tube sheet, and a screen mounted on a screen support plate under said lower tube sheet for maintaining said catalyst in said tubes, the improvement comprising:

securing means for releasably securing said screen and screen support plate against said lower tube sheet;

support means mounted on the underside of said lower tube sheet and extending through said screen and said screen support plate;

means mounted on said support means for carrying said screen and screen support plate during release of said securing means and for lowering said screen and said screen support plate after release of said securing means.

9. The apparatus as claimed in claim 8 wherein said releasable securing means is slotted rod having a pin inserted therethrough.

10. The apparatus as claimed in claim 8 wherein said support means mounted on the underside of the tube sheet is a threaded stud and said means mounted on said threaded stud is a handwheel in threaded engagement with said stud.

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