

UNITED STATES PATENT OFFICE

2,595,384

GRID SEAL FOR FLUIDIZED SOLIDS
CONTACTING SYSTEMS

John H. Johnsen, Hammond, Ind., and Nate H. Snyder, Jr., San Antonio, Tex., assignors to Standard Oil Company, Chicago, Ill., a corporation of Indiana

Application December 7, 1950, Serial No. 199,676

3 Claims. (Cl. 23-288)

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This invention relates to an improved grid seal for fluidized solids contacting systems and it pertains more particularly to structure for preventing the by-passing of gases in fluidized solids contacting systems which operate at high temperatures.

The invention is particularly applicable to regenerators of fluid catalytic cracking systems of the type illustrated, for example, in U. S. 2,457,255 (although steam instead of oxygen may be employed for effecting the stripping). It is important that the grid at the base of the regenerator distribute the incoming regeneration gas-catalyst suspension uniformly across substantially the entire regenerator cross sectional area and since supplemental air is usually introduced below the grid it is important that this supplemental air be likewise uniformly distributed. Heretofore much difficulty has been encountered in effecting a seal between the distributor grid and the reactor walls. The distributor grid may expand or contract several inches during start-up and shut-down periods while there is little or no change in the dimensions of the outer vessel wall. Also, there are tendencies toward deformation due to differential expansion, and the erosive effect of the fluidized solids tends to aggravate the problem of preventing by-passing of air and regeneration gas around the edges of the grid. Such by-passing of air in turn results in channeling along the reactor wall and afterburning in the upper part of the regenerator which is ruinous to the cyclone separators and is often the cause of otherwise unnecessary shut-downs. An object of the invention is to prevent by-passing of gases around the grid. A further object is to provide an improved grid seal which is simple and inexpensive and which will be effective regardless of any warping or distortion of the grid plate which may be caused by differential expansion. Other objects will be apparent as the detailed description of the invention proceeds.

The grid seal of this invention is provided by metal plates of substantially the same curvature as the periphery of grid sections, said plates having a rounded lower surface for contacting the upper surface of a ledge which extends inwardly from the reactor wall underneath the peripheral edges of the grid sections. The plates are held close to the peripheral edges of the grid sections by holders cooperating with brackets on the grid section so that the rounded lower edges of the plates may bear against and slide upon the inwardly extending ledge while the outer surfaces of the grid plate may move upwardly and down-

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wardly along the vertical surfaces of the curved plates while said plates remain in contact with the vertical ledge. The seal is thus effected between the rounded lower edges of the arcuate plates and the inwardly extending ledge and also between the vertical inner sides of the arcuate plates and the periphery of the grid sections. Such a seal construction has been found to be remarkably effective in commercial fluid catalytic cracking regenerators as will be pointed out in the following detailed description.

The invention will be more readily understood from the following description of a specific example read in conjunction with the accompanying drawings which form a part of this specification and in which:

Figure 1 is a diagrammatic sectional view of a conventional catalytic cracking regenerator illustrating the position of the improved grid seal; Figure 2 is an isometric detailed sketch showing the structure of the grid seal in greater detail; and

Figure 3 is a detailed section showing the slideable mounting of the seal plate against the periphery of a grid section.

The regenerator 10 of a fluid catalytic cracking system may be about 40 feet in diameter and about 50 feet in height. The lower section 11 of the regenerator vessel is usually conical or hemispherical in shape. Spent catalyst suspended in a part of the regeneration air stream is introduced into the lower section through line 12 and supplemental air may be introduced into the bottom section through line 13. Regenerated catalyst is withdrawn from the regenerator through standpipe 14, the upper end of which extends above distributor grid 15. This distributor grid may be supported on rings 16 and 17 which in turn are mounted on structural supports 18 and 19. The grid 15 may be in the form of a steel plate about 1 or 2 inches in thickness provided with apertures 20 for uniformly distributing the introduced catalyst suspension across substantially the entire cross sectional area of the regenerator. The outer edges of the grid protrude over a ledge 21 which extends inwardly from the reactor wall. Heretofore, it has been the practice to allow about 1/4 inch clearance between the ledge and the grid but much difficulty has been encountered in preventing short circuiting of regeneration gas such as air around the edges of the grid. Such short circuiting not only detracts from regenerating efficiency but it causes channeling and afterburning in the upper part of the regenerator, which after-

burning often ruins the cyclone separators 22, which are conventionally employed in the upper part of the regeneration chambers for separating solids from gases introduced thereto from inlet 23, the separated solids being returned to the dense phase by dip leg 24 and the gases then being vented from the top of the regenerator through line 25. While a single cyclone is shown in the drawing, it will be understood that a plurality of cyclones are usually employed and often 2 or 3 stages of cyclone separation are used instead of the single stage illustrated.

In accordance with this invention, an arcuate steel plate 26 surrounds the outer edge of each grid section and rests on ledge 21, plate 26 being held by bolt 27 to brackets 28 with either the plate or the bracket being slotted to provide for vertical movement of the periphery of the grid with respect to the plate which is held close to the periphery of the grid in all positions thereof.

The structure will be more readily apparent by reference to Fig. 2 which shows in greater detail the wall structure, grid section and the improved grid seal of this invention. The outer reactor wall 29 is fabricated from steel. Inside the outer steel casing is a layer of insulating cement or concrete 30. When this insulating concrete has set, a steel mesh lining 31 is placed on the inner surface of the walls, this steel mesh preferably being in the form of hexagonal steel grating which, when placed on the concave surfaces, provides a secure anchor for refractory cement which is applied through the steel mesh to form a so-called "gunited" lining 32. Iron bars 33 are welded at 34 and 35 to the steel mesh 31 bent in the form of angular brackets at spaced points around the periphery of the lower part of the vessel and serve as reinforcement for the inwardly extending ledge 21 which is preferably a refractory concrete and which has a substantially flat horizontal upper surface 36.

A vertical arcuate plate 26, which in this case is $\frac{1}{2}$ inch by 9 inch steel plate rolled to grid plate curvature, surrounds the outer peripheral edge of grid section 15. Plate 26 is rounded at its lower end 42 which rests on the top surface 36 of ledge 21 so that plate 26 may slide inwardly and outwardly on the ledge as the grid plate expands and contracts. Angle iron brackets 28 are welded at spaced intervals around the outer edge of the grid. They are provided with vertical slots 39 for receiving a bolt or other holder 27 which extends inwardly through or from plate 26. Alternatively or in addition, vertical slots 41 may be provided in plates 26. The bolt or holder 27 holds the plate 26 in sliding engagement with the outer periphery of the grid plate section 15 so that the outer edges of the grid plate may warp or move up or down and still be substantially sealed by the close proximity thereto of an arcuate plate 26 which in turn is sealed at its lower surface against horizontal surface 36 of ledge 21. If desired, stop plates 37 may be welded to the upper ends of certain of the brackets 28. U-shaped brackets may be employed instead of the bolt and slot arrangement for holding plate 26 against the outer peripheral surfaces of the grid plate section. Since the grid plates are usually fabricated from a plurality of grid sections bolted to supports 16 and 17, seal plates 26 are preferably employed for each segment but in smaller installations it may be feasible to employ a continuous sealing plate extending

around the entire periphery of the grid. The term "grid section" as employed herein is intended to mean either separate or integral grid sections and the arcuate plates for the grid sections may likewise be separate or integral with adjacent plate sections.

In the example hereinabove described, the grid plate was separately supported by rings 16 and 17 so that ledge 21 did not carry the actual weight of the grid. In some cases, however, it may be feasible to support the grid on the inwardly extending peripheral ledges using an annular steel ring instead of refractory cement for the upper surface thereof. Even in this case, any warping of the grid would lead to by-passing of gases around the edges thereof and a structure of the type hereinabove described will provide a remarkably more effective seal.

Prior to the installation of the grid seal hereinabove described in a fluid catalytic cracking regenerator, great difficulty was encountered because of afterburning in said regenerator and ineffective operation thereof. Inspection after a shut-down showed that erosion of the refractory ledge under the grid had occurred to such an extent that the space between the grid and the remainder of the ledge was approximately one inch in many places. Thereafter the above described grid seal was installed in this regenerator and it was found to be remarkably effective in eliminating the by-passing of gases around the grid. Afterburning was no longer encountered and the regenerator functioned with much greater efficiency.

After the installation of said grid seal, the conversion in this catalytic cracking unit was unusually high and the gasoline yields were higher than were ever before obtained on the unit.

While a particular example of the invention has been described in considerable detail, many alternatives and modifications will be apparent to those skilled in the art from the above description.

We claim:

1. A grid seal for a fluidized solids contacting system wherein grid plate sections are supported with their outer edges protruding above a peripheral ledge extending inwardly from the inner wall of a contacting vessel, which grid seal comprises a vertical arcuate plate substantially conforming with the outer edges of each grid section, said plate having a rounded lower surface for contacting the upper surface of the ledge, brackets at the periphery of each grid segment and a holder cooperating with said brackets and said plate for holding said plate close to the outer edge of the grid section while permitting relative vertical movement between the plate and the outer edge of the grid section.

2. The structure of claim 1 wherein the inner vessel walls and upper surface of the ledge, which are adjacent the outer edges of the grid sections, are of refractory cement held in place by steel mesh.

3. The structure of claim 1 which includes separate grid supports for supporting the grid sections so that the weight of said grid sections is not carried by said ledge.

JOHN H. JOHNSEN,
NATE H. SNYDER, JR.

No references cited.