AUSTRALIA
Patents Act

APPLICATION FOR A (b) STANDARD/PETTY PATENT

I/We (c) MOBIL OIL CORPORATION

of (d) 3225 Gallows Road
Fairfax, Virginia 22037-0001
United States of America

hereby apply for the grant of a (e) Standard/Petty Patent for an invention entitled

(f) FCC CATALYST STRIPPING METHOD AND APPARATUS

which is described in the accompanying (g) complete specification.

(Note: The following applies only to Convention applications)

Details of basic application(s)

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<th>Application No.</th>
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This application is a further application made by virtue of sub-section (1) of Section 51 of the Patents Act 1952 from the following original application:

No. of original application 44585/85

Filed in the name of: MOBIL OIL CORPORATION

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Patent and Trade Mark Attorneys
367 Collins Street
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Dated (i) 10 February 1989

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1. A process for fluid catalytic cracking of a hydrocarbon feed comprising the steps of:
   passing a mixture, as a suspension, of the hydrocarbon feed and a catalyst through a riser conversion zone contained within a reactor vessel and cracking the hydrocarbon feed in the riser conversion zone;
   passing the mixture through a deflection zone in which the mixture is physically deflected from an exit of the riser conversion zone towards an exit of the deflection zone; and
   passing the deflected mixture from the deflection zone exit to a separation zone.
2. The process of claim 7, including after the passing steps, the additional steps of:
   separating at least a portion of the catalyst from the mixture in the separation zone;
   passing a gaseous effluent from the separation zone to a downstream fractionation apparatus;
   passing the separated catalyst from the separation zone to a catalyst stripping zone, the catalyst stripping zone...
using a stripping gas to remove hydrocarbons entrained with or absorbed by the separated catalyst; passing the stripping gas with removed hydrocarbons to the downstream fractionation apparatus; and passing the separated catalyst out of the stripping zone.
APPLICATION’S REF.: DIV. OF 44585/85

Name(s) of Applicant(s): MOBIL OIL CORPORATION

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Complete Specification for the invention entitled:

FCC CATALYST STRIPPING METHOD AND APPARATUS

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

P 10/11/77 1
The present invention relates to methods and apparatus for the separation of a catalyst and hydrocarbon materials in a fluidized catalytic cracking (FCC) unit.

Fluid catalytic cracking, has undergone significant development improvements due to advances in catalyst technology. With the advent of zeolite cracking catalysts, new areas of operating technology have been encountered, requiring refinements in processing techniques to take advantage of the high catalyst activity, selectivity and operating sensitivity.

The catalyst usually employed in an FCC installation is preferably a high activity crystalline zeolite catalyst of a fluidizable particle size. The catalyst is transferred in suspended or dispersed phase condition with a hydrocarbon feed generally upwardly through one or more riser reactors (FCC cracking zones), providing a hydrocarbon residence time of 0.5 to 10 seconds, and usually less than 8 seconds. High temperature riser cracking, occurring at temperatures of at least 538°C (1000°F) or higher and at 0.5 to 4 seconds hydrocarbon residence time in contact with the catalyst in the riser, is desirable.

Rapid separation of catalyst from cracked hydrocarbons discharged from the riser reactor is desirable. During cracking, carbonaceous deposits or coke accumulate on the catalyst particles and the particles entrain hydrocarbon vapors upon removal from the riser reactor. The entrained hydrocarbons are removed from the
catalyst by a separator, which could be a mechanical means, and/or stripping gas in a separate catalyst stripping zone. Hydrocarbon conversion products separated and materials stripped from the catalyst are combined and passed to product fractionation. Stripped catalyst containing coke, is then passed to a catalyst regenerator.

Cyclones are typically used for efficient separation of catalyst particles from the gas phase. Cyclones often permit an undesirable extended residence time of the product vapor within a large reactor vessel. This extended residence time reduces the desired product yield by as much as 4% through non-selective cracking. Recent developments in this art have been concerned with the rapid separation of catalyst from cracked products.

Fig. 1 in the present application corresponds to a simplified illustration of Fig. 2 from Anderson et al, U. S. Patent No. 4,043,899, where similar reference numbers have been utilized to illustrate similar structures in the two figures. Anderson et al disclose a method for rapid separation of a product suspension, comprising the cracked product phase and catalyst (entering riser reactor 24), by discharging the entire suspension directly from the riser into a cyclone separator 4. The cyclone is modified to include a separate cyclonic stripping of the catalyst separated from the hydrocarbons vapors in an auxiliary stripper. The cyclone separator is modified to include an additional downwardly extending section comprising a lower cyclone stage 11. Catalyst separated in the upper stage of the cyclone slides along a downwardly sloping helical baffle 12 to the lower cyclone, where stripping steam is introduced to further separate entrained hydrocarbon products from the catalyst recovered from the upper cyclone. The steam and stripped hydrocarbons are passed from the lower cyclone through a concentric pipe 8, where they are combined with the hydrocarbon vapors separated in the upper cyclone.

The separated, stripped catalyst is collected and passes from the cyclone separator 4 by conventional means through a dipleg 22 into a catalyst bed 60 in the bottom of reactor vessel 26 and out
catalyst exit 44. This lower portion of vessel 26 also acts as a catalyst stripping section, comprising baffles 32, 34, and 36, with steam being supplied to the catalyst bed thereunder. Vaporous material separated in cyclone 4 can also be discharged into cyclone 52 and subsequently passed by way of conduit 54 into chamber 46 and withdrawn therefrom by conduit 48 for eventual fractionation.

A substantial amount of catalyst stripping occurs in catalyst bed 60. The stripped hydrocarbon material still contacts with additional catalyst particles as it is carried upward through the catalyst bed and into the entrance of cyclone 52 and from there to chamber 46 and eventual fractionation. This increased hydrocarbon material/catalyst contact contributes to uncontrolled and undesired cracking of the hydrocarbon materials.

At each stripper, in Fig. 1, stage, represented by baffles 32, 34 and 36, the hydrocarbons stripped from catalyst in the lower portion of vessel 26 undergo further catalyst contact while making their way to the surface of the catalyst bed. The catalyst bed acts as a lower seal to the dipleg 22, to prevent the flow of hydrocarbon-laden gas through dipleg 22 into the catalyst bed. The dipleg must be extended deep within the catalyst bed in order to provide a sufficient seal. This depth requirement, plus the desirability of multistage stripping (to ensure that a high percentage of hydrocarbon material is removed from the catalyst) requires a substantial volume of catalyst in bed 60, which increases the uncontrolled contact of hydrocarbons with catalyst.

There is still a need to reduce total contact time between hydrocarbon materials and catalysts to reduce, to the extent possible, non-selective cracking.
Accordingly, the present invention provides a method of fluid catalytic cracking of a hydrocarbon feed comprising the steps of passing a mixture, as a suspension, of the hydrocarbon feed and a catalyst through a riser conversion zone contained within a reactor vessel and cracking the hydrocarbon feed in the riser conversion zone, passing the mixture through a deflection zone in which the mixture is physically deflected from an exit of the riser conversion zone towards an exit of the deflection zone, and passing the deflected mixture from the deflection zone exit to a separation zone.

Fig. 1 is a diagrammatic sketch of the riser reactor, including catalyst stripping zone, illustrated in Fig. 2 of U.S. Patent No. 3,043,899 to Anderson et al; Fig. 2a is a top view of a riser conversion zone illustrating the connection to two cyclone separators; Fig. 2b is a side view of the subject matter in Fig. 2a;

Fig. 3 is a side view partially in section of a four-stage countercurrent stripper which can be directly connected with the exhaust barrel of the cyclone separator illustrated in Figs. 2a and 2b;

Fig. 4 is a side view partially in section in which baffles deflect catalyst particles into the inlet of a cyclone separator adjacent a two-stage short contact time stripper whose lower end is sealed by a catalyst seal pot.

The present invention is directed to a catalyst particle deflector which reduces uncontrolled cracking, as illustrated in Figs. 2a, 2b and 4.

In the drawings like numerals represent like elements throughout the several views.

The present invention provides a riser deflector which assists in moving catalyst particles, along with hydrocarbon vapors, toward the exit of riser 24. In a conventional riser outlet arrangement, where the cyclone inlet is located below the top of the riser conversion zone 24, as shown in Fig. 1, catalyst particles impact against the closed
top of the riser and rebound back towards the riser conversion zone. Thus, the velocity of the rebounding particles must be reduced by dynamic pressure of the rising hydrocarbon feed before again moving upwards and ultimately into the cyclone separator 4. This additional "residence" time (the time during which the catalyst is in immediate contact with hydrocarbon vapor and hydrocarbon material) causes overcracking and loss of precise control of the cracked products.

To prevent the problems caused by rebounding particles, a V-shaped or conical deflector 100 transforms the upward velocity vectors of catalyst particles contained in the hydrocarbon feed to a direction towards the inlet of cyclone separator 4. With the deflector shown in Figs. 2a and 2b, the particle trajectories are as illustrated by the dotted line arrow in Fig. 2b, which reduces "residence" time due to the rebounding of catalyst particles.

In one embodiment of the deflector, the angle $B$ of the deflector surface with respect to the horizontal (for a vertical riser) is between 60 to 70°, although different angles could be used depending upon the location of the cyclone separator inlet with respect to the deflector, the diameter of the riser, the distance from the riser to the separator inlet, etc. Existing risers may be converted to incorporate deflectors by the addition of baffle-type deflectors 102 and/or 104, as shown in Fig. 4. The surface of deflector 100 need not be planar and a smoothly contoured curve from the lowest point of the deflector to the upper surface of the cyclone separator inlet 4 is advantageous in redirecting catalyst travel and reducing pressure drop between the upper portion of riser 24 and cyclone separator 4. Baffle-type deflectors 102 and/or 104 may also be curved to direct the catalyst/hydrocarbon vapor flow to separator 4. While a cyclone separator has been illustrated, the deflector would be equally useful with other types of known separators.
The present invention can be combined with a stripper in the exhaust barrel of a cyclone and/or a short contact time stripper to reduce the "residence" time during which hydrocarbons contact catalyst. In a preferred embodiment, the present invention is used in a single fluid catalytic cracking process or apparatus, such as shown in Fig. 4, which includes the catalyst deflectors 102 and 104, the catalyst stripper located in the barrel of cyclone separator 4, and the two-stage short contact time stripper, sealed with a low volume catalyst seal pot.
CLAIMS
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for fluid catalytic cracking of a hydrocarbon feed comprising the steps of:
   passing a mixture, as a suspension, of the hydrocarbon feed and a catalyst through a riser conversion zone contained within a reactor vessel and cracking the hydrocarbon feed in the riser conversion zone;
   passing the mixture through a deflection zone in which the mixture is physically deflected from an exit of the riser conversion zone towards an exit of the deflection zone; and
   passing the deflected mixture from the deflection zone exit to a separation zone.

2. The process of claim 1, including after the passing steps, the additional steps of:
   separating at least a portion of the catalyst from the mixture in the separation zone;
   passing a gaseous effluent from the separation zone to a downstream fractionation apparatus;
   passing the separated catalyst from the separation zone to a catalyst stripping zone, the catalyst stripping zone using a stripping gas to remove hydrocarbons entrained with or absorbed by the separated catalyst;
   passing the stripping gas with removed hydrocarbons to the downstream fractionation apparatus; and
   passing the separated catalyst out of the stripping zone.

3. The process of either one of claims 1 or 2 wherein the stripping gas is steam.

4. The apparatus substantially as hereinbefore particularly described with reference to any one of Figures 2A, 2B, 3 or 4.

DATED: 10 February 1989
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