April 25, 1944. N. F. LINN 2,347,271

FEED DEVICE

Filed Dec. 30, 1939

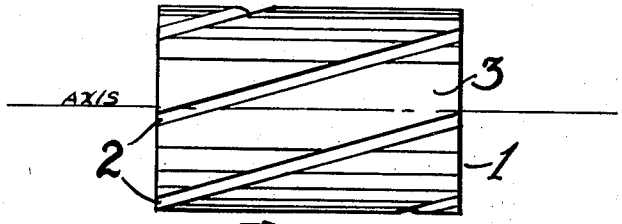

FIG.-1

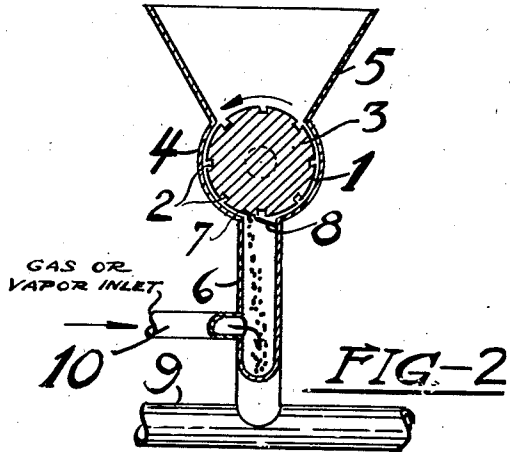

FIG.-2

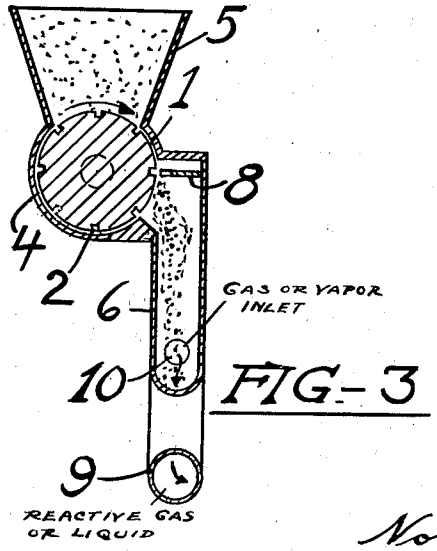

FIG.-3

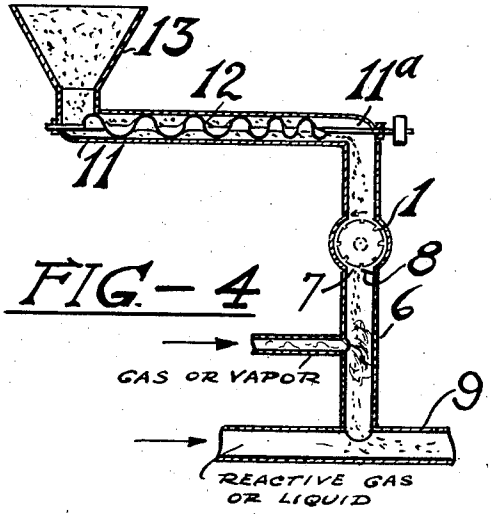

FIG.-4

Norman F. Linn Inventor

By P. L. Young Attorney

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Norman F. Linn, Roselle, Park, N. J., assignor to Standard Oil Development Company, a corporation of Delaware

Application December 30, 1939, Serial No. 311,831

3 Claims. (Cl. 196—2)

The present invention relates to an apparatus for feeding finely divided pulverulent materials into a high pressure zone from a zone of lower pressure. More particularly, the invention relates to a means for discharging finely powdered catalyst materials into a cracking vessel or a feed line thereto, in which a gaseous material is contained under a substantially higher pressure than that existing in the reservoir for the powdered material, or outside the line. Specifically, the invention relates to a pocket type feed mechanism providing for the more or less continuous introduction of powdered catalyst under the circumstances set forth, and to the combination of such a mechanism with other elements in a complete system.

It is an object of the invention to provide for the continuous introduction of a powdered material into a zone of higher pressure without blow-back or pressure loss, and also to prevent any packing or coking of the catalyst material in the vicinity of the point of introduction.

These objects and others inherent in the structure and operation may be fully understood from the following specification when it is read in conjunction with the accompanying drawing, in which

Fig. 1 is a side elevation of a feed wheel according to the invention;

Fig. 2 is a vertical section of the apparatus;

Fig. 3 is a semi-diagrammatic showing of another form of the apparatus, with parts broken away; and

Fig. 4 is a semi-diagrammatic showing of a combination of the feed wheel in a feed system.

Referring to the drawing, the numeral 1 designates a cylindrical member having about its periphery a series of helical pockets 2, cut in the face of the member 1 in such manner that one end of one pocket is disposed in spaced, slightly overlapping relation to the other end of another, along a line parallel to the axis of said member. For the purpose of the description, the cylindrical member 1 may be termed a feed wheel, the pockets 2 being formed or cut between spacing portions 3. These angular, arcuate pockets 2 are preferably formed or cut in the feed wheel at an angle of not more than 30°, with reference to the axis or a surface line parallel thereto.

As shown in Fig. 2, a feed wheel 1 is disposed within a casing 4, the casing opening upwardly and exposing the feed wheel surface within a hopper or reservoir 5, and opening downwardly into a zone of higher pressure, such as line 6, through a restricted opening or slot 7 at the end of the plate 8. The powdered material from the hopper 5 carried through the casing in the pockets, is discharged through the pipe or line 6 into a line 9 containing reactive gas or liquid. Movement of the powdered substance is facilitated to some extent by the introduction of a gas or vapor, also under high pressure, through the line 10. The gas or vapor introduced through the line 10 is preferably an inert material such as steam, flue gas, or the like. When thus introduced, the inert gas acts not only to fluidize the powdered material in the line 6, but also to prevent the reactive material from coming in contact with the powder before it leaves the feeding mechanism.

Various means may be utilized to prevent the accumulation of caked material on the surfaces 3 of the feed member 1 between the respective pockets 2, such as may be caused by pressure between the closely spaced surfaces of the feed wheel and casing. For example, the edge portion of the plate 8 may be held against the gear under slight tension so as to act as a scraper to remove any particles adhering thereto.

Figs. 2 and 3 illustrate the simplest arrangement of elements according to the invention, the powdered material being discharged directly from the reservoir therefor into the reaction zone inlet line. As shown in Fig. 2, the discharge plate 8 is disposed diametrically opposite the hopper outlet. In the structure illustrated by Fig. 3, however, provision is made for balancing the pressure seal desired between the reaction zone or vessel inlet and the reservoir. In this arrangement, the plate 8 is disposed at a point about 90° from the hopper outlet in the direction of rotation of the feed wheel. When the pockets are filled with powder and provide better sealing action between the case and feed wheel, a shorter distance of contact is required, but when the pockets are empty and the seal depends almost entirely upon the surface to surface relation between the case and feed wheel, a greater contact or sealing area is desirable. The desired balance between the sealing areas is obtained substantially in the manner shown.

The structure shown according to Fig. 4 is particularly suitable for use when the pressures existing in the reaction vessel, or adjacent the point at which the powdered material is to be introduced, are exceptionally high. As illustrated, the feed wheel mechanism is combined with a screw type feeder. In addition to the fact that this combination improves the seal obtained,

it has been found that when thus combined, the constancy and uniformity of the feeding step is greatly improved also.

In the structure shown, powdered material is introduced into the line 9 through line 6, by means of the feed member 1. The powdered material to be handled by the feed wheel 1 is received by way of the line 11 in which is disposed a constant diameter screw feed member 12, the line 11 communicating with a hopper or reservoir 13. The screw feed member 12, while it may be constant in pitch as well as diameter, is preferably of decreasing pitch, so that an increased sealing effect may be obtained. The relatively large volumes of solids receivable in the first few flights of the screw are compacted into the smaller volume of the smaller flights, producing the desired result. Although a screw feed member of the compression type contemplated has been utilized previously for a similar purpose, the combination of such a mechanism with the feed wheel described, as stated, has been found to provide better regulation and control of the feed rate. If desired, a similar effect may be obtained by using a screw member of constant pitch and decreasing diameter, rotating in a conical casing to replace the line 11.

While it is not a necessary arrangement, it is preferable that the member 12 be spaced in the line 11 from the entrance to the casing portion in which the gear 1 revolves. This form of structure is illustrated, and it has the advantage of providing for the redispersion of the powdered material discharged from the screw member, aiding in avoiding the formation of lumps of compressed material. That portion of the line 11 in which such re-dispersion is to take place is indicated as chamber 11*a*. The screw member and feed wheel when thus combined are intended to be rotated by power derived from the same source, their speeds of rotation and therefore their rates of delivery being adjusted to their respective capacities.

The structure as described is suitable for use in a variety of operations, but it is particularly adapted to combination in a process for the cracking of hydrocarbon materials in the presence of a finely divided or comminuted catalyst material such as activated clay. In such a process, large volumes of catalyst must be supplied to the system in a continuous fashion, and at a rate which by its uniformity will maintain the proper ratio between the volume of catalyst and the volume of the reactive materials. As disclosed, the apparatus contemplated provides a means by which the feed rate of catalyst may be maintained within the desired limits, while avoiding the effects produced by escape or blow-back of portions of the reactive material into premature contact with the catalyst material to cause coking and clogging of the mechanisms and passages through which the catalyst material must pass.

Various modifications may be made in the apparatus or the operation thereof without departing from the inventive concept involved, and it is not intended that the invention shall be limited to any disclosure which has been made for the purpose of illustration, but only by the appended claims.

I claim:

1. In an apparatus for feeding powdered catalyst into a reaction zone for the heat and pressure treatment of hydrocarbon material, a high pressure reaction zone adapted to contain the hydrocarbon material under elevated temperature and pressure, a reservoir for the powdered catalyst at lesser temperature and pressure, a conduit connecting the zone and reservoir, a feed wheel for positively feeding the catalyst from the reservoir into the conduit toward the zone at a constant and uniform rate, the feed wheel comprising a cylindrical member with relatively wide peripheral spacing portions between a series of helical pockets, the spacing portions cooperating with the wall of the conduit to form a substantially fluid-tight fit, and an inlet for fluid inert to the hydrocarbons opening into the conduit between the wheel and reaction zone to fluidize the powdered catalyst on its way to the reaction zone and prevent the hot hydrocarbon material from contacting the catalyst before the catalyst leaves the feed wheel.

2. In an apparatus for feeding powdered catalyst into a reaction zone for the heat and pressure treatment of hydrocarbon material, a high pressure reaction zone adapted to contain the hydrocarbon material under elevated temperature and pressure, a reservoir for the powdered catalyst at lesser temperature and pressure, a conduit connecting the zone and reservoir, a feed wheel for positively feeding the catalyst from the reservoir through the conduit toward the zone at a constant and uniform rate, and a compression screw member in the conduit between the reservoir and the feed wheel, the feed wheel comprising a cylindrical member with relatively wide peripheral spacing portions between a series of helical pockets, the spacing portions cooperating with the wall of the conduit to form a substantially fluid-tight fit.

3. In an apparatus for feeding powdered catalyst into a reaction zone for the heat and pressure treatment of hydrocarbon material, a high pressure reaction zone adapted to contain the hydrocarbon material under elevated temperature and pressure, a reservoir for the powdered catalyst at lesser temperature and pressure, a conduit connecting the zone and reservoir, a feed wheel for positively feeding the catalyst from the reservoir through the conduit toward the zone at a constant and uniform rate, a compression screw member in the conduit between the reservoir and the feed wheel, the feed wheel comprising a cylindrical member with relatively wide peripheral spacing portions between a series of helical pockets, the spacing portions cooperating with the wall of the conduit to form a substantially fluid-tight fit, and an inlet for fluid inert to the hydrocarbons opening into the conduit between the wheel and reaction zone to fluidize the powdered catalyst on its way to the reaction zone and prevent the hot hydrocarbon material from contacting the catalyst before the catalyst leaves the feed wheel.

NORMAN F. LINN.