

Nov. 30, 1943.

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2,335,604

COKE REMOVAL

Original Filed Nov. 16, 1939

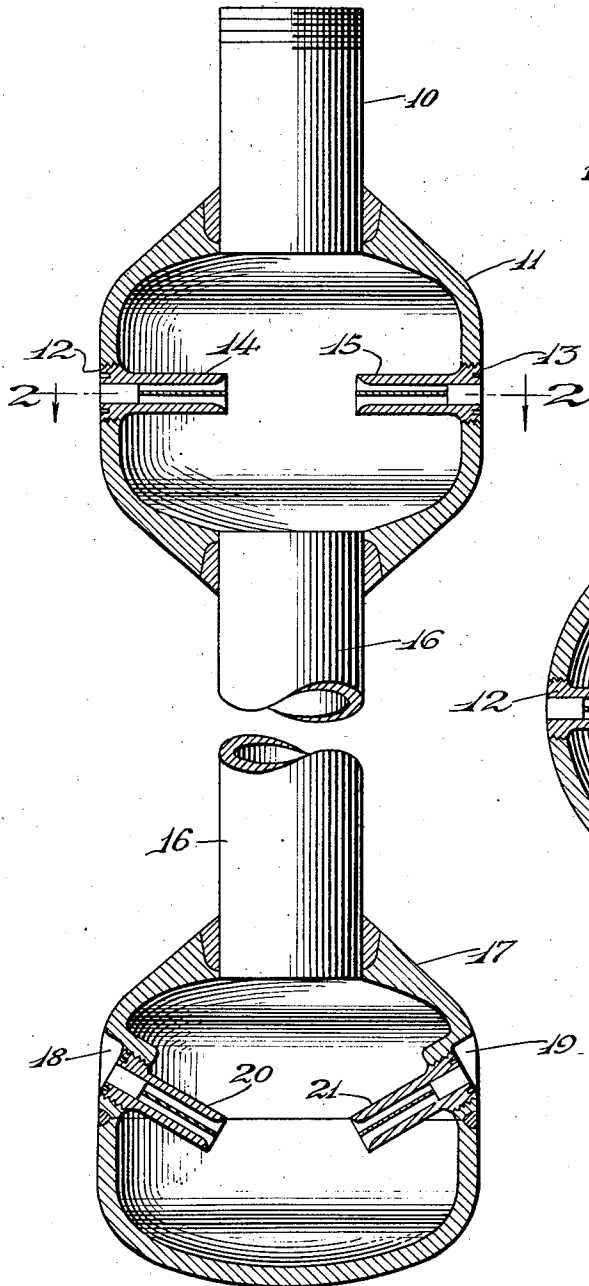


Fig. 1.

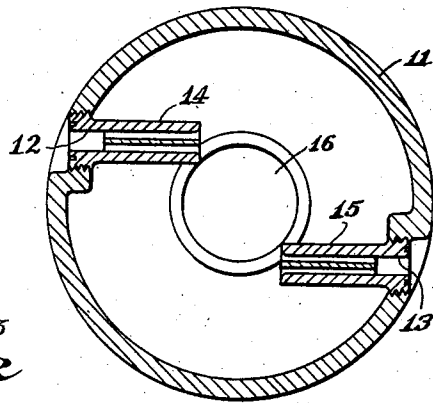


Fig. 3.

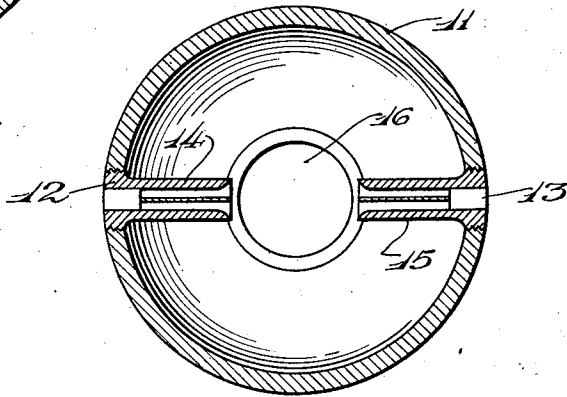


Fig. 2.

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UNITED STATES PATENT OFFICE

2,335,604

COKE REMOVAL

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Original application November 16, 1939, Serial No. 304,790. Divided and this application June 7, 1941, Serial No. 397,023

6 Claims. (Cl. 299—62)

This invention relates to improved apparatus for the removal of solid coke from reaction chambers or soaking drums and, more particularly, it relates to apparatus effective for the removal of solid coke from reaction drums by the use of jets of water at high pressures.

This application is a division of my copending application, Serial No. 304,790, filed November 16, 1939.

In the refining of petroleum oils it is often customary to distil the heavy residual portion of the crude oil at high temperatures whereby the oil is converted partly into low boiling hydrocarbons, such as gasoline, and partly into coke. This is ordinarily carried out in a reactor or "coking drum" which may vary in diameter from about 6 or 8 feet up to 16 or 20 feet or even more. Various means have been employed and suggested for the removal of solid coke from the drums. For example, the drums may be filled with coils of cable prior to coking, the coils being anchored by light wires or chains so that by pulling the cables the anchors are ruptured and the finished coke dislodged. One form of apparatus for such a process is set forth in United States Patent No. 1,825,374. Another proposed method is to blast out the coke by a dynamite charge as set forth in United States Patent No. 1,927,039. Still another suggested means for removing coke is to install in the coking drum, prior to coking, a lattice work of material capable of being charred so that lines or planes of breakage are formed by the disintegration of the lattice as set forth in United States Patent No. 1,980,218. Various other means have been employed and patented. Recently the use of jets of water at high pressure for the removal of coke from drums has been found particularly effective. This method of coke removal has been referred to as "hydraulic decoking" and the term will be so used hereinafter.

The ordinary method of hydraulic decoking consists of first drilling a passage through the coke mass axially, beginning at the uppermost part of the drum. Usually some rotary cutting means, such as a star drill or, preferably, a rock drill, is employed, deriving power from the reaction of discharging water jets. The original cut is further enlarged by these same actuating water jets discharged through cutting nozzles set at an angle and capable of enlarging the drill hole from eight to twelve inches to approximately two to three feet. This operation is usually necessary in order to provide a space

sufficiently large to accommodate the final cutter.

This final cutter consists of two sets of nozzle arms, the upper jets therefrom being used for making a cut through the coke bed to the wall of the drum while the lower jets cut along the wall of the coke drum between the coke and the shell in order to separate the coke mass from the reactor. The cuts are initiated at the lowermost portion of the coke mass and the cutter assembly raised after each successive cut has been made.

As heretofore practiced, the final nozzle assembly comprises a pipe for the water supply terminating in two long adjustable arms to which are attached nozzles for directing the water stream in a solid unbroken jet against the coke mass. At a predetermined height above the lower cutting arms are located fixed horizontal arms, shorter than the lower nozzle arms, with nozzle attachments for directing the water jet against the coke mass. The nozzles in both cases are offset so that the reaction from the streams of water rotates the nozzle assembly, thereby making a circular cut through the coke mass. As the coke is cut into layers and away from the reactor walls by the revolving jets, it breaks away and falls to the bottom of the chamber where it is discharged from the drum.

Experience has shown that quite often the center hole produced by the initial cutter or boring tool is "off center," i. e., it slants from a vertical axial line. Sometimes it is so far "off center" that the pipe holding the cutters hangs almost against one side of the hole, and the nozzle arms project beyond the edges of the initial cut, thereby impeding or preventing the cutting assembly from being raised. Also, the hole is never a clean, smooth cylindrical bore but is only roughly circular, of varying diameters and with lumpy projections or pits at haphazard locations. As a result, the top nozzles and arms as well as the lower ones often are caught in the coke and either cannot revolve or cannot be raised for the next cut. The projection must be cut off or, if this is impossible, then the water pressure must be shut off, the cutter lowered, a platform inserted under the drum, and the manhole covered by a safety guard, so that men may adjust the cutter to clear the projection. This is particularly true when long arms are used, and even when short arms are employed this hazard is still present.

It is an object of this invention to provide an improved final cutting assembly for hydraulic

decoking which will eliminate the possibility of the nozzle arms catching on the coke, thereby facilitating the operations. Another object of this invention is to provide a final cutting assembly for hydraulic decoking in which danger of breakage to the cutting arms by falling coke is reduced or eliminated. It is a further object of this invention to provide a final cutting assembly for hydraulic decoking which is sturdy and compact and simple to manufacture. A still further object of this invention is to provide a final cutting assembly for hydraulic decoking which is "streamlined" in form, thereby permitting it to be raised and lowered without interference by projecting coke lumps or by an "off center" initial cut. Further objects and advantages will become apparent as the detailed description of this invention proceeds.

Figure 1 is an elevation partly broken away of the final cutting assembly, and

Figure 2 is a sectional view taken along the line 2—2 of Figure 1.

Figure 3 is a sectional view of a modified arrangement of Figure 2.

Referring now to the drawing, on pipe 10, which is adapted to be connected to a high pressure water source and to a bearing assembly for rotation of the nozzle head, is welded or otherwise attached an enlarged chamber 11. Sockets 12 and 13 are provided therein for receiving nozzles 14 and 15. These nozzles are designed to be particularly effective for providing an unbroken jet of water for a considerable distance with considerable impact force so that a cut through the coke mass can be accomplished. From chamber 11 extends pipe 16 to another enlarged chamber 17, the two chambers being so spaced that a "cut" of the desired dimensions can be made in the coke mass. Sockets 18 and 19 are provided in this second chamber for nozzles 20 and 21. The nozzles are so located in the sockets that they are substantially wholly within the enlarged chambers, the outer walls of the chambers thus being effective for warding off falling coke from the nozzles, and affording them protection from destruction or injury. The top nozzle assembly preferably has nozzles with their axes horizontal and these can be offset from each other as shown in Figure 3 so that a rotating motion can be imparted to the assembly while the lower cutting nozzles are directed upwards so that a cut at the juncture of the coke mass and the wall can be made. The distance of the lower assembly below the upper nozzle assembly will depend on the diameter of the drum from which coke is to be removed and upon the upward angle of the lower nozzles. The angle of the lower nozzles and distance between the upper and lower nozzle assemblies should be such that the upper and lower jets would intersect approximately at the wall of the coke drum if they were in the same plane. The water jets from this assembly undercut the coke mass at the reactor wall so that the coke mass defined by the circular cut of nozzles 14 and 15 can be freed from the drum and allowed to fall.

Although I have illustrated the upper assembly as comprising a chamber with two nozzles and the lower assembly as comprising another chamber with two nozzles, it is obvious that this may be increased to three or more nozzles as the exigencies of the situation demand. In all events, however, it is desirable that the nozzle assemblies occupy as little space as possible.

The chambers 11 and 17 are formed with ex-

ternal streamlined contours for deflecting falling coke and for prohibiting the interference with the rising nozzle assembly by projecting coke masses. Unprotected long arms are always in danger of being knocked off by falling coke, whereas my apparatus avoids this, due to a more compact and sturdier construction, and to the inclusion of the nozzles within the chambers rather than extending outwardly from it. The streamlined design guides the assemblies around the projections, without difficulty, and deflects the falling coke. The chambers may be forged or spun or otherwise fashioned. This form is generally heavier than the previous assemblies and therefore more rugged, and is adapted to withstand water pressures sufficient to give an impact force of 1200 pounds per square inch or more.

The nozzles may be of the type shown in my patent, United States Patent No. 2,221,455, or may be any other nozzle effective for projecting an unbroken jet of water at pressures above 1000 pounds per square inch and preferably above 1200 pounds per square inch. For example, the nozzle may be of the flat-vaned, straight-tube design, as shown. Other nozzles suitable for this purpose will be known to one skilled in the art.

While my invention has been described by reference to certain preferred embodiments thereof, it is to be understood that these are by example rather than by way of limitation, and my invention is not to be restricted thereto except as defined in the appended claims.

I claim:

1. In a nozzle head for cutting into a body of solid material, the combination comprising a hydraulic conduit, a first and second enlarged chamber means in axial alignment with said conduit, and nozzle means in each of said enlarged chamber means in flow communication therewith and with the outside atmosphere, said nozzle means being disposed substantially wholly within said enlarged chamber means and directing a hydraulic jet outwardly therefrom, said first and said second chamber means being so spaced and the nozzle means in each chamber means being so arranged with respect to each other that a section may be cut from said solid material by said hydraulic jets from said nozzle means.

2. A combination according to claim 1 in which said enlarged chamber means are externally streamlined.

3. A combination according to claim 1 in which the nozzle means in at least one of said enlarged chamber means are offset as to each other, whereby a rotary motion is imparted to said nozzle head.

4. A combination according to claim 1 in which said nozzle means in said first enlarged chamber means are directed substantially horizontally and said nozzle means in said second enlarged chamber means are directed in an upward direction.

5. In a nozzle head for cutting into a body of solid material, the combination comprising a hydraulic conduit adapted to be connected to a source of liquid under pressure, an enlarged chamber means attached thereto and communicating therewith, said chamber means being externally streamlined in the upper and lower portions, nozzle means in said enlarged chamber means and in flow communication therewith and with the outside atmosphere, said nozzle means being disposed substantially wholly within said enlarged chamber means and directing a hydraulic jet outwardly therefrom, a second hy-

draulic conduit extending from said enlarged chamber means, a second enlarged chamber means attached to said second hydraulic conduit, said second enlarged chamber means being externally streamlined in its upper portion, and nozzle means in flow communication with said second enlarged chamber means and with the outside atmosphere, said last-mentioned nozzle means being substantially wholly disposed within said chamber means and directing a hydraulic jet outwardly therefrom and in a direction inclined toward the stream from said first nozzle means.

6. In a nozzle head for cutting into a body of solid material, the combination comprising a hydraulic conduit adapted to be connected to a source of liquid under pressure, an enlarged chamber means attached thereto for communicating therewith, said chamber means being externally streamlined in the upper and lower portions, nozzle means in said enlarged chamber means in flow communication therewith and with the outside atmosphere, said nozzle means being

disposed substantially wholly within said enlarged chamber means and directed substantially horizontally so that a hydraulic jet is directed outwardly therefrom, a second hydraulic conduit extending from said enlarged chamber means, a second enlarged chamber means attached to said second hydraulic conduit, said second enlarged chamber means being externally streamlined in its upper portion, and nozzle means in flow communication with said second enlarged chamber means and with the outside atmosphere, said last-mentioned nozzle means being substantially wholly disposed within said second chamber means and directed outwardly in an upward direction, said nozzle means in said first chamber means and in said second chamber means being so spaced from each other and so directed that hydraulic jets therefrom intersect whereby a section may be cut from said body of solid material.

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