Nov. 17, 1942. W. F. COURT 2,302,299

HYDRAULIC DISRUPTION OF SOLIDS

Filed Nov. 12, 1940 2 Sheets-Sheet 1

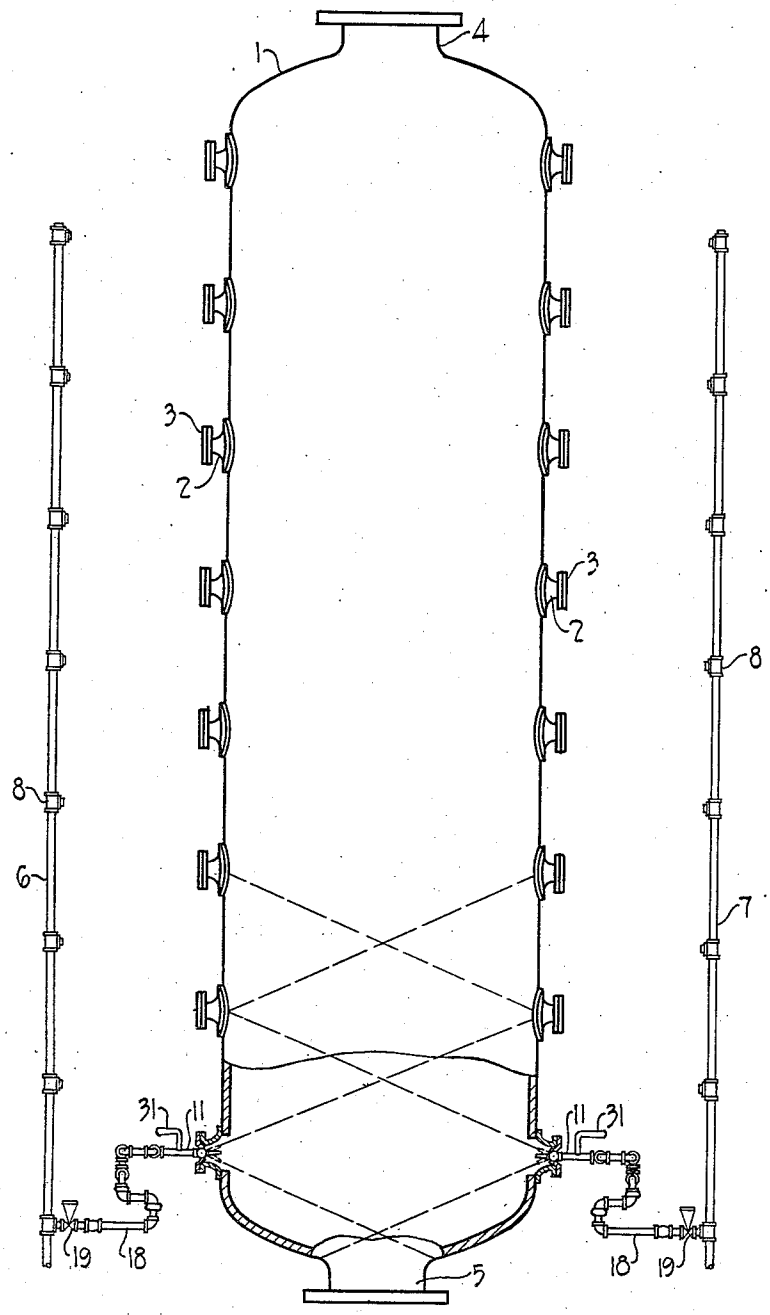

FIG. I

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By his Attorney H. Burch

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HYDRAULIC DISRUPTION OF SOLIDS

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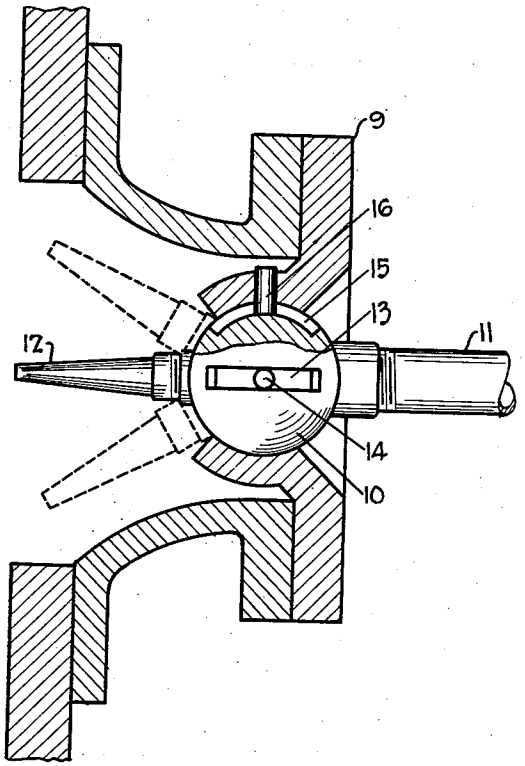

FIG. II

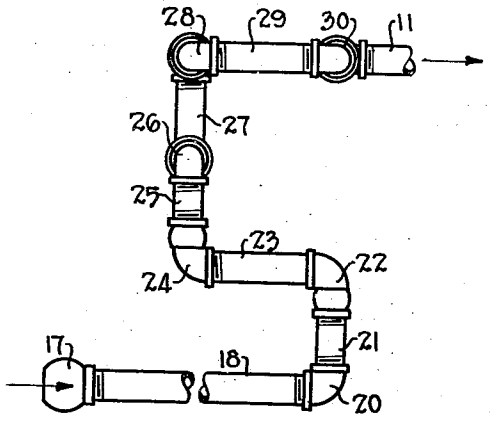

FIG. III

Inventor: William Frederick Court

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UNITED STATES PATENT OFFICE

2,302,299

HYDRAULIC DISRUPTION OF SOLIDS

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4 Claims. (Cl. 141—1)

This invention relates to the cleaning of vessels which contain solids, like carbonaceous material, particularly deposits of coke produced by the carbonization of hydrocarbon oils, such as reaction and coking chambers employed in petroleum cracking plants and the like and asphaltic material, especially the solid, brittle kind. While the apparatus may be applied to the removal of various types of carbonaceous material from diverse forms of apparatus, it is particularly useful for the removal of porous coke of the type produced by heat contained within the body of the oil. For convenience, in the following description the application of the apparatus to the cleaning of a vertical reaction or coking chamber of the type used in connection with a so-called "Dubbs" cracking unit will be described, it being understood that the apparatus may be applied as well to a horizontal reaction chamber, and to containers of other shapes, as well as to the removal of similar type of porous coke or asphaltic materials from containers or conduits in which coke has been deposited due to the carbonization of oil by external as well as internal heat.

The conventional method of removing petroleum coke from cracking plant reaction or coking chambers involves hanging a steel cable in a series of spirals inside the chamber before the unit is placed in operation, and the withdrawal of the cable after the termination of a run by means of a steam hoist. The withdrawal of the cable partially breaks up the body of coke, discharging quantities through a manhole. Following this, several men enter the chamber and remove the coke adhering to the chamber walls with pick-axes. Such a method is objectionable in that it is time consuming, since the chamber must be cooled to a point at which men can work within it; it is hazardous to workmen; and iron wire used to suspend the steel cable is withdrawn together with the coke, rendering it useless for many purposes without subsequent operations for separating pieces of metal.

It is the purpose of the present invention to provide improved apparatus for removing carbonaceous materials, such as coke and the like from containers, which is less laborious than those heretofore employed, consumes less time, is more economical and is less hazardous than methods now employed.

It is a further object to provide hydraulic apparatus for removing coke and the like in which the coke will be free from metallic bodies. Still another object is to provide a novel apparatus for carrying out the process herein described. Other objects of the invention will become apparent from the following specification, taken together with the drawings forming a part thereof, in which a representative embodiment of the process is illustrated, it being understood that the process is not limited to the specific steps illustrated, nor to the cleaning of chambers of the particular type or shape shown.

In the drawings, Figure I is an elevation, partly in section, of a reaction chamber showing the disposition of nozzles and headers as used in the present invention. Figure II is an enlarged sectional view of the cutting nozzle assembly. Figure III illustrates a swivel joint arrangement suitable for connecting a nozzle assembly as shown in Figure II to a source of water under high pressure.

The present invention is based on the discovery that carbonaceous materials of the type described above can be efficaciously broken up and removed from containers by the action of a jet of water directed so as to have a cutting action on the deposit of carbonaceous material. This is effected by directing the water by means of a suitably designed nozzle so as to cause a great impact or reaction on the body of the solid to be removed over as small an area as possible. In this manner the primary action of the water is to cut the solid material into lumps, and erosion is minimized. For the cutting or disruption operation, I prefer to employ water jets which have velocities of more than about 200 feet per second, best results being obtained with velocities of about 300 to 500 feet per second and higher, and which are confined. By "confined" jets, I mean jets which do not substantially break up or spread prior to impact. It is, moreover, desirable to employ jets of sufficient size to cause an impact of more than 100 lbs., best results being obtained with jets having impacts of between 200 and 300 lbs. or greater. When lower velocities are employed, or when the design of the nozzle is such as to cause the jet to break up the cutting action is materially reduced and erosion is increased. This materially increases the time required for the removal of the solid and is, moreover, often undesirable, since it is frequently advantageous to produce maximum lump and egg size coke. As an example, I may employ a jet of water from a 3/8 inch in diameter nozzle, with a velocity of 760 feet per second. Such a jet will cause an impact of about 424 lbs. over an area only slightly larger than 0.11 sq. in., the opening of the nozzle. I am, however, not restricted to the specific examples herein disclosed.

Referring to Figure I, 1 represents a coking chamber of the common type, except that a plurality of nozzle manholes as at 2 are provided on each side of the chamber, each nozzle manhole being positioned opposite a similar nozzle manhole on the opposite side of the chamber. Blind flanges 3 removably affixed, are provided to close the nozzle manholes 2 during cracking operations in the chamber. The chamber is also

of course supplied with the usual top and bottom manholes 4 and 5.

Two high pressure water headers 6 and 7, including a plurality of take-off T's as at 8, corresponding in number to the nozzle manholes 2, are provided as illustrated.

In Figure II, the nozzle assembly comprises a special flange and ball socket 9; this supports a ball 10 adapted for universal movement therein. The ball 10 in turn supports a supply line 11 and cutting nozzle 12, both of which may be detached therefrom. Slot 13 which is provided in ball 10 and pin 14 which is mounted in flange and ball socket 9 serve to limit the horizontal rotation of nozzle 12. Similarly, slot 15 and pin 16 limit the maximum vertical movement of the nozzle.

The swivel arrangement of Figure III serves to supply water from headers 6 and 7 to the cutting nozzle assemblies. A coupling 17 connects one of the header take-off T's 8 with a feed pipe 18 of suitable length. A valve 19, as shown in Figure I, is disposed between coupling 17 and take-off T 8. Elbow 20, nipple 21, swivel joint 22, nipple 23, swivel joint 24, nozzle 25, swivel joint 26, nozzle 27, swivel joint 28, nipple 29 and swivel joint 30 serve to connect feed pipe 18 with supply line 11 which in turn leads to a nozzle assembly as shown in Figures I and II. Handles as at 31 are provided on supply line 11 near the flange and ball socket 9 to enable adjustment of the disposition of cutting nozzle 12.

The method of removing coke according to the present invention, according to the preferred mode of operation, comprises first removing the cover from the lower manhole 5, the blind flange 3 on the bottom two nozzle manholes 2 then being removed, the coke that has formed within the nozzle manholes being barred out by hand sufficiently to permit mounting a pair of cutting nozzle assemblies such as shown in Figure II. These first two nozzle assemblies are then each connected to a high pressure header 6 and 7, valves 19 opened and the cutting operations started. Due to the ball mounting of the cutting nozzles and swivel connection between the high pressure headers and the nozzles, the operator may play the streams over an effective cutting zone as shown in Figure I.

While the first two nozzle assemblies are cutting coke in the lower first stage, a second pair of nozzle assemblies are mounted in the next stage (opposing pair of nozzle manholes) above and these placed in cutting operation as soon as the first two nozzles have finished cutting. While the nozzles in the second stage are cutting, the first pair will be moved to the third stage. This is continued until all of the coke is removed, and by this sequence of operations only four cutting nozzle assemblies will be required. Of course, it is obvious that any desired number of nozzle assemblies may be utilized, although the above-described system is a particularly practical and advantageous one from the standpoint of cleaning time, equipment necessary and operating crew required.

As will be noted in Figure I, the nozzle assemblies should be disposed in such a manner that the effective cutting zone of each, which is a cone with the apex at the cutting nozzle, overlaps sufficiently with adjacent and opposite zones to completely encompass the interior of the coking vessel. For example, in a coking chamber 13 feet in diameter and 50 feet high, wherein nozzle assemblies capable of playing over an angle of approximately 45° are to be used eight nozzle manholes in each side of the coking chamber will be found to provide satisfactory cleanout coverage.

I claim as my invention:

1. Apparatus suitable for hydraulic disruption of coke in a coking chamber comprising a group of manholes uniformly spaced in the wall of said coking chamber in vertical alignment, a second group of manholes in said coking chamber wall uniformly spaced opposite said first group of manholes and in axial alignment therewith, cutting nozzle means adapted for removable mounting in said manholes, said cutting nozzle means being adapted and constructed to permit universal axial adjustment thereof, a conduit spaced from and extending along the elevation of said coking chamber in alignment with said first group of manholes, a plurality of outlet means disposed along the length of said conduit, flexible conduit means between said outlet means and said cutting nozzle means mounted in said first group of manholes, a second conduit spaced from and extending along the elevation of said coking chamber in alignment with said second group of manholes, a plurality of outlet means disposed along the length of said second conduit and flexible conduit means between said last named outlet means and said cutting nozzle means mounted in said second group of manholes.

2. Apparatus suitable for hydraulic disruption of coke in a coking chamber comprising a group of manholes uniformly spaced apart in the wall of said coking chamber along the elevation thereof, cutting nozzle means adapted for removable mounting in said manholes, said cutting nozzle means being adapted and constructed to permit universal axial adjustment thereof, a conduit spaced from and extending along the elevation of said coking chamber, a plurality of outlet means disposed along the length of said conduit, and flexible conduit means between said outlet means and said cutting nozzle means.

3. Apparatus suitable for hydraulic disruption of coke in a coking chamber comprising a group of manholes uniformly spaced apart in the wall of said coking chamber along the elevation thereof, cutting nozzle means adapted for removable mounting in said manholes, said cutting nozzle means being adapted and constructed to permit universal axial adjustment thereof to a limited degree but sufficient to define a conical effective cutting zone having a base diameter at least twice the distance between two adjacent manholes, a conduit spaced from and extending along the elevation of said coking chamber, a plurality of outlet means disposed along the length of said conduit and flexible conduit means between said outlet means and said cutting nozzle means.

4. Apparatus suitable for hydraulic disruption of coke in a coking chamber comprising a group of manholes spaced apart in the wall of said coking chamber along the elevation thereof, cutting nozzle means adapted for removable mounting in said manholes, said cutting nozzle means being adapted and constructed to permit universal axial adjustment thereof, a conduit spaced from and extending along the elevation of said coking chamber, a plurality of outlet means disposed along the length of said conduit, means for supplying liquid under pressure to said conduit and flexible means for conveying liquid under pressure from said outlet means in said conduit to said cutting nozzle means.

WILLIAM FREDERICK COURT.