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TOOL FOR CLEANING TUBES

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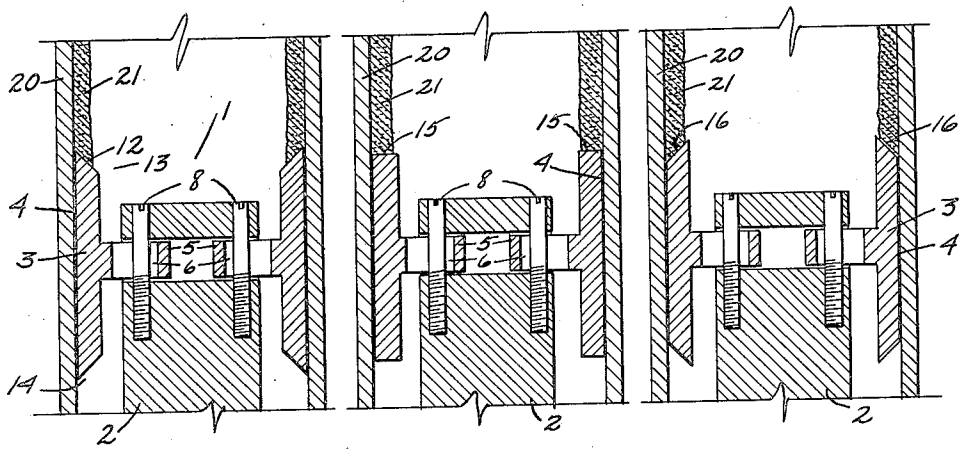

FIG. 7 FIG. 8 FIG. 9

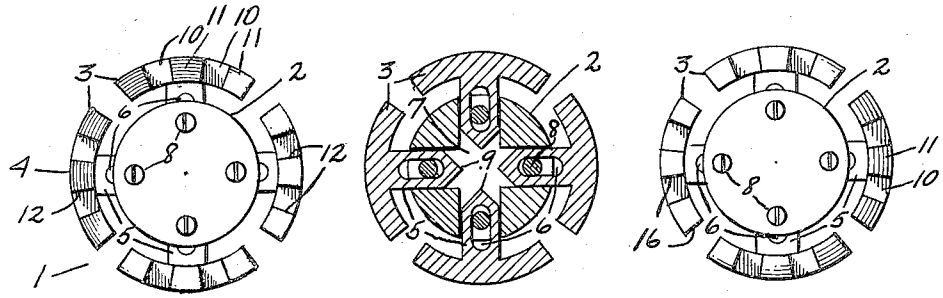

FIG. 1 FIG. 3 FIG. 5

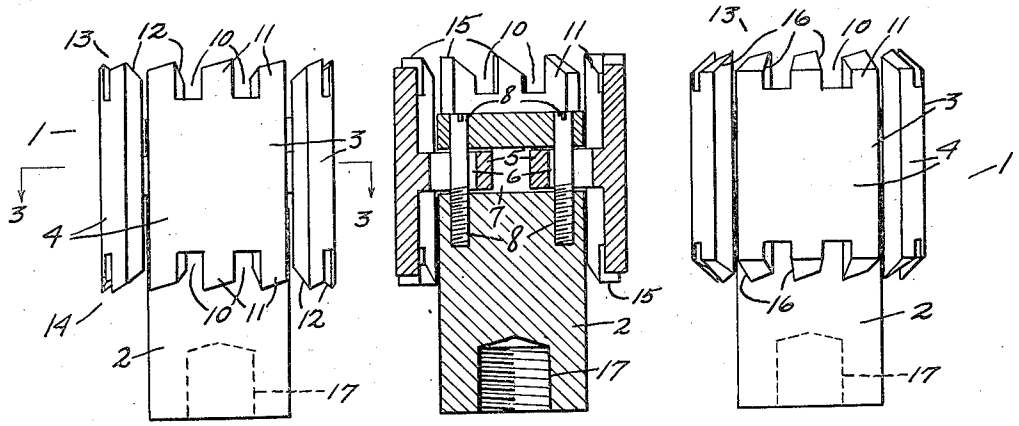

FIG. 2 FIG. 4 FIG. 6

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TOOL FOR CLEANING TUBES

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6 Claims. (Cl. 15—104.09)

The present invention relates to tools for cleaning incrusted deposits from the inside of tubes, with especial reference to those tubes in stills used in the cracking of petroleum products, in which a more or less hard layer of carbon deposits due to the decomposition of the petroleum products under the action of heat.

As these carbon deposits are generally of such nature that they are difficult to remove by means of a wiping or scraping action, it has been heretofore standard practice to employ the rotary types of tube cleaners with tools which, when rotated, deliver striking or gouging blows to the surface of the carbon, chipping it off in much the same manner as is generally used in removing scale from boiler tubes.

As is well known to those skilled in the art, it is difficult to estimate the speed at which this type of tool should be passed through the tube, the proper speed being that which is slow enough to insure proper cleaning but fast enough to prevent the gouging and scraping action from wearing into the walls of the tubes. Experience has shown that if there is a short hesitation during the passage of the tool through the tube, the tube wall at that point is quickly worn down to an extent that a slight pocket or bulge is formed therein.

During subsequent heating operations, carbon deposits more rapidly in these pockets thereby forming a thicker incrustation there than elsewhere, the result being a point of lower heat transfer, and consequently a higher temperature, tending to allow a higher rate of deterioration of the metal in the tube wall at this point.

The principal object of this invention relates to the provision of a rotary tool which removes the incrustation from the inside of the tube without damaging the surface of the tube itself.

Another object relates to the provision of a tool which has a milling or planing action applied to the end or section of the incrustation but presenting a smooth bearing surface to the wall of the tube.

A further object relates to the angle at which the milling or cutting teeth engage the incrustation.

Still another object relates to the provision of means whereby the tool cutters are held in contact with the surface of the tube regardless of variations of diameter of the tube.

Other objects will be made apparent to those skilled in the art by the following description and explanation, which makes reference to the following drawing appended hereto.

Figure 1 is a view of the leading end of a tool embodying the principles of my invention.

Figure 2 is an elevation of the tool shown in Figure 1.

Figure 3 is a transverse section of a tool taken along a line 3—3 in Figure 2.

Figure 4 is a sectional elevation of another embodiment of my invention in which the cutting edges of the teeth are perpendicular to the axis of the curved surfaces of the cutters.

Figure 5 is an end view of a third embodiment.

Figure 6 is an elevation of the third embodiment in which the cutting edges slope back outwardly from the leading ends of the teeth.

Figure 7 is a sectional elevation illustrating the operation of the embodiment of Figures 1 and 2 within a tube.

Figure 8 is a similar illustration of the operation of the embodiment of Figures 3 and 4 within a tube.

Figure 9 similarly illustrates the operation of the embodiment of Figures 5 and 6.

In the drawing, like reference numerals indicate like parts throughout.

Referring to Figures 1 and 2, the tool 1 comprises a supporting head or block 2 of preferably cylindrical form, and a plurality of arcuate cutters 3 attached thereto. These cutters are sectors of a hollow cylinder having a smooth outer surface 4. They are attached to the supporting head 2 by projecting lugs 5 as shown in section in Figures 3 and 4.

A lug 5 is fixed to each cutter 3, substantially perpendicular to the surface 4 of the cutter and projecting inwardly. The lug 5 is preferably cylindrical in form and has a vertical slot 6 cut therein. The supporting head 2 has holes 7 drilled radially and perpendicular to the longitudinal axis of the head. The holes 7 are adapted to receive the lugs 5, which fit into the holes but are slidable therein.

Each lug 5 is retained in its respective holes 7 by means of a bolt or screw 8, which passes through the slot 6 and screws down into a tapped hole in the head 2. The screw 8 thus secures the cutter 3 to the head 2 but permits radial movement of the cutter with respect to the head. The inner ends 9 of the lugs 5 are beveled to allow them to fit together at the center when the cutters are closed in to the head.

It is now evident that a rotation of the head will set up a centrifugal force which tends to throw the cutters outwardly, thereby expanding the effective diameter of the tool.

In each end of the cutters are slots 10 which

are spaced apart to provide teeth 11 between the slots.

Each of the teeth is made a cutting tool by providing a cutting edge on the tooth which, when the tool is rotated, has a planing or milling action on the deposit in the tube as will be later explained. In each of the three embodiments, the cutting edge is radially disposed, that is to say, it lies in, or substantially in a plane which includes the axis of the curved surface of the cutter 3.

In Figures 1 and 2 the cutting edges 12 lie in a plane, which includes the longitudinal axis of the curved surface 4 of the cutter 3, which, in the position shown, is also the axis of rotation. It is obvious, however, that as the cutter is moved in or out of the head, the axis of the surface of the cutter moves away slightly from the axis of rotation. The important consideration, however, is that the cutting edges traverse the end of the cutter from the outer surface to the inner surface of the cutter, as contrasted with tools of the gouging or scraping type in which the teeth are disposed along the outer surface of the tool either longitudinally and substantially parallel to the axis of rotation or in the end of the tool and disposed in the outer periphery thereof. Reasons for the novel construction of this invention will be explained later.

In Figures 1 and 2 the cutting edges 12 not only traverse the thickness of the cutter, but slope back and inwardly from the leading end 13 toward the supporting head 2. The teeth on the trailing end 14 of the cutters are so adapted that if the cutters are removed from the head, reversed end to end, and replaced, they will assume the same relative positions as the teeth now on the leading end. This reversible feature provides a doubly useful life of the cutter before it is necessary to renew or re-sharpen the same.

In Figures 3 and 4 the cutting edges 15 are substantially perpendicular to the axis of the surface 4 of the cutter, that is, they extend transversely across the wall or thickness of the cutter but do not slope back from the leading end, as did the edges in Figures 1 and 2.

In Figures 5 and 6 the cutting edges 16 slope back and outwardly from the leading end of the cutter.

Hence, the only difference between the three embodiments is in the slope of the cutting edges of the teeth. All are adapted to operate in a counter clockwise rotation as shown in the drawing, but of course they could be equally adaptable for clockwise rotation.

Each tooth is so shaped that it is relieved in back of each cutting edge to allow the edge to cut effectively, as is standard machine tool practice.

A tapped hole 17 is provided in the head for attaching it to the tube cleaner.

In Figure 7 the operation of the tool embodied in Figures 1 and 2 is indicated. The tool 1 rotates within a tube 20 in which there is an incrustation or deposit 21. The thickness of the cutter 3 is substantially equal to or greater than that of the incrustation, so that the cutting edge 12 is effective across the end of the deposit 21. As the tool rotates, the cutter progressively planes or mills the end of the deposit while it presents merely a smooth surface 4 to the wall of the tube 20 against which it bears and slides.

Centrifugal force maintains the cutters in contact with the walls of the tube, even though the head 2 deviates from the center of the tube.

In this way the tool mills down the end of the incrustation along a conical, or more accurately, a frusto conical surface. As the cutting action of the tool tends also to expand the cutters against the wall, this embodiment is the preferred one of the three.

In Figure 8, the action of the tool embodied in Figures 3 and 4 is indicated. The cutting edges 15 here cut a square end on the incrustation 21. An advantage of this embodiment is that the teeth 11 are of simpler form and may be somewhat easier to sharpen than those in Figure 2. There is, however, no tendency of the cutting action to force the cutters against the tube. Centrifugal force must be relied on entirely.

In Figure 9, the cutting edges 16 slope back and outwardly, thereby cutting the end of the incrustation on a frusto conical surface which slopes toward an apex ahead of the leading end of the tool, in contrast to the embodiment shown in Figure 7 in which the machined surface slopes toward an apex behind the leading end of the tool.

Here, the cutting action tends to force the cutters away from the wall of the tube, hence the centrifugal force must be greater than the component of the cutting force in order to insure thorough cleaning.

In all three embodiments, however, the tube can be thoroughly cleaned of its incrustation, without injury to the tube regardless of hesitations in the speed of progression through the tube. This speed can be at any desired value up to the upper limit at which thorough cleaning will not take place.

Now having clearly described the construction and operation of my invention, what I desire to protect by Letters Patent of the United States is set forth in the following claims.

I claim:

1. A tool for a rotary tube-cleaner, said tool comprising a supporting head and a cutter member, said member comprising a sector of a hollow cylinder, disposed substantially parallel to the axis of rotation of said tool, a planing or milling edge traversing the leading end of said cutter member from the outer surface to the inner surface thereof, the outer surface of said cutter member being adapted to bear on the inner surface of the tube during normal operation, and means securing said cutter member to said head but allowing a limited radial movement of said cutter member relative to said head, to insure contact between said member and the tube under the action of centrifugal force.

2. A tool for a rotary tube-cleaner, said tool comprising a supporting head and cutter members, said members comprising sectors of a hollow cylinder, disposed substantially parallel to the axis of rotation of said tool, milling edges on the leading ends of said members, said edges lying in substantially radial planes, the outer surfaces of said cutter members being adapted to bear on the inner surface of the tube during normal operation, and means securing said cutter members to said head but allowing a limited radial movement of said cutter members relative to said head, to insure contact between said members and the tube under the action of centrifugal force.

3. A tool for a rotary tube-cleaner, said tool comprising a supporting head and a plurality of cutter members, said members comprising sectors of a hollow cylinder, embracing said head and disposed substantially parallel to the axis

of rotation thereof, each of said cutter members having cutting edges extending transversely across the leading end thereof, the outer surfaces of said cutter members providing smooth contact surfaces adapted for bearing on the inner surface of the tube during normal operation, and means securing said cutter members to said head but allowing a limited radial movement of said members relative to said head, to insure contact between said members and the tube, under the action of centrifugal force.

4. A tool for a rotary tube-cleaner, said tool comprising a supporting head and a plurality of cutter members, said members comprising sectors of a hollow cylinder having cutting edges extending transversely across the leading end thereof, said cutter members having substantially smooth outer surfaces without cutting edges, said surfaces being adapted to conform with and to bear upon the inner surface of the tube during normal operation, and means securing said cutter members to said head but allowing a limited radial movement of said members relative to said head, to insure contact between said members and the tube under the action of centrifugal force.

5. A tool for a rotary tube-cleaner, said tool comprising a supporting head and a plurality of cutter members, said members comprising sectors of a hollow cylinder, disposed substantially parallel to the axis of rotation of said tool, a set of cutting edges on each end of said members, said edges lying in substantially radial planes, the outer surfaces of said cutter members being adapted to bear on the inner surface of the tube during normal operation, and means securing said cutter members to said head but allowing a limited radial movement of said cutter member relative to said head, to insure contact between said member and the tube under the action of centrifugal force, said securing means being adapted to permit reversing the cutter members for operation with either of said sets of cutting edges selectively.

6. A tool for a rotary tube-cleaner, said tool comprising a supporting head and a plurality of cutter members, said members having cutting edges in at least one end thereof, each cutting edge being disposed in a plane approximately radial to the axis of rotation, said cutter members having substantially smooth outer surfaces, without cutting edges, adapted to bear on the inner surface of the tube during normal operation, and means securing said cutter members to said head but allowing a limited radial movement of said cutter members relative to said head, to insure contact between said members and the tube under the action of centrifugal force.

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