Sept. 24, 1963 H. J. WEST 3,104,409

BOILER TUBE SCALE REMOVER

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Fig. 1

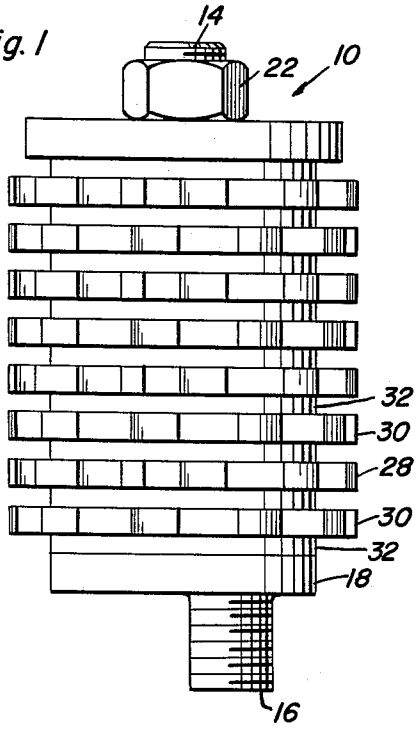

Fig. 2

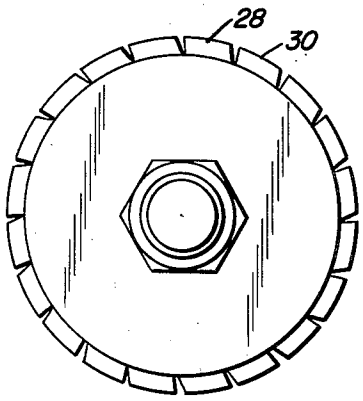

Fig. 3

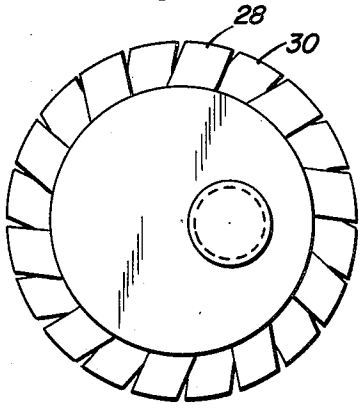

Fig. 4

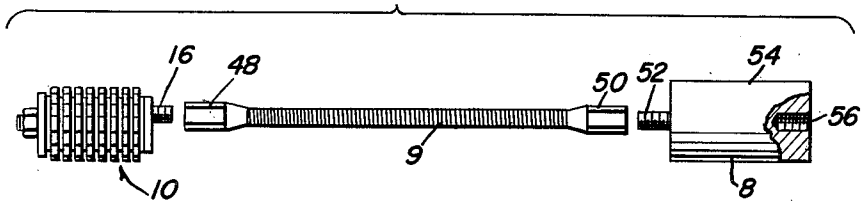

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Fig. 5

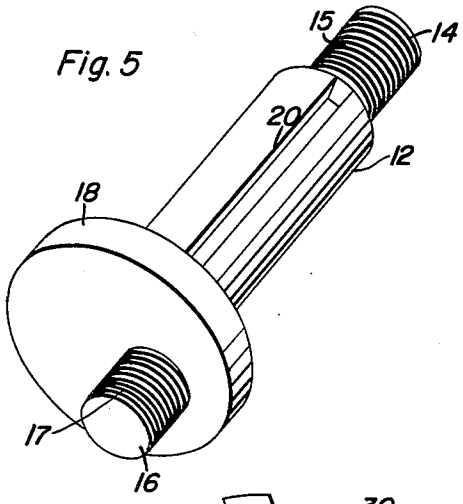


Fig. 6

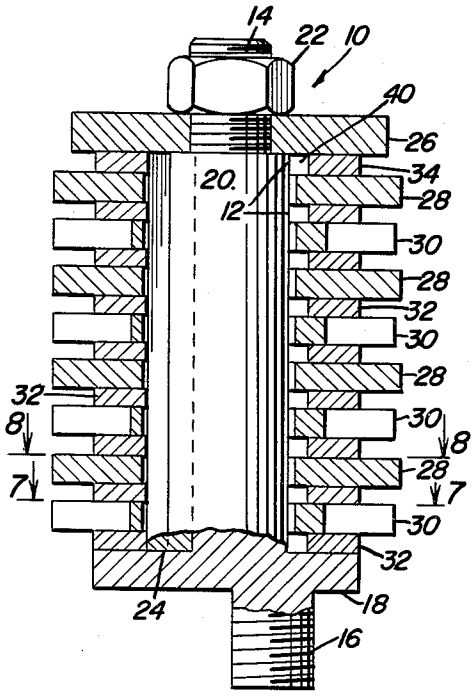


Fig. 7

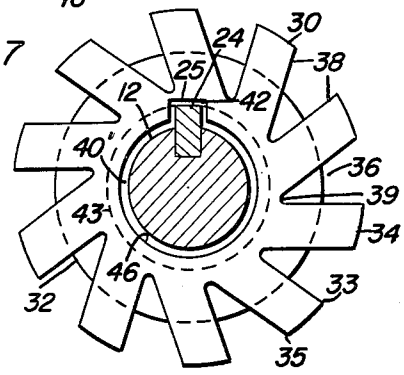


Fig. 9

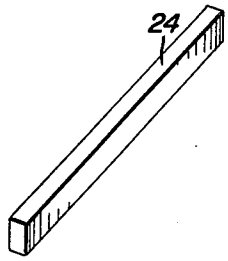
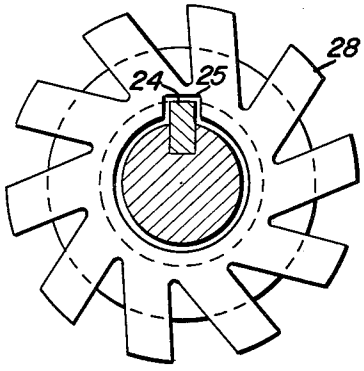


Fig. 8



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United States Patent Office 3,104,409 Patented Sept. 24, 1963

3,104,409

BOILER TUBE SCALE REMOVER

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Filed Oct. 21, 1960, Ser. No. 64,057
7 Claims. (Cl. 15—104.07)

The present invention relates to a device for removing deposits from surfaces.

More specifically, the present invention relates to a scale remover for removing hard scale from the interior of tubes of marine-type boilers.

Therefore, an object of this invention is to provide a device that will efficiently remove scale and deposits from the inside of tubes and pipe without damaging the same.

Another object of this invention is to provide a scale remover having a plurality of scale hammers thereon which are mounted to a hammer assembly in such a manner as to provide automatic over-load release means and shock absorbing means to prevent the hammer assembly from damaging tubes in which it is used.

Another object of this invention is to provide a scaling hammer assembly that is mounted eccentrically on a flexible power driven shaft thereby providing it with a natural whipping action so it will effectively remove scale and deposits within tubes.

Another object of this invention is to provide a scaling hammer assembly that is reliable in use, requires a minimum of parts, is economical to manufacture, and requires very little maintenance.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 shows a side view in elevation of my hammer head assembly;

FIGURE 2 is a plan view of FIGURE 1;

FIGURE 3 is a bottom view of FIGURE 1;

FIGURE 4 shows a plan view of the hammer head assembly with a flexible drive means disconnected therefrom;

FIGURE 5 shows a perspective view of the hammer head spindle;

FIGURE 6 shows a cross-sectional view taken on a vertical plane through FIGURE 1;

FIGURE 7 shows a cross-sectional view taken on the plane of line 7—7 in FIGURE 6;

FIGURE 8 shows a cross-sectional view taken on the plane of line 8—8 in FIGURE 6; and

FIGURE 9 shows a perspective view of the key for the scaling hammers.

The hammer head assembly comprises a spindle assembly 12, as shown in FIGURES 5 through 7, which has integrally secured thereto a concentric circular flange 18 and a concentric extension 14 which is reduced in diameter and has threads 15 thereon. Eccentrically mounted on the flange 18 and integral therewith is another extension 16 of the same diameter as the extension 14 and having the threads 17 thereon. The surface of the spindle 12 has a longitudinal groove 20 therein which is substantially square in cross section for receiving a key 24.

As shown in FIGURES 6 and 7, the key 24 fits tightly within the groove 20 in the spindle. Alternatively, the key may be brazed within this groove. The hammer head assembly is composed primarily of alternate layers of washers 32 and hammer disks 30, 28, stacked and bolted upon the spindle 12. In assembling the hammer head assembly, a washer 32 is first slipped over the spindle

12 and pushed downwardly until it abuts flange 18. Next a hammer disk 30 is slipped over the spindle and pushed downwardly adjacent the first washer 32, then another washer is pushed onto the spindle adjacent the hammer disk 30 and another hammer disk is pushed on adjacent the previous washer, and so on until the spindle 12 is almost entirely covered with alternate layers of washers and hammer disks. Then an adjusting washer 34 is placed adjacent the top hammer disk 28 and then the relatively large clamping washer 26 is slipped over threaded extension 14 and secured in place by nut 22 which is threaded onto the threads 15.

The inside diameter of the washers 32 which is measured across the inner edge 43 thereof, also of the washer 34, is of a dimension to provide a clearance 40 between the edge 43 and the outer surface of spindle 12 which is equal to the radial distance the key 24 protrudes beyond the surface of spindle 12. The hammer disks 28 and 30 have substantially rectangular recesses 25 for receiving the outer portion of key 24. The annular opening 46 through the hammer disk and the rectangular opening 25 are of sufficient size to provide clearance 40' and clearance 42 between the inner edges of a hammer disk and the outer surface of spindle 12 and the outer surface of the key 24, respectively. The hammer disks 28 and 30 are composed of washers having substantially V-shaped grooves 36 formed in their outer edges. Rather than having the V-shaped notches 36 symmetrical about radial lines, it is preferred to have the median lines of these notches slightly inclined to the radial line extending through the respective notches. This provides relatively sharp hammer or chipping edges 33. However, if a more gentle and slower scale removing action is desired, the hammer head assembly may be rotated so as to employ the relatively dull edges 35 as scale removing edges.

The hammer disks 30 are arranged so that the corresponding edges 38 of all these disks are aligned so as to be contained by the same plane. The disks 28 are arranged in the same manner as the disks 30. However, the disks 30 are not in alignment with the disks 28. As more clearly shown in FIGURE 3, the outer edges 34 of hammer disks 30 are centered with respect to the grooves 36 of adjacent disks 28.

The inner ends of the recesses 36 are rounded as at 39 to prevent excessive stress and strain at this point.

I show my hammer head assembly as being composed of eight hammer disks 28 and 30, however, under certain conditions it may be desirable to vary or change this number of disks.

Rather than having alternate sets of scaling hammer disks off center as shown in FIGURES 2 and 3, the teeth of the disks may be arranged to form a spiral about the spindle 20.

As shown in FIGURE 4, my complete scale removal assembly comprises a head assembly 10, the flexible shaft assembly 9 and a concentric pilot plug 54. The flexible shaft 9 has hexagon heads on each end as shown at 48 and 50. A suitable wrench may be used for rotating these hexagon heads and tightening them onto threaded studs 14 of the head assembly and 52 of the pilot plug. The threads on 14 and 52 are angled in such a direction that in normal use the hexagon heads 48 and 50 will tend to become screwed further upon the stud members 16 and 52. The flexible shaft 9 is of the conventional type and may be composed of a coil of any spring wire. The pilot plug 54 is attached to a conventional rotating air motor or other power device.

In operation, the hammer head assembly 10 is inserted into a tube or other hollow member and is driven by means of a power source rotating the flexible shaft 9.

The flexible shaft **9** and stud **16** rotate the head **10** about the axis of stud **16** and since the center of gravity is offset from this axis, the head **10** is moved radially outward by centrifugal force as it rotates. This provides a hammering action against the insides of the boiler tubes thereby permitting the edges of teeth **30** to hammer and chip scale and other debris from the inside of the boiler tubes. The degree of the hammering action may be controlled by varying the speed of rotation at the power source.

The hammering disks **28** and **30** and the washers **32** are all tightly pressed together by means of the clamping washer **26** and the adjusting washer **34**. Due to the friction between the hammering disks and the washers, they tend to remain fixed relative to one another and the spindle **20**. However, when the hammering disks strike the scale on the inside of the boiler tube they may slip a radial distance equal to the clearances shown at **40'**. Also they may slip in a circumferential direction an amount sufficient to take up clearance around the spline **24**. This relative slipping and sliding of the disks and washers provides an automatic shock absorbing means for preventing the teeth from striking the inside of the boiler tubes with too much force and thereby damaging the same. This shock absorbing action also prevents breakage of the teeth. The amount of friction between the washers and disks and thereby the degree of shock absorbing action provided may be adjusted by rotating nut **22** or by varying the thickness of adjusting washer **34**.

Although the head assembly **10** strikes the inside of the tubes with a hammering action, the shock of this hammering action is prevented from being transferred to the power source by means of flexible cable **9**, which absorbs all the shock.

In severe cases where the scaling on the boiler tubes is unusually thick, I employ a solid head assembly, not shown, which is similar in shape and design to the head assembly **10** described above. The solid scaling head is grooved and fluted and also has an off-center attaching pivot **14**. In severe cases, the solid head is used initially for removing most of the scale and then the complex head assembly **10** is used for the finishing operation.

Due to the inherent shock absorbing action provided by the head assembly **10**, this head will remove heavy deposits of scale from inside of boiler tubes and leave the inside surfaces thereof with a substantially smooth finish without damaging the tubes.

The head may be made in a variety of sizes so as to fit boiler tubes of any design or diameter.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A scale remover head assembly comprising a spindle, an abutment on one end of the spindle, an extension on the other end of the spindle, a series of annular hammer disks each having a central opening stacked on the spindle, means on said extension for adjustably compressing said disks against one another and against said abutment, spline means rotatably connecting said disks to said spindle, the openings being of such a size as to permit said disks to move a limited distance in both a radial and circumferential direction about said spindle, and a driving shaft connected to the head assembly at a radially offset point on said abutment.

2. A scale remover head assembly comprising a straight spindle, an abutment on one end of the spindle, a radially offset drive means connected to said abutment, an extension on the other end of the spindle, a series of annular hammer disks stacked on the spindle, means on said extension for adjustably compressing said disks against one another and against said abutment, said disks being separated by washers clamped therebetween and an annular clearance being provided between said spindle and both said disks and washers, said washers being of a thickness less than said disks in an axial direction and means positively driving said disks wherein clearance is provided between the disks and said drive means and between the disks and spindle surface whereby the disks may slip a limited distance in both a radial and circumferential direction relative to said spindle to absorb shock.

3. An assembly as recited in claim 2 wherein said hammer disks are splined to said spindle.

4. An assembly as defined in claim 2 wherein said disks have inclined teeth and the teeth on each disk are axially aligned with the spaces between the teeth of adjacent disks.

5. A scale remover comprising a spindle, a series of cutting disks loosely mounted for limited radial and rotary movement on the spindle and positively driven thereby, and means for rotating said spindle, said means including a drive shaft connected off-center to one end of the spindle.

6. The combination of claim 5, together with means for frictionally securing the disks against movement relatively to each other and to the spindle.

7. The combination of claim 6, said securing means including washers loosely mounted on the spindle between the disks, a flange on one end of the spindle, and a nut on the other end of said spindle cooperable with the flange for clamping the disks and washers therebetween.

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