

No. 634,406.

W. D. FORSYTH & E. T. BELL.

Patented Oct. 3, 1899.

BOILER TUBE CLEANER.

(Application filed Oct. 11, 1897.)

(No Model.)

Fig. 1.

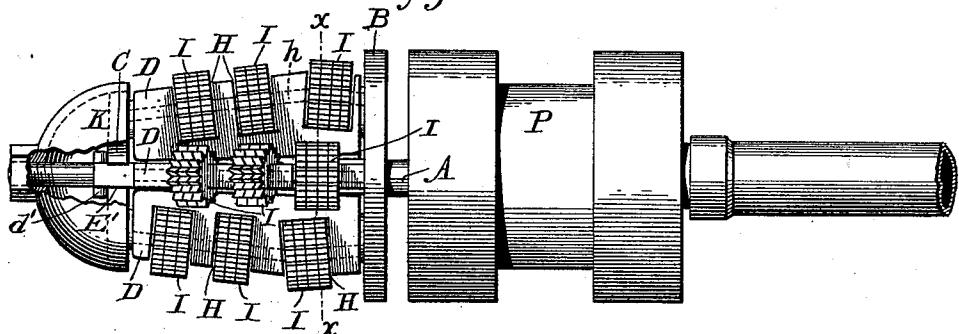


Fig. 2.

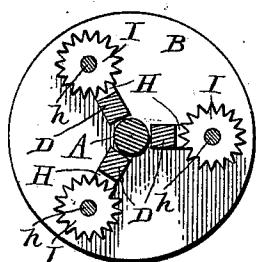


Fig. 3.

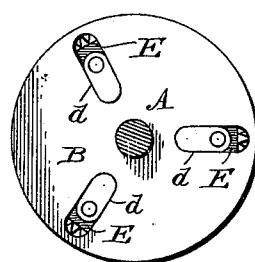


Fig. 4.

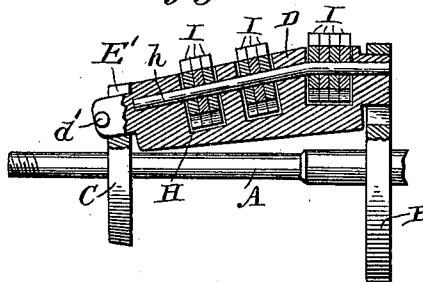
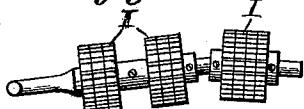


Fig. 5.



Witnesses.

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# UNITED STATES PATENT OFFICE.

WILBER DAVID FORSYTH AND ENOS T. BELL, OF PITTSBURG,  
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## BOILER-TUBE CLEANER.

SPECIFICATION forming part of Letters Patent No. 634,406, dated October 3, 1899.

Application filed October 11, 1897. Serial No. 654,833. (No model.)

To all whom it may concern:

Be it known that we, WILBER DAVID FORSYTH and ENOS T. BELL, citizens of the United States, and residents of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Boiler-Tube Cleaners; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Figure 1 of the drawings is a side elevation of a boiler-tube cleaner embodying our invention. Fig. 2 is a section on the line  $x-x$ , Fig. 1. Fig. 3 is a section on the line  $y-y$ , Fig. 1. Fig. 4 is a detail view, partly in section, showing one of the cutter-carrying arms and its cutters in position in the cutter-head; and Fig. 5 is a detail view showing a modification.

This invention is designed to provide a tool or implement for cleaning boiler-tubes or other tubes requiring similar treatment which is of simple construction, which can be operated without using heavy or cumbersome driving apparatus and can be readily removed from one boiler to another, and which is capable of removing heavy deposits of scale in a rapid and thorough manner. Other advantages arising from the invention will hereinafter be pointed out.

With these objects in view the invention consists in the novel construction and combination of parts, all as hereinafter described, and pointed out in the appended claims.

Referring to the accompanying drawings, the letter A designates the carrying and driving shaft of the tool or implement. Secured upon the forward end portion of said shaft at a distance of several inches from each other are two circular plates B and C, the forward plate C being of considerably less diameter than the rear plate B. Formed in the plate B are a series of closed radial slots E, (usually three in number,) while in the plate C are corresponding slots E', which, however, open through the periphery of the plate.

D designates cutter-carrying arms whose forward end portions are pivotally engaged with the slots E' and whose rear end portions loosely engage the slots E, in which they are free to play to a limited extent. The end portions of the arms which are thus engaged with these slots E E' are usually of reduced flattened form, as indicated at d, in order to prevent the arms from turning, and their forward end portions are formed with T-heads d'. Each of said arms is formed with a series of recesses or openings H extending into its outer edge and having pins or journals h extending across them. Upon these pins or journals are loosely mounted rolling cutters I, which consist of small peripherally-toothed disks.

In the particular tool illustrated in the drawings the tool is provided with three of the arms D. Each of said arms has three recesses or openings, in each of the two foremost of which three of the cutters are journaled, while four cutters are journaled in the rear opening of each arm. The number of openings and the number of cutters therein may, however, be varied. The journals h of the two foremost slots of each arm are inclined outwardly and rearwardly with respect to the shaft A, while that of the rear slot or opening when in normal or non-working position is inclined inwardly and rearwardly, the said opening being cut at an acute angle to the other openings. The cutters journaled in these rear slots are thereby caused to present their cutting edges to the face of the work in planes substantially perpendicular to the axis of the tube being operated upon, the journals thereof, when the arms are at the outer limits of their radial movement in the slots E, being substantially parallel with the shaft A. The cutters of the other sets, it will be seen, present their edges to the work at an angle. The outer longitudinal edges of the arms are parallel with the series of journals h carried thereby, as shown.

K designates a bell-shaped cap having a nut portion k, which is screwed upon the threaded forward end of the shaft A. This cap fits over the disk or plate C and not only secures in place the arms D, but also acts as

a guide for the implement in performing its work.

The shaft A may be extended rearwardly and form the journal of a driving-motor of 5 suitable character, such as the water-motor indicated at P, or it may be connected to any suitable known means of propulsion.

The device is operated by being inserted into the end of the tube to be operated upon, 10 being pushed through the tube with force under rapid rotation or allowed to feed through by its own weight and natural tendency in that direction, this to be governed by the operator, according to the nature of the work being performed. To obtain the best results, the 15 speed of rotation should be rapid, a speed as high as or in excess of three thousand revolutions per minute being preferred. During the operation the tube should be flushed with 20 a small stream of water to carry away the disintegrated scale and also to prevent heating, &c.

The arms D being pivoted at their forward ends and caused to swing outwardly under the 25 force of rotation, the implement is capable of entering a small opening and cutting its way through, the foremost cutters striking the scale at an angle to the axis of the tube, while the rear or finishing cutters act at substantially 30 right angles to such axis, and thereby remove all portions of scale which may be left by the preceding cutters. The construction also causes the cutters which are most in commission, especially in removing heavy scale, 35 to press outwardly with the greatest force on account of the leverage exerted by the following cutters and portions of arms. While being forced deep into the scale, they are at the same time capable of yielding to prevent 40 breakage in uneven scale—that is to say, scale which is unequal either in thickness or in quality or density. The rear cutters not being set at the same angle as the front and intermediate ones also enables the tool to be 45 more readily and easily withdrawn after having by misuse or other cause passed over a portion of scale without removing it, since as the arms move inwardly these cutters assume angular or deflected positions with respect to 50 the shaft A, thereby giving the rear portion of the cutter-head somewhat the form of a cone, whereby it will readily ride over the obstruction. Furthermore, independently of the particular arrangement of the rear cutters 55 as shown and described the arrangement of the cutters generally on the pivoted arms with their journals in the plane of the radial movement of said arms is one of particular effectiveness. It will be understood that the centrifugal force of rotation tends to keep said arms thrown out or expanded to their full extent, but that such movement is opposed by the resistance of the scale. The consequence 60 is that said arms have more or less of a vibratory or hammer action and that during such action the angle of presentation of the teeth of the cutter-wheels varies with great effect—

that is to say, as the said teeth penetrate deeper into the scale their edges not only move outward, but also slightly forward, to 70 the effect that they exercise a prying or wedging action, which is peculiarly effective.

We prefer to differentiate the cutters of the different arms, whereby those of one arm will not cut in the same circular paths as those of 75 adjacent arms. In this manner the cutting action is equally distributed through the length of the head.

For light work the arms D may be in the 80 form of pins which pass directly through the cutters and form the journals thereof, said pins being pivoted at their forward ends and allowed to play in the slots E at their rear ends in the same manner as the arms first described. This construction is illustrated in 85 drawings.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A tube-cleaning tool or implement comprising essentially a carrying and driving shaft, a head secured thereto, a series of arms pivoted to said head at their forward end portions and free to move radially a limited distance at their rear portions, and a number of 95 rolling cutters carried by each of the said arms at different points along its length, and journaled at different distances from, and at different angles with respect to the said shaft and with respect to a plane taken transversely through the said shaft, substantially as specified.

2. A tube-cleaning tool or implement consisting essentially of a carrying and driving shaft, a head secured thereto, a series of arms 105 pivotally secured in or to the said head at their forward end portions and free to move radially at their rear portions, said arms having each a series of sets of rolling cutters journaled thereon, the cutters of the first and 110 intermediate sets being journaled at a different angle from those of the rear sets, substantially as specified.

3. A tube-cleaning device or implement consisting essentially of a driving and carrying 115 shaft, a head secured thereto, a series of arms pivoted to the said head at their forward end portions and extending rearwardly round the said shaft, the forward and intermediate portions of said arms being inclined outwardly 120 with respect to the shaft while their rear portions are reversely inclined and are free to assume positions substantially parallel with said shaft, and a plurality of rolling cutters carried by each of the said arms, substantially 125 as specified.

4. A tube-cleaning tool or implement consisting essentially of a carrying and driving shaft, a head secured thereto, a series of arms pivotally secured to said head at their forward 130 end portions and at their rear end portions loosely engaging the same to have a limited radial movement, and a plurality of rolling cutters journaled to each of the said arms at

different angles with respect to the shaft, the cutters of each arm being journaled so as to work in different circular planes from the cutters of the adjacent arms, substantially as specified.

5. In a rotary boiler-tube cleaner, the combination with a rotary shaft or carrier, of a number of rigid arms disposed longitudinally about the same and pivoted thereto at their 10 forward ends, to move outwardly in radial planes, said arms having journal portions whose axes run lengthwise of the arms and are longitudinal in the planes of the radial movement of said arms, and peripherally- 15 toothed cutter wheels or disks loosely mounted on the said journal portions, substantially as specified.

6. The combination with the shell or body, of a rotary head arranged at the front end of 20 said shell or body, means whereby said head

is rapidly rotated, rearwardly-diverging arms arranged lengthwise of said head and connected therewith at their front ends by transverse pivots so as to be swung out at their rear ends by centrifugal force, and cutter-disks mounted transversely on the free rear portions of said arms, whereby said cutter-disks are caused to trail as the device is moved forwardly and are presented to the work in an oblique position with the entering end 25 nearer the axis of the head than the rear end, substantially as specified.

In testimony whereof we affix our signatures in presence of two witnesses.

WILBER DAVID FORSYTH.  
ENOS T. BELL.

Witnesses:

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JOS. G. ORMSBY.