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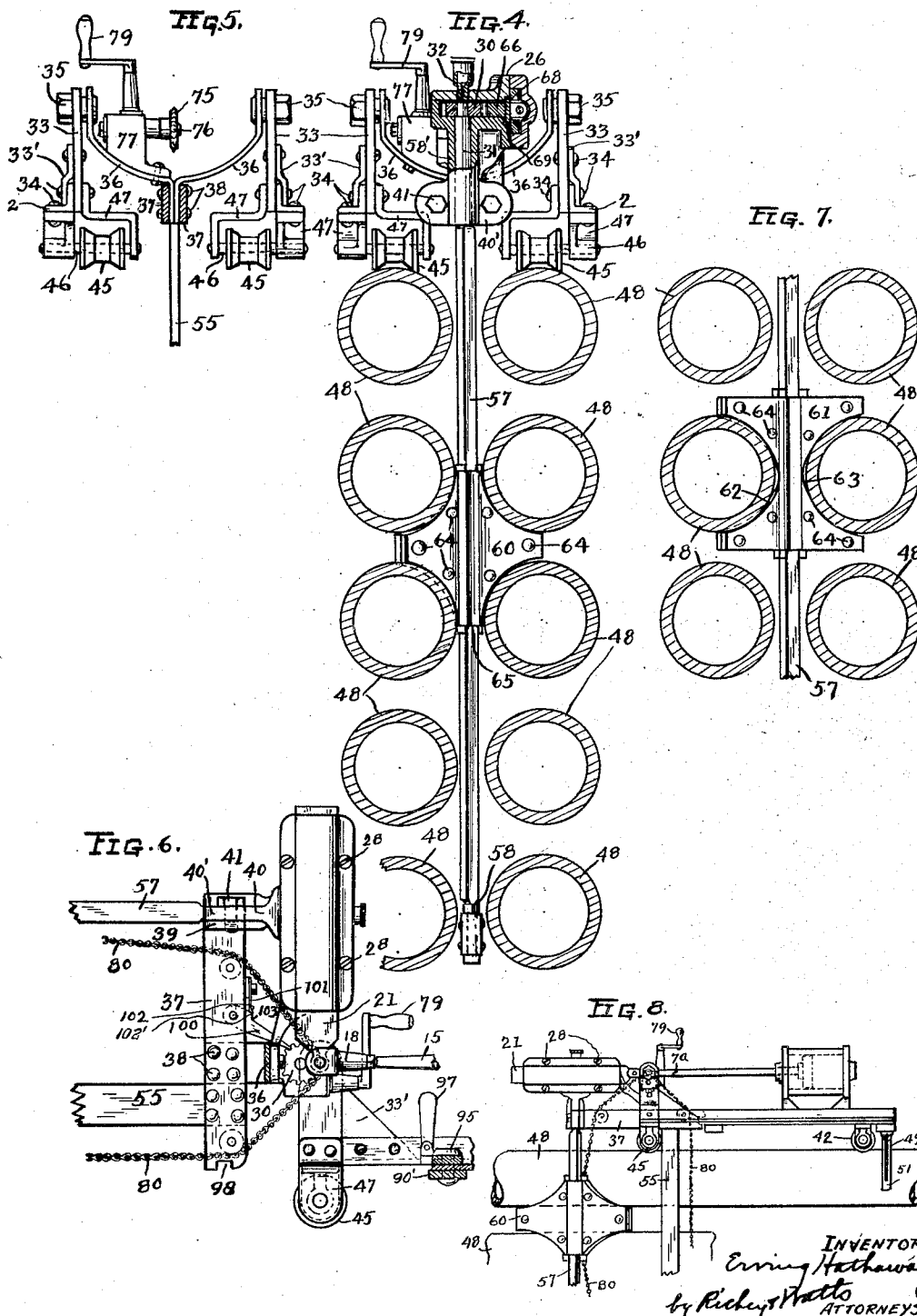
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BOILER TUBE CLEANING APPARATUS

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BOILER-TUBE-CLEANING APPARATUS.

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My invention is an improvement in scale removers and relates more particularly to devices of that class employed to remove the scale from boiler tubes or the like.

An object of my invention is to construct a device of the character mentioned whereby substantially the entire tube area within the boiler may be subjected to the action of the scale removing tool while the tubes are in their natural position.

Another object of my invention is to construct a device of the above named character in which a compact portable mechanism is employed whereby the tool may be shifted from one row of tubes to the next without the necessity of removing the apparatus from the boiler.

Other objects and advantages of my invention will become apparent as the description of an embodiment thereof progresses, reference being made herein to the accompanying drawings which form a part of the specification and in which like characters are employed to designate like parts throughout the same.

In the drawings:

Fig. 1 is a side elevation of a portion of the interior of a boiler showing my apparatus in operating position upon the tubes.

Fig. 2 is a plan view of the apparatus shown in position between adjacent rows of tubes.

Fig. 3 is a rear end view of the apparatus showing the rear supporting rollers.

Fig. 4 is a section taken on line 4—4 of Fig. 1.

Fig. 5 is a section on line 5—5 of Fig. 1.

Fig. 6 is a side view of the forward end of my apparatus showing the auxiliary frame raised to a substantially horizontal position.

Fig. 7 is a detail of a modified form of tool used in connection with my apparatus, and,

Fig. 8 is an elevational view of another form of my invention showing a compressed fluid power plant.

In the drawings:

The base plate 1 of a main supporting frame is provided with side irons 2 bolted or riveted thereon and extending preferably beyond the forward end of the plate 1. An electric motor or other source of power 3 is secured to the supporting base 1 at the

rearward end thereof by bolts 4. In Fig. 8 I have shown an air cylinder and piston as the power source. The motor shaft 5, Figs. 1 and 2 extends forwardly of the frame on which the motor is mounted, and is supported at its forward end in a suitable bearing 6 carried within an arm of a transmission casing 7. When the air cylinder is used as in Fig. 8, the connecting rod 7^a is connected to transmit reciprocating motion directly to the slide 21. The shaft 5, Figs. 1 and 2, is provided with a knurled shaft rotating nut 8 to provide means for rotating the shaft by hand when desired. Keyed to the forward end of the shaft 5 is a beveled gear 9 which is housed within the casing 7 and meshes with a second beveled gear 10 keyed to and rotatably with a shaft 11. The shaft 11 is rotatably mounted in suitable bearings 12 within the casing 7. The casing 7 may be constructed of complementary sections 7' and 7'' secured together as shown in Fig. 1, the casing sections having aligned openings to receive suitable bearings and the ends of the shaft 11. Keyed to one end of the shaft 11 and rotatable therewith exteriorly of the casing 7 is an eccentric 13 which is provided with a crank pin 14. A connecting rod 15 is connected at one end to the pin 14 and is held in place thereupon by means of a suitable nut or the like 16. The other end of the connecting rod 15 is preferably screw threaded as at 17 to receive the threaded end of an adjustable fork shaped member 18. The arms 19 of the fork shaped member are each provided with aligned openings through which a pin 20 is adapted to pass to pivotally secure therebetween an end of a slide member 21.

The slide member 21 is preferably slotted longitudinally at 22, the end walls of the slot being upturned as at 23 and 24. Each of the upturned end walls of the slot carries a pin 25 the purpose of which will be described hereinafter. The slide member 21 is movable in aligned depressions formed in opposite ends of a casing 26. A cover plate 27 is adapted to be secured to the casing 26 by any suitable means such as screws 28 which may be screwed into openings 29 formed in the cover 27 and the casing 26. The casing 26 extends rearwardly and downwardly providing suitable housing, bearing

and supporting means for the gear 30 and a shaft 31. An oil cup or other lubricating device 32 may be threaded into the casing to communicate with the interior thereof to supply lubricant to the bearing surfaces.

To the respective forward ends of the members 2 are secured uprights 33 by any suitable means such as rivets 34. Braces 33' are also secured to the members 2 and uprights 33 by the rivets 34. These uprights 33 are provided with aligned threaded openings in their respective upper ends for receiving removable bearing pins or the like 35. The facing ends of each of the pins form pivotal supporting and bearing means for the respective yoke members 36. This structure is more clearly shown in Figs. 4 and 5, the abutting ends of the yoke members 36 are secured together between substantially parallel auxiliary frame members 37 by means of bolts or rivets 38. The respective forward ends of the frame members 37 are flanged outwardly as at 39. A casing supporting arm 40 which is formed as an extension of the casing 26, is flanged at 40', the flanges 40' abutting the oppositely disposed flanges 39 of the members 37, and is provided with openings in alignment with openings in the flanges to receive securing bolts 41.

The supporting frame 1 and 2 is provided at its rear end with suitable rollers 42 which are rotatable upon a shaft 43 suspended from the base 2 by suitable supports 44. Collars 42' are also carried by the shaft 43 and may be locked in desired axial spaced relations by means of set screws, to limit the relative axial movement of the rollers 42. The forward end of the base is supported by rollers 45 which are loosely mounted on shafts 46 suspended below the base by means of bracket arms 47. The rollers 45 are also movable axially of each other for adjusting themselves to properly engage the spaced tube surfaces. One of the bracket arms supporting each of the rollers is secured to the upright 33 and the side iron 2 by means of rivets 34. The other brackets supporting the rollers 45 are secured directly to the side irons 2 by rivets 34.

It will be seen therefore I have provided suitable means whereby my device may be movably supported upon the boiler tubes 48, so that the entire apparatus may be moved longitudinally along the tubes upon which it is supported. It will also be seen that by the provision of rollers which may rotate about their axes in various axially spaced relations determined by the distance between the boiler tubes upon which they travel, the apparatus may be movably supported within various types of boilers wherein the tubes are spaced at various distances.

By referring particularly to Figs. 1 and 3, it will be seen that I have provided a

means for preventing lateral displacement of the apparatus with respect to the tubes 48 which consists of a slotted bar 49 movably suspended beneath the plate 1 by a removable pin 50. This bar 49 may be suspended from the pin 50 in the position shown in Figs. 1 and 3 in which position it will extend downwardly between adjacent rows of tubes upon which the apparatus is supported, sufficiently to prevent undue lateral movement of the apparatus upon the tubes. When it is desired to remove the bar from this position and support the same beneath the plate 1 as shown by dotted lines in Fig. 1, this is accomplished by gripping the end 51 of the bar and swinging the same rearwardly and upwardly about the pin 50 as a pivot and then exerting a forward force upon the end of the bar, so that the end 52 will be projected forwardly between the plate 1 and the shaft 43. In this manner the shaft 43 serves to support the bar 49 when the latter is not in use.

An auxiliary tool carrying frame composed of substantially parallel top frame members 37, a rear frame member 55 and substantially parallel bottom frame members 56, is pivotally suspended from the main frame by means of the coaxing yoke members 36 which are pivotally secured to the top frame members 37 as shown in Fig. 5. A movable tool carrying rod 57 extends longitudinally and is forwardly of the frame, its lower end being seated in a bearing 58 formed at the forward end of the members 56 and its upper end 57 extending into the downwardly projecting bearing member 58' of the casing 26. The rod is free to oscillate in the bearings and is provided at its extreme upper end with a gear 30 keyed thereto, so that motion imparted to the gear 30 will cause movement of the rod 57. A hammer like tool 60, which is preferably formed as shown in Figures 1 and 4 is slidably mounted on the rod 57. In Fig. 7 I have illustrated a modified form of tool 61 wherein the tool is provided with but two work engaging surfaces 62 and 63, each surface having actual scale removing contact throughout approximately 180° of the circumference of each of adjacent boiler tubes, while the tool shown in Figs. 1 and 4 is provided with four work engaging surfaces, each adapted to engage approximately 90° of each of adjacent tube circumferences. The tool illustrated in Figs. 1 and 4 is capable of removing scale at a maximum from portions of the surfaces of four tubes simultaneously, while the tool shown in Fig. 7 is capable of removing scale from portions of the surfaces of but two tubes simultaneously. It will be noted that in the use of either tool, the tube surface engaged or cleaned by the tool is approximately the same, since the combined working surface

of each tool is approximately 360°. By the use of such tools I am enabled to more completely clean the outer tube surfaces.

Each of the tools 60 and 61 is constructed preferably as shown, each being composed of two sheets of similarly shaped metal riveted together as at 64. It is obvious, though, that I may construct tools using but a single sheet of metal or other material, or I may use more than two sheets of material depending on the material used and the degree of rigidity desired in the tool. A central longitudinal opening 65 of greater diameter than the rod 57 is formed in the tool to permit free movement of the tool along the rod. A cross section through the rod and tool is preferably rectangular in shape or it may take any other polygonal shape whereby only free axial movement of the tool is obtained. It will be seen that oscillation of the gear 30 will impart similar movement to the tool.

As explained above, the gear 30 is secured to the upper end of the rod 57 and is enclosed within the casing 26. A rack bar 66 is provided with teeth 67 arranged on its inner face in meshing engagement with the gear 30. The rack bar 66 is secured to a plate 68 in any suitable manner and is movable therewith, the plate being slidable in a recess 69 formed in the edges of the casing 26. An apertured lug 70 is formed on the plate approximately centrally of the outer surface thereof, and carries a spring retaining pin 71 locked within the aperture, the lug and pin extending into the slot 22 and substantially longitudinally thereof. The pins 25 and 71 are all in substantial alignment as shown in Fig. 2.

I have provided a shock absorbing and resilient driving connection between the rack bar 66 and the sliding plate 21 which consists of coil springs 72 or other cushioning means. One of the springs 72 is supported between the lug 70 and the lug 23, the adjacent ends of the pin 71 and one of the pins 25 extending into the ends of the said coil spring. The other spring is supported between the lug 70 and the lug 24 in a similar manner so that there is relative movement between the plate 21, the plate 68 carrying the rack bar 66 and the casing 26.

When power is transmitted through the connecting rod 15 to reciprocate the plate 21 within the casing 26, this power is transmitted through the springs 71 to the rack bar 66 and thence to the gear 30, thereby imparting an oscillating movement to the tool carrying rod 57.

Since the speed of the shaft 5 is such that the eccentric 13 is caused to rotate rapidly, it is evident that the slide 21 will be reciprocated in rapid succession. I am enabled, by the provision of the shock absorbing or resilient connection between the plate 21 and

the plate 68, to operate my apparatus at a very high speed, thereby more quickly and more thoroughly and efficiently accomplishing one of the purposes of the apparatus.

I have provided means for adjusting the tool 60 along the rod 57, so that it may be adjusted to clean the tubes within a boiler to any desired depth. The auxiliary frame defined by member 37, 55 and 56 is of sufficient length that the tool may extend down far enough into the boiler to clean the lowermost tubes therein.

The tool adjusting driving means includes a driving sprocket 75 secured on one end of a shaft 76 which is rotatably supported in suitable bearings in a casing 77. The shaft 76 is provided with a worm (not shown) which meshes with a worm gear (not shown) formed on shaft 78. A handle 79 is keyed to the shaft 78, so that when the handle is operated to drive the shaft, power will be transmitted through the worm and worm gear to rotate the sprocket 75. The casing 77 and the gear assembly just described, is shown in Fig. 5 secured to one of the yoke members 36 and is movable with the auxiliary frame when the same is moved about its pivot.

The tool adjusting means includes a chain or the like 80 having short lengths of steel cable 80' spliced to its free ends and secured to opposite ends of the tool as shown at 81, Fig. 1. This chain passes from the top surface of the tool 60 over a pulley 82 supported between the members 37, over the driving sprocket 75, over pulley 83 also supported between the members 37, and thence downwardly and over pulleys 84 and 85 carried between the lower frame members 56, and upwardly to the under surface of the tool 60 where it is secured at 81. The short lengths of steel cable 80' serve to provide greater wear resisting qualities when the tool 60 is in one or the other of its extreme vertical work engaging positions. When the handle 79 is turned by the operator the tool will be moved up or down to the desired position between adjacent rows of tubes. The auxiliary frame is capable of being swung from the position shown in Fig. 1, upwardly and forwardly of the main frame about the pins 35 as a center. This is desirable when it is desired to shift the apparatus from one pair of tubes laterally within the boiler to another pair of tubes, or when inserting or withdrawing the apparatus from the mouth of the boiler or when turning the entire apparatus within the boiler.

Before it is possible to swing the auxiliary frame forwardly and upwardly as above described, it is necessary that the centers defined by the pin 20 and the pins 35 be in alignment. If these pins are not in alignment, the operator may turn the shaft

5 by hand by grasping and turning the knurled nut 8 slightly until the desired condition is established. Then the auxiliary frame may be swung.

6 I have provided means for locking the auxiliary frame in its vertical or suspended position. Cross braces 90 are secured at various intervals to the under side of the main frame to reinforce the frame. The
10 forward brace, indicated at 90' is notched at 91 and 92. A slidable plate 93 is provided with slots 94 adjacent each end and is slidably secured to the plate 1 by means of rivets 95 which pass through the slots in the
15 plate 93, the plate 1 and the brace 90'. A portion of the forward edge of the plate 93 extends outwardly at 96 to form a frame engaging locking member. A locking handle 95 is pivotally supported on the member 96
20 and is adapted to engage either of the notches 92 and 91 to lock or unlock the auxiliary frame as the case may be. When the plate 93 is moved into the position shown in Fig. 2 the member 96 will engage aligned
25 notches 98 formed in the rear walls of the members 37 and the handle 97 will be forced into engagement with the walls of the notch 92 by a spring 99, thereby locking the auxiliary frame against forward vertical movement. When it is desired to permit the
30 auxiliary frame to be swung forwardly and upwardly the handle 97 is unseated from the notch 92 and the plate 93 is shifted toward the notch 91, whereupon the handle will seat itself therein and the member 96 will be out of the path of contact with the ends of the frame members 37. I have provided a latch arm 100 pivoted between the
35 frame members 37, which engages the teeth of the sprocket 75 as shown in Fig. 1. A suitable spring 101 also secured to the frame members 37 has an upturned end 102 which engages a projection 102' on the latch arm 100 to maintain the arm in engagement with the sprocket teeth. When the arm is swung
40 forwardly of the frame 1 this spring engages the seat 103 to securely hold the arm out of operative position. When the arm is in position as shown in Fig. 1, it will prevent backward rotation of the sprocket 75
45 due to the weight of the tool, 60.

In operation when it is desired to use the device for cleaning horizontal boiler tubes, the tool 60 may be turned by hand until its arms extend in a plane substantially parallel with the length of the tubes to be cleaned. The auxiliary frame is inserted into the mouth of the boiler with the tool 60 in the position just indicated, so that the auxiliary
50 frame will pass downwardly through adjacent rows of boiler tubes. The remainder of the apparatus is then passed through the mouth of the boiler and is made to rest upon a selected pair of adjacent boiler tubes. the rollers 42 and 45 permitting ease of
55

movement longitudinally of the tubes. The tool is adjusted for vertical position on the rod 57, so that it is in the proper position to engage the surface of the tubes to be cleaned. As shown in Fig. 1, the tool 60 is
60 disposed in such position. The tool is adjusted vertically by turning the hand crank 79 and causing the chain 80 to travel over the sprocket 75 and the rollers carried by the auxiliary frame until the tool is in the
65 desired position. When the tool is in the proper position, power is applied by starting the electric motor 3 or other source of power. The slide 21 is caused to reciprocate within the casing 26, thereby alternately
70 compressing each of the springs 72. Power is further transmitted through these springs to the lug 70 carried by the plate 68, causing the plate and the rack 66 which is attached thereto to reciprocate and to oscillate
75 the gear 30. The oscillating motion is imparted to the gear 30, transmitted to the rod 57 and finally to the tool 60. As the tool oscillates its tube engaging edges, one in contact with the scaly surface of the tubes, and the other beating or striking there-
80 against, will loosen the scale and cause it to drop between the tubes and to the bottom of the boiler. The tool as shown at 60 is so shaped that its tube engaging edges will
85 contact with four adjacent tubes at one time, thus materially reducing the time in which the tubes may be cleaned and also conserving power and reducing the cost of cleaning. The tool shown in Fig. 7 is adapted to en-
90 gage but two adjacent tubes simultaneously, but it will be seen that the tube engaging edges of this tool cover a greater area than the edges of the tool 60. It is obvious therefore that either of these tools may be used
95 with the result that approximately the same tube surface may be cleaned by each in approximately the same time.

As portions of the tubes engaged by the tool are finished, the operator may turn the handle 79 and elevate or lower the tool 60 as desired, thereby presenting additional uncleaned tube surfaces. The same operation is repeated until the tool 60 has cleaned adjacent tube surfaces in a substantially vertical path from the bottom tube to the uppermost tube. As each section is cleaned the device may be moved along the tubes to clean adjacent sections. When it is desired
100 to move the apparatus to the next adjacent set of tubes, or to swing the apparatus about to clean the uncleaned tube ends, the tool is again placed so that it points in a direction substantially parallel to the length of the tubes and the auxiliary frame is swung forwardly upwardly to a substantially horizontal plane where it is free of the tubes. The entire apparatus may then be shifted to the next set of tubes and the auxiliary frame again lowered and all the operations
105 110 115 120 125 130

again repeated. This may be done until all the tubes in the boiler have been cleaned.

It will be seen that with the novel construction which I have disclosed herein, the tubes within a horizontal boiler may be almost entirely relieved of the scaly formation which forms on the outer walls of the tubes during the operation of the boiler.

Various changes in the size, shape and arrangement of parts of my invention may be made without departing from the spirit of the invention or the scope of the subjoined claims.

What I claim is:

1. A boiler tube cleaner or the like consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depending from the main frame, a tube engaging tool carried by the auxiliary frame and adjustable thereon, means to adjust said tool in said auxiliary frame, and a shock absorbing device carried by the auxiliary frame through which power is transmitted to the tool.

2. A boiler tube cleaner consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depending from the main frame, a tool carried by the auxiliary frame and adjustable vertically thereon, means to adjust said tool on said auxiliary frame and a shock absorbing device carried on the auxiliary frame and movable therewith through which power is transmitted from the power device to the tool.

3. A boiler tube cleaner consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depending from the main frame, a tool carried by the auxiliary frame and adjustable thereon, said tool having substantially arcuate tube engaging surfaces, means to adjust said tool vertically of the auxiliary frame and means to lock the auxiliary frame in its depending position.

4. A boiler tube cleaner consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depending from the main frame, a tool carried by the auxiliary frame and adjustable thereon, means for adjusting said tool on said auxiliary frame, means to lock the auxiliary frame in its depending position and shock absorbing power transmission means carried on said auxiliary frame.

5. A boiler tube cleaner consisting of a main frame, axially adjustable supporting rollers carried on said main frame and adapted to engage adjacent tube surfaces, power means carried by the main frame, an auxiliary frame pivoted to and depending from the main frame, a tool carried by the auxiliary frame and adjustable thereon, means for adjusting said tool and means for locking said auxiliary frame in its depending position.

6. A boiler tube cleaner consisting of a main frame, axially adjustable supporting rollers carried on said main frame and adapted to engage adjacent tube surfaces, power means carried by the main frame, an auxiliary frame pivoted to and depending from the main frame, a tool carried by the auxiliary frame and adjustable thereon, means for adjusting said tool and means for locking said auxiliary frame in its depending position and shock absorbing power transmission means carried by said auxiliary frame.

7. A boiler tube cleaner consisting of a main frame, an auxiliary frame pivoted to and depending from the main frame, a power source carried by the main frame, a tool carried by the auxiliary frame, said tool being adjustable thereon, means for adjusting said tool and shock absorbing power transmission means intermediate said power source and said tool consisting of a casing secured to and movable with the auxiliary frame, a slide movable within the casing, a tool carrying rod having one end extending into the casing and resilient means intermediate said slide and said rod for transmitting power from the power source to the tool.

8. A boiler tube cleaner consisting of a main frame, an auxiliary frame pivoted to and depending from the main frame, a power source carried by the main frame, a tool carried by the auxiliary frame, said tool being adjustable thereon, means for adjusting said tool and shock absorbing power transmission means intermediate said power source and said tool consisting of a casing carried by and movable with the auxiliary frame, a slide movable within the casing, said slide having a slot therein, the end walls of which being upturned to provide stops, a tool carrying rod for one end projecting within the casing, a gear secured to the end of said rod, a leg plate slidable within the casing and in meshing engagement with the gear, said leg plate having a lug projecting through the slot in the said slide, and resilient means intermediate the opposite faces of said lug and the respective upturned end walls of the slot.

9. A boiler tube cleaner consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depending from said main frame, a tool adjustably carried by the auxiliary frame, means for adjusting said tool, axially adjustable supporting means carried by the main frame for engagement with adjacent tube surfaces and means carried by the main frame for preventing lateral displacement of the frame.

10. A boiler tube cleaner consisting of a main frame, power means carried thereby, an auxiliary frame pivoted to and depend-

ing from said main frame, a tool adjustably
carried by the auxiliary frame, means for
adjusting said tool, axially adjustable sup-
porting means carried by the main frame
5 for engagement with adjacent tube surfaces
and means carried by the main frame for
preventing lateral displacement of the
frame, said means consisting of a slotted bar
pivotaly suspended from the main frame,
10 so that it will project downwardly between
adjacent rows of tubes.

11. A boiler tube cleaner consisting of a
main frame, power means carried thereby,
an auxiliary frame pivoted to and depending

from the main frame, a tool carried by the 15
auxiliary frame and adjustable thereon and
means for adjusting said tool, said means
consisting of a plurality of pulleys carried
by the auxiliary frame, a hand operated
driving device carried by the auxiliary 20
frame, a driving sprocket and a chain
threaded over said pulleys and said sprocket,
the ends of said chain being secured to op-
posite ends of said tool.

In testimony whereof I hereunto affix my 25
signature this 4th day of January, 1926.

ERVING HATHAWAY.