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2 Sheets-Sheet 1

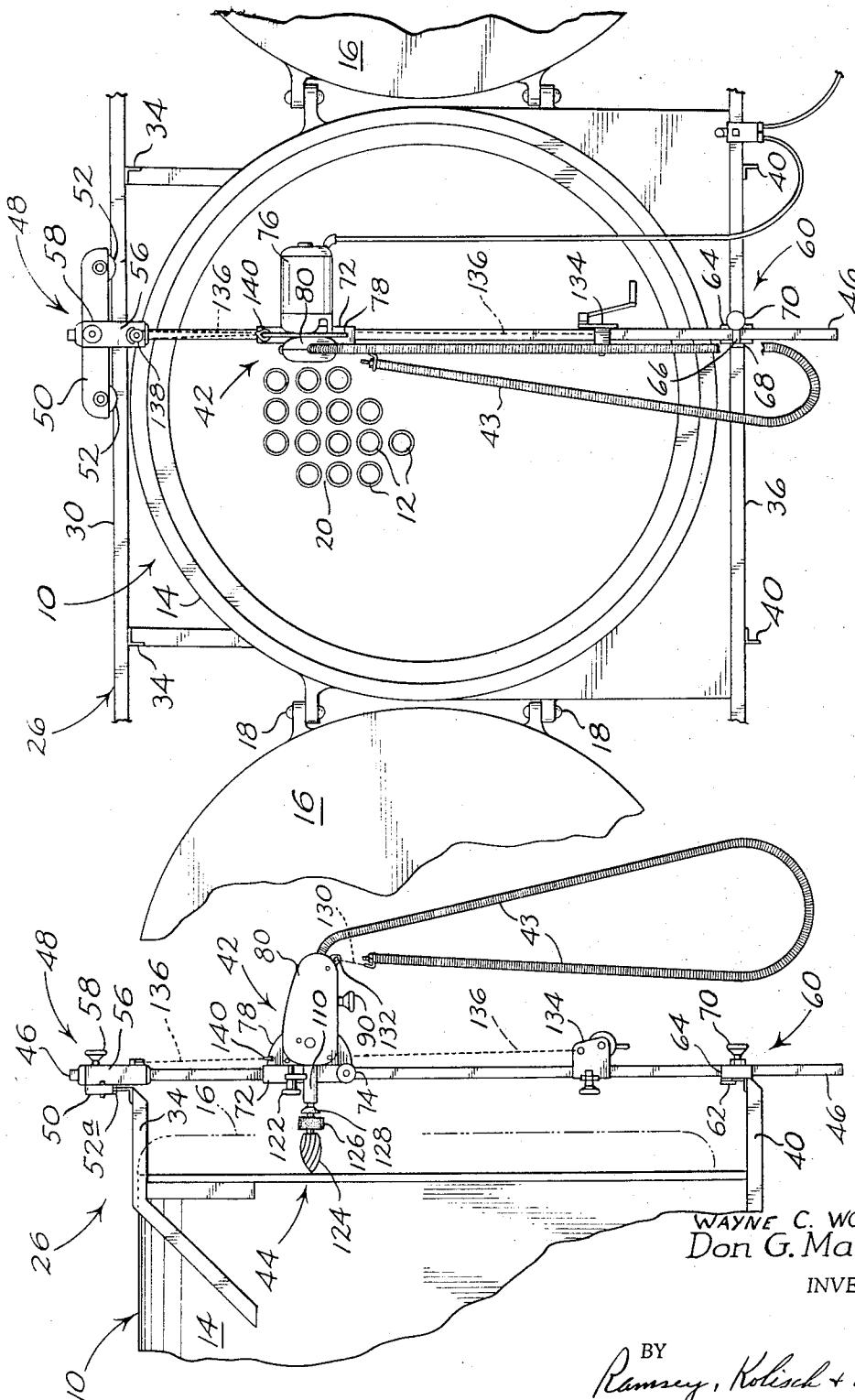


Fig. 2.

Fig. 1.

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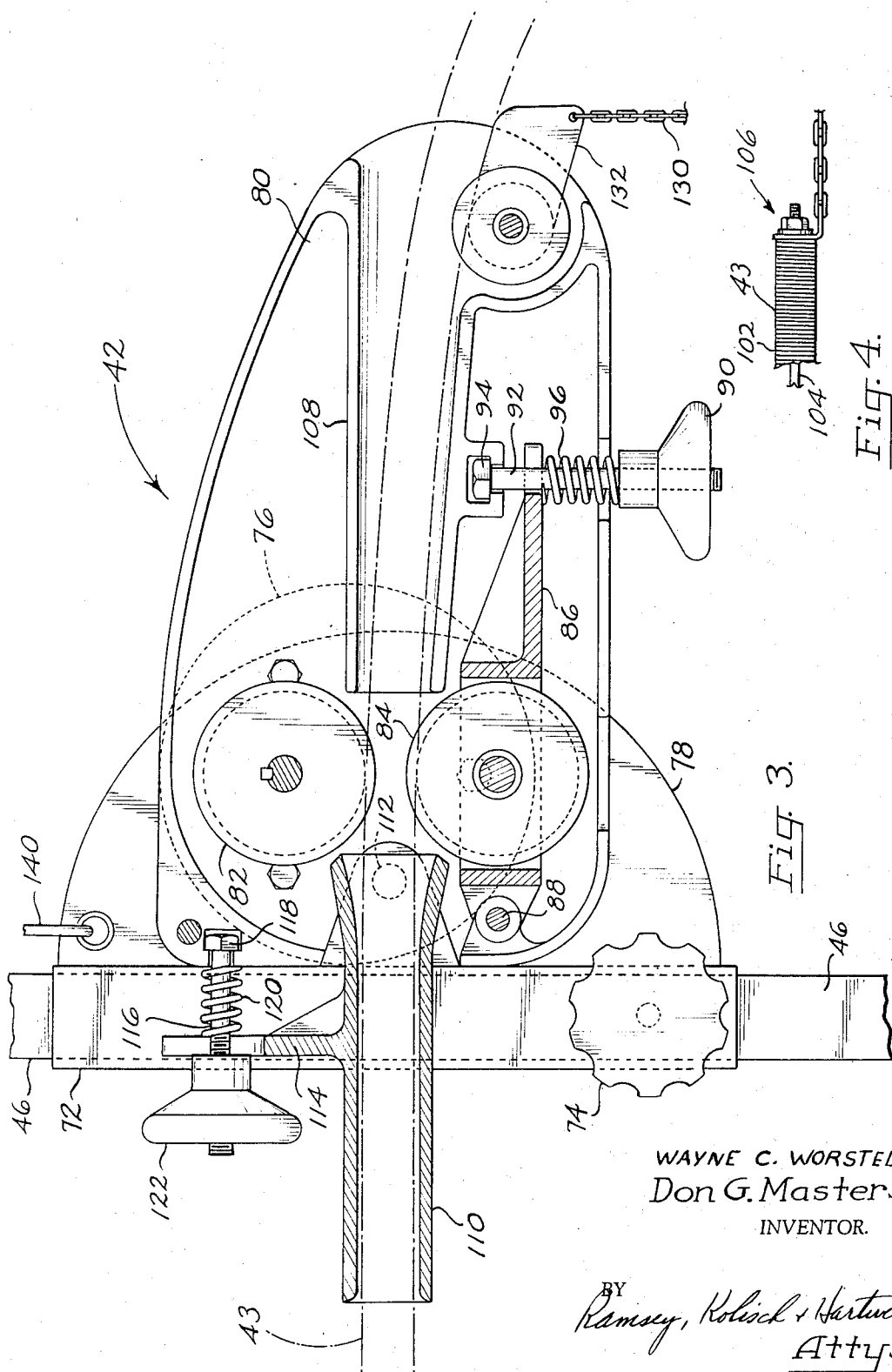
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BOILER TUBE CLEANING APPARATUS

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8 Claims. (Cl. 15—104.1)

This invention relates to apparatus for cleaning the tubes of a boiler.

A common form of boiler includes multiple fire tubes disposed side by side and parallel to each other in the boiler, which periodically must be cleaned of soot and scale in order to maintain the efficiency of the boiler. Studies have shown that the presence of only a small accumulation of scale, ash or soot on the walls of boiler tubes will result in a considerable loss of efficiency. This invention more specifically concerns cleaning apparatus which features a shaft having a boiler tube cleaning instrument mounted on one end thereof, and an ejector which may be operated to thrust the shaft inside a tube so that the cleaning instrument thereon moves along the inside of the tube with such instrument then scraping and brushing the tube.

A general object of this invention is to provide cleaning apparatus of this description which includes a power-operated ejector unit for thrusting a shaft forwardly into a boiler tube, and novel means mounting such unit whereby the same is supported in such a manner as to be fully braced against the reaction forces set up in the unit when the unit is operated, the mounting for the unit at the same time enabling the unit to be readily moved to place it in proper position for cleaning successive ones of a plurality of tubes.

More specifically, an object of this invention is to provide tube cleaning apparatus, which includes tracks extending horizontally adjacent the top and bottom of a boiler, and an upright standard extending between these tracks and anchored adjacent its ends on the tracks by means accommodating travel of the standard in a direction paralleling the tracks, such standard including a vertically movable carriage upon which is mounted the ejector unit previously generally described.

Included in the objects of this invention is the provision of a novel construction whereby the standard may be released from the means anchoring the lower end thereof, to enable the base of the standard to be swung out when desired, thus to produce greater freedom of movement in the standard, whereby when the same is shifted laterally it may be moved to one side of obstructions.

Yet another object is to provide novel mechanism for ejecting a shaft having a cleaning instrumentality mounted thereon toward and thence into a boiler tube.

A further object is to provide cleaning apparatus as above described featuring a novel shaft which is flexible and at the same time compression and tension transmitting. The flexibility in the shaft is important in permitting a reduction in the space required to operate the cleaning apparatus.

Other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawings, wherein

FIG. 1 is a side elevation of apparatus constructed according to this invention, showing portions of a boiler and with cleaning apparatus mounted in front thereof;

FIG. 2 is an end elevation of the apparatus illustrated in FIG. 1;

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FIG. 3 is a cross sectional view, taken generally along the line 3—3 in FIG. 2, and on an enlarged scale, illustrating details of an ejector unit employed to thrust a shaft into a tube for cleaning purposes; and

FIG. 4 is an enlarged view of portions of a shaft used in the apparatus for mounting a tube cleaning instrument.

Referring now to the drawings, in FIGS. 1 and 2 a boiler 10 is indicated, which has mounted therewithin a bank of fire tubes, indicated individually at 12. A shell 14 surrounds these tubes, and as is common with boilers, doors 16 may be provided that normally close off the end of the boiler and that are swung apart on hinges 18 to open up the end of the boiler for cleaning purposes. Tubes 12 within the boiler are shown extending through a plate 20 mounting the tubes in place. The tubes at opposite ends of the boiler have open ends.

In a given installation, it is not uncommon to find a number of the boilers of the type described mounted side by side. With the apparatus of the invention a plurality of such boilers may be serviced by cleaning the fire tubes of each.

As contemplated herein, a stationary framework is provided, which is mounted adjacent the ends of a series of boilers of the type described. This framework supports a power-driven ejector unit which is actuated to produce cleaning of a tube. The framework accommodates movement of the ejector unit in a direction extending transversely of the boilers, whereby successive vertical rows of tubes may be cleaned using the same ejector unit. In FIGS. 1 and 2, this framework is indicated generally at 26.

Considering details of framework 26, at 30 there is illustrated an upper track, comprising a rail which extends transversely of boiler 10 and which is mounted slightly in front of one end of the boiler. Secured, as by welding, to the shell of boiler 10 is a bracket structure 34, which is effective to hold rail 30 securely in a fixed position. While rail 30 has been shown broken off, in a multiple boiler installation, the rail extends as shown across the ends of all boilers.

Paralleling rail 30, and shown extending transversely of the boiler adjacent the bottom of the boiler is another track 36. This track also may comprise a rail, which is mounted in a fixed position, by means of brackets 40 secured to the boiler adjacent the base of the boiler.

According to this invention, a power-driven ejector unit, shown generally at 42, is actuated to thrust forwardly a shaft 43 having a cleaning instrument mounted on one end, shown generally at 44, with the cleaning instrument then moving down the interior of a fire tube. This produces reaction forces in the ejector unit, whereby the same tends to be thrown backwardly away from the boiler and the tube being cleaned. The upper and lower tracks described provide a mounting for this ejector unit accommodating movement of the ejector unit in a transverse direction, while ruggedly bracing the unit so as to prevent the same from being thrown backwardly when the same is operated.

Further describing the mounting for the ejector unit, an upright standard or rail is shown at 46. Mounting the upper end of standard 46 on rail 30 is a trolley or traveling anchoring means 48, including a body 50 with flanged wheels 52 journaled thereon. A sleeve or socket 56 having standard 46 extending upwardly therethrough is joined to body 50. A hand-wheel adjusted screw 58 mounted on this sleeve may be tightened to clamp the standard in a given position within the sleeve. In the construction described, the top edge of rail 30 supports

the weight of the apparatus, and flanges 52a of wheels 52, by engaging the back side of rail 30, i.e., the side facing the boilers, function to prevent the trolley from being forced to the right in FIG. 1, or forwardly of the boiler and off the track.

The bottom end of standard 46 is mounted on the lower track through traveling anchoring means or guide 60. This guide includes a plate 62 that is slidable along the back side of rail 36, and in front of this plate a channel-shaped part 64 which fits about standard 46. Pivoted to channel-shaped part 64 is a gate 66 (pivoted at 68), which is detachably joined to part 64 in back of it by a hand-wheel adjusted screw 70. Thus, by loosening the hand-wheel screw and swinging the gate outwardly, the base of standard 46 is released. The base of the standard when it is released, may be swung outwardly from the boiler and rail 36, with the standard pivoting above an axis generally corresponding to the top of rail 32 (trolley 48 being tiltable to some extent on the top of rail 32). This is an important feature, since in boiler installations, furnaces and other equipment are often found in front of the boilers, and these would offer an impassable obstruction to a standard whose base was constrained to movement along rail 36. By providing the gate and because the standard is swingable as described, the standard is easily shifted past such an obstruction.

Power-driven ejector unit 42 is mounted on a carriage 72 mounted for up and down movement on the standard. At 74 is a hand-wheel adjusted screw, which may be tightened to secure the carriage in place, in different positions on the standard. Also mounted on the carriage is an electric motor 76. Motor 76 and unit 42 are on opposite sides of a plate 78 which is part of the carriage.

Referring now to FIG. 3, unit 42 comprises a housing 80 having journaled therewithin oppositely disposed grooved wheels 82, 84, also referred to as clamping wheels. Wheel 82 constitutes a power-driven wheel, and is connected directly to the output shaft of motor 76. Wheel 84 is a pressure-applying wheel, and is journaled on a member 86 which is pivoted at 88 within the housing. A hand-wheel adjusted nut 90 is screwed onto a stud 92, and the latter is anchored at 94 within the housing. Encircling stud 92 is a spring 96, interposed between member 86 and hand-wheel adjusted nut 90. Spring 96 exerts a bias on member 86, and it will be obvious that by tightening the hand-wheel adjusted nut, a greater compressive force is exerted by the spring on member 86, whereby wheel 84 is urged with greater force toward wheel 82.

Shaft 43 which has cleaning instrument 44 mounted thereon, and referring to FIG. 4, comprises a spring steel, helically wound, hollow body 102. Within body 102 is a cable 104. The cable extends along the inside of the spring steel hollow body, and is secured to the body at the ends of the body by an anchor connection such as the one shown at 106 in FIG. 4. With this construction the shaft is flexible, since the windings of the hollow body may flex with respect to each other and at the same time, the shaft constitutes a thrust transmitting member, in that when the same is thrust forwardly it will transfer this thrust to the cleaning instrument mounted at its forward end. Further, the shaft is a tension-transmitting member, and on being withdrawn will not stretch out because of the inclusion of cable 104 within it which is nonextensible.

Shaft 43 is moved forwardly into a tube and withdrawn from the tube by the power-driven ejector unit, more specifically, by the action of wheels 82, 84 within the unit which engage the shaft on opposite sides. As can be seen in FIG. 3, the shaft enters housing 80 through a funnel-shaped portion 108 of the casing. After passing between wheels 82, 84, the shaft extends through a nozzle part or shaft guide 110, which is pivoted within the housing at 112.

The nozzle part is included in order to afford control

over the direction in which the shaft is fed out from the ejector unit. It will be noted that an ear 114 is provided which projects upwardly from the nozzle part, and that a stud 116 anchored to the housing at 118 extends through a slot in ear 114. A compression spring 120 encircles the stud, and a hand-wheel adjusted nut is shown at 122 which is screwed onto stud 116. On tightening the hand-wheel adjusted nut, the nozzle part swings upwardly, and on loosening the nut, the nozzle part swings downwardly, spring 120 functioning to keep ear 114 tight against nut 122. With the nozzle part swung upwardly, the shaft where it extends out from the nozzle part is directed upwardly, and on swinging the part downwardly, the shaft is directed downwardly.

As can be seen in FIG. 1, cleaning instrument 44 includes a scraper 124, and a brush 126. These are mounted on an end of the shaft through a fitting 128. The opposite end of the shaft may be connected, as by chain 130, to an ear 132 which extends out from the casing of ejector unit 42.

Completing the description of the invention, to raise and lower carriage 72 and the ejector unit, a winch 134 and a cable 136 is provided. The lower end of the cable is wrapped around the drum of the winch, and from thence the cable passes upwardly over a pulley 138 and downwardly to a connection 140 with plate 78 of the carriage. From this it should be obvious that on proper actuation of the winch, the carriage may be shifted either upwardly or downwardly on the standard.

Explaining how the apparatus may be used to clean the tubes in a boiler, the carriage may first be placed at an elevation such that the forward end of the shaft projecting from ejector unit 42 and instrument 44 are at substantially the same level as a bank of tubes within the boiler. Electric motor 76, which is reversible, is then operated, first to advance the shaft into a tube, with the tube then being cleaned. An operator, as by noting the extent to which the shaft has traveled into a tube, determines when instrument 44 has traveled the length of the tube. The operator may then reverse motor 76, whereby the shaft and instrument 44 are withdrawn.

An operator may then easily shift the standard, using the trolley supporting it at the top, and the guide at the bottom, to place the shaft in front of a tube next to the tube just cleaned. The cleaning operation may then be repeated. On cleaning the tubes in a given level, the winch may be operated to either lower or raise the carriage, depending upon which level of tubes is to be cleaned next. The operation may then be repeated.

Where it is desired to make small adjustments in the direction in which the shaft is thrust forwardly from the ejector unit, such can be done by proper manipulation of hand-wheel nut 122. This feature is especially important when cleaning a level of tubes that otherwise would be too high or too low to be reachable with unit 42 with a nozzle part pointing straight ahead.

An important part of the invention is that during movement of the shaft into and along a dirty tube, the ejector unit is ruggedly braced to resist reaction forces set up therein. This is because both top and bottom positions of the standard are held securely from displacement laterally of the tracks. The structure is relatively compact, and as already noted, the standard may be released adjacent its bottom from the lower guide, to accommodate its being swung out and around obstructions such as furnaces and the like.

Because the shaft is flexible, a great deal of space to provide clearance for the shaft when the same is retracted is not needed.

While an embodiment of the invention has been described, changes and variations are possible without departing therefrom. It is desired to cover all modifications and variations as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

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It is claimed and desired to secure by Letters Patent:

1. Apparatus for cleaning tubes in a boiler comprising upper and lower substantially horizontal tracks mounted in a stationary position adjacent the top and bottom of the boiler, respectively, and extending transversely of the tubes,
 - each of said tracks including an elongated rail having an upper edge, and a back side facing one set of ends of the tubes,
 - an upright standard substantially spanning the space between said rails,
 - a first traveling anchoring device supported by and riding on said upper track including means engaging said back side and upper edge of the rail in the upper track and attaching means securing the upper end of said standard to said first anchoring device with the device movable along said upper track while secured to the standard,
 - a second traveling anchoring device supported by and riding on said lower track including means engaging the back side of the rail in the lower track and attaching means securing the lower end of said standard to said second device with the second device movable along said lower track,
 - an ejector unit including power-operated means for thrusting a boiler tube cleaning instrument into and along the length of a boiler tube, and
 - means mounting said ejector unit on said standard with the unit entirely supported by the standard accommodating positioning of the unit at various positions on the standard.
2. The apparatus of claim 1, wherein the attaching means securing the lower end of the standard to said second traveling anchoring device includes adjustable means accommodating release of the standard whereby the standard's lower end may be swung laterally and forwardly of the bottom track and said first traveling anchoring device is shiftable on said upper track while riding on the track to accommodate such lateral swinging of the standard which is attached to the device.
3. Apparatus for cleaning tubes in a boiler comprising upper and lower substantially horizontal tracks mounted in a stationary position adjacent the top and bottom of the boiler, respectively, and extending transversely of the tubes,
 - an upright standard substantially spanning the space between said tracks,
 - a traveling anchoring device supported by and riding on said upper track and attaching means securing the upper end of said standard to said device with the device movable along said upper track while secured to the standard,
 - said last-mentioned device being swingable about an axis substantially paralleling the track,
 - another traveling anchoring device supported by and riding on said lower track and attaching means securing the lower end of said standard to said other device with the device movable along said lower track,
 - said attaching means for said other anchoring device including an openable gate which when opened releases the standard adjacent its lower end whereby its lower end may be swung laterally and forwardly with the standard then pivoting about the upper anchoring means,
 - an ejector unit including power-operated means for thrusting a boiler tube cleaning instrument into and along the length of a tube, and
 - means mounting said unit on the standard with the unit entirely supported by the standard.
4. In boiler tube cleaning apparatus,
 - an upright standard adapted to be mounted in front of an end of a boiler,
 - an upper and a lower horizontal track adapted to be mounted in front of the boiler, first and second an-

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- choring devices supported by and riding on said upper and lower tracks, respectively, attaching means securing the upper end of said standard to said first device with the device movable along said upper track while secured to the standard and attaching means securing the lower end of said standard to said second device with the device movable along said lower track while secured to the standard,
- a carriage mounted on the standard for movement up and down thereon,
- means mounted on the standard operable when actuated to produce such up and down movement, and
- an ejector unit entirely supported on said carriage for thrusting a shaft into a boiler tube and along the length thereof,
- said unit including a shaft guide constructed to have a shaft move lengthwise therethrough and spaced laterally to one side of said standard, and power-operated means for advancing a shaft through said shaft guide.
5. The apparatus of claim 4, wherein a flexible shaft extends through the shaft guide, and the shaft guide comprises an elongated nozzle, and said nozzle has an end which is movable up and down to change the direction along which a shaft travels on passing through the nozzle.
6. In apparatus for cleaning the tubes of a boiler,
 - an elongated flexible shaft,
 - a power-operated unit adapted to be mounted in front of one set of ends of the tubes in the boiler,
 - said power-operated unit including a housing,
 - an elongated shaft guide receiving said shaft and constructed to have said shaft moved lengthwise therethrough with guiding of said shaft toward a boiler tube,
 - means pivotally mounting one end of the shaft guide in said housing,
 - means operatively interposed between the housing and shaft guide for swinging the shaft guide about its pivot connection with the housing, and
 - power-operated means mounted in the housing adjacent said one end of said shaft guide clamping onto said shaft for forcing the same through said guide in either of opposite directions.
7. The apparatus of claim 6, wherein said power-operated means comprises a pair of oppositely disposed clamping wheels journaled in said housing, motor means connected to one of the wheels for rotating the same under power, and means operatively connected to the other wheel exerting a bias on the wheel whereby the two wheels are urged together thus to clamp onto a shaft, the latter means being adjustable to change the bias exerted thereon whereby the clamping pressure exerted by the wheels may be changed.
8. Apparatus for cleaning tubes in a boiler comprising upper and lower substantially horizontal tracks mounted in a stationary position adjacent the top and bottom of the boiler, respectively, and extending transversely of the tubes;
 - an upright standard substantially spanning the space between said tracks;
 - a traveling anchoring device movably supported by and rideable on said upper track, and attaching means securing the upper end of said standard to the device with the standard depending from the device and movably with the device along said track while secured to the device;
 - a traveling anchor device supported by and riding on said lower track, and means mounting the lower end of said standard on said second-mentioned device movable along said lower track while having the standard mounted on it;
 - an ejector unit including power-operated means for thrusting a boiler tube cleaning instrument into and along the length of a boiler tube; and

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means mounting said ejector unit on said standard, with the unit entirely supported by the standard, accommodating positioning of the unit at various positions on the standard with said unit held stationary in said positions.

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References Cited

UNITED STATES PATENTS

690,878 1/1902 Roan ----- 15—104.1
698,193 4/1902 Forsyth et al. ----- 15—104.1

8

782,897 2/1905 Casaday ----- 15—104.1
1,780,435 11/1930 Miller.
2,244,735 6/1941 Silverman ----- 15—104.3
2,631,114 3/1953 O'Brien ----- 15—104.3 X
2,891,268 6/1959 Cheadle ----- 15—104.2

FOREIGN PATENTS

833,209 4/1960 Great Britain.
47,085 3/1909 Switzerland.

10 ROBERT W. MICHELL, *Primary Examiner.*