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H. J. FORSTER

2,173,606

TUBE SCRAPER

Filed Aug. 5, 1935.

FIG. 1.

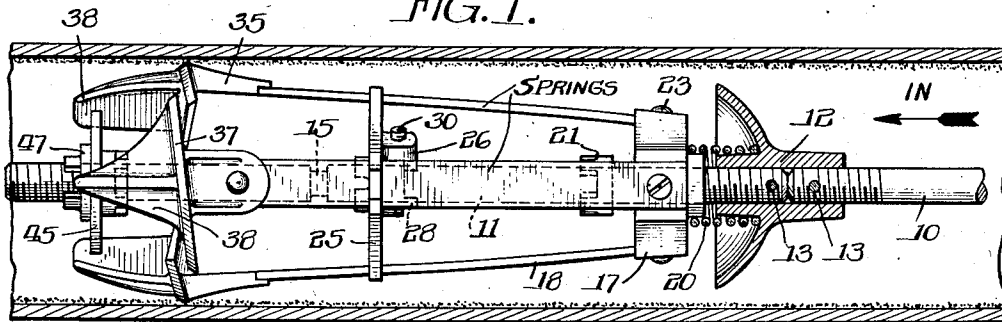


FIG. 2.

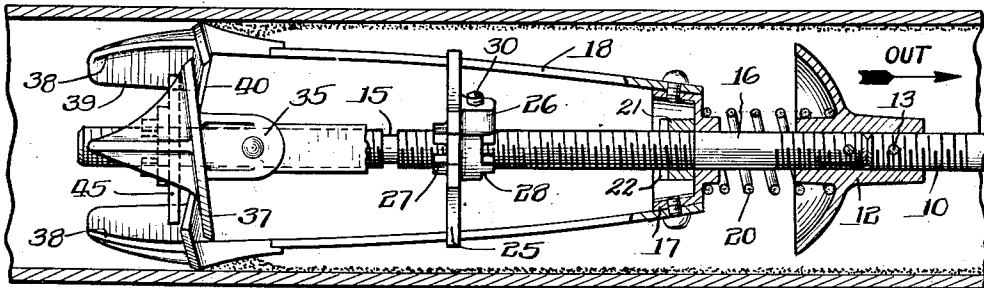


FIG. 3.

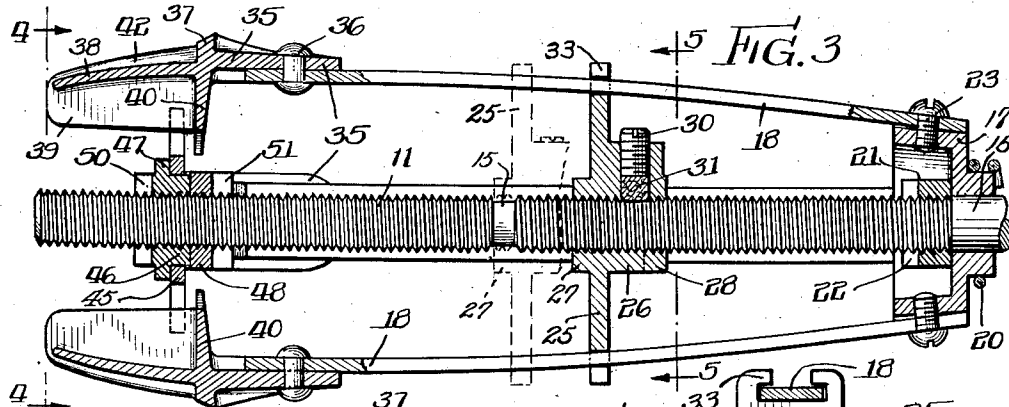


FIG. 4.

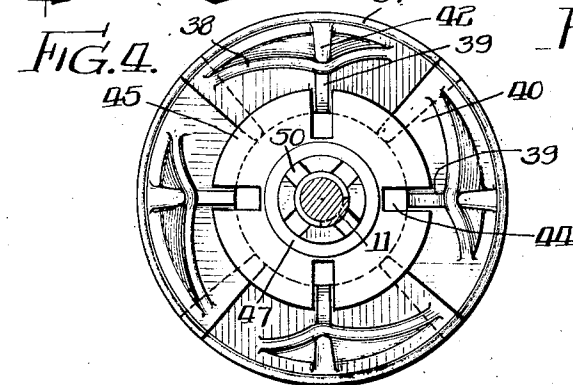
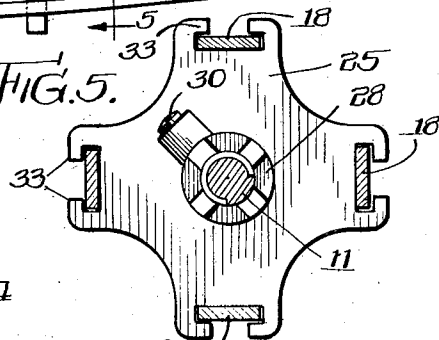


FIG. 5.



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UNITED STATES PATENT OFFICE

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TUBE SCRAPER

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Application August 5, 1935, Serial No. 34,708

10 Claims. (Cl. 15—104.18)

This invention relates to cleaning devices, and particularly to devices for scraping or cleaning the interior of elongated cylindrical objects such as boiler tubes, pipes and the like. This application relates to a modification of the device disclosed in my copending application for Tube scraper filed August 30, 1933, Serial No. 687,399, issued as Patent No. 2,018,124, dated October 22, 1935.

It is an object of the invention to provide an effective tube cleaner which is of simple construction and economical to make, and more particularly to provide a cleaner of simplified construction wherein the pressure of the scrapers against the tube walls is varied automatically as the direction of travel of the scraper through the tube is changed and wherein the pressure of the scrapers may be further adjusted at the will of the operator by manipulation of the cleaner operating rod while the cleaner remains in the tube.

It is a further object of the invention to provide a tube cleaner having means for varying the operating forces required to effect the adjustment of the scraper pressures while the cleaner is in the tube, and having means for locking the adjustment means from operation when conditions are suitable to a non-adjustable cleaner.

It is a still further object of the invention to provide in a tube cleaner means automatically operable as the cleaner is withdrawn from the tube to place a barrier wall across the tube to draw the dirt scrapings outwardly from the tube, a part of said means serving as a guiding arrangement for the scrapers.

Other objects and advantages of the invention will appear from the following specification, when taken in connection with the accompanying drawing, wherein there will be disclosed certain preferred embodiments of the invention.

In the drawing wherein like reference numerals refer to like parts throughout:

Figure 1 is a side view partly in section showing the cleaner within a tube in the condition which it normally assumes as it is pushed inwardly therethrough.

Figure 2 is a similar view showing the cleaner in the position which it assumes as it is drawn outwardly from the tube.

Figure 3 is a partial longitudinal sectional view of the cleaner showing certain of the operating parts in more detail.

Figure 4 is a transverse section taken along the line 4—4 of Figure 3, and

Figure 5 is a transverse section taken along the line 5—5 of Figure 3.

In the embodiment of the invention shown in the drawing for purposes of illustration the reference numeral 10 indicates the operating rod which extends rearwardly or outwardly from the tube and which is adapted to be grasped by the operator to effect the manipulation of the cleaner while within the tube. The operating rod may be any suitable form of flexible or multiple-joined rod commonly used in tube cleaners where the tubes are relatively inaccessible, or it may be a simple elongated solid rod. The operating rod is secured to the mandrel 11 of the cleaner by means of a bell-coupling member 12, the coupling having threaded engagement with both the operating rod and the mandrel and being pinned thereto by pins 13. The mandrel is threaded along its entire length except for a cut-away portion 15 and the non-threaded bearing portion 16 which carries the saddle member 17 to which the flexure springs 18 are rigidly secured. The saddle is mounted for free rotational and sliding movement along the bearing portion 16 of the mandrel. A coiled compression spring 20 loosely embraces bosses provided upon the bell-coupling and the saddle. The compression spring tends to separate the saddle and coupling members or to urge the saddle longitudinally of the mandrel, inwardly of the tube or to the left as shown in the drawing. The saddle is limited in its movement along the mandrel to the right by engagement with the coupling member and to the left by a castellated nut 21 threaded upon the mandrel. The nut, after being located in proper position, is secured against rotational movement on the mandrel by mutilating the mandrel threads between the castellated projections 22 of the nut. The elongated flexure springs 18 are secured at their ends to the saddle by means of screws 23 or other suitable securing means.

As best indicated in Figure 5, four flexure springs are provided in quadrature around the mandrel, although other suitable numbers of springs could be used, if desired. The springs are engaged intermediate their lengths by the flange 25 of the castellated expander nut 26 which is threaded upon the mandrel and which has sets of castellated projections 27 and 28 on the opposite sides thereof. The expander nut carries a threaded set-screw 30 which engages at its inner end against a plunger 31 which is adapted to engage the threads of the mandrel. The plunger 31 may be of suitable fibrous material or composition such as Bakelite or the like. It is preferably sufficiently soft so that its thread engaging portion conforms to the mandrel threads so as to

avoid mutilating the threads as the plunger is pushed thereagainst by means of the set screw.

The flexure springs engage within grooves formed peripherally of the flange 25 of the expander nut, as best shown in Figure 5, and preferably the flange has projections 33 formed thereon which extend over the tops of the springs and hold them in position within the grooves. The springs carry the scraper members 35 at their forward ends, there being one scraper member secured to each spring by any suitable means such as rivets 36. The scraper members comprise scraping transverse blade portions 37, guide portions 38 extending forwardly from the blades, webs 39 extending radially inwardly towards the mandrel from the guide portions, and aprons 40 extending inwardly from the blades and arranged transversely of the cleaner. The blades 37 are of a curvature corresponding to the walls of the tube to be scraped, and are suitably sharpened at their rear edges to produce an effective dirt cutting portion. The guides 38 have ridges 42 formed thereon. The guides with their ridges are tapered inwardly in their forward extension from the blades and by reason of their shaping and positioning facilitate the entrance of the cleaner into the end of the tube.

The webs 39, as best shown in Figure 4, engage within slots 44 cut radially inwardly from the periphery of a disk 45 mounted upon the sleeve portion 46 of a castellated nut 47 threaded upon the forward end of the mandrel. A second castellated nut 48 is threaded upon the mandrel in engagement with the sleeve portion 46 of the nut 47. The sleeve 46 is slightly longer than the thickness of the disk 45 so that the disk may loosely embrace the sleeve for free rotation thereon even though the two nuts are brought tightly into engagement. In assembling these parts the nuts 46 and 47 are threaded tightly into engagement with each other upon the mandrel, and after being located in proper position thereon, the mandrel threads are mutilated between the castellated extensions 50 and 51 of the nuts whereby the nuts are permanently secured in position. The slots 44 in the disk serve to guide the webs 39 and the scraper members in their movements.

The aprons 40 overlap to form a partial transverse barrier across the tube, the central opening of which is closed by the disk 45 when the latter shifts to its position as shown in Figure 2 as the scraper is drawn outwardly from the tube. That is, the aprons, together with the disk when in longitudinal juxtaposition, as shown in Figures 2 and 3, form a substantially complete transverse barrier across the tube which causes dirt and the like, displaced by the scraper blades, to be drawn outwardly from the tube as the cleaner is withdrawn.

In the operation of the device, the expander nut 26 is first adjusted, having regard to the size of the tube to be cleaned, to a position longitudinally of the mandrel which will cause the cleaner structure to assume the position shown in Figure 1 as the cleaner is pushed inwardly through the tube by means of the operating rod. This adjustment is effected by producing relative rotation between the mandrel and the blade structure whereby to thread the expander nut along the mandrel to the desired position. With this adjustment, as the cleaner is pushed inwardly through the tube, as shown in Figure 1, the coil compression spring 20, which is a relatively weak spring, lightly urges the saddle 17 to

the left. The relatively strong flexure springs 18 are inclined with respect to the mandrel axis. Accordingly, under the yielding pressure of the compression spring 20, the expander nut flange 25 exerts a light outward camming pressure against the flexure springs 18 to lightly urge the scraper blades into engagement with the tube walls. As indicated in Figure 1, the saddle assumes an intermediate position upon the mandrel portion 16 between the nut 21 and the coupling 12, and the yielding pressure of the spring 20 insures that the blades will remain in light contact with the tube walls as the cleaner is pushed inwardly. In the event that the scraper blades encounter an unusual obstruction in the tube, the compression spring 20 will yield to allow the saddle to engage the coupling 12. This action moves the flexure springs to the right relative to the expander nut and so relieves the pressure of the scraper against the tube walls. As the saddle engages the coupling the latter will positively push the saddle and blade structure over the obstruction. If the obstruction is, so severe that the scraper blades cannot pass it, the operating rod may be rotated relative to the blades to cause the expander nut to be threaded to the left along the mandrel which movement will draw the blades inwardly sufficiently to allow the obstruction to be passed.

As the direction of travel of the cleaner is reversed at the end of the in-stroke, and the operating rod is withdrawn from the tube, the cleaner automatically assumes the condition shown in Figure 2. Due to the friction between the scraper blades and the tube walls, movement of the blade structure is retarded as the mandrel is withdrawn until the nut 21 engages the saddle 23. This relative movement between the mandrel and the cleaner blade structure causes the expander nut to move to the right relative to the flexure springs whereby, due to the inclination of the springs, the expander nut now exerts a much greater outward force thereon. Whereas on the in-stroke the scraper blades lightly engage the tube wall to merely remove loose dirt, on the outward stroke the pressure of the scrapers against the tube walls is automatically increased to effect a firm scraping action. By virtue of this arrangement, there is no danger that the scraper pressure will be sufficient to buckle the operating rod on the in-stroke of the cleaner, and at the same time the scraper pressure is automatically increased as the cleaner is withdrawn from the tube to perform an effective scraping operation. Further, by producing relative rotation between the mandrel and the blade structure, the operator may at any time, either on the insertion or withdrawal of the cleaner, cause the expander nut to move longitudinally of the mandrel relative to the flexure springs, thereby varying the pressure of the scrapers against the tube walls. This adjustment may be effected while the cleaner is within the tube. On the withdrawal stroke the nut 21 engages the saddle 23 which, by means of the springs 18, pulls the scrapers through the tube.

As will be seen by comparison of Figures 1 and 2, the aprons 40 and the disk 45 are separated as the cleaner is pushed inwardly through the tube whereby to permit the cleaner to pass loose dirt and the like within the tube; but on the withdrawal stroke, the aprons and disk shift into relative juxtaposition to form a substantially complete transverse barrier across the tube which insures that dirt dislodged by the scrapers will

be withdrawn with the cleaner. The disk 45, while forming a part of the barrier structure, at the same time constitutes the guiding means for the webs 39 and the blade structure of the cleaner.

The cut-away portion 15 upon the mandrel is normally to the left out of the operating range of the expander nut. In the event that it is desired to increase the friction between the nut and the mandrel, the nut may be screwed along the mandrel until the castellated portions 27 or 28 thereof are in line with the mandrel cut-away portion. With the parts in this position the castellated extensions may be depressed inwardly toward the mandrel axis to thereby increase the friction between the expander nut and the mandrel. By this means the rotational operating forces required to effect adjustment of the blade pressures by rotation of the operating rod may be increased to the desired degree whereby to prevent accidental relative movement between the expander nut and the mandrel under any given operating conditions. In the event a number of tubes of like character and equally dirty are to be cleaned, the set screw 30 may be operated after the expander nut has been moved to the proper position whereby to lock the expander nut in such position. Operation of the set screw causes the plunger 31 to engage the mandrel threads and lock the expander nut. At the same time the mandrel threads will not be mutilated due to the character of the plunger.

It is obvious that various changes may be made in the embodiments of the invention specifically set forth for purposes of illustration without departing from the scope thereof. The invention is, therefore, not to be limited to the precise embodiments shown and described, but only as indicated in the following claims.

The invention is hereby claimed as follows:

1. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, a flexure spring extending along the axis of the mandrel at an angle thereto and rigidly secured at one end against movement radially away from the mandrel, expander means carried by the mandrel slidably engageable with the spring intermediate its length for forcing the other end of the spring away from the mandrel axis, and a scraper member engageable with the tube wall rigidly carried by said last named end of the spring, the spring and expander means being relatively shiftable axially of the mandrel in response to a reversal of the direction of movement of the mandrel within the tube whereby to vary the pressure of the scraper member against the tube wall, resilient means for urging the secured end of the spring and the expander means toward each other thereby tending to maintain said pressure, and screw threaded operating means manually operable to effect relative axial shiftable movement between the spring and the expander means while the cleaner is in the tube.

2. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, a saddle mounted on the mandrel, a flexure spring extending along the axis of the mandrel at an angle thereto, means for rigidly securing the inner end of the spring to said saddle, expander means carried by a threaded portion on the mandrel engageable with the spring intermediate its length for forcing the outer end of the spring away from the axis of the mandrel, a scraper member engageable with the tube wall rigidly carried by the outer end of the spring, the ex-

pander means being fixed axially of the mandrel but being rotatable thereon and the saddle being freely slidable along and rotatable on the mandrel axis whereby due to the frictional drag of the scraper against the tube wall the spring and expander means are relatively shifted axially of the mandrel automatically upon the reversal of the direction of travel of the scraper along the wall, resilient means for urging the saddle along the mandrel axis toward the expander means, abutments carried by the mandrel for limiting the movement of said saddle, and means to hold said expander means against rotation relative to said spring whereby upon mandrel rotation said expander means may be threaded therealong, the frictional engagement of the scraper against the tube wall holding the expander means against rotation.

3. A tube cleaner comprising a rotatable mandrel adapted to be inserted into a tube to be cleaned, a flexure spring extending along the axis of the mandrel at an angle thereto, a saddle freely slidable along and rotatable on the mandrel to which the inner end of the spring is secured, expander means threadedly secured to a threaded portion of the mandrel slidably but non-rotatably engageable with the spring intermediate its length for forcing the outer end of the spring away from the mandrel axis, resilient means for urging the saddle toward the expander means, and a scraper member engageable with the tube wall rigidly carried by the outer end of the spring, said resilient means being adapted to yield as the scraper member encounters obstructions within the tube whereby to permit the saddle to move away from the expander means to reduce the pressure of the scraper member against the tube wall, and the slidable but non-rotatable engagement between the expander means and the spring serving to hold the expander means from rotation upon rotation of the mandrel if said scraper member is held from rotation, whereby upon mandrel rotation the expander means will be threaded along the mandrel to vary its pressure of engagement against the spring.

4. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, a saddle mounted on said mandrel, a plurality of circumferentially disposed scrapers extending axially of the mandrel and secured at one of their ends to the saddle, said scrapers being free to move at their other ends radially toward and away from the mandrel axis and having portions thereon forming a partial transverse barrier across the interior of the tube when the scrapers are in operative position against the tube wall, a member carried by the mandrel normally spaced from said scraper portions, said saddle and member being arranged for relative movement axially of the mandrel to bring the scraper barrier portions and member into operative juxtaposition to form a substantially complete transverse barrier across the tube, said member having provisions operable in all positions of the parts for guiding the scrapers in their radial movements.

5. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, a saddle mounted on said mandrel, a plurality of circumferentially disposed scrapers extending axially of the mandrel and secured at one of their ends to the saddle, said scrapers being free to move at their other ends radially toward and away from the mandrel axis and having portions thereon forming a partial transverse barrier across the interior of the tube when the scrapers

are in operative position against the tube wall, a disk carried by the mandrel normally spaced from said scraper portions, said saddle and disk being arranged for relative movement axially of the mandrel to bring the scraper barrier portions and disk into operative juxtaposition to form a substantially complete transverse barrier across the tube, said disk having slots operable in all positions of the parts for guiding the scrapers in their radial movements.

6. A tube cleaner comprising a mandrel adapted to be connected to an operating rod and to be inserted longitudinally into a tube to be cleaned, a scraper blade mounted on said mandrel for movement relative thereto toward the tube wall, means for resiliently pressing the blade at a given pressure against the tube wall as the cleaner is forced inwardly through the tube, means operatively associated with the scraper and operated upon a reversal of the direction of drag on said scraper by the tube wall upon a reversal of the travel of the cleaner through the tube to change said pressure, operating mechanism operable at the will of the operator while the cleaner remains in the tube for further adjusting said pressure, means for locking said operating mechanism from movement, and means adjustable without disassembly of the operating mechanism for imparting a predetermined frictional resistance to movement of said mechanism.

7. A tube cleaner comprising a mandrel adapted to be connected to an operating rod and to be inserted longitudinally into a tube to be cleaned, a scraper blade mounted on said mandrel for movement relative thereto toward the tube wall, means for resiliently pressing the blade at a given pressure against the tube wall as the cleaner is forced inwardly through the tube, means operatively associated with the scraper and operable upon a reversal of the direction of drag on said scraper by the tube wall upon a reversal of the travel of the cleaner through the tube to change said pressure, operating mechanism operable at the will of the operator while the cleaner remains in the tube for further adjusting said pressure, friction means operatively associated with said operating mechanism including a pair of relatively movable engageable metal members for imparting frictional resistance to the movement of the operating mechanism, one of said members being constructed and arranged for adjustment relative to the other whereby to vary the engageable pressure therebetween.

8. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, said mandrel having a threaded portion, a flexure spring extending along the axis of the mandrel at an angle thereto and rigidly secured at one end against movement radially away from the mandrel, an expander nut threaded to said man-

drel threaded portion and engageable with the spring intermediate its length for forcing the other end of the spring away from the mandrel axis, a scraper member engageable with the tube wall carried by the last named end of the spring, means for relatively moving said expander nut and spring axially of the mandrel to vary the pressure of the scraper member against the tube wall including means for threading said nut along said mandrel threaded portion, and extensions on said nut frictionally engageable with the threads of the mandrel for imparting resistance to threaded movement of the nut, said mandrel having a cut away portion beyond the normal operating range of the nut for facilitating the adjustable positioning of said extensions.

9. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, said mandrel having a threaded portion, a flexure spring extending along the axis of the mandrel at an angle thereto and rigidly secured at one end against movement radially away from the mandrel, an expander nut threaded to said mandrel threaded portion and engageable with the spring intermediate its length for forcing the other end of the spring away from the mandrel axis, a scraper member engageable with the tube wall carried by the last named end of the spring, means for relatively moving said expander nut and spring axially of the mandrel to vary the pressure of the scraper member against the tube wall including means for threading said nut along said mandrel threaded portion, and extensions on said nut frictionally engageable with the threads of the mandrel for imparting resistance to threaded movement of the nut, said extensions being adjustable whereby to vary the pressure of said frictional engagement.

10. A tube cleaner comprising a mandrel adapted to be inserted into a tube to be cleaned, a scraper device carried by said mandrel and adapted to engage and scrape the tube wall, means for controlling the operative engagement of said scraper device against the tube wall comprising a threaded section on the mandrel and a nut threaded thereon operatively engageable with the scraper device, and extensions on said nut frictionally engageable with the threads of the mandrel for imparting resistance to threaded movement of the nut, said mandrel having a cut-away portion beyond the normal operating range of the nut, and said nut being adjustable along the mandrel to bring said extensions into position over said cut-away portion whereby to permit the bending of said extensions toward the mandrel axis to vary the frictional engagement between the extensions and the mandrel during operation of the cleaner.

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