May 19, 1942. H. G. WEINLAND 2,283,521

ABRASIVE DEVICE FOR CLEANING STILL TUBES AND THE LIKE

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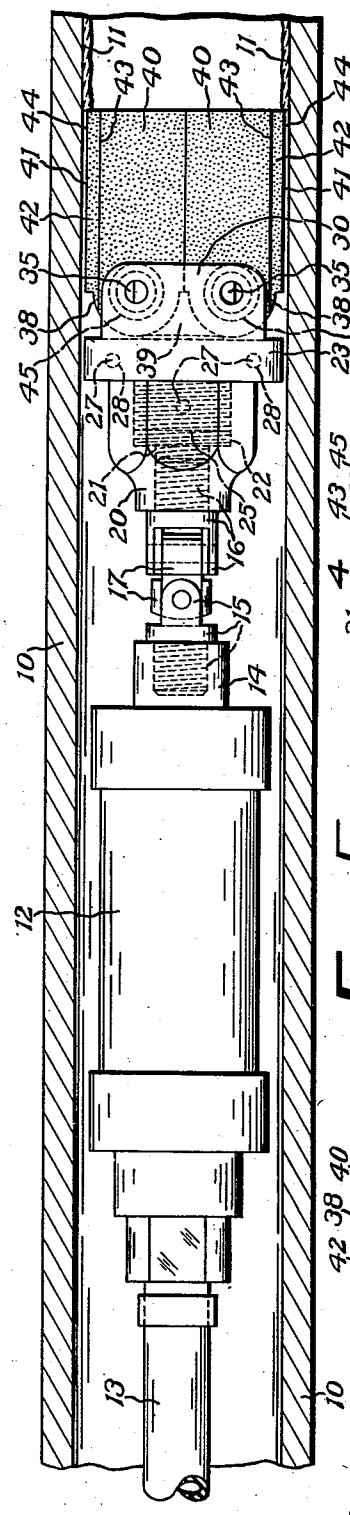


FIG. 5

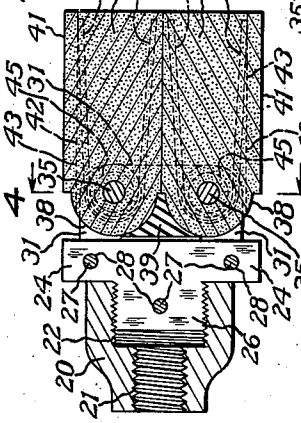


FIG. 3

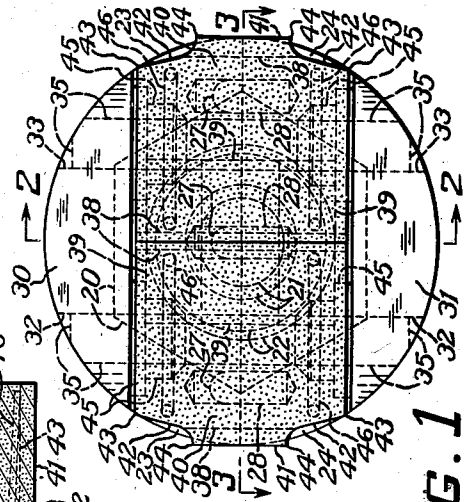


FIG. 1

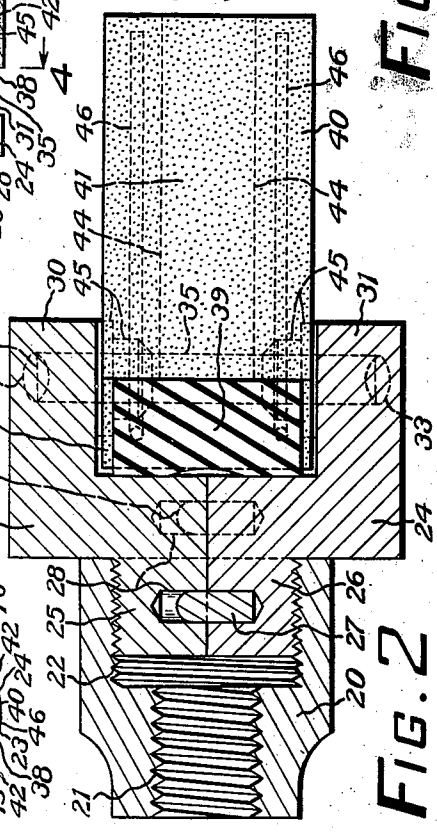


FIG. 2

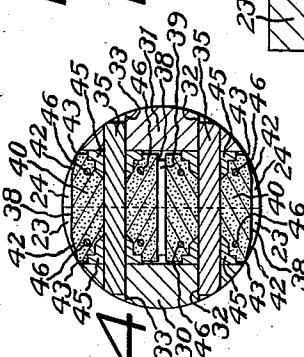


FIG. 4

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ABRASIVE DEVICE FOR CLEANING STILL TUBES AND THE LIKE

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5 Claims. (Cl. 51—184.1)

The invention relates to a tube cleaner designed for removing encrustations from the interior of the tubes of boilers, stills or the like.

One object of the invention is to provide a tube cleaner which shall be more efficient than the metal cutters now in use. Another object of the invention is to provide abrasive sticks of a character readily to cut the encrustation in a still tube but having little effect on the metal of the tube. Another object of the invention is to provide an abrasive stick of such structure and shape that it is highly efficient for the removal of encrustations on a metal tube but will not destroy the tube. Another object of the invention is to provide a complete tool for the removal of carbon deposits in a still tube.

Another object of the invention is to provide an efficient and practical method for cleaning out the encrustations in steel tubes and the like. Another object of the invention is to provide a practical mounting for still tube cleaners of an abrasive nature. Another object of the invention is to provide a more durable cleaning tool for removing the encrustation in still tubes and the like. Another object of the invention is to provide a tube cleaning tool which will cut away encrustations at a faster rate than tools heretofore in use, thus reducing the length of shutdowns of gasoline refineries. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, arrangements of parts, and in the several steps and relation and order of each of said steps to one or more of the others thereof, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing illustrating one of many possible embodiments of the mechanical features of this invention,

Figure 1 is an end view of a still tube cleaning tool constructed in accordance with the invention;

Figure 2 is an axial sectional view taken along the line 2—2 of Figure 1.

Figure 3 is an axial sectional view on a somewhat reduced scale of the still tube cleaning tool, taken along the line 3—3 of Figure 1, the plane of the section being 90° angularly removed from the plane of the section of Figure 2;

Figure 4 is a transverse sectional view, taken on the line 4—4 of Figure 3;

Figure 5 is a view on the same scale as Figures 3 and 4 of the still tube cleaning tool mounted on the end of an air motor inserted in a tube to be cleaned.

As conducive to a clearer understanding of the present invention, it is noted that in the operation of stills for cracking petroleum and for fractionating the higher hydrocarbons, the steel tubes become encrusted with a carbonaceous deposit which is often very hard. Such encrustation not only decreases the capacity of the tube but also materially decreases its thermoconductivity and, therefore, it has been customary to clean out the encrustation from these tubes. For this purpose there have been provided air motors mounted on the ends of heavy hoses and driving divers forms of steel cutters. The air motor and the cutters would be introduced into the tube to be cleaned and pushed through it by pushing the hose. With the use of such tools various difficulties have been encountered, especially the injury of the still tube by the steel cutters, especially when the operator left the cutters in action in one particular place. Furthermore, it has been found necessary frequently to renew or sharpen the steel cutters.

Referring now to the drawing and first to Figure 5, a still tube to be cleaned of encrustation is indicated at 10, the encrustation of hard carbon or similar material being indicated at 11. The tool of my invention may be mounted on the end of a suitable air turbine 12 which is energized by compressed air passing through a rubber hose 13 which is also used as a handle to push the tube as above set forth. Such air turbines 12 mounted on the end of hoses 13 are now readily available and will not, therefore, be particularly described, and any other prime or secondary mover may be provided within the scope of the present invention. Such air turbines are capable of revolving a cleaning tool at speeds of the order of 1000 to 3500 R. P. M.

Still referring to Figure 5, at the end of the turbine opposite the hose 13 is the driven spindle 14. This, as is customary, is drilled and tapped and fitted to a threaded clevis stud 15 which is connected to another threaded clevis stud 16 by means of a link 17, these three parts constituting a universal joint.

Referring now to Figures 2, 3 and 5, I provide a nut 20 having a threaded bore 21 of small diameter and a threaded bore 22 of larger diameter. The threaded clevis stud 16 fits in the bore 21. I further provide a head comprising mating parts 23 and 24 having semi-cylindrical threaded portions 25 and 26 which together fit in the larger

threaded bore 22 of the nut 20. The mating parts 23 and 24 are removably held together by three pins 27 fitting into appropriate holes 28 as shown. When the nut 20 is screwed onto the pair of semi-cylindrical portions 25 and 26, the mating parts 23 and 24 are locked together and form a rigid head for the mounting of the abrasive sticks to be described.

As shown in Figures 1 and 2, the head 24 is a cylinder with a portion thereof cut out by parallel chord planes, thus leaving projecting ends 30 and 31 which together form a fork. I provide a pair of parallel holes 32 and 33 in the projecting ends 30 and 31, the hole 32 in the end 30 being opposite the hole 32 in the end 31, and the hole 33 in the end 30 being opposite the hole 33 in the end 31. These holes or bores 32 and 33 constitute journals for the reception of trunnion pins 35, see especially Figure 4. The trunnion pins 35 are inserted into the holes 32 and 33 as the mating parts 23 and 24 are assembled. The trunnion pins 35 may be made of steel, as preferably is the head 23, 24 and the nut 20, and the trunnion pins 35 are embedded in and project from a pair of abrasive sticks 40. One end of each abrasive stick 40 is preferably rounded over as shown at 38 and a shaped rubber insert 39 is provided which has the effect of cushioning vibrations.

For the manufacture of the sticks 40, I may proceed as follows: Taking a quantity of silicon carbide abrasive in coarse grit size, for example 10 to 16 mesh grit size, and placing it in a mixing pan, I add furfural and mix until each granule is coated with furfural. I mix together a quantity of "A" stage phenol formaldehyde, abrasive fines and quick lime. I add this mixture to the mixing pan while continuing the mixing. I then add a quantity of neutral cresote oil and continue the mixing until the creosote oil has been thoroughly distributed throughout the mass of ingredients in the pan.

The "A" stage phenol formaldehyde is preferably permanently fusible solid phenol formaldehyde resin with sufficient hexamethylene tetramine to harden it. The abrasive fines may be very fine particles of any suitable abrasive, for example silicon carbide or aluminum oxide in grit sizes of the order of 400 to 600 mesh grit sizes. As a specific example of proportions for a suitable stick, I may make up an abrasive structure as follows:

	Per cent by volume
Abrasive	58
Bond	34
Pores	8

In the foregoing the "bond" comprises "A" stage solid resin 50% by weight, alumina fines 40% by weight and quick lime, CaO, 10% by weight. I may use 65 cubic centimeters of furfural and 25 cubic centimeters of creosote oil per pound of the above "bond."

The foregoing is given as an illustrative example only but it is noted that there is thereby formed a hard abrasive structure of slight porosity. By reason of the incorporation of the abrasive fines in the bond, the bond itself is quite tough.

So far as the particular bonding ingredients are concerned and the proportions thereof, I may vary the foregoing widely and, in fact, other bonds besides phenol formaldehyde may be used, such as rubber, shellac and the like. But I have found that of the common abrasives now known, only silicon carbide is satisfactory and I also find that the abrasive structure should be hard and dense.

I provide suitable molding equipment to form sticks of the general shape shown in Figures 1 to 5 inclusive which may be in general described as rectangular paralleopipeds. Preferably the outer or cutting side of the sticks is formed to provide initially a raised portion 41 joined to two bevelled portions 42, giving to each stick a pair of cutting edges 43 and a pair of cutting edges 44. But other shapes may be adopted. I mold the trunnion pins 35 into the sticks 40 at one end thereof, as shown, preferably providing metal washers 45 to locate the trunnions 35 and to transfer the thrust to a wide area of contact. Into the sticks 40 I mold steel wires 46 which may be located as shown. I have found that a pair of hairpin shaped wires 46 for each stick is satisfactory. Preferably these pass around the trunnions 35 and at least one end of each wire extends close to the outer surface of the stick 40 which is adjacent the tube 10 when the stick is being used.

Considering now the operation of the device, the air turbine 12 is introduced into the tube 10 by means of the hose 13 in the usual way and the air is turned on. Sticks 40 cut the encrustation 11 and as the sticks wear away they move apart under the influence of centrifugal force. The sticks 40 are always pressing against the encrustations by reason of the centrifugal force, thus providing a satisfactory abrading pressure and at the same time causing the encrustation 11 to be evenly removed. That is to say, by reason of the fact that the sticks tend to swing apart on their trunnion pins 35, they press against the encrustation 11 at all angular positions irrespective of whether the tool is in exact axial alignment with the tube 10 or not.

Whereas it may take from fifteen minutes to four hours to cut out hard encrustations with the metal cutters, abrasive sticks according to my invention rarely require more than fifteen minutes to do the job, and sometimes will clean a tube in three or four minutes. In this particular work time is of great importance since the entire unit is shut down while the tubes are being cleaned.

I have found that the combination of the use of silicon carbide and the embedded wires 46 gives an abrasive which will cut the encrustation 11 without detrimentally cutting the tube 10. The exact reason for this I do not know, especially since theoretically the wires 46 should wear away faster than the abrasive and also silicon carbide should abrade the steel of the tube. Nevertheless the results have been observed in actual practice and confirmed by repeated tests.

Other shapes of abrasive may be used within the broad features of this invention which involve the use of silicon carbide abrasive bonded with suitable bond having wires or the like embedded therein to form metal islands on the abrasive surface during the life of the tool.

It will thus be seen that there has been provided by this invention an article and a method in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As various possible embodiments might be made of the mechanical features of the above invention and as the art herein described might be varied in

various parts, all without departing from the scope of the invention, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. An abrasive stick for cutting encrustations in a still tube or the like of elongated shape having a hole for pivotal mounting at one end thereof and made of silicon carbide abrasive bonded with organic bond with a metal wire embedded in the abrasive stick and extending around the hole, one end of the metal wire being near the abrading surface of the stick so that as the stick is used and wears away there is a metal island on the abrading surface.

2. An abrasive stick for cutting encrustations in a still tube or the like of elongated shape having a hole for pivotal mounting at one end thereof and made of bonded silicon carbide abrasive, and a pair of hairpin shaped metal wires embedded in the abrasive stick and each extending around the hole, so located that after the stick has been worn away to a considerable extent there will be four metal islands on the abrading surface.

3. A tool for cutting encrustations in a still tube or the like comprising a two-part head, a pair of parallel pins extending between said parts, an abrasive stick pivotally mounted on each of said pins, said abrasive sticks comprising silicon carbide bonded with organic bond, said sticks being free to swing away from each other in the cutting of the encrustations in the still tube as the sticks wear away, and a rubber to reduce vibration, said rubber located between the sticks close to the parallel pins.

4. A tool for abrading the interior of a tube comprising a pair of abrasive sticks having cutting edges and shaped to fit within the tube, pivot pins projecting laterally from each stick near its end, a power driven, universally mounted, axially rotatable head having an internal thread concentric with the axis, two separable supports providing aligned bearings for said pivot pins and having semi-cylindrical ends provided with threads arranged so that the two separable supports may be removably threaded as a unit within said internal thread and thereby secure said pivot pins in place and support the sticks for radial movement of their outer ends under the action of centrifugal force.

5. An abrasive tool for cutting encrustations within a tube comprising a pair of abrasive sticks made of organic bonded silicon carbide abrasive grains, each being shaped as a long narrow body having a cutting edge on a long side, pivots projecting laterally from two opposed long sides at one end of each body, an elongated metal wire embedded within each body substantially parallel with the abrading surface, and arranged to project laterally when the stick has become worn during use, and a universally mounted axially rotatable head having aligned bearings for removably holding the pivots in position and securing the sticks only at their inner ends and providing for a free radial movement of their outer ends.

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