Oct. 18, 1932. G. B. VROOM 1,883,425

METHOD OF MAKING A BRUSH FOR CLEANING BOILER AND CONDENSER TUBES

Filed Nov. 30, 1929

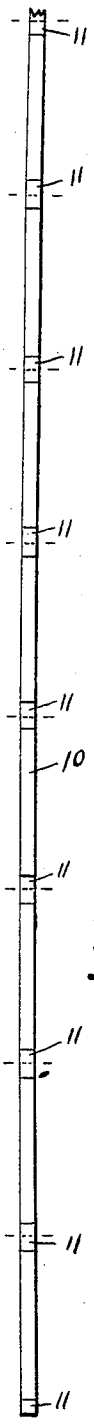



Fig. 1

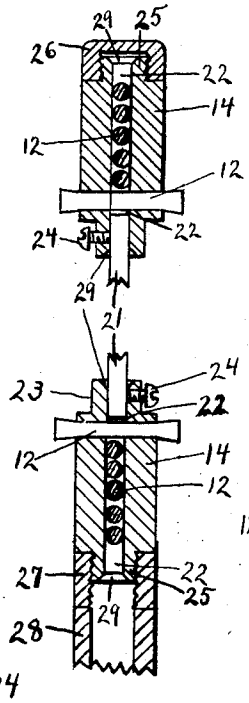



Fig. 3

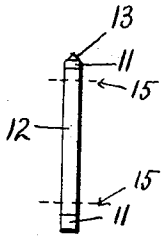



Fig. 2

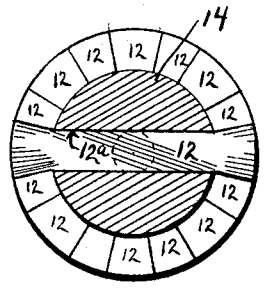



Fig. 6

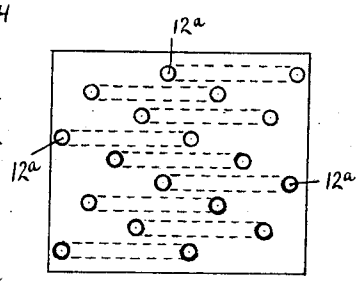



Fig. 7

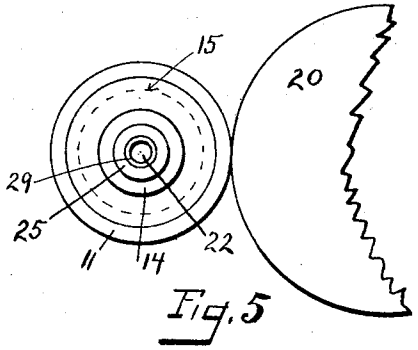



Fig. 5

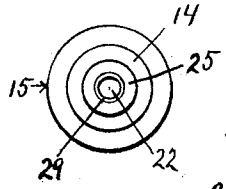



Fig. 4

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Patented Oct. 18, 1932 1,883,425

# UNITED STATES PATENT OFFICE

GUYSBERT B. VROOM, OF NEW YORK, N. Y.

## METHOD OF MAKING A BRUSH FOR CLEANING BOILER AND CONDENSER TUBES

Application filed November 30, 1929. Serial No. 410,840.

(GRANTED UNDER THE ACT OF MARCH 3, 1883, AS AMENDED APRIL 30, 1928; 370 O. G. 757)

Heretofore the bristles of brushes for cleaning the water or other deposit or scale from condenser, boiler and like tubes have been formed of individual wires cut to length and assembled into groups each of a number of wires corresponding to the desired thickness of each group. Each such group is then bent double, or otherwise arranged, and secured to the body of the brush. The cutting to length, assembling into groups and the handling of each group of loose wires are tedious operations requiring time and much hard labor which increases their production cost.

An object of my present invention is to provide such method and apparatus that the assembly of the multiple wires forming each group may be dispensed with and that each such group of multiple wires may be cut and handled as quickly and readily as each single wire thereof was by the practice prevailing before my invention.

A further object of my invention is to provide air apparatus which will efficiently clean boiler and condenser tubes; enable the apparatus to be constructed at substantially lesser production cost and enable the parts to be readily replaced by those even of relatively little, if any, skill in the art.

To attain these and other objects, and in accordance with the general features of this unitary invention of related and interdependent components, my improved method contemplates the various steps hereinafter stated.

To demonstrate the practical utility of my said method, a related, improved and novel apparatus is provided embodying my invention, and which may be used advantageously and economically in practicing said improved method as a unitary invention. Said apparatus may also serve as an example to those skilled in the art, of the facility with which, after becoming familiar with my invention, the many forms and kinds of existing apparatus, with or without substantial modification, may be employed in the efficient practice of my method. Said provided apparatus contemplates and includes the general features and constructions which will be hereinafter stated.

The foregoing and other objects of my invention will be more apparent from the following detailed description and the accompanying drawing illustrating one embodiment of my invention in an improved apparatus, of the many different forms and characters of apparatus, each of which may be employed with or without substantial modification, in the practice of my improved method.

In the accompanying drawing, in which like characters of reference indicate the same parts,

Figure 1 illustrates a portion of a wire cable which I employ in the construction of my cleaning apparatus;

Figure 2 is a view of a portion of Figure 1;

Figure 3 is a central longitudinal plan view of my boiler and condenser tube cleaning apparatus;

Figure 4 is an end elevation view thereof;

Figure 5 illustrates the trimming of the cleaning brush to size; and

Figure 6 illustrates a single group of wires after their securing means has been severed to show their resultant securement in the body 14.

Figure 7 is a diagrammatic view of brush body showing its periphery developed into a flat plane to illustrate the relative positions of the openings extending through the brush body.

One step of my method contemplates and includes the association with such cleaner of a wire cable 10 of a size desired to substantially conform to the diameter of each group of bristles desired to be employed in the production of such cleaner.

The strands of the cable 10 are then secured together at a plurality of points in the length of such cable. Said strands may be secured together by solder 11 applied at a plurality of points along said cable, or the same may be secured together by any other suitable means. The securing means 11 is adapted not to substantially increase the diameter of the cable 10. The securing means 11 is applied to the cable 10 preferably at points corresponding to the length of the bristles desired to be assembled into the

cleaning brush, and which length exceeds the bristle length in the completed brush.

The cable 10 is then severed into lengths, such points of severance being preferably within and near the center of the area of the cable 10 whose strands are secured by said means 11. Such severance of cable 10 provides cable lengths 12, one of which is illustrated in Figure 2. Such lengths 12 have said securing means 11 at opposite ends preferably comprising substantially half the length of the securing means illustrated in Figure 1, due to said severance of cable 10 being preferably at substantially the center of each securing means 11. Preferably one end of each cable length 12, Figure 2, is provided with a bevel or rounded point 13.

The cylindrical body 14 of the cleaning brush has drilled therethrough a plurality of holes of such size preferably that they form a tight fit for the cable lengths 12.

By the first and second stated steps of my method I retain the cable winding stress in the component cable wires, so that the individual wires are retained in intimate association in substantially less diameter than the wires would normally assume if loose. The securing means 11 enables each length 12 to be handled as, if not more conveniently than, a single strand of such cable, as well as facilitates each length 12 being driven into its corresponding hole extending substantially radially through the cylindrical brush body 14. Each cable length 12 is adapted to have a surface length within the solder or other securing means 11. This is more definitely illustrated in Figure 2 by the dotted lines 15, each of which are at a point removed from said solder or other securing means 11, and which lines 15 represent the length of each group of bristles designed to be used in the body 14.

As each length 12 is driven into its corresponding hole in body 14 so as to project preferably substantially equally from opposite sides thereof, the projecting ends of cable length 12 are each severed substantially at the dotted line 15. Said severance removes the solder or other securing means 11 as a by-product of the brush and loosens the several strands of length 12, which strands in their tendency to expand become more firmly fixed in each of their respective holes through the body 14, due to the projecting ends of the length 12 each tending to progressively increase in diameter from the surface of body 14 toward the ends of each length 12.

However, I prefer not to trim the sections 12 as they are driven into place in the brush body 14, but after all the sections 12 are thus mounted to project substantially equally from opposite sides of body 14, the body 14 is mounted between the centers of a grinding machine and the sections 12 are ground by grinding wheel 20 to the proper diameter illustrated between the dotted lines 15 in Figure 2. In the grinding of the sections 12 their soldered ends, including securing means 11, are thus removed, which permits the individual wires of each section 12 to relax from their normal tight wound wire cable condition. This relaxation tends to cause the individual wires of each section 12 to become more firmly fixed in and throughout the lengths of their respective holes 12*a*, as well as to flare at their respective opposite ends which project from said holes 12*a*. This flaring also tends to secure said wires into their respective holes 12*a*.

The holes 12*a* are drilled radially through the body 14 of the brush in any desirable number to afford the required area of wire bristles. The diameter of holes 12*a* is such that the normally tight wound wire cable 10, desired to be used for each separate group of bristles, may be driven into such holes to such extent that each section 12 thereof, so driven, will project substantially uniformly from opposite sides of the brush body 14.

The preferred form of the brush and its body 14 is cylindrical. The holes 12*a* drilled radially completely through body 14 tightly hold each of their sections 12 of wire cable 10 even when the strands thereof are unlayed to the extent permitted by the trimming off the opposite secured ends 11 of each section 12. While each of these units 12 of separate bristles each in their respective holes 12*a* are hard tight, in the sense that they are a serviceable unit substantially fixed with the brush body 14, yet each such bristle unit is capable of longitudinal movement in its hole 12*a* to accomplish the self centering of the brush when in use with the opposite ends of each said unit engaging, with substantially equal force, the opposite walls of the boiler or condenser tube to be cleaned.

The brush body 14 with its bristle units 12 are intended to be rotated within the tube to be cleaned by the motor driven flexible cable boiler tube cleaning apparatus, the same may be rotated otherwise or longitudinally reciprocated or rotated and reciprocated or otherwise moved relative to the tube being cleaned thereby.

In round brushes in which the bristles are radial and extend through the brush and the opposite ends of each bristle are adapted to be in cleaning association, it involves a substantial problem to obtain an adequate number of bristles and sufficient support therefor. The difficulty of such attainment resides in the fact that while the periphery of the brush body is very extensive its center or neutral axis, through which all the bristles pass, is quite limited and such limitation fixes the maximum amount of bristles on the periphery. The preferred method I have devised for overcoming said difficulty is illustrated in Figure 7 showing diagrammatically the body

14 in the flat. In this figure the opposite vertical sides may be visualized as being joined together to make the cylindrical body 14, but its flat diagram discloses most readily my preferred method of arranging the bristle holes 12*a*. The length of each hole 12*a*, the extent between its opposite openings, indicates the exterior diameter of the body 14 as well as discloses relatively the location of the bristles, when projecting from the opposite ends of each hole 12*a*, respecting each other and the superficial area of the body 14. The arrangement disclosed in Figure 7, for instance, of nine holes drilled completely through the cylindrical brush body, affords on its periphery eighteen bristle units in four helical paths, comprising the opposite ends of nine cable portions whose strands are permitted to unlay after these portions are secured in their respective nine holes 12*a*.

The central longitudinal opening 22 extending through the axes of each brush body 14, when desired to be employed, will extend vertically through the center of each horizontally shown hole 12*a* in Figure 7, which center is diagrammatically in this figure at a point midway between the opposite ends of each hole 12*a*. While it may usually appear that in this diagram visually that there would therefore be a number of such openings 22, such appearance is due to the diagram, but the projection of this diagram into a cylinder would render such centers concentric and coincident with the longitudinal center of the opening 22 pierced at different angles by each hole 12*a*. The vertical spaces between the holes 12*a* shown in Figure 7 represents the thickness of metal of the brush body 14 between holes at its center, while this small intervening space at the center increases radially to the outer surface of brush body 14 where the metal thickness between holes 12*a* is substantial. While this outer thickness of metal between holes 12*a* affords ample strength for the brush body 14 as a whole, some such thickness is desirable at the center in order to afford in the essential small diameter of body 14 ample interior surface in each hole 12*a* to exert the requisite binding engagement with its respective portion 12 of cable 10 forming each bristle unit when securing means 11 is removed from each end by trimming the portions 12 so that their opposite ends may be all in cleaning association after portions 12 have been assembled in brush body 14.

As indicated in Figure 6, the diagonal shade lines across the center of cable portion 12 indicates the strands which substantially have not become unlayed by the severance of the strand securing means 11.

The brush body 14 may be of any desired length. However, for cleaning curved or bent boiler and condenser tubes the body 14 is preferably relatively short and a plurality of such bodies 14 are employed with a flexible driving means 21 secured to and extending between each of said bodies 14. Said means 21, in the instance shown in Figure 3, is a wire cable whose ends extend into one end of hole 22 extending longitudinally through the neutral axis of each body 14. A boss 23, integral with each body 14 and surrounding each end of cable driving means 21, has a screw 24 threaded radially through one side of each of said bosses 23 with its screw ends embedded into the opposite ends of cable 21 to rigidly secure said bodies 14 to opposite ends of said cable 21.

The remaining ends of bodies 14 are provided with bosses 25 whose exterior surfaces are provided with like screw threads so that either cap 26 or coupling 27 of handle or flexible shaft 28 may be screwed thereon.

The cap 26 protects the threads on the boss 25 to which the coupling 27 is not attached. A threaded boss 25 is located at each end of the brush, so that when the brush is passed through a tube in one direction, the cap 26 may be removed and another coupling 27 of a handle or flexible shaft may be substituted therefor and the brush thus more readily passed back and forth through such tube. When unbent tubes are to be cleaned the connection 21 and screws 24 are dispensed with, the body 14 of one brush is employed, but preferably of a longer body, and, instead of screw 24, such boss is provided with external threads fitting coupling 27 or cap 26.

The opposite ends of each hole 22 are provided with tapers 29 adapted to accommodate the cone centers of the grinding spindle during the grinding operation illustrated in Figure 5.

It will be understood that instead of securing the strands of cable 10 by soldering bands or points 11, which preferably is done in such manner as not to increase the diameter of cable 10, said strands may be secured in their cable form and stress by electric spot welding or in any other convenient or desirable manner.

From the foregoing it will be apparent, to those skilled in this art, that my improved method contemplates and includes the steps of securing together the strands of a wire cable at a plurality of points; and more specifically that such points be of a distance apart somewhat greater than the total length of each continuous length of bristles to be employed; and

Further includes the step of severing such wire cable at a point intermediate the area of each such securement; and more specifically that one of said ends be chambered; and

Further contemplates and includes the step of associating a plurality of such cut cable lengths with a brush body; drilling or otherwise forming a plurality of holes in said body each of a diameter into which a cable length

may be driven tightly and be held firmly; and more specifically that said brush body be round and said holes extend therethrough and that said cable lengths be so driven therein so as to extend substantially equally at opposite ends from the adjacent surface of the brush body; and

Further contemplates and includes the steps of trimming the projecting ends of such driven cable lengths substantially uniformly to a point which will remove all of the secured portion of the cable strands; and that the severance of said strands or wires will afford some relaxation of the normal cable forming stress of the strands or wires thereof, and that said relaxation will tend to increase their securement in their respective holes including the flaring of the loose end or ends of such strands or wires as formed parts of each of said cable lengths.

It will be appreciated that my improved method produces a brush of superior quality, utility and service life at a very nominal production cost, and that when the bristles have become worn beyond the degree of efficiency they may be readily removed, replaced and trimmed by those relatively unskilled in the art. The brush herein shown and described forms the subject matter of my divisional application hereof, Serial No. 523,927, filed March 19, 1931.

The invention herein described may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon or therefor.

Having now so fully described my invention that others skilled in the art may therefrom make and use the same, what I claim and desire to secure by Letters Patent is:

1. Steps in the method of making cleaners for boiler, condenser and other tubes, comprising securing the strands of a cable at a plurality of points to prevent the cable strands from unlaying and severing from the cable a length whose strands are secured.

2. Steps in the method of making cleaners for boiler, condenser and other tubes, comprising securing the strands of a cable at a plurality of points to prevent the cable strands from unlaying, and severing from the cable a length whose strands are secured substantially at opposite ends.

3. Steps in the method of making cleaners for boiler, condenser and other tubes, comprising securing the strands of a cable at a plurality of points to prevent the cable strands from unlaying, severing from the cable a plurality of lengths whose strands are secured, and pointing one end of said lengths.

4. The method of making cleaners for boiler, condenser and other tubes from a brush body and a piece of cable, including the steps of drilling a hole in a brush body, driving a cable length endwise into said hole while substantially maintaining the normal cable stress of the strands of said cable, and subsequently releasing said stress of said strands.

5. The method of making cleaners for boiler, condenser and other tubes from a brush body and pieces of cable, including the steps of drilling a plurality of holes in said body, driving one of said pieces in each of said holes while maintaining the normal lay of the strands of the cable pieces, and subsequently releasing said stress of said strands projecting from said holes.

6. The method of making cleaners for boiler and condenser tubes from a brush body having a plurality of holes therein and a plurality of cable portions, including the step of placing a plurality of portions of wire cable one in each of said holes whose surface grips their respective cable portions substantially throughout the length of the holes with an end of each cable projecting from its hole in position to clean.

7. The method of making cleaners for boiler and condenser tubes from a brush body having a plurality of holes extending therethrough and a plurality of cable portions, including the step of placing a plurality of portions of wire cable one in each of said holes whose surface grips their respective cable portions substantially throughout the length of the holes with each end of each portion of cable projecting from the opposite ends of its hole in position to clean.

8. The method of making cleaners for boiler and condenser tubes of portions of wire cable and a brush body having openings therethrough, including the steps of inserting into said openings a plurality of portions of wire cable with substantially the normal cable stress of the strands thereof maintained and with the opposite ends of each of said portions projecting from said body to form a cleaning surface, releasing said stress of the strands at the cleaning ends of said portions and maintaining said stress substantially throughout the lengths of said portions, and longitudinally moving relative to the brush body such of said cable portions as may have unequal stress imparted to their opposite ends.

9. The method of making of a holder and cable portions cleaners for boiler, condenser and other tubes including the steps of associating a plurality of several substantially straight portions of a wire cable in radial relation about and extending substantially through a common axis of the holder with the opposite ends of each portion in cleaning association and with the strands of each portion having their normal cable stress substantially maintained, securing each of said portions in said associated relation substantially throughout the substantial extent of the portions adjacent the cleaning ends, and subsequently releasing said stress of the

strands of each of said portions at their cleaning ends and maintaining said stress substantially throughout the secured area of each of said portions.

10. The method of making brushes from a holder and cable portions including the steps of placing in the holder a plurality of severed portions of a cable in definite relation to each other with an end of each portion projecting from the holder in position to clean and with the strands of each portion having their normal cable stress substantially maintained, and trimming the projecting cable ends and unlaying the strands in said projecting ends into a uniform cleaning surface.

In testimony whereof I have hereunto set my hand at the city of Washington in the District of Columbia this twenty-ninth day of November 1929.

GUYSBERT B. VROOM.