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Hoffecker

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[54] **METAL WORKING BRUSH ASSEMBLY**

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[52] **U.S. Cl.** **29/90,** 15/169, 15/180

[51] **Int. Cl.** **B21c 43/00**

[58] **Field of Search** ..... 29/90, 81 H; 15/169, 15/180

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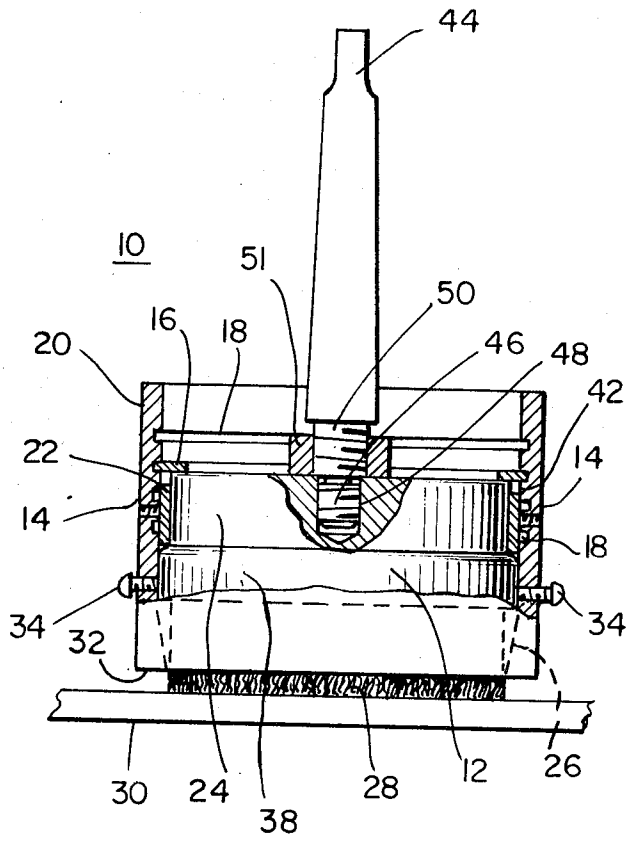
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Attorney—Norman L. Norris

[57] **ABSTRACT**

A brush having a circular array of wire strands located within a central opening of a control collar with the tips of the wire strands protruding from one extremity of the collar. The central opening of the collar adjacent this extremity is formed by an inwardly tapering surface of revolution having a minimum inside diameter at the collar extremity. The brush is locked within the collar by a spring retaining ring which is captured by one of a plurality of axially displaced annular grooves located within the central opening of the collar. Set screws extending through the collar and into contact with the ferrule of the brush are also utilized to lock the brush in place. A concentric ring which encircles the ferrule maintains the collar and the brush in coaxial relationship.

8 Claims, 6 Drawing Figures



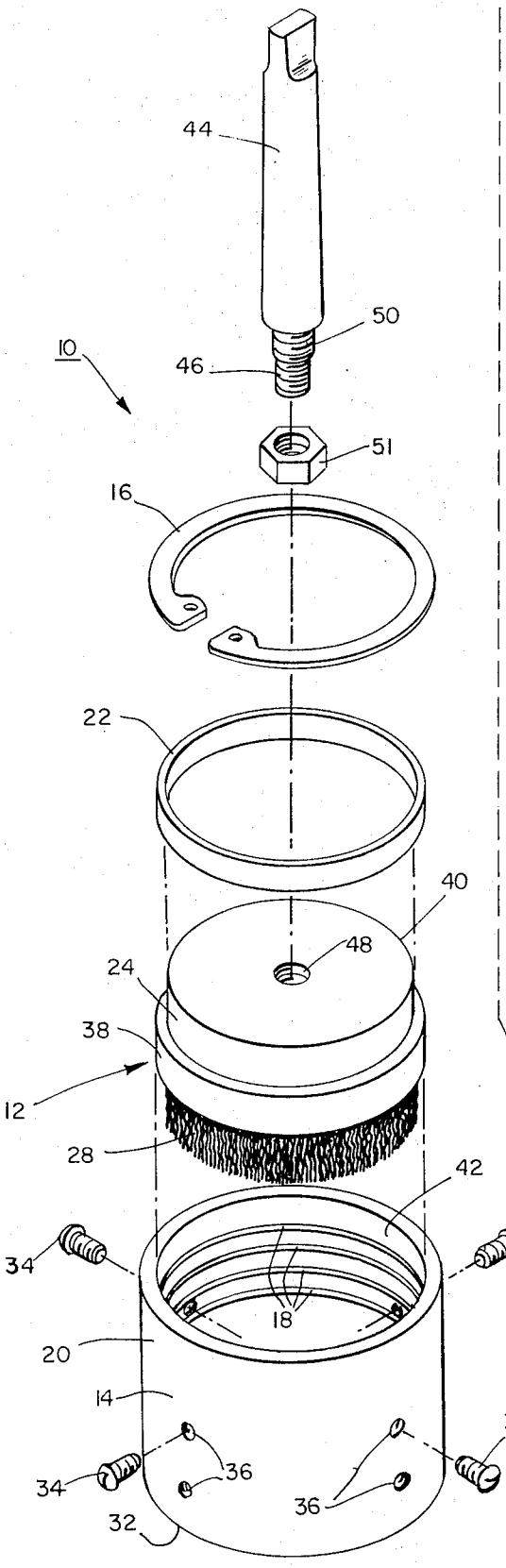

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Fig. 1

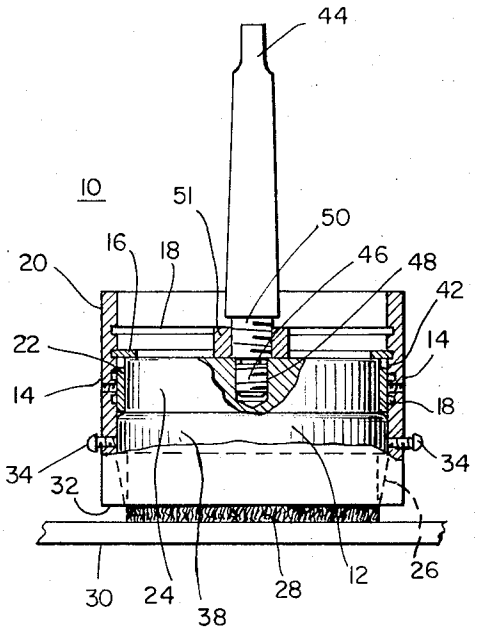

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Fig. 2

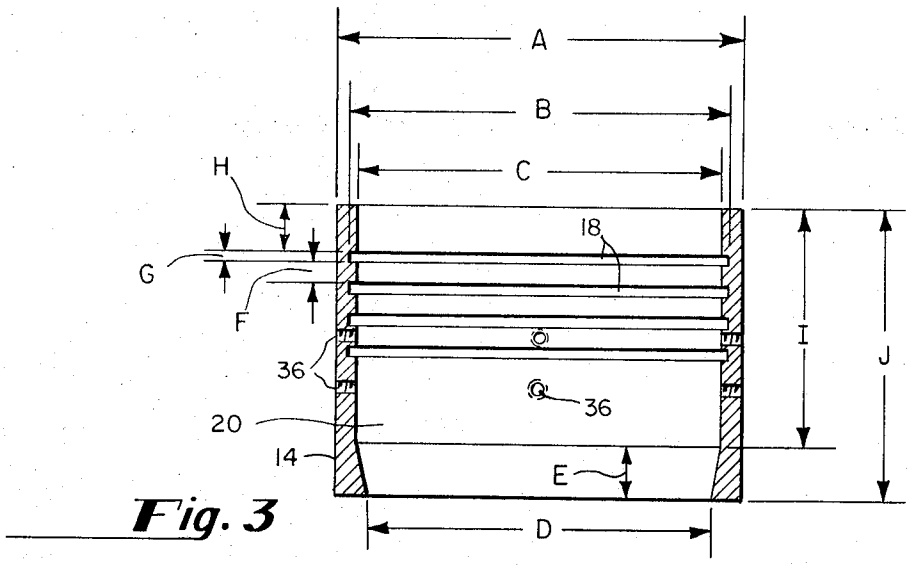


Fig. 3

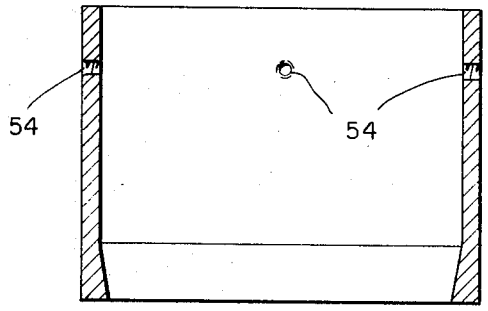


Fig. 4

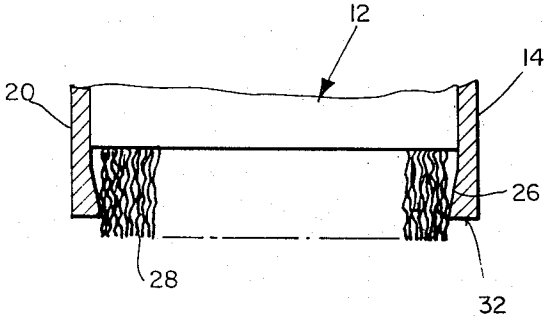


Fig. 5a

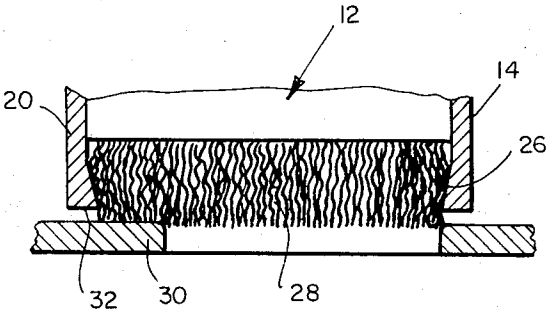


Fig. 5b

METAL WORKING BRUSH ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to metal working brushes. More particularly, this invention relates to the removal of burrs around drilled or punched holes in metal members and the formation of a radius on the periphery of the holes.

This invention further relates to deburring the periphery of drilled or punched holes and the formation of a radius on the periphery of the holes in tube sheets, condenser plates, baffle plates and support plates used in the heat transfer industry and other apparatus such as Feed heaters, evaporators and condensers used in desalination.

When brushes comprising filaments of relatively rigid wire strands are utilized to remove the burrs around the periphery of drilled or punched holes in a ferrous metal member by rotating the brush at a high number of revolutions per minute, e.g., 1,700 to 4,000 r.p.m., the strands of the brush tend to expand outwardly under the influence of the pressure between the metal member and the brush and the centrifugal force resulting from the rotation of the brush. As a result, the strands on the brush flare or "fishhook," i.e., turn outwardly so as to take on the shape of a fishhook, and the life of the brush is reduced. Furthermore, since the sides of the strands rather than the ends of the strands tend to work on the metal member, the r.p.m. of the brush must be raised to perform the burr removal task. This of course compounds the difficulty since the higher r.p.m. tends to expand the strands even further resulting in more fishhooking. In addition, the high r.p.m. of the brush produces high temperatures which fuse the metal from the member being worked to the wire strands.

It will therefore be understood that there are numerous difficulties associated with the deburring of a metal member utilizing a brush comprising wire strands. The same difficulties make it virtually impossible to form a radius in a ferrous metal member at the periphery of the holes.

SUMMARY OF THE INVENTION

It is an object of this invention to increase the life of a metal working brush comprising wire strands.

It is another object of this invention to improve the metal working capability of such a brush.

It is yet another object of the invention to reduce the likelihood of personal injuries in using such a brush.

It is a more specific object of this invention to achieve the foregoing during the removal of burrs around the periphery of holes which are drilled or punched in a metal member comprising a ferrous material.

It is another more specific object of this invention to achieve the foregoing while forming a radius around holes which have been drilled or punched in a metal member comprising a ferrous material.

It is another more specific object of this invention to substantially and efficiently reduce the time required for these or similar operations.

In accordance with these and other objects, one embodiment of the invention comprises a brush having a ferrule and a substantially uniformly dense circular array of wire strands extending from the ferrule which is received in the central opening of a control collar. In accordance with one important aspect of the invention, the opening in the control collar is formed at one end of the collar by an inwardly tapering surface of revolution so as to have a minimum inside diameter at one extremity of the collar. The array of wire strands is mounted coaxially with the inwardly tapering surface with a portion of each of the strands protruding beyond the extremity of the collar. The inwardly tapering surface directs the wire strands toward the metal surface being worked and prevents the outward expansion of the wire strands away from the axis of the assembly as the brush rotates about that axis in contact with the metal surface being worked.

In accordance with one important aspect of the invention, means are provided for holding the brush in the collar in various adjustable positions so as to permit the brush to be moved forward toward the extremity of the collar as the brush wears. In this connection, the collar may comprise a plurality of annular grooves which are adapted to receive a spring retaining ring which bears upon the ferrule of the brush when the wire strands of the brush are brought into contact with the metal surface being worked. The collar may also comprise openings receiving set screws which engage the ferrule of the brush at various positions along the ferrule depending upon the location of the brush within the collar.

In accordance with another important aspect of the invention, the ferrule comprises a cylindrical exterior surface and the collar includes a cylindrical interior surface. A concentric ring is located between the cylindrical interior surface of the collar and the cylindrical exterior surface of the ferrule to maintain a coaxial or concentric relationship between the collar and the brush.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects of the invention will be better understood from the following specification taken in conjunction with the drawings in which:

FIG. 1 is a perspective, exploded view of a brush assembly embodying the invention;

FIG. 2 is an elevational partially sectioned view of the brush assembly of FIG. 1 in metal working contact with a metal member;

FIG. 3 is a section of the control collar taken along section line 3—3 of FIG. 2;

FIG. 4 is a sectional view of another control collar;

FIG. 5*a* is a sectional view of the control collar and the brush taken at one end of the assembly prior to contact with the metal surface being worked; and

FIG. 5*b* is a sectional view similar to FIG. 5*a* with the wire strands of the brush in contact with the metal surface being worked.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, a brush assembly 10 comprises a cup brush 12 which is mounted within a central opening in a control collar 14. The brush 12 is locked in place by a spring retaining ring 16 which is captured by one of the annular indexing grooves 18 located on the interior of the collar at the central opening 20. The brush 12 is maintained in concentric or coaxial relationship with the collar 14 by a ring 22 which encircles a ferrule 24 of the brush 12 and holds the brush 12 in coaxial or concentric relationship with the collar 14.

In accordance with one important aspect of the invention, the interior surface of the collar **14** at one end thereof comprises an inwardly tapering surface of revolution **26**, i.e., a frustoconical surface, which directs a substantially uniformly dense array of wire strands **28** (normally comprising carbon or stainless steel) of the brush **12** toward a metal member **30** which is being worked by the brush assembly while preventing expansion of the strands **28** outwardly away from the axis of the assembly. As shown in FIG. **2**, the strands **28** protrude slightly beyond the extremity **32** of the collar **14**. In order to achieve the most beneficial effect from the inwardly tapering surface **26**, the angle of taper should be at least 10° and less than 45° with an angle of **20** to 25° being preferred. In addition, no more than 50 percent of the length of the strands **28** should extend beyond the extremity **32** of the collar with 25 percent or less being preferred. A protrusion of one-quarter of an inch has been found to be particularly effective. Since only a small portion of the wire strands **28** protrude beyond the extremity **32** of the collar, there is less likelihood that a broken strand will be thrown outwardly and injure the operator.

In accordance with another important aspect of the invention, means are provided for adjusting and indexing the position of the brush **12** within the collar **14** thereby permitting the brush to be advanced toward the extremity **32** as the wire strands **28** wear. In this connection, a plurality of indexing grooves **18** are provided, any one of which may receive the spring retaining ring **16**. The retaining ring **16** which is shown as a Tru-Arc retainer, may be located in the appropriate indexing groove **18** to assure a one-quarter inch of other appropriate protrusion of the wire strands **28** from the extremity **32** of the collar **14**. Of course, as the strands **28** wear, the retaining ring **16** will be advanced to the grooves **18** which are closer to the extremity **32**. In addition, set screws **34** extend through threaded openings **36** in the collar **14** and into engagement with the ferrule **24** along a cylindrical surface **38** to lock the brush **12** in place at a fixed angular position within the collar **14**. Four such openings and screws **36** may be provided.

In accordance with another aspect of the invention, the brush **12** and the collar **14** are maintained in concentric or coaxial relationship by the concentric ring **22** which encircles the exterior cylindrical surface **40** of the ferrule **24** and bears upon the interior substantially cylindrical surface **42** in the opening of the collar **14** which is interrupted by the annular grooves **18**. This concentric ring **22** maintains the circular array of wire strands **28** concentric with the inwardly tapered surface **26** at the extremity **32**.

A shaft **44** for driving the brush assembly in a rotary motion is provided. The shaft which may be a Morse taper shaft includes a right-hand threaded portion **46** which is adapted to extend through the ferrule **24** and be received by a threaded opening **48** in the brush **12**. The shaft also includes a left-hand threaded portion **50** which is adapted to receive a locking nut **51**. The combination of the right and left-hand threaded portions **46** and **50** with the threaded opening **48** and the nut **51** permit the brush assembly to be rotated in both directions without loosening the shaft.

The collar **14** shown in FIGS. **1** and **2** is shown in section in FIG. **3**. It will of course be understood that the collar **14** must be carefully machined to achieve the appropriate cooperation between the wire strands **28** and the inwardly tapering surface **26**. The following table sets forth various dimensions of the collar **14** identified in FIG. **3** as a function of exemplary KEB type brushes. It will be seen that the dimensions A, B, C and D differ depending upon whether a KEB brush of the Newark Brush Company or a KEB brush of the Osborn Manufacturing Company is utilized:

DIMENSIONS IN INCHES

Brush	A	B	C	D	E	F	G	H	I	J
Newark #WK5S2....	5.625	5.260	5.110	4.780	.750	.250	.120	.625	3.250	2.0
Osborn #4625.....	5.500	5.260	5.085	4.750	.750	.250	.120	.625	3.250	2.0

A somewhat modified collar is shown in FIG. **4**. Note that there are no annular grooves provided. The locking of the brush within the collar is achieved solely by the use of set screws inserted through threaded openings **54**. The critical dimensions for the opening of the collar of FIG. **4** are identical with those set forth with respect to FIG. **3** where the same brushes are utilized.

Referring now to FIG. **5***a*, the brush **12** and the circular array of wire strands **28** are shown as inserted into the collar **14**. Note that the peripheral strands **28** are not at all inwardly deflected by the inwardly tapering surface **26** in the absence of the rotary motion of the brush **28** or pressure against a metal surface. The peripheral strands **28** pass just along the edge of the inwardly tapering surface **26** at the extremity **32**. Then, when the brush is rotated and pressure is applied against a metal surface as depicted in FIG. **5***b*, the peripheral wire strands **28** are forced against the inwardly tapering surface **26**. This action at the peripheral strands **28** not only prevents the outward expansion of those strands but also prevents the outward expansion of the more centrally located strands **28** and maintains the strands directed toward the surface being worked. As a result, the surface **30** may not only be deburred along the periphery of the holes therein, a radius may also be formed on the periphery of these holes. Significantly, this deburring and the formation of the radius may be achieved by rotating the brush at 500 to 1,500 r.p.m. with 1,000 r.p.m. being preferred. The metal working capability of the brush is greatly enhanced by this lower r.p.m. since there is less likelihood that the metal of member **30** will fuse to the wire strands **28**.

Eventually, the wire strands **28** will wear to the point that they protrude insufficiently from the extremity **32** of the collar **14**. It then becomes necessary to advance the retaining ring **16** as shown in FIGS. **1** and **2** to the next position using retaining ring pliers.

Although a particular embodiment has been shown and described, it will be understood that various modifications may be made as will fall within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A rotatable metal working brush assembly comprising:

a brush having a ferrule and a substantially uniformly dense array of wire strands extending from said ferrule; and

a control collar having an opening receiving said brush, said opening being formed at one end of said

collar by inwardly tapering surface of revolution, said inwardly tapering surface having a minimum inside diameter at the extremity of said collar, said array of wire strands being mounted coaxially with said inwardly tapering surface with a portion of each of said strands protruding beyond said extremity of said collar, said inwardly tapering surface directing peripheral wire strands in contact with said collar radially inwardly toward the axis of said assembly and thereby prevent the outward expansion of the central wire strands away from the axis of said assembly as said brush rotates about the axis of said assembly in contact with the metal surface being worked; and means for rotating said brush.

2. The metal working brush assembly of claim **1** wherein the angle of taper for said inwardly tapering surface is greater than 10°.

3. The metal working brush assembly of claim **1** wherein said portion of each of said strands protruding beyond said extremity is less than 50 percent of the total strand length.

4. The metal working brush assembly of claim **1** further comprising an adjustable means for holding said brush in said collar in various adjustable positions so as to permit said brush to be moved toward said extremity as said brush wears.

5. The metal working brush assembly of claim **4** wherein said collar comprises a plurality of annular grooves located in a plurality of axial positions along said collar in said opening, said adjustable means comprising a spring retaining ring insertable into any one of said grooves, said ferrule bearing upon said ring when said ring is inserted into said one of said grooves.

6. The metal working brush assembly of claim **4** wherein said collar includes at least one opening extending therethrough, said adjustable means comprising at least one set screw extending through said opening into engagement with said ferrule.

7. The metal working brush assembly of claim **1** wherein said ferrule includes a cylindrical exterior surface and said collar includes a cylindrical interior surface in said opening, said assembly further comprising a concentric ring located between said cylindrical interior surface and said cylindrical exterior surface to maintain the coaxial relationship of said collar and said brush.

8. The metal working brush assembly of claim **1** further comprising shaft threadedly engaging said brush through said ferrule.

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