

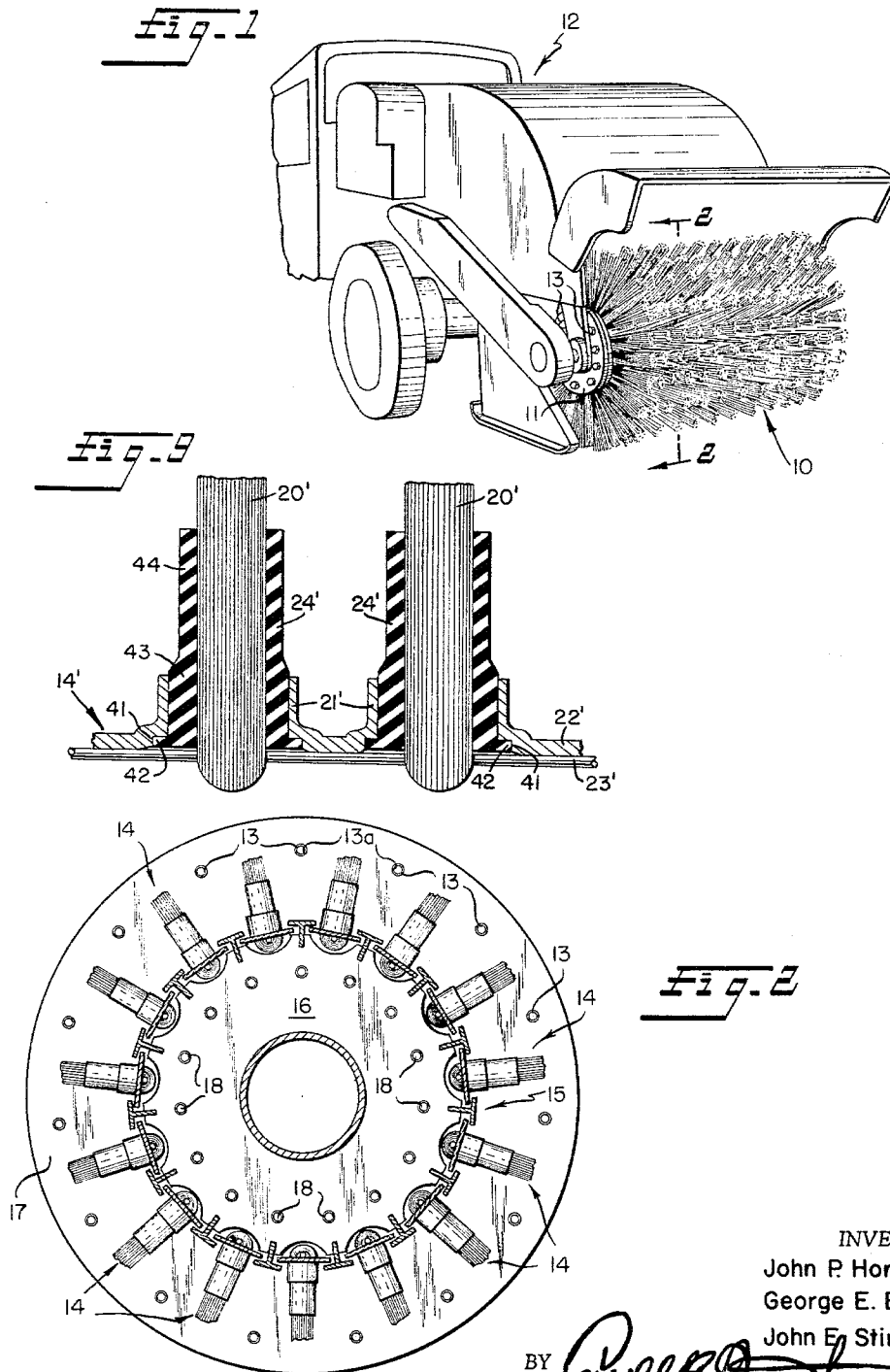
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J. P. HORTON ET AL
CYLINDRICAL BRUSH ASSEMBLY

3,228,053

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2 Sheets-Sheet 1



INVENTOR
John P. Horton
George E. Berry
John E. Stirling
BY *Carroll B. Spaulding*
ATTORNEY

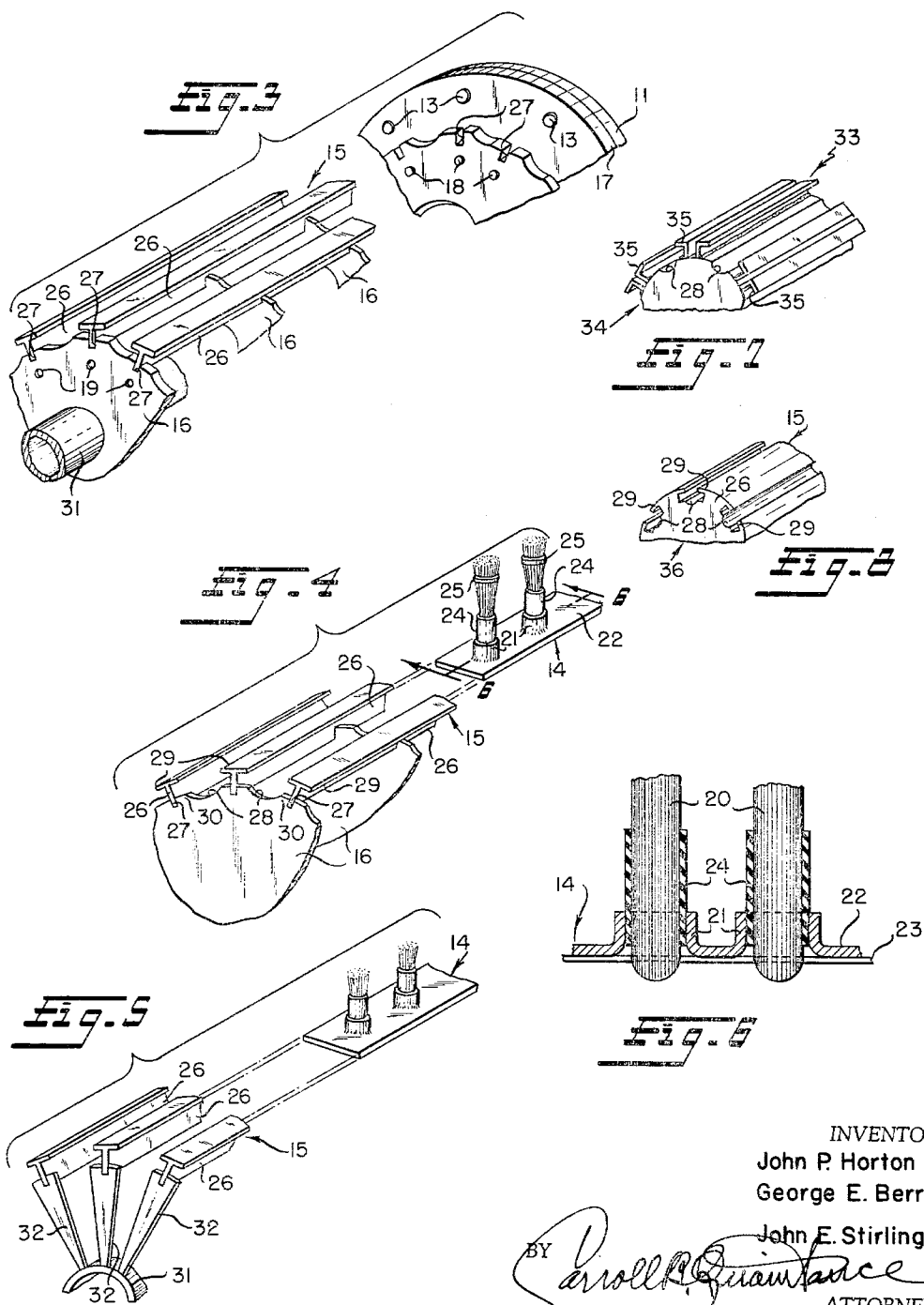
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INVENTOR
John P. Horton
George E. Berry

BY *Carroll R. Quaintance*
John E. Stirling
ATTORNEY

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CYLINDRICAL BRUSH ASSEMBLY

John P. Herton, 79 Old Fort Road, Bernardsville, N.J.;
George E. Berry, Spring Run Lane, Martinsville, N.J.;
and John E. Stirling, 1041 Wychwood Road, Westfield,
N.J.

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This application is a continuation in part of application Serial No. 180,951, filed March 20, 1962, for Cylindrical Brush Assembly, now abandoned.

This invention relates to a brush assembly and, more particularly, to brush assembly for cylindrical rotary brushes.

Many brush assemblies can be visualized from the viewpoint of the brush material and the holders therefor. The present invention is concerned with strips of brush material and the assembly thereof in a holder, or core, to form a cylindrical rotary brush assembly. Many types of brush strips are known and many types of holders for such strips known. Yet, no known brush assembly combines a desired combination of attributes including reliability, durability and efficiency in performance, inexpensiveness in components, simplicity in design and ease of assembly and disassembly. The latter attribute is particularly important where very large dimensioned cylindrical brush assemblies are used such as is the case with certain types of cylindrical brooms used on streets, usually known as pickup brooms, and at airports for cleaning and snow removal. As is known, such brooms may be up to 14 feet in length. Unless the brushes used in such brooms can be easily assembled and disassembled, the user is faced with the necessity of stocking extra brush assemblies or faced with excessive "down time" for expensive equipment.

An important purpose of this invention is to provide a brush assembly that has a minimum number of parts, one that can be interconnected onto a brush core with a minimum amount of labor and in a minimum amount of time.

Another important object of this invention is to provide a brush assembly which is constructed in a manner which increases the cleaning efficiency of the brushes, and also increases the brush bristle durability from the standpoint of increased bristle wear life and decreased loss of individual bristles due to bristle breakage.

Yet another important purpose of this invention is to provide a brush assembly unit that reduces the wear on the brush core.

It is an important object of this invention to provide a brush assembly possessing the attributes mentioned above to an exceptional degree.

It is a special object of the invention to provide a novel brush which may be easily and readily assembled and disassembled and yet will prove sturdy, reliable, and efficient in use.

It is another important object of this invention to provide a novel brush assembly unit that is much less expensive to produce and much less expensive to maintain in operating condition than is the case with conventional brushes.

Other objects and features of the invention will become apparent from the more detailed description which follows.

Broadly considered, the foregoing and related objectives are obtained by providing strips of brush material and a holder, or core, designed to complement one another so as to obtain the objectives of the invention. Thus, the features hereinafter fully described in connection with the annexed drawings are to be considered illustrative only and as indicative of various ways in which the principles of the invention may be employed.

In the annexed drawings:

FIGURE 1 represents a perspective view of one manner of using the brush assembly on a sweeper;

FIGURE 2 represents a cross sectional elevational view taken in the direction of 2—2 of FIG. 1;

FIGURE 3 is a perspective fragmentary view of the brush core showing one manner of mounting the brush assembly on a mounting plate;

FIGURE 4 is an exploded perspective view showing fragmentary sections of brush strip and brush core with indication of assembly methods;

FIGURE 5 is a view like that shown in FIG. 4 but with a different type of brush core;

FIGURE 6 is a cross sectional view of the fragmentary section of brush material taken along line 6—6 of FIG. 4;

FIGURE 7 is a fragmentary perspective view of another type of brush core;

FIGURE 8 is a fragmentary perspective view of still another type of brush core; and

FIGURE 9 is a cross sectional view of a fragmentary section of a preferred modification of brush material which has advantages over the brush material shown on FIG. 6.

In the drawings, at times like numerals are used to represent corresponding parts.

As shown in FIG. 1, the brush assembly, generally designated by the numeral 10, is mounted on the driven plate 11 of a sweeper 12 by mounting bolts 13.

Now referring to FIGS. 1—4, the brush assembly is composed of a plurality of elongated strips of tufted brush material 14 mounted on a brush core between guideways formed between adjacent shoulders of a plurality of cylindrically arranged retaining members constituting elongated T-shaped bars 15 axially supported by a plurality of annular discs 16 and held in place by restraining plates 17 bolted to end discs 16 by bolts 18 screwed into the threaded holds 19.

As is more clearly shown in FIGS. 4, 5 and 6, the tufts of brush material may be made from loops of brush material which extended through an upstanding collar 21 of a flat plate 22 and are retained therein by a rigid rod or locking wire 23 extending along plate 22 and through the loops in the tufts 20. The tufts are advantageously provided with resilient elastomeric damping collars 24 and damping rings 25 made of rubber, neoprene or the like.

As shown in FIGS. 1—4, the vertical section 26 of T-shaped bars are fixedly seated in mating radial slots 27 of discs 16. The peripheries of discs 16 are provided with cutouts 28, centrally disposed between the stems of T-bars. Cutouts 28 are of less width as measured circumferentially of the discs, than the width of strips 14, but are wider than the looped-bristle inner end portions of tufts 20 so as to permit the longitudinal, but free, mounting of the strips 14 in the guideway formed between the horizontal section 29, or shoulder, of the T-shaped bars 15 and the shoulder 30 of discs 16. The T-shaped bars may be axially and radially supported on tube 31 by spoke-like elements 32, as shown in FIG. 5.

In the embodiment shown in FIG. 7, the retaining members for the strips 14 constitute cylindrically arranged inverted L's 33 fixedly attached to a drum-like core element 34 by welding or by other appropriate means. It will be seen that each retaining member has a substantially continuous shoulder 35 extending laterally towards a corresponding shoulder of an adjacent retaining member but is spaced therefrom so that the plates 22 of the strips of brush material 14 can be freely mounted under said shoulders with the tufts 20 of brush material extending outwardly from the core. In this embodiment a U-shaped bar would serve in the same manner.

As shown in FIG. 8, a T-shaped retaining member 15 has been formed as a part of cylindrical core member 36.

When using appropriate metals, this core may be extruded as a unitary part of a solid metal core or the T-shaped retaining member may be cut, for instance, from a solid rod, a drum, or a tube reinforced internally as, for instances, by discs as shown in FIGS. 1-4.

In one practical and very economical embodiment of the invention, the brush core and brush strips holding the tufts of brush material are all fabricated from rolled steel of sufficient thickness to form a rigid assembly. In such an embodiment, the annular discs and the T-shaped bars can be obtained as standard articles, or can be fabricated very readily, while the collars holding the tufts of brush material can be extruded, or drawn, from strips of cold rolled steel without importantly disturbing the cross sectional thickness of the strips. The tufts of brush material may then be assembled in the strips in the factory. The cutouts and the radial slots in the annular discs can be cut, or otherwise formed, without difficulty and the brush core formed, for example, by welding the discs to an axial tube, or rod, and by welding the T-shaped bars into the mating radial slots. The depth and location of cutouts are determined so that the metal strips holding the tufted brush material may be mounted easily and loosely between the shoulders on the discs and under side of the shoulders on the T-bars with the tufts of brush material extending outwardly from the brush core. The annular end discs usually are made of a heavier construction to permit mounting of the brush assembly on the roller of a sweeper.

In one particular embodiment, designed for a runway sweeper, a 14 foot core was provided having $1\frac{1}{2}$ inch tubular axle upon which annular discs were mounted having a $4\frac{3}{8}$ inch radius. Two $\frac{1}{2}$ inch discs having $\frac{1}{2}$ inch threaded holes arranged on a concentric circle having a $3\frac{3}{8}$ inch radius were mounted at the end of the tube while 13 equally spaced $\frac{3}{16}$ inch discs were mounted on the tube therebetween. Sixteen $\frac{7}{8}$ by $\frac{7}{8}$ inch by $\frac{1}{8}$ inch T-shaped bars were welded in the mating radial slots so that the core had an outer radius of 5 inches. Strips of brush material 14 feet long composed of $13\frac{1}{4}$ inch tufts of looped 0.018 inch round crimped steel wire mounted in 1 inch diameter perpendicularly extending $\frac{3}{8}$ inch collars extruded from a $1\frac{1}{2}$ by $\frac{1}{8}$ inch metal strip were longitudinally mounted between the shoulders of the discs and the T-shaped bars so that the tufts of brush material extended outwardly from the core. The tufts of brush material were provided with damping sleeves and rings as described above. Good sweeping action was obtained when about 8 tufts were provided per linear foot of strip brush material. The looped wires were held in the respective collars by locking wires passing through the loops in the respective tufts of material. Typically, the looped ends would extend about $\frac{3}{8}$ inch beyond the metal strip so that corresponding grooves were provided in the annular discs to permit free and easy longitudinal mounting of the strips of brush material between the retaining T-bars and the discs. In this way, a cylindrical brush assembly having an approximately 36 inch outside diameter was provided. When it was desired to have the collars extend inwardly, instead of outwardly, the looped tufts of brush material were correspondingly increased in length and the retaining wires were then inserted through the loops and across the free ends of the collar rather than along the metal strip. Once the strips were mounted a circular retaining plate 16 inches in diameter and $\frac{1}{2}$ inch thick was mounted on each of the end discs by bolts passing through holes mating with the threaded holes in the end discs. The plates prevented longitudinal movement of the strips of brush material. The retaining plates, in turn, exactly matched two mounting plates of the same diameter permanently attached to the sweeper one of which was welded to a shaft supported in a spherical bearing and the other of which was welded to a shaft which ran through a spherical bear-

ing and was provided with a gear sprocket on the outer side of the bearing adapted for mating with a driven chain on the sweeper which rotated the mounting plate. The retaining plates were provided with sixteen $\frac{1}{2}$ inch threaded bolt holes located on a 14 inch bolt circle and exactly matching sixteen corresponding $\frac{1}{2}$ inch holes in the mounting plates. The brush assembly was attached to the sweeper by inserting bolts through the holes in the mounting plates and screwing them into the threaded holes in the retaining plates.

It was surprisingly found that the free and loose mounting of the strips of brush material between the retaining members and the supporting discs was in no way disadvantageous for the centrifugal force normally experienced in the use of the brush assembly was such that the metal strips were lifted off the shoulders on the discs and maintained in contact with the shoulders on the T-shaped bars, or the like. Thus, the retaining members withstand the major force exerted during the use of the brush assembly. The substantially continuous shoulders on the T-shaped bars afford firm and reliable support for the strips of brush material in this type of construction. The shoulders on the discs, or the like, primarily function to maintain the strips of brush material and the core in the assembled state.

The foregoing description of the brush material has related to crimped round steel wires which may be especially advantageously used where vigorous sweeping action is required. It will be understood, however, that the construction set out lends itself advantageously to the use of other types of bristles including natural and synthetic materials such as horse hair, nylon, vegetable fibers, other types of wire and etc.

The loose mounting of the strips of brush materials in the guideways, as discussed above, plays an important role in increasing the wear life of the tufts of brush material and in reducing the breakage of individual brush bristles.

Where airports are being cleaned broken bristles may enter jet engines and cause damage or even cause an accident. Thus a cut down on breakage is not only an economic factor but may be a safety factor.

The use of a relatively soft elastomeric damping collar 24 increases the flexibility of the brush unit thereby further enhancing the centrifugal moving action of the unit and serves to reduce the wearing forces between the brush bristles and protective collar 21.

From a practical standpoint the damping collar may be made from any desired elastomeric material, the degree of flexibility is a matter of choice related to the intended use.

The combination of damper collar 24, damper ring 25, and the loose mounting of the strips of brush material 14 all serve to increase the wearing life and reduce bristle breakage.

The damper collar 24 can be mounted in the upstanding collar 21 of strip 14 in any desired manner, such as form fitting, using adhesives, nesting, etc.

The preferred manner of mounting the damper collar is shown in FIG. 9. This modification shows strip 14', having an upstanding collar 21', and a flat plate 22', collar 21' having a countersink 41 which serves the dual purpose of increasing the strength of collar 21' and the overall rigidity of the strip 14', and it also serves to more adequately retain damper collar 24' in collar 21', due to the seating of flange 42 in countersink 41, during the steps of (1) threading of tufts 20' through collar 21' and strip 14' and (2) the seating of loops of the tufts 20' against the locking wire 23' after they are threaded through the looped ends of the tufts 20'. In addition, the recessing of the flanges 42 in the countersinks 41 facilitates the threading of the wire 23' through the loops of looped ends of tufts 20' located along the length of strips 14' preparatory to the seating of the looped ends of the bristles against wire 23'. During use, flange 42 prevents

damper collar 24' from being forced out of collar 21' and the recess 41 protects flange 42 against the wear of wire 23'.

The flanged damper collar 24', as shown in a preferred embodiment, is provided with a reinforced portion within collar 21' and a relatively thinner, more flexible, portion 44 extending beyond collar 21. The relatively thicker reinforced portion 43 strengthens the damping collar and increases its wearing life, the relatively thinner more flexible portion 44 improves the centrifugal brushing action of the brush unit and helps to reduce wear and bristle breakage.

When the strip and damper collar shown in FIG. 9 are used, no other mounting aids, such as the use of an adhesive to retain the damper collar in the strip collar, or the use of tight form fitting parts, are necessary. This makes assembling of the strip brush material unit relatively easy and economical. All that is required to assemble the strip brush material is to place the damper collar into, the strip collar, hydraulically, or otherwise, force the loops of the tuft material through the damper collar and beyond the back of the strip, place the locking wire through the loops of the tufts, hydraulically, or otherwise, seal the loops against the wire, and lock the wire in place. This is a simple assembly line operation. The strip of brush material is merely slid in place on the guideways attached to the brush core. The entire operation requires a minimum of manual labor and there are a minimum number of bolts to loosen or tighten in placing the strip brush material on the brush core, or removing it therefrom.

In order to further increase the wearing life of the brush assembly the strip 14 or 14' and its collars 21 or 21' are preferably made from aluminum, which is a soft metal that reduces the wear on both the damping collars and, more importantly, reduces the wear on the more expensive steel annular discs 16, and the steel shoulders that form the strip retaining guideways. The aluminum being softer than the steel, and less expensive, will wear out and be economically replaced with another aluminum strip, the more expensive steel structure being harder than the aluminum will have a much longer wearing life. New aluminum strips normally will be provided whenever the wires wear down.

The foregoing description makes it apparent the brushes of this invention are simple and highly flexible in design, inexpensive in components, rugged and reliable in use, and may be assembled and disassembled and mounted on a sweeper with great ease. Experience proves the brushes perform very efficiently.

It is apparent that any desired diameter and length brush assembly may be readily built using the principles of this invention and that the retaining plates may be designed for mounting the brush assembly on various types of sweepers. The fact that the brush strips can be preassembled and freely longitudinally mounted on the brush core without being concerned with close tolerances makes it possible for one to keep a number of sweepers in substantially continuous use, i.e. with very little down time, by stocking necessary quantities of strips of brush material and advantageously a single brush core for it is obvious that the brush material will require replacement more frequently than the core.

Tests made using the brush assembly unit of this invention show that this brush unit more than adequately meets the Air Force's specification of not more than 2% bristle breakage for the life of the brush. These specifications are based upon the wearing life equivalent to that of tufts of about 13 inches worn down to about 6 to 8 inch tufts.

While the invention has been described with reference to a cylindrical broom, it will be apparent that the principles of the invention may be used in connection with other types of brush assembly such as in the making of industrial brushes. Also, the invention has been de-

scribed in detail for illustrative purposes but it is apparent these details may be varied and modified without departing from the spirit of the invention or its scope as defined in the appended claims.

We claim:

1. In a rotary brush assembly, a brush strip comprising an elongated flat metal plate having a series of apertures spaced therealong, metal collars having inner ends integral with said plate around said apertures and having free ends extending outwardly on one side only of said plate, tufts of bristles extending through said collars and apertures, said bristles having free ends projecting beyond the free ends of said collars and looped ends projecting beyond the other side of the plate, a retaining rod engaging against the other side of the plate and extending through the looped ends of the bristles, and elastomeric tubes surrounding said tufts of bristles along part of the lengths thereof, said tubes having inner end portions engaging between the tufts of bristles and said collars and outer end portions extending outwardly from the free ends of said collars and terminating between the free ends of said collars and the free ends of said bristles; and a core assembly mounting said strips for rotation about an axle, comprising a tube, a plurality of supports affixed in axially spaced relation along said tube, means on said supports defining a plurality of open-ended guideways for said strips, said guideways extending parallel to said axis at intervals spaced circumferentially about the arc of a circle, the means defining said guideways each having a pair of opposed sides extending radially of said tube and angularly spaced from one another by distances greater than the width of the plates, radially spaced stop elements extending substantially in the circumferential direction of said circle from inner and outer ends of said side surfaces, respectively, the stop elements at the outer ends of the side surfaces of each guideway terminating in an edge disposed towards and spaced from one another by distances less than the width of the plates and greater than the diameter of the collars, thereby providing clearance therebetween for the collars, and the radial spacing of the stop elements being less than the distance between said other sides of the plates and the free ends of the collars, whereby the collars and tubes protect the bristles from engagement against the stop surfaces at the outer ends of the side surfaces and the outer end portions of said tubes resiliently support said bristles against bending about short radii adjacent the free ends of the collars.

2. In a rotary brush assembly, a brush strip comprising an elongated metal plate having a series of apertures spaced therealong, metal cylindrical collars having inner ends integral with said plate around said apertures and having free ends extending outwardly on one side only of said plate, tufts of bristles extending through said collars and apertures, said bristles having free ends projecting beyond the free ends of said collars and looped ends projecting beyond the other side of the plate, a retaining rod engaging against the other side of the plate and extending through the looped end portions of the bristles, and elastomeric tubes surrounding said tufts of bristles along part of the lengths thereof and having portions thereof engaging between the tufts of bristles and said collars; and a core assembly mounting said strips for rotation about an axis, comprising a tube, a plurality of coaxial annular discs affixed in axially spaced relation on said tube, a plurality of rigid T-shape bars each having a stem portion and a head portion, said bars extending parallel to the axes of the discs and having the stem portions thereof rigidly affixed to the peripheries of the discs and extending radially outward therefrom for distances substantially greater than the thickness of the plates and less than the distance between the other sides of said plates and the free ends of the collars, said T-shape bars being disposed at angularly spaced intervals with the spacing between the stem portions of adjacent ones thereof greater than the widths of the plates and the distances

between adjacent head portions of adjacent ones thereof being less than the widths of the plates and greater than the diameters of the collars, whereby adjacent pairs of said bars cooperate with the peripheries of the discs to define longitudinal slideways into which said strips freely engage longitudinally and in which said strips are loosely confined and said metal collars and elastomeric tubes protect the bristles from engaging against the head portions of the T-shape bars.

3. The combination claimed in claim 2, those portions of the disc peripheries disposed between the stem portions of the T-bars each having a centrally disposed cutout therein of lesser span, in the circumferential directions of the discs, than the widths of the strips, whereby those portions of the disc peripheries which lie between the ends of the recesses and the stems of the T-bars constitute stop surfaces for the strips and whereby said cutouts provide clearance for the looped inner end portions of the bristles.

4. The combination claimed in claim 3, said elastomeric tubes having other portions extending outwardly from the free ends of said collars and terminating inwardly of the free ends of said bristles, whereby to support said bristles against bending about short radii adjacent the free ends of said collars.

5. A brush strip adapted for mounting in an axial guideway in a rotary core, comprising an elongated metal plate having a series of apertures spaced therealong, metal collars having inner ends integral with said plate around said apertures and having free ends extending outwardly on one side only of said plate, tufts of bristles extending through said collars and apertures, said bristles having free ends projecting beyond the free ends of said collars and looped ends projecting beyond the other side of the plate, a retaining rod engaging against the other side of the plate and extending through the looped end portions of the bristles, and elastomeric tubes surrounding said tufts of bristles along part of the lengths thereof, said tubes having inner end portions engaging between the tufts of bristles and said collars and outer end portions extending outwardly from the free ends of said collars and terminating between the free ends of said collars and the free ends of said bristles.

6. A brush strip adapted for mounting in an axial guideway in a rotary core, comprising an elongated metal plate having a series of apertures spaced therealong, metal collars having countersunk inner ends integral with said plate around said apertures and having free ends extending

outwardly from said plate, tufts of bristles extending through said collars and apertures, said bristles having free ends projecting beyond the free ends of said collars and looped ends projecting beyond the other side of the plate, a retaining means engaging against the other side of the plate and extending through the looped end portions of the bristles, and elastomeric tubes surrounding said tufts of bristles along part of the length thereof, said tubes having flanges that fit within said counter sinks of said collars and portions terminating between the free ends of said collars and the free ends of said bristles.

7. The brush strip of claim 6 wherein said tubes have reinforced portions that fit within said collars and more flexible portions that extend beyond the free ends of said collars.

8. A brush assembly, comprising:

a brush core having a plurality of cylindrically arranged and axially supported longitudinally extending retaining members,

each retaining member having a substantially continuous shoulder extending laterally towards a corresponding flat shoulder of an adjacent retaining member but spaced apart therefrom, to form a series of guideways;

a plurality of relatively flat and rigid strips loosely mounted in said guideways, said flat shoulders being substantially at least as long as said flat strips, said strips having integral collars that extend through the shoulders of said guideways to serve as a wear-guard protector, tufts of bristles, extending through said collars, means beyond the inner end of said collars to retain said tufts in said collars, and elastomeric means within said collar and extending beyond said collar to support said tufts against bending about short radii adjacent the ends of said collars.

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CHARLES A. WILLMUTH, *Primary Examiner*.