

July 10, 1962

R. O. PETERSON
ROTARY ABRADING TOOL

3,043,064

Filed Nov. 23, 1959

3 Sheets-Sheet 1

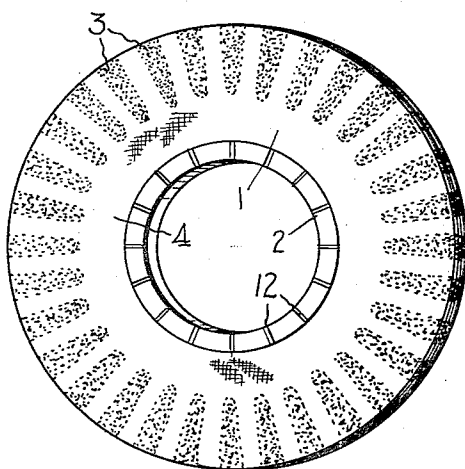


Fig. 1

Fig. 2

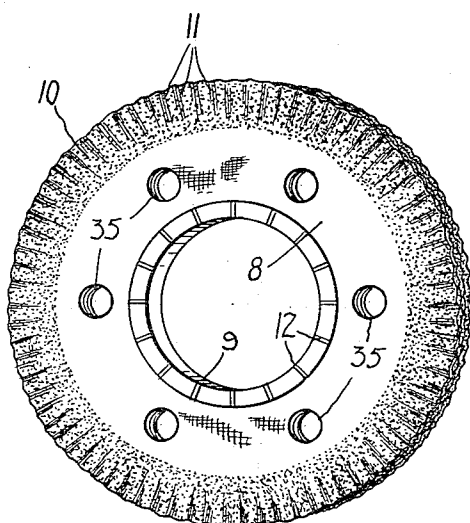
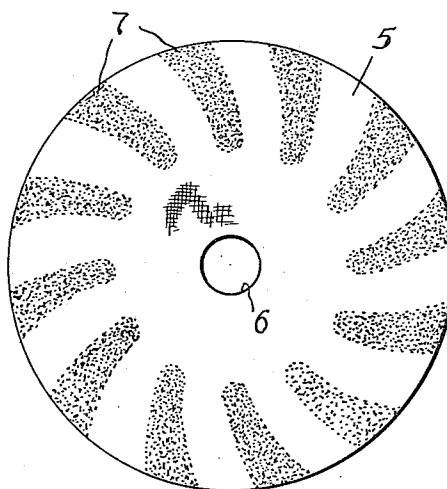


Fig. 3

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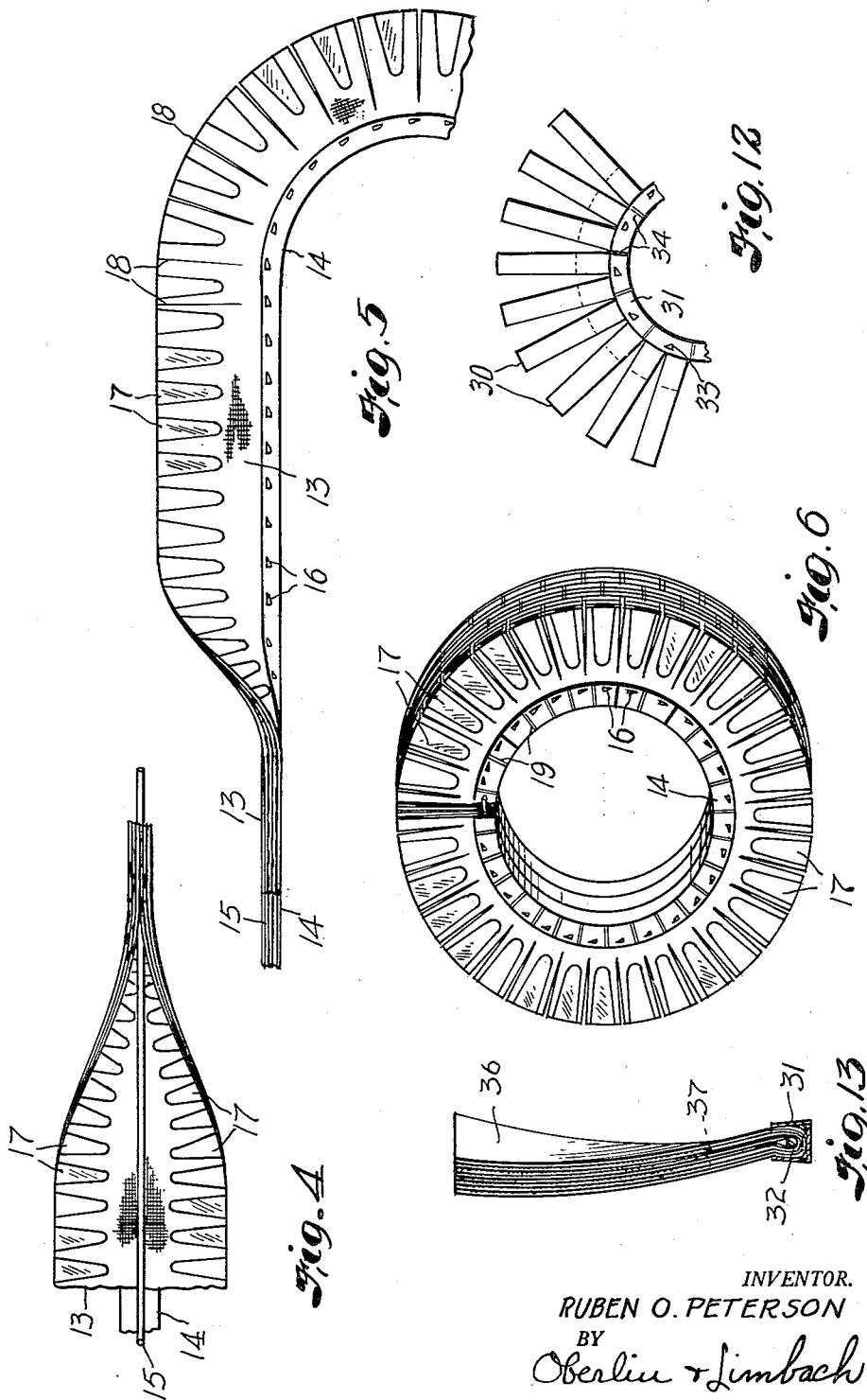
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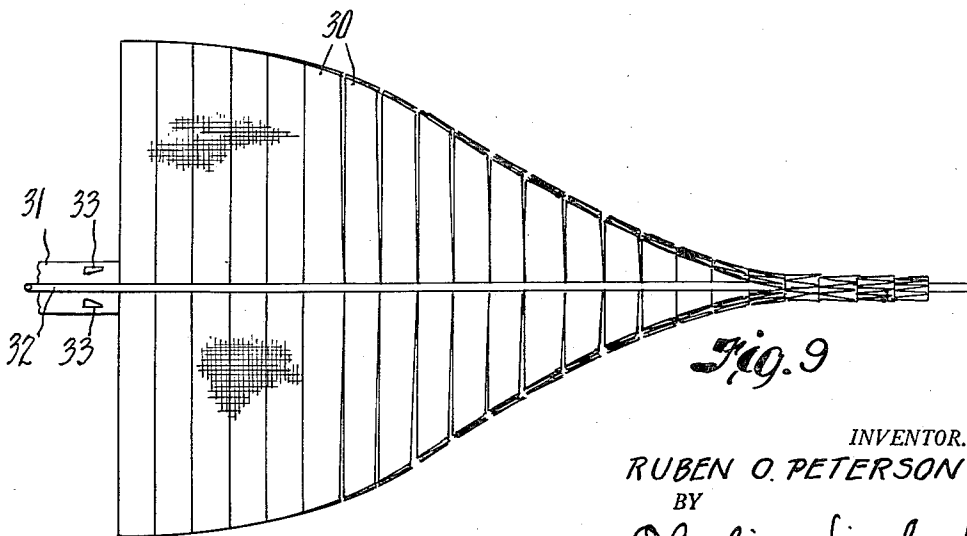
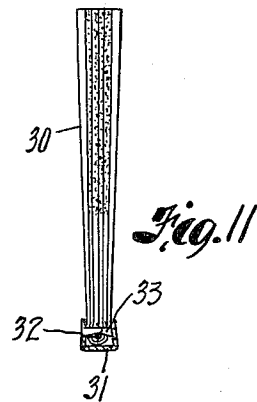
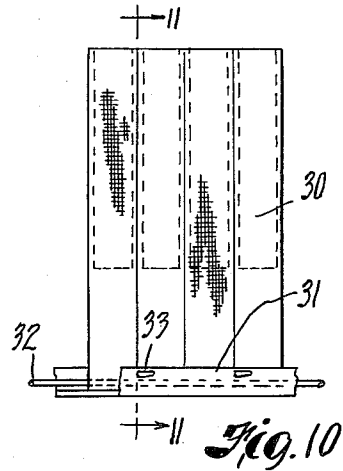
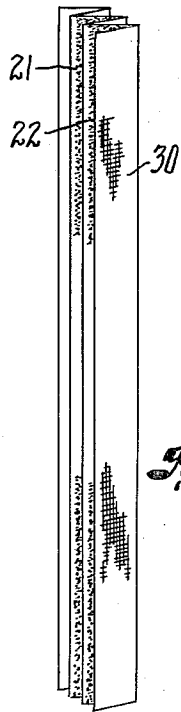
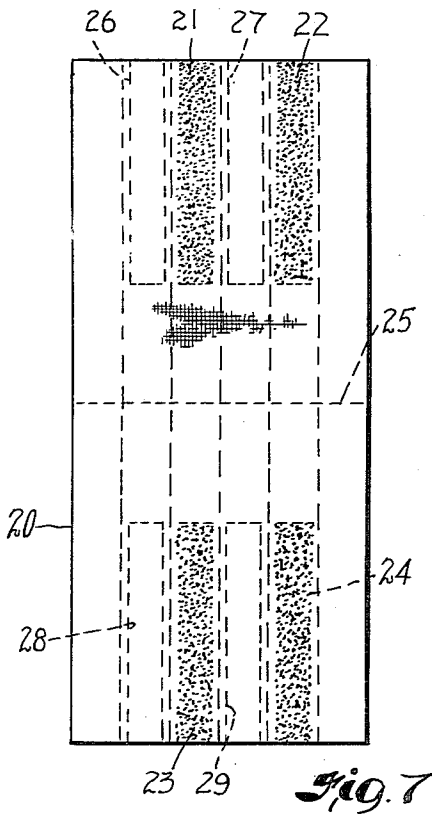
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3 Sheets-Sheet 3



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ROTARY ABRADING TOOL

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Filed Nov. 23, 1959, Ser. No. 854,981

7 Claims. (Cl. 51-193)

This invention relates as indicated to a novel rotary abrading tool, this application being a continuation-in-part of my copending application Serial No. 329,791, filed January 6, 1953, now abandoned, in turn a continuation-in-part of application Serial No. 173,465, filed July 12, 1950, now Patent No. 2,704,916 dated March 29, 1955. More particularly, this invention is concerned with rotary buffs having abrasive material in certain regions as more fully explained below.

Rotary buffs are employed in a wide variety of surface finishing operations and may be required either to remove a considerable amount of material from the work surface being acted upon, or to refine the finish, or to obtain a high reflectivity or gloss on such surface. Perhaps the best known form of buff merely comprises an assemblage of textile fabric discs secured together in side-by-side relationship and provided with an appropriate hub or like supporting means for mounting on an arbor. Standard abrasive and polishing materials such as emery, Carborundum and rouge may be applied to the rotating buff in order that the latter may in turn apply the same to the surface to be conditioned. Certain greases, waxes, oils, glue and other adhesives may be incorporated with the abrasive or polishing material in order that the latter may be at least temporarily adhered to the working surface of the buff and not immediately thrown off and dispersed. This arrangement, of course, makes for somewhat messy working conditions and the work-piece must frequently be subsequently treated with a solvent or other cleansing agent to remove such wax, grease or oil therefrom. Inasmuch as the abrasive material is thus ordinarily intermittently applied to the rotating buff or to the work-piece, it is obvious that the surface conditioning characteristics of the latter can be far from uniform and the work-piece or work-pieces therefore non-uniformly treated.

Merely to form the buff of fabric discs having one or both sides entirely coated with abrasive has not proven a satisfactory solution for the reason, among others, that a very rigid "wheel" results which does not have the resilience and soft yielding action frequently desired in a buff. It is this yielding action which permits a buff to be forced against a work-piece without danger to the latter or to the buff but at the same time obtaining desired penetration into hollows and conformance to irregular contours of the article being buffed.

It is accordingly a principal object of my invention to provide a novel buff construction utilizing fabric having abrasive material adhered thereto or included therein but which will be relatively flexible and adapted to conform to the contours of a work-piece being acted upon.

Another object is to provide an abrasive buff which will be economical in the amount of abrasive employed.

Still another object is to provide such a rotary buff which will not produce streaking on the surface of the work.

Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features herein-after fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments

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of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a side elevational view of a rotary buff embodying the principles of my invention;

FIG. 2 is a side elevational view of a modified buff generally similar to that of FIG. 1;

FIG. 3 is a side elevational view of still another rotary buff in accordance with my invention;

FIG. 4 is a diagrammatic illustration of one method of forming strip material utilizing my abrading elements;

FIG. 5 is a side elevational view corresponding to FIG. 4 and showing how the resultant strip may then be circularized;

FIG. 6 shows an annular cylindrical brushing tool formed of a plurality of such circularized sections;

FIG. 7 shows a sheet of flexible fabric to which abrasive has been bonded in certain areas preparatory to forming abrading fingers comprising a further embodiment of my invention;

FIG. 8 shows the sheet of FIG. 7 folded or pleated to form such novel fingers;

FIG. 9 illustrates the employment of such fingers of FIG. 8 in the continuous manufacture of brush strip;

FIG. 10 is a side elevational view of a section of such strip;

FIG. 11 is a transverse section taken on the line 11-11 on FIG. 10;

FIG. 12 shows a rotary brush section utilizing the abrading fingers of FIG. 8; and

FIG. 13 is a view similar to FIG. 11 of a modified form of abrading finger retained in a channel back.

Referring now more particularly to FIG. 1 of the drawing, the embodiment of my invention there illustrated may comprise a plurality of discs 1 of fabric sheet material assembled in close side-by-side relationship and provided with an annular opening for seating and securing in an annular sheet metal channelform back 2. Generally similar buffs may be produced by methods well known in the art and illustrated, for example, in Myers et al. Reissue Patent 19,894 and Hall Patent 2,027,863. Radial stripes 3 of powdered or granular abrasive material may be adhered to such discs and will extend to the outer peripheries of the latter. In the embodiment illustrated, such stripes are wider at their outer extremities at the periphery of the buff and taper toward the inner periphery of the latter, the elongated uncoated regions intermediate such stripes being of substantially uniform width. The abrasive stripes 3 do not extend entirely to the inner periphery of the fabric discs but their inner extremities are spaced substantially therefrom as shown, ordinarily approximately one-quarter to one-third of the radial extent of the fabric being uncoated, and occasionally such stripes will extend only about one-half the radial extent of the fabric. The resulting inner annular uncoated region 4 of the buff layers may be stitched together in conventional fashion for mounting upon shafting between the usual clamping end plates but will preferably first be mounted in a sheet metal hub 2, as shown. The outer peripheral region of the resultant buff will be more dense than such inner peripheral region 4 due to the application of the abrasive stripes thereto. It is ordinarily preferred that when such stripes 3 are applied to both sides of each fabric disc, they be applied directly opposite one another to facilitate flexing of the buff fabric along radial lines in the uncoated regions intermediate the same. While it may sometimes be preferred to assemble the discs with all of the abrasive stripes in side-by-side relationship so as to afford radial ventilating passages therebetween, it will ordinarily be

satisfactory to assemble such discs indiscriminately without regard to the relative locations of the abrasive stripes of adjacent discs.

The term "fabric" as employed herein and in the claims is intended to include any suitable sheet material whether textile or imperforate plastic sheet, for example. Thus, cotton cloth, nylon (polyamide resins), Pliofilm (rubber hydrochloride), or certain types of paper sheet material are entirely suitable for use in embodiments of my invention for certain purposes, and other natural or manufactured fiber materials may likewise be employed.

While many types of adhesives may be employed to secure the abrasive to the buff fabric, depending on the particular application, the following may be mentioned: animal glues, glycerine phthalate resins such as "Dulux," Bakelite resins, cellulose base resins, casein glue, epichlorohydrin-bisphenol-A resins such as "Epon," and even waxes such as cerotic acid wax and greases such as mutton tallow. Ordinarily, adhesives are preferred which have relatively little stiffening effect on the fabric and do not tend to smear the work, or at least may be readily removed from such work. The adhesive should not be too brittle but should stand up under impact in use. When synthetic plastic sheet material is employed as the buff fabric, the abrasive may be adhered by pressing into the plastic surface, with application of heat or solvent where appropriate to bond the abrasive grains thereto.

Adhesive may desirably be printed on the fabric by the well-known roller process and the abrasive then dusted thereon. In this manner, the abrasive will be secured only to the precise areas desired and all excess is readily blown or sucked away. If desired, however, the abrasive and adhesive can be applied together.

Among abrasive materials suitable for different operations are: aluminum oxides such as Alundum and Aloxite, silicon carbide (Carborundum), precipitated aluminum oxide, emery, rouge, pumice (Tripoli), sharp sand, bauxite, and diatomaceous earth. Fabric having abrasive areas may also be provided by interweaving abrasive strands which may be of the type taught in Radford Patent No. 2,328,998, for example.

Referring now more particularly to FIG. 2 of the drawing, the embodiment of my invention there illustrated comprises a disc of flexible sheet material 5 ordinarily provided with a central hole or opening 6 for mounting on an arbor or the like and having spaced abrasive stripes 7 applied thereto somewhat resembling the stripes 3 of the FIG. 1 embodiment. Stripes 7, however, are of general volute conformation, preferably tapering toward the center of the disc. When a plurality of such discs are assembled in side-by-side relationship, it will be seen that a rotary buff is obtained which will have rather more "give" or yielding action when brought into engagement with the work than is the case with a buff of the FIG. 1 type having an equal area coated with abrasive. If such stripes 7 are applied to both sides of an individual fabric disc, such stripes will preferably be directly opposite one another so that the spaces intermediate the abrasive stripes or fingers will retain their full degree of flexibility. A buff of the FIG. 2 type should be mounted for rotation in a clockwise direction when the volute fingers are arranged in the manner shown. The inner ends of fingers 7 terminate at points spaced substantially from the inner periphery of the disc 5, ordinarily approximately one-quarter to one-third of the radial extent of the flexible sheet material being uncoated. This, of course, facilitates such slight inward yielding action of the buff material when the buff is pressed against the work and also renders the inner portion of the buff less dense, affording improved ventilation and cooling.

Another somewhat different embodiment of my invention is illustrated in FIG. 3 of the drawing, where a plurality of flexible sheet material discs 8 are secured in a channelform back 9 similarly to the FIG. 1 em-

bodiment. A circumferential band 10 of granular abrasive is adhered to such fabric discs adjacent to and extending to the outer peripheries of the latter. Such abrasive region, however, extends radially inwardly only part way to the back 9, and may have a radial extent equal to only one-third or one-half the radial extent of the annular sheet material disc 8. If desired, such abrasive region may sometimes extend further toward the inner periphery of the annular fabric disc but will always be substantially spaced therefrom, i.e. at least on the order of one-fourth the radial extent of such disc. It will be seen that an abrasive buffing tool formed of a plurality of such discs will be quite dense at its outer working face but will be considerably less dense, more flexible and better ventilated adjacent its inner periphery.

Such ventilation is facilitated and streaking of the work avoided by slightly pleating the sheet material 8 as at 11 to afford a somewhat wavy edge to each of the discs. Of course, a somewhat equivalent effect is obtained in the case of the FIG. 1 and FIG. 2 embodiments since the spaced generally radially extending abrasive regions or fingers leave radially extending channels therebetween when a plurality of discs are assembled in close side-by-side relationship, permitting outward flow of ventilating air under the action of centrifugal force.

In my Patent No. 2,879,631, I disclose certain novel sheet metal brush material in the form of thin flat fingers which may be of extremely hard material such as Hadfield steel, for example. In accordance with my present invention, flat fingers of such hard sheet material may be adhered or otherwise secured to the much more flexible buff fabric, for example, in place of the granular abrasive regions above described, thereby providing an abrading tool having the advantages previously explained but of quite a different character in its action on the work.

When thin hard sheet material strips or fingers are secured to the flexible sheet material discs such as 1 and 5 with the outer working portion of the tool being largely formed by the outer ends of such hard sheet material fingers, a tool is thus produced capable of extremely vigorous abrading action but with the abrading elements nevertheless flexibly mounted and secured to the rotatable support. Sheet metal fingers, for example, will be seen to lie in radial planes transverse of the axis of rotation of the tool and will accordingly have an edgewise shredding or cutting action in use.

Obviously a great variety of sheet metal fingers may be employed in addition to austenitic manganese steel (Hadfield steel) including Monel metal and silicon bronze, for example. The metal fingers may be coated with a plastic such as rubber (if operating temperatures are not too high), neoprene (polychloroprene), hycar (modified copolymers of butadiene and acrylonitrile), nylon (polyamide resins), vinyl plastics (vinyl polymers and copolymers), and melamine resins (melamine-formaldehyde reaction products). Such plastic coatings assist in protecting the metal from corrosion and may also have granular abrasive embedded therein, if desired.

When a plurality of fabric discs are stacked as shown in FIG. 1, for example, they may be bonded together by means of adhesive, if desired, to form a relatively solid and rigid wheel. Since the sheet metal fingers do not extend entirely to the inner periphery of the discs, however, the inner peripheral portion of the tool will be less dense and still afford a degree of radially inward yielding action under impact and pressure. The radially extending regions intermediate the sheet metal fingers also afford passages for the outward escape of ventilating air, particularly when my new rotary tool is mounted upon a ventilating hub or adapter of the type shown in my prior Patents 2,316,185, 2,320,384 or 2,409,309, for example. The sides of the sheet metal channelform back may also desirably be crimped or indented as at 12 to facilitate radially outward flow of ventilating air when a number of

annular sections are assembled in close side-by-side relationship.

One method suitable for applying hard metal areas to certain more flexible sheet materials such as cloth is to spray molten metal thereon utilizing well-known procedures and commercially available equipment. Such hard sheet material fingers may also be mechanically secured to the supporting fabric discs, as by stapling, for example, or by a combination of stapling and adhesive.

Referring now more particularly to FIGS. 4 and 5 of the drawing, there is illustrated a method whereby continuous strips of flexible sheet material 13 may be superimposed upon a central longitudinally extending sheet metal backing strip 14 and overlaid with an elongated retaining element such as wire 15 and then doubled about such wire when sheet metal strip 14 is formed into a self-sustaining channelform back in the manner taught in my prior Patent No. 2,303,386. Teeth 16 may desirably be punched in from the sides of such channelform back to penetrate the flexible sheet material 13, which may be in several layers as shown, and to overlaid and secure the elongated retaining element 15. Such teeth should be punched up from sheet metal strip 14 prior to forming the latter to channel shape. Two parallel rows of flat abrading fingers 17 will be secured to such sheet material 13 with such fingers extending from the outer lateral edges of strip 13 toward the longitudinal center line thereof but preferably spaced substantially from such center line as shown. The flexible sheet material 13 may be slit at 18 intermediate such abrading fingers to facilitate subsequent circularization of the brush strip as illustrated in FIG. 5. Such brush strip may be circularized to form annular sections or may be wound upon a mandrel or the like into helical form.

Such abrading fingers 17 may be of thin sheet metal such as Hadfield steel, as illustrated, or they may be of granular abrasive bonded to the flexible sheet material 13 in a manner comparable to the abrasive fingers or areas 3 and 7 of FIGS. 1 and 2. When the brush strip of FIGS. 4 and 5 has been circularized and a plurality of annular sections assembled in side-by-side relationship as illustrated in FIG. 6 for example, it will be seen that a generally cylindrical brushing tool is thereby afforded in which the thin flat abrading fingers 17 lie in planes transversely of and normal to the axis of the tool. This arrangement of the flat abrading fingers is particularly effective when utilized in pipe cleaning pigs of well-known construction, for example, and when such annular or helical sections are mounted for rotation about their axes, an edgewise shredding action may thereby be obtained. Just as the thin metal fingers 17 of FIGS. 4-6 inclusive may replace the granular abrasive fingers on the discs of FIGS. 1 and 2, so likewise may such granular abrasive fingers be substituted for the sheet metal fingers 17 of FIGS. 4-6 inclusive.

When the brush strip is to be circularized as shown in FIGS. 5 and 6, it is desirable that the abrading fingers 17 taper in the manner generally indicated in such figures in order that the action of the tool may be more uniform as its periphery wears back in use. When a number of layers of sheet material 13 are utilized as illustrated, the adjacent layers extending from a single channelform back may be bonded together so that they will form composite fingers of substantial thickness. Each layer of flexible sheet material 13 may have an abrading finger 17 secured to one or both sides thereof, or certain of such layers may have no such fingers secured thereto, to afford a modified effect. In another modification, alternate fingers, for example, may be of sheet metal and granular abrasive, thereby obtaining certain of the attributes of each material. The sides of the channelform back 14 may desirably be crimped or indented as at 19 to facilitate radially outward flow of ventilating air or other fluid.

It will generally be preferred that the fabric strips 13

be continuous not only to facilitate manufacture of the tools but also to maintain the abrading regions or fingers in proper relationship in the finished tool. Unless such strips are preliminarily pleated intermediate the abrading fingers, however, to allow for subsequent circularization, it will ordinarily be necessary to slit the edges of the strips intermediate such abrading fingers as shown in FIGS. 5 and 6 to make such fingers substantially independent of one another and therefore considerably more flexible. Rigidity may be increased by bonding several layers together as described above, as by means of stitching or adhesive. In the latter case, it will sometimes be desired to incorporate granular abrasive in the adhesive so that in effect a sandwich of thin metal sheets and granular abrasive may be produced. Due to the flexibility of the sheet material 13 and the fact that the abrading fingers 17 preferably do not extend entirely to the sheet metal channelform back 14, a relatively less dense and more flexible region intervenes between the inner ends of the abrading fingers and the channel back. This permits such fingers to yield somewhat in use when engaging the work, this being a characteristic of a rotary brushing tool as contrasted to the ordinary grinding wheel or rotary knife, for example. Moreover, the usual concentrations of vibrations and stresses incurred when metal bristles or the like are seated directly in a back element such as channel 14 may be avoided.

Referring now more especially to FIGS. 7-11 inclusive of the drawing, a modified embodiment of my invention is there illustrated. A sheet of flexible fabric material 20 has applied and adhered thereto certain spaced regions 21, 22, 23 and 24 of granular abrasive, such regions extending to the outer edges of the rectangular piece of fabric but spaced at their inner ends from the center line 25. Similar regions of abrasive material 26, 27, 28 and 29 may be bonded to the opposite side of the sheet 20 in similar regions opposed to non-abrasive panels on the near side of the sheet (FIG. 7). Sheet 20 may then be pleated as illustrated in FIG. 8 to form an elongated strip 30 with the abrasive areas inside, the sheet having been pleated intermediate the same. Moreover, when such abrasive areas are spaced as shown in FIG. 7 for example, they will be opposed to non-abrasive areas when the sheet is thus pleated, and consequently no two abrasive areas will rub against one another. A plurality of flat pleated fingers 30 may be placed in close side-by-side relationship transversely of a sheet metal backing strip 31 in the manner taught in my prior Patent No. 2,303,386, and an elongated retaining element such as wire 32 placed thereon longitudinally of such strip. When the strip is now formed to channel shape with the strips 30 being thereby folded about wire 32 and the latter secured within the channel by teeth 33 punched in from the channel sides, the respective ends of the pleated strips 30 will now extend in the same general direction in side-by-side relationship. Brush strip of this type may be circularized to form annular or helical elements in the general manner illustrated in FIG. 6, for example.

It will be appreciated that a continuous strip of flexible sheet material may have stripes or regions of abrasive applied thereto in the indicated pattern and that such strip may thereafter be cut into sections comparable to that shown in FIG. 7. Where the brush strip formed therefrom is to be circularized, the abrasive areas may desirably taper somewhat toward the inner ends of the fingers. As explained above in connection with the other embodiments of the invention, the abrading material employed may be in the form of metal sheets or strips secured to the flexible sheet material in the same regions indicated for the granular abrasive, such metal strips being cut or formed by spraying the molten metal directly on the fabric.

The pleated fingers 30 are self-ventilating to a large degree in use and are, of course, relatively more flexible

in the region where joined to the supporting back than they are in their outer abrasive end portions. If desired, the outer pleated end portions of the finger bearing the abrasive may themselves be bonded together to form a somewhat stiffer region. Since the abrasive is preferably confined interiorly of the pleated strip, relatively little is thrown off and lost in use without having been effectively applied to the work. While, of course, the length and proportions of the pleated strips making up my novel buffing or brushing fingers may vary over a wide range, the folded or pleated finger 25 may commonly have a width of from 1/4 inches to 1/8 inch. Instead of employing spaced regions of abrasive as shown in FIG. 7, the entire outer end portions of the strip may be covered with abrasive material, particularly when such outer end portions are to be bonded together after the sheet has been pleated to FIG. 8 form. When thus bonded, opposed abrasive surfaces will not rub together in use with consequent premature loss of abrasive particles therefrom. The teeth 33, when utilized, may desirably be located to project inwardly over wire 32 at points intermediate such fingers 30. In some cases it may be desired to compress the edges of the channelform back to form a constricted pressure neck.

When a length of brush strip such as that of FIG. 10 has been circularized to form an annular section (FIG. 12), it will be seen that the fingers 30 will extend generally radially therefrom and substantially independently of one another. Radially extending crimped or indented regions 34 similar to the regions 12 of FIG. 1 may desirably be provided to facilitate radial outward flow of air for ventilating purposes. With the disc type of construction illustrated in FIG. 3 for example, additional ventilation may be afforded by holes 35 extending entirely through the assembled layers, and this arrangement may additionally afford a somewhat more yielding action to the tool.

As previously indicated, the pleated fingers of FIGS. 7 to 12 may be tightly closed and bound together by the adhesive in their abrasive outer end portions, thereby forming a stiffer and more narrow self-supporting unit which nevertheless will desirably be somewhat flexible in the region where secured in the brush back or support. Referring now to FIG. 13 of the drawing, the fingers 36 are generally similar to the fingers 30 except that the adhesive binder (which may be a synthetic resin) may extend to a point 37, for example, rather closer to the sheet metal channelform back 31 wherein the doubled finger is secured by retaining element 32. Before such resin sets, the fingers may be given a partial twist to turn the abrading outer end portions out of planes normal to the axis of rotation of the tool (as in FIG. 12) into planes somewhat skewed thereto. The fingers 36 thus extend individually but nevertheless reinforce each other somewhat in use, and the likelihood of streaking the work is reduced. It is preferred that granular abrasive or other abrading material secured to the fingers be held internally of the folds so that the generally flat outer surfaces of the fingers will be relatively non-abrasive although abrasive will be exposed at the working ends.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A rotary tool comprising a rotatable support and a plurality of generally flat fingers of sheet material extending therefrom and lying in planes generally normal to the axis of rotation of said support, said fingers being flexible in the regions adjacent said support and comprising sheets of flexible fabric pleated to form generally flat elongated strips, said strips being doubled at their mid-points and there secured to said support with their two end portions extending therefrom in general side-by-side relationship, and regions of hard abrading material on said fingers extending to the working ends thereof but spaced substantially from said support.

2. A rotary tool comprising a rotatable support and a plurality of generally flat fingers of sheet material extending therefrom and lying in planes generally normal to the axis of rotation of said support, said fingers being flexible in the regions adjacent said support and comprising sheets of flexible fabric pleated to form generally flat elongated strips, said strips being doubled at their mid-points and there secured to said support with their two separate end portions extending therefrom in general side-by-side relationship, and regions of granular abrasive secured to internal flat surfaces only of said pleated fingers opposed to non-abrasive surfaces thereof and extending to the working ends of said fingers but spaced substantially from said support to afford a relatively flexible connection therewith.

3. A brush element comprising a rotatable support and a plurality of generally flat flexible fingers extending therefrom, said fingers comprising sheets of flexible material pleated to form generally flat elongated strips, said strips being secured to said support and extending radially outwardly therefrom with their flat pleats lying in planes normal to the axis of rotation of said support, and regions of hard abrading material on said fingers extending to the outer working ends thereof but spaced substantially from said support to afford a relatively flexible connection with said support.

4. The brush element of claim 3, wherein said pleats of each said pleated strip are bonded together to compact and stiffen the same.

5. The brush element of claim 3, wherein said pleats of each said pleated strip are bonded together to compact and stiffen the same and twisted to skew the outer end portions at an angle to such inner end portions.

6. A rotary brush element comprising a central support and a plurality of generally flat abrading fingers extending generally radially outwardly therefrom, adjacent inner end portions of said flat fingers lying in substantially the same plane where secured to said support but similarly twisted to skew their outer end portions at an angle to such inner end portions.

7. A brush element as defined in claim 6, wherein said flat abrading fingers are formed of flexible textile fabric sheet material.

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