Jan. 9, 1945. C. F. SCHLEGEL 2,366,877

POLISHING DISK

Filed Aug. 9, 1940 3 Sheets-Sheet 1

Fig. 1

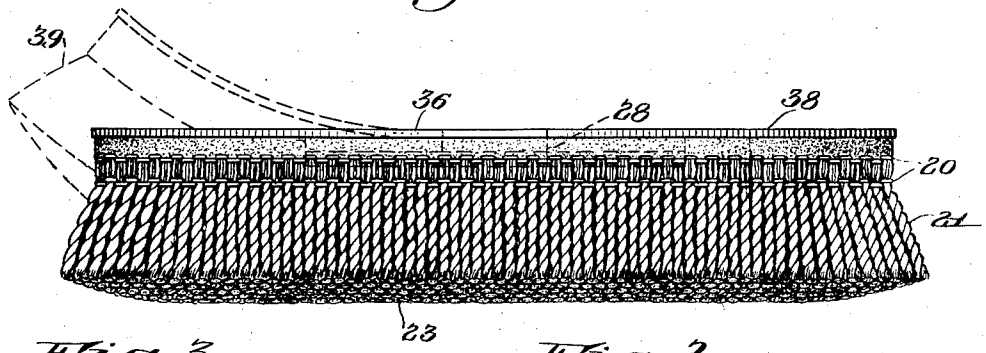


Fig. 3

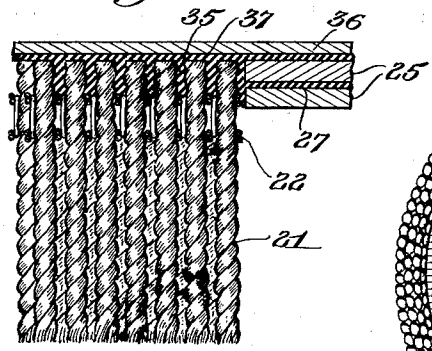


Fig. 2

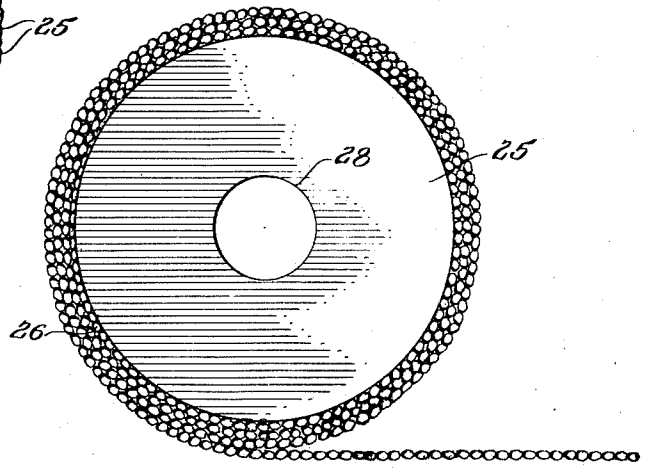


Fig. 4

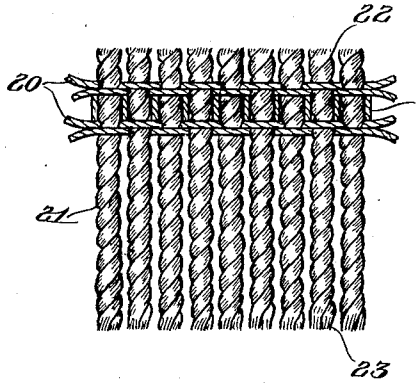
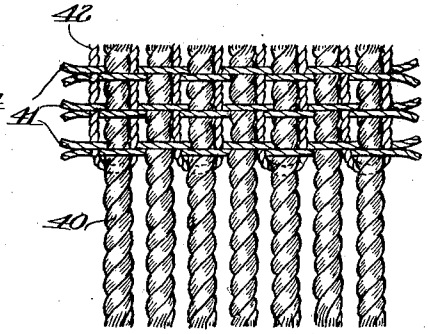


Fig. 5



INVENTOR.
Carl F. Schlegel
BY Cumpston & Shipard
his ATTORNEYS.

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POLISHING DISK

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Fig. 6

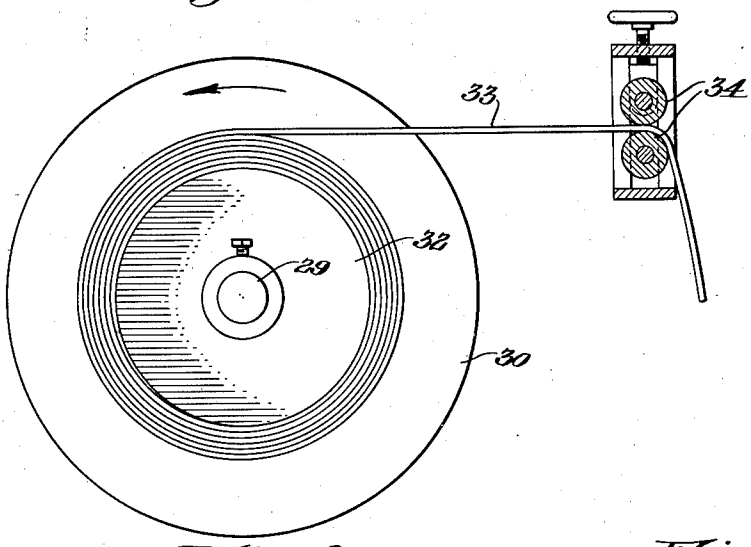


Fig. 7

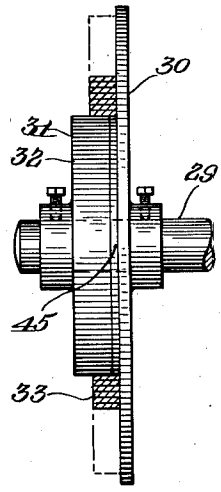


Fig. 8

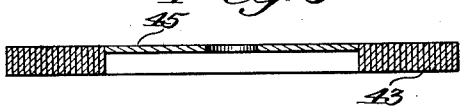


Fig. 9

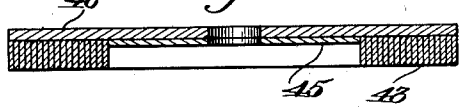


Fig. 10

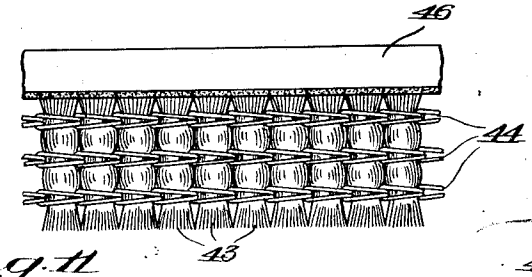
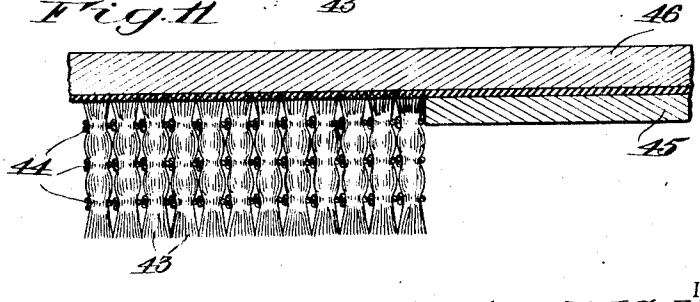


Fig. 11



INVENTOR.
Carl F. Schlegel
BY Cumpston & Shipard
his ATTORNEYS.

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POLISHING DISK

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Fig. 12

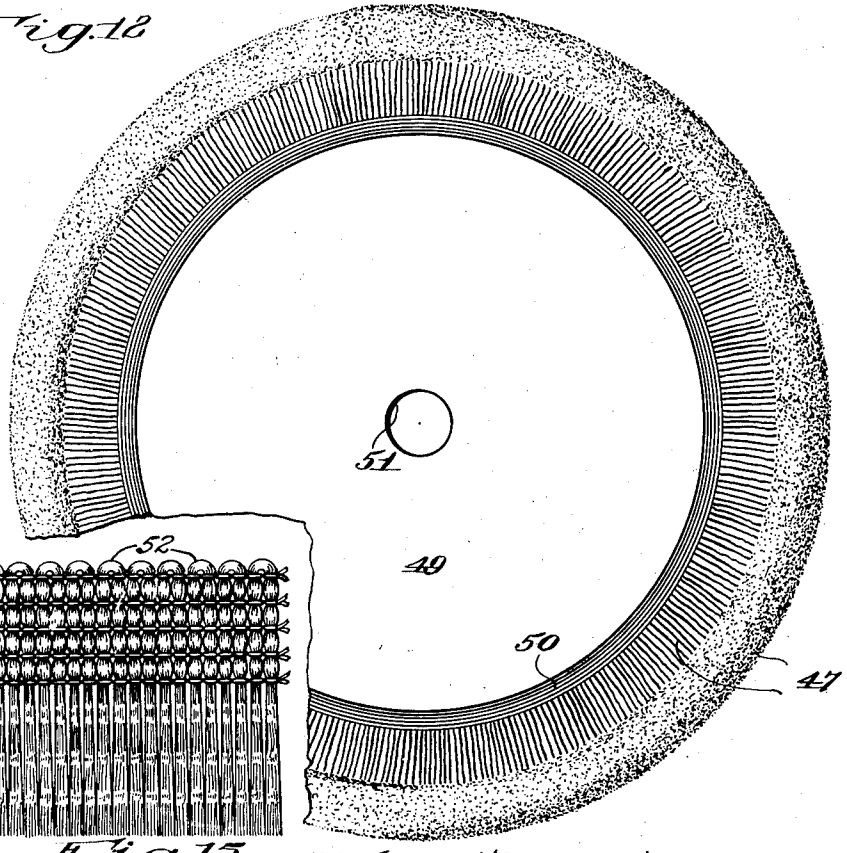


Fig. 15

Fig. 13

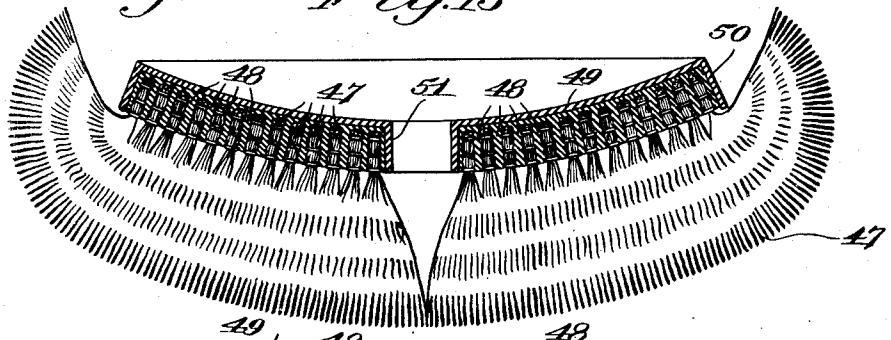
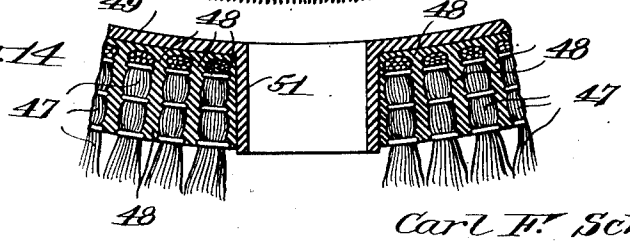


Fig. 14



INVENTOR.
Carl F. Schlegel
BY Crumpston & Shepard
his ATTORNEYS.

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UNITED STATES PATENT OFFICE

2,366,877

POLISHING DISK

Carl F. Schlegel, Brighton, N. Y., assignor to The Schlegel Manufacturing Company, Rochester, N. Y. a corporation of New York

Application August 9, 1940, Serial No. 351,972

8 Claims. (Cl. 15—230)

This invention relates to polishing pads or disks, for polishing a variety of articles, such, for example, as metal sheets, automobile bodies, furniture and the like, one object being to provide a generally improved pad or disk of a relatively simple and inexpensive type, having a unitary and durable construction capable of being efficiently adapted to a variety of uses.

Another object is the provision of a pad or disk of the above nature having a flexible type of construction adapted to conform to and polish either regular or irregular surfaces, efficiently and with minimum labor.

Another object is the provision of such a polishing element having a polishing face formed by the free ends of a multiplicity of fibers which are securely anchored in the body portion of the element and of a predetermined density and firmness.

A further object is to provide an element of the character described having a round and balanced construction adapted for mounting conveniently upon a motor driven mandrel for rotation at relatively high speeds.

To these and other ends the invention resides in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a side elevation of one form of polishing pad or disk embodying the present invention;

Fig. 2 is a top plan view of such a disk with the backing portion removed and partly unrolled, to illustrate the construction;

Fig. 3 is an enlarged sectional view through a portion of the disk;

Fig. 4 is an enlarged view of a portion of one form of strip employed for assembling the polishing fibers in such a disk;

Fig. 5 is a similar view showing a modified construction of the fiber strip;

Fig. 6 is a diagrammatic view showing one method of making such a disk;

Fig. 7 is a side elevation partly in section of parts shown in Fig. 6;

Fig. 8 is a sectional view showing another form of disk embodying the invention, partly constructed.

Fig. 9 is a view similar to Fig. 8 showing the disk completed;

Fig. 10 is an enlarged sectional view of parts shown in Fig. 9;

Fig. 11 is a similar view at right angles to that of Fig. 10;

Fig. 12 is a top view of still another form of disk embodying the invention;

Fig. 13 is a transverse sectional view of parts shown in Fig. 12;

Fig. 14 is an enlarged view of parts shown in Fig. 13, and

Fig. 15 is a face view of a section of a textile material or strip used in the modification of Figs. 12 to 14 inclusive, but showing five warp strands instead of three.

The same reference numerals throughout the several views indicate the same parts.

There has long existed a substantial demand for a flexible, durable, inexpensive pad for polishing automobile bodies, furniture, and the like, including a type of construction adapted to be rotated at relatively high speed by a motor driven mandrel. It has been proposed to construct such polishing pads and disks of natural wool or other animal fleeces, but such fleeces are not uniform in structure nor durable under the hard usage involved, while the attempted use of fleeces carefully selected to stand such usage has proven too expensive.

It has also been proposed to construct polishing pads and disks of carpet having a pile surface on a woven base, with or without treatment of the base with a latex or other strengthening coating, but it has been found that such pads are not strong enough to prevent the raveling out of the fibers, particularly under rotation at high speed, not adapted for production in variably predetermined flexibility and density and such pads are furthermore not conveniently adapted for attachment to a driving mandrel.

As a result of the investigation of such prior constructions and their defects, it has been found that such defects can be overcome by a principle of construction specially devised to afford the characteristics desired in such an article and to meet the requirements of the exacting usage to which they are commonly subjected.

In carrying out the invention, it is preferred to first assemble the polishing fibers in an elongated strip in which they are suitably secured adjacent one end as by means of one or more interwoven warp strands, portions of said strip being then assembled together in side by side relation to form the pad or disk.

Referring more particularly to the drawings for an illustrative embodiment of the invention, there is shown in Fig. 4 a fragment of such a strip, including warp strands 20 securing together a multiplicity of weft strands 21 forming the polishing fibers. Either the warp strands or the

weft strands or both may be of any suitable textile material, such as cotton, linen, wool, fleece, jute, hemp, silk, rayon, etc. Ordinarily some inexpensive textile material, such as cotton strands, is used for both the weft and warp, but if a greater degree of strength and stiffness is desired some or all of the warp strands may be of linen or even of metallic wire. It has been found that cotton and wool are quite satisfactory for the polishing fibers, where a soft texture is desired, but stiffer materials and even metallic wire may be employed, where required by the nature of the work to be performed. The polishing fibers may have any suitable length, depending upon the material employed and the desired stiffness of the polishing surface, fibers of one-fourth inch in length having been found suitable for some purposes, and of a length of one inch or more for other purposes.

As shown in Fig. 4, the warp strands **20** are located adjacent an end of the polishing fibers to provide for the strip an anchoring edge **22** at which it is subsequently secured in the pad or disk, the opposite ends of the fibers being free to form the fringe or polishing edge **23**. Such warp strands may be interwoven with the polishing fibers by any suitable type of stitching, a simple chain stitch having been found satisfactory, as illustrated in Fig. 4 where two spaced rows of chain stitching are shown with the two rows joined together by cross strands **24**. For manufacturing convenience, such a strip may be woven double the width shown in Fig. 4 and then cut in two along its center line to afford two strips, such as shown in Fig. 4.

Portions of fiber strips, such as described above are assembled together in substantially parallel relation with the fringe edges in a dense, compact mass forming a polishing surface, and with the anchoring edges lying substantially in an anchoring face. Such assembly is accomplished preferably, though not necessarily, by winding a strip of the above described material in what may be described as spiral convolutions, with successive portions or layers of the strip superimposed on each other, so that the anchoring edges lie against one another in a surface or plane, and the fringe edges also lie against one another to provide the polishing surface.

It has been found preferable also to wind the strips spirally upon a core or hub **25** of suitable material, as illustrated, for example, in Figs. 2 and 3. One end **26** of the strip is secured in any suitable manner to an edge of the hub **25** and then wound spirally upon the edge and upon itself in successive spiral convolutions, as shown, preferably by rotating the hub, as more particularly described hereafter.

While the hub may be constructed of metal or molded plastic material, it has been found advantageous for many uses to make it of some flexible material, such as a sheet of compressed sisal or other fibrous material which is economical and may be employed in any desired thickness or number of plies to afford any desired degree of flexibility. Cores of such fibrous material have the further advantage that they are sufficiently soft to avoid serious abrasion of the work in case of contact with it. Fig. 3 shows two plies of such material secured together to form a hub by latex or other suitable flexible cement **27**. Such a hub serves both as a form around which the fibrous strip is wound, and also as a hub for attaching the finished disk to a mandrel or other motor driven mounting for rotating the same in polishing contact with the work. For this purpose the core is preferably constructed with an axial opening **28** to receive a driving shaft or mandrel on which it may be clamped in any suitable manner as by means of the usual collar and nut. It will be noted that such a hub provides a surface free of fibers around the mandrel opening, which facilitates the application of means for securing the hub on the mandrel. It is also economical in eliminating polishing fibers at the central portion of the disk where they are least effective in the polishing operation.

The method of winding the strip to form such a disk is illustrated diagrammatically in Figs. 6 and 7, comprising a rotatable shaft **29** on which is fixed a collar or shoulder **30**. The hub **31** for the disk is placed on the shaft against the collar and preferably clamped thereagainst and supplemented in width by a detachable ring or follower **32** to temporarily increase the width of the hub as a base for winding the strip. One end of the fibrous strip **33** is then secured to the hub, as described above, and shaft **29** is rotated to rotate the hub portions **31** and **32** on which the fibrous strip is then spirally wound, as described, under suitable tension applied as by means of tension rolls **34** of any known or suitable type, as well understood in the art.

Winding of the strip is continued until a disk is built up of the desired diameter, the portions or convolutions of the fibrous strip and hub being secured together in place, preferably by the application of a flexible type of cement, such as the commercially available "latex," which may be brushed along the anchoring edge of the strip at the warp strands, as the strip is wound on the disk as at **35**, Fig. 3. The cement may be applied, however, in a loosely wound disk, for example, by dipping the anchoring face in the cement which penetrates between the ends of the fibers as far as the obstruction formed by the first warp strand.

A disk so formed is preferably provided with a backing or reenforcing sheet **36** of any suitable material. Such backing sheet may be, for example, a suitable textile material, such as canvas, buckram, duck, or the like, to both strengthen and also to finish off the periphery and back portion of the disk. It is preferred likewise to attach such backing sheet by an application of the flexible cement described above, between the sheet and the fiber ends of the anchoring face as at **37**, Fig. 3, such coating of adhesive serving to unite the backing material and the strip edges and fiber ends lying in the anchoring face, to form together an effective anchoring section or body for the polishing element or disk which is thin in relation to the whole thickness of the element, so that the polishing element as a whole is relatively flexible in directions transverse to the anchoring section to enable it to conform bodily to uneven surfaces to be polished. The completed disk so constructed is illustrated generally at **38**, in Fig. 1, where the portion **39** in broken lines indicates its flexing to conform to an irregular portion or corner in a surface to be polished, such as the painted surface of an automobile body.

In a disk so constructed, the polishing fibers lie against and laterally support one another, so as to form a dense, compact mass affording a firm, yet soft polishing face. The invention permits the density and firmness of the fibers at the polishing face to be predetermined in several

ways. Thus the use of warp strands of predetermined thickness tends to control the separation and spacing of the fibers from one another and their density, and this effect may be multiplied by interweaving with the warp strands and polishing fibers one or more stuffer strands of predetermined thickness, as a means of further spacing the fibers to increase the softness of the polishing face. Fig. 5 shows polishing fibers 40 woven into a strip by three lines of warp stitching 41, with such stuffer strands 42 interwoven back and forth between the fibers to increase their separation. Fig. 5 shows a strip first formed in multiple, as described, and subsequently cut along its center line to form duplicate strips, so that only one-half of the interwoven loops of the stuffer strands are shown in Fig. 5.

The firmness of the polishing face may also be varied by the number of warp strands employed, as well as by the depth to which the cement is applied inwardly from the fiber ends at the anchoring face. Figs. 1 and 3, for example, show the cement applied over the ends of the fibers and between them up to the first or nearest warp strands, but such depth of the adhesive layer between the strands may be varied more or less as desired. The firmness and density may also be varied by the compactness or tension with which the fringe strip is assembled or wound in building up the disk.

A modified embodiment is illustrated in Figs. 8 to 11, inclusive, in which the fibers 43 are secured together in a strip, as before, but by means of three spaced warps 44, each in the form of chain stitching. The fibers in this modification are shorter, being wool strands of about three-eighths inch long, closely held by the warps and tightly wound in the disk so as to be closely confined and form a more dense, firm polishing face than that of the softer construction shown in Fig. 1. The fibrous strip is wound upon a coarse textile core 45 of hemp or the like. In view of the shortness of the polishing fibers, the flexible adhesive coating is applied only over the ends of the fibers in the anchoring face and is prevented from penetrating substantially between the fibers by the close binding of them by the warps. The coating, as before, unites with the core or hub 45 a backing sheet 46 which, in this instance, is a sheet of fibrous material about one-eighth of an inch thick and relatively stiff, but combining with the other parts to still permit substantial flexibility, suitable, for example, for the application to the dense fiber ends of a cement and a granual abrasive for polishing metal surfaces, as well understood in the art.

Still a further modification is illustrated in Figs. 12 to 14, inclusive, in which the polishing disk or element is made up, as before, of a spirally wound, textile strip 47, of the same general kind previously described. This strip has at its woven anchoring edge or margin, a selvage in which the weft or polishing fiber strands 52 are looped or folded over the outermost warp thread 53 and have their opposite end portions interwoven with the remaining warp threads and projecting therefrom to form the pile polishing face, as shown in Fig. 15 where, however, five warp threads are shown instead of three. In this instance, the successive layers or convolutions of the strip are secured to each other by a flexible adhesive, such as latex, indicated at 48, applied to the sides of the fibers adjacent their anchoring ends. The adhesive is likewise applied, as shown, over the ends of the fibers in the anchoring face, and to strengthen the construction and hold the anchoring edges of the strips more securely, the rear or anchoring face area is covered with a coating of rubber 49, which extends also in a circumferential flange 50 embracing the outer periphery of the anchoring section of the fibrous strip, and in another annular flange 51 around the periphery of the opening which is provided, as before, to receive the mounting means of the driving mandrel. The rubber of portions 49, 50, and 51 is preferably a soft flexible rubber which, with the flexible adhesive of the thin anchoring section, affords a particularly flexible form of polishing disk capable of bending readily for conforming to irregular surfaces, angles, and corners. In this instance also the polishing fibers are soft wool with relatively long, free ends to produce a dense but soft polishing face. The body portion of the disk may have a somewhat curved shape, as shown, or may lie in a flat plane as in the modifications previously described.

This modification is one of the species described in my copending application which matured into Patent No. 2,214,351, dated September 10, 1940, of which the present application is a continuation in part.

The principles of the invention may thus be adapted to the manufacture of polishing pads of various types. By the selection of suitable material, the use of relatively long fibers loosely bound by the warps, and with a flexible backing sheet, a very soft, flexible type of pad may be produced as represented, for example, by the modification shown in Figs. 1 and 12. On the other hand, by the use of relatively short fibers tightly bound in by the warps and the relatively stiff backing sheet, a harder and stiffer pad may be produced as represented, for example, by the modification shown in Fig. 9. In all of these modifications, however, the same type of construction is preserved with its relatively thin, unitary and flexible body portion capable of being controlled as to flexibility by the means described.

By first securing the polishing fibers together in substantially parallel relation in an elongated strip, and particularly when accomplished by means of interwoven spaced warps, an opportunity is afforded for securely binding the fibers together with a predetermined closeness and density to suit the intended use, and the location of the warps relative to the anchoring ends of the fibers aids in controlling the thickness of the anchoring body of adhesive. Such method of construction likewise permits of the building up of the fibers under predetermined tension and with predetermined density in the disk, and the spiral winding of the strip in the disk results in a multiple tying-in and reenforcement, by successive convolutions, to strongly anchor the fibers in place. The strength of the construction is increased by the backing sheet which aids in resisting the centrifugal forces applied by rotation at high speeds. The several parts are tenaciously bound together by the latex cement to produce, as a whole, a relatively thin, light, and economical, but flexible and exceedingly tough construction which is capable of efficiently withstanding the hard wear and tear of the usage to which such articles are subjected, as well as being substantially resistant to chemical attack.

The above described structure and method of assembly furnishes, furthermore, a disk construction which is particularly efficient for attachment to a motor driven mandrel, for rotation at relatively high speeds, in accordance with modern

shop practices. Such a construction is readily adapted for making a dynamically balanced article, capable of being rotated at high speed without substantial vibration, and the winding of the same about a flexible hub provides for the convenient attachment of the securing devices of the mandrel to surfaces free and clear of polishing fibers, and without interference with the flexibility of the disk.

The described construction moreover affords a disk with securely finished and anchored peripheral portions which have been found to effectively resist the raveling and disintegration to which prior devices of this sort, such as those cut from a pile carpet, have been seriously subject.

The described constructions thus accomplish the objects of the invention, and while certain modifications and details of structure and of methods of construction have been described, it is contemplated that various other modifications and details will occur to those skilled in the art without departing from the principles of the invention as set forth in the appended claims.

I claim:

1. As a new article of commerce, a flexible polishing element comprising a multiplicity of flexible fibers secured together adjacent one end by interwoven warp strands to provide an elongated strip having an anchoring edge and a fringe edge, stuffer strands of predetermined thickness interwoven with said warp strands and fibers, portions of said strip being assembled together in substantially parallel relation with said fringe edges thereof in a dense, compact mass forming a polishing surface and said anchoring edges lying substantially in an anchoring face, the density of said polishing surface being determined by the thickness of said stuffer strands, and a coating of flexible adhesive uniting said anchoring edges and fiber ends of said anchoring face to form therewith an anchoring section, said section being thin in relation to the whole thickness of said element, and said element as a whole being readily flexible in directions transverse to said anchoring section to conform bodily to said uneven surfaces to be polished.

2. As a new article of commerce, a flexible polishing element comprising a multiplicity of flexible fibers secured together adjacent one end by a plurality of interwoven, spaced warp strands to provide an elongated strip having an anchoring edge and a fringe edge, stuffer strands of predetermined thickness interwoven with said warp strands and fibers, a plurality of lengths of said strips being assembled together in substantially parallel relation with said fringe edges in a dense, compact mass forming a polishing surface and said anchoring edges lying substantially in an anchoring face, the density of said polishing surface being determined by the thickness of said stuffer strands, a backing sheet of flexible material overlying said anchoring face, and a coating of flexible latex adhesive uniting said material and said anchoring edges and fiber ends of said anchoring face to form therewith an anchoring section, said section being thin in relation to the whole thickness of said element, and said element as a whole being readily flexible in directions transverse to said anchoring section to conform bodily to uneven surfaces to be polished.

3. As a new article of commerce, a flexible polishing disk for rotation at high speed, comprising a multiplicity of flexible fibers secured together adjacent one end by a plurality of interwoven warp strands to provide an elongated strip having an anchoring edge and a fringe edge, said strip being wound in spiral convolutions to form a disk with the fringe edges of said convolutions in a dense, compact mass forming a polishing face of said disk and said anchoring edges lying substantially in an opposite anchoring face, stuffer strands of predetermined thickness interwoven with said warp strands and fibers to determine the density of said polishing face, a backing sheet of relatively flexible material overlying said anchoring face, and a coating of flexible adhesive uniting said material and fiber ends to form an anchoring section which is relatively thin so that said disk as a whole is readily flexible in directions transverse to said anchoring section to conform bodily to uneven surfaces to be polished.

4. As a new article of commerce, a flexible polishing disk for rotation at high speed, comprising a multiplicity of flexible fibers secured together adjacent one end to provide an elongated strip having an anchoring edge and a fringe edge, a hub portion, said strip being wound spirally about said hub portion to form a disk with the fringe edges of the convolutions in a dense, compact mass forming the polishing face of said disk and said anchoring edges lying substantially in an opposite anchoring face, a sheet of backing material overlying said anchoring face, and a coating of flexible adhesive uniting said material and anchoring face and hub to form a unitary anchoring section which is relatively thin in relation to the whole thickness of said disk and said disk being readily flexible in directions transverse to said anchoring section to conform bodily to uneven surfaces to be polished, said hub having an opening therethrough to receive a mandrel for rotating said disk.

5. As a new article of commerce, a flexible polishing disk for rotation at high speed, comprising a multiplicity of flexible fibers secured together adjacent one end by a plurality of interwoven warp strands to provide an elongated strip having an anchoring edge and a fringe edge, a hub portion formed of a sheet of flexible material, said strip being wound in spiral convolutions to form a disk with the fringe edges of said convolutions in a dense, compact mass forming the polishing face of said disk and said anchoring edges lying substantially in an opposite anchoring face, a backing sheet of relatively flexible textile material overlying said anchoring face, and a coating of flexible adhesive uniting said sheet and anchoring face and hub to form a unitary anchoring section which is relatively thin so that said disk as a whole is readily flexible in directions transverse to said anchoring section to conform bodily to uneven surfaces to be polished, said hub having an opening therethrough spaced from said fibers for attachment to a mandrel for rotating said disk.

6. A processing disk having a body formed of a fabric strip wound spirally upon itself about the axis of the body, said strip for a portion of its width and along one longitudinal margin being woven and for the remainder of its width and along the opposite longitudinal margin being composed only of loose weft strands projecting from the woven marginal portion forming a pile on one side of the disk body, said strip having its longitudinal woven marginal portion only impregnated with a rubber composition entering the interstices and securing the weft strands to the warp strands against detachment therefrom

and securing the woven marginal portion of successive spirals adhesively together, said rubber composition extending as a connective binder body throughout the successive spirals of the spirally wound woven portion only of the strip.

7. A processing disk having a body formed of a fabric strip wound spirally upon itself about the axis of the body, said strip for a portion of its width and along one longitudinal margin being woven and for the remainder of its width and along the opposite longitudinal margin consisting solely of loose weft strands projecting from the woven marginal portion forming a pile on such side of the disk body, said weft strands each being so interwoven with the warp threads as to be folded over the outermost warp thread with the opposite end portions of each weft strand interwoven with the remaining warp threads and projecting therefrom forming said pile, said strip having its longitudinal woven marginal portion only impregnated with a rubber composition entering the interstices and securing the weft strands to the warp strands against detachment therefrom and securing the woven marginal portion of successive spirals adhesively together, said rubber composition extending as a connective binder body throughout the successive spirals of the spirally wound woven portion only of the strip.

8. A flexible, rotatable polishing disk comprising a textile strip of strands of fibrous material having a body portion and a fringed edge portion, said body portion having warp strands interwoven with the fibrous strands, the body portion of said strip being arranged in convolutions to form a disk-shaped structure with the convolutions extending spirally with respect to a central axis and with the fringed portion of the strands forming a circular and somewhat bushy polishing face, the body portion having the interstices between the fibrous strands and the warp strands substantially filled with an adhesive material which is flexible upon curing and which intermingles with the strands and binds the strands and convolutions of the body portion into a unitary mass which is flexible as a whole in a direction normal to the plane of the disk, and means comprising a filler interwoven with the warp strands for varying the spacing of said fibrous strands.

CARL F. SCHLEGEL.