

United States Patent

Schaffner

[15] 3,706,167

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[54] FINISHING APPARATUS

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[52] U.S. Cl. 51/334, 51/394

[51] Int. Cl. B24b 9/02, B24d 11/00

[58] Field of Search 51/334-338, 295,
51/394; 15/230

[56] References Cited

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3,548,550 12/1970 McAleer 51/334

3,556,752 1/1971 Wilson 51/295

3,188,777 6/1965 Block 51/337

Primary Examiner—Othell M. Simpson

Attorney—Hymen Diamond

[57] ABSTRACT

There is disclosed a work-finishing wheel including an annulus of flaps bonded near the center to form a substantially solid hub in which flaps of woven abrasive web or fabric are interleaved with flaps of non-woven fibrous abrasive web or fabric of the material disclosed in Hoover et al. U.S. Pat. No. 2,958,593.

3 Claims, 9 Drawing Figures

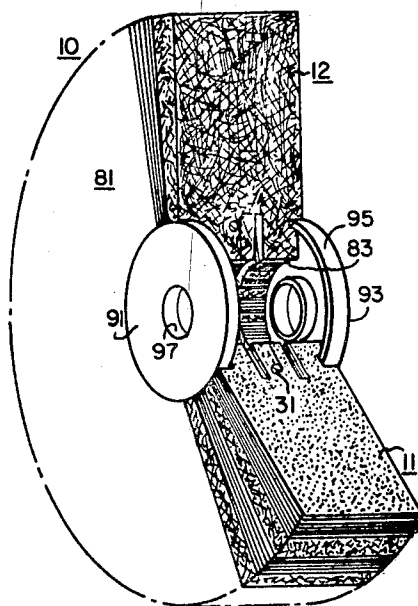


FIG.1

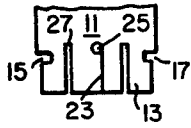


FIG.2

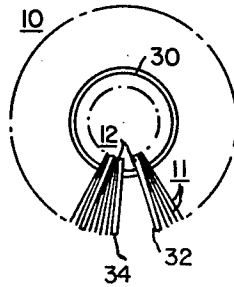


FIG.3

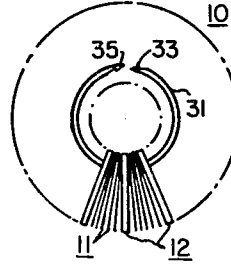


FIG.4

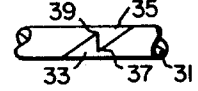


FIG.5

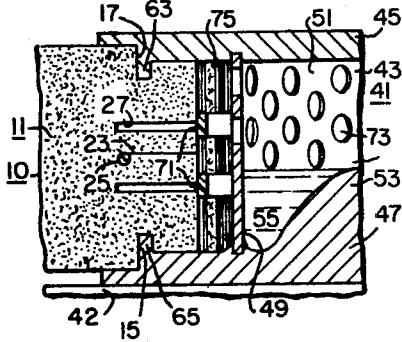


FIG.6

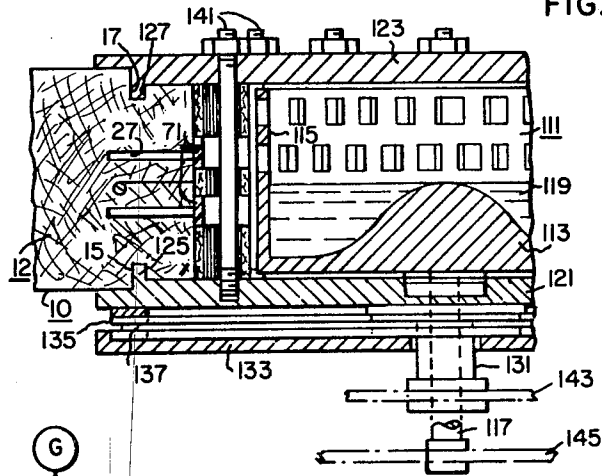


FIG.7

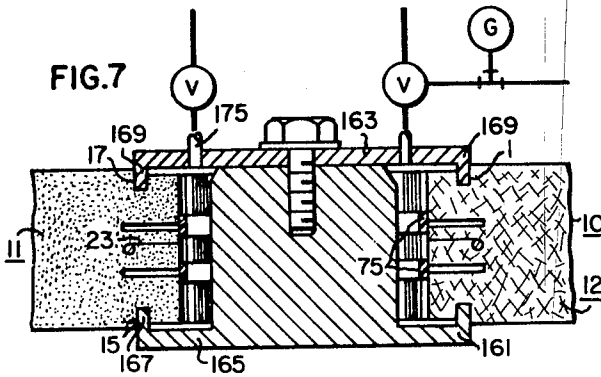


FIG.9

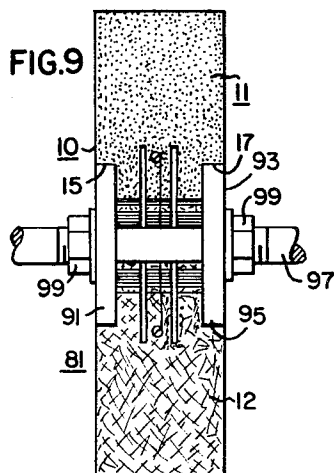
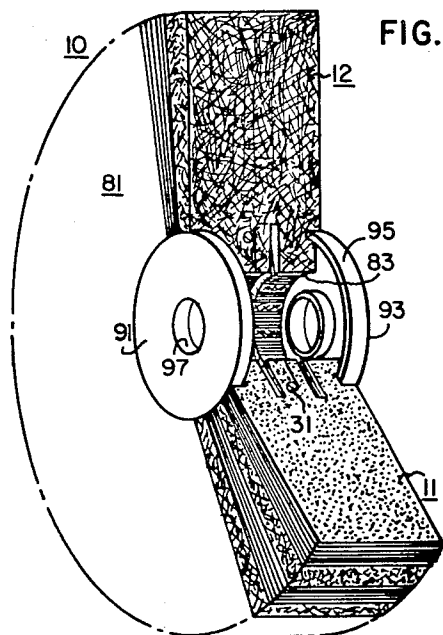


FIG.8



FINISHING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to the surface-finishing art and has particular relationship to finishing wheels.

In the surface-finishing art the surface of work composed of metal, wood or plastic is typically subjected to a polishing operation during which stock is removed to obliterate scratches and other irregularities. The surface is then subjected to a blending operation to remove the grit lines produced by the polishing. Conveniently, the finishing is carried by finishing wheels, such as are disclosed in Schaffner U.S. Pat. Nos. 3,206,894 and 3,294,502, each composed of an annulus of flaps of woven abrasive fabric or web extending from a central substantially solid hub. The fabric is produced by impregnating woven cloth with an adhesive, thereafter depositing the abrasive in the form of powder by gravity or by electrostatic attraction on the adhesive, and then curing the adhesive. In accordance with the teachings of the prior art, the polishing and blending are carried out by separate finishing wheels, the polishing being carried out by wheels of flaps with coarser abrasive and the blending by wheels of flaps with finer abrasive.

It is an object of this invention to eliminate the demand for separate wheels for a complete finishing operation and to provide a finishing wheel composed of flaps extending from a central hub which shall lend itself to the carrying out of polishing by stock removal and blending in a single operation.

SUMMARY OF THE INVENTION

In accordance with this invention a finishing wheel is provided which is composed of an annulus of flaps extending from a substantially hard central core or hub, flaps of woven abrasive fabric being interleaved with flaps of non-woven, fibrous abrasive fabric as disclosed in Hoover et al. U.S. Pat. No. 2,958,593 (as supplemented by Maisel U.S. Pat. No. 2,784,132). The expression "non-woven fibrous abrasive fabric" when used in this application means fabric as disclosed in Hoover et al. U.S. Pat. No. 2,958,593 or the like. The expression "woven abrasive fabric" when used in this application means woven cloth impregnated with adhesive on which an abrasive powder, SiC_4 , Al_2O_3 , flint or the like has been deposited. The woven and non-woven flaps may alternate or may have any relationship periodic or aperiodic. Typically every fourth or fifth flap may be non-woven and the others woven.

The "non-woven fibrous abrasive fabric" as disclosed in Hoover et al. patent is a uniform lofty open non-woven three-dimensional lightweight web formed of many interlaced randomly disposed flexible durable tough organic fibers which exhibit substantial resiliency and strength upon prolonged subjection to water or oils. Fibers of the web are firmly bonded together at points where they intersect and contact one another by globules of an organic binder, thereby forming a three-dimensionally integrated structure. Distributed within the web and firmly adhered by binder globules at variously spaced points along the fibers are abrasive particles. The many interstices between adjacent fibers remain substantially unfilled by the binder and abrasive particles, there being thus provided a composite structure of extremely low density having a network of many

relatively large intercommunicated voids. These voids make up at least about three-quarters or four-fifths, and preferably more, of the total volume occupied by the composite structure. Typical thicknesses of these structures are one-fourth inch and one-half inch. The structures are so open that in thicknesses of about one-fourth inch they are highly translucent or even transparent when held up to light, e.g., ordinary daylight, under conditions where substantially all of the light registering on the viewer's eyes passes through the structure. Additionally, the structures are flexible and readily compressible and upon subsequent release of pressure, essentially completely recover to the initial uncompressed form.

The resulting lightweight lofty extremely-open fibrous abrasive constructions exhibit a remarkably effective and unique abrasive action, contrary to what would be expected of such type of structure.

Actual experience in using the wheel according to this invention to finish work has led to the discovery that in a single operation this finishing wheel produces a two-fold blending finish; it produces a deep cut and at the same time leaves the work with a soft fine surface finish. In finishing the bottoms of cooking utensils, this finishing wheel produces an attractive uniform sun-ray finish in a single operation.

BRIEF DESCRIPTION OF THE DRAWING

For a better understanding of this invention, both as to its organization, and as to its method of operation, together with additional objects and advantages thereof, reference is made to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a view in side elevation of the lower portion of a flap, both woven and non-woven, used in the practice of this invention;

FIG. 2 is a view in side elevation showing how the flaps shown in FIG. 1 are mounted on a solid ring to form an annulus;

FIG. 3 is a view in side elevation showing how the flaps shown in FIG. 1 (or like flaps without slits) are mounted on a split ring to form an annulus.

FIG. 4 is a fragmental view showing how the ends of a split ring interlock;

FIG. 5 is a view in longitudinal section showing apparatus of one type for forming a finishing wheel of interleaved woven and non-woven flaps according to this invention;

FIG. 6 is a view in longitudinal section showing apparatus of another type for forming such a wheel;

FIG. 7 is a view in longitudinal section showing apparatus of a third type for forming such a wheel;

FIG. 8 is a view in perspective showing a finishing wheel in accordance with this invention; and

FIG. 9 is a view in longitudinal section showing the manner in which a finishing wheel in accordance with this invention is used.

DESCRIPTION OF PREFERRED EMBODIMENTS

The finishing wheel 10 according to this invention is formed of an annulus 10 of interleaved flaps 11 of woven abrasive fabric and 12 of non-woven fibrous abrasive fabric. The flaps 11 and 12 extend from a solid hub formed by injecting adhesive between the portions of the flaps 11 and 12 near the center of the annulus.

The flaps 11 and 12 in accordance with this invention are of generally rectangular form with a stem 13 extending from one side of the rectangle. The stem has notches 15 and 17 which are symmetrically disposed with reference to the longitudinal axis of the stem. The stem 13 also has a slit 23 (FIG. 1) which terminates in a hole 25 and a pair of slots 27. The slots 27 extend an appreciably greater distance from the end of the stem 13 than the hole 25. The flap 11 is coated with an abrasive on one side and is smooth on the opposite side. The flap 12 is abrasive throughout.

In the practice of this invention a large number of flaps 11 and 12 are formed into an annulus in which the flaps are tightly packed. The annulus is produced by stringing the flaps 11 and 12 on a solid ring 30. Bundles of the appropriate number of flaps 11 and 12 are assembled with the slits 23 and the holes 25 aligned and are mounted on ring 30 by slipping the ring 30 through the slits 23 until the ring 30 engages holes 25. Typically, where the annulus consists of groups each of four woven flaps 11 and one non-woven flap 12, each bundle may include two groups of ten flaps in all with each four flaps 11 followed in sequence by a non-woven flap 12. The flaps 11 may be inserted in the bundle with the abrasive surfaces of contiguous flaps 11 facing in opposite direction. Alternatively selected flaps 11 of the annulus, for example, every third or fourth flap may face in the direction opposite to the others. Different finishing effects may be produced by driving the annulus with selected flaps 11 facing oppositely to the others in opposite directions. When the ring 30 is substantially filled, adjacent flaps 32 and 34 at one point are pressed back and clamped, and additional flaps 11 are slipped onto the ring 30. Flaps 32 and 34 are then released and a tightly packed annulus is formed. The non-woven flaps 12 are usually substantially thicker than the woven flaps 11 and have substantial resilience so that the interposition of the non-woven flaps 12 facilitates the formation of a tight annulus 10.

The flaps 11 and 12 may also be strung onto a resilient split ring 31. In this case the slits 23 may be omitted. The ends 33 and 35 of the ring 31 are provided with mating notches 37 and 39 (FIG. 4) which overlap so that in the closed position the ring 31 is locked by the engagement of the notches 37 and 39.

In forming the annulus the ring 31 is opened and the flaps 11 and 12 are mounted on the ring by threading the holes 25 in the flaps over the split ends of the ring. A plurality or bundle of flaps 11 and 12 may be strung onto the ring during each stringing operation. Each bundle should be assembled so that the slits 23 are coextensive and the slits of the bundle should be passed together over the ring 31.

When a sufficient number of flaps 11 and 12 have been strung on the ring 31 to form a tightly packed annulus the ends 33 and 35 are released and permitted to snap into engagement. The annulus 10 which is thus formed has a hub supported on ring 31, circular grooves formed by the notches 15 and 17, and circular slots formed by the slots 27.

The rings 30 and 31 may be composed of metal. While mild steel or aluminum may be used, spring steel is preferred in certain situations.

The annulus 10 is now provided with a solidified hub or core. For this purpose the stems 13 are secured together by an adhesive. The adhesive may be formed

by combining a resin such as Hysol 2030 or Bakelite ERL-2774 with a hardener such as diethylene triamine. Bakelite ZZLD-0814 or combinations of the diethylene triamine and Bakelite ZZLD-0814. The adhesive consists of 100 parts by weight of resin and 10 to 40 parts by weight of hardener. The hardener may have any composition between 100 percent triamine and 0 of '0814 and 0 of triamine and 100 percent of '0814. The adhesive so formed is a liquid and is injected between the surfaces of the stems 13 by centrifugal force. The higher the triamine the lower the viscosity of the adhesive.

For this purpose, a receptacle 41 (FIG. 5) mounted on a turntable 42 to rotate about a vertical axis is provided. The receptacle 41 includes a cylindrical wall 43 and the space within which is closed by upper and lower plates 45 and 47. The lower part 49 of the wall 43 is solid and the upper part 51 is perforated. The lower plate 47 may be secured to the lower part 49 of the wall 43, for example, by welding and has a projection 53. An annular trough is thus formed between the projection 53 and the part 49 in which the liquid adhesive 55 is disposed. The upper plate 45 may be flat. This plate may be removably mounted on the wall 43. Each of the plates 45 and 47 extends beyond the wall 43 and the extending portions are provided with annular projections 61 and 65 adapted to engage the grooves 15 and 17 of the annulus 10.

In the practice of this invention the plate 45 is removed from the wall 43 and the adhesive 55 is poured into the trough between part 45 and projection 53. The circular slots 27 in the annulus 10 are then closed by strips of adhesive tape 71 extending around the radially inner wall of the annulus 10 at the slots 27. The annulus 10 is then mounted encircling the wall 43 with its grooves 15 and 17 engaging the projections 61 and 65. To facilitate removal of the annulus after treatment, polyethylene sheet or silicone parting agent (not shown) may be interposed between the grooves 15 and 17 and the projections 61 and 65. The top 45 is then mounted on the wall 43 with the projections 61 and 65 engaging the grooves 15 and 17. Polyethylene sheet or a conventional mold release or parting agent (not shown) may be interposed in this case between the projections 61 and 65 and the grooves 15 and 17. The annulus 10 should be held tightly between the plates 45 and 47.

The assembly 41-10 is then mounted on the turntable 42 and rotated. The rotation causes the adhesive 55 to rise along the wall 43 and be projected through the openings 73. The adhesive impinges on the radially inner periphery 75 of the annulus 10 and because the rotation of the annulus 10 is injected between the surfaces of the stems 14 of the flaps 11. Sufficient adhesive flows down the wall 75 to provide for coating of the portions of the surfaces of the stem 13 opposite the part 49 of the wall 43. The speed of rotation should be so coordinated with the viscosity of the adhesive that the adhesive is injected only to the region just beyond the ring 31 (FIG. 8) and not beyond the inner ends of the slots 27. The following table shows relationships between viscosity, speed and time of injection which have proven satisfactory for the above-described adhesives. The viscosity was set in each case by adjusting the proportions of the hardeners diethylene triamine and Bakelite ZZLD-0814.

viscosity in centipoise	rotational speed, r.p.m.	time of treatments, Minutes
100 to 500 —	275	3
600 to 1,200 —	550	2

After being treated as just disclosed the annulus 10 is removed from the receptacle 41 and the adhesive is cured by heating the treated annulus. The tape 71 is then removed. A finishing wheel 81 (FIG. 8) with a solid hub 83 which is not fragile is thus produced. Because of the rotation about a vertical axis the adhesive is uniformly distributed over the hub. The ring 31 serves as reinforcement. The slots 27 which are free of adhesive throughout and communicate with the separable parts of the flaps 11 and 12 serve to ventilate the wheel in use.

When the wheel 81 is to be used, it is provided with end plates 91 and 93 having projections 95 which engage the grooves 15 and 17. The plates 91 and 93 have central openings through which a shaft 97 passes. The shaft 97 is threaded and is held in firm engagement with the plates 91 and 93 by nuts 99.

In use the shaft 97 is rotated rotating the wheel 81. The outer periphery of the wheel 81 is in polishing and blending engagement with the work while the wheel is rotated. Where the abrasive surfaces of the woven flaps 11 face in opposite directions in the annulus the finishing wheel 81 is capable of being rotated in opposite directions by a reversing motor (not shown) or other reversible drive.

To improve the distribution of the adhesive the annulus 10 is rotated at a different speed than the adhesive. This is accomplished with apparatus as shown in FIG. 6 which includes a cup-shaped receptacle 111 having a solid base 113 and a wall 115 which is solid in the lower part and perforated in the upper part. A vertical shaft 117 extends from the center of the base 113. The adhesive 119 is disposed in the lower part of the receptacle 111. The apparatus also includes lower and upper plates 121 and 123 each having annular projections 125 and 127 adapted to engage the grooves 15 and 17 in the annulus 10. A hollow shaft 131 extends from the lower plate 121 and this plate is also provided with an opening coaxial with the shaft 131 adapted to accommodate the shaft 117.

When this apparatus is to be used the plate 121 is mounted on a bearing plate 133 with a bearing ring 135 extending from plate 121 engaging bearings 137 in plate 133. The receptacle 111 with the adhesive 119 in the base is mounted on plate 121 with the shaft 117 extending through plate 121 and shaft 131. The shaft 117 extends below shaft 131. The annulus 10 (with slots 27 taped) is then mounted on plate 121 (preferably with polyethylene sheet or a suitable mold release agent interposed between 15 and 17 and 125 and 127). The

upper plate 123 is then mounted on the annulus 10 and bolted to the lower plate 121 by bolts 141 passing between the receptacle 111 and the annulus 10. The shafts 117 and 131 may then be provided with driving pulleys 143 and 145 and the annulus assembly 10-121-123 and receptacle 111 rotated at different speeds. The direction of rotation may be the same or opposite.

The speed of the receptacle is so related to the viscosity of the adhesive 119 that the adhesive is projected on the radially inner surface 75 of the annulus. The speed of the annulus is so related to the viscosity of the adhesive that the adhesive is injected between the surfaces of the stem 13 as described above. After this treatment the annulus is cured and a finishing wheel 81 as described above is produced.

The adhesive may also be injected into the annulus 10 under pressure. For this purpose the apparatus shown in FIG. 7 is provided. This apparatus includes a flanged stub 161 and cooperative plate 163. The flange 165 of the stub 161 includes projections 167 and 169 adapted to engage the grooves 15 and 17. The annulus 10 is compressed between the flange 165 and 163 by bolting the plate 163 to the stub 161. O-rings 171 and 173 are compressed between the grooves 15 and 17 and the projections 167 and 169. Adhesive is then injected under pressure through openings 175 in the plate 163. The pressure causes the adhesive to penetrate between the surfaces of the stems 13. After this treatment the annulus 10 is cured.

While preferred embodiments of this invention have been disclosed herein, many modifications thereof are feasible. This invention then is not to be restricted except insofar as is necessitated by the spirit of the prior art.

I claim as my invention:

1. A finishing wheel comprising an annulus of flaps, the radially inner surfaces of said flaps being bonded together for a predetermined distance along said flaps to form an inner substantially solid hub, from which the unbonded portions of the flaps extend, the said wheel being characterized by that in said annulus flaps of woven abrasive fabric are interleaved with flaps of non-woven fibrous abrasive fabric, the said fabric being a uniform lofty open non-woven three dimensional lightweight web formed of many interlaced randomly disposed fibers which exhibit substantial resiliency.

2. The finishing wheel of claim 1 wherein the non-woven fibrous abrasive flaps are substantially thicker than the woven abrasive flaps and are resilient, the non-woven fibrous abrasive flaps being compressed so that the resilience of the said non-woven fibrous abrasive flaps contributes to the formation of a tight annulus.

3. The finishing wheel of claim 1 wherein one surface of the woven abrasive flaps is abrasive and the opposite surface is smooth and in the annulus the abrasive surfaces of some of said abrasive flaps faces in one direction and the abrasive surfaces of others face in the opposite direction.

* * * * *