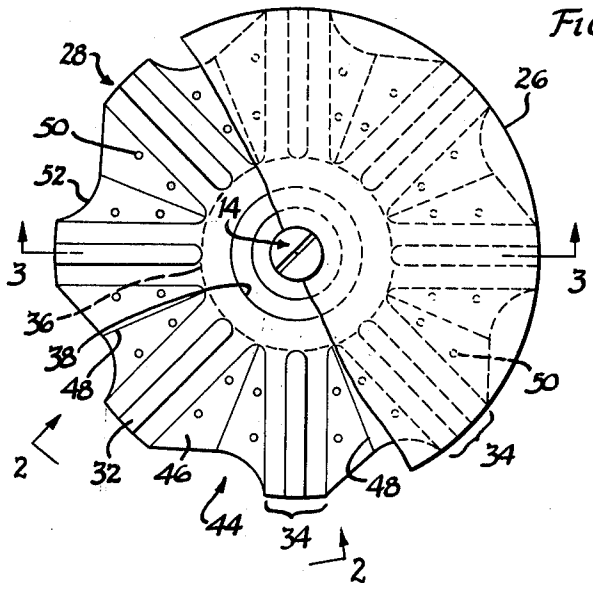
June 8 1965 E. J. SOPCAK ETAL 3,187,475

BACKING DISC FOR ABRASIVE SHEET

Filed Feb. 18, 1963

FIG. 1



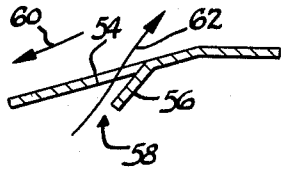
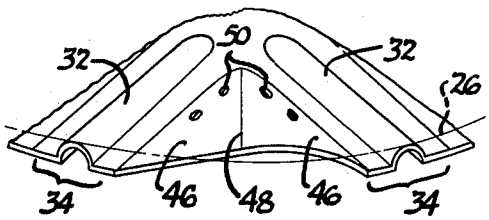


FIG. 5

FIG. 2



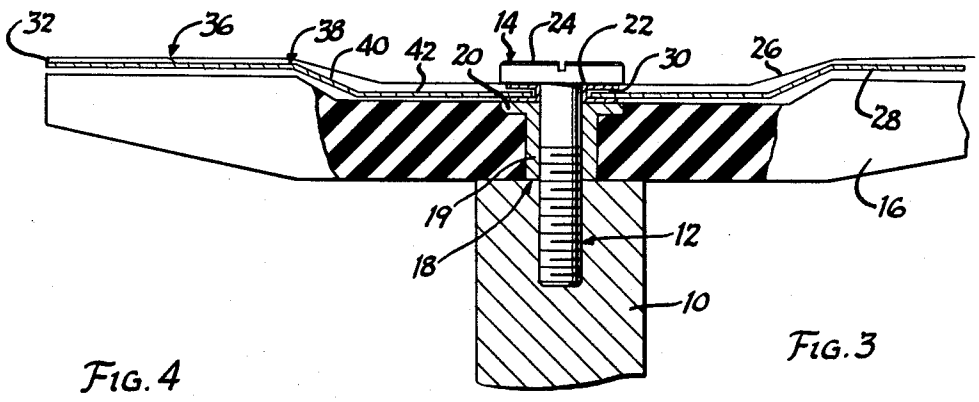
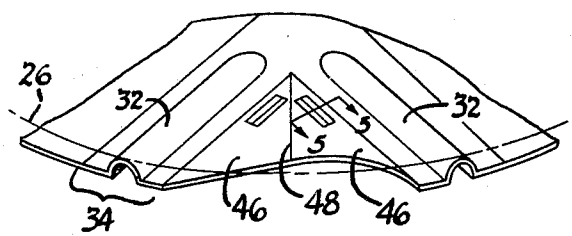


FIG. 3

FIG. 4



INVENTORS
EDWARD J. SOPCAK
BY THOMAS L. DRAPER
WILSON, SETTLE & CRAIG
ATTORNEYS

United States Patent Office 3,187,475 Patented June 8, 1965

3,187,475

BACKING DISC FOR ABRASIVE SHEET

Edward J. Sopcak, 3315 Pinckney Road, Howell, Mich., and Thomas L. Draper, 111 Abbey, Birmingham, Mich.

Filed Feb. 18, 1963, Ser. No. 259,109
4 Claims. (Cl. 51—356)

This invention relates to the abrasive art; and more particularly to the support of abrasive sheets for use on rotary abrading machines.

The problem

In the grinding or dressing of surfaces such as of metal castings, automobile bodies for repainting and the like, the rotary abrasive machine or sander has been found to be particularly desirable because the rotary action tends to cause the abrasive to be self-cleaning by rejecting the material removed from the surface that would otherwise clog the abrasive grit.

In the past, to enhance this cleaning action, various types of backing discs have been utilized, the most prominent being a foam rubber pad which permits the abrasive to flex as it contacts the surface being dressed and the flexing tends to reject the removed particles such as paint or other, and extend the cutting life of the abrasive. However, a problem encountered with rubber backing pads has been that heat that builds up during the abrading operation and is retained because the rubber backing pad acts as an insulator. It will be understood that when paint is being removed from a surface such as a car body, the heat generated tends to make the paint gummy and actually the insulating effect of the rubber has caused early gumming and short life of the abrasive in such applications.

Further, as is well known, the life of rubber is short under heat.

These disadvantages offset the advantages of the rotary operation.

One of the attempts to overcome the problems has involved a metal backing sheet with ventilating grooves formed therein. However, such metal structures have relatively short life and thus are costly from a replacement standpoint. Also, a very dangerous condition is produced when, at the high speeds of the rotating machine, the metal plate disintegrates, producing shrapnel that is destructive to life and limb.

Accordingly, an important advance in the art would be provided by a rotary abrasive system wherein the life of the abrasive sheet is prolonged by adequate cooling during use, thus enhancing self-cleaning; and wherein a backing plate is employed that is substantially immune to explosive disintegration, thus nullifying any hazard from flying fragments as heretofore encountered. And also wherein a backing plate so employed has enough flexibility to aid in self-cleaning.

Objects

Accordingly, an important object of the present invention is to provide a novel backing member for a rotary abrasive disc.

A still further object is to provide a backing member for a rotary abrasive disc made of specific materials, and that is resistant to destruction by centrifugal force.

Another object is to provide a backing sheet for a rotary abrasive disc that has long life and will withstand extended flexing and contact under extremely heavy duty working conditions without appreciable deterioration.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

The drawings

FIGURE 1 is a plan view of a backing disc of invention having an abrasive sheet assembled therewith, the abrasive sheet being partly cut away to expose a portion of the backing disc;

FIGURE 2 is an enlarged fragmentary edge perspective view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged section view taken along the line 3—3 of FIGURE 1;

FIGURE 4 is a view similar to FIGURE 2 showing another embodiment of the invention; and

FIGURE 5 is a section view taken along the line 5—5 of FIGURE 4.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

The environment

The environmental surrounding of the present invention comprises an electric motor driven and generally hand held grinder or abrasive machine. The machine includes a driving motor mounted within a die cast aluminum housing or equivalent with a handle or handles so that the operator can pick up the unit and manipulate it as over the fender of an automobile in repairing the same or the like. A drive shaft is journaled in the housing and is suitably geared to the motor.

The shaft of the machine has an extending stub and this is designated by the reference numeral **10** in FIGURE 3 of the drawing. The stub **10** is provided with an axially extending threaded bore **12** to receive a cap screw **14**, used to hold the grinding assembly to be hereinafter described, to the end of the shaft stub **10**.

The general components of the system

Referring first to FIGURE 3, it will be noted that a rubber drive washer **16** of substantial body and thickness is provided with a metal insert **18**. The insert **18** suitably takes the form of a tubular sleeve **19**, flanged on the top end as at **20**. The metal sleeve insert **18** is joined as by vulcanizing to the center hole of the rubber drive washer **16**. It will be noted that the cap screw **14** is inserted through the bore of the insert **18** for assembly to the end of the shaft stub **10**.

A spacer **22** of annular configuration and defining an annular channel of U-shape section opening outwardly, is positioned between the cap **24** of the screw **14** and the top flange **20** of the metal sleeve insert **18**.

It will be noted that an abrasive sheet **26** of circular form and having an appropriate center hole, is held between the cap **24** of the screw **14** and the top side of the spacer **22**.

The backing disc

Upon the foregoing general background, the backing disc of invention is superimposed. Thus, it will be noted that the backing disc **28** is of generally circular configuration, as best shown in FIGURE 1, and has a center hole **30**, FIGURE 3, whereby it is fitted into the spacer **22** for retention against axial movement; however, it will be noted that the hole **30** is slightly bigger than the bight portion or web of the spacer **22** so that the backing plate **28** is free to rotate relative to the spacer **22** and thus is also rotatable relative to the rubber, or like, material backing member or drive washer **16**.

Referring again to FIGURE 3, it will be noted that the abrasive sheet **26** is secured against rotation beneath

the cap 24 of screw 14 and the top of the spacer 22. From the foregoing, it will be understood that the backing disc is movable relative to the abrasive sheet 26 and to the rubber drive washer 16; but that the sheet 26 and washer 16 move together. The advantage of this arrangement is that every time a workman lifts the unit away from a surface being worked upon, the backing disc 28 will move slightly relative to the abrasive sheet 26 and the drive washer 16; and next contact will force different abrasive grains into contact with the work surface and therefore give those previously used a chance to unload.

Specific embodiment of the backing disc of invention

By reference to FIGURES 1 and 2, it will be noted that the backing disc is of generally circular outline and has a plurality of radially extending raised ribs 32 formed therein, the top surfaces of which are higher than the remaining portion of the body of the disc to provide a line contact with the back side of the abrasive sheet to force spaced line-like portions of the sheet into contact with the work surface. It will also be noted that each rib 32 is of generally semi-circular shape and is formed generally centrally of a flattened island portion designated by the reference numeral 34, note particularly in FIGURE 2. It will be noted that the ribs 32 extend inwardly and terminate at a circle designated 36, FIGURE 1, whereas the islands 34 extend inwardly to a further circle designated 38, see also FIGURE 3.

Now, by further reference to FIGURE 3, note that the disc 28 dishes downwardly from the inner circle 38 as an annular downwardly slanting wall 40 to a lower annular flattened portion 42, at the center of which is the center, mounting hole 30. The recessed wall 42 accommodates the cap 24 of screw 14 so that it is below the level of the contact surfaces formed by the tops of the ribs 32 and therefore does not contact and scar the work during operation.

Referring back now to FIGURES 1 and 2, note that between the island portions 34 the intervening webs 44 taper downwardly at each side as at 46 to a center line 48. As best shown in FIGURE 2, the surfaces 46 are below the remainder of the bottom of the disc for air-fanning purposes. Now also by reference to FIGURES 1 and 2, it will noted that a plurality of air holes designated 50 are provided in each of the downward tapered sections or surfaces 46. It is to be understood that during rotation of the backing plate 28, these holes are effective to scoop in air to the underside of the abrasive sheet, or in combination with the edge scallops, designated 52, are effective to provide a substantial circulation of air beneath the abrasive sheet to disperse heat produced by frictional contact between the surface of the sheet and a work surface.

At this point, the particular shape of the scallops 52 will be highlighted. Note that these are not truly semi-circular; instead the bottom of the scallop is off-center relative to the centerline 48. This gives enhanced air movement over a symmetrical scallop, in which the low point would be precisely at the centerline 48. However, the extended scope of invention would include the latter or a disc with no scallop at all.

Thus, a very substantially extended life is provided to the abrasive sheet in accordance with the present invention; and it will be noted that a much more effective air circulation is provided in the present embodiment than analogous prior art structures which depend upon centrifugal force alone for air movement, rather than a positive fanning action.

Alternate embodiment of air scoop

As shown in FIGURES 4 and 5, an alternate air scoop embodiment which may be used in accordance with the present invention in place of the holes of FIGURES 1 and 2, comprises slot-like openings. These are made by slitting along a line as at 54, and pressing down a lip 56, FIGURE 5, to form an air scoop designated generally 58.

By reference to FIGURE 5, it will be understood that movement of the backing disc 28 in the arrow 60 direction will be effective to sweep air through the air scoop 58 in accordance with the flow of the arrow 62. This air then fills the pocket formed by the abrasive sheet 26, the ribs 32, the island portions 34 and the downward tapered walls 46 to the center line 48 for effective heat radiation from the abrasive sheet, substantially as fast as it is formed, thus imparting a long life and improved self-cleaning action to the abrasive sheet.

The material of the backing disc and process of production

The material used in forming the backing disc in accordance with the present invention is cotton duck or other fiber or paper impregnated with a thermosetting resin, a phenol formaldehyde resin being generally preferred.

Preferably fabric of natural or man-made fiber having a weight of about fifteen ounces pe square yard will be used in about three or four layers thickness for average applications. However, fabric weights from about 2 to about 25 ounces per square yard are within the scope of invention.

The elements of the present invention can be made in substantially any thickness range, and when using one ply of cotton duck will be generally about 0.015 inch thick; but can be made up to as high as 0.250 inch in thickness or more for heavier load conditions by using an appropriate number of layers of the fabric as will be described below.

As a generality, the material will comprise from about 40–70% of the weight of the final product.

Abrasive sheets which can be used in conjunction with the backing discs of invention are well known, and these of course include backings of paper, cloths of various kinds and plastics, carrying such abrasives as aluminum oxide, silicon carbide and the like. It is believed that the present invention will substantially extend the life in heavy production operations of substantially any abrasive sheet material, although it will be recognized that the cloth backed industrial grades will usually display better durability than the lighter duty paper base materials.

The method of invention involves generally the following steps:

(1) Dipping a layer of fabric of natural or man made fiber into a liquid thermosetting resin, e.g., a volatile solvent system.

(2) Vaporize the solvent at an elevated temperature to convert the resin to the B stage.

(3) Final cure the resin to the C stage under heat and pressure to produce the rough blank.

(4) Then, trim and cut the blank to the appropriate profile with center hole and air directing apertures.

(5) Or, steps 3 and 4 could be eliminated by trimming the product of steps 1 and 2 to size and molding the final shape.

In the light of the foregoing brief perspective view of the method involved in the present invention, a full and complete description of each stage and the co-ordination of the stages in the process will now be provided.

Step I.—Impregnate fabric or fiber. The layers of fabric or fiber are suitably impregnated by dipping into a liquid thermosetting resin containing a volatile solvent. The resin such as a phenolic-based material can be carried by a volatile solvent such as alcohol or water, so that the solvent can be later removed and the resin remain in the fabric or fiber.

Step II.—Drying. Drying of the dipped fabric or fiber is effected by vaporizing the solvent at an elevated temperature in the range from about 150° to 300° F. for a period of time of about 5 minutes up to about 20 minutes. This temperature-time cycle will generally be effective to convert the resin to the B stage, that is, to a dry, non-tacky state, and render the impregnated blank a handleable mass. This concludes Step II.

Step III.—Final cure. To perform the final cure of the impregnated fabric or fiber, it is placed between matched metal molds and the molds brought together under pressure with heating. A broad pressure range of about 100 to 2,000 pounds per square inch can be used, preferred range will be about 550 to 650 pounds per square inch. A temperature in the range of about 250° to 400° F., preferably about 300° F., for a time cycle of approximately 1.5–5 minutes will be effective to provide a cured article. This concludes Step III.

Step IV.—Trim and cut. The cured blank is now trimmed to outside profile, removing all flash and burrs, and providing a uniform circular outer perimeter with or without the scallops, designated 52, being formed as by die cutting. At the same time, the air holes 50 or scoops 58 are formed, along with the center hole 30, as shown in FIGURE 3.

In case of prior trim and cure to finish sized product, Step IV is omitted, as pointed out above.

The finished product is now ready for use.

In accordance with the foregoing, it will be understood that the process of the present invention has proven commercial utility and is capable of producing a novel functional product.

Actual tests

A backing disc of invention of nine inch outer diameter and having a three-quarter inch center hole was subjected to the following test:

The disc was chucked to a 1½ horsepower rotary grinder and operated at 4,000 r.p.m. The device was so placed that the backing disc itself, without an abrasive overlayer, was placed against a concrete wall at a 30° impact angle. The unit was run for eighteen hours against the concrete wall and without discernible deterioration of the backing plate, except for minor abrasion on the surface by rubbing against the grains of sand of the concrete.

The durability and long life of the unit is thus outstandingly demonstrated by the foregoing actual static test.

Extended scope of invention

The foregoing disclosure has related to a thermosetting resin impregnated fabric or fiber, material or man made. It is not, however, to be considered limiting upon the invention to use any particular thermosetting resin. The phenolics have been mentioned; however, the materials capable of imparting the desired long-life properties and toughness are to be included within the scope of invention, therefore a thermosetting resin broadly being used to designate the impregnating agent.

While the profile of the ribs 32 has been designated as semi-circular, the broad scope of invention would include triangles or other providing approximately line contact between abrasive and work surface.

Advantages of the present invention

In addition to the long life and toughness (with flexibility) provided by the present invention, the unique air scoop features provide rapid cooling and long life to the abrasive sheet itself. Thus, greater economy of operation is provided.

Still further, the novelty of the ridges 32 provides only a line type contact at the abrasive-work surface contact line; and thus, self-cleaning of the abrasive material is provided by such contact.

Still further, the novelty of the ridges 32 provide an air duct, and thus, a forced cooling channel for efficient heat removal.

By virtue of the toughness of the present product and the unique configuration and air circulation provided, a truly novel product has been provided to advance the state of the art.

We claim:

1. In a backing disc,
a plate-like body member of generally circular profile and of generally planar configuration and having opposed faces,
at least one rib raised above one of said faces,
a canted surface spaced from said rib and extending slightly above the other face of the body,
and an air passage in said canted surface.

2. In a backing disc,
a plate-like body member of generally circular profile and of generally planar configuration and having opposed faces,
at least one radially extending semi-circular rib raised above one of said faces,
a canted surface formed in said body in spaced relation to said rib and extending slightly above the other face,
an air pasage in said canted surface,
and said body being formed of resin impregnated, non-metallic fibrous material.

3. In a backing disc,
a plate-like body member of generally circular profile and generally planar configuration and having opposed faces,
a recessed mounting hole formed centrally in said body,
a plurality of radially extending ribs spaced uniformly around the body member and raised above one of said faces,
a concave web between each pair of adjacent ribs and extending slightly above the other face of the body member,
said body member being cut away in an arcuate scallop along the terminal edge of each said web, and
at least one air opening in each said web.

4. In a circular abrasive sheet system,
a mounting cap screw having a body and head,
an annular drive washer made of rubber-like resilient material,
means at the center of said drive washer mounting the same on said mounting screw body,
an annular collar having an outwardly opening U-shaped channel positioned on said screw body between said mounting means and said screw head,
a backing disc comprising a plate-like member of generally circular profile and generally planar configuration with opposed faces,
a recessed mounting hole formed centrally in said body and rotatably seated within said U-channel,
a radial rib formed in said body and extending above one of said faces,
and a circular abrasive sheet between the head of said cap screw and said annular collar.

References Cited by the Examiner

UNITED STATES PATENTS

2,573,411	10/51	De Michel	51—195
2,986,798	6/61	Koenig et al.	28—76
2,997,819	8/61	Schacht	51—195
3,048,482	8/62	Hurst	51—297 X
3,057,036	10/62	Koenig	28—76
3,110,140	11/63	Reames	51—379

LESTER M. SWINGLE, *Primary Examiner.*