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ABRASIVE DISK AND METHOD OF MAKING SAME

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This invention relates to improvements in abrasive articles and to a method of manufacturing the same, and especially to improvements in abrasive-coated discs for detachable and renewable application to the grinding heads of rotary grinding machines. It is particularly concerned with coated abrasive discs in which the backing comprises vulcanized fiber or other moisture-absorbent material, for example of the type disclosed in the R. F. Carlton Patent No. 1,686,696 of September 10, 1926.

In use such discs are mounted through a central aperture therein on a rotatable spindle having a supporting head for the non-abrasive side of the disc, and are rotated very rapidly as high as 5000 revolutions per minute. The discs are usually pressed against the workpiece at an angle in such a manner that the abrading is done by a band about 2 inches wide extending inwardly from the periphery of a disc 8 inches in diameter. Certain types of use require the disc to bend in a rather sharp arc while being pressed against the work and being rotated at high speeds. Under such usage the disc may break, and broken segments flying from the discs at high speed may create a real hazard to the person operating the grinding machine. Thus a tough, elastic disc is required and a brittle disc backing, although having the required mechanical strength is unsuitable.

Discs of the coated abrasive type have heretofore commonly been made with a vulcanized fiber backing alone or with a composite backing of a layer of cloth bonded to a layer of vulcanized fiber with abrasive grains bonded to the exposed cloth surface. Animal glue and thermo-setting resins, such as the phenol-aldehyde resins which are capable of withstanding both the elevated temperatures developed in the disc during dry grinding, and also the solvent action of water as employed in wet grinding, have been used as the abrasive bonding coat and as the adhesive securing the cloth and vulcanized fiber in the manufacture of discs having a composite backing.

In order that the disc may fit snugly against the supporting pad of the grinding machine it is essential that the disc be flat or that the abrasive side of the disc be slightly convex. If the abrasive side of the disc is concave when applied to the grinding machine, the slight depression or bending of the central portion of the disc by the retaining clamp bolt (as illustrated in the previously mentioned Carlton patent) when the same is tightened in place is ordinarily sufficient to cause radial cracking, which accelerates subsequent failure of the disc when in use. A concave disc is also susceptible to catching on the workpiece and to tearing off of fragments of the disc, and particularly the fluttering edges of a concave disc tend to gouge the work.

It is customary in the art to obtain a flat disc or a slightly convex disc (a disc 9 inches in diameter should have a chord height of approximately 7/8 inch) by controlling the degree of cure of the adhesive securing the abrasive particles to the vulcanized fiber and the degree of drying of the vulcanized fiber backing prior to stamping the discs from the coated web. A disc that is too convex (a chord height of more than 1 inch in a 9-inch disc) is just as unsatisfactory as a disc having its abrasive side concave. The web of abrasive-coated material is thus customarily dried to the desired degree before the discs are stamped or cut therefrom.

The art has found by experience that ordinary vulcanized fiber discs having grit bonds of heat-hardened synthetic resins do not long retain their initial flat or slightly convex shape under fairly humid atmospheric conditions. Vulcanized fiber is a relatively hygroscopic material; and at 32% relative humidity will contain about 5% moisture, at 65% relative humidity about 8.5% moisture and at 100% relative humidity 32% moisture. Thus the backing swells and expands under fairly long exposure at high humidity conditions. The disc cannot expand evenly on both surfaces since the resin-coated surface does not absorb moisture at the rate that it is absorbed by the vulcanized fiber and the resin coat thus holds the surface of the fiber on which it is coated against stretching. Thus the disc tends to curl and the abrasive-coated surface becomes concave.

It is, therefore, an object of this invention to provide an abrasive disc having a re-enforced vulcanized fiber backing that is of sufficient mechanical strength to resist the force tending to curl the disc when the vulcanized fiber absorbs moisture. A further object of the invention is to provide such a disc having the required mechanical strength that is not brittle.

Various expedients have been proposed to overcome the disc-curling problem. It has been suggested by our contemporaries that a disc, dried to the desired degree of curvature, be covered on the uncoated vulcanized fiber surface with a sheet of thin metal foil or other material that is impervious to moisture. While this type of laminated disc may retain its initial shape for short
periods of exposure to high humidity conditions of up to approximately five days, thereafter the moisture penetrating into the vulcanized fiber through the edges of the disc and through cracks in the abrasive-coated surface is sufficient to curl the disc and render it concave on the manner known to the art, curing the adhesive grit binder and drying the coated web to the desired degree to obtain a flat or slightly convex shape; discs are then cut from the web and a disc or a combination of non-hygroscopic material of the size and shape of the backing and fiber disc is adhesively secured to the uncovered surface of the disc. The non-hygroscopic material may comprise perforated aluminum, copper or tin foil. The perforations are of pin-point size to permit the solvent vapors' escape and to let moisture reach the vulcanized fiber backing and may be spaced 1/8 of an inch apart. The number and size of the perforations may be varied, but they should not be so large or so numerous as to weaken the mechanical strength of the supporting metallic sheet to any considerable extent. We have found that perforated half-hard aluminum foil of 2½ to 3 mils thickness has the mechanical strength to resist the tendency of the vulcanized fiber to curl upon absorbing moisture. Perforated hard aluminum foil 1½ to 2 mils thick, as well as ordinary window screen in which the meshes are approximately 1/8 inch, may also be used as the re-enforcing element.

This construction is readily understood by reference to the accompanying drawing in which:

Figure 1 is a side elevation of a disc made according to the present invention, and

Figure 2 is a perspective view of the improved disc showing its slightly convex shape.

In the drawing the reference character indicates a backing consisting of vulcanized fiber to one side of which a layer of abrasive grains is attached by bond 12. The other side of the fiber is provided with a layer 13 of a perforated non-hygroscopic material, preferably metallic in nature, which is attached to the vulcanized fiber by an adhesive 14.

The adhesive securing the perforated metallic support to the backing may comprise a heat-hardening phenolic resin such as phenol-aldehyde, urea-aldehyde or resorcinol aldehyde resins. Such resins firmly bond the re-enforcing layer to the vulcanized fiber without slippage in use.

The layer of perforated metal foil may be applied to the web of vulcanized fiber before or after the abrasive grits are bonded to the vulcanized fiber, and before the discs are cut from the coated web.

As previously mentioned, the invention may be employed with disc backing materials of moisture-absorbent material other than vulcanized fiber, such as paper or cloth, or a combination of vulcanized fiber and cloth. The curling problem is usually not so acute when combination backings are employed since the cloth is impregnated rather completely with the combining adhesive and a thin web of vulcanized fiber, of about 10 mils thickness, is bonded to the surface of the material. The combination of 10-mil vulcanized fiber does not absorb as much moisture as does the thicker layers of this material. When vulcanized fiber is used alone as the backing a layer of 20 to 40 mils thick is generally employed.

The abrasive grains may be attached to the moisture-absorbing backing by any suitable adhesive such as a synthetic resin or by a combination of different adhesives. For example, they may be directly attached to the backing by a so-called "making coat" of glue and then a second or sizing material, such as a phenol-aldehyde resin may be applied over the abrasive grains and the glue making coat, as is described in the patent to Netherly, Cross and Anderson No. 2,269,415 of January 6, 1942.

While our invention has been described and illustrated in the form of a preferred embodiment, it is not necessarily described in the art of making abrasive-coated sheet material that all variations and substitutions within the scope of the broad concepts of our invention are comprehended.

We claim:

1. A flexible abrasive disc of the coated abrasive type comprising a backing of vulcanized fiber, a layer of abrasive grains adhesively attached to one side of the backing and a porous metallic sheet adhesively secured to the side of the backing which is opposite the abrasive coating, the metallic sheet being characterized by sufficient tensile strength so that it can hold the vulcanized fiber coating on substantially the same plane when the vulcanized fiber absorbs moisture and tends to curl the abrasive side of the disc to a concave shape and by sufficient flexibility so that the disc can be bent when being applied to the workpiece.

2. A flexible abrasive disc of the coated abrasive type comprising a backing of water-absorbing cellular sheet material, a layer of abrasive grains adhesively attached to one side of the backing and a perforated non-hygroscopic sheet adhesively attached to the other side of the backing, said perforated sheet being characterized by sufficient tensile strength to retain the backing in substantially its normal shape when the water-absorbing sheet absorbs moisture and tends to curl the abrasive side of the disc to a concave shape and by sufficient flexibility so that the disc can be bent while being applied to the workpiece.

3. A flexible abrasive disc as defined in claim 1 in which the foraminous metallic sheet comprises perforated metal foil of at least 2-mil thickness.

4. A flexible abrasive disc of the type defined in claim 2 in which the perforated non-hygroscopic sheet comprises window screening.

5. A flexible abrasive disc as defined in claim 2 in which the nonhygroscopic sheet comprises hard aluminum foil with pin-hole perforations spaced at least 1/8 of an inch apart.

6. A flexible abrasive disc of the coated abrasive type comprising a composite backing consisting of a vulcanized fiber disc and a foraminous thin metallic disc adhesively attached to one surface of said vulcanized fiber disc and a layer of abrasive grains adhesively secured to the other surface of said vulcanized fiber disc, said thin metallic sheet being characterized by sufficient mechanical
strength to retain the vulcanized fiber disc in its normal convex shape with the abrasive-coated surface outwardly when the vulcanized fiber disc absorbs moisture and tends to curl the abrasive side of the disc to a concave shape, and by sufficient flexibility so that the disc can be bent while being applied to the workplace.

7. The method of making flexible abrasive discs of the coated abrasive type which comprises adhesively securing a layer of abrasive particles to one surface of a web of vulcanized fiber, cutting discs from the abrasive-coated web, heating the discs to drive moisture from the vulcanized rubber so that the abrasive-coated side of the discs is convex and has the desired radius of curvature, and adhesively attaching discs of perforated non-hygroscopic material to the hygroscopic cellulosic material discs on the side opposite the abrasive coating, said non-hygroscopic discs having sufficient tensile strength to retain the convex shape of the discs when the hygroscopic cellulosic material expands upon absorbing moisture.

8. The method of making flexible abrasive discs which comprises bonding a layer of abrasive grains to one surface of a web of vulcanized fiber with a heat-hardenable synthetic resin, securing a sheet of perforated metal foil to the other surface of the vulcanized fiber with a heat-hardenable synthetic resin, heating the coated web to cure the resin bonds and to dry the vulcanized fiber and then cutting discs from said coated web, said perforated metal foil having sufficient tensile strength to retain substantially the initial convex shape of said discs even when exposed to high humidity over long periods of time.

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No references cited.