Jan. 23, 1968 G. R. RUSK ETAL 3,364,630

ABRASIVE ROLL

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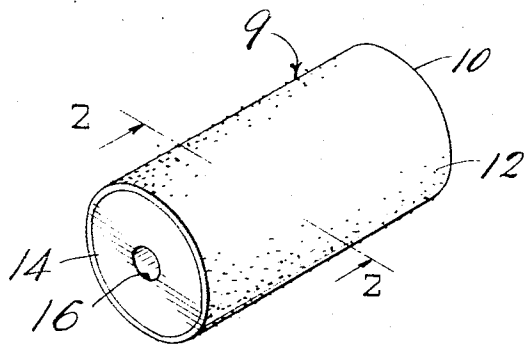


FIG-1-

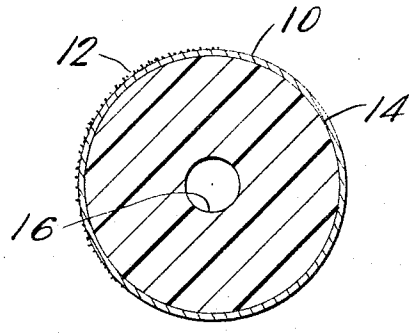


FIG-2-

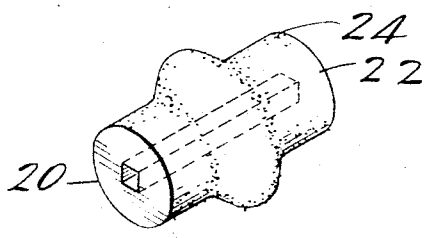


FIG-3-

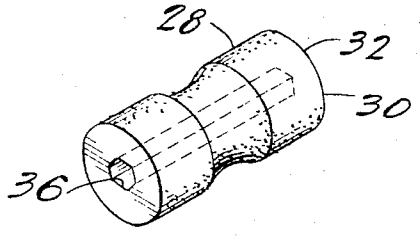


FIG-4-

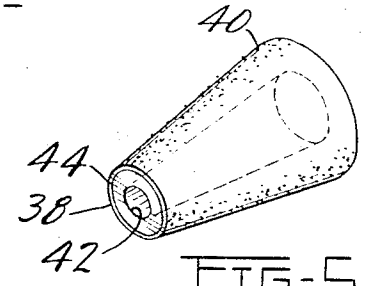


FIG-5-

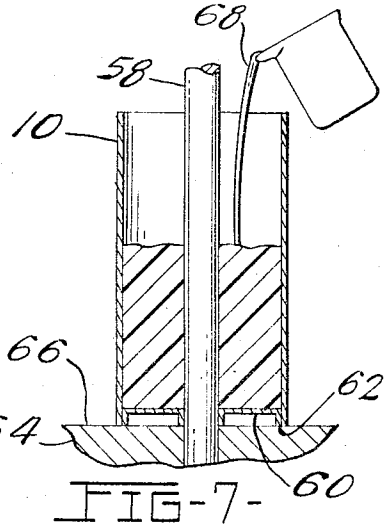


FIG-7-

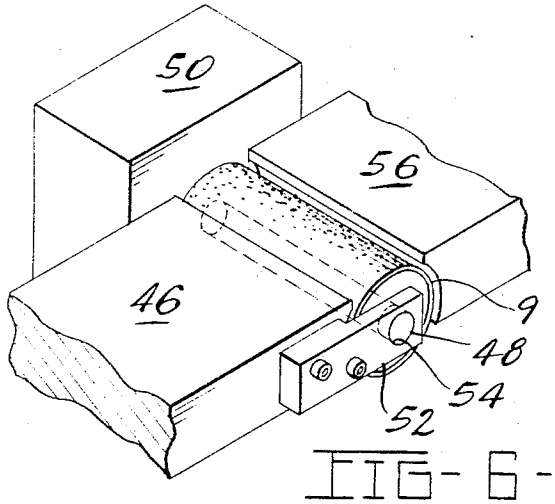


FIG-6-

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ABRASIVE ROLL

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The present invention relates to a disposable type of construction for devices which telescopically engage rotatable shafts, and more particularly to a new and improved construction of an abrasive sanding roll.

An object of the present invention is the provision of a new and improved means for centering and driving rotatable bodies with respect to rotatably driven spindles and which is simple in design, inexpensive to manufacture, and efficient in its operation.

Another object of the invention is the provision of a new and improved abrasive roll having a cellular plastic body that is telescopically inserted upon the spindle of a sanding machine to wedge the cellular plastic onto the shaft and thereby automatically center the roll with respect to the spindle.

A further object of the invention is the provision of an abrasive roll of the above described type having an internal opening so shaped and proportioned as to give an interference fit which rotatably drives the abrasive roll.

A still further object of the invention is the provision of a new and improved method for making an abrasive roll.

The invention resides in certain constructions and combinations and arrangements of parts, and further objects and advantages thereof will become apparent to one skilled in the art to which it relates from the following description of several preferred embodiments described with reference to the accompanying drawing forming a part of this specification, and in which:

FIG. 1 is an isometric view of an abrasive roll according to the invention;

FIG. 2 is a cross sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is an isometric view of another embodiment of an abrasive roll in accordance with the invention;

FIG. 4 is an isometric view of still another embodiment of an abrasive roll in accordance with the invention;

FIG. 5 is an isometric view of yet another embodiment of an abrasive roll in accordance with the invention;

FIG. 6 is a fragmentary isometric view of a sanding machine which incorporates an abrasive roll according to the invention; and

FIG. 7 is a fragmentary cross sectional view depicting a method by which an abrasive roll can be made in accordance with the invention.

A rotatably driven structure according to the invention, such as a sanding roll, comprises a body of a foamed resin having an axially extending opening therethrough which has an interference fit with respect to a rotatably driven spindle. Where the rotatably driven structure is a sanding roll, the external surface of the body of foamed material is, of course, a surface of revolution that is coated with abrasive particles in any convenient manner. It has been found that foamed resins can be sufficiently rigid adequately to support the structure with respect to the spindle of a machine during use, and yet be deformable enough so that it can be deformed by any irregularities in the surface of the spindle to an extent giving good driving engagement therebetween.

An abrasive roll 9 shown in FIG. 1 generally comprises a cylindrically shaped outer tube 10 which is coated with abrasive granules 12. The tube 10 may be made of any suitable material, and as shown in the drawing is made from a paste board material quite similar to a

conventional mailing tube, and the abrasive particles 12 are bonded to the tube 10 by means of a thermoset phenol formaldehyde resin. The embodiment shown in FIG. 1 is completed by a body 14 of a foamed resin that is cast within the tube 10. The cast body 14 may be of any suitable resin, preferably a thermoset resin, in order that it will not be softened at elevated temperatures, and includes an axially extending opening 16 therethrough which is made to have an interference fit with respect to the spindle of the particular sanding machine for which the abrasive roll is made.

Unlike the embodiments shown in FIGS. 1 and 2, that of FIG. 3 contains an annular projection in its outer surface of revolution making it generally unfeasible to construct the abrasive roll within an outer tubular member. The embodiment shown in FIG. 3, therefore, is constructed by either machining a prefoamed and set plastic to the desired shape, following which coatings of adhesive and of abrasive particles are applied thereto, or by casting a body 20 of foamed material within a suitable mold to provide the desired external configuration, and then applying layers of adhesive 22 and abrasive particles 24 and curing the adhesive in situ. As in the previous embodiment, the adhesive is preferably a thermosetting resin such as a phenol formaldehyde. The body 20 of foamed material also has an axially extending opening 26 therethrough which in the present instance is square in cross section and of such a dimension as to have a slight interference fit with a square spindle of a sanding machine. The square shape has the advantage of providing a better driving fit between the body and the spindle than does a straight cylindrical shaft and opening.

The embodiment shown in FIG. 4 is quite similar to that of FIG. 3 in that it is also formed by bonding abrasive granules 28 directly to the external surface of a foamed body 30 by means of an adhesive 32. The embodiment shown in FIG. 4, however, has a depression 34 in its external surface, which makes it unfeasible to use the tube type of construction shown in FIGS. 1 and 2 and has a hexagonally shaped axially extending opening 36.

FIG. 5 of the drawings shows an abrasive roll having a generally conically shaped external surface. Inasmuch as the external surface is of the type which can be generated by a straight line when revolved about an axis of rotation, the tube type of construction shown in FIGS. 1 and 2 is feasible and an outer tube portion 38 that is generally a truncated cone can be used. Particles 40 are bonded to its exterior surface in the same manner described in any of the previous embodiments. The embodiment shown in FIG. 5 differs from those previously described in that its axially extending opening 42 through a body 44 of foamed material is not of a constant cross section but is tapered so as to provide a tight telescopic fit with respect to a tapered spindle. The tapered fit enables a tight wedging action between the body 44 and the shaft and gives an excellent driving engagement with respect to the shaft.

The present invention can be used to make grinding wheels and abrasive rolls, as well as other types of rotatably driven structures which are used for a period of time and then discarded. An abrasive roll or the like according to the invention can be used with a sanding machine shown in FIG. 6 and comprising a housing 46 from which a rotatably supported spindle 48 is suitably spaced. The spindle 48 is supported at one side by means of a structure 50 which includes a drive motor (not illustrated) and is supported at its other side by means of a removable bracket 52 having an opening 54 adapted rotatably to receive the end of the spindle 48. The abrasive roll 9 of FIGS. 1 and 2 is shown mounted in the machine. It should be pointed out, however, that the central open-

ing 16 of the roll 9 is slightly smaller than is the spindle 48, so that the body 14 of foamed material is deformed when the roll 9 is slid axially over the right end of the spindle 48, as seen in FIG. 6. Thereafter, the bracket 52 may be replaced over the shaft and suitably bolted in position. It has been found that the deformation that is involved in providing the described interference fit not only accurately centers the abrasive roll with respect to the spindle, but provides sufficient frictional engagement therewith adequately to drive and support the abrasive roll. The machine shown in FIG. 6 can be used in the sanding of boards and the like and so has a work support 56 positioned on the opposite side of the roll 10 from the housing 46.

The foamed bodies according to the present invention can be cast in situ as has been described with reference to FIGURES 1, 2 and 5. For most applications, the tube 10, for example, can be centered about a shaft 58 which acts as a form and is slightly smaller in diameter than is the spindle 48. The tube 10 can be centered in any convenient manner, and as shown in the drawing is centered by means of an annular centering disc 60 having an axially extending flange 62 that has an outer periphery which tightly engages and centers the tube 10. The lower end of the shaft 58 is received in a support 64 having a smooth upper surface 66 that is perpendicular to the shaft 58. With the tube 10 installed about and centered with respect to the shaft 58, a measured amount of a foamable, curable, resinous material is poured within the tube 10 and around the shaft 58 so that it will foam around the shaft for substantially the full length of the tube 10, and subsequently harden or cure into a stiff body bonded to the inner surface of the tube 10. After the foamable resin is poured in place, a centering disc similar to the disc 60 is preferably installed in the upper end of the tube 10 to insure concentricity of the shaft 58 with the tube 10. In order that the cast body can be removed easily from the surface of the shaft 58, and from the annular disc 60, a coating of a suitable mold release agent can be applied to these surfaces before the foamable material, which is designated 68, is poured in place.

Some stratification of foamed material may occur in abrasive rolls having lengths several times their diameter if the foamable material is merely poured into an upright cylinder. In some instances, therefore, it may be desirable to close off the tube with an annular cover disc similar to the lower disc 60 after the foamable material is placed inside, and to rotate the entire assembly in a horizontal position to cause the material to grow evenly from the surfaces of the tube toward the center shaft 58. As a consequence of such an operation the foamed material is of substantially the same apparent density throughout its length, but may vary slightly in density radially of the finished product. Such an operation also has the advantage of assuring an even better bond with respect to the tube 10.

As previously indicated, irregularly shaped rolls can be made by machining the body from a generally cylindrically shaped section of foamed material. This can be done by chucking a section of the foamed material in a lathe and using a file or abrasive paper to contour the foamed material into its desired shape. In other instances, however, it may be more economical to cast the foamable material into the desired shape, and this can be accomplished readily by replacing the tube 10 shown in FIG. 7 with a suitably shaped split mold the interior surfaces of which have been suitably coated with a lubricant. The separable mold can be positioned about a suitable centering body prior to being filled with the foamable material.

While any suitable foamable, curable, synthetic resinous composition, or other foamable, curable material, can be used to make the bodies of the present invention, it will in most instances be desired to make the bodies from a foamable thermal setting resin, particularly where the articles are to be used for abrasive rolls and the like, so that the material will not be softened by the heat that is produced during sanding operations.

A suitable foam material can be made using a resin composition of the following composition:

Glycerol, 4 moles;
Adipic acid, 2.5 moles; and
Phthalic anhydride, 0.5 moles.

The above resin composition can be caused to foam by mixing it with water and tolylene diisocyanate. By way of example, a suitable foaming mixture can be prepared using:

30 parts of the above resin composition,
0.5 part of water,
20 parts of tolylene diisocyanate, and
1.0 part of alkylated phenoxy polyethoxoxy ethanol.

The above materials are blended together until the reaction mass warms up, thins out and tends to become clear. The above blending will take from 1 to 2 minutes, following which the mixture is poured, either into a cylindrical cardboard tube the outer service of which has already been coated with an abrasive or into a suitable separable mold.

Where a 4-inch diameter cardboard tube 8-inches long of the type shown in FIG. 1 is to be used, the tube is centered around a vertically extending steel shaft 7/8 inch in diameter, and a 5.0 ounce portion of the above mixture is poured into the cylinder evenly around the shaft. In approximately two minutes the foam rises to the top of the cardboard cylinder and the foamed material is ready for post-cure. The foamed material may be post-cured by heating to 150–160° F. for one hour following which it can be cured for two hours at 240–300° F. The foam has a density of approximately 15 to 16 pounds per cubic foot.

Where articles such as shown in FIGS. 3, 4 and 5 are to be made, the blended foamable material above described can be poured into a separable mold the surfaces of which have been coated with a silicone mold release agent. The material is allowed to foam, following which the mold is separated and the article removed. The article is thereafter cured and its surface suitably shaped as desired. The article may be shaped by bringing a preshaped abrasive tool against the cast foamed body while it is revolving on a suitable spindle. Thereafter the shaped body is coated with a suitable cement as for example that referred to on page 1248 of "The Chemistry of Synthetic Resins" by Carleton Ellis, published in 1935. The body coated with cement is thereafter rolled in a tray of suitable abrasive until all parts are covered with the abrasive, and the cement is thereafter allowed to dry and harden.

In another method of producing the foamed roll bodies, a tube 10 was centered with respect to a shaft 58 mounted on a support 64 by means of an annular centering disc 60. The shaft was coated with a heavy paste wax to facilitate later separation from the foamed material. Thereafter, 2.5 ounces of a liquid resin made by the Archer, Daniels Midland Company under their trade name Aropol 7825, and 2.5 ounces of a liquid resin made by the same company and designated Aropol 7846 were mixed together in a container and then poured into the tube 10. The material immediately foamed to fill the tube and after 7 minutes was sufficiently hard that removal from the shaft 58 was possible. The material had a density of approximately 20 pounds per cubic foot.

In still another method of producing the foamed roll bodies, a tube 10 can be centered with respect to a shaft 58 mounted on a support 64 by means of an annular centering disc 60. The shaft 58 is coated with a mold release agent and foamed polystyrene beads are placed into the tube 10 about the shaft and a top centering disc similar to the disc 60 is placed in the top of the tube 10. The top centering disc is preferably yieldably held in place

and is provided with vent openings therethrough, through which steam is admitted to the polystyrene beads. Steam is admitted to the beads for about 20 seconds to cause the beads to adhere to the tube **10** and to each other. The steam causes a slight swelling of the beads which eliminates all voids from the body of foamed polystyrene beads and causes the tube **10** to be completely filled.

In general the density of the foam which is used can be varied depending upon the unit load that is to be applied to the roll during use. The foam material must not be deformed beyond the yield point in most instances, and generally speaking the yield strength increases with the density for a given type of foam material. Foam materials having a density greater than approximately one pound per cubic foot will be required for most applications, and densities as high as approximately 20 pounds per cubic foot may be required for some applications. For most applications, however, densities of from approximately 2 to approximately 6 pounds per cubic foot will provide the necessary strength. For those applications where uneven surfaces are to be sanded, it will be highly desirable to use a resiliently deformable foam that will conform to uneven surface configurations being sanded without being loaded beyond the yield point, and which will recover its original shape when the load is removed from the sanding roll.

It will be apparent that the objects heretofore enumerated as well as others have been accomplished and that a new and improved spindle driven rotatable body has been provided. The rotatable body can be an abrasive roll, and is supported relative to the spindle by means of a body of light weight foamed plastic material.

While the invention has been described in considerable detail, it is not to be limited to the particular embodiments shown and described, and it is intended to cover hereby all novel adaptations, modifications and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

We claim:

1. A replaceable abrasive roll for telescoping insertion directly onto and around a rotatably supported spindle, said roll comprising: a body substantially rigid of foamed resin having an internal axially extending opening therethrough for forming an interference fit on said spindle, said body having an external surface of revolution that is coaxial relative to said internal opening, and abrasive particles uniformly affixed to said external surface of said body of foamed resin, whereby said abrasive roll is automatically accurately centered on said spindle when said body of foamed resin is telescopically pressed onto said spindle.

2. A replaceable abrasive roll for telescoping insertion directly onto and around a rotatably supported spindle, said roll comprising: a thin walled container having an external surface of revolution, said external surface having abrasive particles firmly affixed thereto, a substantially rigid body of a foamed resin in said container and bonded thereto, said body having an axially extending opening therein concentric with the axis of revolution of said external surface of said container and which telescopically engages said spindle, whereby said abrasive roll is automatically accurately centered on said spindle when said body is telescopically pressed onto said spindle.

3. A replaceable abrasive roll for telescoping insertion directly onto and around a rotatably supported spindle, said roll comprising: a thin walled container having an external surface of revolution, said external surface having abrasive particles firmly affixed thereto, a body of a rigid, foamed, resilient polyurethane resin in said container and bonded thereto, said body having an axially extending opening therein concentric with the axis of revolution of said external surface of said container for telescopically engaging said spindle and forming an interference fit therewith, whereby said abrasive roll is automatically accurately centered on said spindle when said body is telescopically pressed onto said spindle.

4. A power driven sander comprising: a housing, a shaft rotatably journaled in said housing, said shaft having surfaces which will telescopically receive internal openings of other bodies, a body of substantially rigid foamed thermoset resin having an internal axially extending opening therethrough forming an interference fit with said shaft, said body being telescopically engaged over said shaft and having an external surface of revolution that is coaxial relative to said internal opening, and abrasive particles uniformly affixed to said external surface of said body of foamed resin, whereby said abrasive roll is automatically accurately centered on said shaft when said body is telescopically pressed onto said shaft.

5. A readily replaceable rotatably driven structure for insertion directly on a spindle that is rotatably supported and which is adapted telescopically to receive the driven structure, said driven structure comprising: an axially extending hollow structure intended to perform work when rotatably driven, and a body of substantially rigid foamed resin filling said hollow structure and bonded thereto, said body having an axially extending opening therein forming an interference fit with said spindle when telescoped onto said spindle, whereby the deformation of said foamed material during telescopic engagement centers and rigidly connects said structure to said spindle.

6. An assembly comprising a replaceable abrasive roll telescopically inserted directly onto and around a rotatably supported spindle, said roll comprising: a thin walled container having an external surface of revolution, abrasive particles uniformly and firmly affixed to said external surface, a body of a substantially rigid foamed resin in said container and bonded thereto, said body having an axially extending opening therein which is coaxial with the external surface of said container and which is so dimensioned and shaped, relative to the dimensions and shape of said spindle, that said abrasive roll is engaged by an interference fit with said spindle.

7. An assembly comprising a replaceable abrasive roll telescopically inserted directly onto and around a rotatably supported spindle, said roll comprising: a body of substantially rigid foamed resin having an internal axially extending opening therethrough, said body having an external surface of revolution that is coaxial relative to said internal opening, and abrasive particles uniformly affixed to said external surface of said body, said internal opening being so dimensioned and shaped, relative to the dimensions and shape of said spindle, that said body is engaged by an interference fit with said spindle.

References Cited

UNITED STATES PATENTS

661,282	11/1900	Bachman	51—381 X
1,646,852	10/1927	Carnowsky	51—72
2,021,371	11/1935	Manchester	51—402
2,142,873	1/1939	Krause	51—375
2,862,806	12/1958	Nestor	51—298 X
2,950,584	8/1960	Welch	51—298 X

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