

June 11, 1968

S. D. BLUE

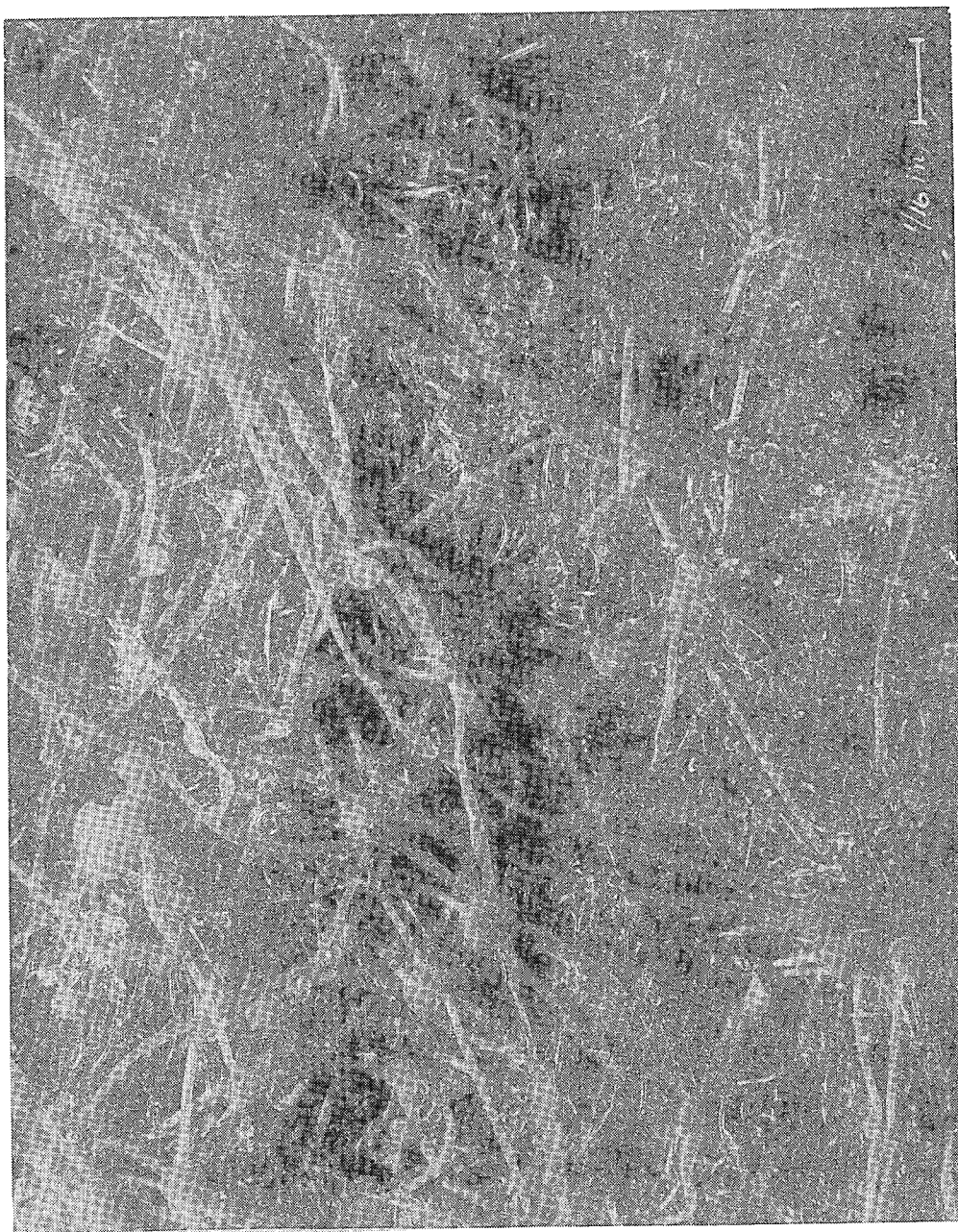
3,387,956

ABRASIVE SCOURING MATERIALS

Filed June 16, 1965

3 Sheets-Sheet 1

FIG. 1



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FIG. 2

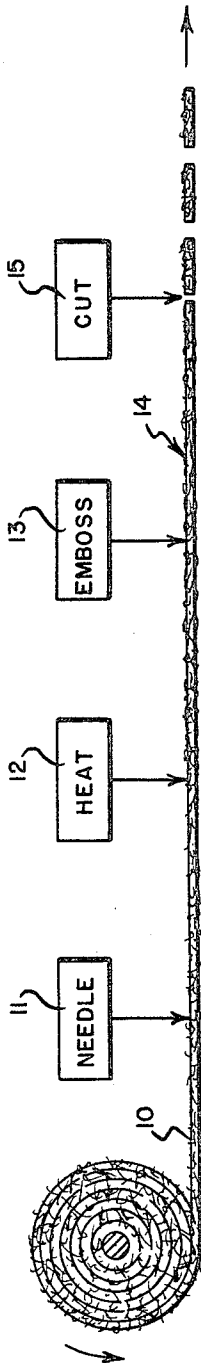


FIG. 3

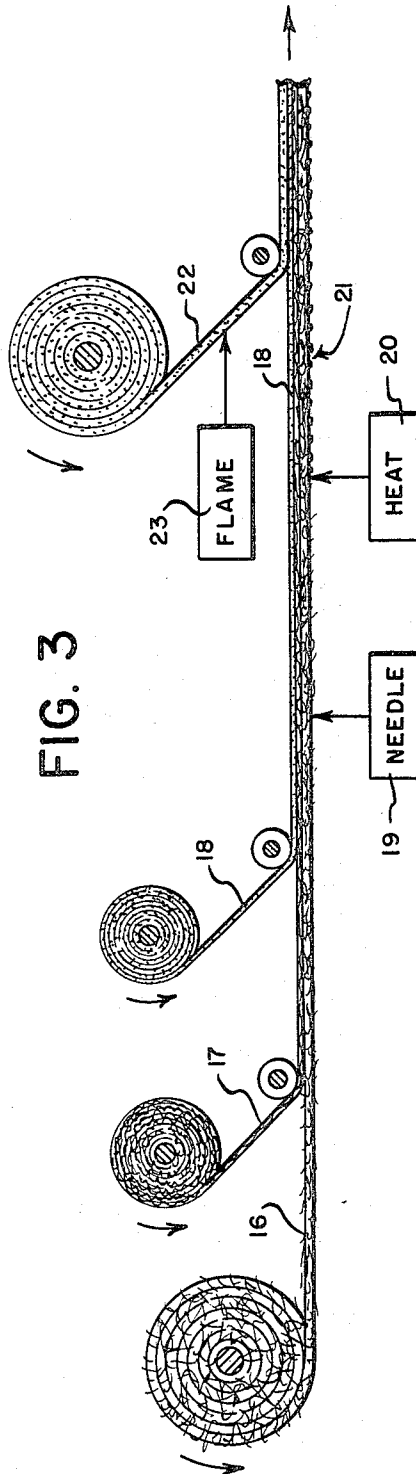
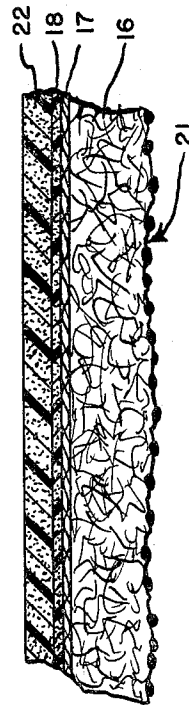


FIG. 4



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FIG. 5

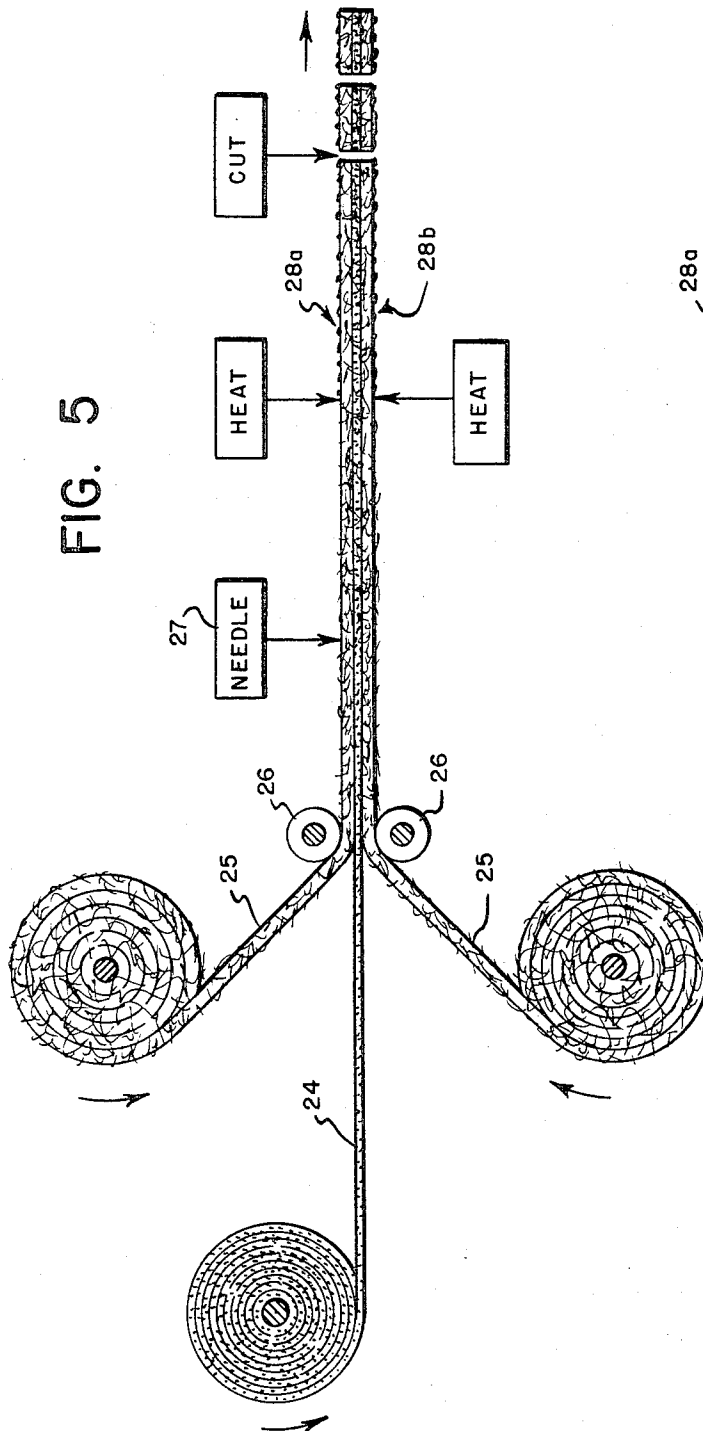
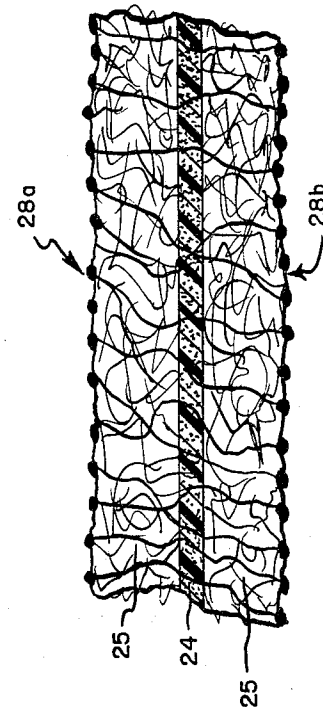


FIG. 6



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ABRASIVE SCOURING MATERIALS

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10 Claims. (Cl. 51-297)

ABSTRACT OF THE DISCLOSURE

Abrasive scouring materials are produced by (a) compacting axially drawn, staple fibers of a normally solid, thermoplastic polymer into a batting, the broad faces of which batting are defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, (b) heating at least one of the broad faces of the batting to a temperature above the melting point of the thermoplastic polymer for a period of time just sufficient to melt the thermoplastic polymer at the free ends and points of contact of those fibers which are exposed to such heating, and (c) cooling the heated face to a temperature below that of the melting point of the thermoplastic polymer, thereby transforming the heated face into an abrasive surface which results from globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and from agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived. Abrasive scouring materials made by such process are characterized by having their working or abrasive surfaces formed entirely from the compacted thermoplastic batting material itself without the addition of abrasive additives.

This invention relates to abrasive materials and, more particularly, to abrasive scouring materials which are particularly suitable for household use. The invention provides an improved abrasive scouring material which comprises a compacted batting composed of axially drawn, staple fibers of a normally solid, thermoplastic polymer, at least one broad face of which batting possesses an abrasive surface which results from globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and from agglomerations of resolidified polymer at several points at which the fibers cross each other. The invention also provides a process for producing these improved abrasive scouring materials.

Many types of abrasive materials are available for household use, the most commonly used for scouring being steel wool and other similar metallic pads. The wide acceptance of these metallic scouring pads is evidence of the effectiveness with which they may be used in the performance of a wide variety of household duties, but along with this acceptance is a correspondingly wide recognition of the inherent difficulties which invariably occur when these metallic scouring pads are used in the household. For example, cooking utensils fabricated from relatively soft metals, such as aluminum and copper are easily scratched by these metallic pads, while scratching also occurs when metallic scouring pads are used to clean silverware, porcelain and enamel surfaces of appliances, as well as wooden surfaces. Moreover, deep scratches in such cooking or eating utensils are difficult to keep clean of food residue. In addition to the damage which is frequently caused to those articles which are scoured, persons who use these metallic scouring pads are often inflicted with the painful experience of having a sliver of fine wire becoming embedded beneath the skin.

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Because of these and other reasons, attempts have been made to manufacture scouring pads from synthetic materials, one example of which is described in the Cameron Patent No. 2,601,771 which discloses a pad formed by knitting a synthetic ribbon-shaped monofilament yarn. A more recent example is described in the Hoover et al. Patent No. 2,958,593, which discloses a web made of nylon monofilament fibers into which web an abrasive material is sprayed. Neither of the abrasive materials disclosed in these patents has significantly invaded the market for metallic scouring pads.

The present invention provides a synthetic abrasive material and scouring pad having a unique construction as well as a simple and novel process for producing these abrasive materials. Broadly stated, the abrasive scouring material of the invention comprises a compacted batting composed of axially drawn, staple fibers of a normally solid, thermoplastic polymer, the broad faces of which batting are defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other. At least one broad face of the batting possesses an abrasive surface which results from globules of resolidified polymer at the free ends of some of the fibers which extend from such surface, as well as from agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived.

To produce these unique abrasive scouring materials in accordance with the process of the invention merely involves (a) compacting axially drawn, staple fibers of a normally solid, thermoplastic polymer into a batting, the broad faces of which batting are defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, (b) heating at least one of the broad faces of the batting to a temperature above the melting point of the thermoplastic polymer for a period of time just sufficient to melt the thermoplastic polymer at the free ends and points of contact of those fibers which are exposed to such heating, and (c) cooling the heated face to a temperature below that of the melting point of the thermoplastic polymer, thereby transforming the heated face into an abrasive surface which results from globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and from agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived. Because the batting is composed of axially drawn (or "axially oriented," the two terms being used interchangeably) staple fibers, briefly heating the surface of the batting to a temperature above the melting point of the thermoplastic polymer causes those fibers which are exposed to such temperatures to undergo shrinkage with the concurrent formation of a globule at the free ends and agglomerations at the points of contact of such fibers. If the period of heating is not prolonged much past the time necessary for such globules and agglomerations to undergo formation, then cooling of the heated surface to a temperature below that of the melting point of the thermoplastic polymer causes the solidification of these globules and agglomerations. It is the presence of these globules and agglomerations of resolidified polymer which actually results in the heat-treated surface of the batting becoming abrasive, thereby presenting a very effective abrasive surface for scouring. Moreover, by embossing the abrasive surface to form a pattern of raised portions, the scouring ability of the abrasive surface may be even further improved.

The abrasive scouring materials of the invention are characterized by having their working or abrasive surfaces formed entirely from the compacted thermoplastic batting material itself without the addition of abrasive additives. This considerably reduces material cost as well as the expense incurred in the fabrication of the material. In addition, the abrasive scouring materials of the invention offer all the advantages of a synthetic material, since they are practically inert and will not rust, mildew or harbor bacterial growth, and will not puncture the skin of the user. Even more importantly, however, the abrasive surface has been found to be effective for most household scouring uses and yet does not scratch or craze soft metals, porcelain, enamel, glass, wood, or floor coverings such as vinyl and linoleum.

Several preferred embodiments of the invention are described below with reference to the accompanying drawings, in which

FIG. 1 is a reproduction of a photomicrograph of the abrasive surface of the abrasive scouring material of the invention;

FIG. 2 is a schematic illustration of the basic process for producing abrasive scouring materials in accordance with the invention;

FIG. 3 is a schematic illustration of a modified version of the process for producing abrasive scouring materials in accordance with the invention;

FIG. 4 is a section, partly cut away, of the abrasive scouring material produced by the process which is schematically illustrated by FIG. 3;

FIG. 5 is a schematic illustration of yet another modification of the process for producing abrasive scouring materials in accordance with the invention; and

FIG. 6 is a section, partly cut away, of the abrasive scouring material produced by the process which is schematically illustrated by FIG. 5.

In the manufacture of the abrasive scouring materials of the invention, staple fibers of a normally solid thermoplastic polymer are formed into a pad or web or a multiple layer of webs, all of which may be collectively termed a "compacted batting," the broad faces of which batting are defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other. Prior to being cut into staple fibers, the filaments from which such thermoplastic fibers are formed must be axially drawn or oriented, so that upon subsequent heating to a suitable temperature the fiber will undergo shrinkage and concurrent formation of globules at its free end and agglomerations of its points of contact with other fibers.

Although the axially drawn, staple fibers of many thermoplastic polymers may be used in the abrasive scouring materials of the invention, particularly satisfactory results have been obtained by using the axially drawn, staple fibers of normally solid, high molecular weight polymers of propylene, such as isotactic polypropylene. Isotactic polypropylene is preferred because its surface hardness and scratch and abrasion resistance is superior to other polyolefins and other low-cost polymers. However other thermoplastic fibers, including the polyamides and polyacetals, may be used in the abrasive scouring materials of the invention, providing such staple fibers have properties enabling the fibers to be compacted into a batting or sheet-like mass and heated to form an abrasive surface in accordance with the process of the invention. Axially oriented, isotactic polypropylene fiber has a retracting character to it when subjected to its melting temperature in that as the fiber melts it retracts linearly and a globule will form on the free end of the fiber. Isotactic polypropylene is also preferred because of its relatively low melting point.

The compacted batting is formed of fibers cut to staple lengths of all one length or of mixed lengths, generally in the range from about 1½ to about 5 inches. The denier size of the staple fiber may vary over a wide range and

may be of all one denier size or a blend of several sizes. It has been found that a 30-denier polypropylene fiber produced globules and agglomerations of a size which was very effective as an abrasive. It was particularly found that a more cohesive pad may be made from a blend of about 20 to 25 percent by weight of 6-denier fiber with the balance 30-denier fiber, the use of which blend also facilitates fabrication into a variety of types of abrasive scouring pads. FIG. 1 illustrates a photomicrograph of the abrasive surface of an abrasive scouring material in which the compacted batting had been formed from a blend of axially drawn, staple polypropylene fibers, of which blend about 20 percent by weight were 6-denier fibers and the balance were 30-denier fibers. The globules of resolidified polypropylene at the free ends of some of the fibers, as well as the agglomeration of resolidified polypropylene at several points at which the fibers cross each other, are strikingly observable in this photomicrograph.

In FIG. 2 a schematic illustration of the steps of forming an abrasive scouring material is shown. A compacted batting 10, which has been formed into a sheet-like mass by processing the axially drawn, staple polypropylene fiber through either a garnett or a random webber, is passed through a needle punching loom 11 to reduce the thickness of the pad and increase its dimensional stability. In this example the abrasive material is to consist of a thickness of one pad of compacted batting material and it was found that a weight of about 6 to 8 ounces of fiber per square yard is preferred and gave satisfactory performance with respect to its durability and flexibility. On the other hand, if a dual layer of compacted batting material is to be formed, pads of 3 to 4 ounces of fiber per square yard each are preferred.

After needling, the sheet-like mass of compacted batting material is defined by discontinuous lengths of polypropylene fibers, the sheet-like mass being characterized by having a cross-section of a multiplicity of the fibers. The broad faces of the sheet-like mass are defined in part by free ends of those fibers which extended therefrom and in part by fibers substantially crossing each other.

As shown in FIG. 2, after needling the compacted batting material, it is run through a heat source 12, which may be a conventional gas-flame laminator, at a running speed of 50 to 60 yards per minute. Both broad faces of the compacted thermoplastic batting material are exposed to a flame, with the temperature of the flame being about 750° C. at this running speed. This temperature is sufficient to fuse the fibers at the surface of the broad faces. In fusing the surface fibers, the fiber ends at the surface retract when melted and form globules at the free ends—these globules are clearly evident in FIG. 1, both at the ends of the 30-denier fibers and upon closer inspection at the ends of the 6-denier fibers. The fibers which cross each other at the surface fuse together at the point at which they cross and form agglomerations of melted fibers in the nature of a crystalline structure. In FIG. 1 the agglomerations are also clearly shown, and it is to be noted that the globules and agglomerations have generally irregular sizes larger than the diameter of the fibers from which they are formed. FIG. 1 shows the agglomeration formations between the crossed fibers of both denier sizes; in some instances the agglomerations formed are a composite of melted crossed fibers of both denier sizes. In this example the abrasive material formed had a thickness of about ¼ inch at its loftiest surface.

The abrasive surface formed in this manner is preferably formed by fusing in such a way that only the fibers at the broad face of the sheet-like mass of batting material are fused into the globules and agglomerations; thus, the abrasive surface is defined by an irregular pattern of spaced globules and agglomerations formed within entangled fibers and the crossed fibers and fiber ends

within the body of the compacted batting material are generally free from agglomerations or globules.

After the material has been fused at its surface to form an abrasive surface of a plurality of fused globules and agglomerations, it is then subjected to an optional embossing operation 13, in which by a heated embossing roll a pattern of raised portions are formed to give a more abrasive effect to the one broad surface 14 which is to be exposed on the scouring pad being formed. After embossing, the abrasive material is passed through a cutter 15, where the sheet is cut to the desired scouring pad size.

FIG. 3 schematically illustrates a method by which a polyurethane-backed abrasive scouring material may be fabricated in accordance with the invention. As shown in FIG. 3, a compacted batting 16 composed of staple polypropylene fibers is fed together with a woven scrim 17 and a thin sheet of polyurethane foam 18 so that the woven scrim is sandwiched between the compacted batting 16 and the polyurethane foam 18. The three layers are needled together by passing them through a needle punching loom 19, thereby reducing the thickness of the composite pad and increasing its dimensional stability.

After needling, the compacted pad is passed under a gas flame laminator 20 at a speed of 50 to 60 yards per minute so that the exposed face of the compacted batting 16 is exposed to a flame at a temperature of about 750° F. at this running speed. As in the process illustrated in FIG. 2, this heat treatment causes those polypropylene fibers exposed to the flame to form globules of molten polypropylene at the free ends of the fibers as well as agglomerations of molten polypropylene at points at which the fibers cross each other. Since the composite pad is exposed to this flame treatment only for a very short time, these globules and agglomerations readily solidify and transform the exposed working face 21 of the composite pad into an abrasive surface. To provide a thicker pad, a heavy sheet of polyurethane foam 22 may be passed under a gas flame laminator 23, according to the flame lamination process, and this thick sheet of polyurethane foam 22 then heat laminated to the thin layer of polyurethane foam 18 which forms part of the composite pad.

The resultant polyurethane-backed abrasive scouring pad is illustrated by FIG. 4 which shows (a) the base layer of polyurethane foam which base layer is composed of the thick sheet 22 and thin sheet 18 of polyurethane foam laminated together, (b) the intermediate layer of woven scrim 17 having one of its broad faces needled to the base layer, and (c) the compacted batting 16 bonded to the woven scrim 17 (and also secured to the polyurethane foam 18 by needling), the exposed working face 21 of the batting possessing an abrasive surface.

In FIG. 5 the abrasive scouring material is produced by feeding a thin sheet of polyurethane foam 24 together in the two sheets of compacted thermoplastic batting 25 between rollers 26 so that the polyurethane foam 24 is sandwiched between layers of the compacted thermoplastic batting 25. The three layers are then needled by passing them through a needle punching loom 27, after which both of the broad exposed faces 28a and 28b of the composite pad are flame treated to convert these faces into abrasive surfaces in accordance with the process of the invention. The resultant abrasive scouring pad is shown in FIG. 6.

The use of polyurethane foam as an intermediate or as a base layer offers some advantages in retaining water or soaking up liquids during use. Because the compacted batting material is quite porous and is needled to the polyurethane foam, there is free passage of liquid through the pad. It is also interesting to note that when polypropylene fiber is used it has a specific gravity of 0.92 and consequently an abrasive scouring pad formed of this material will float.

I claim:

1. An abrasive scouring material consisting essentially of a compacted batting composed of axially drawn, staple fibers of a normally solid, thermoplastic polymer, the broad faces of the batting being defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, at least one broad face of the batting possessing an abrasive surface consisting essentially of globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and of agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived.

2. An abrasive scouring material according to claim 1, in which the batting is composed of axially drawn, staple fibers of a normally solid, high molecular weight polymer of propylene.

3. An abrasive scouring material according to claim 1, in which the batting is composed of axially drawn, staple fibers of a normally solid, high molecular weight, isotactic polypropylene.

4. An abrasive scouring material according to claim 1, in which the batting is composed of axially drawn, staple fibers having lengths in the range from about ½ to about 5 inches and diameters in the range from about 6- to about 30-denier.

5. An abrasive scouring material according to claim 4, in which the batting is composed of a blend of axially drawn, staple fibers, of which blend about 20 to 25 percent by weight are 6-denier fibers and the balance are 30-denier fibers.

6. An abrasive scouring material consisting essentially of (a) a base layer of a backing material, and (b) a compacted batting having one of its broad faces bonded to the base layer and composed of axially drawn, staple fibers of a normally solid, thermoplastic polymer, the broad faces of the batting being defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, the exposed working face of the batting possessing an abrasive surface consisting essentially of globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and of agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived.

7. An abrasive scouring material according to claim 6, in which the base layer is a sheet of polyurethane foam.

8. An abrasive scouring material according to claim 6, in which the base layer is a sheet of polyurethane foam and the batting is composed of axially drawn, staple fibers of a normally solid, high molecular weight isotactic polypropylene.

9. An abrasive scouring material consisting essentially of a composite three-layer pad having two exposed and abrasive surfaces, each of the two outer layers comprising a compacted batting composed of discontinuous, axially drawn fibers of a normally solid, thermoplastic polymer, the intermediate layer consisting essentially of a sheet of polyurethane foam sandwiched between and bonded to both of the two outer layers, the broad faces of each of the battings being defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, the exposed working face of each of the two battings possessing an abrasive surface consisting essentially of globules of resolidified polymer at the free ends of some of the fibers which extend therefrom and of agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and the agglomerations having an irregular size larger than the diameter of the fibers from which they are respectively derived.

10. A process for producing an abrasive scouring material consisting essentially of (a) compacting axially drawn, staple fibers of a normally solid, thermoplastic polymer into a batting, the broad faces of which batting are defined in part by the free ends of those fibers which extend therefrom and in part by fibers substantially crossing each other, (b) heating at least one of the broad faces of the batting to a temperature above the melting point of the thermoplastic polymer for a period of time just sufficient to melt the thermoplastic polymer at the free ends and points of contact of those fibers which are exposed to such heating, and (c) cooling the heated face to a temperature below that of the melting point of the thermoplastic polymer, thereby transforming the heated face into an abrasive surface which results from globules of resolidified polymer at the free ends of some of the fibers which extend

therefrom and from agglomerations of resolidified polymer at several points at which the fibers cross each other, both the globules and agglomerations having an irregular size larger than the diameter of the thermoplastic fibers from which they are respectively derived.

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15 DONALD J. ARNOLD, *Primary Examiner.*