April 16, 1968 J. TENG ET AL 3,377,643

WIPING DEVICE

Filed Feb. 16, 1966

Fig. 1.

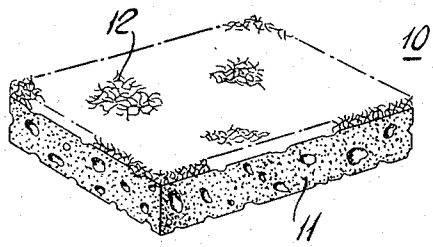


Fig. 2.

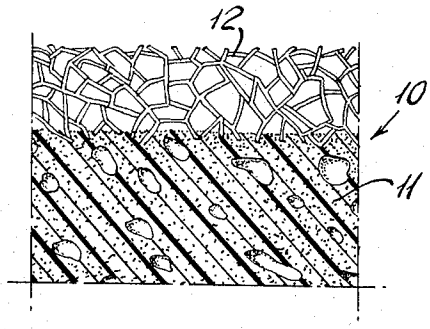
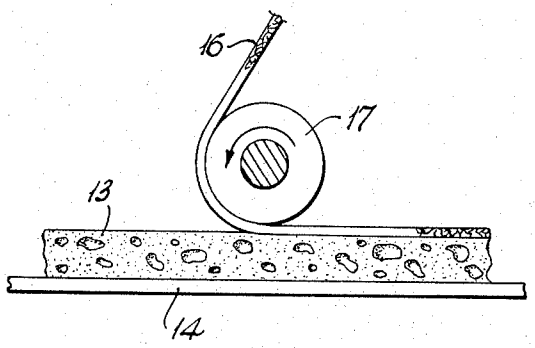


Fig. 3.



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3,377,643
WIPING DEVICE

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11 Claims. (Cl. 15—118)

ABSTRACT OF THE DISCLOSURE

A wiping device includes a regenerated cellulose sponge having partially imbedded in a face thereof a flaccid, resilient, porous open pore preferably reticulated layer of polyurethane of a thickness of less than ¼ inch. The pore size and thickness of the polyurethane layer are such that under normal compression of the cleaning device the polyurethane layer functions as a squeegee to conduct liquid from the wiped surface to the regenerated cellulose sponge which rapidly absorbs the liquid, and inhibits the regenerated cellulose sponge from contacting the wiped surface.

The present invention relates generally to improvements in cleaning devices and it relates particularly to an improved device for wiping and drying wet or damp surfaces and is a continuation-in-part of copending patent application Ser. No. 458,566, filed May 25, 1965 now abandoned.

It is a common practice to wipe wet or damp surfaces with a hydrophilic sponge as typified by the regenerated cellulose sponges which possess the desirable property of being highly hydrophilic and which rapidly absorb large amounts of water. However, when such a sponge is employed for wiping a wet surface the procedures are accompanied by the streaking of the surface resulting from the presence of thin films of water thereon which are left by the sponge. It appears that when the sponge is drawn along the wet surfaces, the working face of the sponge absorbs water from the wet surface which saturates the sponge face since the water from the working surface does not dissipate or diffuse sufficiently rapidly into the sponge body. As a consequence, the saturated sponge surface, being unable to absorb water at a sufficient rate, leaves a trail of excess water on the surface being wiped which assumes the appearance of streaks. The hydrophobic type sponges such as those formed of the synthetic organic polymeric resins are unsuitable for wiping wet surfaces since their water absorption properties are entirely inadequate.

It is therefore a principal object of the present invention to provide an improved cleaning device.

Another object of the present invention is to provide an improved device for wiping wet and damp surfaces.

Still another object of the present invention is to provide an improved device for wiping wet surfaces without causing or leaving streaks or extensive residues thereon.

A further object of the present invention is to provide a wiping device of the above nature characterized by its high water absorption properties, its flexibility, adaptability, long life and low cost.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawing, wherein:

FIGURE 1 is a perspective view of a wiping device embodying the present invention;

FIGURE 2 is an enlarged fragmentary transverse sectional view thereof, and

FIGURE 3 is a side elevational view of an apparatus which may be employed in producing the present device.

In a sense the present invention contemplates the provision of a cleaning device comprising a hydrophilic sponge structure having adherent to a surface thereof a layer of a thickness not exceeding ¼-inch of a flexible soft, compressible, resilient, three-dimensional, open pore material of a hydrophobic synthetic organic polymeric resin having the opposite faces thereof interconnected by substantially free passageways when said layer is under compression, the interface of said layer and said sponge structure being water permeable. The passageways which interconnect the opposite faces of the hydrophobic layer advantageously have at least parts thereof which extend freely between the opposite layers of the hydrophobic layer in a direction perpendicular to the opposite faces. Moreover, the hydrophobic layer is advantageously of a porosity and thickness that at most only a small area of the hydrophilic sponge in normal use reaches the level of the exposed face of the hydrophobic layer but advantageously is not spaced a distance exceeding 1/32-inch when the cleaning device is used and is under normal manual compression.

While the hydrophobic layer is advantageously a three dimensional substantially open retiform skeletal network of integrally interconnected strands of a hydrophobic resin, it may be an open pore foam provided that it meets the above requirements. The hydrophilic sponge is advantageously a regenerated cellulose sponge and the hydrophobic layer is advantageously formed of polyurethane and preferably polyurethane ether. It should be noted that strands of the skeletal network or the open pore foam may be provided with a thin resin coating in any suitable manner, such as, for example with polyethylene, polyvinyl chloride and chlorosulfonated polyurethane. The hydrophobic layer is advantageously anchored or bonded to the sponge structure by partially embedding the layer in the sponge structure.

It has been discovered that a cleaning device of the above nature possesses superior properties over the conventional hydrophilic sponges such as those of regenerated cellulose and over other sponges such as those formed of the hydrophobic synthetic resins, particularly when applied to the wiping of wet or damp surfaces. With the present improved wiping device streaking is completely obviated and an insignificant quantity of water is left on the wiped surface. Moreover, any water which is left on the wiped surface is in the form of extremely fine droplets which rapidly evaporate without leaving any streaks or unsightly or objectional residues. It is believed that the above advantages are achieved by reason of the hydrophobic open pore or retiform network of the above character preventing any substantial direct contact between the water absorbent hydrophilic sponge and the wiped surface, the open pore or retiform layer functioning to scrape or squeegee the water or moisture on the wiped surface by reason of the numerous hydrophobic surfaces, fine filaments, strands or pore wall edges traversing the wiped surface but retaining little of the squeegeed water by reason of its hydrophobic nature. However, since during the wiping action the hydrophilic sponge is closely spaced from the working face of the open pore or retiform skeletal layer, the water squeegeed by the retiform layer is conducted into contact with the hydrophilic sponge which is widely exposed to the squeegeed water and is rapidly absorbed. Thus, the wiping surface of the device is always less saturated than the corresponding face of a hydrophilic sponge. It is important to note that the open pore or retiform skeletal layer should be resilient, compressible and flexible and the filaments forming the layer should be soft and non-abrasive, and that the layer be no greater than the above

specified thickness to achieve the above superior operation. In addition, the open pore or retiform skeletal network advantageously has a pore size between 40 and 100 p.p.i., that is, pores per linear inch.

Referring now to the drawing and particularly FIGURES 1 and 2 thereof which illustrate a preferred embodiment of the present invention, the reference numeral **10** generally designates the improved cleaning device which includes a backing member **11** and a face member **12**. The backing member **11** may be a block, slab or sheet of any desired configuration and may range in thickness from about ⅛-inch to 3 inches or more. While the backing member **11** is advantageously formed of regenerated cellulose sponge, preferably fiber reinforced in the known manner and preferably produced by the viscose process, it may be formed of other highly hydrophilic sponge materials.

The face member is a layer of a flexible, soft, resilient, three dimensional substantially open retiform skeletal network of integrally connected strands of a hydrophobic synthetic organic polymeric resin and is substantially free of membraneous resin and should be of a thickness, as measured from the contiguous face of the backing member **11**, not exceeding ¼-inch and preferably not exceeding ⅛-inch and is preferably at least 1/32-inch thick and is flaccid in its independent state. The polymeric resin forming the retiform skeletal network layer **12** is advantageously a polyurethane resin and preferably a polyether polyurethane resin. The polyurethane retiform skeletal network may be produced in any known manner, for example, by the method described in U.S. Patent No. 3,171,820 granted March 2, 1965, to Volz et al. The retiform skeletal network advantageously has a porosity of between 40 and 120 p.p.i. and preferably between 45 and 80 p.p.i.; a density advantageously between 1 and 4 pounds per cubic foot, preferably between 1.5 and 2.5 pounds per cubic foot and voids constituting advantageously between 90 and 99 percent by volume and preferably between 95 and 98 percent. The porosity in p.p.i. of the retiform skeletal network advantageously increases with decreasing thickness of the face member **12**. For a thickness of the face member **12** of 1/32-inch the optimum porosity thereof is 100 p.p.i., for a thickness thereof of 1/16-inch the optimum porosity is 80 p.p.i. and for a thickness of ⅛-inch the optimum porosity is 60 p.p.i.

The face member **12** is bonded to the backing member **11** so that the interface thereof is water permeable and the surface of the backing member **11** at such interface is exposed to the voids in the face member **12**. The bonding is advantageously effected by embedding the filaments of the retiform skeletal network at the interface of the backing member **11** and the facing member **12** in the backing member **11** whereby the facing member **12** is firmly anchored to the backing member **11** and there is little impediment to the flow of water through the face member **12** to the backing member **11**.

The cleaning device **10** may be produced by superimposing a layer of the retiform skeletal network upon a layer of a viscose sponge forming mass of the desired thickness, sufficient pressure being applied to the network to effect the embedment of the underface thereof into the viscose sponge forming mass, and thereafter coagulating the viscose, regenerating the cellulose therein and then purifying the resulting composite material and cutting it to the desired shapes and sizes.

Thus, for example, as seen in FIGURE 3 of the drawing a layer **13** of a viscose sponge forming mass is continuously deposited at a uniform height upon a continuously advancing endless belt **14**. The composition of the sponge forming mass is well known and may be, for example, that described in U.S. Patent No. 3,048,888 granted April 14, 1962, to A. Shockley et al. or U.S. Patent No. 2,899,704 granted August 18, 1959, to F. Pekarek and may be continuously deposited upon the advancing belt **14** in the manner described in U.S. Patent No. 2,989,775 granted June 27, 1961, to F. Pekarek or in any other suitable manner. A web **16** of the desired retiform skeletal material as above set forth is drawn from a roll or other supply thereof and extends around the periphery of and in contact with the surface of a feed roll **17** into superimposed engagement with the advancing sponge forming mass **13**. The roll **17** preferably has an elastomeric friction surface and is positively driven at a peripheral speed approximately equal to the rate of advance of the belt **14**. The roll **17** is vertically adjustable and is positioned to effect the desired depth of embedment of the web **16** in the sponge forming mass **13**. The web carrying mass **13** is then coagulated and the cellulose therein regenerated in the known manner such as by resistance electrical heating thereof or by transporting the mass through a hot salt solution. The regenerated cellulose is then washed, purified and bleached.

The face member **12** instead of being a retiform skeletal network of the nature described in the above identified Volz et al. patent may be a layer of an open pore foam, preferably of polyurethane and having the properties and dimensions described above. The opposite faces of the open pores foam layer should be free of skin and the layer is advantageously formed by slicing the foam along said opposite faces from a block thereof whereby the pores along said opposite faces are crosscut to fully open the pores and expose the edges of the walls thereof. The open pore foam layer advantageously has a pore size between 40 and 120 p.p.i. and a thickness between 5/32 and 1/16 inch, the thickness preferably varying directly as the pore size as in the case of the skeletal network. The density of the foam advantageously does not exceed 2.5 pounds per cubic foot and is preferably between 1.0 and and 1.5 pounds per cubic foot. The hydrophobic open pore layer is anchored to the sponge in the manner of the skeletal network, as described above.

While there have been described and illustrated preferred embodiments of the present invention it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof. For example, a polyester polyurethane resin, or any other polymeric resin which is soft, non-abrasive, flexible, compressible and resilient may be substituted for the polyether polyurethane resin, and in which the open pore layer thereof is independently susbtantially flaccid. Moreover, while the cleaning device has been illustrated as of flat rectangular form with a hydrophobic open pore layer along only one face thereof, the opposite faces of the hydrophilic backing member may be provided with the hydrophobic layer and may assume other shapes.

What is claimed is:

1. A wiping device comprising a hydrophilic sponge member having partially imbedded in a surface thereof a compressible resilient open pore, porous hydrophobic layer of a thickness between 5/32 and 1/16-inch, of a flexible, soft non-abrasive, material having a pore size between 40 and 120 p.p.i., the interface of said layer and said sponge member being water permeable, said layer having a thickness and pore size such that it substantially inhibits the hydrophilic sponge member from contacting a surface being wiped under normal compression of the wiping device but conducts fluid from said surface to the hydrophilic sponge member.

2. The wiping device of claim **1** wherein said hydrophilic sponge member comprises regenerated cellulose.

3. The wiping device of claim **1** wherein said hydrophobic layer material is polyurethane.

4. The wiping device of claim **1** wherein said layer of hydrophobic material comprises a three-dimensional substantially open retiform skeletal network of integrally interconnected strands of a hydrophobic polyurethane resin and said hydrophilic sponge member comprises regenerated cellulose.

5. The wiping device of claim **4** wherein said skeletal network is substantially free from membranes.

6. The wiping device of claim 1 wherein the opposite faces of said hydrophobic layer are sliced along the planes thereof.

7. The wiping device of claim 1 wherein said hydrophobic layer is flaccid in an independent state.

8. The wiping device of claim 1 wherein said hydrophobic layer has voids constituting between 90 and 99% by volume thereof.

9. A wiping device comprising a hydrophilic sponge member having partially imbedded in a surface thereof a compressible, resilient open pore, porous hydrophobic layer, not exceeding a thickness of ¼ inch, of a flexible soft non-abrasive material, said layer having a thickness and a pore size such that it substantially inhibits the hydrophilic sponge member from contacting a surface to be wiped under normal compression of the wiping device but conducts fluid from said surface to the hydrophilic sponge member, the interface of the hydrophobic layer and hydrophilic sponge member being water permeable.

10. The wiping device of claim 9 wherein the opposite

faces of said hydrophilic layer are sliced along the plan thereof.

11. The wiping device of claim 10 wherein said hydr philic sponge comprises regenerated cellulose and sa hydrophobic layer comprises polyurethane.

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DANIEL BLUM, *Primary Examiner.*