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J. A. CAMERON

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METALLIZED SCOURING ARTICLE AND METHOD OF MAKING SAME

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FIG. 1

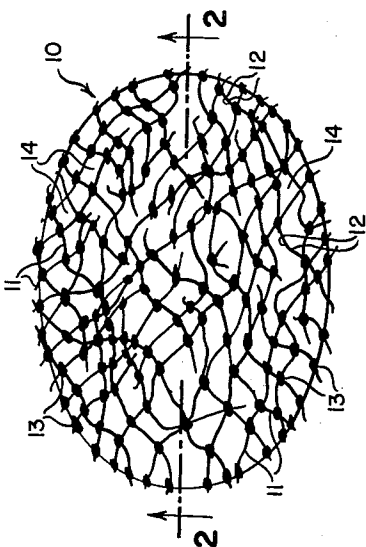


FIG. 2

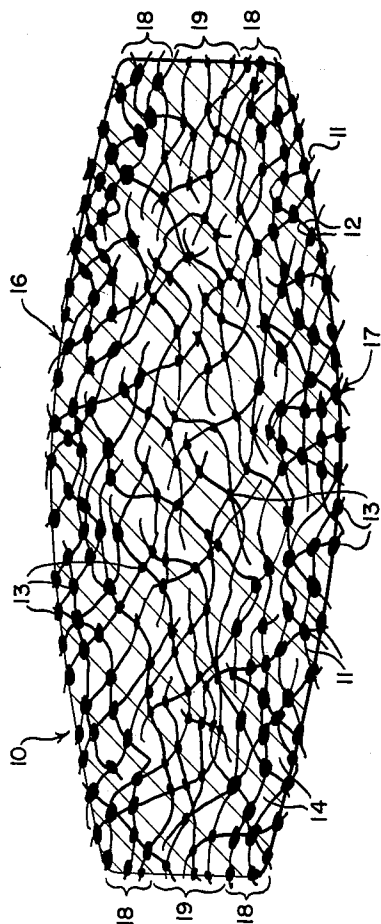


FIG. 3

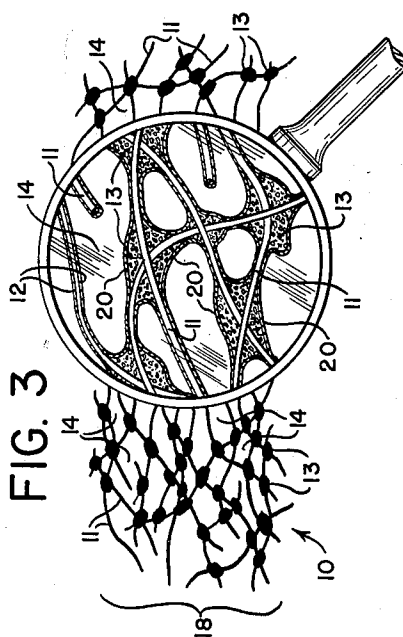
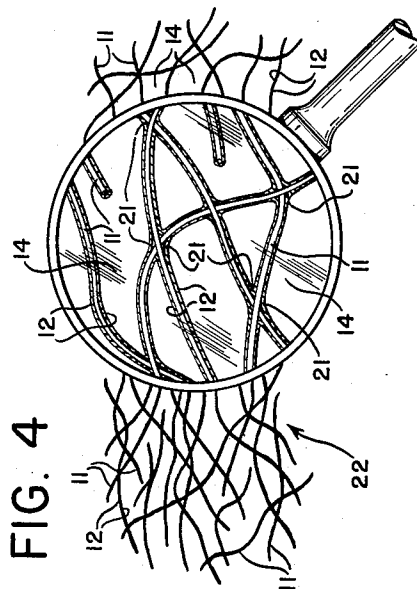


FIG. 4



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METALLIZED SCOURING ARTICLE AND METHOD OF MAKING SAME

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9 Claims. (Cl. 15—209)

This invention relates to a scouring device of the type used in the home and in various industrial areas. Metal wool, for example so-called steel wool, has gained wide acceptance as a material from which scouring articles can be formed. Scouring and polishing pads made from steel wool which has been matted or felted together, or intertwined or interwoven into a mass of filaments, are marketed in a variety of sizes and shapes. These pads have proved highly effective as household cleaning agents, being widely used to scour such articles as pots and pans. The pads are also well adapted to industrial uses, such as for removing old waxes from a floor area preparatory to the reapplication of wax.

However, it is well known that metal wool scouring pads have several undesirable characteristics. Metal wool, itself, is harsh and unpleasant to the touch. Rusting may occur after several immersions of a pad in water, and the rusted pad is both unsightly and disagreeable to handle. Moreover, there is a tendency for metal wool to break or splinter, which can result in slivers of the metal entering the skin of the user or being left as a residue on the scoured structure, the latter requiring an uneconomical clean-up period after scouring.

It has long been a goal of the trade to provide a scouring article which incorporates the effective abrasive characteristics of a steel wool scouring pad and further embodies the advantages inherent in the use of other metals which also have excellent abrasive characteristics and do not rust as easily as steel wool pads. Aluminum, for example, is a metal which might appear to be admirably suitable for use in the manufacture of a wool type of scouring article. Yet it has been found extremely difficult to make a fine grade of aluminum wool. This is because aluminum is of such innate softness that fine-grade strands tend to lose their shape and to snap or break as the strand is being formed. Another metal which would appear to be highly advantageous for use in an intertwined scouring pad is nickel. However, nickel has the property of hardening as it is worked, so that it will harden as it is being cut into strands and will thereby become unsuitable for use in a scouring pad, which must, of necessity, be somewhat flexible. In addition, nickel is far too expensive to be used to form strands of commercial scouring articles for household uses.

The present invention concerns an article produced by plating nickel, aluminum, or other metals or alloys on fibers of organic material. Such an article has excellent abrasive characteristics and is rust-resistant, light in weight, and economical to manufacture.

It has been determined that optimum abrasive properties are achieved when the scouring article has a work-contacting surface which is hard, irregular, and flexible. Such a surface, when moved across the surface of work to be scoured, presents a series of structures which can be conformed to the surface of the work and are harder than substances to be removed from the work. Thus, for example, in a scouring action in which a household pot or pan is to be cleaned, a scouring article which will best perform this function is one which presents a succession of surfaces which are flexible enough to enter irregularities in the pan surface yet hard enough to force particles in the irregularities therefrom.

It has now been discovered that a web or batt formed

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from relatively short, intermingled, synthetic organic fibers so arranged with respect to one another as to provide a high degree of loft and flexibility, and having plated thereon a metal of suitable hardness, provides a scouring article which admirably incorporates all these important abrasive properties. A preferred batt has such a degree of loft that at least 75 percent of its total volume consists of void spaces between the fibers.

Such a batt may be produced by a number of felting apparatus now employed in the textile art. Typically, a "Rando-Webber" Curlator machine, manufactured by the Curlator Corporation, of Rochester, New York, may be employed. One such machine is described in U.S. Patent No. 2,890,497, issued June 16, 1959.

A structure produced by such a machine preferably has applied thereto an adhesive serving to bond the randomly arranged fibers at their spaced points of contact, although such bonds may be created autogenously by the employment of a fiber which is thermally activatable to a bonding condition. Bonds may also be effected through the intermediation of the metal deposited.

Metal deposition can be achieved by vacuum and gas techniques which are known in the art, electrodeposition being a less preferred method in view of the non-conductivity of the organic fibers employed to produce the batt. Methods and apparatus for the gas deposition of the metallic particles are disclosed in U.S. Patent No. 2,759,848, issued August 21, 1956, and U.S. Patent No. 2,763,576, issued September 18, 1956. Methods and apparatus for vacuum deposition of metals are disclosed in U.S. Patents No. 2,756,166, issued July 24, 1956, and No. 2,793,609, issued May 28, 1957.

An article of the foregoing structure has superior abrasive characteristics in that it offers a plurality of working surfaces which are both hard, spaced from one another, and flexible. The metallized plastic fibers retain sufficient flexibility to permit the metallized, hard, working surfaces to conform generally to the plane or shape being scoured. By virtue of the void spaces between the fibers of the batt, the hard surfaces of the metallized fibers are spaced sufficiently from one another to present a series of hard structures to the surface of the work as the scouring article is advanced thereover. By reason of the openness of the structure, matter removed from the work is effectively displaced into a non-functional locale of the article and hence does not interfere with the scouring action of the plated fibers. The plastic fibers from which the batt is produced generally lack the substance needed to provide a lofty, springy, spongiform body, but by the reinforcing or stiffening effect provided by metallizing the structure, a correspondingly stiffer, more resilient character of the batt is assured.

It has also been discovered that plating a batt of randomly arranged fibers serves a function in addition to reinforcing and hardening the fibers to produce a pad with excellent abrasive characteristics. Where the batt has been sprayed with a liquid adhesive which binds fibers of the batt to each other at spaced locations where the fibers cross and contact one another, the metallic plating serves to overlaid the adhesive and strengthen the adhesive bonds. When autogenous bonds have been formed to stabilize the loft and shape of the batt, the metallic plating serves to reinforce those bonds. When there has been no prior bonding between the fibers of the batt, the plating alone is utilized to form the bonds.

A batt according to any of the above-described structures may be plated either on one or a multiplicity of surfaces thereof, or may be so contacted with molecular particles of metals or alloys that the fibers of the batt are completely plated throughout the batt. While a batt which has been completely plated would appear to have a longer working life, a batt which makes use of less

metal in its plating will, of course, present economic advantages. As a practical minimum it has been found that a batt should be plated to a depth of at least $\frac{1}{32}$ of an inch below one surface thereof.

The depth of plating of metal on fibers will necessarily vary in accordance with the use to which the article is to be put and the metal with which it is coated. In theory, the coating is molecular, i.e., a layer of molecules is deposited along the length of a fiber to a depth of one molecule only. However, in practice, depths up to about $\frac{1}{1000}$ of an inch have been found advisable, and a depth of plating of approximately $\frac{1}{10,000}$ of an inch is desirable.

The lengths of filaments which have been found suitable for use in forming batts according to this invention are from about $\frac{1}{2}$ inch to about 4 inches. Before the filaments have been plated or a binder applied thereto, they have a fineness of from about 5 deniers to about 85 deniers.

A wide variety of adhesives may be utilized to bind the adjoining fibers together in that embodiment of the invention where an adhesive binder is utilized. Such a binder is ordinarily cured prior to the plating of the batt with a metal or alloy. After curing the adhesive may be flexible or inflexible. Where those parts of the batt to which an adhesive is applied are later plated, the plating can be carried out so that the adhesive binder is completely covered by the metal. Such a structure enables a water-soluble adhesive to be used, such an adhesive usually being substantially less expensive than a water-insoluble adhesive. Although the finished pad is to be immersed in water, the water-soluble adhesive will be protected from becoming tacky or from dissolving during the immersion because of its protective coating of metal.

Among those metals which are desirable for use in a plated scouring article are nickel, stainless steel, iron, copper, tin, aluminum, brass, bronze. Other metals and alloys which would be useful in plating a batt will, of course, be apparent to those skilled in the art, the selection of the particular metal utilized being dependent upon the use for which the scouring article is intended. In order to be operable for the intended purpose, the metallic particles selected should have a hardness at least approaching and substantially equal to that of the surface to be scoured.

These and other objects, features, and advantages of the invention will become more apparent when considered in connection with the embodiment thereof illustrated in the accompanying drawing, which forms a part hereof, like reference characters referring to like parts, and in which:

FIG. 1 is a top plan view showing an embodiment of a scouring article according to the present invention;

FIG. 2 is an enlarged vertical sectional view along line 2-2 of FIG. 1;

FIG. 3 is a sectional view showing in detail a group of fibers of an outer zone of the article of FIGS. 1 and 2.

FIG. 4 is a sectional view of another embodiment of the invention showing in detail a group of fibers thereof.

Referring now to the drawings, and in particular to FIG. 1, a finished scouring article, indicated generally by reference numeral 10, is shown. The article 10 is oval in shape and is formed from an intermingled mass of fibers 11 plated with a continuous coating 12 of metallic particles. Joining the fibers 11 at spaced locations where they cross and contact one another are globules of adhesive, indicated as dark areas 13, which are likewise plated with metal. (The size of areas 13 has been exaggerated for emphasis.) Between the fibers is a network of voids 14, which extends throughout the depth of the pad 10.

The sectional view illustrated in FIG. 2 shows the degrees of density of zones of the scouring article 10. In accordance with the embodiment there illustrated,

the batt from which the scouring article has been formed has been sprayed with adhesive binder 13 on its upper surface 16 and lower surface 17. Because of such spraying the zones 18 adjacent to those surfaces have become somewhat matted, while the central zone 19, having a lesser quantity of adhesive binder therein, has a greater void volume and has retained a greater degree of elasticity. The batt from which the scouring article 10 has been formed has likewise been sprayed or otherwise plated with metallic particles applied on the upper and lower surfaces 16 and 17. Thus the fibers 11 of outer zones 18 have a coating 12 applied thereto, while the fibers of the central zone 19 are substantially uncoated by metallic particles. Since the coating 12 is very thin, the coated fibers appear only if slightly greater in diameter than the uncoated fibers.

FIG. 3 illustrates a magnified view of an outer zone 18 of the article 10 of FIGS. 1 and 2. In FIG. 3 it will be seen that the metal particles form a coating 12 which is of shallow, uniform depth along the lengths of the fibers 11. At the spaced locations where the fibers 11 cross and contact one another globules of adhesive binder 13 are stationed. The metallic particles are also plated on the globules of adhesive 13, forming a film 20 which encloses globules of binder 13 and is connected at its ends to the adjoining fibers which the adhesive binds together. The film 20 serves to encapsulate and protect the globules of binder 13, as well as to strengthen the bond between the connected fibers.

The modified pad 22 illustrated in FIG. 4 is similar to the pad 10, except that no adhesive binder has been used to join fibers 11 at the spaced locations where they cross and contact one another. Instead, a film 21 of metallic particles bridges the grooves between fibers at locations where they cross and contact one another and serves to bond the fibers together at those locations. The scouring article of FIG. 4, wherein adjoining fibers are bonded together solely by film 21, may have zones of different densities similar to the zones of the pad of FIG. 2, or may be of uniform density throughout the depth of the pad. A batt which is initially of uniform density can, upon the deposition of metallic particles by a method such as vacuum deposition, form the basis of a finished scouring article which will retain the uniform density of the original batt.

A variety of methods may be utilized to form a scouring article according to this invention. For example, a batt may first be formed on a Curlator machine and an adhesive binder then applied by many known methods, such as by spraying. Then a metallic coating can be produced in accordance with prior art processes to provide an article of the type shown in FIG. 3. Another method consists of initially applying a metallic coating to a continuously moving filament, after which the filament is cut into lengths of from about $\frac{1}{2}$ inch to about 4 inches, and then assembled to form a batt in which the fibers are in random, three-dimensional arrangement. An adhesive binder may be thereafter applied to this batt to unite adjoining fibers thereof.

Examples of methods for preparing webs suitable for the subsequent deposition of metals on surfaces thereof are as follows:

Example 1

Fibers consisting of $1\frac{1}{2}$ inch lengths of crimped 16 denier acetate were intermingled on a "Rando-Webber" machine manufactured by Curlator Corp. and a web having a thickness of approximately $\frac{1}{4}$ inch formed by the fibers. A binder adhesive of B. F. Goodrich Geon 576, a modified vinyl chloride polymer, was sprayed by means of a spray booth and horizontal reciprocating spray machine manufactured by Binks Mfg. Co. on the one surface of the web as it moved at a rate of 18 ft./min. The quantity of binder adhesive sprayed was 4.3 oz./yd.² of a 50% solids binder. The web was then passed on a slat conveyor into a Fostoria infra-red type drying and curing

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oven in which the web passed in one 20 ft. flight. The web was then inverted and the other surface thereof sprayed. The web was passed back into the oven through a second 20 ft. flight after which the cured web was wound on a reel prior to plating. The total dry weight of the resulting web was 7.07 oz./yd.².

Example 2

Fibers of 15 denier crimped nylon 1½ inches in length were formed into a continuous ¾ inch web in the same manner as the fiber of Example 1. The web was sprayed with an adhesive binder mixture consisting of 70% dry weight Hycar 2671, a polyacrylic latex of B. F. Goodrich Co.; 10% dry weight Geon 990, a polyvinyl acetate latex manufactured by B. F. Goodrich; and 20% dry weight Durez 14170, a phenol-formaldehyde resin manufactured by Hooker Chemical Corp. The web was moved at a velocity of 11 ft./min., and 10.5 oz./yd.² of a 50% solids adhesive binder was consecutively sprayed on each side of the web, the web being passed through a Fostoria drying and curing oven after each such spraying. The total dry weight of the web after the curing and drying operation was 15.5 oz./yd.².

The webs produced in accordance with the above examples were then plated with metals. Examples of methods by which such plating was accomplished are as follows:

Example 3

The web produced in accordance with Example 1 was gas plated by being passed through a gas lock heating zone which utilized hydrogen gas to purge the batt during heating. In the heating zone the web was heated to a temperature of 300° F. The web was then passed to a plating zone where it was exposed to nickel carbonyl vaporized in hydrogen gas. With the temperature of the web at approximately 300° F., a ¼/10,000 inch deposition of nickel was plated on the surfaces of the web in 3 to 5 seconds residence time of the web in the plating zone. After plating, the web was carried into a nitrogen gas lock cooling chamber and there permitted to cool to room temperature. The web was then cut into portions of suitable length.

Example 4

The web produced according to Example 2 was vacuum plated with aluminum. The web was first degassed in a vacuum-treating machine which pulled the web forward and backward to remove contaminants. The web was then passed through a vacuum chamber and aluminum, vaporized by a carbon-tantalum boat filament heated by passing an electric current therethrough, was deposited on the web in the vacuum chamber. A batch of 2,000 feet of web was metallized at a rate of about 20 ft./min. Including the time for loading and unloading the unmetallized and metallized webs, respectively, the vacuum plating procedure for the 2,000 feet of web consumed approximately 1½ to 1¾ hours.

Scouring articles, as described hereinbefore and illustrated in FIGS. 1, 2, 3 and 4 may be further modified in accordance with their intended uses. For example, a soap or synthetic detergent may be impregnated in the batt, the globules of soap or detergent clinging to the fibers along their lengths and permitting the retention of a network of voids throughout the article. A handle may be fixed on one surface of the batt by means of a suitable binder to enable the batt to be easily gripped and manipulated in household uses. Abrasive grit may be mixed with the adhesive binder and stationed on the fibers.

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Thus, while the present invention has been described with particular reference to specific embodiments of the scouring article, it is to be understood that the invention is not to be limited by those embodiments, but that its scope is to be determined only by reference to the following appended claims.

What is claimed is:

1. An article suitable for scouring a surface, consisting of a three-dimensional batt composed of organic fibers which are intermingled to form a filamentary structure, an abrasive bonding together a plurality of said fibers at spaced locations where they cross and contact one another to unite said fibers at said locations and produce a batt which resumes its original shape after compression, and a plating of metallic particles at least on fibers at a surface of said batt, said metallic particles having a hardness at least substantially equal to that of said surface and being distributed in relatively shallow depths along the lengths of said fibers and, at said spaced locations, overlying said adhesive and strengthening the bonds provided thereby.

2. An article suitable for scouring a surface, consisting of a three-dimensional batt composed of organic fibers activatable to an adhesive condition and intermingled to form a filamentary structure, a plurality of said fibers having been activated to an adhesive condition and then set while said fibers were in contact with one another at spaced locations to autogenously bond said fibers together at said locations and form a resilient lofty batt, and a plating of metallic particles at least on fibers at a surface of said batt, said metallic particles having a hardness at least substantially equal to that of said surface and being distributed in a relatively shallow, uniform depth along the lengths of said fibers and, at said spaced locations, forming a continuous film linking said fibers at said locations and strengthening the bonds thereat.

3. A method of making an article suitable for scouring a surface, consisting, in sequence, of intermingling a plurality of organic fibers in random arrangement to form an open high loft structure, bonding said fibers together at locations where they cross and contact one another to unite said fibers at said locations and produce a batt which resumes its original shape after compression, and then plating metallic particles having a hardness at least substantially equal to that of said surface on said fibers along the lengths thereof at least at one surface of said batt.

4. A method is claimed in claim 3, in which the fibers are plated to a depth of from one molecular layer of the metal to about ¼/1000 of an inch.

5. A method is claimed in claim 3, in which the fibers are plated to a depth of about ¼/10,000 of an inch.

6. A method as claimed in claim 3, in which said metallic particles are plated on said fibers by means of vacuum deposition.

7. A method as claimed in claim 3, in which said metallic particles are plated on said fibers by means of gas deposition.

8. A method as claimed in claim 3, in which said metallic particles are nickel.

9. A method as claimed in claim 3, in which said metallic particles are aluminum.

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