

Aug. 16, 1955

D. M. HAWLEY

2,715,596

SHEET MATERIAL AND METHOD FOR THE MANUFACTURE THEREOF

Filed July 7, 1953

3 Sheets-Sheet 1

FIG. 1

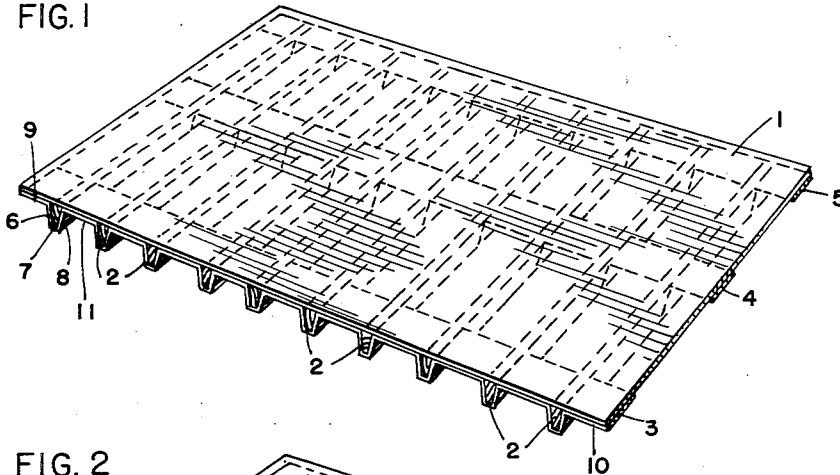


FIG. 2

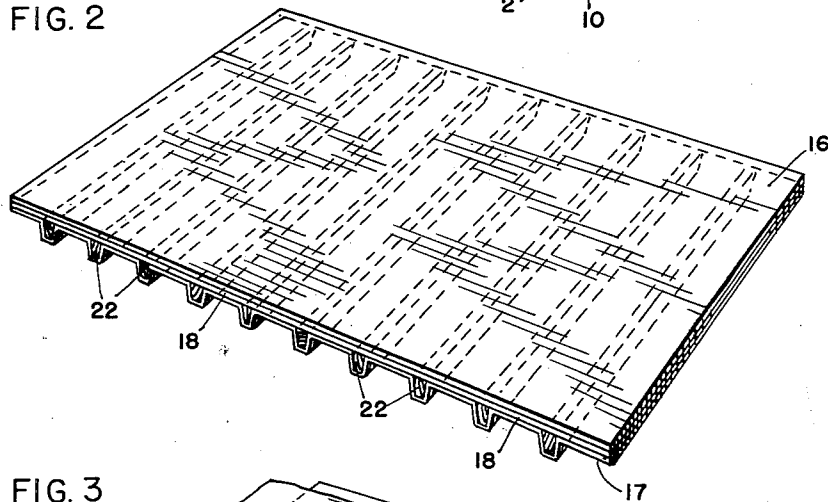
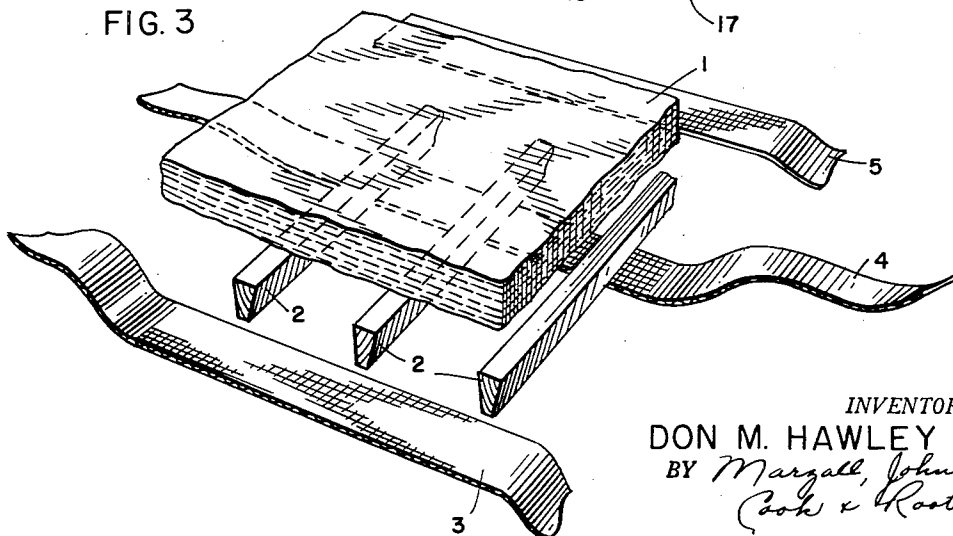


FIG. 3



INVENTOR:
DON M. HAWLEY
BY *Margall, Johnston*
Cook & Root
ATT'YS

Aug. 16, 1955

D. M. HAWLEY

2,715,596

SHEET MATERIAL AND METHOD FOR THE MANUFACTURE THEREOF

Filed July 7, 1953

3 Sheets-Sheet 2

FIG. 4

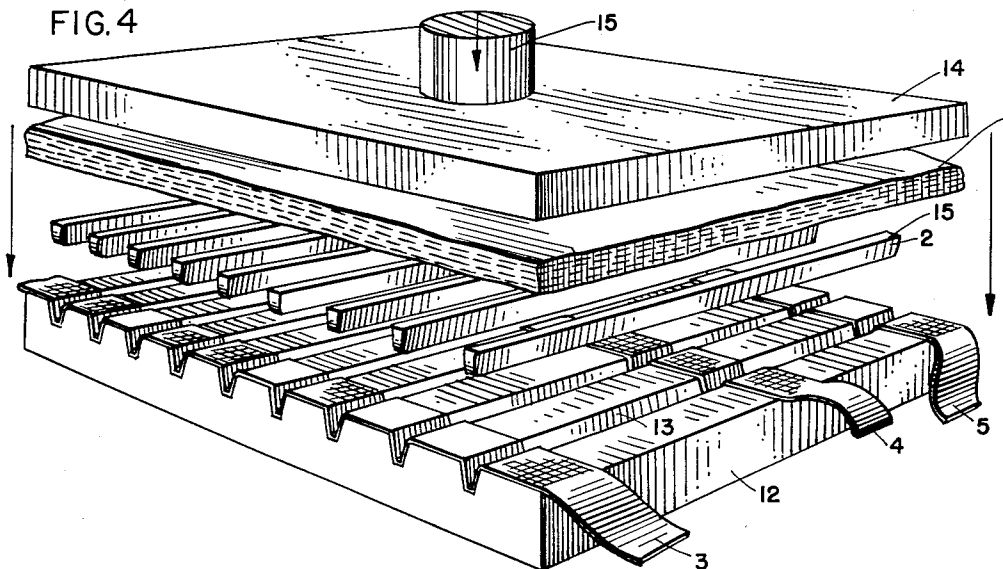


FIG. 5

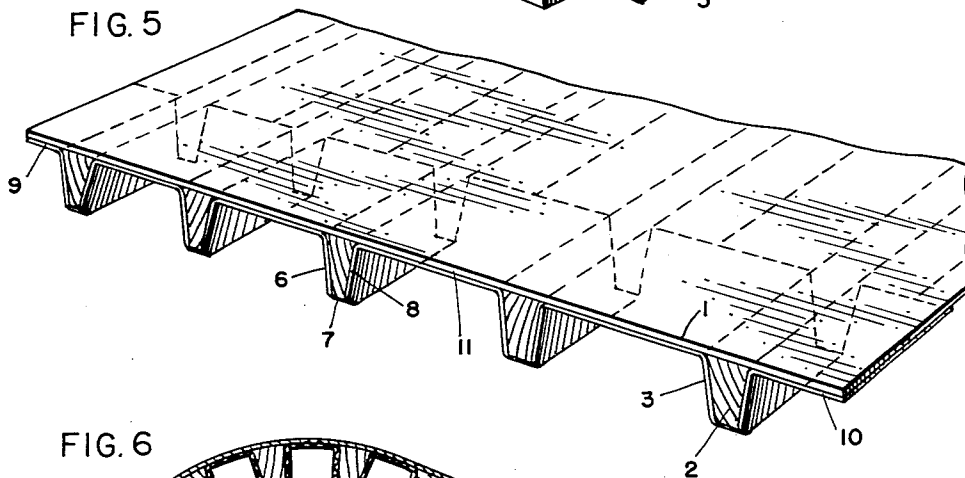
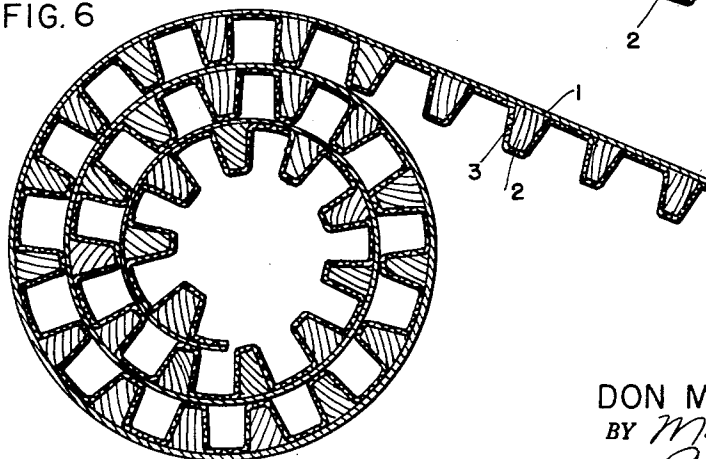


FIG. 6



INVENTOR:

DON M. HAWLEY

BY *Margall, Johnston,*
Cook & Root

ATT'Y

Aug. 16, 1955

D. M. HAWLEY

2,715,596

SHEET MATERIAL AND METHOD FOR THE MANUFACTURE THEREOF

Filed July 7, 1953

3 Sheets-Sheet 3

FIG. 7

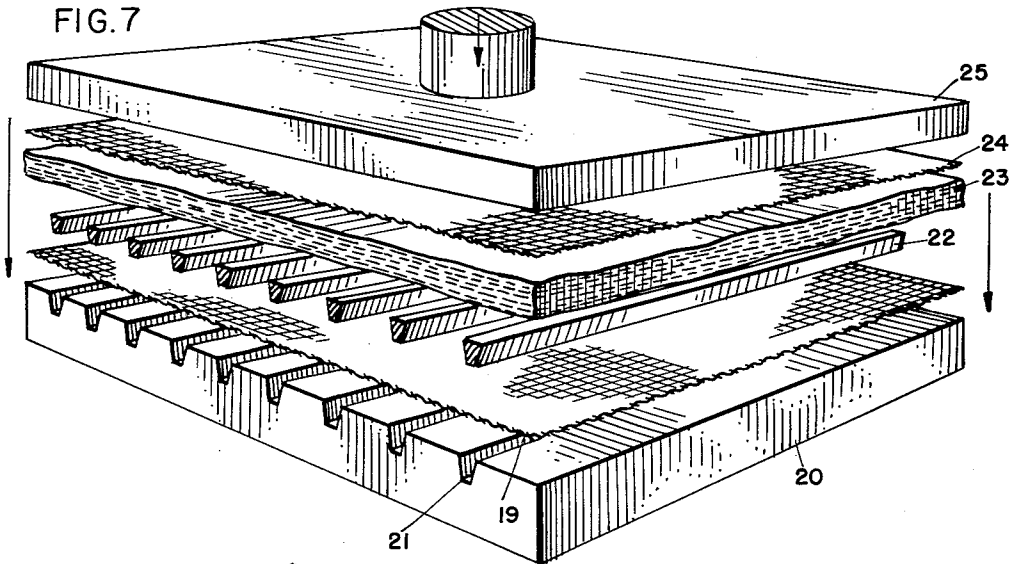


FIG. 8

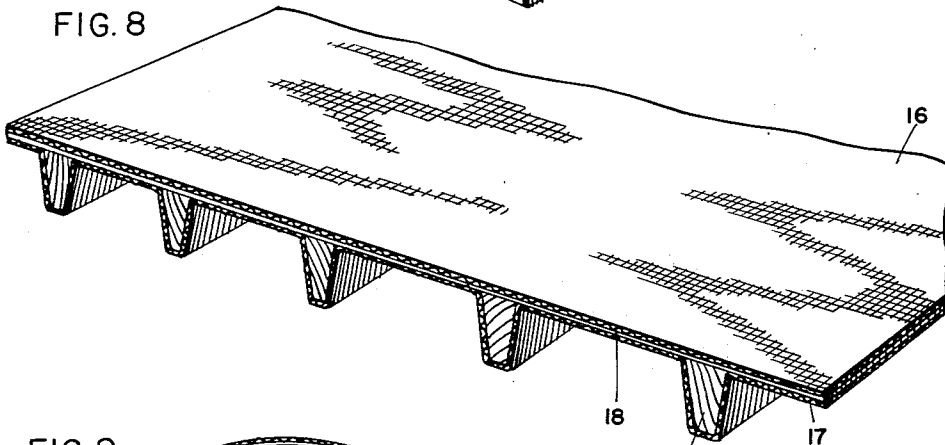
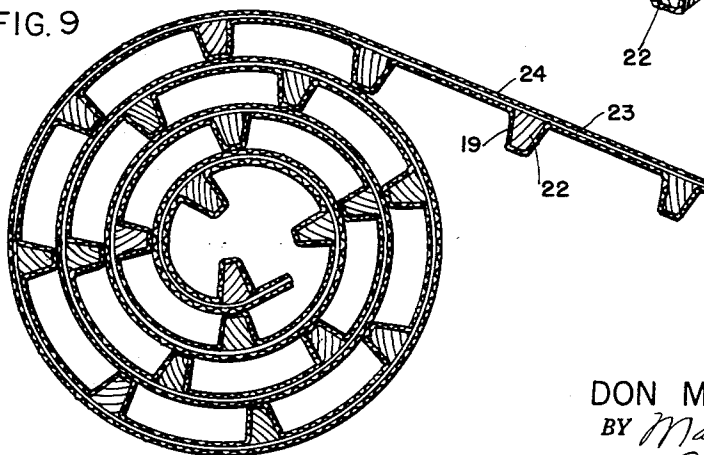


FIG. 9



INVENTORS:

DON M. HAWLEY

BY *Margall, Johnston,*
Cook & Root

ATT'Y

1

2,715,596

SHEET MATERIAL AND METHOD FOR THE MANUFACTURE THEREOF

Don M. Hawley, Geneva, Ill., assignor to Hawley Products Company, St. Charles, Ill., a corporation of Delaware

Application July 7, 1953, Serial No. 366,482

8 Claims. (Cl. 154—99)

This invention relates to a new and improved sheet material, more particularly to a new and improved flexible, reinforced sheet material which is capable of being prepared, transported, stored and used in rolled form, and to a new and improved method for the manufacture of such a material.

One of the objects of the invention is to provide a new and useful flexible, rollable, reinforced sheet material which is capable of being employed as a table top in portable furniture of the type wherein the table top material is stored in roll form within the furniture and is adapted to be unwound from the roll and pulled out from the furniture to provide a flat top or surface suitable for use as a table.

Another object of the invention is to provide a material of the type described which is adapted to be used as a rolled table top in cabinets and other types of built-in furniture.

Still a further object of the invention is to provide a new and improved material of the type described capable of being used as an awning.

A further object of the invention is to provide a new and improved material of the type described capable of being used as a partition material, as, for example, to provide removable partitions in rooms or entrances to rooms.

Still a further object of the invention is to provide a new and improved material of the type described capable of being used as a landing mat for airfields and as a surfacing material in other places where a strong, stain and weather resistant surface is desired.

Another object of the invention is to provide new and improved methods for manufacturing a material of the type described.

Other objects and advantages of the invention will be apparent with reference to the following description in conjunction with the accompanying drawings in which:

Fig. 1 represents in perspective one form of article of manufacture provided in accordance with the invention;

Fig. 2 represents in perspective another form of an article of manufacture provided in accordance with the invention;

Fig. 3 illustrates in perspective an exploded view of the component parts employed in making the article shown in Fig. 1;

Fig. 4 illustrates in perspective the manner in which the component parts of the article shown in Fig. 1 are assembled;

Fig. 5 illustrates in perspective a portion of the article of Fig. 1 after the component parts have been consolidated by the method shown in Fig. 4;

Fig. 6 is a profile view of the article of Fig. 1 in roll form;

Fig. 7 illustrates in perspective a method of making the article shown in Fig. 2;

Fig. 8 illustrates in perspective an enlarged portion of the article of Fig. 2 made by the method illustrated in Fig. 7; and

2

Fig. 9 is a profile view of the article of Fig. 2 in roll form.

In accordance with the invention a new and improved flexible, rollable, reinforced sheet material is provided which is characterized by a heat and pressure consolidated sheet of interlaced, flexible, thread-like glass filaments, preferably bundles of flexible, thread-like glass filaments, impregnated with a thermosetting flexible resin and united by said resin with spaced, substantially parallel, substantially rigid members. In the manufacture of said article, a layer or strips of woven cloth are preferably provided to assist in holding said rigid members in place, said woven cloth also being united by means of said resin with said sheet of interlaced glass filaments.

In Fig. 1 the article shown is a composite article composed of a surface sheet or layer 1 formed of interlaced glass filaments impregnated with a thermosetting flexible resin and adhesively secured by said resin to spaced, substantially parallel, substantially rigid members 2 which can be made of wood, metal or any other suitable material. Strips of woven cloth 3, 4 and 5, preferably cloth woven from glass filament threads, are secured to said sheet material by means of said resin. It will be noted that these strips are in contact with the outer surfaces 6, 7 and 8 of each of the reinforcing members 2 and are also in contact with the lower surface of the sheet 1 in the spaces 9 and 10 adjacent the marginal edges of the sheet 1 and in the spaces 11 between the reinforcing members 2.

A preferred method of making a flexible, reinforced sheet material in accordance with the invention is to consolidate under heat and pressure a batt of intermingled glass filaments impregnated with a flexible, fusible resin positioned in contact with a plurality of substantially rigid reinforcing members spaced apart substantially parallel to each other and strips of woven cloth woven from glass filament threads positioned in contact with the outer surfaces of said reinforcing members and with the portions of the surface of said batt between said reinforcing members. When these components are consolidated under heat and pressure, the density of the batt is greatly increased and the resin permeates the strips of woven glass cloth causing them to adhere to the batt and also causing the reinforcing members 2 to adhere to the batt, and to the strips of glass cloth.

In the preferred practice of the invention the batt of intermingled glass filaments is saturated with the fusible resin preferably by impregnating a batt of intermingled glass filaments with a sufficient amount of the resin to fill the pores or spaces between the glass filaments and allowing the batt containing the resin to stand for a half hour or more until the spaces are completely filled with resin. According to one embodiment of the invention, the woven cloth of glass filament threads is also saturated with a fusible resin.

The preferred type of apparatus for assembling and consolidating the component parts of the desired article is illustrated in Fig. 4. As shown, the strips of woven glass cloth 3, 4 and 5 are placed on a die 12 provided with a series of grooves 13 complementary to the reinforcing members 2. The reinforcing members 2 are then placed in the grooves 13 on top of the woven strips 3, 4 and 5 and the batt 1 composed of intermingled glass filaments impregnated with resin is placed on the die 12 over the reinforcing members 2 and the woven cloth strips 3, 4 and 5. A heated platen 14 is then pressed against the assembly with sufficient pressure to cause the batt 1 to be consolidated to a relatively dense sheet of predetermined thickness, and at the same time to cause the resin content in the spaces between the filaments of the batt 1 to be squeezed against the edges 15 of the reinforcing members 2 and against the cloth strips 3, 4

3

and 5. Any excess of resin is squeezed out around the die 12.

In order to carry out this operation the die 12 and the platen 14 can be mounted in a conventional press equipped with the proper tooling to handle them. The platen 14 can be heated internally by means of steam or other heating fluid, or can be positioned next to another steam heated platen (not shown) and thereby heated by conduction in the steam heated platen. Similarly, the die 12 can be heated internally by steam or any other suitable fluid or by mounting it on a steam heated platen positioned adjacent thereto. Ordinarily the die 12 is held in a stationary position and the platen 14 is moved up and down with respect thereto by means of a piston member 15 which can be operated by hydraulic cylinders (not shown) or in any other suitable manner.

In the modification of the invention illustrated in Fig. 2 a woven cloth 16 and another woven cloth 17 are positioned respectively above and below the densified glass filament sheet 18, the latter being similar to the glass filament sheet 1. This type of article is desirable for some purposes but for table tops and other articles where a smooth surface is desired the reinforced sheet material described in Fig. 1 is preferable.

The method of making the article shown in Fig. 2 is similar to that described for the article shown in Fig. 1. As illustrated in Fig. 7 the article shown in Fig. 2 is preferably made by placing a cloth 19 of woven glass filaments over the die 20 provided with grooves 21 complementary in shape to the cross-section of the rigid members 22, then placing the rigid members 22 in the grooves 21 with the cloth 19 also disposed in said grooves between the surface thereof and the outer surfaces of the rigid members 22, thereafter positioning a batt 23 of intermingled glass filaments impregnated with a flexible, fusible resin in contact with the upper surfaces of the rigid reinforcing members 22 and the woven cloth 19, then positioning another woven cloth 24 over the batt of intermingled glass filaments and finally moving the heated platen 25 downwardly to consolidate the component parts of the article in the manner described with respect to Fig. 4. By this process of consolidation the density of the batt 23 is increased, the resin contained in the spaces between the glass filaments is squeezed through the pores or spaces in the cloth coverings 16 and 17 and the reinforcing members 22 are adhesively united to the densified sheet of glass filaments and also to the cloth covering 17.

One of the features of the invention is that the resultant articles can be rolled and unrolled. Thus, the article illustrated in Figs. 1 and 5 when rolled assumes the appearance shown in Fig. 6. The article of Figs. 2 and 8 when rolled assumes the appearance of Fig. 9.

The batt of intermingled glass filaments is preferably formed by felting, either wet or dry, cut rovings or bundles of glass filaments cut into lengths from about 1/4 inch to six inches, preferably around 1 inch to 2 inches. The glass fiber rovings of commerce are suitable for this purpose. They are mainly made from glass filaments of approximately 0.00038 inch in diameter. About 102 to 204 of such filaments are collected in a bundle. A roving consists of about 60 such bundles. For the purpose of the invention the roving or the bundles of glass filaments is preferably coated with a substance that imparts an affinity for resins to glass, for example, stearate chromyl chloride, vinyl trichlorosilane and materials of the type disclosed in U. S. Patents 2,273,040, 2,359,858, 2,381,752 and 2,401,645. It is known in the art to coat glass rovings or bundles of glass filaments with such materials. The quantity of the glass filaments employed may vary depending upon the type of end product desired. In order to make a flexible table top material good results have been obtained by using from about 1 1/2 ounces to 3 ounces of the glass filament material per square foot. The glass filament material

4

is uniformly distributed by the felting operation so that the filaments are interlaced or intermingled with each other.

The resin employed for the purpose of the invention is preferably a thermosetting resin which is initially applied in a fusible form and with the assistance of heat in the presence of a catalyst sets to an infusible form. The fusible form of the resin is also sometimes referred to as the uncured state and the infusible form is referred to as the cured state.

The preferred resins employed for the purpose of the invention can be described as condensation products of a polyhydric alcohol and a polybasic acid (or the corresponding acid anhydride) and monomeric aryl compounds having a vinyl side chain. Usually at least a portion of the polybasic acid component is maleic anhydride. The polyhydric alcohol-polybasic acid composition is added to 10% to 40% by weight of a monomeric aryl vinyl compound, such as styrene. For example, a relatively rigid or non-flexible resin can be prepared by reacting 2 mols of ethylene glycol with 1 mol of phthalic anhydride and 1 mol of maleic anhydride for 2 to 4 hours at a temperature of 160° C. in an inert atmosphere such as nitrogen, carbon dioxide or illuminating gas and then adding to the resultant product 10% to 40% monomeric styrene. The resin in this form is liquid and usually has an acid number around 10 to 50. When this liquid resin is heated with a curing catalyst a solid, infusible resin is formed.

Suitable catalysts are the organic peroxides which are soluble in the hydrophobe or resin phase, e. g., benzoyl peroxide, acetylbenzoyl peroxide, cumene hydroperoxide, para tertiary butyl perbenzoate, and other oil soluble oxygen supplying catalysts.

In order to produce flexible thermosetting polyester resins higher molecular weight polyalkylene glycols, e. g., polyethylene glycol 200, e. g., polyethylene glycol 400, polyoxypropylene glycols and mixed polyoxyethylene-polyoxypropylene glycols are substituted for the ethylene glycol, or a portion of the dibasic acid is adipic or higher number of carbon atoms.

Instead of styrene other monomeric aryl compounds having an unsaturated side chain can be employed, e. g., vinyl toluenes, vinyl naphthalenes, vinyl ethyl benzenes, alpha methyl styrene, vinyl chlorobenzenes, vinyl xylenes, divinyl benzene, divinyl toluenes, divinyl naphthalenes, divinyl xylenes, divinyl ethyl benzenes, divinyl chlorobenzenes, divinyl-phenyl vinyl ethers and diallyl phthalate. Lower boiling monomers such as vinyl acetate usually are not satisfactory because the reaction which takes place when the resin is cured is very exothermic and the heat would drive off low boiling monomers.

As an illustration of a specific resin which can be used in the practice of the invention a relatively flexible resin is prepared by condensing 2 mols of ethylene glycol, 1 mol of maleic anhydride and 1 mol of adipic acid for 3 hours at 160° C. under an atmosphere of carbon dioxide and to the resultant resin there is added 20% to 30% by weight of styrene and 1% by weight of benzoyl peroxide. This produces what may be described as a catalyzed polyester resin, the benzoyl peroxide being the catalyst. This resin is a heat setting resin and will cure at temperatures in the neighborhood of 180° F. or higher.

A more rigid polyester resin can be obtained by omitting the adipic acid and substituting 1 mol of maleic anhydride. The more rigid types of resins can be employed in admixture with the more flexible resins in order to vary the flexibility of the resultant article.

In a similar manner, instead of ethylene glycol any of the normally liquid polyethylene glycols can be employed such as, for example, polyethylene glycol 200, polyethylene glycol 300 and polyethylene glycol 400. Instead of styrene other compounds capable of polymerizing such as diallyl phthalate can be used.

The fusible resin should preferably have a viscosity

within the range of 100 centipoises to 2000 centipoises. However, resins having a greater viscosity can be used by diluting them with a solvent such as methylethyl ketone.

Excellent results have been obtained by mixing 2 parts of a flexible resin with approximately 1 part of a rigid resin.

The quantity of resin employed is subject to variation but should preferably be at least sufficient to fill the spaces between the glass filament bundles when the batt is consolidated to its final form. Ordinarily, the amount of resin required will be at least as great as the weight of the glass filaments and good results have been obtained by using two or three times as much resin as the weight of the glass filaments.

The flexibility of the articles produced in accordance with the invention can be varied by varying the spacing between the reinforcing members 2 (or 22 in Figs. 2, 7, 8 and 9). Thus, by increasing the space between the reinforcing members, the flexibility of the material can be increased and by decreasing the space the rigidity can be increased.

The cloth strips or tapes 3, 4 and 5 can be omitted but the article obtained is less desirable for many purposes, particularly where it is subjected to stress and strain caused by rolling and unrolling. Especially good results have been obtained by holding the reinforcing members in place by means of a woven cloth or by strips of cloth formed from woven glass filaments because the glass filaments being of the same nature as the glass filaments in the layer 1 are bonded by the resin.

It will be understood, however, that other types of woven materials can be used such as beef cloth and other woven cotton cloths having a relatively open weave.

A typical table top material made in accordance with the invention is approximately 40 inches wide and the reinforcing members 2 (Figs. 1, 4, 5 and 6) are 46 inches long and thereby extend beyond the edges of the glass filament sheet 1 in order to permit the ready removal of the finished product from the die 12. After the component parts of the article have been consolidated, the ends of the reinforcing members 2 which extend beyond the edges of the sheet 1 are then sawed to produce a finished article in which the ends of the reinforcing members 2 are flush with the marginal edges of the glass filament sheet 1 as shown in Figs. 1 and 5. The reinforcing members 2 are preferably made of wood and are approximately $\frac{3}{8}$ inch wide at the top adjacent the glass filament sheet 1, $\frac{1}{4}$ inch wide at the bottom and $\frac{3}{4}$ inch high. Good results have been obtained by spacing these reinforcing members approximately 2 inches apart. The tapered sides of the reinforcing members 2 facilitate the removal of the finished article from the die 12. The resultant article as illustrated in Figs. 1 and 5 and with the specified dimensions previously described has been found to be especially useful for use as an extensible table top material in furniture where the table top material is carried inside the furniture in rolled form. The glass filament sheet material 1 impregnated with the infusible resin forms a surface which is very hard, wear resistant and resistant to stains. This surface is also easily cleaned and is not damaged by washing with soap and water.

The heat and pressure conditions used in consolidating the components of the article in the manner previously described are subject to variation depending upon the particular resin employed and the density and flexibility desired in the final article. In general, good results can be obtained by using temperatures within the range of 180° F. to 300° F. and pressures around 50 to 300 pounds per square inch.

The material prepared in accordance with the invention can also be employed as an extensible table top material in cabinets and other built-in furniture. It is adapted to be used as an awning material. It is also useful

as a partition material to provide removable partitions in rooms or entrances to rooms. The material is also capable of being used as a landing mat for airfields and in other places where a strong stain resistant and weather resistant material is desired. It will be recognized that the relative size of the material can be varied depending upon the particular use.

The invention is hereby claimed as follows:

1. A rollable material comprising a resinous sheet material of sufficient flexibility to be wound into a roll, permanently united on one surface only to spaced apart, substantially parallel, substantially rigid elongated members extending only transversely of the direction in which said sheet material is to be wound, said elongated members each having a plurality of surfaces, one of which is adherently secured to said surface of said sheet material, the opposite surface of said sheet material being a hard, wear-resistant, impervious resinous surface which is resistant to stains, easily cleaned and not damaged by washing with soap and water, and the spacing between said elongated members being sufficient to permit said sheet material to be wound into a roll.

2. A rollable table top material comprising a resinous sheet material of sufficient flexibility to be wound into a roll, permanently united on one surface only to spaced apart, substantially parallel, substantially rigid elongated wooden members extending only transversely of the direction in which said sheet material is to be wound, said elongated wooden members each having a plurality of surfaces in different planes, one of said surfaces of each of said wooden members being adhesively secured to said surface of said sheet material and the other surfaces of said wooden members extending outwardly from said surface of said sheet material, the opposite surface of said sheet material being a hard, smooth, wear-resistant, impervious, resinous surface which is resistant to stains, easily cleaned, and not damaged by washing with soap and water, and the spacing between said elongated members being sufficient to permit said table top material to be wound into a roll.

3. A rollable material comprising a heat and pressure consolidated resinous sheet of sufficient flexibility to be wound into a roll, permanently united on one surface only to spaced, substantially parallel, substantially rigid, elongated members extending transversely of the direction in which said sheet is to be wound and spaced from each other a sufficient distance to permit said sheet to be wound into a roll, the surface of said sheet opposite the surface to which said elongated members are secured being a hard, wear-resistant, impervious surface which is resistant to stains, easily cleaned, and not damaged by washing with soap and water.

4. A flexible rollable sheet material comprising a heat and pressure consolidated sheet of intermingled bundles of flexible thread-like glass filaments impregnated with a thermosetting resin and united by said resin to spaced, substantially parallel, substantially rigid, elongated members extending transversely of the direction in which said sheet material is to be wound into a roll, said elongated members extending outwardly from one surface only of said sheet material and being spaced at intervals sufficient to permit said sheet material to be wound into a roll, the opposite surface of said sheet material being a hard, wear-resistant, impervious surface which is resistant to stains, easily cleaned, and not damaged by washing with soap and water.

5. A method of making a re-enforced sheet material capable of being wound into a roll which comprises permanently uniting to one side only of a resinous sheet material of sufficient flexibility to be wound into a roll transversely of the direction in which said sheet material is to be wound, substantially parallel, substantially rigid, elongated members, said elongated members each having a plurality of surfaces, one of which is secured to said surface of said sheet material, and spacing said elongated

7

members a sufficient distance apart to permit said sheet material to be wound into a roll.

6. A method of making a re-enforced sheet material capable of being wound into a roll which comprises adhesively securing to one side only of a resinous sheet material of sufficient flexibility to be wound into a roll transversely of the direction in which said sheet material is to be wound, substantially parallel, substantially rigid, elongated members, said elongated members each having a plurality of surfaces, one of which is secured to said surface of said sheet material, and spacing said elongated members a sufficient distance apart to permit said sheet material to be wound into a roll.

7. A method of making a re-enforced sheet material capable of being wound into a roll which comprises consolidating under heat and pressure a batt of intermingled glass filaments impregnated with a flexible, fusible resin positioned in contact at one surface of said batt with a plurality of substantially rigid elongated re-enforcing members spaced apart substantially parallel to each other a sufficient distance to permit the resultant sheet material to be wound into a roll and extending transversely to the direction in which said sheet material is to be wound, and continuing the application of heat and pressure until said sheet material is densified to a sheet material of sufficient flexibility to be wound into a roll and said re-enforcing members are adherently secured to one surface thereof.

8

8. A method of making a re-enforced sheet material capable of being wound into a roll which comprises consolidating under heat and pressure a batt of intermingled bundles of flexible thread-like glass filaments impregnated with a thermosetting flexible, fusible resin positioned in contact at one surface of said batt with a plurality of substantially rigid elongated re-enforcing members spaced apart substantially parallel to each other a sufficient distance to permit the resultant sheet material to be wound into a roll and extending transversely to the direction in which said sheet material is to be wound, and continuing the application of heat and pressure until said sheet material is densified to a sheet material of sufficient flexibility to be wound into a roll and said re-enforcing members are adherently secured to one surface thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

1,191,765	Crumbaugh	July 18, 1916
1,297,643	Boyer	Mar. 18, 1919
1,325,363	Lindsay	Dec. 16, 1919
2,052,490	Reinhardt et al.	Aug. 25, 1936
2,135,057	Slayter et al.	Nov. 1, 1938
2,197,132	Lougheed	Apr. 16, 1940
2,574,221	Modigliani	Nov. 6, 1951