

Patented Nov. 3, 1925.

1,559,846

UNITED STATES PATENT OFFICE.

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IMPREGNATED MATERIAL AND PROCESS OF PRODUCING SAME

No Drawing.

Application filed April 18, 1923. Serial No. 633,015.

To all whom it may concern:

Be it known that I, KIRK BROWN, a citizen of the United States, and resident of Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Impregnated Materials and Processes of Producing Same, of which the following is a specification.

The invention relates to impregnated material and process of producing the same, and particularly to a fibrous material, preferably of the laminated cardboard type, impregnated with a phenolic condensation product, and a process of producing the same.

Such products are used in the manufacture of a large variety of articles, such as gears and gear blanks, insulating parts, etc. Important uses of the product require that it shall be readily punched, drilled, sheared and otherwise mechanically worked. It is also important for many uses that it should be thoroughly water-resistant.

Such material is commonly strongly impregnated with phenolic resins and chemically reacted throughout by the application of heat to a hard, infusible and insoluble condition, to make it thoroughly water-resistant and to give it other desired properties. In such case, however, it cannot readily be operated upon mechanically. The usual method of securing the easy working property is to utilize a considerably less proportion of phenolic resin or impregnating material, that is, to reduce the proportion of impregnating or binding material to the fibrous or cellular base, either throughout the body or in any desired portion thereof. The water resistance of the product is, however, decreased by such reduction.

Another method of obtaining easy working properties is to limit the reaction of the condensation product, so that it does not thoroughly harden. This, however, requires a nicety of control with respect to temperature and time. To make sure that the reaction is not carried too far towards the complete hardness and infusibility which will be produced by the full reaction, adds to the difficulty of manufacture, and increases cost. The process is not easily performed, since the time required will be different in accordance with variations of temperature used, and in accordance with

the mass of the work being treated. Another disadvantage of this process is that the outer surface as well as the interior portion, are not brought to the hardened infusible stage and are therefore, lacking in finish and appearance and the electrical property known as surface resistivity. This defect is obviated by my invention.

These difficulties are overcome by the present invention, the product of which has the property of being readily machined while being at the same time water-resistant throughout. This is accomplished by impregnating the whole body with a sufficient proportion of phenolic condensation product to produce the water-resistant quality throughout, the condensation product in the exterior portion containing, however, a greater proportion of the methylene-containing body, or hardening ingredient, in proportion to the phenol or equivalent in the composition, than is the case with the condensation product in the interior. By this means the finished impregnated mass will have a hard outer covering or shell, which may be quite fully infusible and which will provide a fine finish for the product, the hard outer shell being, however, of insufficient thickness to interfere with easy working property of the product, the interior or main body portion of the mass being considerably softer and more readily machined than the exterior portion. In its preferred form such a product is formed of superposed laminations or sheets of fibrous material substantially saturated throughout with the phenolic condensation product which is substantially fully reacted throughout, but is, as stated, of greater hardness on the exterior than in the interior because of the greater proportion of methylene-containing or other hardening reagent in the condensation product with which the outer portion is impregnated.

The object of the invention is the production of products of the character referred to as articles of manufacture and the production of a suitable process by which the same may be formed.

The invention may be carried into effect in various ways. In the manner of practicing the same which I now prefer, sheets of paper, woven fabric, felt, or similar fibrous sheets, intended to form the main body portion of the product, are impregnated with a

solution containing substances capable of reaction on application of sufficient heat to produce a phenolic condensation product. The sheets are preferably saturated with the solution so that substantially the maximum amount of phenolic condensation product is contained within and on the fibrous material after the final reaction has been completed, so as to render the material water-impervious. The impregnating material for these sheets contains formaldehyde, or other methylene-containing substances, or other equivalent hardening reagent in such a proportion that the condensation product will not harden to the same degree that it would if a greater proportion of the hardening agent were included, the sheets so impregnated being intended, as stated, for the main body portion, or interior of the mass. The sheets, which are to form the exterior surface or surfaces of the laminated product are thoroughly impregnated with substances capable of reaction to produce a phenolic condensation product in which the methylene-containing, or hardening ingredient is present in greater relative quantity and is preferably present in proper proportion to yield a hard and fully reacted phenolic condensation product. The impregnated sheets are superposed one upon the other with the sheet or sheets containing the larger proportion of hardening reagent at the outer side or sides, the mass is consolidated and final reaction is caused in the usual way by application of sufficient heat and pressure.

The impregnating material may comprise in each case mixtures of fusible phenolic resins with an added percentage of hardening reagent, such, for example, as hexamethylenetetramin, or it may comprise partial reaction products containing the desired proportions of aldehyde or methylene-containing body or other hardening agent, capable of transformation, on application of heat, to form a harder more infusible product, or it may comprise phenol and formaldehyde or the like original elements in proper proportions to form the desired condensation products. Likewise the invention is not limited in any way to any particular manner in which the fibrous material or base is impregnated with the binding materials.

As an example of one way in which the invention may be practiced the laminations or sheets which are to form the outside surfaces of the product may be saturated with a solution in alcohol or other appropriate solvent of a fusible phenol resin and a proportion of hexamethylenetetramin in suitable quantity to react with the fusible phenol resin on application of heat in the usual way to transform the mass into the hard infusible condition. The final condensation product formed by reaction of the phenol resin and the hexamethylenetetramin may be that or similar to that described in patent to J. W. Aylsworth No. 1,020,593, March 19, 1912, a solution of such a fusible phenol resin and hardening agent therefor in a suitable solvent being described in the patent to J. W. Aylsworth No. 1,098,608, granted June 2, 1914. The laminations which are to form the main body or interior of the laminated mass may similarly be saturated with a solution, in alcohol or other appropriate solvent of the fusible phenol resin and hexamethylenetetramin, the latter in approximately one-half the proportion which is used in impregnating the outside sheets, or in any other desired proportion, according to the particular effects required. The sheets may then be permitted to dry somewhat and superposed one on the other with the sheets containing the larger amount of hexamethylenetetramin at the top and bottom. The assembled mass may now be submitted to heat and pressure in a press in the well-known way to effect the transformation of the condensation product into its final condition, the mass being at the same time compacted into a substantially integral body. The heat treatment should preferably be continued sufficiently to cause the reaction between the phenol resin and the hexamethylenetetramin to proceed to completion or substantially so throughout the mass so that the hexamethylenetetramin will substantially all go into the reaction. The result of such a process will be the production of a product which is thoroughly water-resistant throughout, so that if the structure is cut in half or a section of the interior of the mass is otherwise exposed water or other fluid which may come in contact with the exposed section will not penetrate therein to a material or objectionable extent. The body will have a comparatively thin shell or outer covering which is comparatively hard and which will take a high finish while the body as a whole may be readily punched, drilled, sheared, etc., because of the fact that the main body portion is considerably softer and more readily machined than the outer shell, the latter being comparatively thin.

It will be noted that the term "phenolic substance" in the claims is intended to include phenol and its equivalents, as well as phenolic resins, or phenolic condensation products which are capable of further reaction with hardening agents to produce a harder and more fusible product. The term "a hardening reagent" in the claims is intended to include substances which will react with phenol or equivalent or with fusible phenolic resins to produce harder and more infusible bodies, such hardening reagents including methylene-containing bodies, such as formaldehyde and its polymers,

hexamethylenetetramin, etc., and such substances as acetaldehyde, paraldehyde, other bodies having an aldehyde character, etc.

It should also be noted that the invention is not limited to the particular details of process and construction of the product which have been particularly described, but that the same is as broad as is indicated by the accompanying claims.

What I claim is:

1. A process of producing impregnated material, comprising, impregnating the interior portion of a body of fibrous material with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in proportion less than that required, in reaction with said phenolic substance, to produce maximum hardness and infusibility, impregnating the outer portion of the body with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in greater proportion than the first mentioned hardening reagent, and applying heat to cause the reactions between said phenolic substances and hardening reagents therefor to ensue.

2. A process of producing impregnated material, comprising, impregnating one or more laminations or sheets of fibrous material with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in proportion less than that required, in reaction with said phenolic substance, to produce maximum hardness and infusibility, impregnating one or more laminations or sheets of fibrous material with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in greater proportion than the first mentioned hardening reagent, superposing said sheets to form a laminated body, with said last named lamination or laminations at the outside, and applying heat to cause the reactions between said phenolic substances and hardening reagents therefor to ensue.

3. A process of producing impregnated material, comprising, impregnating the interior portion of a body of fibrous material with a fusible phenolic resin and a hardening reagent therefor in proportion less than that required, in reaction with said resin, to produce maximum hardness and infusibility, impregnating the outer portion of the body with a fusible phenolic resin and a hardening reagent therefor in greater proportion than the first mentioned harden-

ing reagent, and applying heat to cause the reactions between said phenolic resins and hardening reagents therefor to ensue.

4. A process of producing impregnated material, comprising, impregnating one or more laminations or sheets of fibrous material with a fusible phenolic resin and a hardening reagent therefor in proportion less than that required, in reaction with said resin, to produce maximum hardness and infusibility, impregnating one or more laminations or sheets of fibrous material with a fusible phenolic resin and a hardening reagent therefor in greater proportion than the first mentioned hardening reagent, superposing said sheets to form the laminated body with said last named lamination or laminations at the outside, and applying heat to cause the reactions between said phenolic resins and hardening reagents therefor to ensue.

5. A process of producing impregnated material, comprising, impregnating the interior portion of a body of fibrous material with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in proportion less than that required, in reaction with said phenolic substance, to produce maximum hardness and infusibility, impregnating the outer portion of the body with substances capable of reaction to produce a water-resistant phenolic condensation product, such substances comprising a phenolic substance and a hardening reagent therefor in sufficient proportion to produce a hard infusible condensation product, on reaction with said phenolic substance, and applying heat to cause the reactions between said phenolic substances and hardening reagents therefor to ensue quite fully, the impregnation with said reactive substances being sufficient to substantially saturate the fibrous material therewith.

6. A process of producing material of the character described, comprising, forming a main body portion of sheeted material and substances adapted to form a binder therefor, said substances including a hardening reagent and a body adapted to combine therewith, forming an exterior portion of sheeted material and substances adapted to form a binder therefor, said substances comprising a hardening reagent in greater proportion than said first mentioned hardening reagent, and a body adapted to combine therewith to be hardened thereby, and subjecting the composite material thus formed to heat and pressure sufficient to consolidate the mass and cause reactions between said hardening reagents and combining bodies to ensue, the proportion of hardening reagent in said exterior portion being sufficient to produce a hard infusible surface layer after the final

reaction, and the proportion of hardening reagent in said interior portion being sufficiently less than that in the exterior portion to enable the same readily to be

5 machined.

7. An article of the character described, comprising laminations of fibrous material substantially saturated throughout with a phenolic condensation product, the mass being substantially water-impervious throughout, the condensation product being substantially fully reacted throughout, and the exterior laminations being harder and more infusible than the interior of the mass, and

10 the interior of the mass being readily machinable.

8. An article of the character described, comprising a body of fibrous material strongly impregnated throughout with phenolic condensation product, to render the

20 same thoroughly water-resistant throughout,

the condensation product being substantially fully reacted throughout, the exterior portion of the mass being hard and infusible, and the interior portion being of a less degree of hardness and infusibility.

9. An article of the character described comprising laminations of fibrous material substantially saturated throughout with a phenolic condensation product, the mass being substantially water-impervious throughout, the condensation product being substantially fully reacted throughout, and the exterior laminations being harder and more infusible and containing the methylene-containing hardening element in greater proportion to the phenolic element than the interior of the mass.

In testimony whereof I have signed my name to this specification.

KIRK BROWN.