R. KEMP.

PROPELLER.

APPLICATION FILED MAR. 9, 1918.

1,433,728. Patented Oct. 31, 1922.

Fig. 1.

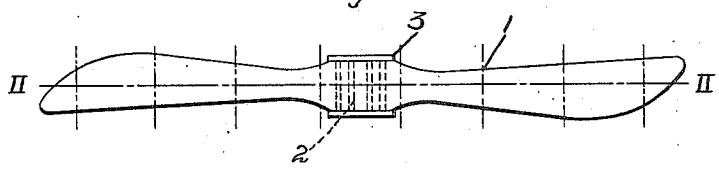

Fig. 2.

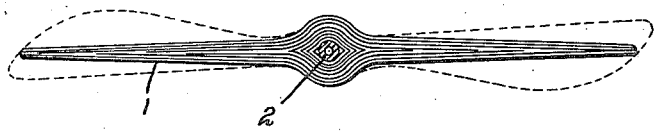

Fig. 3.

WITNESSES:

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Patented Oct. 31, 1922. 1,433,728

UNITED STATES PATENT OFFICE.

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PROPELLER.

Original application filed May 26, 1916, Serial No. 99,995. Divided and this application filed March 9, 1918. Serial No. 221,371.

To all whom it may concern:

Be it known that I, ROBERT KEMP, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Propellers, of which the following is a specification.

My invention relates to propellers and more particularly to propellers for aircrafts, being a division of a co-pending application for Structural elements filed by me, May 26, 1916 and bearing the Serial Number 99,995.

Heretofore, in the construction of propellers, the cost of production has been very considerable, owing to the length of time required for the completion of propellers by the present-day methods of construction, the high price of the material required, the large number of parts and the necessity of employing expert or skilled workmen. The primary object of my invention is to cheapen the cost of production and the time required for manufacture, as well as to improve the propeller itself, by employing new and entirely different material in the propeller construction.

More particularly, one object of my invention resides in forming a propeller of a normally flexible material made rigid by the application of a binder, preferably a binder which will harden or may be hardened, such as a phenolic condensation product. Preferably, also, the propeller is built up from laminations, or layers of flexible or plastic material, pressed, molded or otherwise formed into the desired shape, such material being impregnated with a phenolic condensation product so that, when the built-up propeller is heated, under pressure, the entire propeller will be rendered solid, hard, substantially insoluble and non-inflammable and will possess great strength and rigidity.

Heretofore, in the manufacture of propellers, builders have confined themselves principally to the use of wood or wood reinforced with metal. In the present instance, I propose to employ filling materials which are normally flexible, such materials being assembled in laminations, or in layers, in association with a suitable binder, being then pressed into proper shape and size by means of a mold or other suitable device and hardened by the application of heat.

Although various binders may be employed, I prefer the use of a comparatively new and peculiarly adaptable material for this purpose, such as a phenolic condensation product of the type described in the U. S. Patents Nos. 942,700, 942,809 and others to Leo H. Baekeland, or condensation products of metra-cresol and formaldehyde as set forth in other U. S. patents issued to the same inventor. With the employment of such a binder, the resultant product possesses unusual properties of lightness, durability and strength, being extremely resistant to moisture and chemical agents, as well as for all practical purposes, fireproof and unaffected by light. Furthermore, a fibrous material impregnated with such a binder, when the binder is hardened, possesses unusual toughness and offers extreme resistance to wear.

In addition to these advantages, the cost of manufacture of propellers, employing the materials which I have specified, is greatly reduced, both because of the cost of the materials themselves, because of the saving in time required in the manufacture and the possibility of utilizing relatively unskilled, untrained labor.

It has been found, as set forth in the patents above cited, that certain condensation products of phenolic bodies and formaldehyde, or their equivalents, after being subjected, under proper conditions, to the action of heat, become hard, infusible and extremely resistant to chemical agents, as well as to practically all kinds of liquids. The filling materials, with which such condensation products are combined, are preferably fibrous in character, as, for example, wood or asbestos fibre, paper pulp, sheets of cardboard or paper, or layers of cloth or like fibrous, porous materials which may be impregnated with the liquid or dissolved partial condensation products of phenol and formaldehyde. Filling materials, when so impregnated and heated, under suitable conditions, are converted into hard, strong and durable homogeneous bodies.

Such material, after it has been impregnated with a phenolic condensation product and before it has been hardened by the action of heat and pressure, may be molded or otherwise brought to any desired form and, even after it has been hardened, may be turned, cut, drilled and otherwise handled

in much the same manner as wood and metals.

In the drawings, Fig. 1 is a side elevation of a propeller constructed in accordance with my invention; Fig. 2 is a longitudinal sectional view taken on the line II—II of Fig. 1, and Fig. 3 discloses a series of transverse sections taken through the blade of the propeller at the points indicated by the lines appearing above the several sections.

The propeller, which is designated, as a whole, by the numeral 1, is preferably formed of a series of long and short layers of fabric, paper or paper-like material, impregnated with a binder which will harden or which may be hardened. In the construction of this propeller, however, I find it preferable to use a phenolic condensation product as a binder, as such a product may be hardened by application of heat. The layers of the fibrous material, which have been previously impregnated with such binder, are pressed, one upon another, in a suitable two-part mold of proper shape and contour. These layers are laid longitudinally of the propeller in the manner indicated in Figs. 2 and 3 of the drawings, with a shaft or axle bearing 2 inserted between the layers at the center of the propeller. As indicated in these figures, the intermediate portions of the several layers are disposed substantially parallel to the axis of this shaft bearing or hub, while the end portions are oppositely twisted so that the various laminations, constituting the blades of the propeller, lie in planes substantially parallel with the working faces of the blades.

It will be understood that, as the propeller varies in thickness at different points throughout its length, a greater number of layers will be applied at the thicker portions, such as at the hub, than at the thinner portions, such as at the ends of the blades. As shown in Fig. 2, the added layers at the hub are shorter than the remaining layers, and the longer layers, which extend throughout substantially the entire length of the propeller, are the outermost layers.

Preferably, all of the layers are laid lengthwise of the propeller and each layer extends substantially uniformly at opposite sides of the hub. This hub or bearing 2 is preferably provided with spaced flanges 3 between which the various layers are bound. After the propeller body has been properly assembled in the mold, the mold is closed and the propeller is finished by subjecting it, while still in the mold, to the combined action of heat and pressure to convert the binder to its solid and substantially insoluble, infusible state.

Obviously, a propeller may also be formed by heating, in a mold of an approved shape, the proper quantity of any suitable filling material, in pulp or shredded form, impregnated with a suitable binder, such as a phenolic condensation product. I, therefore, reserve the right to make any changes in the filling materials employed, in the impregnating agent used and in the manner of forming the body of the propeller from such materials, which may seem advisable or desirable, and which may come within the scope of the appended claims.

I claim as my invention:

1. A propeller of molded fibrous material and a binder which hardens and becomes substantially insoluble and infusible upon the application of heat.

2. A molded propeller of fibrous material and a phenolic condensation product as a binder.

3. A propeller of laminated material and a binder which hardens and becomes insoluble upon the application of heat.

4. A propeller of laminated material and a phenolic condensation product as a binder.

5. A propeller of laminated fibrous material and a binder which hardens and becomes insoluble upon the application of heat.

6. A propeller of laminated fibrous material and a phenolic condensation product as a binder.

7. A molded propeller composed of a fabric material and a binder which hardens and becomes insoluble upon the application of heat.

8. A molded propeller of fabric material and a phenolic condensation product as a binder.

9. A molded propeller comprising laminations of fabric material and a binder which hardens and becomes insoluble upon the application of heat.

10. A molded propeller comprising laminations of fabric material and a phenolic condensation product as a binder.

11. A propeller molded from a substance which hardens and becomes insoluble upon the application of heat and a filler.

12. A propeller molded from a substance which hardens and becomes insoluble upon the application of heat and a fibrous filler.

13. A propeller molded from a substance which hardens and becomes insoluble upon the application of heat and a filler of fabric material.

14. A molded propeller comprising a plurality of superimposed layers of fabric material and a binder which hardens and becomes insoluble upon the application of heat.

15. A molded propeller comprising a plurality of superimposed laminations of fabric and a phenolic condensation product as a binder.

16. A molded propeller consisting essentially of cellulose material and a phenolic condensation product as a binder.

17. A molded propeller consisting of lam-

inations of essentially cellulose material and a phenolic condensation product as a binder.

18. A molded propeller of fabric and a binder in which the fibers of the fabric run continuously throughout the length of the propeller.

19. A molded propeller of fabric and a phenolic condensation product as a binder in which the threads of the fabric run lengthwise and cross-wise throughout the entire extent of the propeller.

20. A propeller formed of a plurality of relatively long and short layers of fibrous material extending upon opposite sides of the center of the propeller, said layers being united by a binder into a hard and homogeneous mass.

21. A propeller formed by baking, in a mold, a mass of fibrous material compounded with a binder composed of a phenolic condensation product until said mass is hardened into a homogeneous body.

22. A propeller comprising a plurality of superimposed laminations of fibrous material, associated with a phenolic condensaton product as a binder, and a hub interposed between certain of the laminations at the intermediate portion of the propeller.

23. A propeller comprising a plurality of superimposed laminations of fibrous material, associated with a phenolic condensation product as a binder, and a hub interposed between certain of the laminations at the intermediate portion of the propeller, the intermediate portions of the laminations lying in planes parallel to the axis of the hub and the remaining portions being twisted to lie in planes substantially parallel with the working faces of the blades of the propeller.

In testimony whereof, I have hereunto subscribed my name this 26th day of Feb. 1918.

ROBERT KEMP.