July 31, 1923. 1,463,153

N. S. CLAY

FAN STRUCTURE

Filed Oct. 9, 1920

Fig. 1.

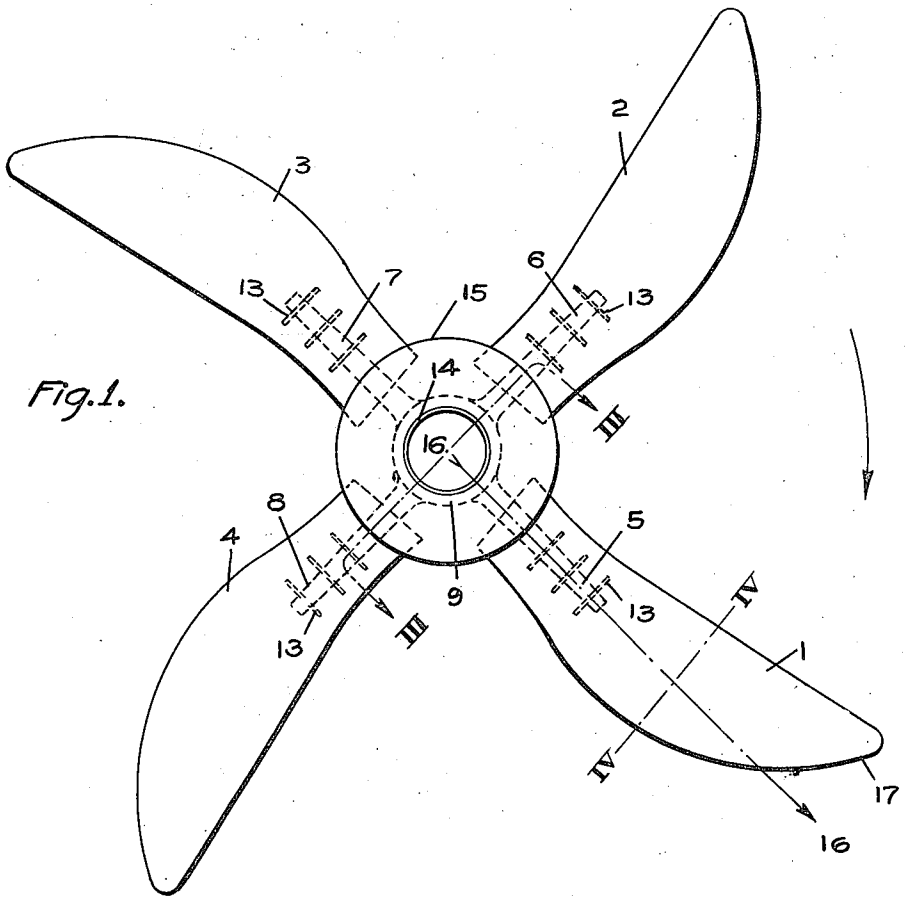



Fig. 2.

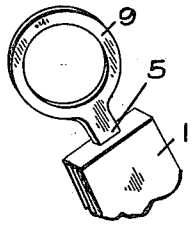



Fig. 3.

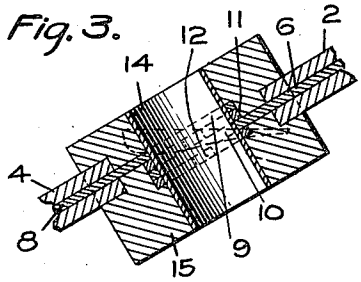
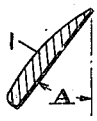



Fig. 4.




WITNESSES:

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# UNITED STATES PATENT OFFICE.

NOBLE S. CLAY, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

## FAN STRUCTURE.

Application filed October 9, 1920. Serial No. 415,767.

*To all whom it may concern:*

Be it known that I, NOBLE S. CLAY, 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 Fan Structures, of which the following is a specification.

This invention relates to a fan structure and, more especially, to a peculiar arrangement and construction of fan blades which will produce a fan structure which is inexpensive to manufacture, and efficient in use.

My invention contemplates the use of a material for fan blades which is flexible to a certain degree, but which is stiff enough to resist moderate air pressures. Such fan blades are usually made of material which may consist of sheets of paper, fabric, or the like impregnated with a phenolic condensation product or other binder capable of hardening under heat and pressure. This method of manufacture is described in the copending application of Johnson, Serial No. 268,792, filed December 30, 1918, and assigned to the Westinghouse Electric and Manufacturing Company.

If desired, such fan blades may be formed of loose fibers held together by a hardened binder, or the body of such blades may consist of fibers and a binder while the outer layers may consist of fabric or the like molded to the body portion.

It is desirable, in a fan structure such as is used in conjunction with the engine of a motor car, to force air through the radiator thereof so that, when the speed of the engine increases beyond a certain point, the volume of air forced through the radiator is not increased in proportion since, at the higher speeds, too great a quantity of air would be forced through the radiator. It has been found that, at high speeds, with fans hitherto used, not only was too large an amount of air forced through the radiators, but the power consumed by such a fan increased very rapidly, and tests have shown that, in the case of large engines, as much as $2\frac{1}{2}$ to 3 horse-power was consumed by the fan at high speeds.

My invention obviates these disadvantages, it being among the objects thereof to produce a fan structure which will deliver a volume of air at higher speeds which is not proportional to the speed of the engine, and one which does not consume a large amount of power.

A further object of this invention is to produce a structure of fan in which blades are formed individually and then assembled in a novel manner to form a unitary structure of great durability.

In the accompanying drawings forming a part hereof and which illustrate one embodiment of my invention,

Fig. 1 is a plan view of a fan structure embodying my invention;

Fig. 2 is a detail perspectvie view of the inner end of one fan blade;

Fig. 3 is a cross section on line 3—3 of Fig. 1, and

Fig. 4 is a cross section on line 4—4 of Fig. 1.

In practicing my invention, I form a blade of composite structure, including fibrous material and a hardened binder, of such character that it is flexible and so that, at high speeds, the pressure of air causes a tortional movement of the fan blade tip, reducing the effective cross-sectional area thereof, thus tending to deliver less air and to consume less power. I preferably form the tips of the blades with a back-sweep, so that the area above the center line of the blade will be subjected to more air pressure than the area below the center line.

The blades 1, 2, 3 and 4 are usually molded with metallic bars 5, 6, 7 and 8, respectively, at the inner ends thereof, the other ends of said bars terminating in rings 9, 10, 11 and 12, respectively. Preferably, the bars are formed with projections 13, whereby they may be more securely anchored in the fan blade material. The rings are then assembled, as shown in Fig. 3, upon a bushing 14 and the blades properly spaced around the periphery thereof, after which material 15, preferably the same as that composing the fan blades, is molded therearound to form a unitary structure. The position of the bars in the various blades of a fan should be slightly different so that, when assembled, all the blades will be in alinement.

The individual fan blades are so formed that the tips 17 thereof lie above the center line 16—16 of the blades. By so forming the blades, it will be noted that the area above is considerably greater than the area below such center line and the pressure of air

being forced against the blades will tend to decrease the pitch angle A. The inherent stiffness of the material prevents any substantial deflection while the fan speed and, therefore, the air pressure, is low, but allows such angle to decrease, due to the inherent flexibility and resiliency of the material, at higher speed.

Although I have shown and described a specific structure of fan, with the use of certain materials, it is to be understood that my invention is not limited to the exact construction shown nor the materials utilized therein. For instance, although I prefer to make bars 5, 6, 7 and 8 of iron, it is obvious that various other metals or even non-metallic substances may be substituted therefor.

The hub 15 may be of material different from that of the fan blades. For instance, I may use a mixture of wood flour and a condensation product instead of fibrous material and the binder. The cross-sectional shape of the fan need not be air-foil, as shown, but may be flat, or curved, if desired. These and other changes may be made in my construction without departing from the spirit of my invention, which is to be construed broadly, except as limited by the claims appended hereto.

I claim as my invention:

1. A fan blade comprising a body of flexible non-metallic material, a metallic bar secured to the inner end thereof, and a ring member on said bar.

2. A fan structure comprising a plurality of fan blades of flexible non-metallic material, metallic bars secured to the inner ends thereof, rings on said bars, and a hub of non-metallic material molded about said rings.

3. A fan structure comprising a plurality of fan blades of flexible material, bars secured to the inner ends thereof, rings on said bars, said rings being mounted on a bushing, and a hub molded about said rings.

In testimony whereof, I have hereunto subscribed my name this 7th day of October, 1920.

NOBLE S. CLAY.