No. 829,747. PATENTED AUG. 28, 1906.

R. A. WORKMAN.

PROPELLER.

APPLICATION FILED AUG. 1, 1904.

3 SHEETS—SHEET 1.

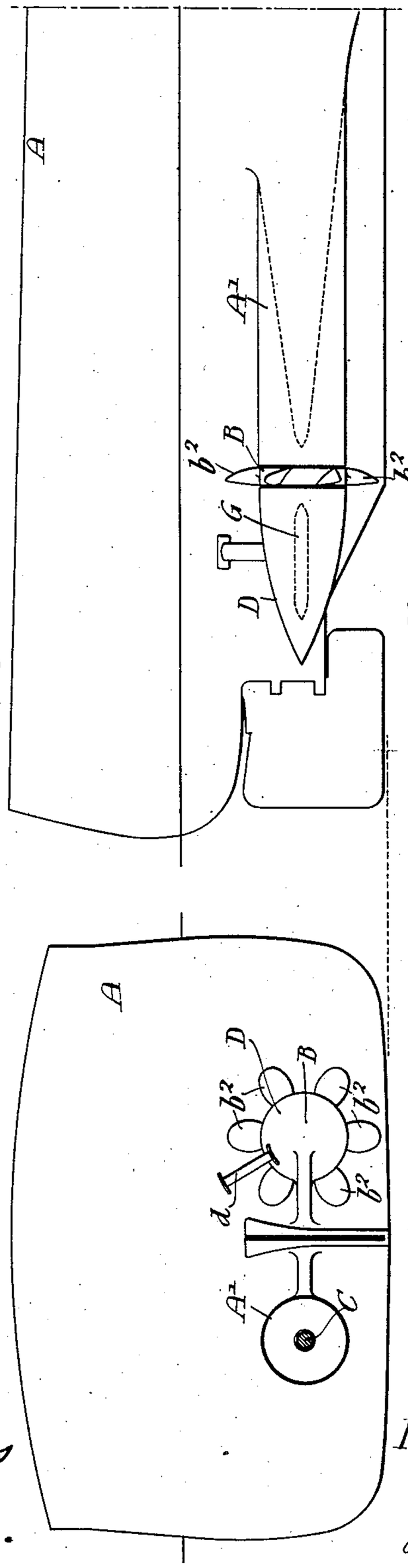

Fig. 1.

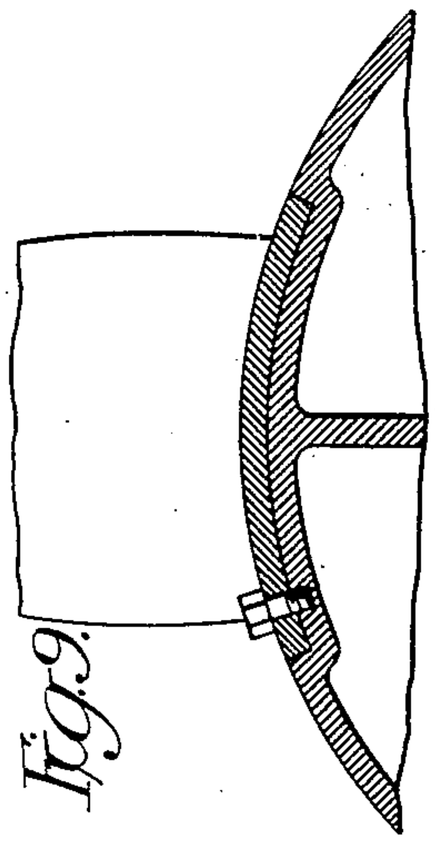

Fig. 9.

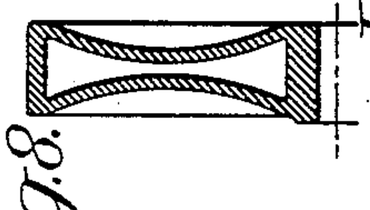

Fig. 8.

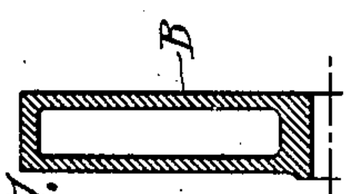

Fig. 7.

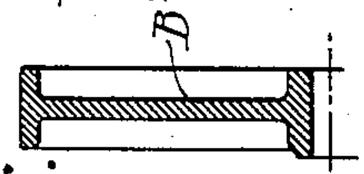

Fig. 6.

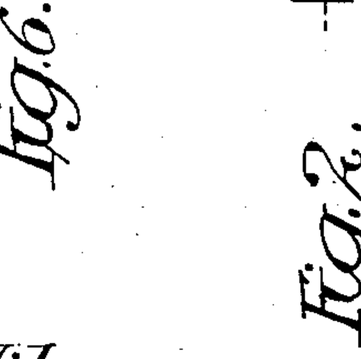

Fig. 2.

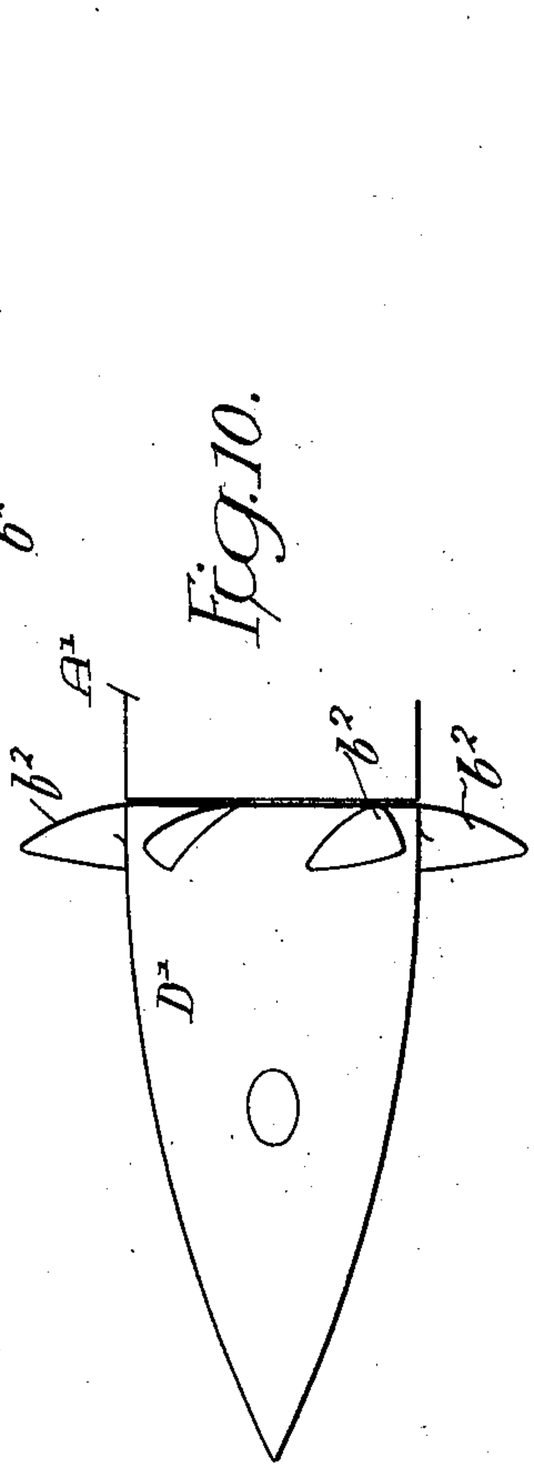

Fig. 10.

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Inventor:
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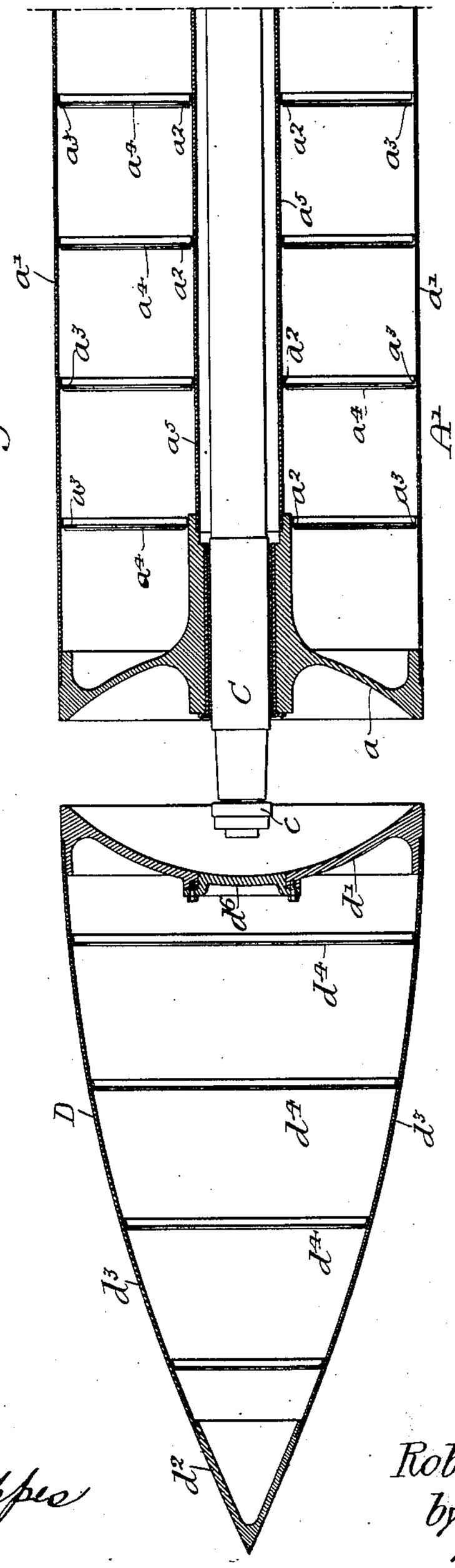
3 SHEETS—SHEET 2.

Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 3.

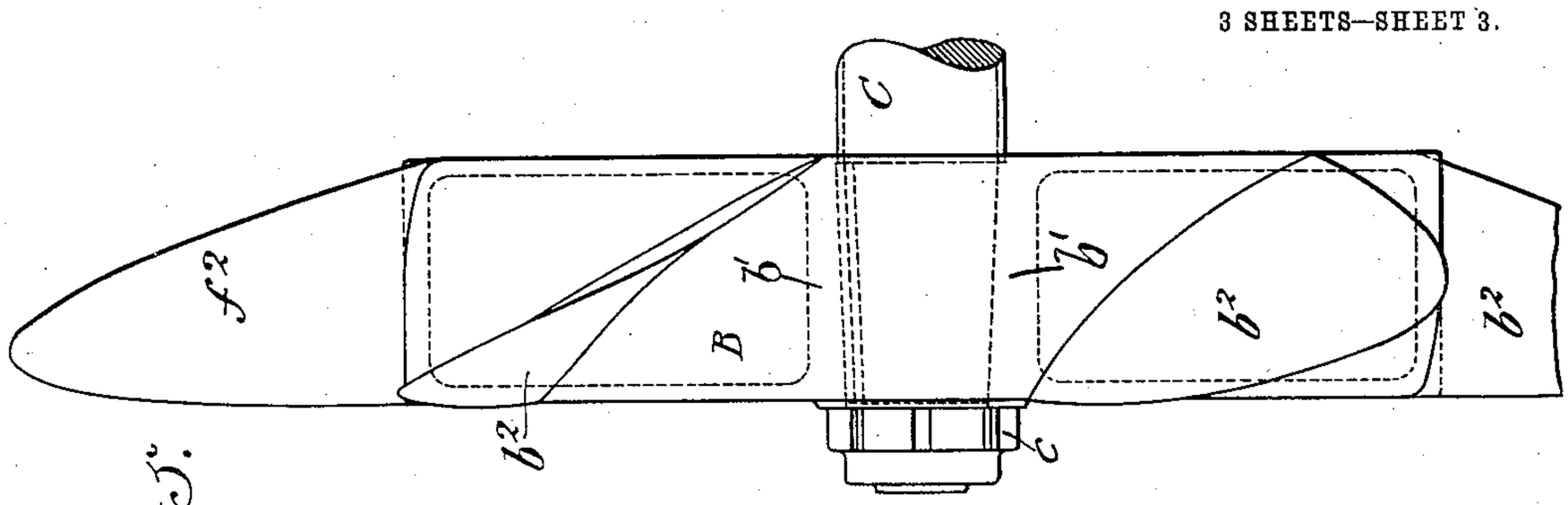
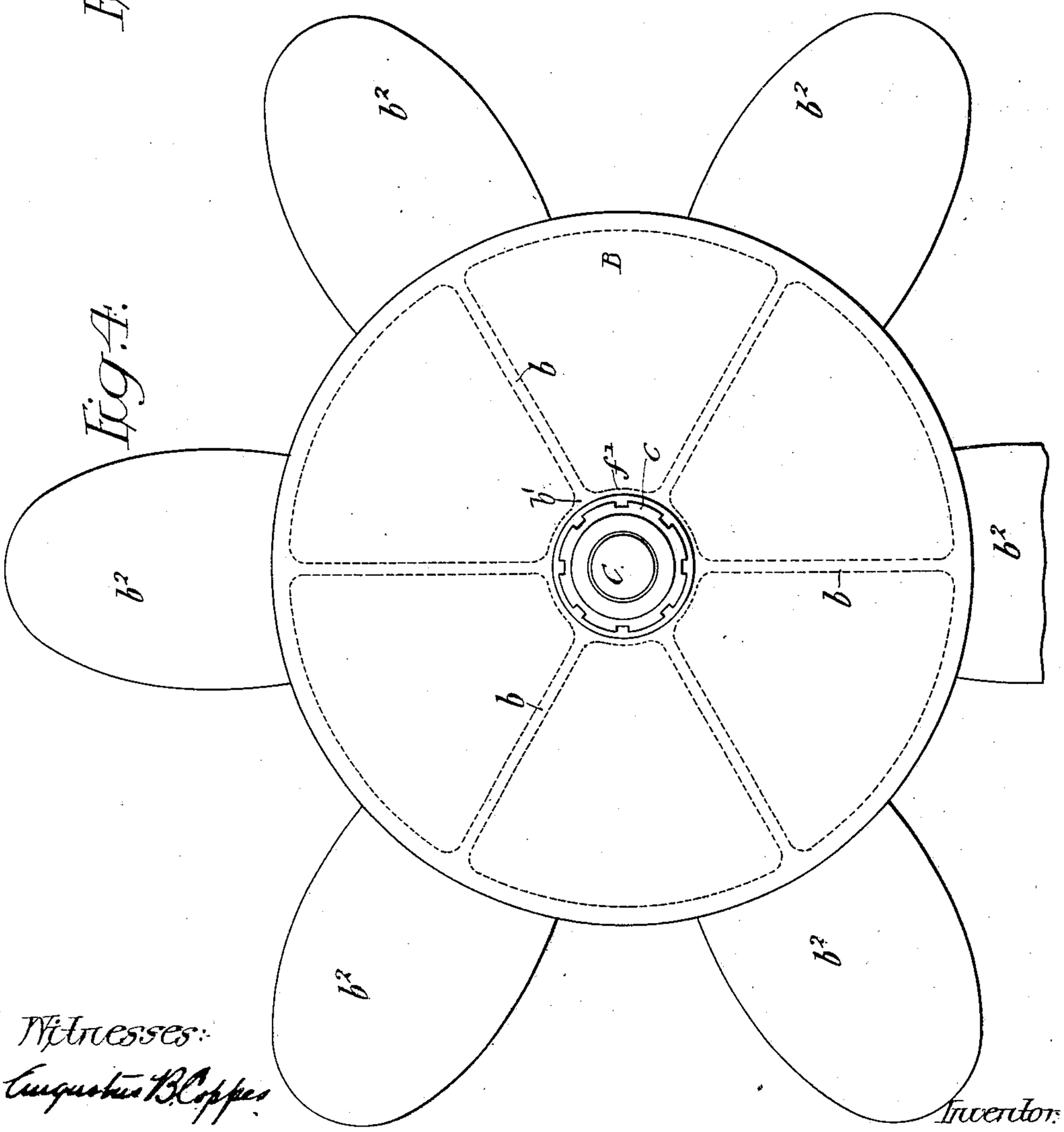


Fig. 4.



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UNITED STATES PATENT OFFICE.

ROBERT A. WORKMAN, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO LUTHER D. LOVEKIN, OF PHILADELPHIA, PENNSYLVANIA.

PROPELLER.

No. 829,747. Specification of Letters Patent. Patented Aug. 28, 1906.

Application filed August 1, 1904. Serial No. 219,099.

To all whom it may concern:

Be it known that I, ROBERT A. WORKMAN, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Propellers, of which the following is a specification.

The main object of my invention is to provide a propeller which shall be more efficient in operation than has hitherto been the case with the propellers in common use—that is, by my invention I desire to provide a propeller which in a given time and with a given consumption of fuel shall be capable of driving the vessel on which it is used through a greater distance than has previously been possible or, from another standpoint, shall be capable of driving a vessel through a given distance in a given time with the consumption of less fuel, and consequently at a less cost, than is at present possible with propellers of the ordinary type.

It is further the object of my invention to provide a propeller capable of securing the above-named object, with coöperating structures particularly designed to act with it, to secure such a flow of water toward and from it as will retard the motion of the vessel through the water to a minimum extent.

These objects I attain as hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of a part of a vessel equipped with propellers constructed according to my invention and showing one of said propellers with its coöperating parts. Fig. 2 is a rear end elevation of the vessel shown in Fig. 1, showing one of the propellers in position and illustrating the end construction of the shaft-tube for the second propeller, which for the sake of clearness is not shown. Fig. 3 is an enlarged sectional elevation of the shaft-tube and stationary dome used in connection with my improved propeller and illustrating the detail construction of said parts. Fig. 4 is an elevation of my improved propeller looking forward. Fig. 5 is a side elevation of the propeller shown in Fig. 4. Figs. 6, 7, and 8 are sectional elevations illustrating various forms of the disk on which are carried the blades of the propeller. Fig. 9 is a transverse sectional elevation illustrating a method which may be employed for propellers of large sizes for securing the blades to their supporting-disk; and Fig. 10 is a side elevation showing a modification of my invention in which the disk and shell to the rear of the same are made integral, said shell being under these conditions free to revolve instead of being rigidly supported from the framework of the ship, as in the other form of the invention.

It has long been a well-known fact that half of an ordinary propeller-blade nearest the hub is relatively inefficient under operating conditions, since the elements of its surface lie at such an angle to the plane of revolution of the propeller that said portion acts to a great extent upon the water so as to merely churn the same without doing useful work in driving the vessel ahead. In other words, these inner portions of propeller-blades of the ordinary construction are necessarily so placed as to require work to be done in turning the propeller, of which work but a relatively small part is effective to propel the ship.

In order to provide a propeller which shall have the same effective surface without requiring an increased diameter for a given power, I increase the number of blades employed, securing a construction such as is shown in the drawings herewith.

In the drawings, A represents the body of a vessel having a pair of propellers, one of which is shown at B, while their detail construction is illustrated in Figs. 4 and 5. Each propeller includes a supporting-disk, which preferably consists of a cylindrical shell having strengthening-ribs b and a central hub b', properly bored to receive the propeller-shaft C, upon which the disk is keyed and held in place by means of a nut c in the usual manner. Integral with the disk B or bolted thereto, as illustrated in Fig. 9, are any required number of propeller-blades b^2—in the present instance six—and it will be noted that the length of said blades is in the case illustrated slightly less than the radius of the disk in which they are carried. The active portions of these blades are helical surfaces and, as above noted, may be best described as each consisting of the outer half of a propeller-blade of the ordinary type. The hol-

low disk is made of such a length between its opposite faces as is required by the pitch of the blades and when said blades are made independently to it is provided with recesses, as shown in Fig. 9, into which fit flanges formed as part of the blades, said flanges entering the recesses, so as to be flush with the surface of the disk, and being held therein by bolts, as indicated.

In order that the disk B may not retard the motion of the ship in the water, I provide a construction supported from the side of said vessel, as illustrated in Fig. 3. This will be seen to consist substantially of a cylindrical shell A′, having its outer end closed by a casting *a*, provided with a stern-bearing for the after end of the propeller-shaft. This casting is supported from the main frame of the vessel in any desired manner and has its outer face dished, as shown, in order to minimize the braking effect occurring by reason of the water filling the space between it and the adjacent face of the disk of the propeller. As shown in Fig. 3, the body of the shaft-tube consists of plates a' entering a suitable recessed portion of the casting *a*, so as to be flush with the periphery of the same, and supported at intervals by means of a series of bulkheads formed by concentrically-curved angles a^2 and a^3, braced and connected together by plates a^4. Certain of these outer angles are preferably merely extensions of the ribs or side members of the vessel's framework and project from the body of said vessel through that portion which is intersected by the said shaft-tube. Within the inner set of angles a^2 is a second tube a^5, directly surrounding shaft C, and, as shown in Figs. 1 and 2, the shaft-tube A′ is continued forwardly until its plates intersect the plating of the vessel of which they are merely an extension, as indicated by dotted lines.

In order that the water to the rear of the vessel shall not exert a suction upon the rear face of the disk or create undue disturbance of the water, I provide a dome-shaped shell D of circular section and made with its sides of parabolic curvature. This curvature is determined by a consideration of the normal velocity of the vessel and the time taken for a particle of water to fall under the action of gravity from the circumference to the center of the propeller-disk. As shown in Figs. 1 and 3, this dome is supported from the side of the vessel by means of the ship-frames and a brace *d*, so that its circular base is adjacent to the rear face of the disk of the propeller. Said base in the present instance is formed by the casting d', which, like the casting *a* of the shaft-tube, is made dished, so as to reduce the water-friction between it and the propeller-disk to a minimum, there being a manhole in the casting closed by a cover d^6, through which access may be had to the nuts, &c., at the end of the propeller-shaft. The point of the dome-shell also consists of a casting d^2, and both of said castings are slightly recessed, so as to permit the plates d^3, forming the body of the dome, to fit flush with their surfaces. These plates are carried by the outwardly-curved angles d^4 of the ship's framework, which angles extend from the vessel's body into the shell D through the space or opening G. (Shown in full lines in Fig. 2 and by dotted lines in Fig. 1.) It will be noted that the disk upon which the propeller-blades are carried is not necessarily of the construction shown in Figs. 5 and 7, since, if desired, its two faces may be dished, as shown at B′ in Fig. 8, or it may be made as a pulley or fly-wheel having a single web, as illustrated at B^2 in Fig. 6.

Under operating conditions it will be seen that water is free to flow to the propeller-blades over the shaft-tube A′ and after it has left said blades is permitted to flow to the rear of the vessel over the double curved or parabolic surface of the dome D in a manner which is both theoretically and practically the one causing the least disturbance. Moreover, since the propeller-blades are of such construction that only those portions are used which are practically effective in causing forward motion of the vessel there is no unnecessary churning of the water, with the result that much more effective action of the propeller is secured. Such action also results in increased economy of fuel and permits the attainment of higher speeds than would otherwise be possible.

If desired, I may, as shown in Fig. 10, make the disk as part of the shell D, the whole resulting structure D′ being free to revolve and having the blades in the same relative positions as before.

I claim as my invention—

1. The combination with the hull of a vessel of a substantially cylindrical extension therefrom, a shaft in said extension, and a propeller on said shaft, the end of the extension adjacent to said propeller being provided with a concave head, substantially as described.

2. The combination with the hull of a vessel of a substantially cylindrical shaft-tube, a shaft therein, a propeller on said shaft and a stationary shell to the rear of the propeller, the shell and the tube being provided with concave heads adjacent to said propeller, substantially as described.

3. The combination with the hull of a vessel of a substantially cylindrical extension from the same, a casting in the end of said extension, a shaft in the extension having a bearing in said casting and a disk on the shaft having blades, said casting being of substantially the same diameter as said disks and being formed concave thereto, substantially as described.

4. The combination with the hull of a ves-

sel of a substantially cylindrical extension from the same having a casting in its rear end, a stationary and substantially conical shell to the rear of said extension also having a casting in one end, a disk on said shaft of substantially the same diameter as the two castings and blades projecting from said disk, said two castings being concave relatively to said disk, substantially as described.

5. The combination with the hull of a vessel, of an extension to the same, a substantially conical shell supported from the vessel and forming a continuation of said extension, a shaft, a disk supported thereon between the shell and the extension from the hull, and blades on said disk, there being a head for the conical shell adjacent to the disk, and said shell having one opening in said head adjacent to the end of the shaft and a second opening into the interior of the vessel's hull, substantially as described.

6. The combination with the hull of a vessel of a tubular extension from the same, a substantially conical shell having its base adjacent to the rear of said extension a propeller and a shaft in the extension supporting said propeller between the end of said extension and the shell, there being a normally closed opening through the base of the shell adjacent to the shaft, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT A. WORKMAN.

Witnesses:

WILLIAM E. BRADLEY,

JOS. H. KLEIN.