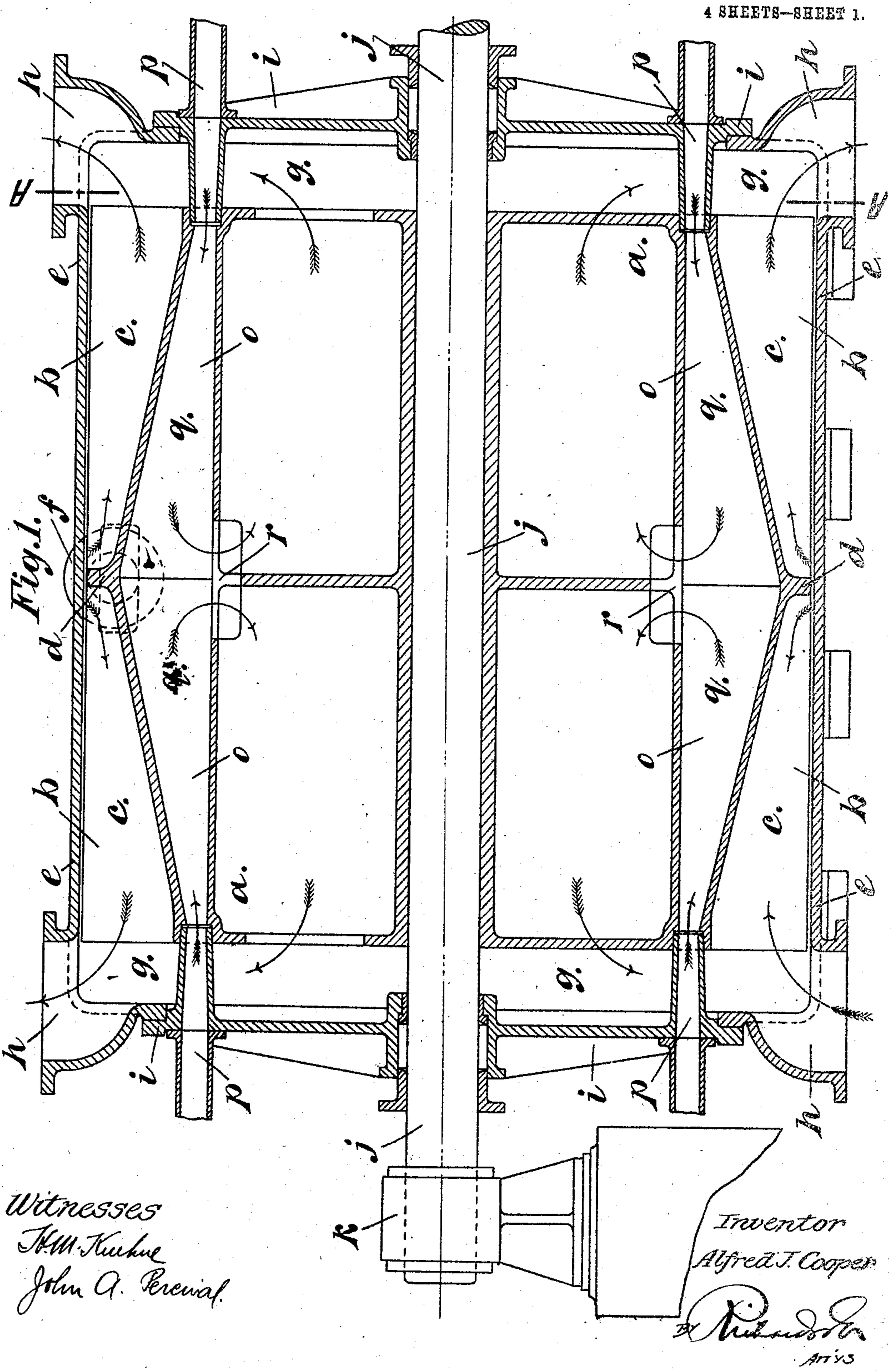
No. 845,334. PATENTED FEB. 26, 1907.

A. J. COOPER.

TURBINE.

APPLICATION FILED MAY 22, 1905.

4 SHEETS—SHEET 1.



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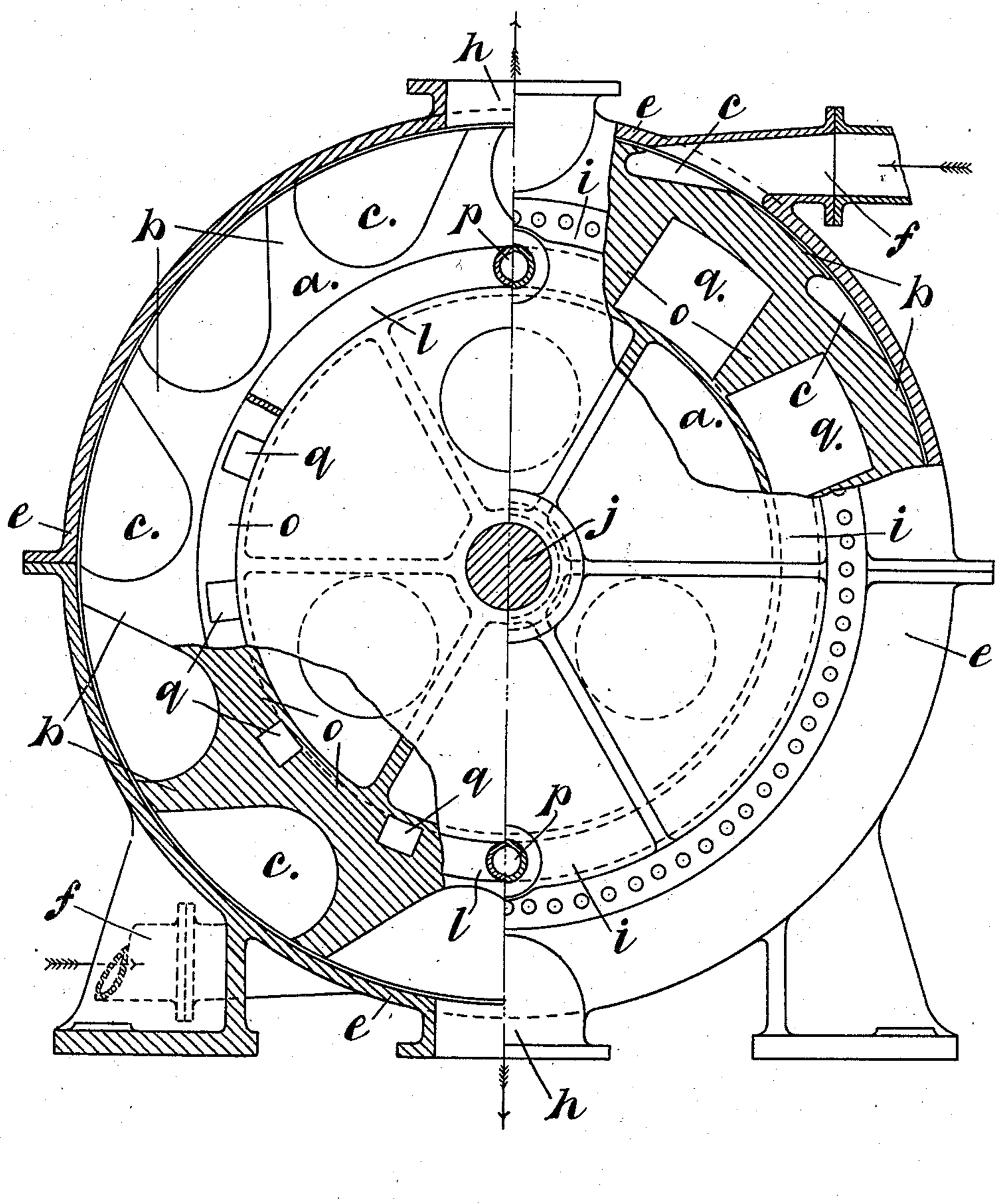
4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

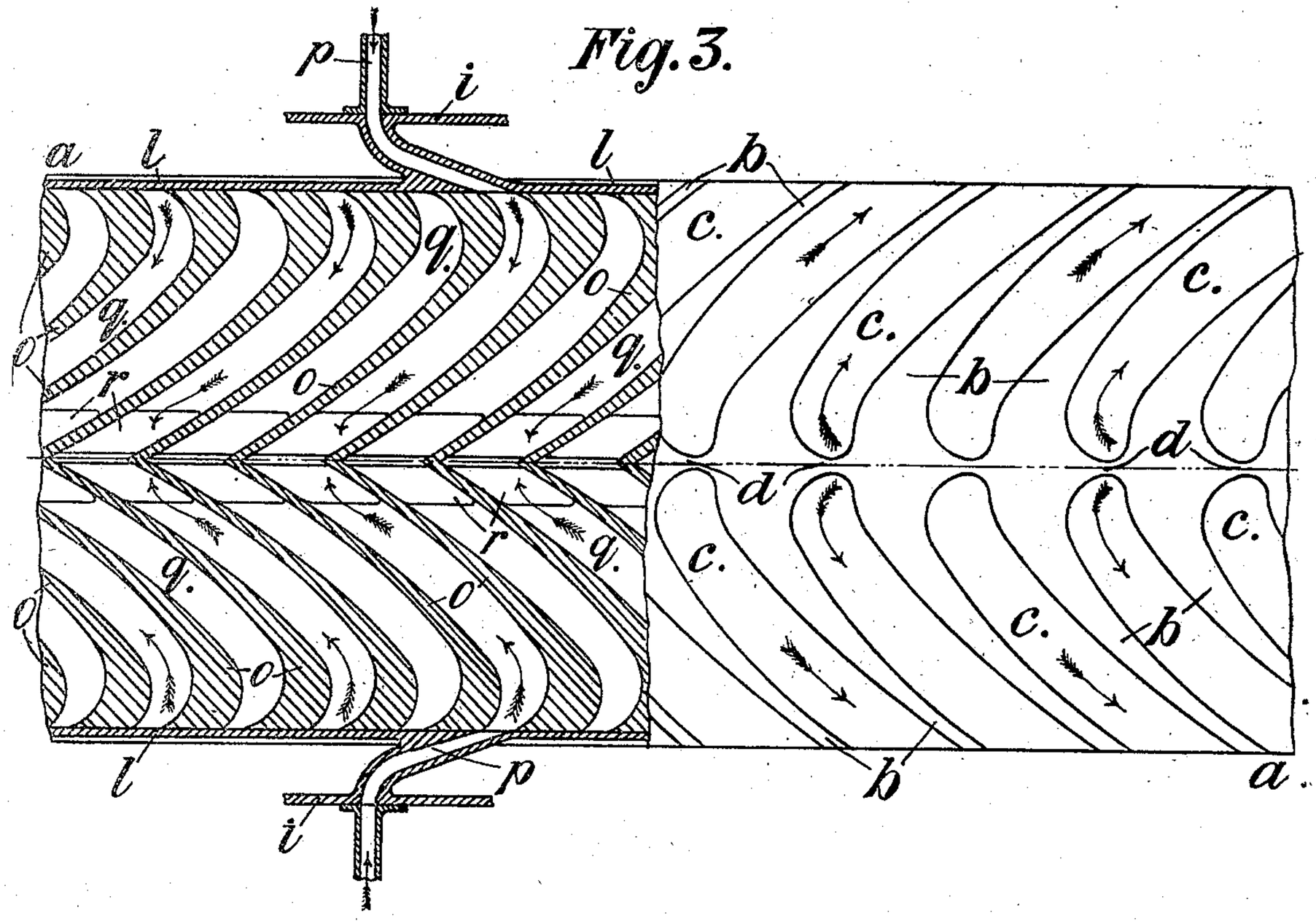


Fig. 4.

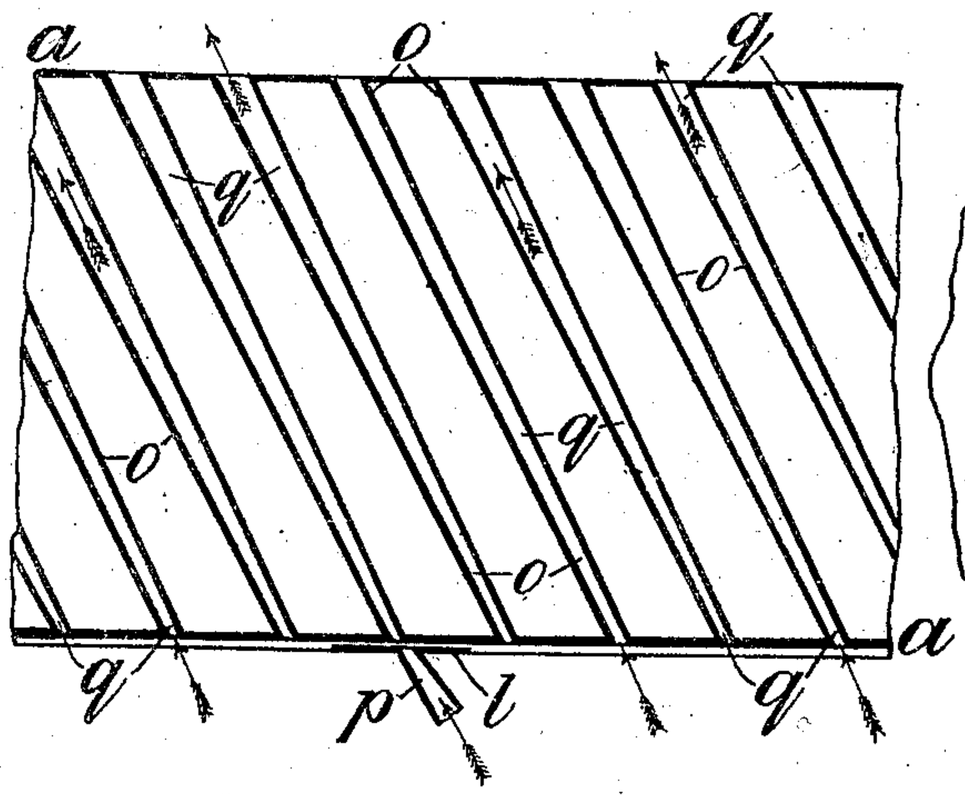
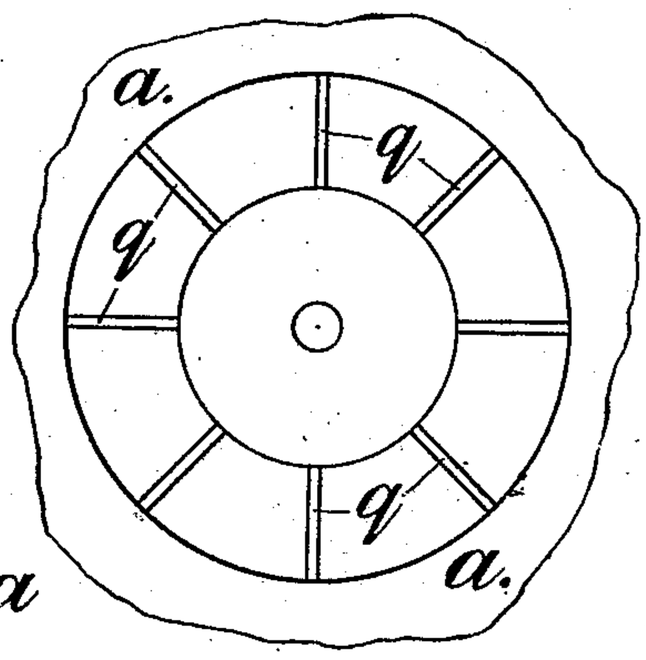


Fig. 5.



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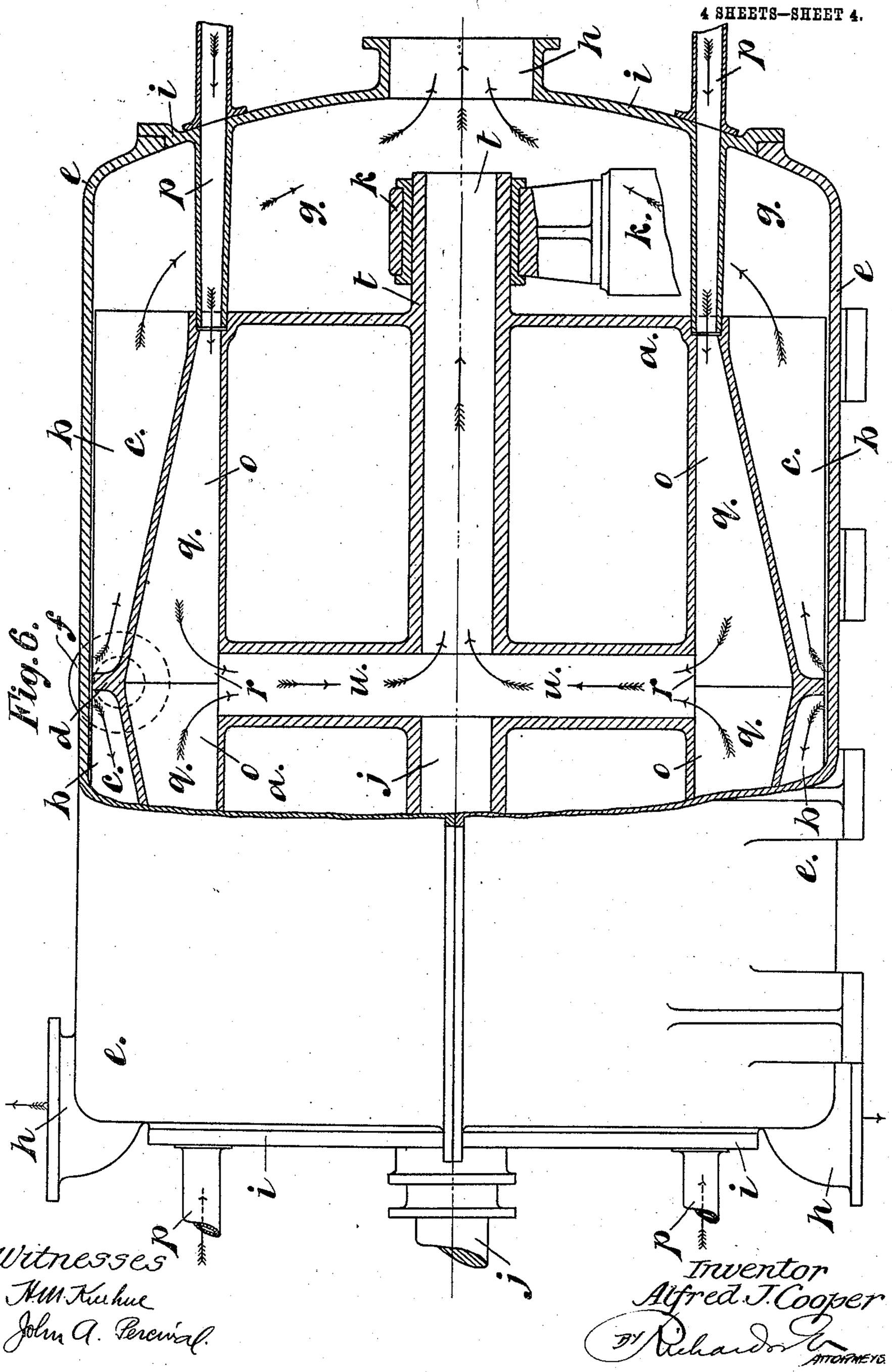
4 SHEETS—SHEET 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

ALFRED J. COOPER, OF LIVERPOOL, ENGLAND.

TURBINE.

No. 845,334. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed May 22, 1905. Serial No. 261,728.

To all whom it may concern:

Be it known that I, ALFRED JOPLING COOPER, a subject of the King of England, residing at Liverpool, in the county of Lancaster, England, have invented new and useful Improvements in Turbines, of which the following is a specification.

This invention has reference to turbines driven by the impact and force, due to the velocity and pressure therefrom, of steam or other motor fluid; and it has for its primary objects and effects to provide a turbine-engine which is of simple construction and inexpensive to make and at the same time efficient as regards consumption of steam or motor fluid; and it also has for its object to provide a simple construction of reversible turbine.

The invention will be described with the aid of the annexed drawings, in which—

Figure 1 is a longitudinal sectional elevation. Fig. 2 is half in cross-section at A A, Fig. 1, and half in outside view; and Fig. 3 is a plan showing a rotary barrel laid flat. Figs. 4 and 5 are sectional plan and end elevation of a modified form of stern or reverse blades for driving the engine in the reverse direction to the normal. Fig. 6 is a sectional view showing a modified mode of exhausting the stern system of blades.

The rotary barrel *a*, which has the propelling-blades *b* upon its periphery, is relatively long, and the motor fluid is introduced by nozzles *f* on the casing *e* at about a tangent to the circle passing through the centers of the blades *b*, and the steam strikes the blades *b* near the center longitudinally of the barrel and then is caused to travel, due to the form of the blades, (which form channels *c*,) in a curved direction outward and forward and then backward obliquely, it being discharged at the edge of the barrel. Therefore after striking the curves of small radius of the blades near the center it is caused to flow in a backward and outward direction by the rest of the curvature of the blades, which is of larger radius and which forms the greater portion of the length of the blade. Thus the steam is kept acting upon the blades for a relatively great length of time, during the greater part of which it is acting on the outer part of the larger radius. These blades constitute generally those used for driving the motor in the normal or "forward" direction. Then inside the blades *b* there is an annular set of blades *o*, which are of the same form substantially as the blades *b*, but set in the reverse direction, steam being admitted to them from the ends of the barrel by nozzles *p*, set at an inclination (see Figs. 1 to 3) and exhausting at the center.

The cylinder or casing *e*, in which the barrel *a* works, has a chamber *g* at each end, with exhaust branches *h* upon it, and a cover *i* is provided on each, through which the shaft *j* of the barrel *a* passes, this shaft being supported in bearings *k* outside the casing. The reverse steam-supply nozzles *p* extend through the covers *i*, and a ring *l* is connected with their ends, which keeps the outer ends of the channels *q*, formed by the blades *o* and their inner and outer annular walls, closed at the steam-inlet end. The steam exhausts from the passages *q* through the openings *r* into the hollow space within the barrel, which are in communication with the exhaust-chambers *g*.

The "ahead" blades *b* are shallow at the point of entrance of the steam (see Fig. 1) and increase in radial depth toward the edges, so that a greater area of blade is acted upon by steam as it expands and flows outward, and similarly the ways *q* and blades *o* are shallow near the point of entry—namely, at their edges—and increase in radial depth toward the center at the point of exhaust. The forward blades *b* also are curved forward in the radial direction—that is, they overhang at the outer edges of the channels *c*. This causes the steam in striking them to be directed inward toward the barrel, so that the motor fluid tends to drive into the blades and under the overhanging part and crowd under it, giving thereby an increased effective impact-pressure, while at the same time little or no back pressure or negative effect upon the leading surface of the blade next in sequence is caused, and then in addition to this the steam acting upon the blades *b*, first at the sharp curvature—namely, at about a tangent to the direction of flow of the steam (and this applies to both forward and reverse)—and then at the less curvature and for a continued contact a highly efficient and economical propulsive effect and consumption of steam is accomplished. The steam in entering the cylinder can be by separate nozzles *f*, arranged on each side of the septum *d*, which separates the channels *c* at the center, and this steam by the curvature of the blades is guided outward right and left.

By this construction of turbine a full and efficient propulsive effect from the force of the motor fluid is utilized and economically, while at the same time a very simple and cheap construction and type of turbine is furnished, and for large-powered turbines especially it furnishes substantial advantageous qualities and characteristics. The construction may be applied and used in a single unit or in multiple units and arranged and adapted to suit the varying conditions and requirements of the differing applications of the invention or improvements. Where desired, the exhaust-passages *h* can be connected to a condenser for maintaining a vacuum in the end chambers *g*, or they could be connected up with a second turbine in case it is desired to work with higher pressures and with a plurality of turbines in series.

In the turbine shown in the annexed drawings the steam is supplied at the center in connection with duplicate sets of blades; but, if desired, instead of duplicate sets of blades being used only a single set may be employed.

In the modification shown in Figs. 4 and 5 the reversing propelling-pasages *q* are inclined in a direct line, in which case the steam from the nozzles *p* will be introduced to them in a direction parallel with the axis of the barrel, and the force of the impact on the inclined blades *o* and flow over them from one end to the other will produce the reverse propulsive effect. The inclination of these blades and passages and propulsive effect will be opposite those of the outer set of blades, which will be of the same construction as that set forth with reference to and shown in Figs. 1 to 3.

In some cases a double set of these inclined blades *o*, as shown in Figs. 4 and 5, may be used in annular arrangement, the steam or fluid escaping from the discharge at one end of the barrel being returned through the other set, in which case a cover at the end of the barrel opposite the supply-nozzles would be provided to receive the steam from one set and return it to the others.

With regard to Fig. 6 the exhaust-passage *r* of the inner set of blades and passages *o q* extend to the center, and one part of the barrel—that is, the right-hand half—is supported in a bearing *k* inside the right-hand chamber *g* by an extension of its end in tubular form at *t*, and the exhaust from the inner set of passages passes down through the openings *r* to a central chamber *u* and thence through a hollow center and out into the right-hand chamber *g* and then through the central exhaust branch *h* of the cover. On the other side of this chamber *u* there is a solid shaft *j*.

What is claimed is—

1. A turbine in which a barrel working in a case *a* has blades *b*, extending in the direction of length of the barrel, the blade-surfaces being in curved form, and nearly tangential to the flow of steam, and of comparatively short radius at the point at which the steam impinges upon them, and extending beyond this part in the direction of length of the barrel in curved form of greater radius than the said impact part, and round in a backward direction, the depth of blade increasing from the point of impact to the point of discharge.

2. A turbine in which a barrel working in a case has longitudinal blades *b* on its periphery, extending in the direction of length of the barrel, and curved in the direction of their length, and another set of blade-surfaces, extending longitudinally through the barrel, and disposed annularly within the outer blades each of the blades varying in width.

3. A turbine in which a barrel working in a case *a* has blades *b* on its periphery, extending in the direction of length of the barrel, the blade-surfaces being in curved form, and nearly tangential to the flow of steam, and of comparatively sharp or short radius at the point at which the steam impinges upon them, and extending beyond this part in the direction of length of the barrel in curved form of greater radius than the said impact part, and round in a backward direction, the depth of blade increasing from the point of impact of fluid to the point of discharge; and reverse propelling-surfaces *o*, arranged inside the blades *b* annularly, and consisting of curved surfaces and passages, the surfaces at the points at which the entrance of steam takes place being about tangential to the direction of the jet of steam at their entrance, and of a short radius, and the curve between this point and the discharge-point being of a larger radius and inclined obliquely to the axis of the shaft or barrel, and in the direction of length thereof.

4. A turbine in which a barrel working in a case *a* has two sets of blades on its periphery, extending between the center and the ends in opposite directions along the barrel, and of curved form, the curvature being nearly tangential to the flow of steam at the point at which the steam impinges upon them, and of comparatively short radius, and extending from this point to the point of discharge in a curve of greater radius than the said impact part, and an inner set of blade-surfaces arranged inside the outer sets of blades annularly, and consisting of two sets of curved surfaces and passages on either side of the center of the barrel of similar form to the outer sets, but of opposite dispositions and direction; one set being supplied with steam at the center of the barrel, which flows right and left toward its edges, and the other set being supplied with steam at the ends of the barrel, which flows toward each other and discharges at the center.

5. A turbine-barrel working in a case *a*, having blades *b*, extending in curved form in the direction of length of the barrel, the blade-surfaces being in curved form, and nearly tangential at the point at which the steam impinges upon them to that of the direction of the steam, and of comparatively short radius, and inclined in a forward direction radially, so that the tip or outer part of the blade overhangs the part below it; and the depth of blade increasing from the point of impact to the point of discharge.

6. A turbine-engine, in which a rotary barrel revolves in a cylinder, and has duplex sets of blades, extending between the center point of the barrel and the edges of same, and chambers *g*, at the ends of the barrel in the case *a*, into which all the motor-fluid passages discharge or exhaust the motor fluid.

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

ALFRED J. COOPER.

Witnesses:

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W. HARRISON.