No. 733,105. PATENTED JULY 7, 1903.

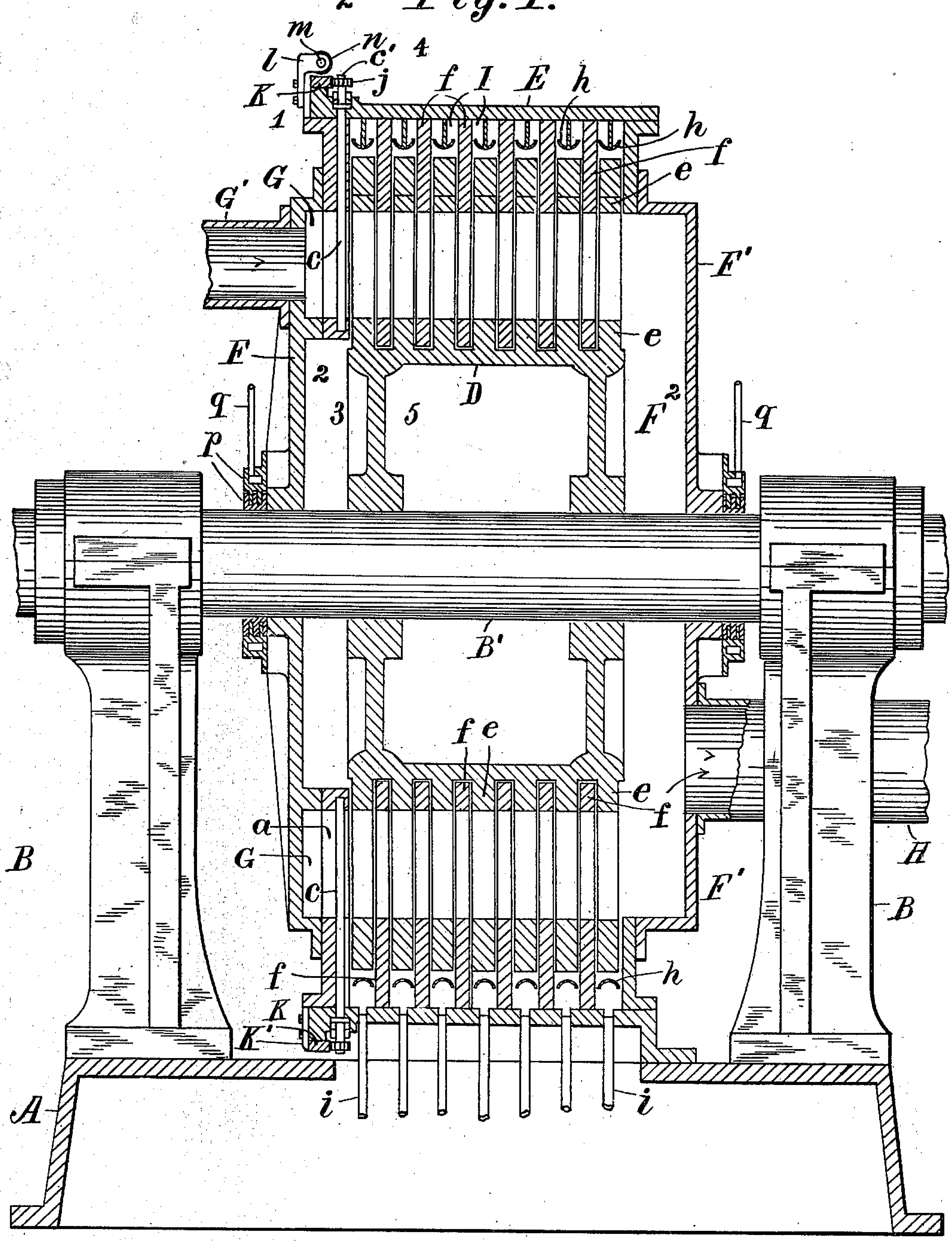
L. WILSON.

ELASTIC FLUID TURBINE.

APPLICATION FILED JAN. 30, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

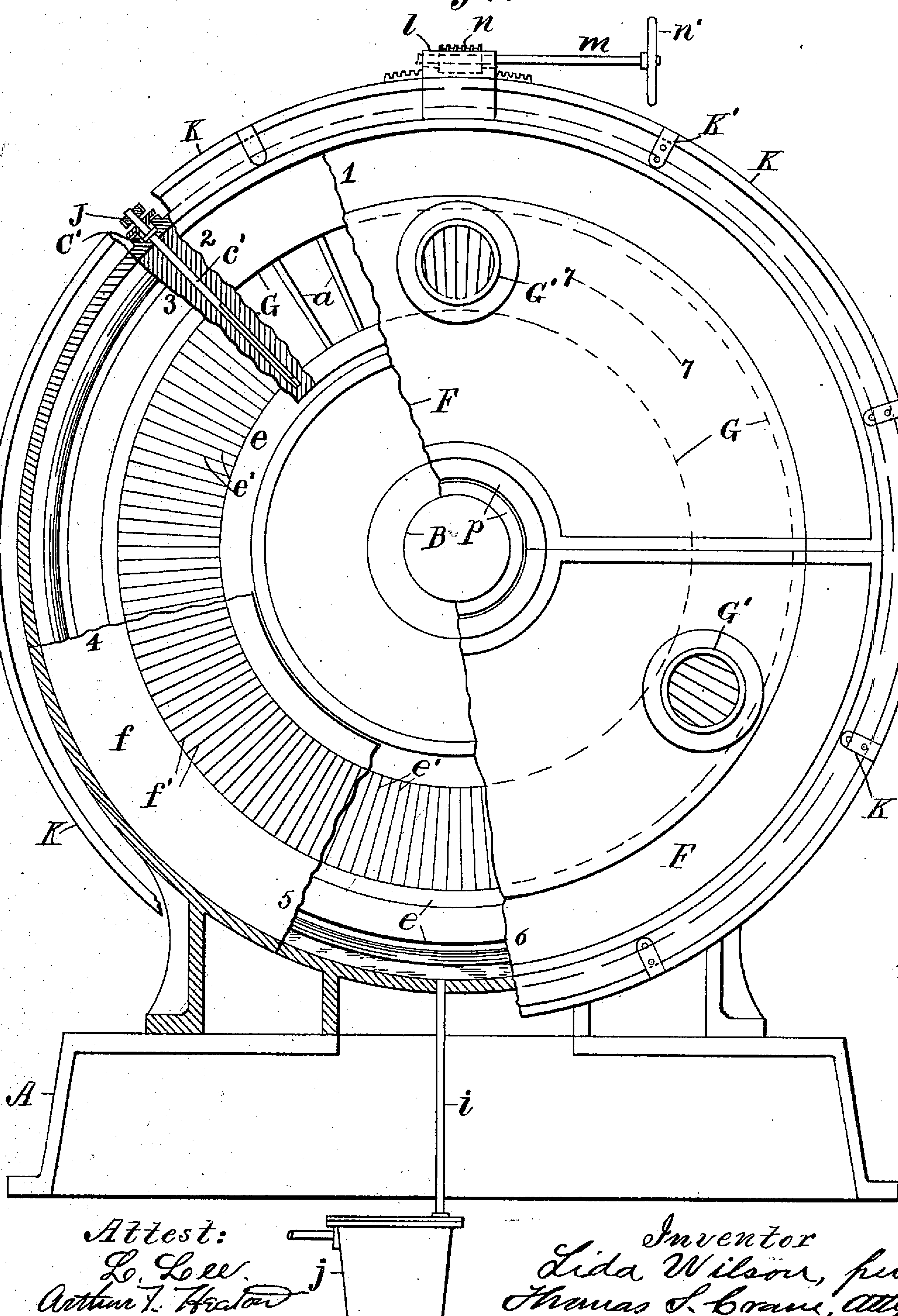

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Fig. 3.

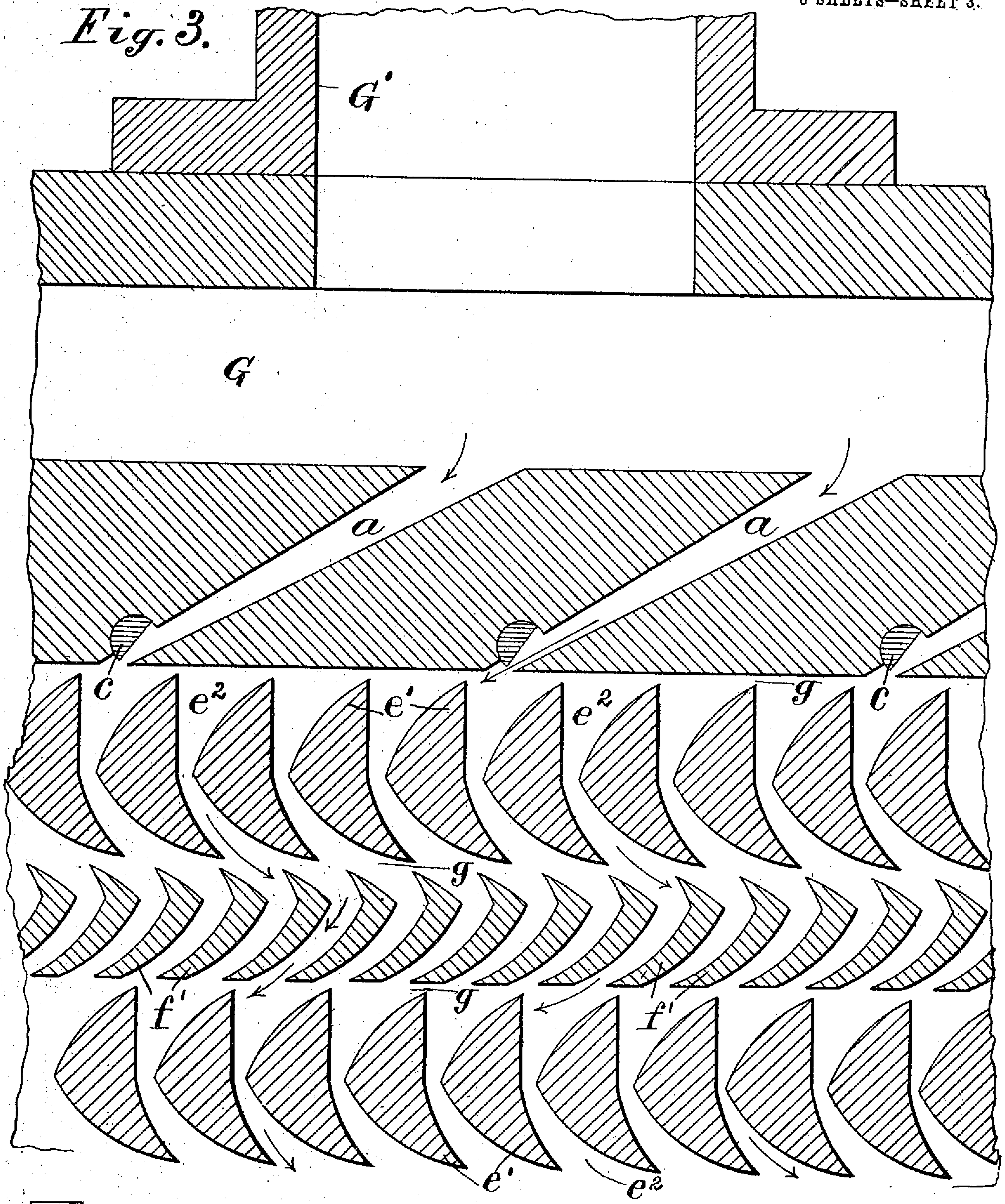


Fig. 4.

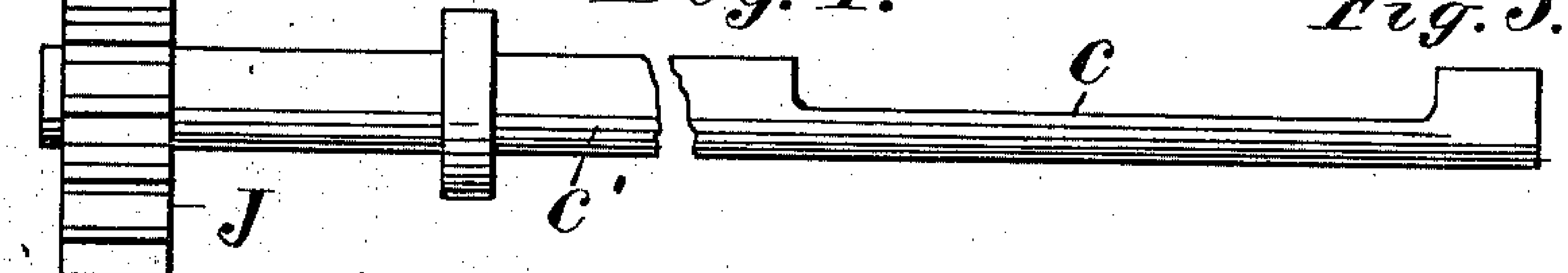
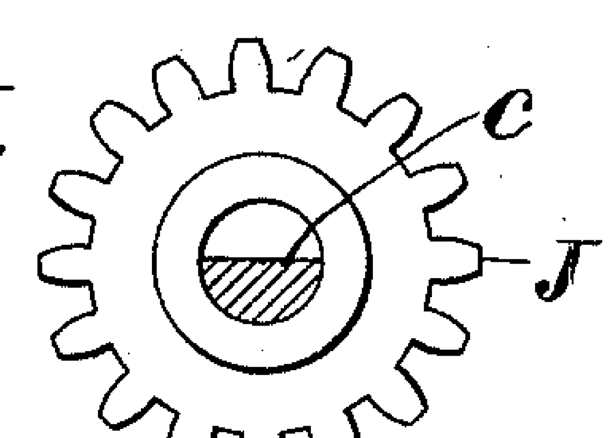


Fig. 5.



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No. 733,105. Patented July 7, 1903.

UNITED STATES PATENT OFFICE.

LIDA WILSON, OF BROOKLYN, NEW YORK.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 733,105, dated July 7, 1903.
Application filed January 30, 1903. Serial No. 141,159. (No model.)

To all whom it may concern:

Be it known that I, LIDA WILSON, a citizen of the United States, residing at Pierrepont House, Montague street, Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Elastic-Fluid Turbines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The present invention relates to improvements in turbines operated by steam or other gaseous elastic fluid, whereby liquid occurring in the turbine may readily be removed therefrom and whereby the gaseous elastic fluid may be maintained at high pressure (even when being used at reduced volume) until it is discharged from the nozzles upon the blades of the turbine.

For turbines having moving blades liquid intermeshed between these causes great friction, especially if arranged in alternate series with fixed blades or alternately with other moving blades running in a reverse direction; and this invention provides means for the prompt removal of such liquid and to prevent its further friction with the moving parts of the turbine. I effect this by the following-described appliances: Between the fixed blades (when such exist in the turbines) and the moving blades and (when there are no fixed blades) between the moving blades themselves a clearance-space provided through which the liquid may be thrown outward in the direction of the outer casing by the centrifugal action of the moving blades. The liquid so ejected would upon striking the casing be reflected back onto the moving blades unless caught and removed from the turbine. For this purpose I provide a trough located in a chamber around each series of the moving blades between them and the outer casing to receive the discharged liquid. These troughs are separated from each other when there are fixed blades in the turbine by the rings which attach the fixed blades to the casing, or in case all the blades revolve, by rings extending between each series of moving blades for a short distance toward the center of the turbine, the clearance-space between the moving blades being sufficiently enlarged for such distance to allow space for such rings. At the upper part of the turbine the chambers receive the liquid and deflect it into the troughs, (thrown centrifugally by the moving blades,) and at the lower part of the turbine the troughs return the liquid again to the chambers, whence it is removed through pipes to suitable traps which permit the exit of the liquid, but not of gas, (such as steam,) so that any hot gas (such as steam) which passes with the liquid to the chamber through the clearance-space between the respective blades cannot escape from the turbine-casing with the liquid, but forms a heating-jacket around the moving blades and helps to equalize the expansion of the outer with that of the inner parts of the turbine. The fixed blades and other stationary parts of the turbine may be provided with water-lute joints where desired around the shaft and other moving parts of the turbine.

In turbines operated by steam or other gaseous elastic fluid it is desirable to regulate the supply of such motive fluid in proportion to the work to be done from time to time. If this is effected by throttling off the gaseous motive fluid by the main supply-valve, it reaches the turbine-blades much expanded at greatly-reduced pressure and correspondingly-reduced efficiency. It is therefore desirable to throttle the gaseous motive fluid in the nozzle by which it enters the turbine as near to their inner orifices adjacent to the turbine-blades as possible, so that the pressure may be fully maintained (even when the volume delivered to the blades is reduced) up to the said orifices, which should be so situated that the gaseous motive fluid has the shortest possible distance to travel therefrom and in which to expand itself before its primary impact upon the turbine-blades. I effect this by inserting a rotatable throttle-valve of special construction in each nozzle situated as close to the inner orifice adjacent to the blades as possible, the shank of each throttle-valve extending through a suitable stuffing-box to the outside of the turbine and all the shanks connected to be actuated simultaneously by suitable gearing, which may be operated (as preferred) by hand or automatically by a governor of any convenient type. The drawings illustrate the throttle-valves placed in a series of nozzles leading from the gaseous-motive-fluid-supply chamber to the turbine-blades. On the throttle-valve shanks outside the turbine are pinions actuated by teeth on a ring surrounding the casing, this ring being actuated by suitable gearing moved by the governor or by hand when preferred.

My invention will be understood by reference to the annexed drawings, in which—

Figure 1 is a side elevation in section at the center line where hatched of a turbine employing my improvements. Fig. 2 is an end elevation of the turbine-casing with the parts broken away where hatched into sections at various planes, the portion between lines 1 and 2 being in section on line 1 2 in Fig. 1, the portion between lines 2 and 3 being in section on line 2 3 in Fig. 1, the portion between lines 3 and 4 and 5 and 6 being in section at the end of the drum, and the portion between lines 4 and 5 being in section on line 4 5 in Fig. 1. Fig. 3 is a section on line 7 7 in Fig. 2. Fig. 4 is a side view, and Fig. 5 a cross-section near the top end, of one of the nozzle-valves. Figs. 3 to 5 are on a large scale.

A designates the bed-plate, and B the pedestals for the shaft B′ of the turbine-drum D. The drum is carried by the shaft and has attached to it a series of wheels *e*, having radial impact-blades *e*′ and rotated within the casing formed of the shell E and heads F F′. The head F is formed with an annular motive-fluid chamber G, from which nozzles *a* extend nearly to the impact-blades *e*′ on the first wheel *e*. The motive-fluid chamber is supplied with motive fluid by one or more pipes G′. Each wheel, as shown in Figs. 2 and 3, is formed with a series of radial blades *e*′, the spaces e^2 between the blades forming channels through which the motive fluid passes from one side and direct it backwardly from the opposite side. The wheels are spaced apart upon the shell of the drum sufficiently to admit intermediate flat rings *f*, which are attached to the casing E and are formed with blades *f*′, adjacent to the blades *e*′, the faces of the blades *f*′ being opposed reversely to the faces of the blades *e*′, so as to receive the backward current of motive fluid and discharge it again forwardly upon the blades of the succeeding wheel *e*. The nozzles *a* are extended radially at suitable intervals and are tapered in cross-section and inclined from the chamber G to their outlets to deliver the motive fluid in a forward direction upon the blades *e*′. A space is provided between the periphery of each wheel and the casing to form a chamber I between the adjacent flat rings *f*. A clearance-space *g* is formed between each of the rings and wheels to permit the escape of liquid which may be condensed between the blades, and an annular trough *h* is attached to the casing within the chamber I by a central plate *h*′ to receive the liquid which is discharged from the wheels and prevent it from falling back again upon the wheels. The chamber I, existing between flat rings *f*, serves in the lower half of the casing to lead the liquid to its lowest point, where a discharge-pipe *i* conducts the liquid to a trap *j*. One of the traps is shown for illustration in Fig. 2. Seven of the wheels *e* are shown upon the drum in Fig. 1, and the motive fluid is therefore expanded repeatedly in passing from one wheel to another through the blades of the stationary ring *f*. The rings *f* extend from the casing inwardly, close to but not in contact with the shell D of the drum, and thus divide the interior of the casing into separate chambers, each of which is trapped separately by the construction described, so that condensed liquid is not only discharged from the bottom without permitting gas to escape, but communication between the chambers I, surrounding the several wheels, is prevented. The flat rings *f* thus form partitions which prevent the motive fluid in one of the chambers I from communicating with the motive fluid in any of the other chambers I, and the reduction of pressure, therefore, takes place by the expansion of the motive fluid in passing through the blades *e*′ and *f*′. The casing contains an exhaust-chamber F^2 at the last of the series of wheels, into which the exhaust-steam is delivered and discharged therefrom by any suitable outlet, as the pipe H in Fig. 1.

Fig. 3 shows several of the nozzles *a*, having enlarged inlets from the chamber G, the inclination of the nozzle to the side of the wheel *e* forming a sharp corner at one side of the nozzle's outlet, opposite to which a sectoral valve-plug *c* is fitted in a sectoral groove formed along the side of the nozzle opposite to said corner. The valve in cross-section is a sector of a circle and is fitted to the sectoral groove, so as to lie flush with one side of the nozzle when full opening of the latter is desired. The valve is so located that when the edge nearest to the outlet of the nozzle is turned inwardly, as shown in Fig. 3, it moves toward the sharp corner at the opposite side of the nozzle's outlet, and thus contracts the passage directly adjacent to the delivery-point, where the motive fluid is discharged upon the blades *e*′. This construction is adapted to prevent the expansion and consequent loss of pressure in the motive fluid when throttled at a distance before it is discharged upon the first rotating wheel, and this effect is produced by employing the rotating valve-plugs and locating them opposite to the sharp corner at the outlet of the nozzle, where they may operate at the actual delivery-point. The stems *c*′ of the valves are of cylindrical form and are extended radially outward through the casing, which is provided with stuffing-boxes C′ for the stems. Beyond the stuffing-boxes a toothed pinion J is applied to each of the stems and meshes with an annular ring-gear K. The ring-gear is broken away in Fig. 2 to expose one of the pinions and is shown in Fig. 1 fitted to a circular seat upon the left-hand end of the shell E, upon which it may be moved to turn the pinions. Bearings *l* are attached to the shell E and support a shaft *m* and a worm *n*, which meshes with a section of teeth upon a periphery of the ring-gear. A hand-wheel *n'* upon the shaft *m* enables the operator to turn the ring-gear and adjust all of the valves *c* within the nozzles simultaneously. The heads F' are shown provided with lute-joints applied to the shaft B' where it passes through the heads. Such joint furnishes a means between the stationary and revolving parts of turbines to prevent the escape of fluid, while avoiding the friction and heat engendered by a closely-fitting packing. The lute-joint is composed of a series of rings and intermediate grooves upon one surface and corresponding rings and intermediate grooves upon the other surface, the opposing rings and grooves intermeshing with one another nearly but not quite in contact, so that fluid between such rings and grooves renders them fluid-tight by their centrifugal action as they revolve intermeshed with one another. A ring P upon the shaft B' is shown provided with such rings and grooves, and the head F' is provided with an annular chambered casting having similar rings and grooves, the chamber being supplied with water under pressure by a pipe *q*, which water is delivered from the chamber between the rings by suitable passages, so as to lubricate the moving parts. The centrifugal force generated by the rotating rings throws the fluid forcibly into the opposed grooves, and thus forms a fluid-tight joint which prevents the escape of any fluid from the casing, while the moving surfaces are fully lubricated. Such a packing of luted rings and grooves may be applied to the junction of any of the moving and stationary parts—as, for instance, the inner edge of the rings *f* and the adjacent surface of the drum D. It will be readily seen that the pressure within the casing tends to discharge through the lute-rings around the shaft any liquid that may be carried by the motor fluid, and where such liquid suffices to lubricate the rings the supply of liquid through the pipe *q* would not be required.

It will be observed that the blades carried by the drum are formed between a hub and felly, permitting each wheel to be made of cast metal in one piece and bored to fit upon the drum and secured thereto by any usual means. If made of cast metal, a metal tire or clamping-band (shown at *t* in Fig. 1) is preferably shrunk upon the felly to strengthen the wheel. The rings *f*, which contain the reversing-blades *f'*, are of similar construction, embracng an inner hub and an outer annulus, to both of which the blades *f'* are attached, and the outer annulus attached to the casing E. The cross-section of the blades *e'* and *f'* is clearly shown in Fig. 3 adapted to throw the current of motor fluid alternately in opposite directions to make impact with the opposing surfaces of the blades *e'* in the most effective manner. The blades may be strengthened by being connected circularly at intermediate points between the hub and felly.

Having thus set forth the nature of the invention, what is claimed herein is—

1. A turbine having moving blades, and opposed fixed blades to reverse the motion of the motive fluid, with a clearance-space between the respective sets of blades, a casing inclosing the whole, and a trough supported inside the casing surrounding the said clearance-space to catch the liquid discharged from the clearance-space.

2. A turbine having a series of moving wheels formed with blades, such wheels spaced at intervals, a casing inclosing such wheels, intervening rings fixed to the casing between the said wheels with clearance-space between such rings and wheels, the rings having opposed blades for reversing the motive fluid and forming chambers within the casing around said wheels, and a trough supported in each chamber surrounding each wheel to catch the liquid discharged from such clearance-space, a pipe for drawing the liquid from the said chamber, and a trap connected with such pipe to prevent the escape of gas therefrom.

3. In a turbine, the combination, with several series of moving blades arranged at intervals, and a gas-tight casing surrounding said blades, of rings attached to the casing extending inwardly between the respective series of moving blades, the said rings supporting stationary blades between the respective series of moving blades, with a clearance-space between such respective series, the gaseous motive fluid expanding progressively in the several series of fixed and moving blades and becoming gradually reduced in pressure in its progress through said successive series of blades, troughs in the chambers between the rings to guide, receive and transmit the liquid from the clearance-spaces, a pipe from each chamber to draw the liquid from the same and a separate trap upon each of the said pipes to discharge the liquid without permitting the gaseous motive fluid to pass out.

4. In a turbine, the combination, with blades carried therein, and a casing inclosing them, of nozzles to deliver the motive fluid upon the blades, within the casing, rotatable valves inserted across the nozzles near their outlets and adapted when turned to contract the area of the nozzles directly adjacent to the said blades, a ring-gear encircling the casing, a pinion upon each valve-stem outside the casing and meshing with such ring-gear, and means for turning the ring-gear to adjust the valves simultaneously.

5. A turbine having a drum provided with and supporting a series of wheels, each comprising a hub, felly and intermediate blades of suitable shape to cause the motive fluid to traverse laterally through the wheel and to

deflect it backwardly, and a clamping-band applied outside of the felly to hold the wheel firmly together.

6. The combination of a turbine, of a drum provided with and supporting series of spaced moving wheels each comprising a hub, felly, clamping-band and intermediate blades, of suitable shape to cause the motive fluid to traverse laterally through the wheel, and to deflect it backwardly, a casing surrounding the wheels, stationary rings attached to the casing between the wheels, and having passages of suitable shape to cause the motive fluid to traverse laterally through them and direct it forwardly, clearance-spaces between each wheel and the adjacent rings, a chamber containing a trough around each moving wheel between its periphery and the casing, means to remove liquid from each chamber separately but not to permit gas to pass out with such liquid, nozzles provided with rotatable valve-plugs near their orifices, the valves being arranged to be turned simultaneously by suitable gearing, luted rings and grooves to form fluid-tight joints where desired between stationary and moving parts of the turbine, all provided, constructed and combined in the same turbine, as and for the purposes and substantially as herein described.

7. The combination in a turbine, of a drum provided with and supporting series of spaced moving wheels each comprising a hub, felly, clamping-band and intermediate blades of suitable shape to cause the motive fluid to traverse laterally through the wheel and to deflect it onto the adjacent moving wheel, a casing surrounding the wheels, stationary rings attached to the casing and extending inwardly for a short distance therefrom between each series of moving wheels, clearance-spaces between each moving wheel and its adjacent moving wheels, a chamber containing a trough around each moving wheel between its periphery and the casing, the chambers being separated by the stationary rings attached to the casing extending inwardly for a short distance between the moving wheels, means to remove liquid from each chamber separately but not to permit gas to pass out with such liquid, nozzles provided with rotatable valve-plugs near their orifices, the valves being arranged to be turned simultaneously by suitable gearing, luted rings and grooves to form fluid-tight joints where desired between stationary and moving parts of the turbine, all provided, constructed and combined in the same turbines, as and for the purposes and substantially as herein described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LIDA WILSON.

Witnesses:
THOS. F. J. KELLY,
R. W. WOOD.