(No Model.)

3 Sheets—Sheet 1.

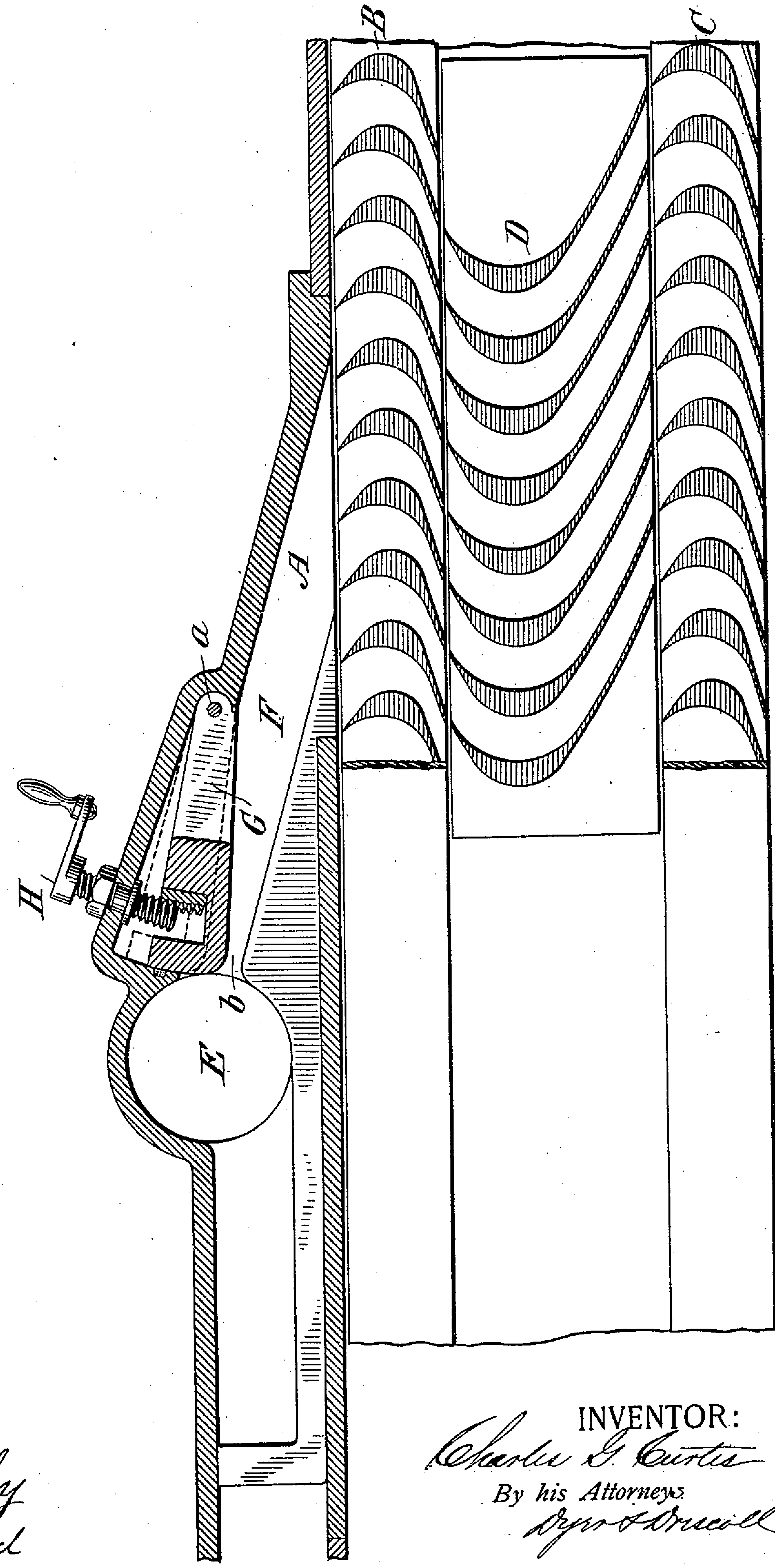
C. G. CURTIS.

ELASTIC FLUID TURBINE.

No. 589,466.

Patented Sept. 7, 1897.

Fig. 1.



WITNESSES:

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THE NORRIS PETERS CO. PHOTO-LITHO., WASHINGTON, D. C.

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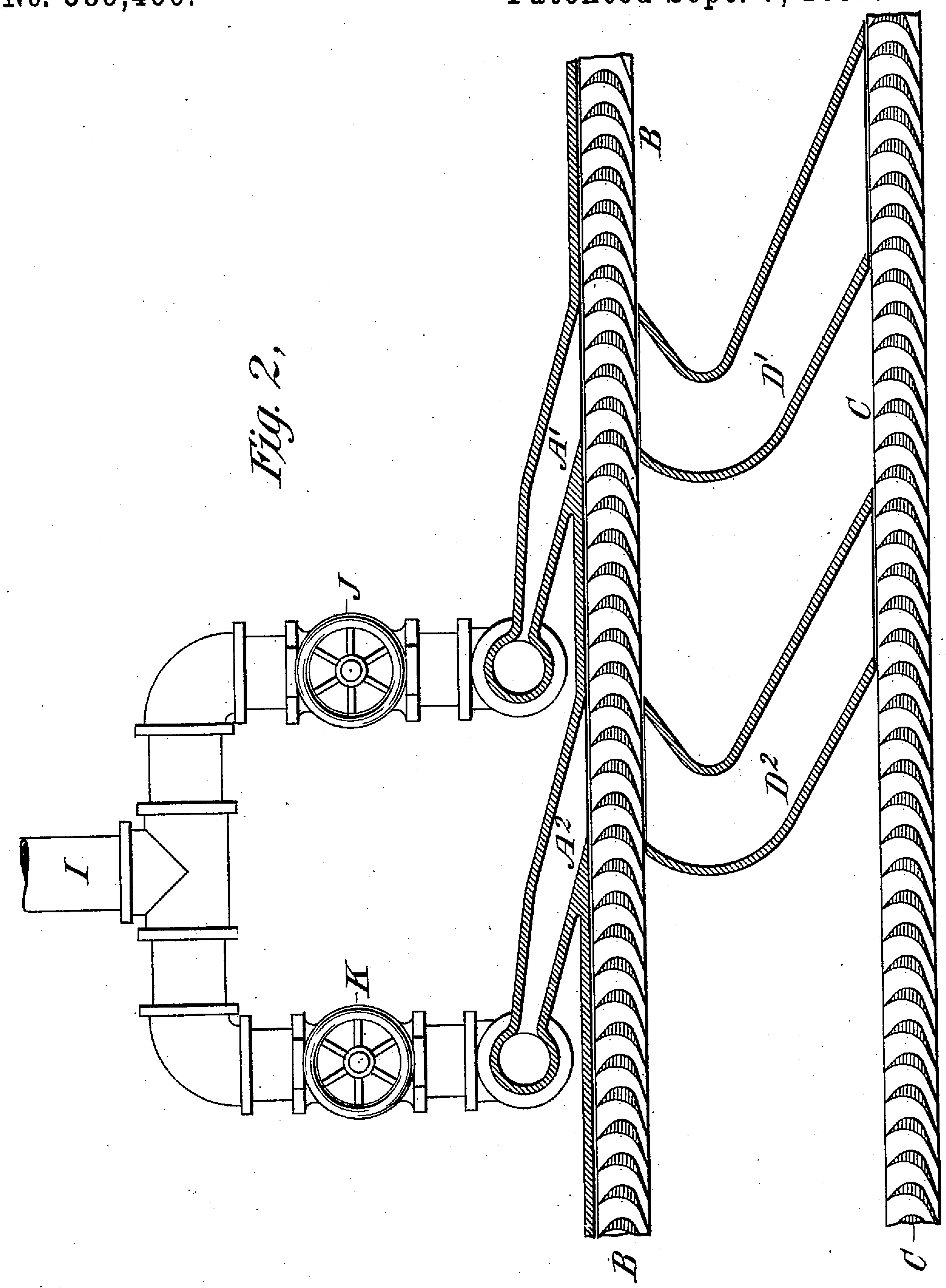
Fig. 2,



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3,

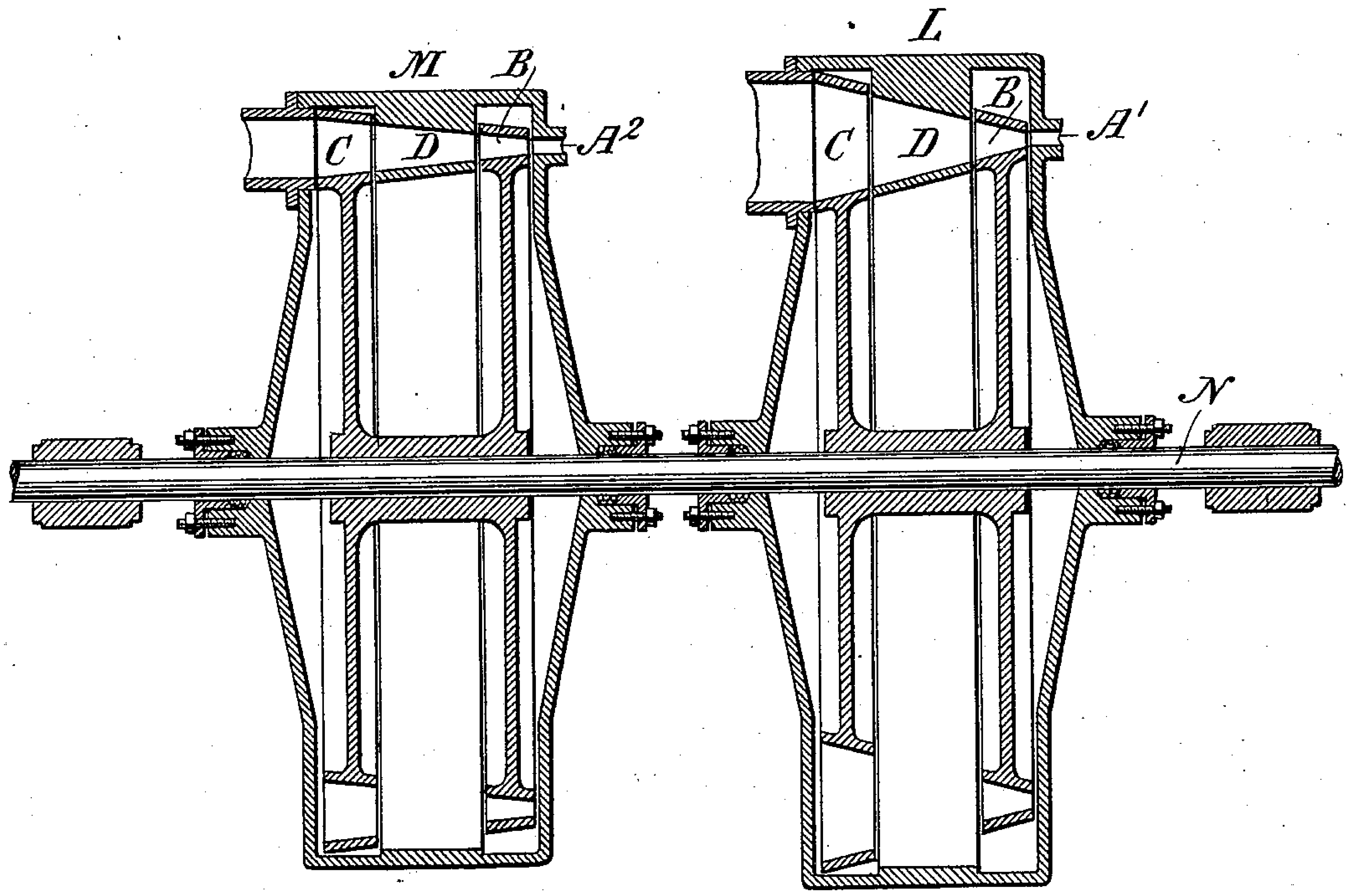


Fig. 4,

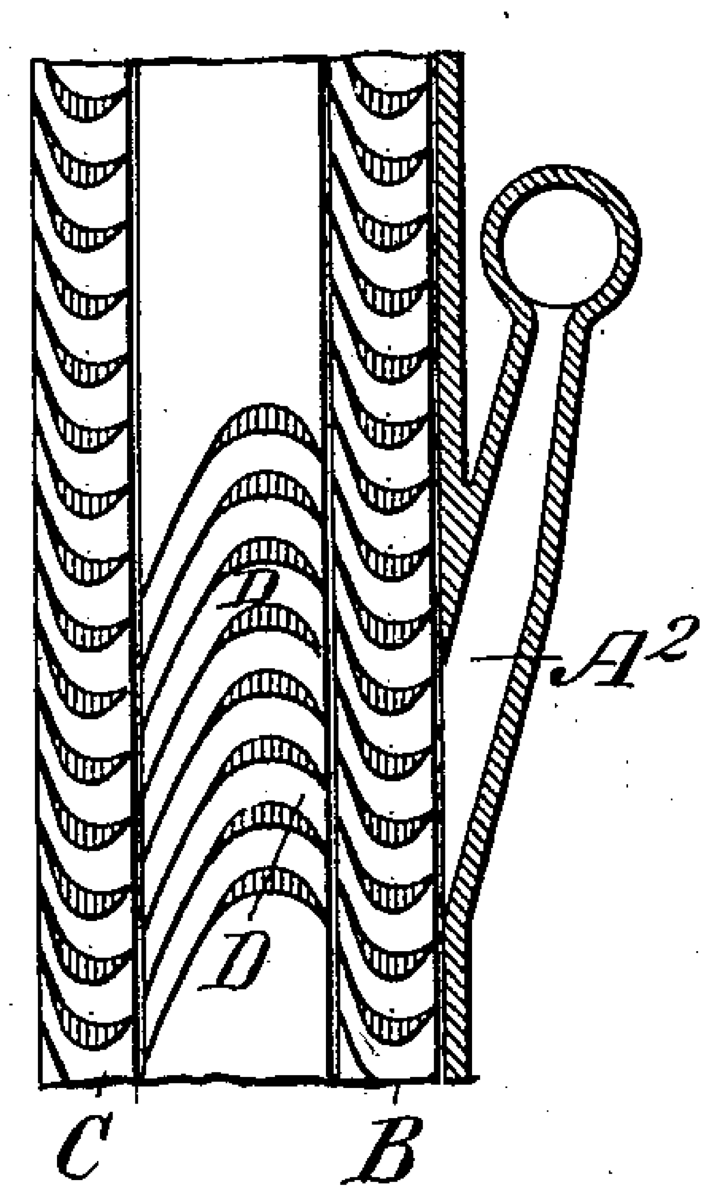
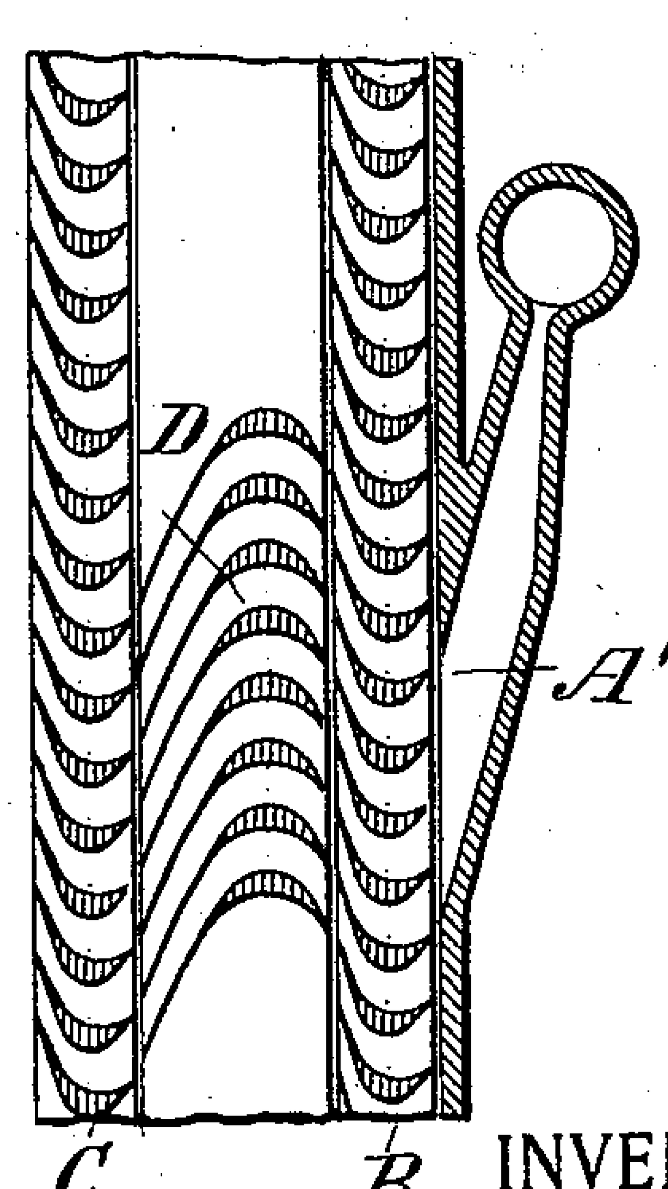


Fig. 5,



WITNESSES:
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INVENTOR:
Charles G. Curtis
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UNITED STATES PATENT OFFICE.

CHARLES G. CURTIS, OF NEW YORK, N. Y., ASSIGNOR TO THE CURTIS COMPANY, OF SAME PLACE.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 589,466, dated September 7, 1897.

Application filed August 4, 1896. Serial No. 601,601. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. CURTIS, a citizen of the United States, residing at New York city, in the county and State of New York, have invented a certain new and useful Improvement in Elastic-Fluid Turbines, of which the following is a specification.

The object I have in view is to produce an elastic-fluid turbine which may be used either as a condensing or non-condensing engine with high efficiency.

The invention is especially applicable to elastic-fluid turbines, such as are described in applications for patents already filed by me, Patents Nos. 566,967, 566,968, and 566,969, dated September 1, 1896.

In the accompanying drawings, Figure 1 is a horizontal section through the nozzle and vane-passages of one form of my elastic-fluid turbine embodying my present invention. Fig. 2 is a similar view illustrating a modification of the invention. Fig. 3 is a vertical section through a turbine of somewhat different form embodying my invention, and Figs. 4 and 5 are horizontal sections through the nozzles and vane-passages of the two elements of the turbine of Fig. 3.

In Fig. 1 is illustrated the invention applied to a turbine, wherein A is an expansion-nozzle. B C are two sets of rotating vane-passages mounted upon the same shaft, and D is a stationary intermediate passage divided by vanes. E is the inlet to the nozzle from the steam-boiler or other source of elastic fluid under pressure. F is an adjustable tongue forming one side of the expansion-nozzle and varying by its movement the size of the nozzle throughout its length simultaneously and proportionately, thus regulating the speed of the turbine by varying the volume of the fluid-jet unaccompanied by substantial variations in its velocity. The tongue F, as will be understood, is preferably connected with a speed-governing mechanism, whereby it is adjusted automatically. G is an adjustable piece pivoted at *a* and forming the diverging side of the nozzle opposite the tongue F. This piece G is adjusted by means of a hand-operated screw H, or by any other suitable means, so that the throat *b* of the nozzle may be varied in size and at the same time the divergence of the nozzle will be varied, so as to change the ratio of expansion of the elastic fluid and the ratio of conversion of pressure into velocity which will take place in the nozzle. If the position of the pivoted piece G, which is shown in full lines in Fig. 1, is that suitable when the turbine is working as a condensing-engine or with a vacuum exhaust produced otherwise than by a condenser, a larger opening at the throat *b* and a less divergence of the nozzle will be required when the turbine is working as a non-condensing engine or with an atmospheric exhaust. The adjustment of the piece G to the position indicated by dotted lines is intended to illustrate the position of that piece when the turbine is acting as a non-condensing engine. Whatever may be the adjustment of the piece G the tongue F operates by its movement to vary the cross-sectional area of the nozzle simultaneously and proportionately at its receiving and discharging ends. This means for varying the cross-sectional area of the receiving end or throat of the nozzle and for simultaneously varying the angle of divergence of the walls of the nozzle may also be employed to compensate for variations in the boiler or initial pressure when the turbine is working either with an atmospheric or a vacuum exhaust.

In the construction of turbine shown in Fig. 2 I employ two expansion-nozzles A′ and A^2, the former having the proper proportions for a condensing-turbine and the latter the proper proportions for a non-condensing turbine. The two sets of rotating vane-passages B C are connected by two intermediate stationary passages D′ D^2, the former having a larger cross-sectional area than the latter to accommodate the increased volume of the elastic fluid arising from its lower pressure when passing through the intermediate passage of the turbine when used as a condensing-engine over the smaller volume arising from the greater pressure which the elastic fluid will have at the same point when the turbine is used as a non-condensing engine. The two nozzles A′ A^2 are connected with the common supply-pipe I, valves J K being employed to admit the elastic fluid to one nozzle or the other, as may be desired.

I propose to apply for a separate patent upon the specific form of the invention shown in Fig. 2, Serial No. 619,742, filed January 19, 1897. It illustrates, however, one of the several ways of carrying out the broad invention herein claimed.

In Figs. 3, 4, and 5 is illustrated an elastic-fluid turbine having two elements L M, each composed of a wheel provided with rotating vane-passages B C and an intermediate stationary passage D. Two nozzles A′ A^2 are employed, connected with the supply of elastic fluid and controlled by separate valves, as are the similar nozzles of the construction shown in Fig. 2. The two wheels are mounted upon a common shaft N. This construction enables the proper theoretical expansion to be provided in the movable and stationary passages of the two elements of the turbine, so as to operate with the highest efficiency, whether condensing or non-condensing. This is illustrated in Fig. 3, in which the passages of the element L are proportioned for a condensing-engine and the passages of the element M are proportioned for a non-condensing engine.

What I claim is—

1. An elastic-fluid turbine comprising means by which the elastic fluid is used at different ratios of expansion, whereby the turbine may be used either as a condensing or a non-condensing engine, substantially as set forth.

2. In an elastic-fluid turbine, a delivery-nozzle adjustable to vary the ratio or degree of conversion of pressure into velocity therein, substantially as set forth.

3. In an elastic-fluid turbine, an expansion delivery-nozzle adjustable to vary the ratio of expansion, substantially as set forth.

4. In an elastic-fluid turbine, an expansion delivery-nozzle, in combination with an adjustable piece forming one of the diverging side walls and controlling and varying by its movement the ratio of expansion, substantially as set forth.

5. In an elastic-fluid turbine, a delivery-nozzle adjustable to vary the ratio or degree of conversion of pressure into velocity and also adjustable to vary the volume of the fluid without substantial variations in its velocity, substantially as set forth.

6. In an elastic-fluid turbine, a delivery-nozzle having one of its sides adjustable to vary the volume of the fluid without substantial variations in its velocity, and its opposite side adjustable to vary the ratio of conversion of pressure into velocity, substantially as set forth.

7. In an elastic-fluid turbine, the combination with the nozzle A, of the sliding tongue F and the pivoted piece G, substantially as set forth.

This specification signed and witnessed this 30th day of July, 1896.

CHARLES G. CURTIS.

Witnesses:
EUGENE CONRAN,
JNO. R. TAYLOR.