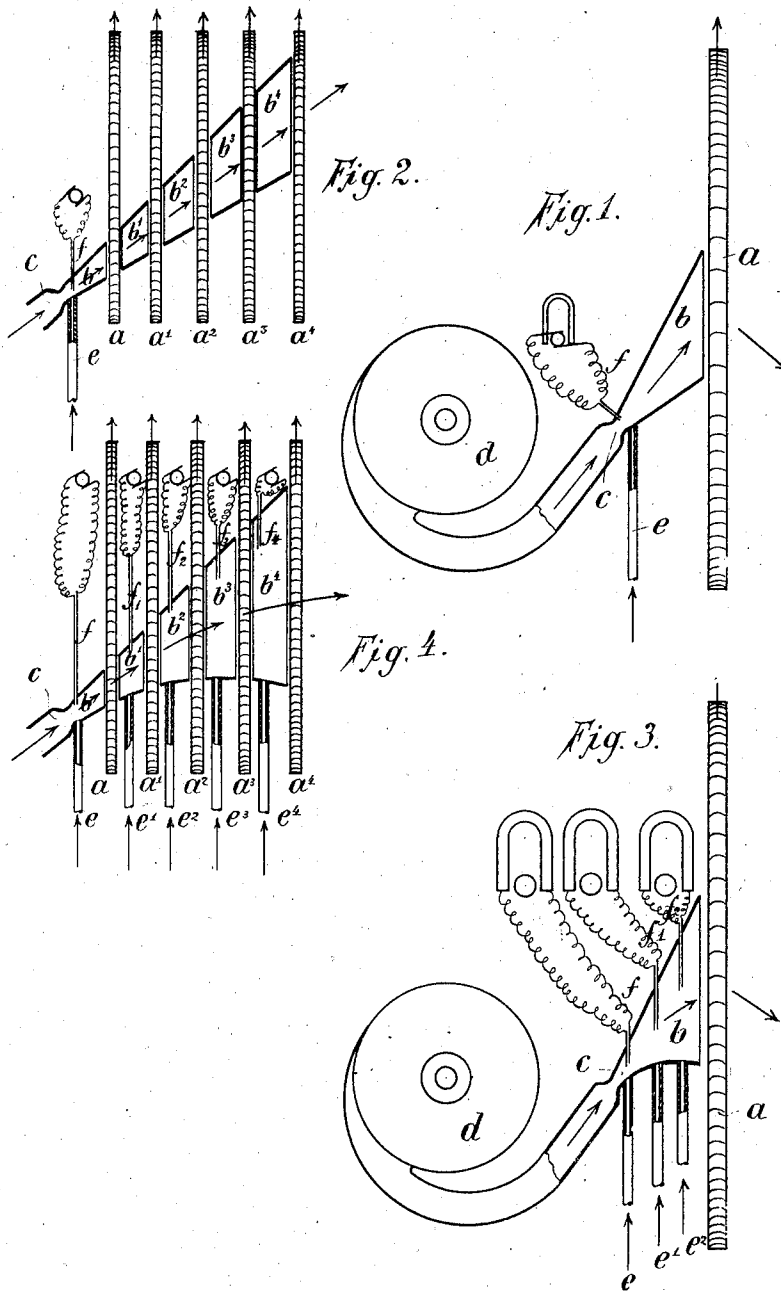


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PATENTED AUG. 27, 1907.

H. LENTZ.
TURBINE ENGINE.

APPLICATION FILED MAR. 31, 1905.



WITNESSES;

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TURBINE-ENGINE.

No. 864,315.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HUGO LENTZ, a subject of the German Emperor, residing at 10/11 Potsdamerstrasse, Berlin, Germany, have invented a new and useful Improvement in Turbine-Engines; and I do hereby declare the following to be a full, clear, and exact description of the same.

The present improvements relate especially to turbine-engines driven by pressure due to ignition of gas mixed with air, and one of the objects of the invention is to render unnecessary the combustion-chamber usually employed with structures of the kind described.

A second object, is the production of a turbine-engine employing a succession of turbine-wheels and means between successive wheels for reexpanding the air by heat, thus renewing its pressure, after it has driven a wheel and has lost power.

In the form of turbine-engine illustrated in the accompanying drawings, I may dispense with all valves for controlling the regulation and mixture of air and gas, as well as the valves employed for admitting the ignited charge to the nozzle.

Referring to the accompanying drawings, Figure 1 is a side-view showing, in section, a form of nozzle preferably employed by me, and delivering pressure-medium to the blades of the turbine-wheel; Fig. 2 is a similar view of a form of turbine-engine having a succession of turbine-wheels; Fig. 3 is a view, like Fig. 1, and provided with a plurality of igniting means; and Fig. 4 is a view, like Fig. 2, and provided with means, located between successive wheels, for renewing the spent pressure of the air as it operates upon the wheels.

Referring to Fig. 1, *a* represents a turbine-wheel, its direction of rotation being indicated by the vertical arrow. *b* indicates a flaring nozzle for delivering pressure-medium from its mouth and to the paddles of the turbine-wheel, as indicated by the arrows. The nozzle has a contracted supply-port, *c*, which is smaller than the pipe which delivers compressed air to the nozzle.

While it is not inconsistent with the spirit of my invention to connect the nozzle with a reservoir or similar chamber containing compressed air, I prefer to directly connect the contracted supply-passage *c* with a pipe leading from a compressor *d*, which may, as described and claimed in a co-pending application Serial No. 253,108, filed simultaneously herewith for Letters Patent, be operated by pressure-medium after it has left the turbine-wheel or turbine-wheels of the engine.

The combination of parts shown in Fig. 1 eliminates the usual forms of combustion-chamber, and I permit the ignition of the charge to take place in the nozzle itself. The nozzle will preferably be flaring and may be made of or lined with porcelain or other refractory material, to resist the heat due to combustion therein of the gas. Gas in an amount required for the charge is

also fed directly into the nozzle, through a pipe *e*, being fed into the nozzle preferably by suction of the air passing through the nozzle. The ignition of the gas, after entering the nozzle, is assured by any suitable means located therein. I have shown an electrical igniter, *f*, which may be energized by wires leading from a magneto, or otherwise. The igniter is preferably located, as shown, at a point between the contracted supply-port *c* and the delivery mouth of the nozzle.

The structure illustrated in Fig. 1 permits a continuous and regular operation of the turbine-engine, and all valves or other cut-off devices usually employed with combustion-chambers or other combustion-apparatus, for regulating, igniting and delivering pressure-medium are rendered unnecessary. Owing to the contracted supply-passage *c*, and the great speed of expansion of the charge, as well as owing to the action of the compressor, a return stroke or back-action of the pressure is impossible, and the combustion within the nozzle takes place with almost complete uniformity.

In addition to simplicity of construction and economy incident to elimination of combustion-chambers, etc., there are lesser losses in cooling, as the generation of heat occurs in the nozzle and at the time when the gas and air are moving very rapidly.

As shown in Fig. 3, gas may be fed, into the nozzle *b* at a succession of points, the pipes *e*, *e*¹ and *e*² being provided for that purpose, and in order that the ratio of air and gas may be regulated as desired. In such event, a succession of igniting means, *f*, *f*¹, *f*² may be provided in the nozzle, and will successively or practically simultaneously ignite the gas several times or at several points.

In Fig. 2, I have shown the structure of Fig. 1 applied to a turbine-engine provided with a succession of wheels, *a*, *a*¹, *a*², *a*³ and *a*⁴, and have provided, between successive wheels, tubular continuations *b*¹, *b*², *b*³ and *b*⁴ of the nozzle *b*. As shown, the successive tubular continuations may all be flaring and be in line with nozzle *b* and with one another.

Another form of turbine-engine, embodying my improvements is shown in Fig. 4, wherein each of the tubular continuations *b*¹, *b*², *b*³, and *b*⁴, constitute a combustion-chamber and is employed for the purpose of renewing the pressure of the air after it has left a wheel and before it acts upon the next succeeding wheel. For this purpose, each tubular continuation is provided with a gas inlet *e*¹, *e*², *e*³, *e*⁴, and with an igniting means *f*¹, *f*², *f*³, and *f*⁴. It is to be observed with reference to Fig. 4, that the feeding of fuel takes place not only at *e* but also at *e*¹, *e*², *e*³, *e*⁴, so that separate ignitions can take place at *b*, *b*¹, *b*², *b*³, *b*⁴. The desired result will be secured, if sufficient air or excess of air be supplied, for all the gas mixtures, to the first nozzle *b*. In the first nozzle *b*, therefore, the ex-

cess of air will be largest and will be smallest in the last nozzle or nozzle continuation *b*⁴. The presence of already-burned gases in the successive nozzles, while not advantageous, produces no bad effect

5 What I claim is:

1. In a turbine-engine, a wheel provided with paddles, a nozzle having a contracted supply-passage and a mouth for delivering pressure-medium to the wheel, gas-igniting means in the nozzle near the contracted supply-passage, means for supplying air through said supply passage and separate means for supplying gas to said nozzle near the contracted part aforesaid.

2. In a turbine-engine, a wheel provided with paddles, a nozzle having a contracted supply-passage and a mouth arranged to deliver pressure-medium to the wheel, a compressor connected by a pipe with the receiving end of the nozzle, and means in said nozzle for igniting gas mixed with air at a point in the nozzle between the contracted supply-passage and the mouth.

3. In a turbine-engine, a wheel provided with paddles, a flaring nozzle provided with a contracted supply-passage and having a connection with an air-compressor and a separate connection for admitting gas directly into the nozzle, and means in said nozzle for igniting the admitted gas in the nozzle at a point between the contracted supply-passage and the mouth.

4. In a turbine-engine, a wheel provided with paddles, a flaring nozzle, igniting means therein, and tubular connections for separately leading air and gas into the nozzle.

5. In a turbine-engine, a succession of turbine-wheels an igniting means and a nozzle for supplying pressure medium to the first of said wheels, a tubular continuation of said nozzle between successive turbine-wheels, and means for igniting pressure-medium in the tubular continuation aforesaid.

6. In a turbine-engine three turbine-wheels, an igniting means and a nozzle for supplying pressure-medium to the first of said wheels, a tubular continuation of said nozzle, between the first and second of the turbine-wheels, a second tubular continuation between the second and third of the turbine-wheels, and means for igniting pressure-medium repeatedly as it passes through the tubular continuations aforesaid.

7. In a turbine-engine, a turbine-wheel provided with paddles, a nozzle for delivering an ignited mixture of air and gas against the paddles of the wheel, a tubular passage at the opposite side of the wheel for receiving pressure-medium after it has left the wheel and for directing it against the paddles of a second turbine-wheel and means in said passage for increasing the pressure of the pressure-medium passing therethrough.

8. In a turbine-engine, a turbine-wheel provided with paddles, a nozzle for delivering an ignited mixture of air and gas against the paddles of the wheel, a tubular passage at the opposite side of the wheel for receiving pressure-medium after it has left the wheel and for directing it against the paddles of a second turbine-wheel, means for feeding gas to said passage, and igniting means located therein.

9. In a turbine-engine, a wheel provided with paddles, a nozzle having a contracted part and a flaring mouth for delivering pressure-medium to the wheel, means for separately and directly supplying air and gas to and mixing the same at the contracted part of said nozzle, and gas-igniting means in the nozzle near said contracted part.

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

HUGO LENTZ.

Witnesses:

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KARL H. MERK.