R. KUTSCHINSKI.

COMBUSTION TURBINE.

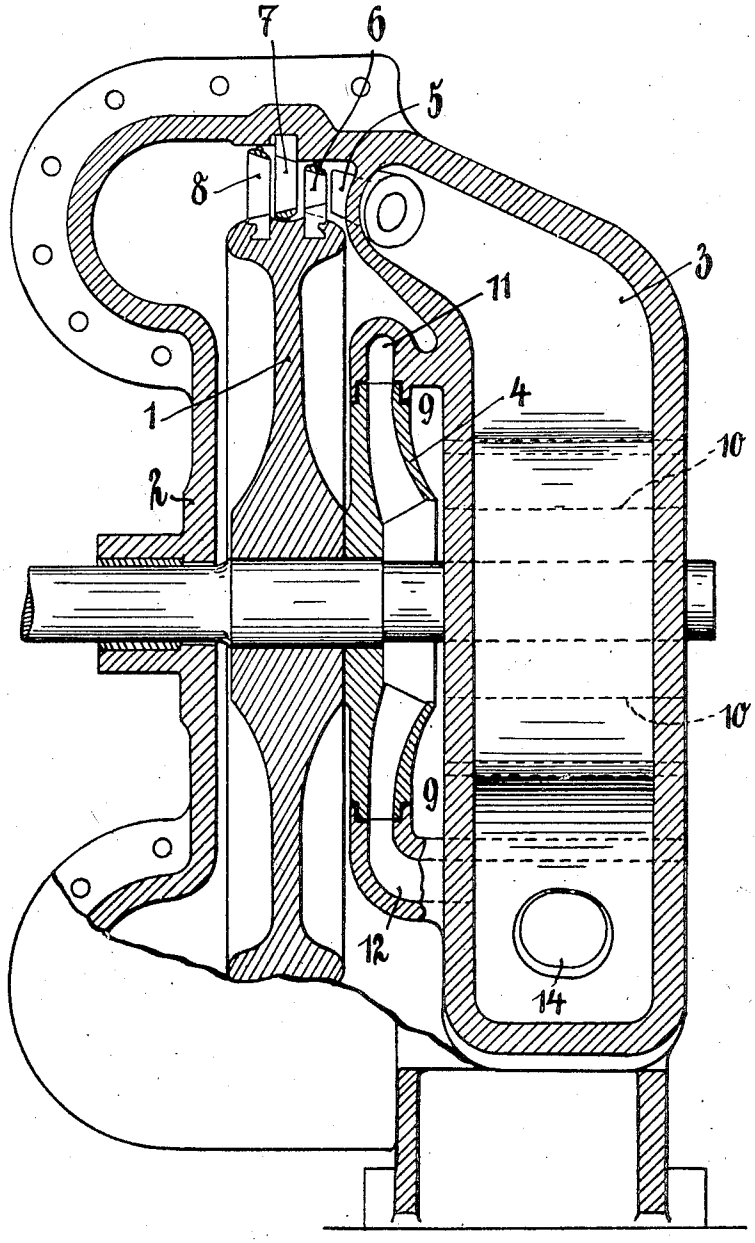
APPLICATION FILED NOV. 11, 1913.

1,130,090.

Patented Mar. 2, 1915.

2 SHEETS—SHEET 1.

Fig. 1



Witnesses:
B. Dominers
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Robert Kutschinski.
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COMBUSTION TURBINE.

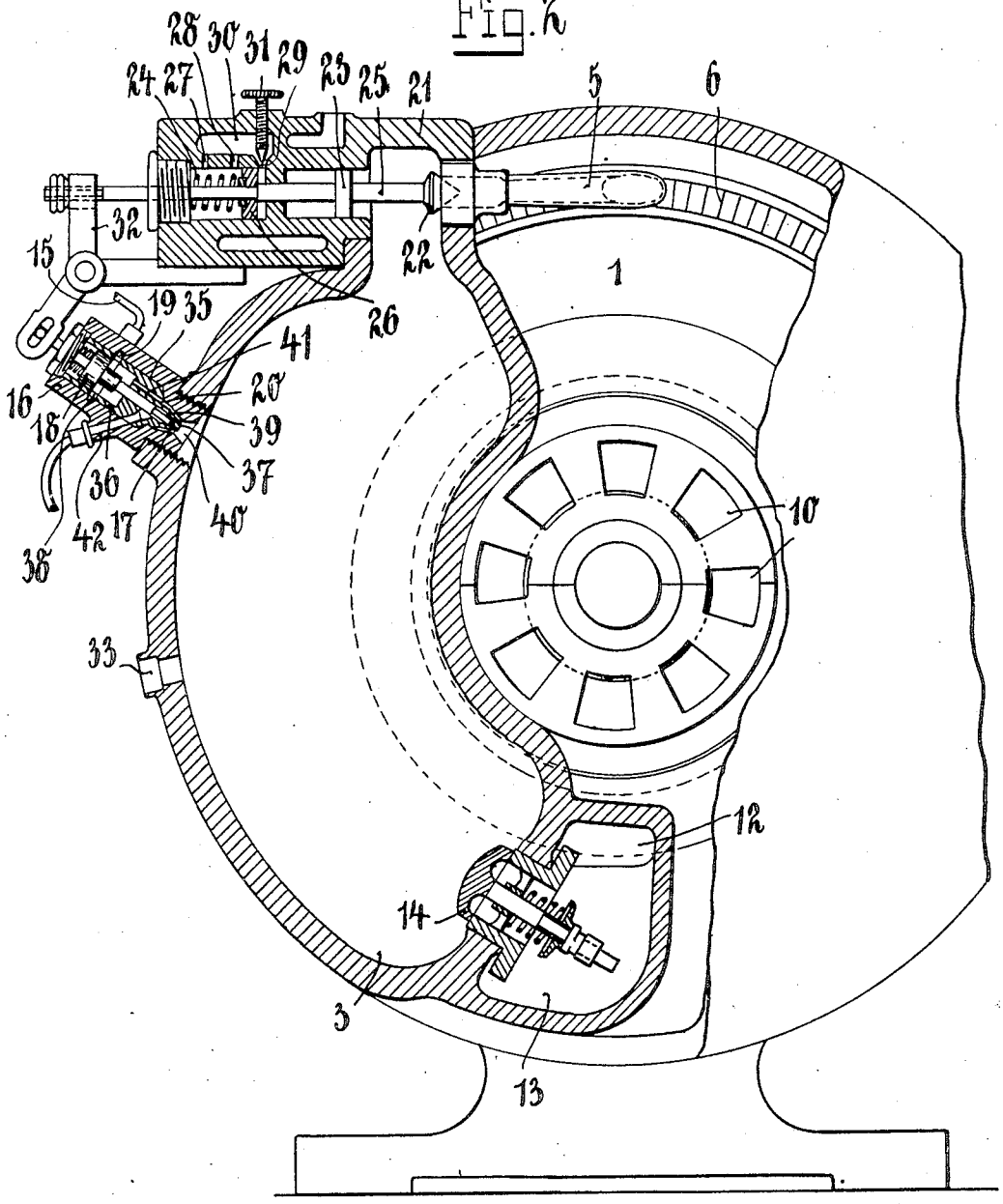
APPLICATION FILED NOV. 11, 1913.

1,130,090.

Patented Mar. 2, 1915.

2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

ROBERT KUTSCHINSKI, OF KOHLHASENBRÜCK, NEAR BERLIN, GERMANY.

COMBUSTION-TURBINE.

1,130,090. Specification of Letters Patent. Patented Mar. 2, 1915.

Application filed November 11, 1913. Serial No. 800,322.

To all whom it may concern:

Be it known that I, ROBERT KUTSCHINSKI, of Kohlhasenbrück, near Berlin, Germany, have invented certain new and useful Improvements in Combustion-Turbines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

The present invention relates to arrangements in combustion turbines, in particular in such turbines as are run with gaseous or liquid fuels.

The invention, essentially, consists in that the pressure of the explosion in the combustion chamber is utilized for automatically opening and closing both the valve, which controls the entrance of the explosion gases into the nozzle of the turbine, and also the fuel admission valve. The movements of the nozzle valve, and therewith also of the admission valve are regulated by the adjustment of a liquid brake co-acting with the first mentioned valve.

In the accompanying drawings the invention is exemplified in a constructional form.

In these drawings Figure 1 is a vertical axial section through the turbine, the section being laid on the right side of the figure through the combustion chamber. Fig. 2 is a vertical section transversely to the axis, which is laid on the left side of the figure through the combustion chamber, and in a plane which lies in front of the sectional plane through the turbine itself.

The arrangement consists of the turbine itself, comprising the rotor 1 and the stator 2, the combustion chamber 3, the fan 4 and the various valves and accessories.

In the drawings a two-stage axial turbine with partial impingement has been shown. The combustion gases pass from the combustion chamber 3 through a nozzle 5 into the blades 6 of the first stage, flow through the guide blades 7, and after having again expended their energy in the blade flange 8, they escape into the housing of the turbine, whence they pass into the exhaust.

On the turbine wheel 1 follows directly the air blower or fan 4. The suction chamber 9 of this blower communicates with the atmosphere through a plurality of passages 10, which penetrate the bearing of the turbine shaft next to the combustion chamber. Thereby a very effective cooling of this bearing is insured, which would otherwise, owing to the proximity of the hot combustion chamber, have to be moved farther away. A similar arrangement may also be provided for the other bearing.

On the fan 4 follows in an axial direction the combustion chamber, which is made integral with the housing of the turbine, following the lines of the latter. The ring-shaped passage 11 encircling the delivery side of the fan 4 communicates through a conduit 12 with an ante-chamber 13 of the combustion chamber. In the partition a non-return valve 14 is fitted, which opens inward and serves to admit the scavenging air into the combustion chamber. Before the air in conduit 12 enters into the chamber 13 the compressed air may be submitted to the action of a throttle valve. From the delivery side of the fan 4 another conduit 15, not seen in Fig. 1, proceeds, which supplies the necessary compressed air to the injection valve. This valve is made in form of a mixing valve, so that it is unnecessary to provide any special means for gasifying liquid fuels, or in other words no carbureter is required. The arrangement of the valve will be more particularly described farther below. The admission valve is automatically operated by the outlet valve 21 controlling the gas nozzle 5 of the turbine.

The outlet valve consists of the valve cone 22, the spindle of which carries a piston 23, the section of which is larger than that of the valve body 22, so that the valve is lifted contrary to the action of a spring 24, when the pressure within the combustion chamber 3 rises. The valve spindle 25 further has a piston 26 which works in the cylinder containing the spring 24. This cylinder communicates through three passages 27, 28 and 29 with a chamber 30. The passage 29 can be made narrower by means of a set screw 31. This arrangement, the cavities of which contain oil or some other liquid, forms a regulable liquid brake and has the object of keeping the nozzle valve 23 so long open after the explosion, until the scavenging air has driven out the burnt gases.

The free end of the valve spindle 25 is connected by means of a double-armed lever 32 with the spindle of the admission

valve 16, the nozzle body of which 34 fitted into the outer housing has two bores 35 and 36 respectively. The smaller bore 35 is tapered at the end toward the mouth of the nozzle and terminates in the mouth of the nozzle 37 which consists of a fine bore of about 0.3 millimeter diameter. The wider bore 36 has about at its middle slots 38 in the sides, which lead into a ring-passage 19 cut into the housing 16, and which communicates directly with the atmosphere or through the pipe 15 with the fan or a compressed air vessel.

The nozzle needle 17, the free tapered end of which in its terminal position closes the bore of the nozzle, is ground into the cylindrical part of the bore 35 and acts there as a piston. In the wider part 36 there is another piston 18 likewise connected to the nozzle needle, which piston 18 is preferably provided with packing rings. The front end of the nozzle body is tapered and is surrounded by a threaded shoulder which contains two inverted conical cavities. Of these cavities the inner one 39 approximately follows the taper of the front end of the nozzle, while the other 40 flares toward outside. The cavity 39 communicates with the cylindrical chamber 36 through a plurality of passages 41. The fuel is introduced through a connection tube 42 which communicates through a passage with the bore 35 of the nozzle body.

The operation of the injection valve is as follows: After the bore 35 of the nozzle has filled partly with fuel after the needle 17 has been withdrawn, and the cylindrical chamber in front of the piston 18 has been put into communication with the atmosphere or the source of the compressed air, the nozzle needle 17 is driven forward. Thereby the liquid in the bore 35 is driven out through the gradually contracted ring-shaped slot between the front end of the nozzle needle and the wall of the bore of the nozzle and through the fine orifice of the nozzle, the fuel being thereby finely diffused. This diffusing and the further spreading of the cone of diffused fuel is assisted by the air driven by the piston 18 through the passages 41 into the cavity 39, which air is driven through the ring-shaped gap between the contraction of the two hollow cones and the front end of the nozzle, and is thereby intimately mixed with the already diffused fuel. It may be further mentioned, that it is not absolutely necessary to employ compressed air for working the injection valve; a very effective diffusion will be already obtained, if air is supplied at 15 under atmospheric pressure only. The injection valve may, of course, also be employed for internal combustion engines of other kinds.

At 33 a connection is shown intended to receive a spark plug, which operates when the gas turbine is started. During the normal running of the turbine the ignition is automatic, as the combustion chamber is continuously at a high temperature.

The operation of the turbine is as follows: It shall be assumed that the turbine is already running and a charge of fuel has just been injected through the valve 16 into the chamber 3. The fuel is introduced through the nozzle finely diffused and intimately mixed with the combustion air, so that an instant and complete combustion takes place on the hot inside walls of the chamber. In consequence of the rise of the pressure caused thereby the nozzle valve 22, which, until then was kept closed by the spring 24, is opened, as the pressure acting on the piston 23 exceeds the pressure on the effective surface of the valve cone. The combustion gases under high pressure pass out through the nozzle 5 and impinge on the turbine wheel. The instant closing of the nozzle valve 21 is prevented by the liquid brake, which allows of the valve returning quite gradually only. During this period the pressure in the combustion chamber gradually drops until the spring of the scavenging valve 14 together with the pressure of the air in the chamber 13 acting on the outside of the valve prevails and opens the valve toward inside. The spring of the valve is so dimensioned, that it will hold the valve normally closed against the pressure of the scavenging air, generally not exceeding 1 atmosphere. Through the valve the compressed air supplied by the fan or compressor 4 enters into the combustion chamber and passes out through the still open valve of the nozzle 5, whereby the combustion chamber is thoroughly scavenged and all combustion products are removed therefrom. After this has taken place, the nozzle valve 22 closes again under action of the spring 24. The time in which the valve returns can be varied in a very simple manner by adjusting the screw 31 of the liquid brake.

The scavenging air is supplied, as hereinbefore described, to the chamber 13 by the fan 4, which sucks it through the passages 10 in the bearing of the turbine shaft. Also the compressed air entering at 15 into the fuel valve 16 is supplied by the fan 4.

The control of the inlet valve is positively geared to the outlet valve 22 in such a manner, that when the latter is lifted, for instance, when the combustion gases under high pressure escape through the nozzle 5 both the admission of draft air is closed by the piston valve 18 and that of the fuel through the needle valve 17, whereas when the nozzle valve is closed the piston valve and the needle valve are open, so that the fuel can enter into the chamber 3. As the movements

of the inlet valve are dependent on those of the outlet valve and thus also on the liquid brake of this valve, the succession of the explosions and thereby also the running of the turbine can be controlled in a simple manner by the adjustment of the throttle screw 31.

In place of the single nozzle 5 shown obviously also several nozzles, and also several combustion chambers may be provided, which are then preferably distributed in an even manner over the whole circumference of the turbine.

I claim:

1. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa.

2. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa and means for automatically opening the nozzle valve under the action of the pressure of the combustion gases.

3. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa, a piston in connection to said nozzle valve and being under action of the combustion gases and of a yielding opposed force, said piston having a larger section than the effective surface of said nozzle valve.

4. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa and a regulable brake in combination with said nozzle valve.

5. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa, means for automatically opening the nozzle valve under the action of the pressure of the combustion gases, and a liquid brake with adjusting screw in combination with said nozzle valve.

6. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, a double-armed lever coupled at one end to the said nozzle valve, at the other end to the said inlet valve, and means for automatically opening the nozzle valve under the action of the pressure of the combustion gases.

7. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, a double-armed lever coupled at one end to the said nozzle valve, at the other end to the said inlet valve, a cylinder communicating with said combustion chamber and a piston in said cylinder and in combination with the said nozzle valve and under the action of a spring, said piston having a larger section than the effective surface of said nozzle valve.

8. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, a bearing for the turbine shaft, in the walls of said bearing passages and means for conducting the combustion air through said passages.

9. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa, a blower for the combustion air directly driven from the turbine shaft, a bearing for the turbine shaft, passages in the walls of the body of said bearing and means for sucking the air for the blower through said passages.

10. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet

valve for the fuel, said nozzle valve positively coupled to said inlet valve in such a manner, that the inlet valve closes automatically when the nozzle valve opens and vice versa, means for automatically opening the nozzle valve under the action of the pressure of the combustion gases, and a non-return valve under action of a spring, in the wall of said combustion chamber for admitting the scavenging air, said spring so dimensioned that the non-return valve opens before the said nozzle valve closes and closes essentially simultaneously with the same.

11. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said inlet valve comprising an injection nozzle, a needle displaceable in said nozzle and having a shoulder, adapted to drive the fuel introduced into the nozzle shortly before the mouth of the nozzle is closed through the ring-shaped gap left free by the needle.

12. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said inlet valve comprising a nozzle having two bores arranged in the same axis, a narrow one and a wide one, the wider bore communicating with the pipe for the combustion air, the narrow bore with the fuel supply pipe, a nozzle needle displaceable in said bores, said nozzle needle having a piston and a shoulder, said piston being displaceable in the wider bore, said shoulder in the narrow bore, and adapted to drive the fuel introduced into the nozzle shortly before the mouth of the nozzle is closed through the ring-shaped gap left free by the needle.

13. In a combustion turbine comprising a separate combustion chamber, a rotor and an outlet nozzle, adapted to conduct the combustion gases into the said rotor, a nozzle valve controlling said outlet nozzle, an inlet valve for the fuel, said inlet valve comprising a nozzle having two bores arranged in the same axis, a narrow one and a wide one, the wider bore communicating with the pipe for the combustion air, the narrow bore with the fuel supply pipe, a nozzle needle displaceable in said bores, said nozzle needle having a piston and a shoulder, said piston being displaceable in the wider bore, said shoulder in the narrow bore, the mouth of said injection nozzle surrounded by a mouthpiece being within of a double-conical shape, communicating passages between the interior of said mouthpiece and said wider bore, said shoulder of the nozzle needle adapted to drive the fuel introduced into the nozzle shortly before the mouth of the nozzle is closed through the ring-shaped gap left free by the needle.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

ROBERT KUTSCHINSKI.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.