H. HOLZWARTH.

GAS TURBINE.

APPLICATION FILED JULY 29, 1911.

Patented Nov. 5, 1912.

1,043,767.

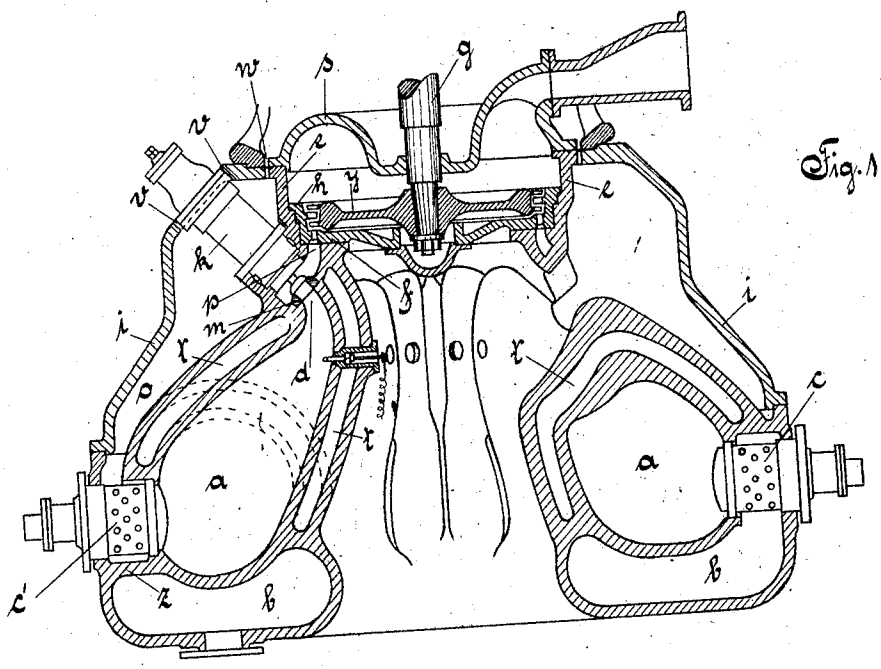

Fig. 1.

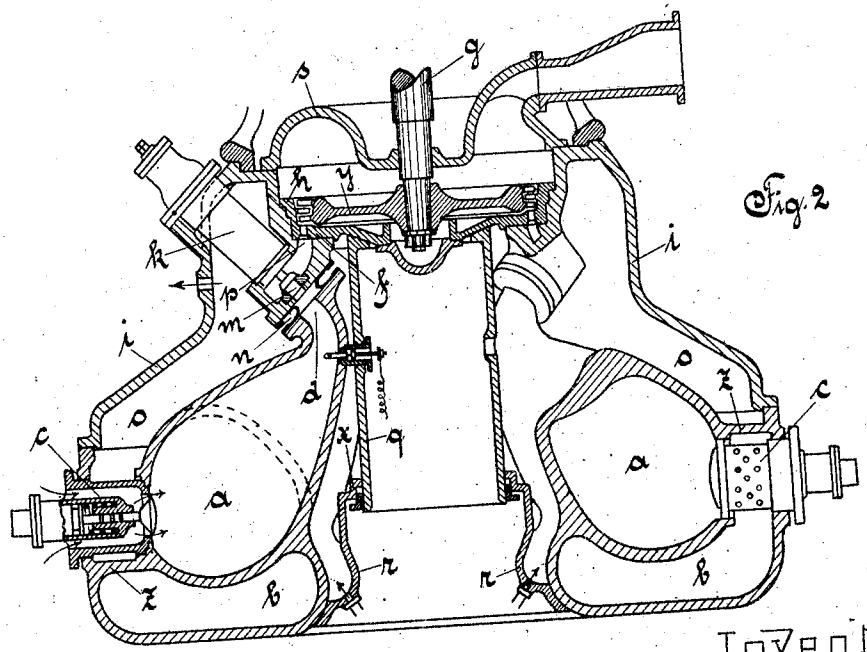

Fig. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

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GAS-TURBINE.

1,043,767. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed July 29, 1911. Serial No. 641,360.

To all whom it may concern:

Be it known that I, HANS HOLZWARTH, subject of the German Emperor, residing at Mannheim, in the Empire of Germany, have invented certain new and useful Improvements in Gas-Turbines, of which the following is a specification.

My invention relates to gas turbines with combustion chambers which are provided with controlled means for closing them, and has for its object an improved construction of such a machine for the purpose of allowing the freest possible alteration in the form of the combustion chambers under variations of temperature both relatively to the other parts of the machine, for instance, the casing, and also to one another.

The invention is of particular importance for gas turbines of the kind in which the combustion chambers are periodically exposed to unequal strain, as, for instance, where for the purpose of regulating the power or number of revolutions, certain chambers are temporarily unutilized.

The improved construction of gas turbine is mainly characterized by the combustion chambers being substantially only rigidly connected with one another at their bottoms, the arrangement for feeding the individual chambers being placed in this zone of connection, while that part of the combustion chambers from which the hot gases of combustion flow into the turbine is so formed that it can move, if desired, with the other parts mounted on it, as freely as possible relatively to the other parts of the machine.

In order better to explain the invention, reference will now be made to the accompanying drawings, in which two forms of construction of the machine are shown as examples.

Figure 1 is an axial section of that part of the gas turbine which constitutes the invention; Fig. 2, a similar view of a modified form of construction.

According to Fig. 1, the combustion chambers *a* are arranged in a circle around the vertical shaft *g* of the turbine and connected with one another by an annular part *b*, which also forms part of the machine. The gas chamber which is provided in the base or foundation *b* may be connected with the combustion chambers *a* by means of controlled valves *c* for feeding the combustion chambers. In the part *b*, other inlet valves *c'* for the combustion chambers *a* are also provided, which valves may connect the annular chamber *o*, which is filled with air, with the combustion chambers. The gas inlet valves *c* and the air inlet valves *c'* are similarly located in the wall of the casing. They are simply placed in the air chamber or gas chamber by the separating wall *z* between the air chamber *o* and gas chamber *b* being suitably omitted at that point. The chambers *a* extend into necks *d* from which the gases of combustion escape and flow to the nozzles *p*, which are arranged in a ring *f* common to all. The necks *d* of the chambers are provided with valve seats *m* for so-called nozzle valves, the casing *k* of which is shown in elevation, and connected with one another by an annular part *e* which carries the nozzle ring *f* and the guide wheel *h*, but together with these parts can move freely relatively to the casing *i* fixed on the base *b*, that is to say can follow expansions due to heat. In order to allow of this expansion the casing *i* allows the valve shell *k* to pass through it with a space *v* for play. The annular part *e* also passes with a space *w* for play through the casing *i*. It carries, in addition to the ring *h* of guide blades, the cover *s* of the turbine chamber, in which the rotor *y* rotates on the shaft *g*. In order to enable the explosion chambers *a* to be externally cooled or in order to be able to bring them before starting to the temperature necessary for igniting the contents of the chamber, a space *t* is provided in which a cooling or heating medium may circulate. It is quite evident that when the combustion chambers *a* are heated, their necks *d* together with the parts located thereon, namely the valve casing *k*, the nozzle ring *f*, guide wheel *h*, ring *e*, and turbine chamber cover *s* can move freely upward. The space or interval between the nozzle ring *f* and the rotor *y* is of course calculated in such a way that the blades of the turbine are not encountered in this movement.

The form of construction shown in Fig. 2 has in general the same parts as the one in Fig. 1; the same reference letters are therefore employed. It differs, however, mainly by the necks *d* of the combustion chambers no longer themselves carrying the valve casing *k* and the nozzle ring, et cetera, so that the latter parts must follow the expansion due to heat of the combustion chambers, but

on the other hand the necks d of the combustion chambers are elastically connected with the valve seats m and also with the valves k and the nozzles p. The connection by means of a so-called compensation piece n of hammered steel plate or the like is also shown. In place of the flexible compensation piece n, of course any other compensating arrangement might be employed, for instance, one which admits of a telescopic, tightly packed displacement of the neck d in the part e or vice versa of the part e or the valve seat m in the neck. The construction of this flexible connection is, however, an unimportant part of the invention.

A further modification, as compared with the construction shown in Fig. 1, consists in a chamber for the cooling medium being constituted by the external walls i of the casing and the walls r and q, in place of the cooling jacket formed by the double walls of the combustion chambers. The wall q which is preferably cylindrical, is packed by a gland x relatively to the wall r, which arrangement enables it to make a movement relatively to the base b. Now as the chamber o is filled with the cooling medium, the combustion air, as indicated by arrows, is drawn through the valves c' from the outside. This construction is certainly more expensive than the one shown in Fig. 1, but it renders the walls of the combustion chambers accessible. In the form of construction shown in Fig. 2, the advantage is also obtained that the nozzle ring h and turbine chamber cover s may be rigidly mounted on the casing i of the machine.

Various modifications in the construction are of course possible and lie within the scope of the invention, so long as the freest possible mobility of the explosion chambers relative to one another and to the other parts of the machine is provided for, and the combustion chambers where the feeding arrangements (valves c) are provided, are rigidly connected with one another.

I declare that what I claim is:—

1. In gas turbines a plurality of combustion chambers connected together at one side and free to move with the parts mounted thereon at the other sides, a rotor, means for conveying the products of combustion to the rotor, and valves for admission of gases to the combustion chambers.

2. In gas turbines, a plurality of combustion chambers connected together at one side, and free to move with the parts mounted thereon at the other sides, a rotor, means for conveying the products of combustion to the rotor, controlled members for shutting off the comubustion chambers from the rotor, and controlled members for supplying gas and air located at that side of the combustion chambers where the latter are connected together.

3. In gas turbines, a plurality of combustion chambers connected together at one side, and free to move with the parts mounted thereon at the other sides, a rotor, means for conveying the products of combustion to the rotor, controlled members for shutting off the combustion chambers from the rotor, and controlled members for supplying gas and air located in the walls where the combustion chambers and the gas and air chambers are connected together.

4. In gas turbines, a plurality of combustion chambers, a rotor, means for conveying the products of combustion to the rotor, controlled members for shutting off the combustion chambers from the rotor, controlled members for supplying gas and air, and means at the outlet side of the combustion chambers for permitting movement of the outlet part of the combustion chambers and the parts mounted thereon on their expansion due to heat.

5. In gas turbines, a pluraiity of combustion chambers, a rotor, means for conveying the products of combustion to the rotor, controlled members for shutting off the combustion chambers from the rotor, controlled members for supplying gas and air, means at the outlet side of the combustion chambers for permitting movement of the outlet part of the combustion chambers and the parts mounted thereon, and means for connecting together the combustion chambers at their lower end.

6. In gas turbines, a plurality of pear-shaped combustion chambers, a rotor, means for conveying the products of combustion to the rotor, controlled members for shutting off the combustion chambers, controlled members for supplying gas and air, means at the outlet side of the combustion chambers for permitting movement of the outlet part of the combustion chambers and the parts mounted thereon, and means for connecting together the combustion chambers at their lower end only.

7. In gas turbines, a plurality of pear-shaped combustion chambers connected together at their lower ends only, a rotor, means for conveying the products of combustion to the rotor, a nozzle valve in a casing seated at the outlet of each combustion chamber, an annular part carrying the part having the fixed guide blades and a ring of nozzles for the turbine, controlled members for supplying gas and air, and means for permitting the outlet end of the combustion chambers and the parts mounted thereon to move relatively to the fixed part of the combustion chambers and the machine casing on the expansion of the parts by heat.

8. In gas turbines, a plurality of pear-shaped combustion chambers connected together at their lower end only, cooling jackets on the combustion chambers, a rotor,

means for conveying the products of combustion to the rotor, a nozzle valve seated at the upper end of each combustion chamber, an annular part carrying the part having the fixed guide blades and a ring of nozzles for the turbine, controlled members at the lower end of said combustion chambers for supplying gas and air, and means for permitting the outlet end of the combustion chambers and the walls of the cooling jackets, and the nozzle valve and the said annular part mounted on the outlet end of the combustion chambers to move relatively to the fixed part of the combustion chambers and the machine casing.

In witness whereof I have hereunto signed my name this 7th day of June, 1911, in the presence of two subscribing witnesses.

HANS HOLZWARTH.

Witnesses:

ALFRED O. TITTMANN,

S. H. SHANK.