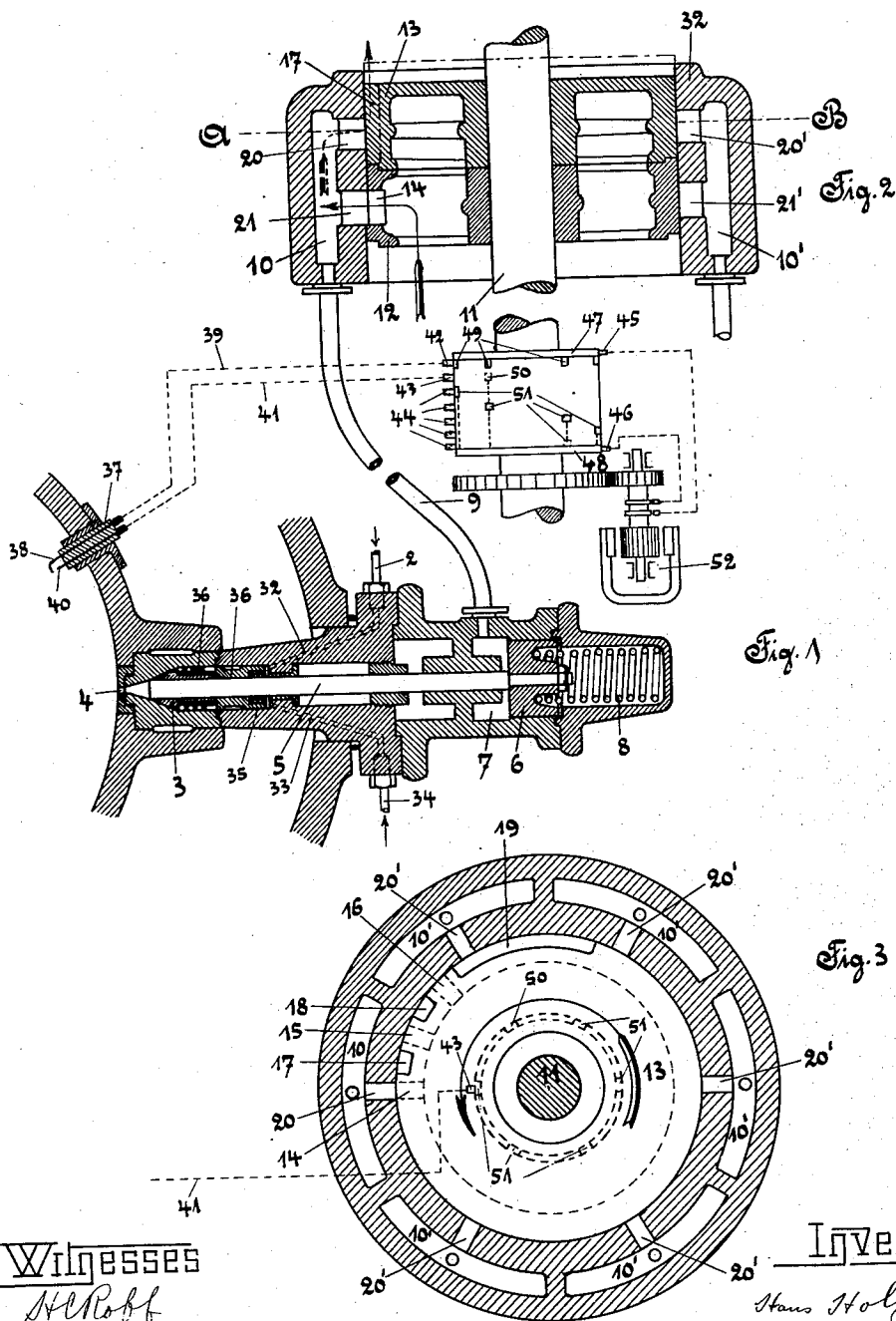


H. HOLZWARTH.
GAS TURBINE AND THE LIKE.
APPLICATION FILED FEB. 25, 1911.

Patented July 16, 1912.

2 SHEETS—SHEET 1.

1,033,015.



Witnesses
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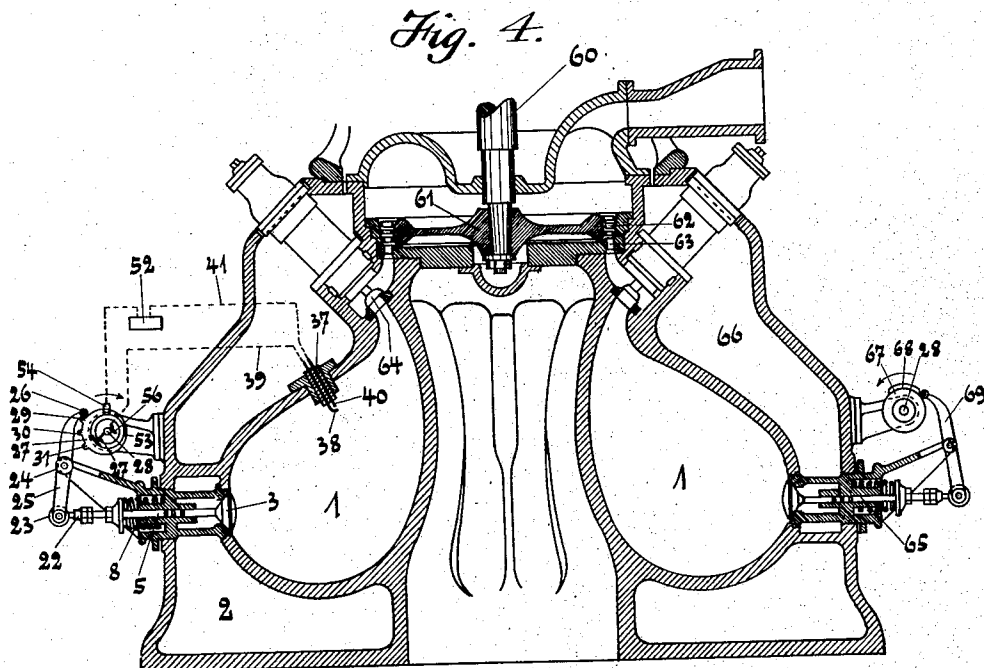
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UNITED STATES PATENT OFFICE.

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GAS-TURBINE AND THE LIKE.

1,033,015.

Specification of Letters Patent.

Patented July 16, 1912.

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To all whom it may concern:

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

This invention relates to improved means for feeding the explosive mixture into the combustion chambers of gas turbines and the like, and more particularly such gas turbines as work with periodic combustion and in which the explosive mixture is only made in the combustion chambers themselves. In such gas turbines by this invention I do not as was previously customary, introduce into the combustion chamber the combustible necessary for each explosion all at once, but successively in several portions. By this means I am able to mix the combustible vapor more easily with the air contained in the explosion chamber and thus the combustion is more complete. Between the separation, successively injected, clouds of combustible vapor, there are layers of air and the diffusion of the combustible into the air proceeds more easily the smaller the separate portions of combustible are. Heavy combustible, such, for instance, as blown-oils and even still less combustible oils such as coal tar oil and gas tar oil may in this way, as thoroughly complete experiments have established, be smokelessly consumed, without dilution with more easily combustible substances.

This invention will now be hereinafter more particularly described with reference to the accompanying diagrammatic drawings, in which:—

Figure 1 is an axial section of a valve for injecting liquid combustible; Fig. 2, also an axial section of an arrangement for the hydraulic control of this valve; and Fig. 3, a section of the same arrangement on the line A—B of Fig. 2; Fig. 4 is another form of construction of the invention for the mechanical operation of the valve for the combustible where gaseous combustible is employed, and also showing the turbine as a whole and the nature and arrangement of the air inlet valve to be used with either form of inlet valve for the combustible.

In Fig. 1, 1 indicates one of the explosion

chambers of the gas turbine, 2 is a pipe for the oil used as fuel, which pipe connects with a passage 32 in the valve casing of the valve 3. A compressed air pipe 34 connects with another passage 33 of the same casing. Both passages are connected at their ends with a cylindrical chamber 35 which, in addition to the valve 3 and the valve spindle 5, also contains several parts 36 which, in already known manner, have apertures running parallel with the axis of the valve and also the parts are so arranged that the mixture of combustible and air enter through apertures in the one part which do not register with those in the next part, so that the mixture is sprayed and mixed. The valve 3 closes an aperture (nozzle) 4 of the chamber 35, which aperture opens into the explosion chamber 1. The valve spindle 5 of the valve 3 has a piston 6 which is displaceable in a cylinder 7 and is subject to the action of a spring 8 which presses it and the valve 3 in the direction of closing the valve. A pipe 9 from the chamber 10 of a distributor which is shown in Figs. 2 and 3, connects with the cylinder 7.

The distributor consists substantially of two disks 12 and 13 mounted on a shaft 11 and provided with passages, which disks are set in rotation by the shaft 11 in a casing 132 provided with a cylindrical perforation and lateral passages. The casing 132 has in addition to the previously mentioned chamber 10 for the valve 3 as many chambers 10' as there are valves on the gas turbine, which are to be controlled like the valve 3. Each of these chambers 10 or 10' has a passage 21 or 21' respectively, opening opposite the disk 12, and each a passage 20 or 20' respectively opening opposite the disk 13. The distributing disk 12 has several, for instance, three passages 14, 15, and 16 which, on the disk being rotated in the direction of rotation indicated by the arrow in Fig. 3, successively bring the pressure chamber containing the oil used (in Fig. 2 located beneath the disk 12) into communication, first, with the chamber 10, and then the next chamber 10' in the direction indicated by the arrow, and so forth. In the position shown, in which the passage 14 is opposite the passage 21, the chamber 10 is at first placed in communication with the oil pressure chamber

beneath the disk 12 and the oil, delivered under pressure by any suitable pump or the like, flows in the direction indicated by the arrow in Fig. 2 into the chamber 10 and out of it through the pipe 9 into the cylinder 7 and there forces the piston 6 to the right against the pressure of the spring 8. By this means the valve 3 is opened and the liquid combustible which is kept under pressure, is injected through the nozzle 4 into the explosion chamber 1. The passage 20 of the chamber 10 is in the position shown closed by the disk 13. On the further rotation of the disks 12 and 13, the passage 14 leaves the passage 21 and the latter is closed by the cylindrical wall of the distributor 12. Shortly afterward the passage 17 located in the disk 13 comes opposite the passage 20 and places it and the chamber 10 in communication with the suction chamber situated above the disk 13 and the chamber for the discharge or accumulation of the oil under pressure. The spring 8 can then push the piston 6 to the left and close the valve 3 and the oil flows away through the pipe 9, chamber 10, passage 20 and passage 17 in the direction indicated by the arrow shown in dotted lines. On a further rotation the passage 20 is again closed and the passage 21 connected by the passage 15 in the disk 12 with the pressure chamber, then the passage 21 is again closed and passage 20 placed in communication with the suction chamber through the passage 18. Then the passage 20 is again closed, passage 21 again connected with the pressure chamber by the passage 16 again closed, and finally the passage 20 is placed in communication with the suction chamber by means of passage 19. In this way the inlet valve 3 is opened three times and also on the further rotation, the other injection valves belonging to the chambers 10 are also opened and closed three times.

Each of the explosion chambers 1 is provided with at least one sparking plug consisting of an insulated part 37 and two electrodes 38 and 39 facing one another in the ignition chamber, which electrodes are connected to wires 39 and 41. These wires are in turn connected with contact brushes 42 and 43, each wire 39 of each spark plug of each explosion chamber being connected to the same brush 42, while to the brush 43 only the spark plug of the explosion chamber 1 is connected and if necessary the spark plugs of the other chambers which are to be ignited simultaneously with the chamber 1. The wires 41 of the spark plugs of the other chambers which are to be ignited at a different time are each connected to a different brush 44. The brushes 42, 43 and 44 rest against a drum mounted on the shaft 11, which drum consists mainly of insulating material but is provided with metal contact

pieces. For conveying the current from the dynamo 52, the drum has two continuous friction rings 45 and 46 connected with the dynamo 52. The friction ring 47 has as many contact pieces 49, projecting in the path of the brushes 42, distributed over the periphery of the drum as there are chambers provided which are to be successively ignited. On the other friction ring 48 at various distances from it, other contact pieces 50 and 51 are connected, of which the contact piece 50 on the rotation of the drum can only come in contact with the brush 43 and each of the other contact pieces 51 with only one of the brushes 44. On the periphery of the drum the contacts 50 and 51 are uniformly spaced. The contact 50 is so arranged that, shortly before the passage 19 of the distributor 13 comes in front of the passage 20, it comes in contact with the brush 43 thereby supplying current to the sparking plug of the explosion chamber 1.

The distributor controlling the oil and the time of ignition may, of course, be constructed in various ways. For instance it is possible to provide each chamber 10 and 10' with only one passage which is alternately placed in communication with the pressure chamber and the suction chamber, but by the use of two passages 20 and 20' for each, it is possible to cause the opening and re-closing to take place in more rapid succession.

Fig. 4 shows a purely mechanical valve motion operating according to the invention. The gas turbine has, for instance, a rotor 61 mounted on a vertical shaft 60, which wheel acts in a suitable manner in conjunction with the stationary ring 62 of guide blades and nozzles 63, which latter form the outlets from the explosion chambers 1 and may be shut off from the explosion chambers by valves 64. Each of the explosion chambers 1, of which two are shown in section, has an air admission valve 65 through which it may be placed in communication with an air filled chamber 66, and a valve 3 for the admission of combustible (for instance a heavy gas) through which it may be placed in connection with the chamber 2 containing the combustible (gas). For controlling the valves 65 and 3, a line of shafting 28 carried around the machine with cam disks 67 and 27 is employed. The cam 68 on the disk 67 periodically opens in the ordinary way by means of a lever 69, the valve 65 which is usually pressed on its seat by a spring or the like and thus causes the chamber 1 to be filled with air. Shortly after the lever 69 or rather a roller mounted on it has quitted the cam 68, the valve 3 for the admission of the combustible to the same chamber 1 is opened by the means hereinafter described.

The spindle 8 of the valve 3 is acted on by a spring 5 which usually keeps the valve closed and has at its end a projection 22 against which bears a pressure roller 23 of a double lever 25 rocking on the pin 24, the other arm of which lever has a roller 26 which travels on a cam disk 27 which is turned in the direction indicated by the arrow by a main shaft 28. In this rotation, the cam 29 first rests beneath the roller 26, lifts the latter, turns the lever 25, pushes the valve spindle 5 to the right and opens the valve 3, so that a portion of combustible passes into the air filled combustion chamber 1. The roller 26 then slips off the cam 29, the valve 3 is closed by the spring 8, the cam 30 then lifts the roller 26 and allows it to drop back, so that the valve 3 is again opened for a short time, finally, the cam 31 lifts for the third time the roller 26, and again allows it to drop, so that the valve 3 is for the third time opened and closed.

The ignition apparatus is shown diagrammatically. A disk 53 of insulating material is mounted on the main shaft 28 and has a contact piece 55 which is electrically connected with the shaft 28. On the disk 53 a brush 58 rubs and on the shaft 28 a brush 56. The brushes 58 and 56 lie in the circuit of the spark plug of the chamber 1 which is operated by means of the disks 27 and 53. The contact piece 55 is arranged in such a relative position to the cams 29, 30 and 31 that it only comes under the brush 58 when the roller 26 has already slipped off the cam 31. The circuit of the igniting apparatus 52 through the wires 39 and 41 to the sparking plug 37 is then closed, so that now the ignition spark passes between the electrodes 38 and 40 and can ignite the mixture in chamber 1. Even with this mechanical arrangement, the valve gear and the ignition may be carried out in various ways. In any case, in contrast to the methods previously employed, the combustible necessary for a combustion or explosion is not introduced into the explosion chamber at once but in several portions. The portion first introduced forms in the explosion chamber a cloud which is already partially mixed with air, and is surrounded on all sides with air. This first cloud is pushed forward at the second introduction or injection of combustible and the second cloud of combustible is similarly pushed forward by the third introduction of combustible and so forth, each cloud is thus separated from the others by a layer of air. Both layers of air bordering on all sides the combustible vapor can thus be better enriched with combustible vapor, and also the clouds of combustible which are surrounded by air and considerably smaller, can be better penetrated by the air than in

the methods hitherto adopted. Only after these repeated introductions of combustible into the explosion chamber is the mixture ignited.

I declare that what I claim is:—

1. Explosion chambers for gas turbines comprising in combination, an explosion chamber proper, means for filling the said chamber with air, separate means for subsequently admitting combustible in several portions successively, and means for igniting the mixture after all the various portions of combustible have been introduced into the explosion chamber. 70
2. Explosion chambers for gas turbines comprising, in combination, an explosion chamber proper, means for filling the said chamber with air, a valve opened and closed successively for subsequently admitting combustible in several portions successively, and means for igniting the mixture after all the various portions of combustible have been introduced into the explosion chamber. 75
3. Explosion chambers for gas turbines comprising, in combination, an explosion chamber proper, means for filling the same chamber with air, a valve for subsequently admitting combustible, a spring on the stem of the said valve for closing the latter, fluid pressure means for successively opening the said valve for admitting combustible in several portions, and means for igniting the mixture after all the various portions of combustible have been introduced into the explosion chamber. 80
4. Explosion chambers for gas turbines comprising, in combination, an explosion chamber proper, means for filling the said chamber with air, a valve for subsequently admitting combustible, a spring on the stem of the said valve for closing the latter, a piston on the valve stem for opening the valve by fluid pressure, means for successively applying and removing the pressure of the said piston, whereby the valve is opened and closed successively for admitting combustible in several portions, and means for igniting the mixture after all the various portions of combustible have been introduced into the explosion chamber. 85
5. A gas turbine comprising, in combination, a rotor and stator, a plurality of explosion chambers, means for admitting air and combustion to each explosion chamber in turn, ignition devices in each chamber a commutator for controlling the time of ignition in each chamber, a plurality of brushes resting on the said commutator, connections from one of the terminals of all the ignition devices to a single brush, separate connections from the other terminals to separate brushes. 90
6. Explosion chambers for gas turbines comprising, in combination, an explosion chamber proper, means for filling said cham- 95

100 105 110 115 120 125 130

bers with air, valves for subsequently admitting combustible, means for successively opening and closing said valves to admit the combustible in several portions to each
5 chamber, means for igniting the explosive mixtures after all the various portions of combustible have been introduced into the explosion chamber, a shaft carrying controlling mechanism for the said combustible
10 inlet valves, and a commutator arranged on

the said shaft for controlling the said ignition means.

In witness whereof, I have hereunto signed my name this 4th day of February, 1911, in the presence of two subscribing witnesses.

HANS HOLZWARTH.

Witnesses:

A. O. TITTMANN,
ERNEST OPPENHEIMER.