P. KRAUSE

GAS TURBINE.

APPLICATION FILED MAY 20, 1910.

1,000,924.

Patented Aug. 15, 1911

4 SHEETS—SHEET 1

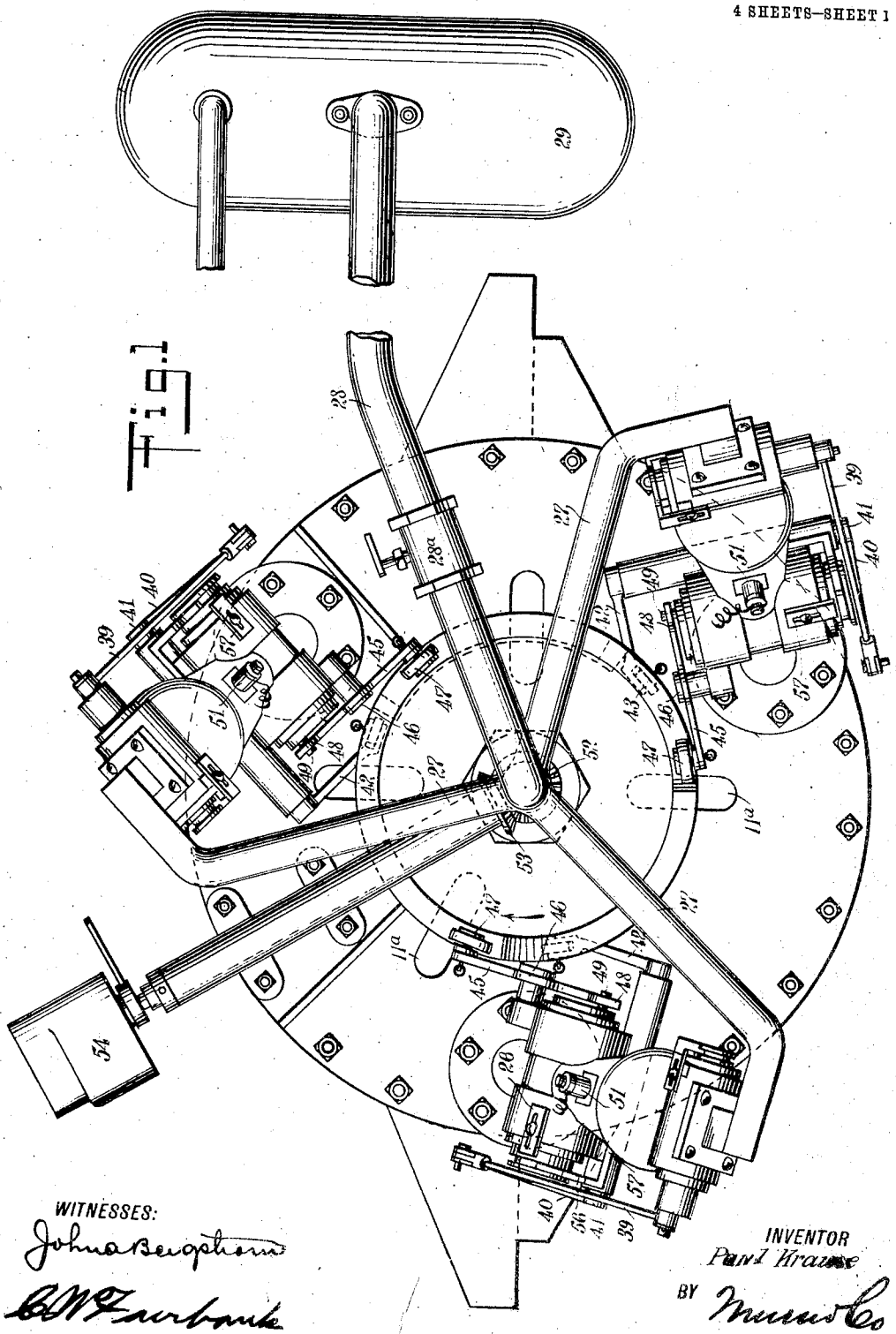

Fig. 1.

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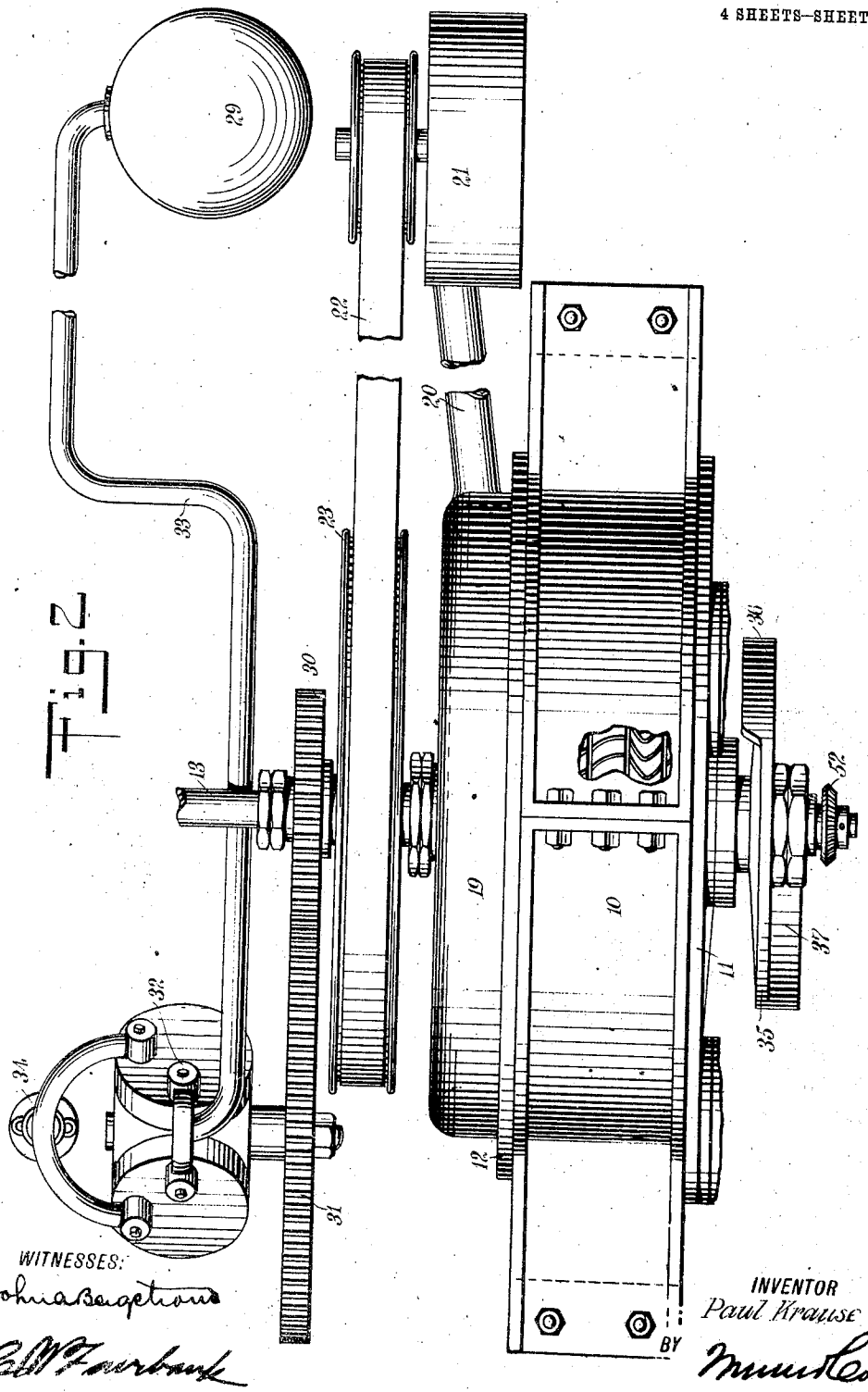

Fig. 2.

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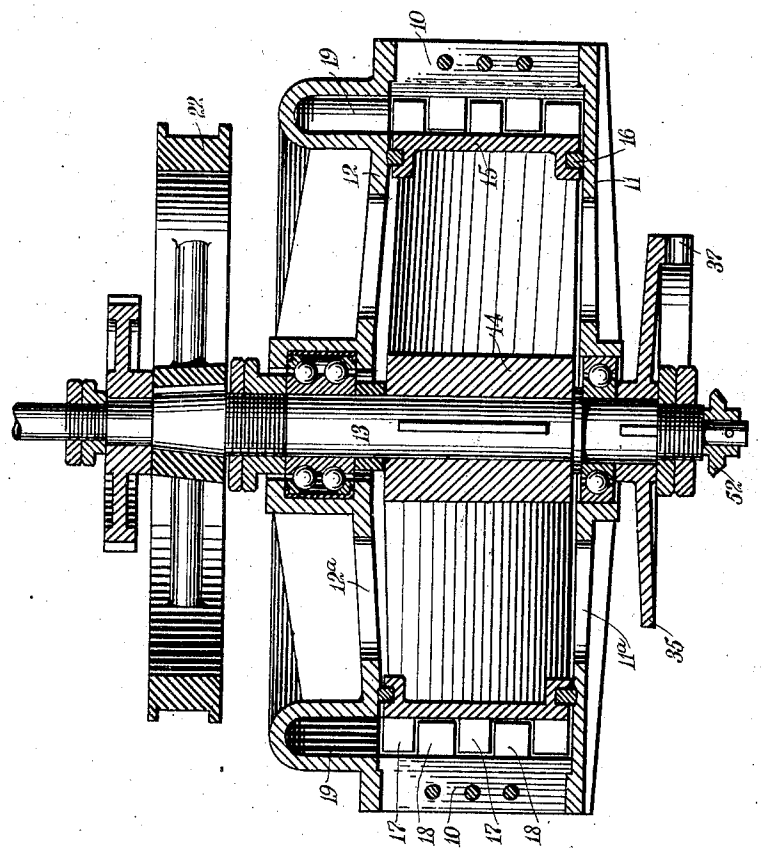
4 SHEETS—SHEET 3.

Fig. 3.



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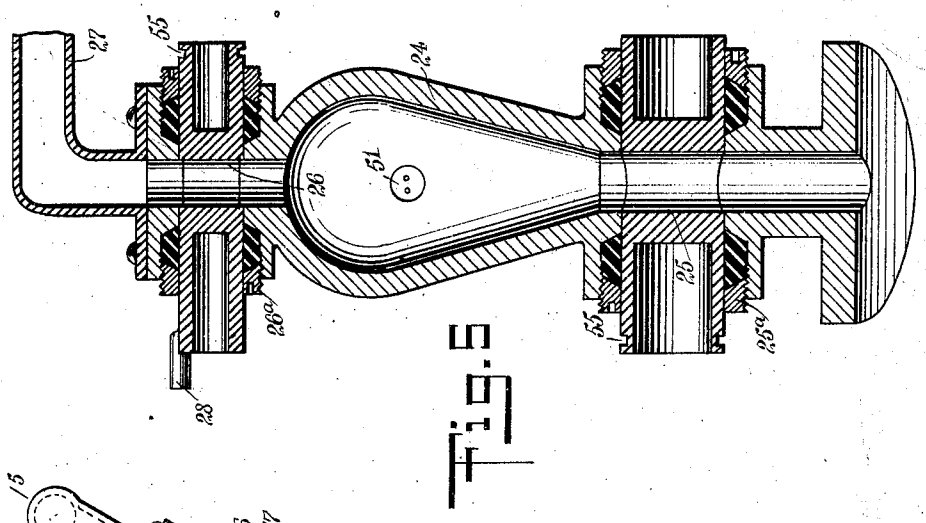

Fig. 5.

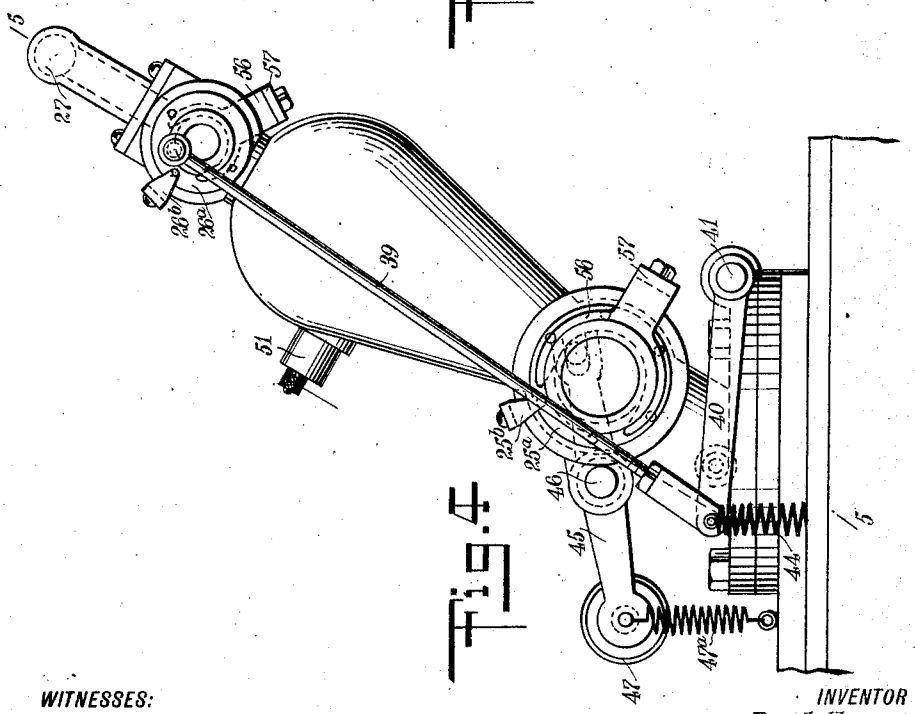

Fig. 4.

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UNITED STATES PATENT OFFICE.

PAUL KRAUSE, OF BABYLON, NEW YORK.

GAS-TURBINE.

1,000,924. Specification of Letters Patent. Patented Aug. 15, 1911.

Application filed May 20, 1910. Serial No. 562,469.

To all whom it may concern:

Be it known that I, PAUL KRAUSE, a subject of the German Emperor, and a resident of Babylon, in the county of Suffolk and State of New York, have invented a new and Improved Gas-Turbine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in turbines and more particularly to that type of turbine in which an explosive mixture is ignited in a separate chamber and admitted to the blades of the turbine.

One of the important features of my invention is the means employed for controlling the explosive mixture and the delivering of the same to the blades of the turbine.

In my improved turbine one or more separate chambers are provided, which are secured to the wall of the turbine casing and within which the explosive charge is ignited. These chambers terminate in nozzles set at an angle to the blades, so that the ignited gases in entering the main casing engage with the blades at the proper angle. The admission of the gas to the chamber, the ignition of the gas therein, and the delivering of the ignited gas through the nozzles, are all automatically controlled by the rotor of the turbine, so that there is no liability of injury from a delivery or an ignition of the gas at the wrong time.

The invention consists in the combination and arrangement of parts hereinafter defined in the claims, and one embodiment of which is described in detail.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures, and in which—

Figure 1 is an end view of a gas turbine constructed in accordance with my invention; Fig. 2 is a top plan view thereof; Fig. 3 is a transverse section in a plane along a diameter of the turbine, the combustion chambers and their appurtenances being removed; Fig. 4 is a side elevation of one combustion chamber; and Fig. 5 is a longitudinal section on the line 5—5 of Fig. 4.

In my improved turbine, I employ a stator in the form of a casing having an annular peripheral wall 10 formed of sections bolted together, and two end walls 11 and 12. The two end walls have suitable bearings for supporting the main shaft 13 of the turbine, which extends axially through the casing and beyond both end walls. Within the casing is the rotor having a hub portion 14, keyed or otherwise rigidly secured to the shaft 13 and having a rim portion 15 held rigid in respect to the hub by suitable spokes. The rim 15 is of a width substantially equal to the interior width of the casing, and adjacent each edge of the rim 15 are suitable packing rings 16, for forming a tight joint and preventing the admission of gas from the annular space outside the rim to the space between the rim and hubs. The end walls 11 and 12 are provided with apertures 11^a and 12^a, respectively, and the spokes are set at an angle to constitute fan blades and to create a circulation of air through the casing inside of the rim when the rotor is in motion. The rim 15, upon its outer or peripheral surface, carries a series of rows of outwardly-extending blades or vanes 17, while the peripheral wall of the casing carries a plurality of rows of vanes or blades 18 extending inwardly toward the rim, the rows of blades 17 being arranged alternately with the rows of blades 18. The end wall 11 is provided with a plurality of inlet ports, here illustrated as three in number, and through which the ignited gas may enter the space containing the vanes, blades or buckets. The gas may travel axially of the turbine through this space to the opposite end wall 12, and may there escape into an annular channel 19 opening into the annular blade space throughout the entire peripheral length of the latter. The gas may escape from this annular channel 19 through a conduit 20, which may lead to a fan chamber 21. A suction fan is mounted within the fan chamber and operates to create a partial vacuum in the annular exhaust chamber or channel 19. The suction fan may be driven by a suitable belt 22, which may receive its power from a large combined pulley and fly wheel 23 on the shaft 13 adjacent one end of the turbine casing.

One of the most important features of my invention is the means employed for compressing, igniting and delivering the gas to the vanes or blades. In the specific form of turbine illustrated, I employ three separate combustion chambers 24, each secured to the end wall 11 of the turbine casing and each set at an angle in respect thereto, so as to deliver the gas against the buckets in the first row and turn the rotor by impact as

well as by reaction. Each combustion chamber has a valve 25 for closing communication between the chamber and the interior of the turbine casing, and at the outer end each chamber has a valve 26 for controlling the admission of explosive mixture to the combustion chamber. In the specific form illustrated, both of these valves are in the form of turning plugs, and each provided with suitable packing at each end, to prevent the escape of the gas to the outside atmosphere. The gaskets are held in place by glands 25^a and 26^a, and these glands have apertures in their outer surfaces. To prevent the glands from rotating during the rotation of the plugs, suitable spring stops 25^b and 26^b are secured to the valve casings and have projections entering the apertures in the glands, as is illustrated particularly in Fig. 4. To regulate the rate of flow of the gas through the two turning plugs independent of a variation in the degree of rotation, the two plugs are mounted so as to be movable longitudinally to bring the passage through the plug into or out of direct registry with the openings in the valve casing. Each valve has an annular groove 55, adjacent one end adapted to receive a yoke 56, which is carried by an arm 57 adjustably secured to the valve casing. By moving the arm lengthwise, the valve plug may be similarly moved lengthwise and the rate of flow through the plug will thus be controlled.

The explosive mixture is delivered to the several combustion chambers by branch conduits 27, which extend radially in respect to the turbine casing, and all of which unite with a main delivery conduit 28, which latter may be controlled by a throttle valve 28^a. By connecting the delivery conduit 28 to the several branches 27 in alinement with the axis of rotation of the turbine, all of the branches will be of exactly the same length and each branch will receive the same quantity of gas. The delivery conduit 28 may receive its gas supply from any suitable source, as, for instance, a reservoir 29. As illustrated, the main shaft 13 of the turbine has a gear wheel 30, which intermeshes with a gear wheel 31 of a pump 32, which latter delivers the explosive mixture through a conduit 33 to the pressure chamber 29. The pump may be of any suitable character and may have a carbureter 34 connected to the inlet thereof.

For controlling the inlet valves 26 and outlet valves 25 of the several combustion chambers, the main shaft 13 is provided with a cam wheel 35 presenting a cam 36 on one side for controlling one of the valves, and a cam 37 on the other side for controlling the other valve. Each valve 26 has a pin at one end thereof eccentric in respect thereto, and to this pin is connected an operating rod 39. The rod at its lower end is connected to the end of a lever 40 pivoted on a rock shaft 41. At the opposite end of the rock shaft is an arm 42 carrying a roller 43 at its outer end which engages with the cam 36. To hold the roller 43 in engagement with the cam, a suitable compression spring 44 may operate on the under side of the lever 40 or the arm 42.

For rotating the outlet valve 25, a lever 45 is pivoted on a stud 46 on the valve casing, and at one end has a roller 47 in engagement with the cam 37. The lever, at its opposite end, has a fork or yoke 48, for the reception of a pin 49 on the valve 25 and eccentric in respect thereto. A roller 47 may be kept in engagement with its cam by a suitable spring 47^a. The cams 36 and 37 are so constructed that as the rotor and cam turns, the valve 26 will be intermittently opened to permit the delivery of explosive mixture under pressure to the combustion chamber. The valve 26 will then close, and as the charge is ignited, the valve 26 is opened to permit the escape of the gases of combustion to the blades of the turbine. For igniting the explosive mixture, each combustion chamber is provided with an igniter, which in the drawings is illustrated as a spark plug 51. The main shaft 13 of the engine may have a bevel gear 52, intermeshing with a bevel gear 53, which drives a timer 54, a distributer, or a combined timer and distributer, dependent upon the character of the ignition system.

The number of combustion chambers illustrated is not important, as a larger or smaller number of combustion chambers may be employed, if desired, but all of said chambers are so mounted that they deliver the gas in the direction in which the rotor turns. The cams may be so constructed that all of the combustion chambers will deliver their charges at the same time, or the combustion chambers may deliver in succession but in the reverse order to the direction of rotation, so that they will not all deliver gas to the same point on the rotor. The time of ignition may be readily varied at the timer in the ordinary manner, and the speed of the turbine may be controlled not only by varying the time of ignition but also by varying the pressure of the gas in the reservoir 29, or by varying the amount of gas delivered to the combustion chamber, or by regulating the opening of the valve 25 and controlling the time which is required for the delivery of the gases of combustion from the combustion chamber to the blades. The blades of the rotor and stator are supported between the rim 15 and the peripheral wall 10 of the casing and both the rim and the wall are freely exposed to the atmosphere, so that the temperature will be kept sufficiently low to prevent injury to the parts.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A gas turbine having a stator, including an annular peripheral wall and end walls, a rotor within said stator and having a peripheral rim in gas-tight engagement with said end walls, and spaced from said peripheral wall of the stator, a plurality of rows of blades within the space between said rim and said peripheral wall, and a plurality of combustion chambers secured to one of said end walls at an angle thereto and delivering therethrough tangentially and diagonally against said blades, the other of said end walls having an annular groove or channel for receiving the exhaust gas, and each of said combustion chambers having an inlet valve at the outer end thereof and an outlet valve adjacent the end wall of the stator, and means controlled by the rotation of said rotor for operating said valves.

2. A gas turbine having a stator presenting a series of radially-disposed blades and having an end wall, a rotor presenting a plurality of radially-disposed blades adjacent the first-mentioned blades, a plurality of combustion chambers secured to said end wall at an angle thereto and delivering therethrough tangentially and diagonally against said blades, each of said combustion chambers having an inlet valve at the outer end and an outlet valve adjacent the end wall of the stator, and cam-controlled means controlled by the rotation of said rotor for operating said valves.

3. A gas turbine, having a stator presenting a plurality of rows of blades and an end wall, a rotor presenting a plurality of blades adjacent said first-mentioned blades, a plurality of combustion chambers secured to said end wall at an angle thereto and delivering therethrough against said blades, each of said combustion chambers having an inlet valve at the outer end thereof and an outlet valve adjacent the end wall of the stator, a cam operated by said rotor, and lever arms connected to said valves and terminating adjacent said cam, for operating the valves upon the rotation of the cam.

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

PAUL KRAUSE.

Witnesses:
C. M. Weeks,
Wm. G. Nicoll.