J. R. PFLAUME.

ENGINE.

APPLICATION FILED MAR. 17, 1919.

1,343,473.

Patented June 15, 1920.

4 SHEETS—SHEET 1.

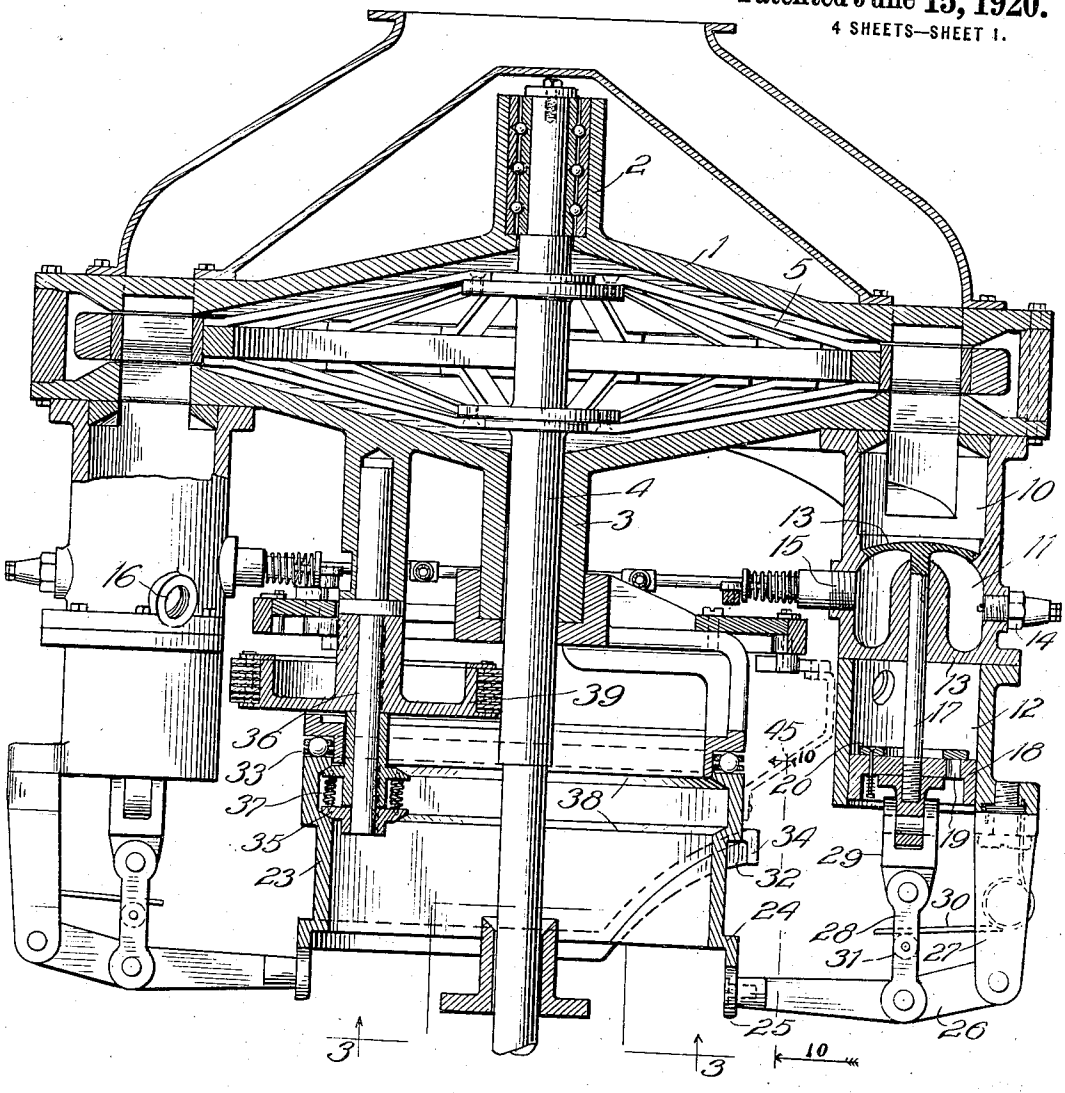


Fig. 1

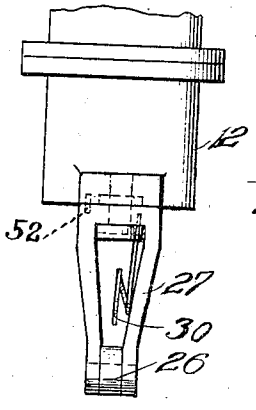


Fig. 2.

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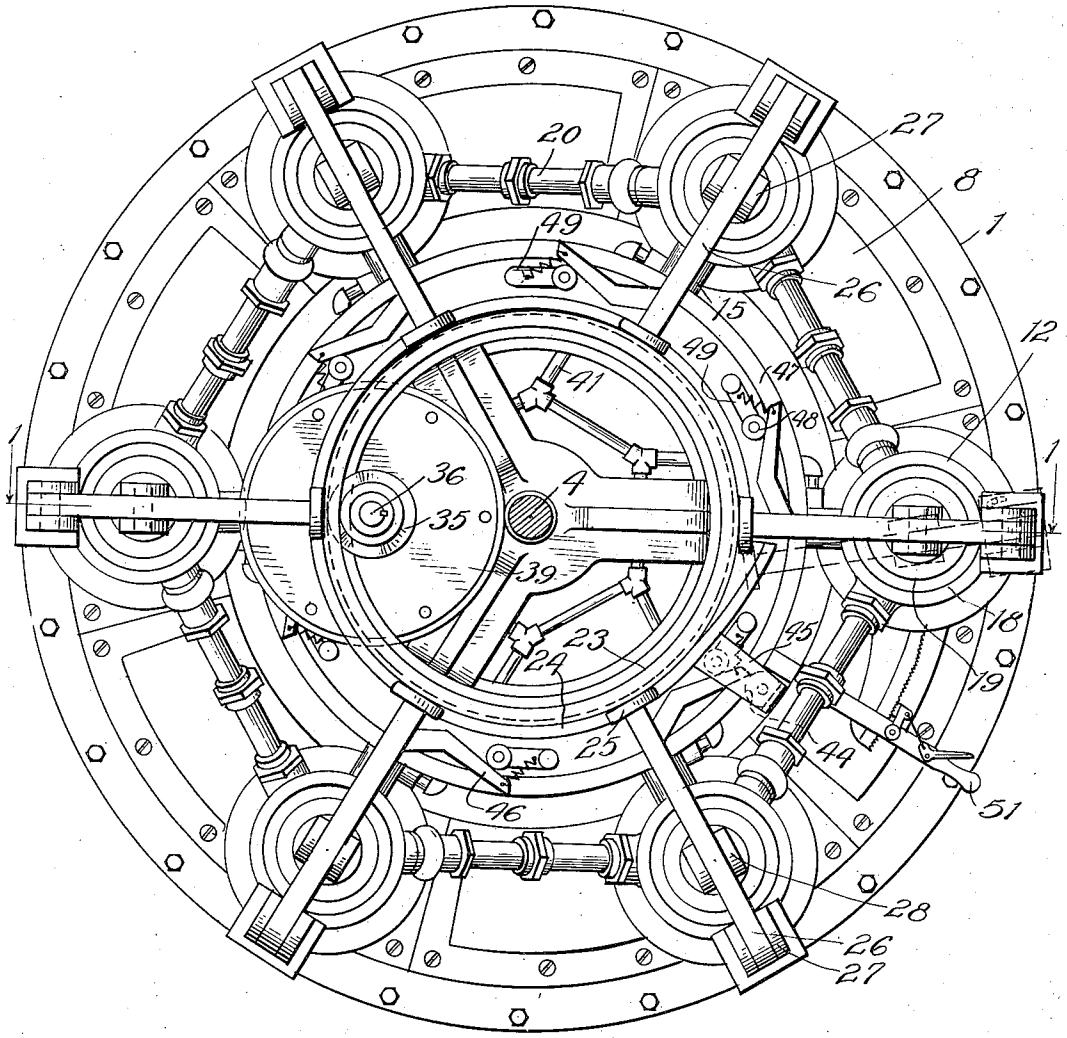


Fig. 3

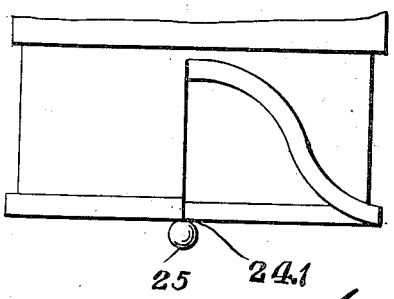


Fig. 10.

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4 SHEETS—SHEET 3.

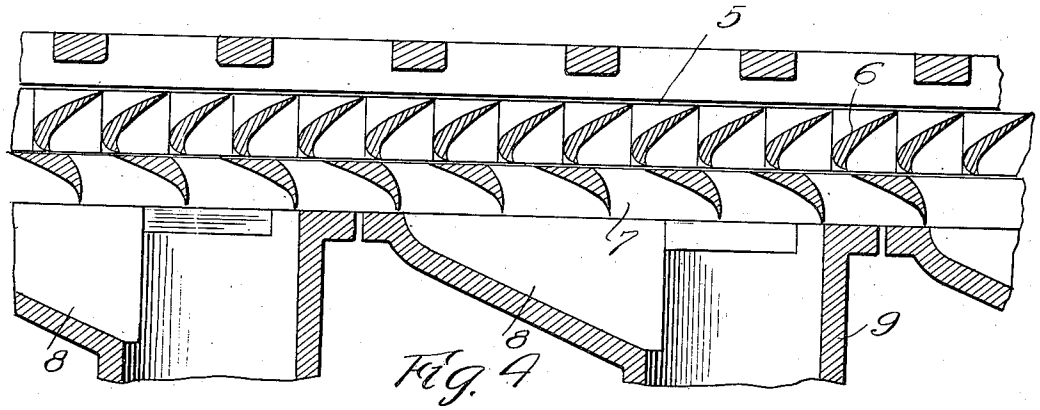


Fig. 4

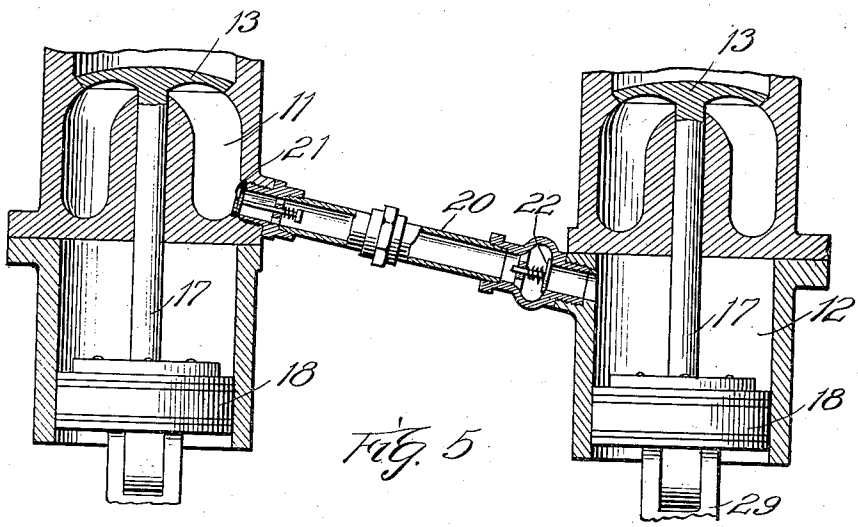


Fig. 5

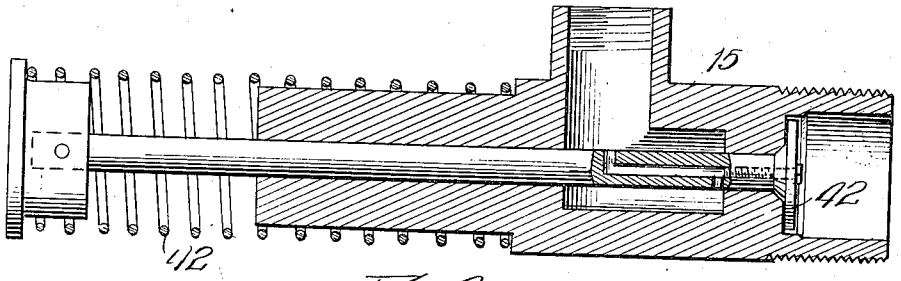


Fig. 6

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4 SHEETS—SHEET 4.

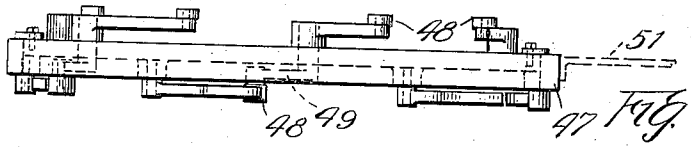


Fig. 8

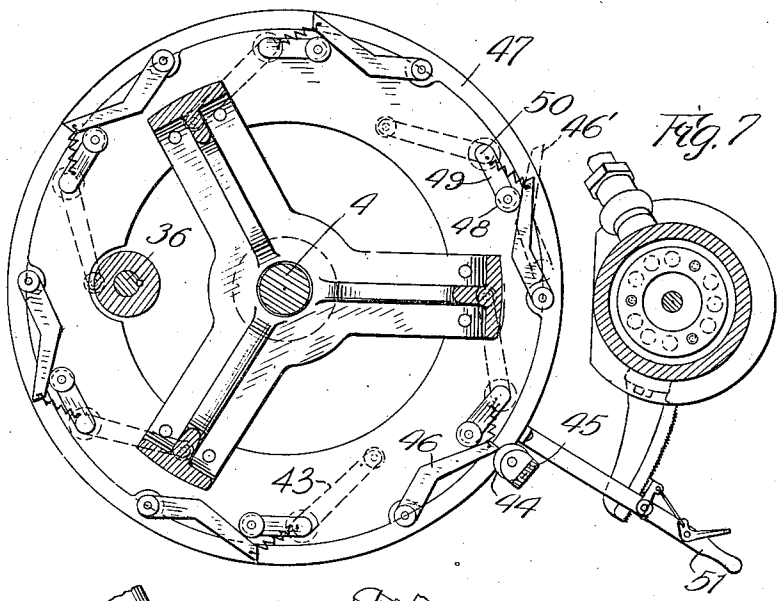


Fig. 7

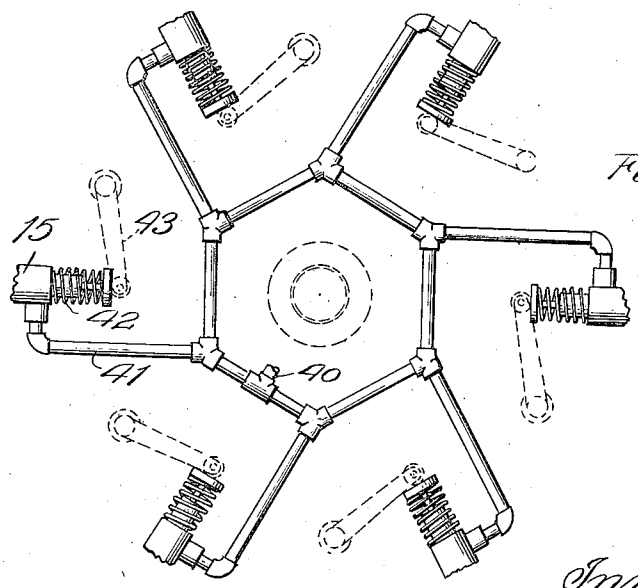


Fig. 9

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UNITED STATES PATENT OFFICE.

JULIUS R. PFLAUME, OF CHICAGO, ILLINOIS, ASSIGNOR TO METEOR MOTOR COMPANY, A CORPORATION OF ILLINOIS.

ENGINE.

1,343,473. Specification of Letters Patent. Patented June 15, 1920.

Application filed March 17, 1919. Serial No. 283,250.

To all whom it may concern:

Be it known that I, JULIUS R. PFLAUME, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Engines, of which the following is a specification.

This invention comprises improvements in engines of the gas turbine type wherein a turbine wheel is driven by the impact of the products of combustion from a plurality of explosion chambers arranged around the driven wheel. In the design, the general plan is followed of utilizing the explosion in one chamber for operating a pump to supply air to another explosion chamber in which the ignition occurs later.

The invention relates more particularly to the design of pump mechanism whereby, in proportion to the force of the explosion, an ample supply of air is supplied to the explosion chambers for cooling purposes and to insure complete combustion of the fuel.

Objects of the invention are to provide an improved controlling cam for restoring the air pumps and timing the ignition, and to provide an improved connection between the cam and pump pistons and outlet valves for the combustion chambers which serves to hold the pump pistons and the valves in normal position until the exact moment of firing, when the valve and piston may act without other restraint than the work performed. Another purpose of the invention is to provide an improved governor-controlled friction drive for said cam.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which—

Figure 1 is a transverse vertical section of an engine constructed according to this invention.

Fig. 2 is a detail showing a swiveled connecting link between a pump piston and a cam-controlled arm for restoring the piston.

Fig. 3 is a bottom plan view of the engine.

Fig. 4 is an enlarged sectional detail of the driven wheel, and nozzles through which the products of combustion are delivered to the wheel.

Fig. 5 is a sectional detail of a pair of cylinders showing combustion chambers and air pumps.

Fig. 6 is an enlarged sectional detail of a fuel-controlling valve.

Fig. 7 is a bottom plan view showing adjustable means for regulating the charges of fuel delivered to the combustion chambers.

Fig. 8 is a side view of the construction shown in Fig. 7.

Fig. 9 is a plan view showing the arrangement of the fuel supply conduits and controlling valves.

Fig. 10 is a side elevation of the cam as viewed from the plane of the line 10—10 of Fig. 1.

Gas turbines of the general type shown in the drawings are frequently provided with a gearing or positive drive between the turbine shaft and the fuel and air-regulating devices. In the present machine an arrangement is provided whereby the air and fuel supply is under perfect control independently of the rate of rotation of the turbine wheel. This arrangement includes a governor-controlled friction drive between the turbine shaft and a cam which controls the air pumps and fuel inlets for the different combustion chambers.

Another distinguishing feature of the design over prior arrangements is the means for maintaining the outlet valves of the combustion chambers tightly seated until the instant of the explosion.

Referring to the drawings, the frame structure 1 includes bearings 2 and 3 within which rotate the shaft 4 carrying the rotor 5. The rotor 5 is shown provided with a customary design of vanes 6 which the products of combustion impact against upon leaving the nozzles 7. Nozzles 7 communicate through the passages 8 with a plurality of combustion cylinders 9. Each of the cylinders 9 as shown in Fig. 1 comprises three compartments. The uppermost compartment 10 is open to the nozzles 7, the central compartment or explosion chamber 11 is separated from the lower air pump chamber 12 by the diaphragm 13 but with respect to the compartment 10 is alternately opened and closed as controlled by valve 13. Each compartment 11 is provided with a spark plug 14, a fuel inlet 15, and an air inlet 16.

Assuming that, air and fuel having been admitted to compartment 11 and ignited, valve 13 will be blown upwardly from its seat and the products of combustion may then enter the chamber 10, which communicates with the nozzles 7, and by the latter the products of combustion are directed

against the blades of the rotor at a velocity proportional to the pressure developed in chambers 11 and 10. The upward motion of the valve 13 through its stem 17 serves to operate the air compressor piston 18 within the cylinder 12. The piston 18 is provided with inlet apertures 19 controlled by the check valve 20. The air within the compartment 12 passes through a conduit 20 to the explosion chamber 11 of a cylinder which in turn is supplied with fuel and then after the ignition occurs therein actuates its air pump. This cycle of operation is repeated in all the cylinders in succession.

The conduit 20 serves as a reservoir between one pumping cylinder and the respective explosion cylinder. Each conduit is provided with back pressure valves 21 and 22 which are respectively held in closed position at the time of an explosion and during the intake stroke of piston 18.

The means for maintaining valves 13 normally in firm engagement with their seats includes a rotatable cam 23. This cam is provided with a flange 24 for engaging rollers 25 on arms 26 pivoted at the lower ends of swiveled posts 27 depending from flanges on the lower ends of the pump cylinders. The arms 26 are connected by a pair of pivoted links 28 and 29 with the piston 18, a restoring spring 30 bears between a roller 31 on link 28 and the post 27. Spring 30 normally urges the valve 13 toward its seat, and it likewise serves to return piston 18, but the action of the spring is supplemented by the positive means provided by the curved portions 32 of flange 24.

The cam 23 is rotatably mounted upon bearings 33 and when the high points 24.1 (Fig. 10) of flange 24 passes the rollers 25, the ignition takes place in the corresponding combustion cylinders. The arrangement of swiveled posts 27 and pivoted links 28 and 29 permits the desired rapidity of action of the valve 13 and piston 18 by allowing the rollers 25 to swing off from the high point 24.1 of the cam the instant the explosion takes place. The rate of motion of the arm 26 when an explosion takes place with respect to the comparatively slowly driven cam 23 necessitates providing means for permitting the arm to roll off of flange 24. The swiveled post 27 and the pivited links 28 and 29 permit this action. The roller 25 may swing to one side clear of the low part of flange 24 and into line with the outwardly extending upper portions 34 of the flange.

The cam 23 is rotated by the governor-controlled friction disks 35 fast to a shaft 36. The disks 35 are normally urged into contact with the internal inclined surfaces 38 of the cam by the spring 37. Shaft 36 receives its rotation from shaft 4 at approximately a 5 to 1 reduction by means of the friction wheel 39 fast to shaft 36 and bearing against shaft 4. The friction wheels 35 in turn drive the cam 23 at approximately a 5 to 1 reduction from the rate of rotation of shaft 36.

The fuel is fed from a supply conduit 40 (Fig. 9) through the different branch conduits 41 to the fuel inlets 15 of the combustion chambers 11. The inlets 15 are controlled by valves 42. These valves are opened against spring pressure by the oscillating arms 43. The arms 43 are oscillated in succession by means of a roller 44, Fig. 7, carried by an arm 45 secured to cam 23. Roller 44 coacts with pivoted arms 46 carried by an annular frame 47. The arms 46 are in position to engage rollers 48 carried by arms 49 rigid with the valve-operating arms 43 and rockable around the pivots 50. Frame 47 may be given an angular adjustment by means of the handle 51 for the purpose of regulating the throw of arms 46 under the action of rollers 44 and consequently varying the extent of opening a number of the valves 42. This is illustrated in Fig. 7 by showing one of the arms 46 by dotted lines 46'.

In operation, the engine is started by means of customary starting devices which may be arranged to impart rotation to the shaft 4. The time during which the fuel valves 42 are held in open position is regulated by an adjustment of the ring 47 around its rigid support by means of the handle 51. This adjustment of the rings results in the operating arms 46 for the valves extending more or less across the path of travel of roller 44. The ignition takes place in the different cylinders in succession, an explosion in one cylinder causing its valve to be lifted from its seat a distance corresponding to the force of the explosion. The piston 18, which is rigid with the valve, has its compression stroke as the valves moves upwardly. Air is by this means forced through the conduit 20, past valves 22 and 21 into the chamber 11 of a cylinder wherein an explosion is to occur, following in time the explosion in the cylinder which operated the piston. Rotation of shaft 4 through the friction wheels 39 and 35 causes rotation of the cam 23 at about a 25-to-1 ratio. The flange 24 of the cam has cut-away portions suitably located to permit upward motion of rollers 25 during the upstroke of pistons 18 and the valves 13 at the correct times. Springs 30 serve to restore the valves 13 and the pistons 18 to normal position, but the power of the springs is supplemented by the engagement of the part 32 of flange 24 with the rollers 25. The cam by this means serves to positively restore the pistons and valves to normal position. In order that the motion of valves 13 and the piston 18 at the time of explosion may not in any manner be

interfered with by the flange 24, the arm 26 is free to rock sidewise around its support on the cylinders. The rocking motion of arm 26 is limited by a pin 52 extending into a slot in the post 27. The governor-control friction device 35 serves to drive cam 23 at a constant speed, irrespective of increases in speed of the turbine wheel 5. Accordingly, the fuel valves 42 are held open any predetermined time and accordingly the richness of the charge is not lessened due to increased speed of the rotor.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. An engine of the class described, wherein a rotor is driven by the products of combustion from a series of annularly arranged combustion chambers, a corresponding number of pumping cylinders arranged in axial alinement with the respective combustion chambers, valves operable by explosions in said combustion chambers and adapted to control the discharge of the products of combustion to said rotor, pistons in said pumping cylinders directly connected to the respective valves so as to be operated by the movement of said valves, conduits connecting the pumping cylinders which are alined with each combustion chamber, with another combustion chamber, and means for holding the respective piston valves closed during the ignition of a charge in the combustion chamber.

2. An engine of the class described, comprising a rotor and a series of combustion chambers arranged to deliver products of combustion to nozzles arranged around the rotor, a corresponding number of pumping cylinders, a reservoir connecting each pumping cylinder with a combustion chamber, back-pressure check valves arranged in each of said reservoirs adjacent the points of connection with said pumping cylinder and combustion chamber, valves controlling the outlets of said combustion chambers, pump pistons movable with said valves and arranged to supply air to said combustion chambers, said last-mentioned valves being opened by explosions and causing the pistons to move an extent corresponding to the force of the explosions.

3. An engine of the class described, wherein a rotor is driven by the products of combustion from a series of annularly arranged combustion chambers, and air pumping pistons operated by explosions in said chambers and serving to supply the chambers with air, a cam for restoring said pistons, a lever coöperating with said cam and having a pivotal connection with said piston permitting a limited lateral motion of said lever while also serving to restore said piston.

4. An engine of the class described, comprising a rotor, a combustion chamber arranged to deliver products of combustion to the rotor, a valve controlling the outlet of said combustion chamber, means for pumping air under pressure into said combustion chamber, a cam for retaining said valve in closed position against the gas pressure, and connections between said cam and valve comprising a lever, a roller carried by said lever and having rolling contact with said cam, said roller being shiftable to one side of its normal position with respect to said cam for the purpose of instantly clearing the cam to permit action of the valve at the time of an explosion.

5. An engine of the class described, wherein a rotor is driven by the products of combustion from a series of annularly arranged combustion chambers, and air pumping pistons operated by explosions in said chambers and serving to supply the chambers with air, a cam for restoring said pistons, a lever coöperating with said cam and having link connection with said piston permitting a limited lateral movement of said lever with respect to the axis of said piston, and having a pivotal fulcrum also arranged to permit axial and lateral movement of said lever with respect to said piston whereby said lever may be thrown sidewise out of coöperative relation with said cam, and means normally urging said lever to a position for coöperative relation with said cam.

6. An engine of the class described, comprising a rotor, combustion chambers in a series around and having outlets to said rotor, fuel feed conduits leading to said combustion chambers, valves controlling said fuel conduits, a rotary valve-operating device driven by said rotor, and adjustable means intermediate said valve-operating device and the valves for regulating the duration of opening of said valves under the action of said valve-operating device.

7. An engine of the class described, comprising a rotor, combustion chambers in a series around and having outlets to said rotor, fuel feed conduits leading to said combustion chambers, valves controlling said fuel conduits, a rotary valve-operating device driven by said rotor, a series of arms inclined with respect to the path of said rotary valve-operating device and adapted to coöperate therewith for regulating the duration of opening of said valves under the action of said valve-operating device.

Signed at Chicago this 11th day of Feb., 1919.

JULIUS R. PFLAUME.