No. 892,206. PATENTED JUNE 30, 1908.

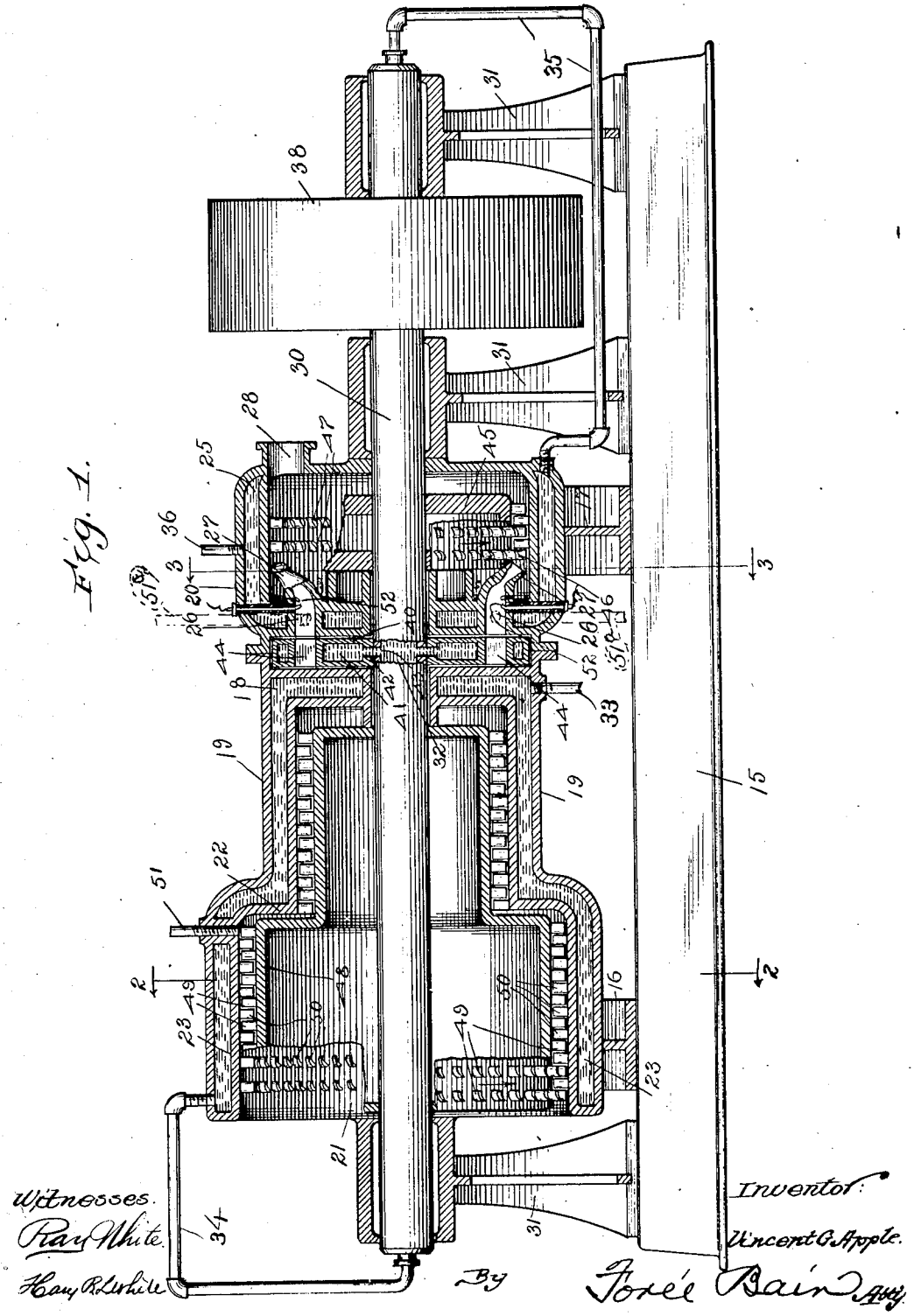
V. G. APPLE.

TURBINE GAS ENGINE.

APPLICATION FILED NOV. 9, 1903.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
Ray White.
Harry R. Burhite.

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Vincent G. Apple.
By Foré Bain Atty.

No. 892,206. PATENTED JUNE 30, 1908.

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4 SHEETS—SHEET 2.

Fig. 2

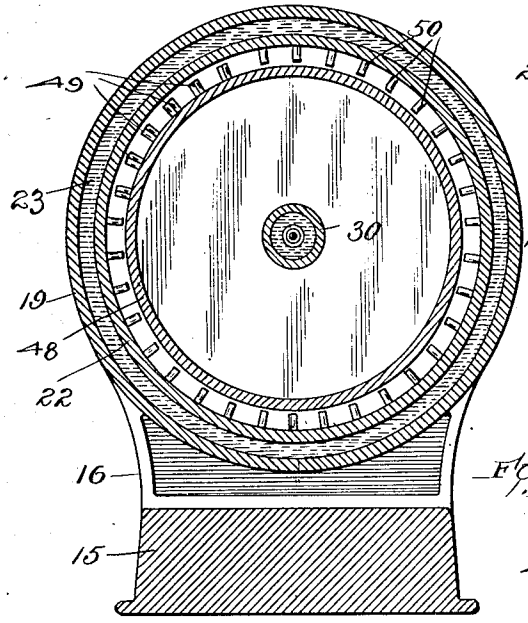


Fig. 3

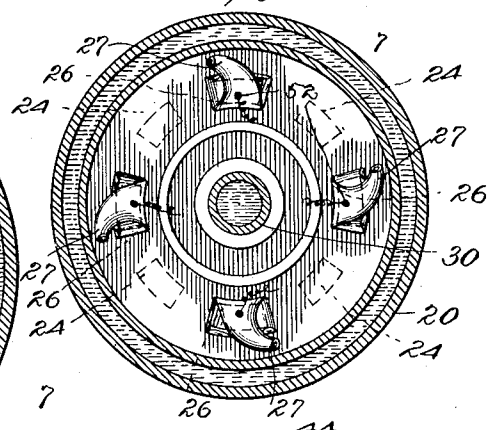


Fig. 4

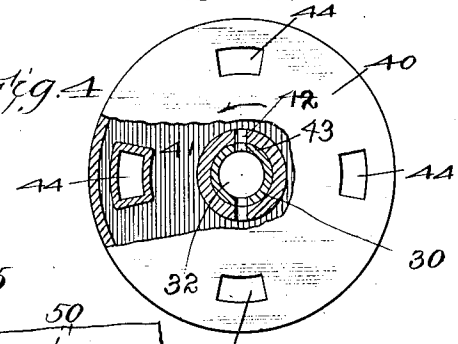


Fig. 5

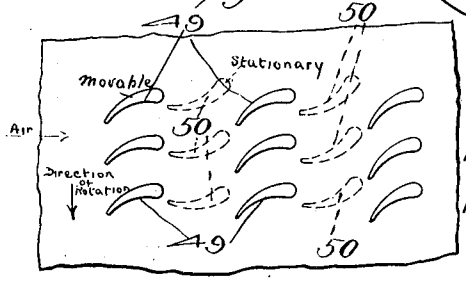


Fig. 6

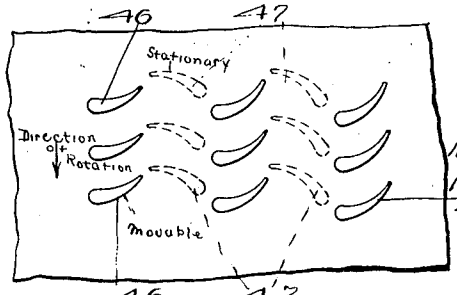
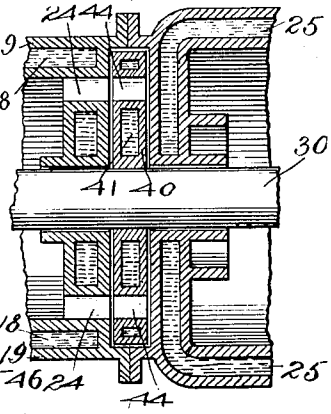


Fig. 7



Witnesses:

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Inventor:

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No. 892,206. PATENTED JUNE 30, 1908.

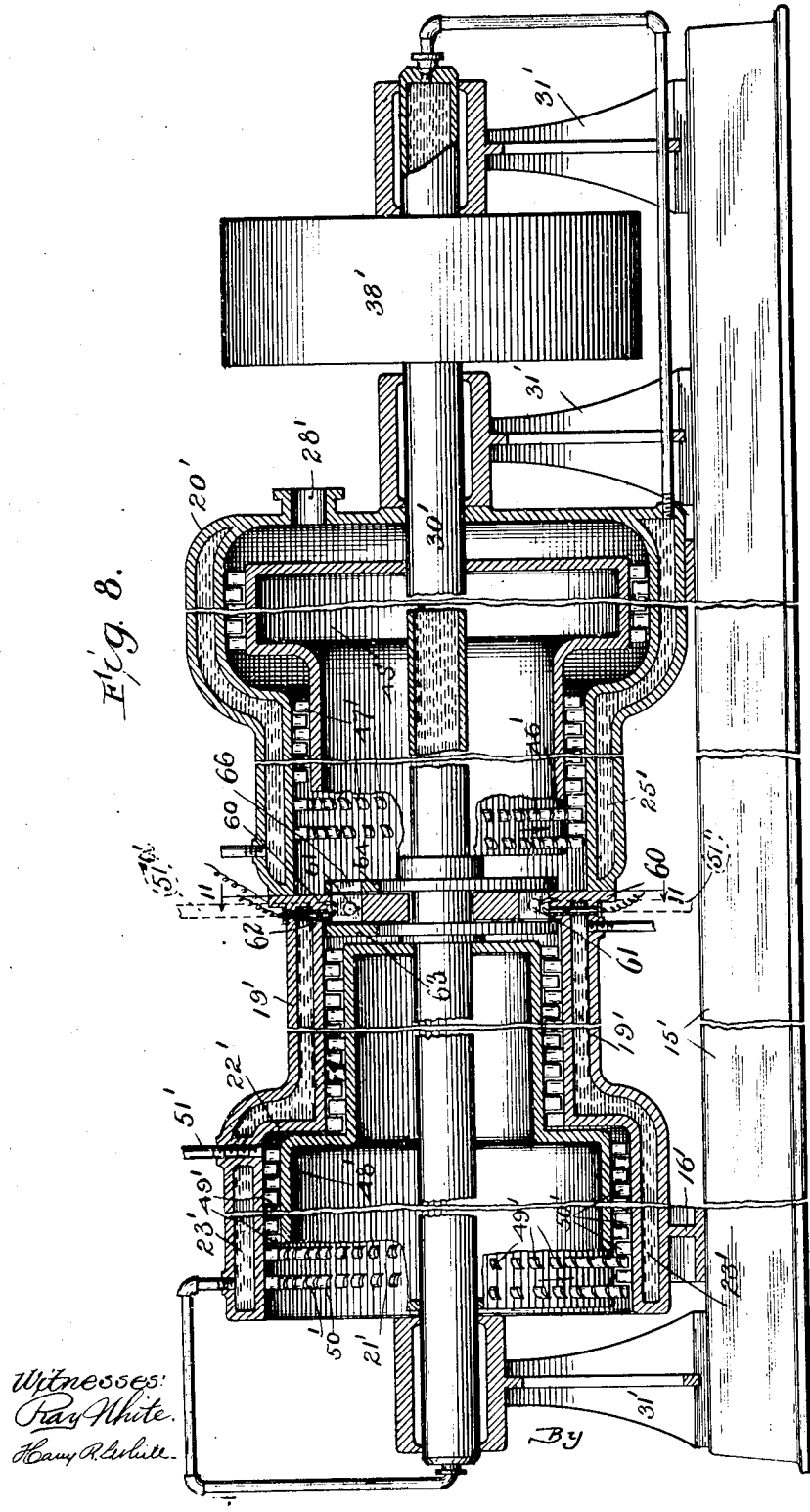
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TURBINE GAS ENGINE.

APPLICATION FILED NOV. 9, 1903.

4 SHEETS—SHEET 3.

Fig. 8.



Witnesses:
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No. 892,206. PATENTED JUNE 30, 1908.

V. G. APPLE.

TURBINE GAS ENGINE.

APPLICATION FILED NOV. 9, 1903.

4 SHEETS—SHEET 4.

Fig. 9

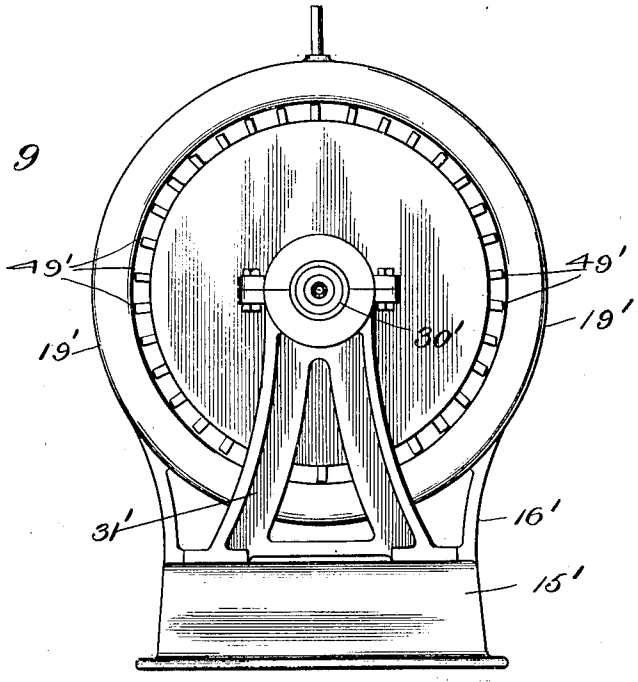


Fig. 10

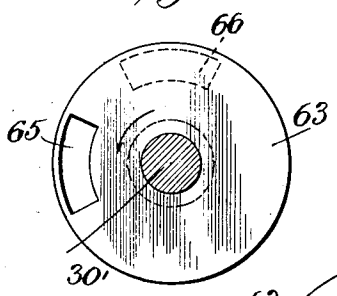


Fig. 12

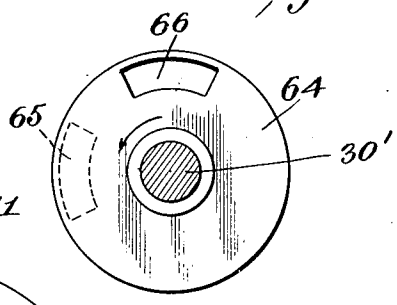
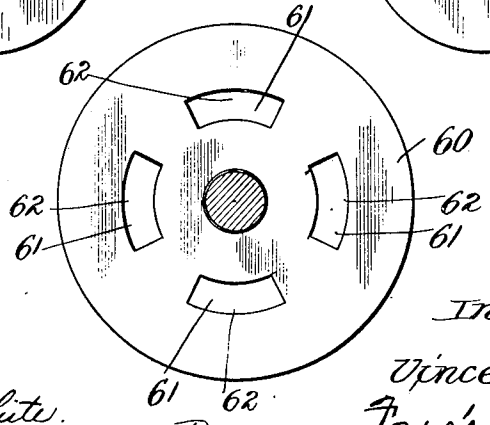


Fig. 11



Witnesses:
Ray White.
Harry R.L. White.

Inventor:
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UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

TURBINE GAS-ENGINE.

No. 892,206. Specification of Letters Patent. Patented June 30, 1908.

Application filed November 9, 1903. Serial No. 180,465.

To all whom it may concern:

Be it known that I, VINCENT G. APPLE, of Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Turbine Gas-Engines; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to improvements in turbine gas engines, wherein a rotatable impulse member or rotor is impelled by the action upon its vanes or blades of the force exerted by the expansion of a suitable substance under the influence of heat generated within the engine by combustion of a suitable fuel.

One object of my invention is to provide means for properly supplying the fuel and the expansible substances to be employed in supplying power to the impulse member, arranged in a unitary casing with said impulse member to be driven thereby.

A further object of my invention is to provide in a device of the character described, a fuel compressor of novel design.

A further object of my invention is to provide advantageous means for controlling and timing the introduction of fuel to the point of combustion and directing the application of the force generated by the expansion thereof upon the impulse member or rotor.

A further object of my invention is to provide a machine of the character described of improved economical and efficient construction.

With a view to attaining these and further objects, which will become apparent to those skilled in the art, my invention consists in the features of construction and arrangement of parts hereinafter more fully described and specified in the claims.

Referring now to the drawings, Figure 1 is a longitudinal vertical section, with some parts in broken elevation, of a gas turbine constructed in accordance with my invention. Fig. 2 is a vertical cross section thereof on line 2—2 of Fig. 1. Fig. 3 is a similar section on line 3—3 of Fig. 1. Fig. 4 is a detail of the valve detached, with parts of the valve face broken away. Fig. 5 indicates an extended fragment of the surface of the air propeller, illustrating the arrangement of the vanes, or blades, thereof, and, Fig. 6 is a similar illustration of the blade arrangement of the rotary impulse member, or rotor. Fig. 7 is a fragment of the valve and the adjacent casing, showing the valve parts in communication with the compressor. Fig. 8 is a view similar to Fig. 1, of a modified embodiment of my invention. Fig. 9 is an end view of the same taken from the front, or compressor end. Fig. 10 is a detail of the inlet port, taken from the rear. Fig. 11 is a detail of the partition member taken from the rear, and, Fig. 12 is a detail of the outlet valve, likewise taken from the rear.

Throughout the drawings like numerals of reference refer to like parts.

Referring now to the form of machine illustrated in the Figs. 1 to 6, 15 indicates a base, of suitable construction, supporting two standards, 16 and 17, whereon are supported the engine casing 18. The casing 18 is preferably made in two parts, 19 and 20, as herein illustrated, the part 19 constituting the casing of a compressor, and the part 20 constituting the casing of what I will call the impulse chamber. The portion 19 of the casing is preferably open at its front end, as at 21, and is of relatively large diameter, its diameter, however, being reduced by one or more steps, as indicated at 22, so that the rear end of the compressor chamber is of less diameter than the inlet or forward end 21. The sides and rear end of the chamber 21, are surrounded by a jacket of water contained in the jacket-chamber 23 formed in the casing 19.

24—24 indicate ports made into the water jacketed rear end of the compression chamber casing, such ports being preferably four in number, equidistant from the axial center of the casing.

The impulse-chamber casing 20, is constructed to form a water-jacket chamber 25, entirely surrounding the front end thereof, as indicated in the drawings.

26—26 indicate ports made through the front end wall of the casing, at the same distance from the axis as the ports 24 of the compressor casing, and of equal size therewith, but offset with relation to the ports 24 of the compressor, so as to be out of register therewith.

27—27 indicate nozzles secured to or formed integral with the rear face of the front wall of the casing 20, one of said nozzles surrounding each of the ports in said casing. The nozzles 27 are suitably shaped to control the expansion of the impelling substances, and direct such substances at their

maximum velocity against the impulse member to secure the operation of the machine hereinafter described.

28 indicates an exhaust opening formed at the rear end of the impulse chamber casing. Sufficient space is left between the front end of the impulse-chamber casing and the rear end of the compressor casing to admit a suitable rotary valve.

30 indicates a rotatable shaft extending axially through the engine casing, and mounted for rotation in suitable bearing brackets 31—31. The shaft 30 is preferably hollow, as indicated at 32, to form a water-chamber. Suitable water piping connections are provided to supply the various water-cooled members with a supply of water. In the present illustration 33 indicates a water inlet pipe communicating with the compressor water jacket-chamber 23; 34 indicates a connection between said jacket 23 and the shaft chamber 32; 35 indicates a connection between said shaft chamber and the water jacket space 25 of the impulse chamber casing; and, 36 indicates the water outlet from said jacket space 25.

38 indicates a power transmitting instrumentality mounted in the shaft 30 for rotation therewith.

Intermediate the compression and impulse chambers, I provide means for regulating, as to the time and quantity, the passage of gaseous substances from the first named chamber to the other.

In the specific embodiment shown in Figs. 1 to 7, 40 indicates a rotary valve mounted upon the shaft 30 for rotation therewith and arranged between the adjoining water-jacketed end walls of the air compressor and the impulse chamber. The valve 40 is preferably hollow throughout, as indicated at 41, and is provided with an aperture 42 arranged to register with similar aperture 43 in the hollow shaft 30.

44—44 indicate ports formed in the valve 40 preferably equal in number to the ports in the rear end wall of the compressor casing, and arranged to pass in register therewith during rotation, as indicated in Fig. 7. The ports 44 of the valve 40 also register with the ports 26 of the impulse chamber casing, but subsequently, as to the cycle or rotation of the valve, to the register of its ports 44 with the compressor ports 24. The valve 40 is preferably arranged out of frictional contact with the adjacent faces of the stationary casing members, to reduce the frictional heat and wear, and the provision of a connection from the hollow parts of the valve to the water-containing hollow shaft 30, provides a means for dissipating such heat as might otherwise deleteriously affect the valve, and for causing the condensation of products of combustion within the valve ports.

45 indicates a rotary impulse member, or rotor, which comprises a cylinder or drum somewhat less in diameter than the interior diameter of the impulse chamber casing provided on its periphery with a suitable number of circumferentially arranged rows of vanes or blades, 46, of such configuration and arrangement that they cause the cylinder to rotate when under a pressure created by a substance moving rearwardly therepast.

47—47 indicate coacting blades or vanes arranged in rows interspaced with and extending down between the rows of vanes 46 and carried by the casing.

The vanes of the impulse member may be of any suitable form or configuration, but I have illustrated in Fig. 6 the arrangement thereof which I consider the most advantageous. By reference to said figure it will be noted that the movable vanes are somewhat dished, or curved, and are arranged in positions more oblique to a line parallel with the axis of rotation as they progress from the point of first application of the impelling force. The stationary blades, illustrated in dotted lines, are so arranged that they tend to direct the impelling substance against the blades of the impulse member at the most efficient angle.

The compressor member comprises a drum or cylinder 48 mounted for rotation on the shaft 30, and provided on its periphery with rows of blades 49 similar in construction to those of the power motor, or impulse member, coacting with stationary blades or vanes 50 upon the inner surface of the inner casing. The relative arrangement of the stationary and movable blades or vanes 49 and 50, may best be seen from Fig. 5, wherein the direction of rotation of the cylinder and the direction of the air are indicated by arrows. The arrangement of the rows of movable vanes is such that their obliquity to a line parallel with the axis of the cylinder increases from the point of entrance of the air toward the rear of the casing, as clearly shown in Fig. 5.

51 indicates a gas inlet pipe, through which gas under any proper degree of compression may be forced.

Suitable ignition means are provided in conjunction with the impulse chamber ports. In the present illustration; 52—52 indicate spark plugs mounted in the ports or nozzles of the impulse chamber and adapted to be connected with a suitable ignition system, not shown in detail, in the usual manner as will be well understood.

The operation of the device herein described will be as follows; The initial rotation being imparted to the shaft 30 in any suitable manner, the blades 49 of the compressor member serve to propel air, or the gaseous fuel substance, inward from the open end of the casing toward the rear end thereof, the course of such air impelled by the vanes 49 being directed by the stationary vanes 50

upon the casing. The capacity of the vanes arranged at the least obliquity, at the intake end of the air compressor, being greater than the capacity of the blades arranged at greater obliquity, the air is compressed to some degree as it passes from row to row of the blades, such compression being furthered by the reduction, at one or more points, of the size of the casing, and correspondingly its capacity. The gas inlet 51 is preferably arranged in the position shown, so that the gas is mixed with the air while it is passed through the compressor, and is itself submitted to the same degree of compression as the air introduced to support the combustion to follow. The gas may, however, be introduced into a stationary element of the valve mechanism, as by pipes 51[a], illustrated in dotted lines, communicating with the partition ports 26. The rotation of the shaft 30 carrying with it the valve 40 serves to intermittently bring the valve ports 44, first into register with ports 24 in the wall of the air compressor casing and then with the ports 26 of the impulse chamber. As the valve ports register with compressor ports 24 the compressed air and gas are trapped into the valve ports 44 and a quantity of the fuel mixed is consequently carried forward by each valve port in its rotation. After leaving the position of register with the ports 24, the valve ports 44 come into register with the fuel outlet ports 26 of the impulse chamber casing, and at such time, by suitable ignition mechanism, sparks are caused to be emitted from the ignition devices 52, or the charges are in any other suitable manner ignited. The charges of fuel gas contained within the valve ports 44 are consequently fired, and by their explosion or rapid combustion, occasion a high degree of expansion of the substances within the port, and force said substances through the nozzles 27, where their expansion is partly or wholly completed. The substances thus impelled are directed by the nozzles, while moving at high velocity, against the vanes 46 of the power rotor, to rotate the latter at a high rate of speed. The arrangement of the blades on the power rotor being such that each successive row renders the line of passage of the impelling substance more tortuous, tends to utilize to the fullest degree the dynamic effect of the motive substance, and secures a high efficiency of the engine.

Referring now to Figs. 8 to 12, it will be apparent that the general arrangement of the air compressor and the power rotor, as to their respective localities and the like, are the same as those described, and I will, therefore, describe only the points of differentiation of the two devices, it being understood that parts throughout the machine illustrated in Figs 8 to 12 are identical in corresponding with those already described in connection with Figs. 1 to 7, and are indicated by like numerals of reference differentiating by an exponent prime (′) mark. The air compressor illustrated is a duplicate of that illustrated in the preceding figures except as to the arrangement of the ports thereof.

In the modified embodiment of my invention, the air compressor and impulse chamber are separated by a single partition 60, having formed therein ports, preferably four in number, as indicated at 61, each of said ports being provided with ignition devices 62, adapted to be connected with suitable ignition circuits to cause its operation for the purposes to be set forth. Two valves, 63 and 64 are employed, one of said valves 63 being mounted on the shaft within the air compression chamber and provided with one or more ports 65, as best illustrated in Fig. 10. The coacting valve 64 is provided with a similar port 66 and is mounted for rotation with the shaft 30′ within the impulse chamber. The ports of valves 63 and 64 are so arranged that they are out of register, the port 65 preceding (in the direction of rotation) the port 66.

In operation the ports 61 of the stationary partition will be successively opened to the inflow of the combustible fuel by the passage of the port 65 of the intake valve 63, and then closed by said valve upon the air compressor side. The partition ports 61 are then successively opened to the impulse chamber side as the ports 66 of valves 64 come in register therewith. At the moment such registry of the ports of the partition and of the outlet valve 64 occur, the charge within the partition is fired as by the sparking igniter 62, and the consequent expansion acts upon the vanes 46′ of the rotor 45′ to impel the same rotarily, as before described. As indicated in Fig. 8 the rotor may be shaped in the same manner as the compressor, with diameter increasing in one or more steps intermediate its ends to accommodate the expansion of the heated rotor impelling substance.

While I have herein for purposes of full disclosure, described somewhat minutely a specific embodiment of my invention, I do not desire to be understood as limiting myself thereto in all details, as it will be apparent to those skilled in the art that numerous changes might be made in the construction thereof without departing from the spirit and scope of my invention.

Having described my invention, what I claim and desire to secure by Letters Patent, of the United States, is:—

1. In a gas turbine, a rotary compressor, a turbine comprising an impulse chamber wherein is maintained a pressure higher than the compression produced by the compressor, and a rotor, and a rotary trapping valve between the turbine chamber and compressor, arranged to maintain the turbine and com-

pressor constantly out of communication, and to trap low pressure mixture from the compressor into operative relation to the turbine chamber to rotate the rotor when exploded.

2. In a machine of the character described, a unitary casing comprising two chambers separated by two walls spaced apart and provided with non-registering apertures, a shaft extending through both chambers, a compressor rotor in one chamber, a turbine rotor in the other chamber, and a ported valve on the shaft in the interspace between the separating walls.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

VINCENT G. APPLE.

In presence of—
L. M. ARNOLD,
L. WELLS.