

Sept. 28, 1937.

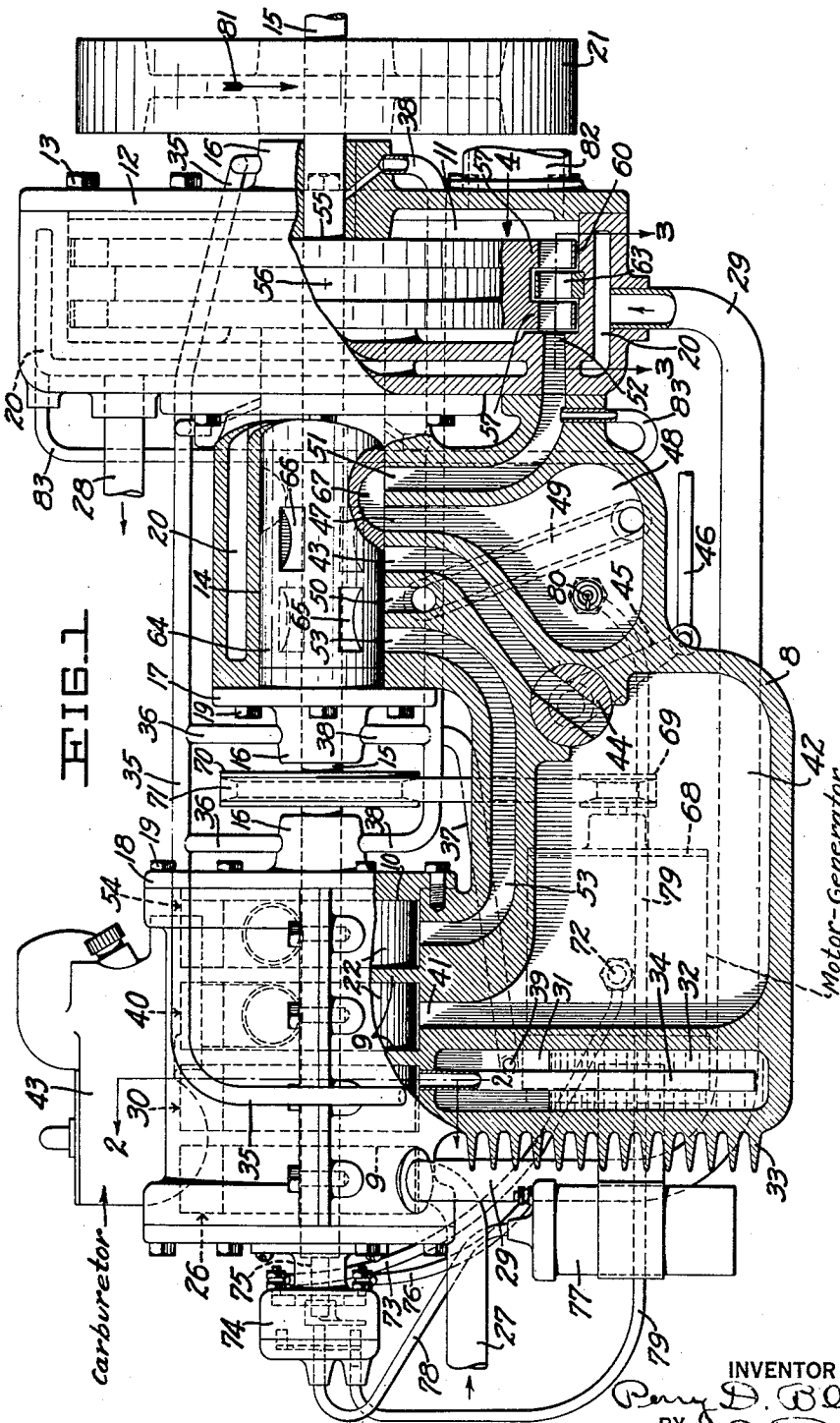
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2,094,055

GAS TURBINE

Filed Jan. 13, 1936

2 Sheets-Sheet 1



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FIG. 2

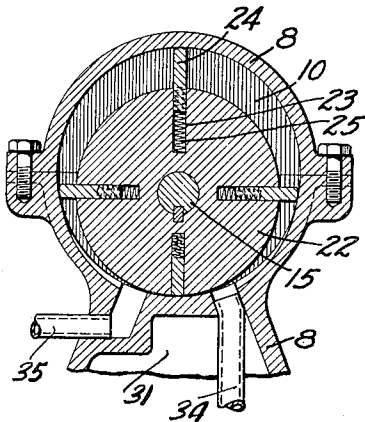


FIG. 3

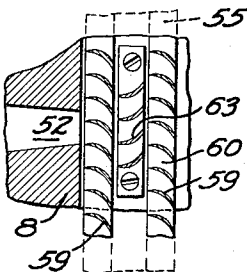


FIG. 4

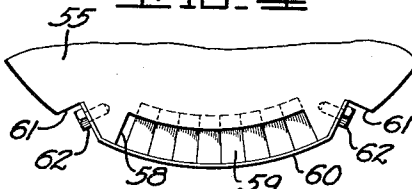


FIG. 5

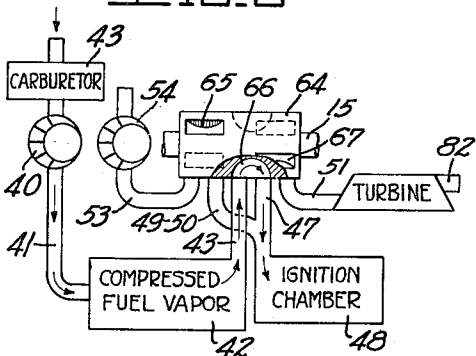


FIG. 6

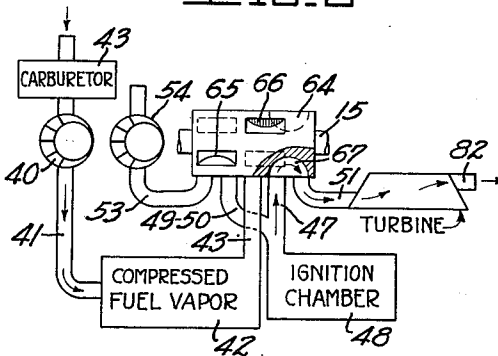
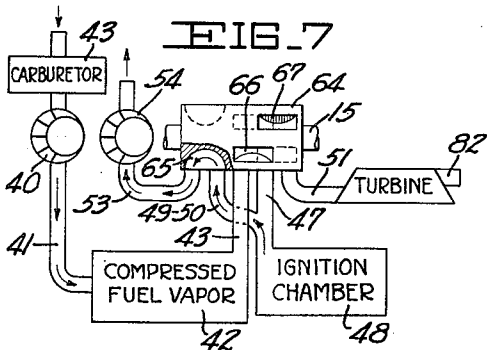


FIG. 7



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GAS TURBINE

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1 Claim. (Cl. 60—42)

This invention relates to rotary internal combustion engines of the turbine type.

It is an object of the invention to provide, in an engine of the class described, improved means for apportioning successive fuel charges prior to ignition thereof.

Another object of the invention is to provide means for scavenging burned gases from the combustion chamber between explosions, and causing said scavenging means to assist in recharging the combustion chamber with a fresh charge of fuel.

Another object of the invention is to provide a reservoir in which a supply of fuel mixture is constantly maintained under pressure.

Still another object of the invention is to provide several explosions per revolution of the engine so as to produce an even flow of power with a minimum of vibration.

A further object of the invention is to provide means for cooling the vanes of the turbine.

The invention possesses other objects and features of advantage, some of which together with the foregoing will be specifically set forth in the specification hereunto annexed. It is to be understood, however, that the invention is not to be limited to that form thereof shown and described as various embodiments thereof may be employed within the scope of the appended claim.

Referring to the drawings:

Figure 1 is a side elevational view, for the most part in section, of an engine embodying the principles of the invention.

Figure 2 is a cross sectional view, taken transversely of the engine shaft, showing a typical pump of the group mounted on the shaft to the left of Figure 1. The plane of section is indicated by the line 2—2 of Figure 1.

Figure 3 is a fragmental horizontal sectional view showing the turbine vanes and the jet. The plane of section is indicated by the line 3—3 of Figure 1.

Figure 4 is a side elevational view of a portion of the turbine rotor. The direction in which the view is taken is indicated by the arrow 4 of Figure 1.

Figures 5, 6 and 7 are diagrammatic views showing different phases of operation of the engine.

In detail, the engine comprises a housing 8 having at one end a bore provided with spaced partitions 9, which are integral parts of the housing, to provide a plurality, preferably four, of separate cylindrical pump chambers 10 each of which is closed at its respective ends, at the other

end with an enlarged expansion chamber 11, closed by a plate 12 secured to the housing by screws 13, and at a point intermediate the ends, and adjacent the expansion chamber, with a bore 14 which communicates with the latter chamber. Each of the chambers 10 and 11, and the bore 14, are alined and a shaft 15 passes axially through each of them. Suitable bearings 16 are provided for the shaft in the plate 12 and in plates 17 and 18 secured by screws 19 to the housing at the ends, respectively, of the bore 14 and that which forms the chambers 10. The expansion chamber 11, and that portion of the housing immediately surrounding the bore 14, are provided with double walls to provide a water jacket 20 through which water may be circulated to cool these parts.

A flywheel 21 is secured to the end of the shaft 15 where it emerges from the bearing 16 in the plate 12.

Secured for rotation with the shaft 15 in each pump chamber, as is shown in the typical one thereof illustrated in Figure 2, is the familiar type of rotary pump impeller comprising a hub 22 disposed eccentrically of the chamber in the usual manner and provided with a plurality of radial slots 23 each containing a blade 24 the outer end of which is urged outwardly into contact with the chamber wall by springs 25 interposed between the opposite end of the blade and the bottom of the slot 23. Inlet and outlet passages, similar to the passages 34 and 35 shown in Figure 2, which will be referred to later in the description, are provided for allowing entry and discharge of fluid to and from each pump.

One of the pumps, generally indicated by the numeral 26, is for the circulation of cooling water and is provided with an inlet conduit 27, which may be connected to a radiator, not shown, the conduit 28 entering the water jacket of the expansion chamber 11 adjacent the top thereof being also connected to the radiator. A conduit 29 connects the lower portion of the expansion chamber water jacket with the outlet port of the pump. When the shaft 15 is rotated water in the conduits and water jackets will be circulated therethrough by the pump 26, the jacket surrounding the bore 14 also receiving circulated water due to its connection with the expansion chamber jacket.

Another of the pumps, generally indicated by the reference numeral 30 is for the purpose of circulating lubricants to the various parts requiring the same. Formed in the housing, below the pump 30, is a well 31 in which is contained

a quantity of lubricating oil 32, and the housing, on the outer surface thereof, is provided with heat radiation fins 33 which insure that the temperature and the viscosity of the oil, since these factors govern the lubricating qualities of the oil, are maintained within desired limits. The intake port of the pump is provided with a conduit 34, which extends downwardly to a point adjacent the bottom of the well, through which oil may be drawn into the pump. The discharge port of the pump is connected to a conduit 35, which extends longitudinally of the engine, and is provided with branch conduits 36 leading to each bearing 16 and others which may require lubrication. A return conduit 37, fed by branch conduits 38 connected to each bearing, leads the oil back into the well, the oil discharging through an orifice 39 located near the top of the well as is shown in Figure 1.

The third pump, generally indicated by the reference numeral 40, has its outlet port connected, through a duct 41 formed in the main engine housing, with a reservoir 42, and its inlet port with a carburetor 43 so that when the pump is rotated, a mixture of vaporized fuel and air will be drawn from the carburetor through the pump and stored under pressure in the reservoir 42.

Entering the bore 14 are a plurality of passages, one, 43, of which communicates with the reservoir 42, through a rotary valve 44, connected by a lever 45 with an operating rod 46. By moving the rod, which may be connected to a hand lever or pedal for actuation by the hand or foot of the operator, the valve 44 may be opened or closed thereby controlling the flow of fuel mixture from the reservoir into the passage 43.

A second passage 47, also entering the bore 14, communicates with an ignition chamber 48 and a duct 49 connects this chamber with a third passage 50 entering the bore 14 alongside of the passage 43.

A fourth passage 51, immediately adjacent the passage 47, terminates in a jet 52 disposed in the expansion chamber 11, and a fifth passage 53 enters the bore adjacent the passage 50 and communicates with the inlet port of a fourth pump generally indicated by the reference numeral 54. The discharge port of this pump communicates directly, or through a suitable conduit, with the atmosphere.

Mounted on the shaft 15, within the expansion chamber 11, is a rotor 55 having one side thereof disposed closely adjacent the jet opening 52, and provided with a peripheral groove 56 to form a pair of spaced rims 57. As will be clearly seen in Figures 1 and 4, each rim is provided with diametrically opposed notches 58 in which are disposed spaced turbine vanes 59 one end of each of which is embedded, or otherwise secured in any manner employed in turbine construction, in the rotor, and the other end of each of which is secured to a strap 60 whose ends are secured in V notches 61, formed at each end of the notch 58, by screws 62. The provision of the notches 61 is to place the heads of the screws 62 within the rotor periphery so that the surface of the latter will be free of projections.

Secured to the housing within the expansion chamber 11 and disposed in the groove 56 in line with the jet 52, is a group of stationary turbine vanes 63.

Secured to the shaft 15 for rotation within the bore 14 is a rotary valve 64 provided with duplicate sets of notches 65, 66 and 67 spaced around the periphery thereof, each notch of a pair being spaced apart a distance of 180 degrees and

adapted when the valve is rotated to allow communication between different sets of passages entering the bore 14 as will be later explained. Each notch, as will be noted in Figure 1, is arcuately shaped, in a plane parallel with the axis of the shaft so as to offer as little resistance, to the flow of fluid from one passage to the other, as possible.

Mounted on the side of the main engine housing is a combined motor generator 68, of well known construction, provided with a pulley 69 which is connected to a pulley 70, mounted on the shaft 15, by a belt 71. The output terminal 72, of the generator, is connected, by a lead 73, with a distributor mechanism 74, whose shaft 75 is connected for rotation with the shaft 15, having therein the well known interrupter mechanism by means of which the constant current delivered by the generator may be changed to pulsating current; and a lead 76 connects the distributor with the primary winding of the well-known spark coil 77. The high tension current is led from the coil through a lead 78 connected with the distributor cap in the usual manner and the lead 79 connects the distributor with a spark plug 80 located in the ignition chamber 48.

In starting the engine, the throttle valve 44 is closed and the motor section of the motor-generator 68 is energized from a suitable source of current such as the usual storage battery. This causes rotation of the shaft 15, due to its connection with the motor-generator through the belt 71, and also the pumps; the pump 40 drawing fuel mixture from the carburetor 43 and storing it, under pressure, in the reservoir 42 and the suction pump 54 causing a reduced pressure in the passage 53. Simultaneously, with the rotation of the shaft and the pumps, the valve 64 will be rotated causing the notches 65, 66 and 67 to move past their related passages and further causing, during the intervals when the notch 65 is in communication with the passages 50 and 53, a reduced pressure in the ignition chamber 48 comparable to that in the passage 53.

While the rotation of the parts by the motor-generator is taking place, a sufficient time interval being allowed to permit the pressure of the fuel mixture in the reservoir 42 to build up to the desired degree, the throttle valve 44 is gradually opened thus allowing communication between the reservoir and the passage 43. Referring now to the diagrams in Figures 5, 6 and 7, it will be seen that as the valve 64 rotates, the direction thereof being indicated by the arrow 81 on the fly-wheel 21, Figure 1, the notch 66 will move into registry with the passages 43 and 47. When this occurs a charge of fuel mixture will pass, due to the pressure in the reservoir and the partial vacuum existing in the ignition chamber 48, into the latter. The rotation of the valve 64 will then continue until the notch 66 passes out of registry with the passages mentioned and the notch 67 moves into registry with the passages 47 and 51. When this latter condition obtains the passage 43 will be sealed by the periphery of the valve as is clearly shown in Figure 6. As soon as the passages 47 and 51 are in communication, ignition of the fuel charge in the chamber 48, by the spark plug 80, occurs causing the resulting expanding gases to flow out of the chamber, through the passage 51, and be discharged by the jet 52 past the turbine vanes 59 and 63 into the expansion chamber 11 from whence they are discharged through an exhaust pipe 82 to the atmosphere. The flow of gases past the turbine vanes will of course impart a powerful thrust tangentially of the rotor 55 and 75

cause the latter, assisted by the momentum of the fly-wheel 21, to rotate.

After the exploding charge in the ignition chamber exerts its force on the rotor the latter will cause further rotation of the valve 64 to bring the notch 65 into registry with the passages 50 and 53 whereupon, due to the reduced pressure in the latter passage, the ignition chamber will be evacuated of all burned gases remaining therein, these flowing through the passages 49, 50 and 53 to the pump 54 through which they are exhausted to the atmosphere directly or through the suitable exhaust conduit mentioned above. After this scavenging of the ignition chamber of its burned gases, the pressure in the chamber will be reduced, prior to closing off of communication between the chamber and the pump 54 by the valve, so as to condition the chamber for the reception of the succeeding fuel charge from the reservoir 42 when one of the notches 67 again registers with the passages 47 and 51 to admit the charge. Upon admission of a fresh fuel charge to the ignition chamber the cycle of operations described above will be repeated.

While the mechanism illustrated is capable of delivering two power impulses to the rotor, during each revolution of the latter, since two sets of turbine vanes are provided on the rotor and two sets of notches are provided on the rotary valve, it will be understood, of course, that this showing is merely exemplary since as many sets of vanes and their related valving notches may be provided respectively on the rotor and rotary valve as is desired, the only elements of the structure being affected being the rotor and the valve whose diameters would, of course, have to be increased to allow for the added parts.

Due to being subjected to successive blasts of the exceedingly hot gases being discharged from the jet 52, the turbine vanes may become overheated and to overcome this I provide means for cooling them. I accomplish this by providing a small conduit 83 whose upper end enters the water jacket 20 of the expansion chamber, and whose lower end projects slightly into the passage 51 adjacent the jet 52. When the engine is running the flow of gases through the passage 51 will create a reduced pressure at the lower terminus of the conduit thereby drawing water vapor from the upper portion of the water jacket which vapor will enter the gas stream and be carried thereby into contact with the turbine vanes.

From the above description of my invention it will be seen that I have provided, in an engine of the class described, improved means for apportioning successive fuel charges in the ignition chambers thereof, improved means for scavenging burned gases from the ignition chamber and causing the scavenging means to assist in recharging the chamber with a fresh charge of fuel, a reservoir in which a supply of fuel mixture, under pressure, is constantly available, several explosions per revolution of the engine so as to produce an even flow of power with a minimum

of vibration, and improved means for cooling the turbine vanes in such an engine.

I claim:

A gas turbine comprising a housing having therein an expansion chamber, a bore in communication with said expansion chamber, an ignition chamber, a storage chamber for combustible fluid fuel, and a gas expansion nozzle, a shaft journaled in said housing extending axially through said bore and into said expansion chamber, a rotor disposed in said expansion chamber and fixed for rotation with said shaft, said rotor having a peripheral groove therein to provide a pair of spaced flanges each having diametrically opposed notches therein, turbine vanes mounted in each of said notches and arranged to pass adjacent said gas expansion nozzle when said rotor is rotated, turbine vanes fixed in said expansion chamber between said rotor flanges and in the path of discharge of gas from said expansion nozzle, a plurality of separate pumps connected with said shaft, each of said pumps having an inlet and an outlet opening, a duct connecting said gas expansion nozzle with said bore, a pair of ducts connecting said ignition chamber with said bore, a duct connecting said fuel storage chamber with said bore, a duct connecting said bore with the inlet opening of one of said pumps, a duct connecting said storage chamber with the outlet opening of a second of said pumps, a carburetor connected with the inlet opening of said second pump whereby when said pump is rotated by said shaft a mixture of fuel vapor and air will be drawn from said carburetor and forced into said storage chamber, the outlet opening of said first pump being open to the atmosphere, a rotary valve in said bore and fixed to said shaft for rotation therewith, said valve having a plurality of spaced peripheral notches therein successively registrable with said ducts as said valve is rotated, the first of said notches effecting a connection between the duct communicating with said storage chamber and one of the ducts leading to said ignition chamber whereby a charge of fuel mixture from said storage chamber may enter said ignition chamber, means in said ignition chamber for exploding said fuel charge to expand it, the second of said notches effecting a connection between the duct leading to said ignition chamber and that connected to said gas expansion nozzle whereby the exploded fuel charge in said ignition chamber may be conducted through said nozzle and be projected thereby past said turbine vanes, the third of said notches effecting a connection between the second duct leading to said ignition chamber and the duct connected with the inlet opening of said first pump whereby the pressure in the ignition chamber will be reduced below atmospheric prior to the connection of the storage chamber duct and the first ignition chamber duct, and a throttle valve in said storage chamber duct for controlling the flow of fuel mixture therethrough into said ignition chamber.

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