United States Patent

Pieper

[15] **3,672,164**

[45] **June 27, 1972**

[54] INDEPENDENT IGNITION ENGINE

[72] Inventor: **Don B. Pieper,** Rolling Meadows, Ill.

[73] Assignee: **Whim, Inc.**

[22] Filed: **March 27, 1970**

[21] Appl. No.: **23,368**

[52] **U.S. Cl.**.....**60/39.38,** 60/39.78, 60/39.81

[51] **Int. Cl.**.....**F02c 5/04**, F02d/5/00;

[58] **Field of Search**..... 60/39.81, 39.8, 60/39.79, 39.78, 32 M, 39.38

[56] **References Cited**

UNITED STATES PATENTS

2,273,406	2/1942	Lasley	60/39.38
2,129,691	9/1938	Hazwarth	60/39.79
2,003,292	6/1935	Hazwarth	60/39.79
2,517,822	8/1950	Anderson	60/39.8
2,112,672	3/1938	Lasley	60/39.38

FOREIGN PATENTS OR APPLICATIONS

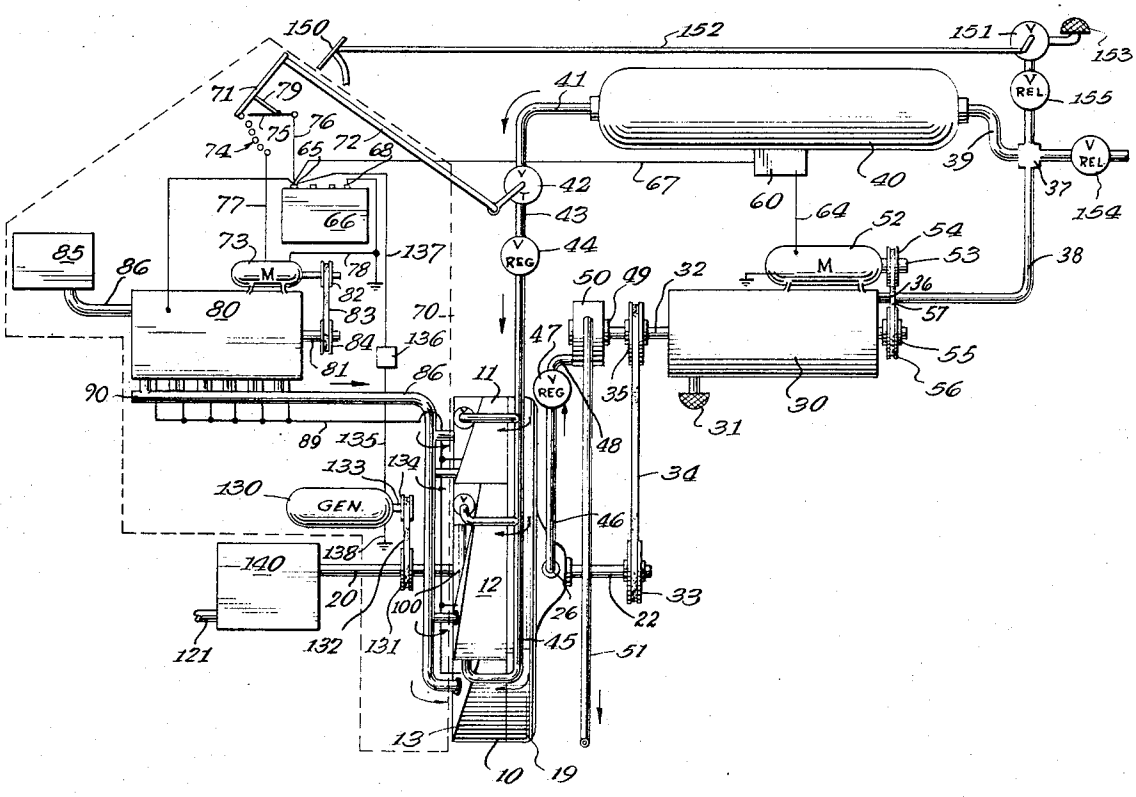
418,184	10/1934	Great Britain	60/39.79
449,115	6/1936	Great Britain	60/32 M

Primary Examiner—Benjamin W. Wyche
Assistant Examiner—Warren Olsen
Attorney—Mason, Albright and Stansbury

[57] **ABSTRACT**

Optimum or most economical air-fuel mixture for a turbine engine is maintained by having the fuel injection system, the ignition system and the pressure air system operate independently of the rotational velocity of the drive shaft of the engine or any of its primary rotating parts. The engine turbine and its drive shaft may be decelerated by placing a high air compression load on the drive shaft.

11 Claims, 5 Drawing Figures



PATENTED JUN 27 1972

3,672,164

SHEET 1 OF 2

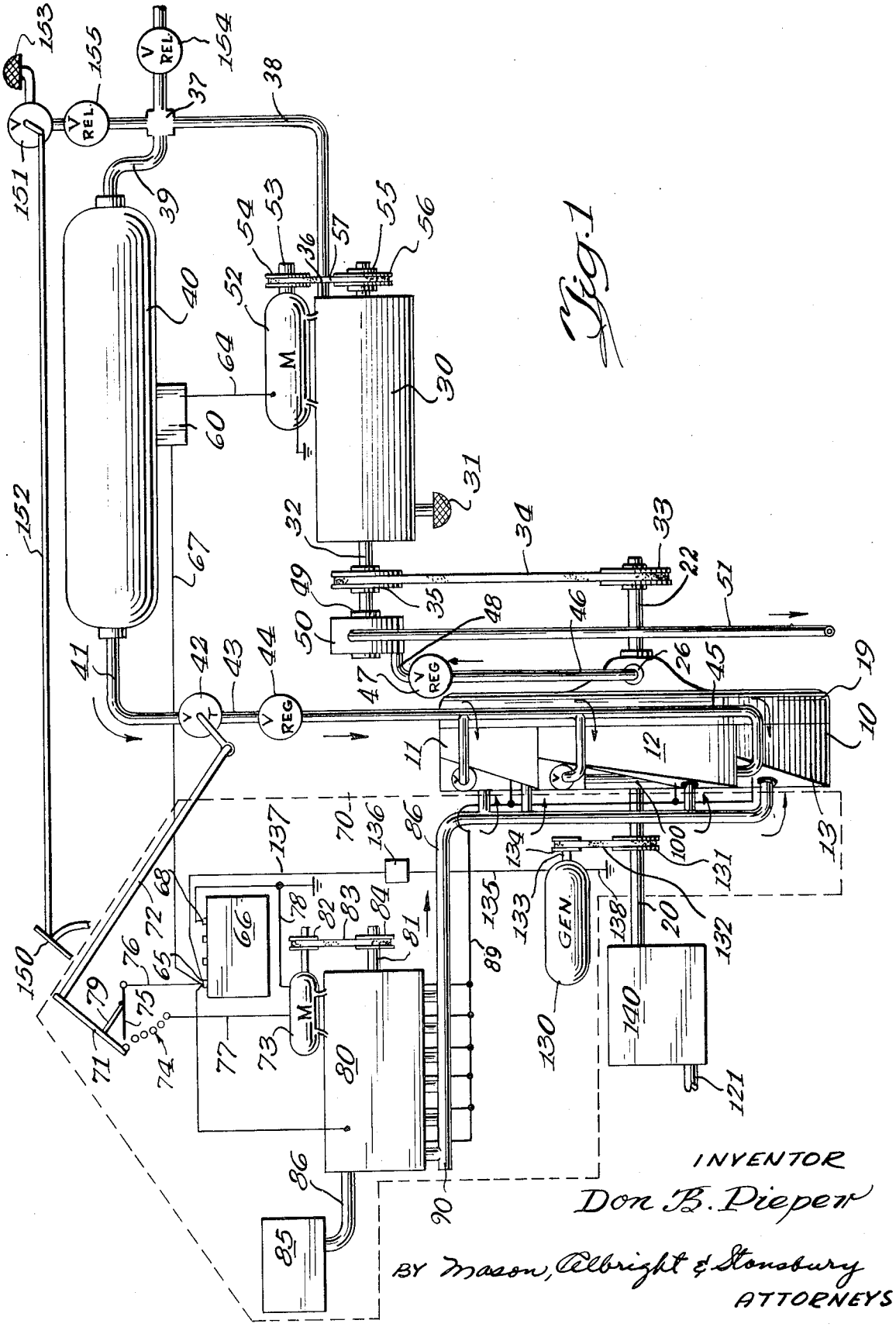


Fig. 1

INVENTOR

Don B. Pieper

BY Mason, Albright & Stansbury

ATTORNEYS

Fig. 5

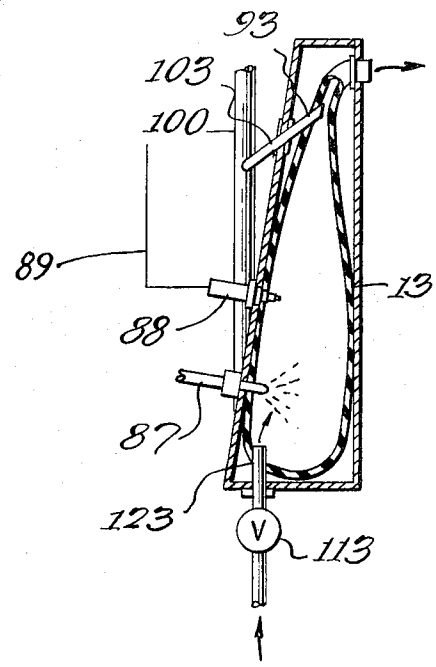


Fig. 4

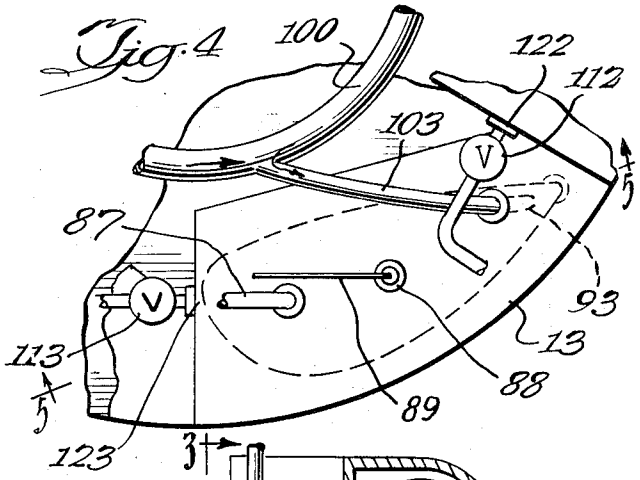


Fig. 3

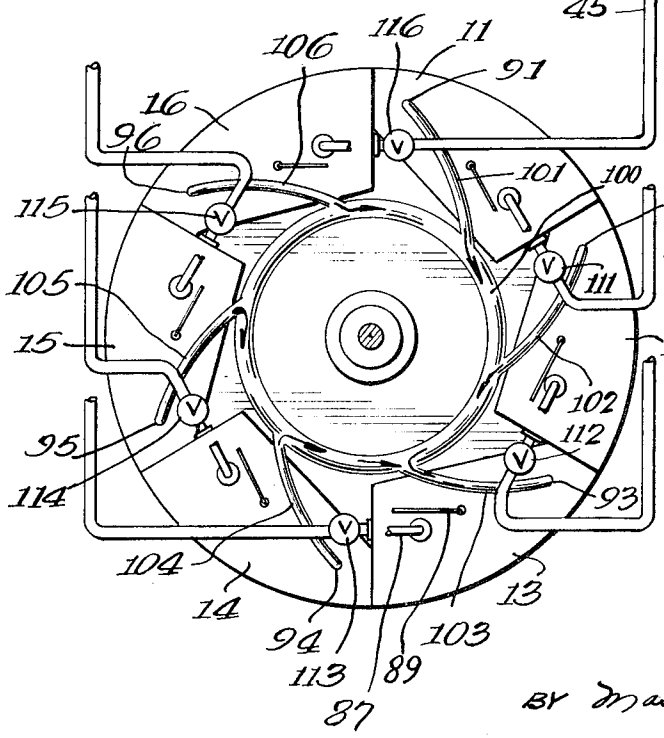
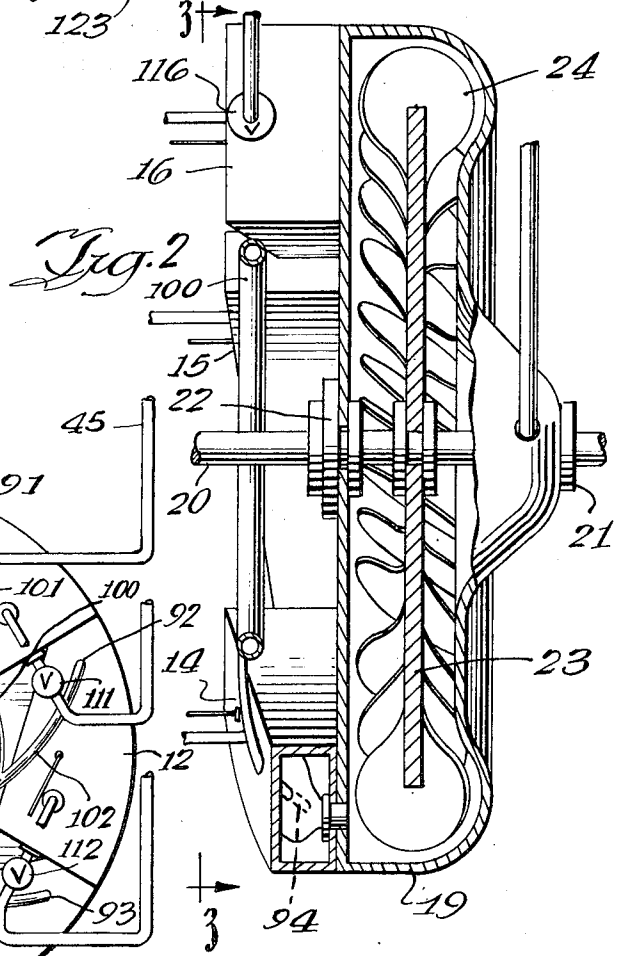


Fig. 2



INVENTOR

Don B. Pieper

BY Mason, Albright & Stansbury

ATTORNEYS

INDEPENDENT IGNITION ENGINE

The present invention refers to an engine wherein the fuel injection system, ignition system, and pressure air system operate independently of the rotational velocity of the drive shaft of the engine or any of its primary rotating parts.

In a conventional internal combustion gasoline engine utilizing a fuel injection system, valves are opened by a cam shaft attached to the main drive shaft to inject fuel into the cylinders and to allow the exhaust gases to escape. A distributor is connected to the main drive shaft to fire the combustible mixtures in the chambers. Thus, the rate of fuel injection and ignition in the cylinders or firing chambers of an internal combustion gasoline engine depend upon the rotational velocity of the main drive shaft. In diesel engines of the type not requiring spark ignition, a high pressure fuel pump device is connected to the main drive shaft to time the repetition rate of the fuel injectors to the rotational velocity of the main drive shaft. In ram jet engines and in turbo jet engines, fuel burning is continuous and if there is variable control it is accomplished by varying the amount of fuel being injected into the firing chamber per unit time. In all these normally conventional engines, the air-fuel ratio must necessarily vary with the desired torque of the drive shaft and thus a constant predetermined air fuel ratio cannot be maintained at all operating speeds.

For every combustible fuel used in these various engines there is a best air-fuel ratio for the most complete combustion of the fuel, which reduces to a minimum undesired pollution of the air by the release of unburned hydrocarbons to the surrounding atmosphere. The most economical air-fuel mixture for each of these engines is usually different from the others. However, in order to achieve either the most economical air-fuel mixture or the most completely combustible air-fuel mixture, it is necessary to maintain the ratio of air to fuel in the mixture at a predetermined constant ratio.

The present invention provides means for setting the air-fuel mixture at a substantially constant ratio for all speeds of the drive shaft, for all speeds of the fuel injection system, and for all speeds of the ignition system. A separate control provides and governs the repetity of the operation of the fuel injection system and the ignition system.

Thus, an object of the present invention is to provide a new and improved engine.

Another object is to provide an engine wherein the torque on the drive shaft and the output horsepower of the engine is controlled by the repetitive frequency of the fuel injection and ignition systems.

An additional object is to provide an engine wherein the operations of the fuel injection and ignition systems are independent of the rotational velocity of the main drive shaft and independent of any other primary driving parts of the engine.

Still another object is to provide an engine that does not require a lubricating system.

Yet another object is to provide an engine which does not require a liquid cooling system and fan.

A further object is to provide an engine which utilizes a constant optimum productive fuel-air mixture at all ranges of velocity.

A still further object is to provide an engine which uses fuel only when it is required to produce work.

Still another object is to provide a high acceleration turbine-type engine.

An important object is to provide an engine wherein the combustion chambers are purged of exhaust gases without the use of complicated and expensive valves.

Another additional object is to provide an exhaust turbine with an engine which recovers part of the energy in the exhaust gases.

Another additional object is to provide a method of storing kenetic energy obtained in a forced deceleration by conversion to pressure air for use in the next acceleration of a vehicle.

Another additional important object is to provide an engine having smooth acceleration in a wide range of speeds.

A still further object is to provide an engine that does not require an automatic transmission with heavy heat energy losses.

Still another object is to provide an engine with a minimum of machined and lubricated parts in combustion areas.

Further objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of a preferred embodiment of my invention;

FIG. 2 is a partially broken away cross sectional end view of the turbine portion of my preferred embodiment illustrated in FIG. 1;

FIG. 3 is an elevational view of the turbine portion illustrated in FIG. 2 taken along the line 3—3;

FIG. 4 is an exploded view of a single combustion chamber of the turbine illustrated in FIGS. 2 and 3; and

FIG. 5 is a partial sectional view of the combustion chamber illustrated in FIG. 4 taken generally along the line 5—5.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail, an embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring to FIGS. 1 – 3, a turbine **10** has six combustion chambers **11 – 16** mounted on a rotor housing **19**. A shaft **20** is rotatably mounted in bearings **21** and **22** which are mounted on the rotor housing **19**. A turbine rotor **23** is rigidly mounted on the shaft **20** for rotation therewith. A series of turbine blades generally indicated as **24**, are mounted on the periphery of the rotor **23** in the conventional manner well known to those skilled in the art.

Referring to FIG. 1, an air compressor **30**, which may be of any conventional type well known to those skilled in the art, has an air intake **31** mounted thereon to receive atmospheric air and has a compressor drive shaft **32** rotatably mounted therein. The air compressor shaft **32** is driven by the turbine shaft **20** through a pulley **33** rigidly mounted on one end of shaft **20**, a drive belt **34** and a forward engaging clutch type pulley **35** mounted on the compressor shaft **32**. A compressed air output port **36** of the compressor **30** is connected to a demand pressure control manifold **37** by a compressed air line **38** to supply compressed air to the manifold **37**. The demand pressure control manifold **37** is connected by a high pressure air line **39** to an air accumulator tank **40** for the purpose of supplying compressed air to the accumulator tank. Manifold **37** is connected to a relief valve **155**, which is connected through a shut-off valve **151** to a vent **153**, and to a high pressure relief valve **154**. High pressure air from the accumulator tank **40** is supplied to each of the combustion chambers **11–16** and thereby to the entire turbine housing **19** through a high pressure line **41**, a valve **42**, a high pressure line **43**, a pressure regulator **44**, and a high pressure air manifold **45** connected to each of the respective firing chambers **11–16**. Pressure in the turbine housing **19** is controlled by a pressure release valve **47** which is preset to open at a pressure slightly below the release pressure setting of pressure regulator **44**.

Two alternative methods for aiding the driving of the compressor **30** are provided in addition to the direct drive from the turbine shaft **20**. An exhaust line **46** connects an exhaust port **26** of the turbine **10** to the input side of the pressure release valve **47**. An output side of the pressure release valve **47** is connected to a conventional exhaust turbine **50** by an exhaust gas line **48**. An output drive of the exhaust turbine **50** (not shown) is connected to the compressor shaft **32** by a one way forward clutch coupling generally indicated at **49**. Exhaust gas from the exhaust turbine **50** is expelled through an exhaust gas line **51**.

An electric compressor drive motor **52**, large enough to turn the compressor unassisted, has an output drive shaft **53**

with a pulley **54** rigidly mounted thereon. Compressor shaft **32** has a one way clutch coupling **55** with a drive pulley **56** incorporated therein for driving the shaft **32** through the coupling **55** when the electric compressor motor **52** is energized. A drive belt **57** connects the pulleys **54** and **56**.

A pressure operated electrical switch **60** is mounted on the accumulator tank **40** so that a pair of contacts are closed when the pressure in the accumulator tank **40** falls below a predetermined value. The motor **52** is connected to the switch **60** by an electrical conductor **64**. Switch **60** is connected to a terminal **65** of a storage battery **66** by a conductor **67**. The storage battery **66** may be of any conventional design well known to those skilled in the art and may, for example, provide 12 volts of potential between a grounded terminal **68** and the terminal **65**. The electrical motor **52** is connected to circuit ground in order that the battery **66** may be connected across the motor **52** to energize it whenever the switch **60** is closed. Thus, three sources of energy to turn the compressor are evidenced. Each is connected to compressor shaft **32** with a forward clutch type pulley so that the effort exerted can be alternate combinations of torque forces. At constant operating speed the exhaust turbine **50** and the turbine shaft **20** will turn compressor **30**. But, it should be noted that motor **52** and exhaust turbine **50** can take over, assuring demand air volume irrespective of the speed of turbine shaft **20**.

A fuel and firing system generally indicated within the dash line **70** operates completely independently of the speed of the turbine rotor **23** and the turbine output shaft **20**. An accelerator pedal (or lever) of any conventional design well known to those skilled in the art **71** is connected through suitable mechanical linkage **72** to the high pressure air valve **42**. An electrical motor **73** and a rheostat **74** having a slide **75** are connected in series across the terminals **65** and **68** of battery **66** by the electrical conductors **76**, **77** and **78**, respectively. The position of the slide **75** of the rheostat **74** is controlled by the position of the accelerator pedal **71** through connecting mechanical linkage **79**. Therefore, the position of the accelerator pedal **71** controls the speed of rotation of the motor **73**.

A fuel and ignition distributor unit **80** has a drive shaft **81** rotatably mounted therein. A high pressure fuel pump having six compression pump chambers is mounted in the unit **80** and driven by the shaft **81** so that fuel is pumped through a set of six fuel line **90** to each of a set of injectors **87** mounted on the respective combustion chambers **11 – 16** so that fuel is supplied to the injectors sequentially at a rate determined by the speed of rotation of the drive shaft **81**. The drive shaft is driven by the motor **73** through the motor output pulley **82**, a belt **83**, and a pulley **84** rigidly mounted on shaft **82**. A fuel tank **85** is connected by a fuel line **86** to the input side of the pump in unit **80**. An electric distributor is also mounted in the unit **80** and connected to the drive shaft **81** to be driven thereby. An electrical output harness **89** connects the distributor to a spark plug or ignitor such as **88** mounted in the wall of each of the respective chambers **11 – 16**. The connections of the pump and the distributor are such that immediately after fuel is sequentially introduced in each of the chambers **11 – 16** an ignition spark is provided by the spark plug or ignitor in each of the respective firing chambers to ignite the fuel mixture. During the operation of the engine, high pressure air is supplied at all times to the respective firing chambers and, therefore, is available to produce a combustible mixture and to aid in purging of the fired chambers of exhaust gases after each cumbustion. The air regulator **44** keeps the pressure introduced in the chambers by the air manifold **45** at a constant pressure and the fuel pump of distributor unit **80** delivers a given amount of fuel to each chamber regardless of the seed of rotation of the drive shaft. Therefore, a constant fuel-air mixture may be maintained. This fuel-air mixture, being constant, may be set at the optimum fuel-air ratio for the most complete combustion so that the harmful exhaust products of the exhaust gas from the turbine are reduced to a minimum.

Referring now to FIGS. **2**, **3**, **4** and **5**, each chamber has a port **91 – 96** in the side of each firing chamber angled toward the nozzle. These are each in turn connected through gas conduits **101 – 106** to a ring tube **100**. When combustion occurs in any given firing chamber the effect, due to ventouri action, is to draw air or exhaust from the respective attached gas conduit which in turn tends to reduce the internal pressure in the ring. Because of the tendency to equalize this lowered pressure some exhaust will be purged or drawn from each of the other chambers as indicated by the arrows in FIG. **3**. When a chamber is fired the purging of exhaust will be substantially complete with fresh air replacing the exhaust gases through one way valve **111 – 116** and the pressure air inlet **121 – 126**. Increasing the firing rate tends to lower the internal ring pressure and make purging of chambers more rapid.

An electrical generator **130** is connected to shaft **20** to be driven thereby through a pulley **131** rigidly mounted on shaft **20**, a drive belt **132** and a pulley **133** and a generator drive shaft **134**. The electrical output of the generator is connected to battery **66** through a conductor **135**, a voltage regulator **136**, a conductor **137** and a grounded conductor **138**. The shaft **20** is connected to a conventional transmission **140** which may be of any type well known to those skilled in the art. It may be of either the mechanical gear type or a fluid drive type. The transmission **140** has an output drive shaft **121** to be connected to suitable driving wheels or tracks of a land vessel, the propellor of an aircraft, the propellor or fluid drive pump of a vessel or to the input drive shaft of stationary machinery.

An alternate form of firing chamber may be utilized in the turbine **23**. Rather than utilizing the ring purging system, a valve exhaust port may be provided which is opened subsequent to combustion in each chamber which allows the exhaust gases to be removed under the pressure of incoming air from high air pressure manifold **45**.

Those skilled in the art will recognize that the present invention may be utilized in many varying forms. All such forms are intended to be within the scope of the appended claims. For example, either one or a large multiplicity of firing chambers may be employed. Either the ring **100** exhaust purging system shown in FIGS. **2**, **3**, **4** and **5**, the exhaust system set forth in the previous paragraph, or neither of these may be utilized relying upon only the high pressure air to force excess gases out through the nozzles and into the turbine blades. Various voltage electrical systems may be utilized and other auxilliary drive systems, such as hydraulic systems may be employed to drive such motors as motor **52** and motor **73**.

The braking system illustrated in FIG. **1** is substituted for conventional braking systems. Referring now to FIG. **1**, a brake pedal **150** is connected to a shut-off valve **151** by a mechanical linkage **152**, closing off an over demand release vent **153**. Because shaft **20** would continue to turn compressor **30** on the deceleration of a vehicle, an increasing volume and pressure would be added to the accumulator tank **40**. THis would tend to slow a vehicle by converting kinetic energy to static energy in the form of increased air pressure which is stored for the next start. Further depression of brake pedal **150** would engage conventional braking shoes (not shown) if needed. An extreme high pressure relief valve **154** is provided.

Referring now to FIGS. **1** through **5** of the drawings, the operation of the preferred embodiment of the invention illustrated in the figures will be described in greater detail. In order to start the engine, the accelerator pedal **71** is slightly depressed opening shut-off valve **42** to allow air from the accumulator tank **40** to flow through the pressure regulator **44**. The output pressure from regulator **44** is held by the regulator at 90 psi. This air flows through combustion chambers **11 – 16** and finally against the turbine blades **24** causing the turbine to commence to rotate. At the same time that air begins entering the combustion chambers **11 – 16**, the foot accelerator has operated slide **75** to allow current to commence flowing through the rheostat **74** energizing the motor **73** to run at a low speed. This causes the distributor unit **80** to provide fuel

and electrical ignition to the cylinders sequentially. The order of charging and firing the combustion chambers is not critical, but it is believed desirable to fire cylinders which are approximately opposite to each other. In other words, a sequence which might begin with chamber **11**, followed by chamber **14**, chamber **12**, chamber **15**, chamber **13**, and chamber **16**. If desired, all six chambers could be fired at once, but under this situation all of the residual burnt gases in the chambers would have to be expelled by the fresh air coming from the manifold **45**. As the accelerator pedal **71** is further depressed, it moves a slider **75** on rheostat **74** to increase the speed of motor **73** whereby increasing the number of firings of the chambers **11** – **16** per unit time. Thus, the pressure on the turbine blades is kept at a higher average level increasing the speed of the turbine rotor.

As aforementioned, there are three methods of maintaining sufficient pressure in the accumulator tank **40** to insure that the engine will have at least the required 90 psi in the air manifold **45**. At low speeds the direct drive from the turbine shaft **20** to the compressor shaft **32** drives the compressor **30**. As the rotational speed of the turbine increases, the pressure of the exhaust gases in the line **46** increases to the point that the relief valve **47** opens allowing the exhaust gases to operate the turbine **50**. Thus, the exhaust gases themselves through the one way clutches **49** will be driving the shaft **32** as the turbine speed increases reducing the torque that must be supplied by the shaft **22** to a zero value so that the shaft **22** is then applying all of its available torque to the transmission **140**. The compressor under such conditions provides a pressure of approximately 125 psi to the demand pressure control manifold **37**. However, the pressure relief valve **155** will open at a pressure of 100 psi, thereby preventing the pressure in the acculator **40** from exceeding approximately 100 psi. Since the shut-off **150** is normally open, air passing through the relief valve **155** escapes easily through the vent **153**. In starting the unit, after the turbine has been shut down for a long period of time, there may not be sufficient pressure in the accumulator tank **40** to operate the regulator valve **44**. However, the switch **60** is activated whenever the pressure in the tank falls below 90 psi to energize the motor **52** which will operate the compressor **32** to build up the pressure in the accumulator tank. Thus, there is available sufficient air to start the turbine, and with this air, the firing chambers commence to fire immediately upon the operation of the foot pedal **71** because the firing rate is completely independent of the speed of the drive shaft **20**.

As aforementioned, the compressor and accumulator tank can be utilized to slow down the turbine. With the combustion chambers not firing, the exhaust turbine **50** slows down and the compressor is driven by the shaft **20** through the belt **34** placing a load on the shaft **20** tending to bring it to a stop. This slowing of the shaft **20** is further increased by the operation of the brake pedal **150** which closes shut-off valve **151** forcing the pressure in the accumulator tank to increase to **175** psi. The compressor attempts to provide increasing pressure and thereby puts a greater demand on the turbine shaft **20**. If the pressure in the tank **40** and the connecting line **38** reaches 175 psi the release valve **154** will open to prevent the pressure in the system from exceeding 175 psi.

The constant source of air pressure allows the ratio of fuel to air to be held at substantially a constant value. This is a ratio which has been selected for the most complete burning of the fuel, and, therefore, the least possible production of unwanted exhaust by-products such as hydrocarbons.

I claim:

1. An engine comprising:

a. a housing,

b. a drive shaft rotatably mounted in said housing,

c. a turbine rotor having turbine blades and rigidly mounted on said drive shaft,

d. at least one combustion chamber mounted on said housing having an exhaust nozzle directing exhaust gases against said turbine blades,

e. means for injecting air into said combustion chamber,

f. means for injecting fuel into said combustion chamber at periodic intervals, to produce a fuel and air combustible mixture at said periodic intervals,

g. means for igniting said combustible mixture at said periodic intervals, and

h. means for starting, stopping and varying the rotational speed of said drive shaft including

1. a variable speed electric motor mechanically connected to drive said fuel injection means and mechanically connected to drive said igniting means at variable frequencies of said periodic intervals and

2. control means connected to said motor for energizing, deenergizing and varying the operating speed of said motor.

2. An engine in accordance with claim **1**, wherein said means for injecting air into said combustion chamber comprises:

a. an accumulator tank,

b. a pressure regulator connected between said tank and said combustion chamber to deliver air to said combustion chamber at a constant pressure, and

c. a compressor connected to said accumulator tank to raise the air pressure in said tank to a valve grater than the pressure regulated by said pressure regulator.

3. An engine in accordance with claim **2**, wherein said compressor is connected to be driven by an electric motor which is energized by an electrical pressure switch that is mounted on said tank to determine the interval air pressure of said tank.

4. An engine in accordance with claim **2**, wherein said compressor is connected to be driven by said turbine drive shaft.

5. An engine in accordance with claim **2**, wherein said compressor is connected to be driven by another exhaust gas turbine that is connected to said housing through a pressure regulator to receive exhaust gases from said housing at a predetermined pressure.

6. An engine in accordance with claim **1**, wherein said means for injecting fuel into said combustion chamber, comprises:

a. a source of fuel,

b. a fuel pump connected to be driven by said variable speed motor and connected to said source of fuel to pump at said periodic intervals a predetermined quantity of fuel,

c. an injector mounted on each said combustion chamber, and,

d. a fuel conduit connecting said pump and each said combustion chamber to inject fuel into each said combustion chamber at said periodic intervals.

7. An engine in accordance with claim **6**, wherein said control means connected to said motor comprises

a variable resistance connected in series with a source of electrical potential and said variable speed motor to vary the rotational velocity of said motor.

8. An engine in accordance with claim **1**, wherein said means for igniting said combustible mixture at said periodic intervals comprises:

a. an ignitor mounted in each combustion chamber, and

b. an electrical distributor connected to be driven by said variable speed motor and having a rotor periodically contacting each ignitor.

9 An engine in accordance with claim **8**, wherein said means for injecting fuel into said combustion chamber, comprises:

a. a source of fuel,

b. a fuel pump connected to said source of fuel to pump at said periodic intervals a predetermined quantity of fuel, said pump being driven by said variable speed motor,

c. an injector mounted on each said combustion chamber, and

d. a fuel conduit connecting said pump and each said combustion chamber to inject fuel into each said firing chamber at said periodic intervals.

10. In an engine as specified in claim **1**:

a. a multiplicity of combustion chambers,

b. a port adjacent the nozzle of each combustion chamber, and

c. manifolds means connecting two or more said ports.

11. An engine as specified in claim 1, wherein said means for injecting air includes pressure regulator means to deliver air into said at least one combustion chamber at a predetermined pressure and said means for injecting fuel includes quantity measuring means to deliver equal quantities of fuel into said at least one combustion chamber whereby the ratio of fuel and air in said combustible mixture remains constant at a predetermined value regardless of the frequency of said periodic intervals.

* * * * *