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HOT-GAS RECIPROCATING ENGINE WITH MEANS
FOR AUGMENTING THE PRESSURE MEDIUM
AND SUPPLYING COMBUSTION AIR
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FIG. 1.

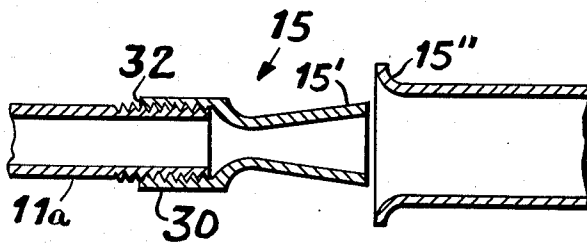
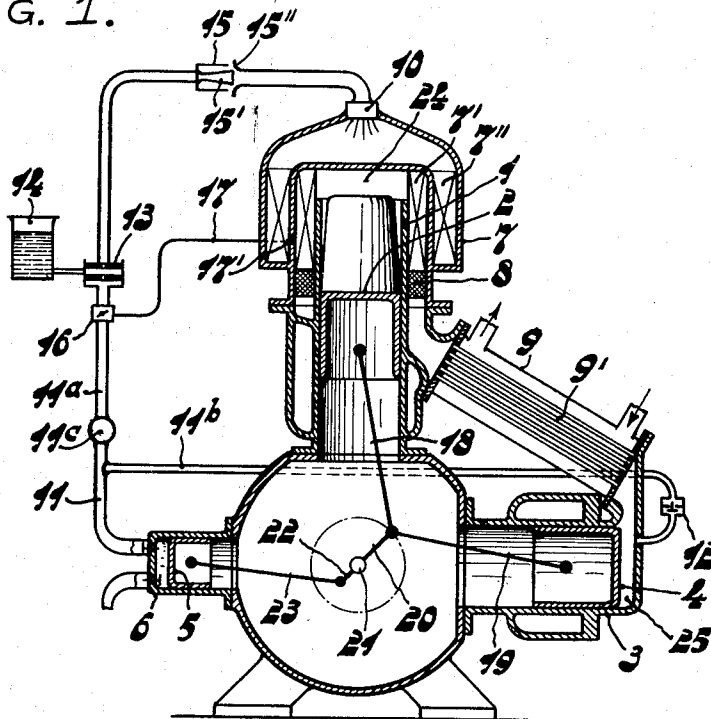


FIG. 2.

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HOT-GAS RECIPROCATING ENGINE WITH
MEANS FOR AUGMENTING THE PRESSURE
MEDIUM AND SUPPLYING COMBUSTION
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5 Claims. (Cl. 60—24)

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This invention relates generally to hot-gas reciprocating engines and more particularly to hot-gas engines which include a device for the supply of a gaseous medium under pressure to the working space thereof. It is customary to provide hot-gas reciprocating engines with such a device, which may, for example, be a compressor or an auxiliary pressure vessel.

As is known, leakage of the working medium from the working space may sometimes occur in hot-gas reciprocating engines, due to which the power of the engine drops. If it is desired to restore this power, working medium must be supplied to the working space of the engine. Similarly, the power of an engine may be increased by supplying an additional quantity of working medium to the working space. In the hitherto known constructions use is made to this end of the gas supplied by a compressor or an auxiliary pressure vessel as indicated hereinbefore.

In other known constructions, a compressor or a fan supplies air which serves as combustion air for the burners of the hot-gas reciprocating engine. Consequently, two devices for the supply of gaseous medium are usually found in the engines; namely, a fan for the supply of combustion air and a compressor for supplementing the working medium.

In order to avoid this complication engendered by two separate gaseous medium supply means, the hot-gas reciprocating engine according to the invention is characterized in that only part of the gaseous medium supplied by the device for supplying gaseous medium under pressure, is used as supplemental medium in the engine. Another part of this gaseous medium is used for the supply of combustion air to one or more burners of the engine.

The gaseous medium used for supplementing the working medium is required to have a comparatively high pressure. It naturally follows, therefore, that the compressor must supply a medium having a comparatively high pressure. Part of the medium supplied by the compressor may then be used for the supply of combustion air to the burners. To this end use may, for instance, be made of an injector through which combustion air is drawn in. Obviously the gaseous medium under pressure may be of different composition than that injected as combustion air. It may, for instance, be nitrogen gas or hydrogen gas instead of air.

Furthermore, hot-gas reciprocating engines generally comprise one or more fuel pumps by which liquid fuel is pumped to the burners. These fuel pumps can now be omitted if, as in

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a further embodiment of the invention, the gaseous medium used for the supply of combustion air is at the same time used for conveying liquid fuel to one or more burners of the engine.

In a further embodiment of the invention, the gaseous medium used for supplying combustion air moreover sucks in liquid fuel by means of a jet pump, for example an injector. This embodiment provides an intimate mixture of combustion air and fuel.

In a further embodiment of the invention, the quantity of gaseous medium used for drawing in combustion air may be controlled by the use of a control device operated by a thermostat. The arrangement is such that an increase in temperature of the hot space results in a reduced supply of gaseous medium, whereas a decrease in temperature results in an increased supply of this medium.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described more fully with reference to the accompanying drawing, given by way of example, in which:

Figure 1 shows diagrammatically one form of a hot-gas reciprocating engine according to the invention.

Figure 2 shows an enlarged view of one of the injectors in section.

This hot-gas reciprocating engine comprises two cylinders 1 and 3 arranged at an angle of 90° with respect to one another. The cylinder 1 has a piston 2, and the cylinder 3 has a piston 4, which define the extremities of the working space in which the working medium is contained. The pistons 2 and 4 are secured through connecting rods 18 and 19, respectively, to a common crank 20 of the crank shaft 21. To a crank 22 of this crank shaft 21 is furthermore secured the connecting rod 23 of a piston 5 reciprocating in a compressor 6. Each of connecting rods 18, 19 and 23 and each of cranks 20 and 21, being conventional per se, are shown diagrammatically.

The space above the piston 2 is the hot space 24 of the hot-gas reciprocating engine and communicates by way of passage 7' in a heater 7, via a regenerator 8 and through the tubes 9' of a cooler 9, with the space 25 before the operative surface of the piston 4. This space 25 is the cooled space of the hot-gas reciprocating engine. By means of a burner 10, thermal energy is supplied to the passages 7'' in the heater 7, the passages 7' and 7'' being in heat exchange relationship. On the other hand, heat is taken from the tubes 9' by circulating a cooling medium, such

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as water, for example, through the cooler 9. The compressor 6 supplies compressed air which is used for supplementing the working medium in the engine and at the same time for the supply of combustion air and liquid fuel. To this end, a conduit 11 connected into the pressure chamber of the compressor 6 has two branches 11a and 11b. The air carried off through the conduit 11b is preferably introduced into the cold space of the hot-gas reciprocating engine, as shown in the drawing, to serve as supplemental air. This conduit 11b comprises a check valve 12 to prevent working medium from being forced from the engine working space if the pressure therein periodically exceeds the pressure in the conduit 11b.

The conduit 11a is connected to the burner 10. The air supplied by the compressor first traverses an injector 13 by means of which liquid fuel from a vessel 14 is drawn in. The fuel air mixture subsequently passes through an injector 15 by which secondary combustion air is drawn in. This quantity of air may be increased or reduced in a simple manner, such as altering the relative position between the edge of the nozzle 15' and the surface of the Venturi flare 15'', so that the control of the burner 10 is very simple. For example, the Venturi section 30 may be adjusted by means of a screw thread 32.

In order that the quantity of thermal energy supplied to the engine may be kept constant, a valved control device 16 is provided which is adapted to be controlled by means of a thermostatic system 17. The latter has the thermosensitive element 17' thereof subjected to the temperature of the hot space 24 or of the heater 7 as shown. The valved control device 16 is such that an increase in temperature of the hot space 24 or heater 7 results in a smaller quantity of medium being supplied, whereas a decrease in temperature results in a larger quantity of medium supplied.

Sometimes, the pressure of the supplemental medium is too high for use in an injector. Therefore, it will sometimes be desirable to provide a reducing valve 11c in the conduit 11a in front of the injector 13.

What we claim is:

1. A hot-gas reciprocating engine comprising means defining a working space, piston means in said working space, a crankshaft, means connecting said piston means to said crankshaft, a device for supplying gaseous medium under pressure, first conduit means for directing a part of the gaseous medium supplied by said device to said working space, a burner operatively associated with said working space for supplying heat to a portion thereof, second conduit means for directing a part of the gaseous medium supplied by said device to said burner, and means drivingly connecting said crankshaft to said device.

2. A hot-gas reciprocating engine comprising means defining a working space, a device for supplying gaseous medium under pressure, first conduit means for directing a part of the gaseous medium supplied by said device to said working space, a burner operatively associated with said working space for supplying heat to a portion thereof, second conduit means for directing a part of the gaseous medium supplied by said device to said burner, liquid fuel supply means connected into said second conduit means, and injector means in said second conduit means located between said burner and said liquid fuel supply means connection, and means adjustably

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communicating said injector means with the atmosphere.

3. A hot-gas engine comprising a closed system containing gas of invariable chemical composition as the working medium and having first means enclosing a hot space, second means enclosing a cold space, third means connecting said hot space and said cold space, said third means having a heater, a regenerator and a cooler therein, a plurality of pistons for varying the volumes of said spaces, rod and shaft means interconnecting said pistons and reciprocating them at a constant phase difference, a device for supplying gaseous medium under pressure, first conduit means connecting said device to said cold space to direct a part of the gaseous medium supplied under pressure to said closed system in order to regulate the power output of the engine, a heater around said hot space for supplying heat to a portion thereof, a burner for said heater, second conduit means connecting said device to said burner to direct a part of the gaseous medium supplied by said device to said burner, and means in said second conduit means for varying the quantity of gaseous medium supplied by said device to said burner.

4. A hot-gas engine comprising a closed system containing gas of invariable chemical composition as the working medium and having first means enclosing a hot space, second means enclosing a cold space, third means connecting said hot space and said cold space, said third means having a heater, a regenerator and a cooler therein, a plurality of pistons for varying the volumes of said spaces, rod and shaft means interconnecting said pistons and reciprocating them at a constant phase difference, a device for supplying gaseous medium under pressure, first conduit means connecting said device to said cold space to direct a part of the gaseous medium supplied under pressure to said closed system in order to regulate the power output of the engine, a heater around said hot space for supplying heat to a portion thereof, a burner for said heater, second conduit means connecting said device to said burner to direct a part of the gaseous medium supplied by said device to said burner, fuel injector means connected into said second conduit and air injector means in said second conduit whereby the high pressure medium from the compressor acts to draw air into said second conduit.

5. A hot-gas engine comprising a closed system containing gas of invariable chemical composition as the working medium and having first means enclosing a hot space, second means enclosing a cold space, third means connecting said hot space and said cold space, said third means having a heater, a regenerator and a cooler therein, a plurality of pistons for varying the volumes of said spaces, rod and shaft means interconnecting said pistons and reciprocating them at a constant phase difference, a device for supplying gaseous medium under pressure, first conduit means connecting said device to said cold space to direct a part of the gaseous medium supplied under pressure to said closed system in order to regulate the power output of the engine, a heater around said hot space for supplying heat to a portion thereof, a burner for said heater, second conduit means connecting said device to said burner to direct a part of the gaseous medium supplied by said device to said burner, valve means in said second conduit, and thermostatic means responsive to the temperature in said

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heated portion of said working space for controlling said valve means.

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Number

334,153

1,169,308

2,067,453

5 2,434,726

2,588,530

Number

10 196,620

References Cited in the file of this patent

UNITED STATES PATENTS

Number

Name

Date

155,087

Hirsch ----- Sept. 15, 1874

270,036

Eimecke ----- Jan. 2, 1883

6

Name

Date

Babcock ----- Jan. 12, 1886

Vuia ----- Jan. 25, 1916

Lee ----- Jan. 12, 1937

Udale ----- Jan. 20, 1948

Ifield ----- Mar. 11, 1952

FOREIGN PATENTS

Country

Date

Great Britain ----- Oct. 20, 1924