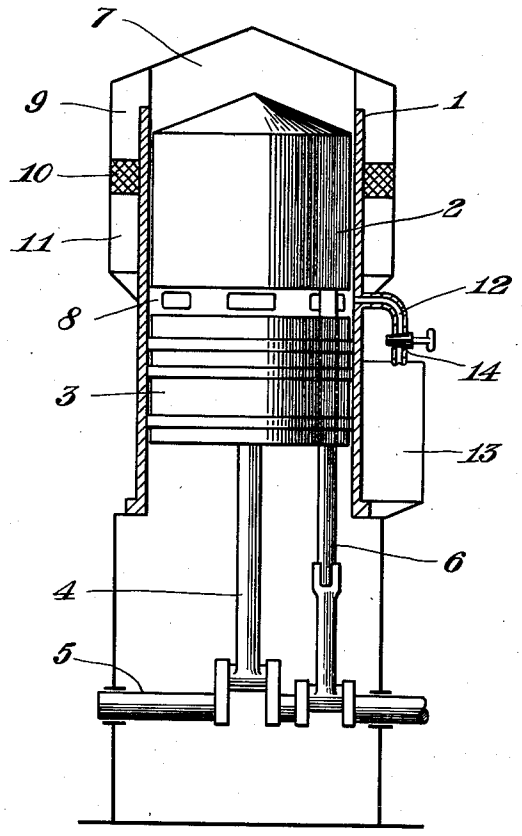
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HOT GAS RECIPROCATING ENGINE WITH WORKING MEDIUM AUGMENTING MEANS

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HOT GAS RECIPROCATING ENGINE WITH WORKING MEDIUM AUGMENTING MEANS

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1

It is a known phenomenon that in hot-gas reciprocating engines of the closed cycle type (which term is to be understood to include refrigerating machines operating according to the reversed hot-gas engine principle wherein a quantity of working medium is continuously enclosed in the working space throughout the cycle of operation) working medium leaks away in time. This leakage of working medium results in a decrease in the power of the engine. It is therefore common practice to replenish the quantity of working medium periodically in order to restore the power to its original level. As a rule, in replenishing the working medium use is made of the control-system provided in the engine. However, such control-systems generally comprise moving parts, the energy required for actuating these parts being supplied by the engine itself. When this control-system is used frequently for replenishing the working medium, the energy required for actuating the parts of the control-system may assume a value which cannot be neglected. In this case the mechanical losses of the engine thus increase.

The object of the invention is to provide a closed cycle hot-gas reciprocating engine in which the working medium is replenished in a simple manner, the mechanical losses of the engine not being substantially increased.

According to the invention a hot-gas reciprocating engine is characterized in that provision is made of means comprising a communication duct providing continuous communication between the working space and a second space containing a supply of working medium, said means being such that the power output of the engine under operating conditions is decreased by no more than 5%, preferably by no more than 10% due to the presence of said means.

During that part of the cycle in which the pressure in the working space is lower than the pressure in the auxiliary space, a certain quantity of working medium will flow through the communication duct between the two spaces to the working space, whilst during that part of the cycle in which the pressure in the working space exceeds that in the auxiliary space, a certain quantity of working medium will flow through the communication duct to the auxiliary space.

When working medium leaks away from the working space, the quantity of working medium flowing to the working space will, since the mean pressure in the engine drops, be greater than the quantity of medium flowing to the auxiliary space.

2

To ensure satisfactory operation of the device for replenishing the medium, it is of importance that the resistance to flow in the communication duct should be so small that it is possible, having regard to the pressure differences between working space and auxiliary space, to replace the quantity of medium leaked away, and should be so high that the flow of working medium through the communication duct during a cycle substantially does not affect the power output of the engine. Furthermore, it is of importance that the clearance volume of the communication duct should be so small that the power of the engine is not decreased excessively thereby.

Since, as a rule, the leakage losses of a closed cycle hot-gas reciprocating engine increase with increase in the time the engine has been continuously in use, it is advantageous if the resistance to flow in the communication duct is variable; it is thus possible to control the replenishment of medium in accordance with the leakage losses.

In one preferred embodiment of the invention, this communication duct is in the form of a tube. It is possible to shape the communication duct in different forms, for example, to be circular, annular, and so forth. The duct is preferably so shaped that the resistance to flow is as far as possible equal in both directions.

The communication duct may be of porous material.

It is obvious that the resistance to flow between the working space and auxiliary space may alternatively be provided in various other ways, for example by filling up at least part of the duct by fine wire material and the like, or by providing one or more narrow apertures therein. In the latter case it is possible that the narrow apertures form a labyrinth, for example, a number of narrow and wide apertures may be provided in series. It is furthermore possible to narrow the apertures, for example, by obturating one or more channels to a smaller or greater extent by one or more screws. The rate of replenishing may thus be varied.

If it is not necessary that the power of the hot-gas reciprocating engine should be varied rapidly, the replenishing device may also be used for controlling the power output of the engine. For this purpose it is required that either the pressure in the auxiliary space or the resistance to flow in the duct, at substantially invariable leakage losses, should be varied for the power output of the engine to be also varied.

In certain cases, it may be desirable to have

the mean pressure of the engine equal to the atmospheric pressure; in this case the auxiliary space may be constituted by the ambient free atmosphere.

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, showing diagrammatically, by way of example, one embodiment of a closed cycle hot-gas reciprocating engine according to the invention.

The closed cycle hot-gas reciprocating engine comprises a cylinder 1, in which a displacer 2 and a piston 3 are adapted to move. The piston 3 drives a crank shaft 5 through a driving rod 4, the displacer 2 being moved up and down, with the use of a rod system 6, taken through the piston 3, due to the rotation of the crank shaft. The movements of piston 3 and the displacer 2 take place with a constant phase difference. The enclosed working space of the engine comprises a hot space 7 and a cold space 8, which communicate with one another by way of a heater 9, a regenerator 10 and a cooler 11. The cold space 8 communicates continuously by way of a narrow tube 12 with an auxiliary space 13. It is possible to vary the resistance to flow in the tube 12 in this embodiment of the invention by means of a cock 14. In the auxiliary space 13 prevails a pressure substantially equal to the mean pressure of the working medium in the working space. It is possible to vary, in known manner, the pressure in the auxiliary space 13, so that the device 12, 13, 14 may be used, in addition, to control the power output of the engine.

What I claim is:

1. A closed cycle hot-gas reciprocating engine comprising means defining an enclosed working space therein for enclosing the working medium, means defining an auxiliary space separate from said enclosed working space, conduit means continuously connecting said two spaces, said conduit means comprising means to resist equally the flow of working medium therethrough in either direction of flow thereof.

2. A closed cycle hot-gas reciprocating engine comprising means defining an enclosed working space therein for enclosing the working medium, means defining an auxiliary space separate from said enclosed working space, conduit means continuously connecting said two spaces, said conduit means comprising means to resist equally the flow of working medium therethrough in either direction of flow thereof, and a porous material at least partly filling said conduit means.

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