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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Forced Draught Combustion Apparatus

I, FRITZ COCKERELL, a German citizen, of Maria - Einsiedel - Strasse 28, Munich 25, Western Germany, do hereby declare the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a forced draught combustion apparatus for the production of hot gas under pressure, which is of the piston type and intended to be used principally for the heating of evaporators and steam super heaters.

Forced draught combustion apparatus has in the past usually been operated with oil burners which are fed with compressed air by a compressor. Such forced draught combustion apparatus requires a considerable capital expenditure in the operation of the air compressor and delivers hot gases under high pressure, whose economic utilisation in evaporators makes it necessary to have a large heating surface.

In contrast, the present invention is directed to the provision of a forced draught combustion apparatus wherein the hot gas is produced in a piston operated machine, which resembles an internal combustion engine in having a crank shaft and admission and discharge valves arranged in the cylinder head, but which does not however operate as a prime mover. The air necessary for combustion is in this case drawn in by the piston of the machine so that the compressors which are usually necessary for forced draught combustion apparatus together with the appertaining driving arrangements can be dispensed with, and hot gases can be generated at a comparatively low pressure, which makes possible an economic thermal utilisation of small heating surfaces in evaporators or super heaters arranged downstream of the combustion apparatus.

It is already known to use piston machines as hot gas generators, the hot gases being however generated under high pressure. A known piston machine of this type operates in a cycle of six or more strokes, the driving medium supplied being subjected to high compression before its ignition, on the Diesel principle. The expansion of the combustion gases in the cylinders is only allowed to proceed to such a magnitude as is necessary to maintain the machine in operation without an external drive, but, for the purpose of the high compression of the driving medium and for the 6-or-more stroke cycle of operation of the machine, a substantial part of the energy delivered by the driving medium must be converted into compression work and driving work. The machine delivers a gas under high pressure, corresponding to the high compression necessary for ignition in the cylinder.

There is also known a hot gas generator in the form of a piston machine operated on a two-stroke cycle, which works after the manner of the conventional two-stroke internal combustion engine, with piston controlled admission and discharge ports and with cylinder scavenging. The ignition follows the closing of the discharge port and the subsequent compression of the combustion mixture in the region of the outer reversal position of the piston. In this case likewise there must be a considerable part of the energy developed in the fuel which is converted into compression work, and moreover a portion of the combustion mixture is lost by the cylinder scavenging.

The present invention provides forced flow combustion apparatus for the production of hot gas under pressure, the apparatus comprising a piston displaceable in a cylinder and connected to a crankshaft, and admission and discharge valves arranged in the cylinder head, ignition of the fuel-air mixture sucked in by the piston being arranged to occur at maximum cylinder filling in the region of the lower dead centre position of the piston without compression, and the admission and dis-

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charge valves being controlled in such a manner that in the lower dead centre position of the piston the discharge valve opens, and in the upper dead centre position of the piston the discharge valve closes and the admission valve opens the combustion gas being expelled during a full piston stroke. With this arrangement the machine of the invention is relieved of any compression work and immediately delivers the hot gas in an expanded condition and at such a low pressure that it can be economically utilised in an evaporator with a small heating surface connected downstream.

Because compression in the combustion chamber is dispensed with and only a small amount of driving energy is required for drawing in the combustion mixture, the crankshaft can be driven by a motor of small power. Alternatively, the closing of the admission valve and the ignition point can be so advanced that the amount of energy transmitted by the combustion gases to the piston suffices to drive the machine with its accessories.

The cylinder of the machine can be provided with a cooling water jacket, which is connected to a water supply line, and appropriately operates by evaporation cooling, and preheats the water necessary for the operation of the evaporator, so that the heat taken up by the cooling water is also utilised for steam generation.

So that the invention may be more readily understood and carried into effect, an illustrative embodiment thereof is described below with reference to the accompanying drawing, in which:

Figure 1 shows a section in a vertical plane through the machine embodying the invention;

Figure 2 shows a crank cycle control diagram for external drive of the crankshaft; and

Figure 3 shows the same diagram for self-drive of the crankshaft.

As will be clear from Figure 1, the machine has a piston 1 displaceable in a cylinder and connected to a crankshaft 2 through a connecting rod 3. In the cylinder head 4 there are situated an admission valve 5 and a discharge valve 6. The admission valve 5 is connected through a suction line, not shown in the drawing, to a carburettor, and the discharge valve 6 is connected through the exhaust gas line 8 to an evaporator 9. The evaporator 9 is mounted on a stub pipe 7 of the cylinder head, which is connected to the exhaust gas line 8. The cylinder head 4 is provided with an ignition plug which is not visible in Figure 1. The cylinder is provided with a cooling water jacket 12, which is connected below to a water pump 13 driven by the crankshaft 2, and at the top to the water jacket of the cylinder head 4, and in the region of the pipe 7 to a port 11 in a jacket 10 of the evaporator 9.

The control cycle of the admission and discharge valves 5 and 6 is evident from the crank cycle diagram of Figure 2. In Figure 1, the piston is shown situated near its lower dead centre position. In this position the admission valve 5 has just closed, at the point E on the diagram of Figure 2. Ignition is effected at Z in the crank cycle diagram, in the piston position immediately after the closing of the admission valve, and the discharge valve opens a little later at A almost at the lower dead centre point UT. With this control arrangement, no power is delivered externally and the crankshaft is driven through a belt pulley 14 by an electric motor of very small power not shown in the drawing.

According to the crank cycle diagram of Figure 3, the small driving power for keeping the machine in operation can be derived from the combustion gases, which apply a transient dynamic pressure to the piston. The closing of the admission valve at point E and the ignition point Z are in this case slightly advanced and will succeed each other at about 45° before the lower dead centre point UT.

In both cases the discharge valve 6 opens at A, almost in the lower dead centre point UT of the piston, which now uses its full piston stroke for expelling the hot combustion gas, until in the upper dead centre position OT the discharge valve 6 closes and the admission valve 5 opens.

The piston operated machine thus works on a two-stroke cycle, without compression of the gas-air mixture, and essentially without an expansion stroke of the piston. In this way an excessively high pressure of the hot gas is avoided and this makes it possible to adopt a relatively light construction for the piston and for the crank driving mechanism.

The through-flow cross section of the discharge valve 6 is dependent upon the throughput weight of the hot gas and can, for a partial load, be influenced by varying the lift of the discharge valve. Preferably the machine has two cylinders, with pistons operating with 180° crank displacement and 180° ignition phase separation, in order to ensure a continual flow of the hot gas.

Benzine can be employed for operation, particularly in the case of small installations for vehicles or households; stationary installations of large power are operated preferably with natural gas or the like. As compared with other hot gas generators of equivalent power, the forced draught combustion apparatus here described is characterised by a low weight and small space requirements.

WHAT I CLAIM IS:—

1. Forced flow combustion apparatus for the production of hot gas under pressure, the apparatus comprising a piston displaceable in a cylinder and connected to a crankshaft, and admission and discharge valves arranged in the cylinder head, ignition of the fuel-air mixture sucked in by the piston being arranged

to occur at maximum cylinder filling in the region of the lower dead centre position of the piston without compression, and the admission and discharge valves being controlled in such a manner that in the lower dead centre position of the piston the discharge valve opens and in the upper dead centre position of the piston the discharge valve closes and the admission valve opens, the combustion gas being expelled during a full piston stroke.

2. Apparatus as claimed in claim 1 in which the crankshaft is arranged to be driven by an external power source.

3. Apparatus as claimed in claim 1 in which the closing point of the admission valve and the ignition point are so arranged that the amount of combustion gas energy transmitted to the piston just suffices to maintain the machine in operation.

4. Apparatus as claimed in claim 1, 2 or 3, in which the cylinder is provided with a cooling water jacket to which water is arranged to be continuously supplied and which is connected through a water discharge port to an evaporator which is fed with the combustion gases of the apparatus.

5. Apparatus as claimed in claim 4, in which the cooling water jacket has a water supply line connected to a water feed pump driven by the crankshaft, the feed water pump delivering only water to be converted into steam.

6. Apparatus as claimed in claim 4 or 5 in which the evaporator is mounted upon the cylinder head with the evaporator heater body connected to the exhaust gas outlet port of the cylinder head and with the evaporator water space connected to the outlet of the cooling water jacket.

7. Apparatus as claimed in any preceding claim arranged to operate as a two stroke two cylinder machine, the two pistons of which have 180° crank displacement and 180° ignition phase displacement.

8. Forced flow combustion apparatus for the production of hot gas under pressure substantially as herein described with reference to Figures 1 and 2 or Figures 1 and 3 of the accompanying drawing.

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1027852 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

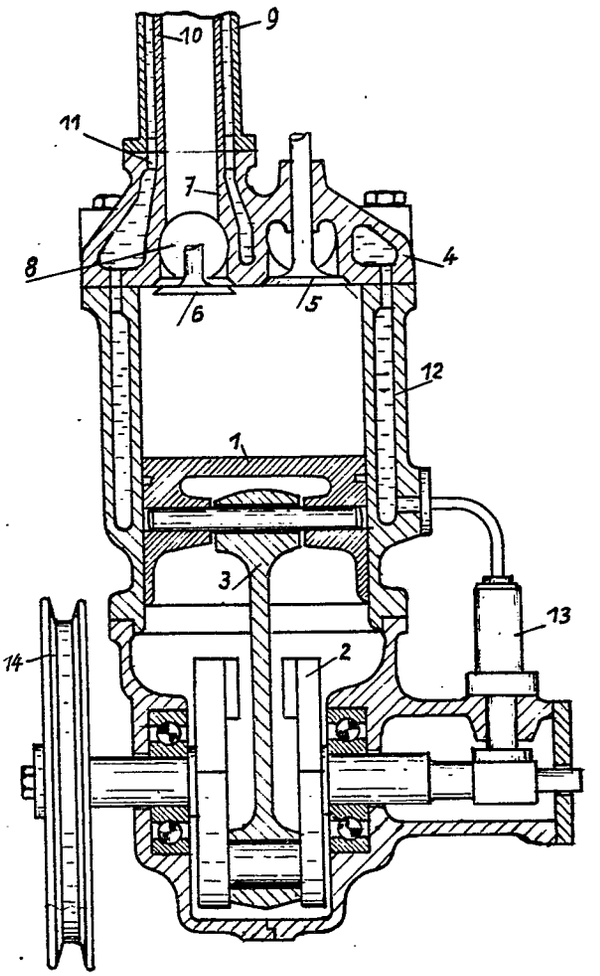

Fig. 2

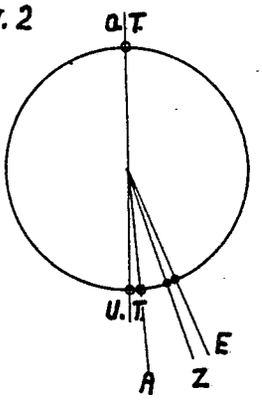

Fig. 3