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HOT-GAS RECIPROCATING ENGINE
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FIG. 1.

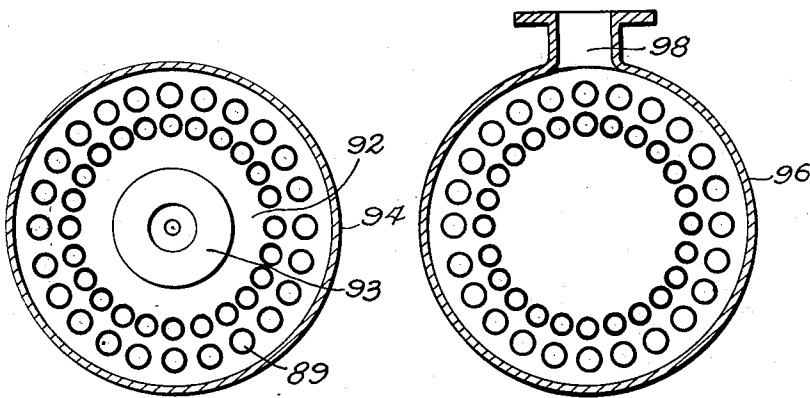
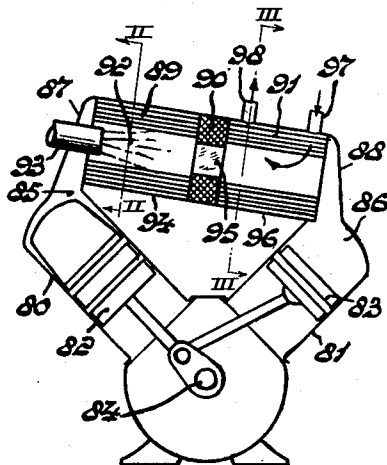


FIG. 2.

FIG. 3.

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HOT-GAS RECIPROCATING ENGINE

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3 Claims. (Cl. 60—24)

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This invention relates to hot-gas reciprocating engines.

A hot-gas reciprocating engine is known in which the hot and cold spaces associated with a thermodynamic cycle and arranged in two different cylinders are in open communication with each other through a heater, a regenerator and a cooler. Further particulars concerning hot-gas reciprocating engines are to be found in Philips Technical Review, volume 8, page 129 et seq. and volume 9, page 97 et seq. and page 125 et seq.

The object of the invention is to provide an improved hot-gas reciprocating engine in that by suitable combination and relative arrangement of the heater, regenerator and cooler the resistance to flow of working medium of the engine through the elements is reduced and it is furthermore possible for the heater and the cooler to be built up from very simple components. In addition, when employing the invention, the combustion chamber of the engine is suitably defined.

The engine according to the invention exhibits the feature that the tube heater, regenerator and tube cooler, which are arranged immediately after one another, are in line with one another and the tubes of the heater are arranged in one or more coaxial rings and thus define the combustion space of the engine.

Due to the fact that the heater, the regenerator and the cooler are in line with one another, the resistance to flow of the medium of the engine through these elements is but low. The said three elements may be united to form a single unit with the use of simple constructional members, in which tube material is a factor of importance, said unit being adapted to be fitted on the engine cylinders by means of transfer passages. Due to the fact that the tubes of the heater define the combustion space of the engine they ensure not only satisfactory heat transfer from the combustion gases and the flame of the burner to these tubes but also a simple construction of the furnace wall proper, since the pipes of the heater protect this wall from excessive heating.

According to a preferred embodiment of the invention, the tubes of the cooler are also arranged in one or more coaxial rings so as to be substantially in line with the tubes of the heater and they are preferably housed in a cooling agent container. Particularly the first-mentioned measure has the effect of further reducing the resistance to flow of the medium through the heater, regenerator and cooler.

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If, in accordance with an alternative embodiment of the invention, the regenerator is annular and its inner and outer diameters are very nearly equal to the inner and outer diameters of the zone in which the heater and cooler tubes are opened out into the regenerator space, it is ensured that the path to be traversed by the working medium of the engine in the heater, regenerator and cooler is substantially straight.

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 in which:

Figure 1 shows a preferred embodiment of a hot gas engine according to the invention;

Figure 2 shows a cross-sectional view of the heater taken along the line II—II in Figure 1, and

Figure 3 shows a cross-sectional view of the cooler taken along the line III—III of Figure 1.

Figures 1-3 show one embodiment of a hot-gas engine according to the invention, which comprises two cylinders 80 and 81, the longitudinal axes of which are at right angles to each other. The pistons 82 and 83 are linked by a common crank to a crank shaft 84. The space 85 above the piston 82 in cylinder 80 constitutes the hot space of the thermodynamic cycle performed in the engine and the space 86 above the piston 83 in cylinder 81 constitutes the cold space associated with that cycle. The cylinders 80 and 81 are provided with transfer passages 87 and 88 which are separated by a heater 89, a regenerator 90 and a cooler 91, which are integral with one another. The heater 89 comprises tubes arranged in coaxial rings, a cavity 92 being defined within the inner ring. This cavity acts as a combustion space for the burner 93. The tubes 89 are intermediate the combustion space and the furnace wall 94 so that this wall is not subjected to high temperatures and may be of very simple construction. The regenerator 90 is annular, the central aperture being sealed by a body 95 of refractory material. The cooler 91 also comprises tubes arranged in coaxial rings and is contained within a wall 96. These tubes are substantially in line with the tubes of the heater, so that the resistance to flow of the medium is extremely low. The space within the wall 96 and without the tubes contains cooling-water supplied through a duct 97 and discharged through a duct 98. An extremely simple engine is thus obtained.

What we claim is:

1. A hot-gas reciprocating engine having a closed thermodynamic cycle, comprising a first

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cylinder enclosing a hot space, a second cylinder enclosing a cold space, means connecting said hot and cold spaces, a tubular heater, tubular cooler and regenerator arranged in line in said means, said heater being formed by a plurality of tubes arranged in coaxial rings with an open central combustion space.

2. A hot-gas reciprocating engine having a closed thermodynamic cycle, comprising a first cylinder enclosing a hot space, a second cylinder enclosing a cold space, means connecting said hot and cold spaces, a tubular heater, tubular cooler and regenerator arranged in line in said means, said heater being formed by a plurality of tubes arranged in coaxial rings with an open central combustion space and said cooler also having a plurality of tubes forming coaxial rings which are substantially in line with said tubes in said heater.

3. A hot-gas reciprocating engine having a closed thermodynamic cycle, comprising a first cylinder enclosing a hot space, a second cylinder enclosing a cold space, means connecting said hot and cold spaces, a tubular heater, tubular cooler and regenerator arranged in line in said means, said heater being formed by a plurality of tubes

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arranged in coaxial rings with an open central combustion space, said cooler also having a plurality of concentric tubes forming coaxial rings which are substantially in line with said tubes of said heater and said regenerator being formed by an annular body located between the tubes of said heater and said cooler with a refractory member in the central aperture of the annular regenerator body to minimize heat transfer from said central combustion space to said cooler.

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