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REGENERATOR FOR USE IN HOT GAS RECIPROCATING ENGINES

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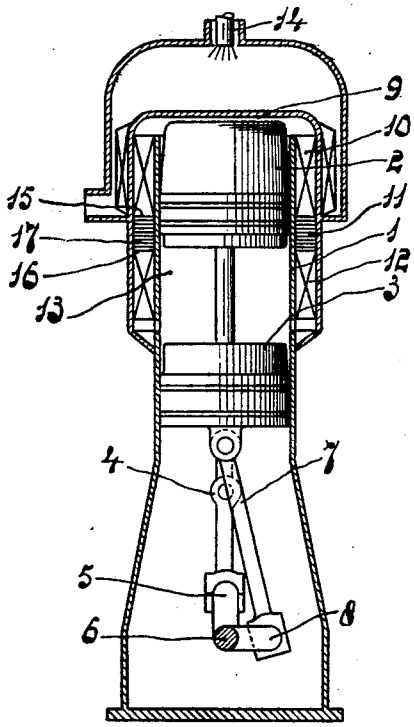


Fig. 1

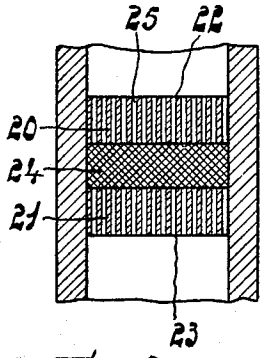


Fig. 2

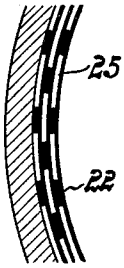


Fig. 3

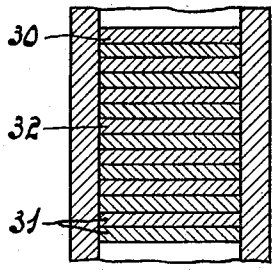


Fig. 4

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REGENERATOR FOR USE IN HOT GAS RECIPROCATING ENGINES

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2 Claims. (Cl. 257—6)

It has been suggested before to construct regenerators for use in hot gas reciprocating engines in such manner that the loading mass comprises in the main direction of flow of the gas through the regenerator parts of different thermal capacity per unit of regenerator volume, a hot gas reciprocating engine being understood to include a refrigerator acting on the reversed hot gas reciprocating engine principle or a heat pump acting on this principle.

The object of the known construction is to reduce as fast as possible the losses of flow of the gas flowing through the regenerator at the hot side of the regenerator, since while flowing from the cold to the hot side of the regenerator, the gas is heated therein so that the same quantity of gas by weight at the hot side will have a larger volume than at the cold side. Due to this large gas volume the speed of the gas at the hot side would be largest if the passage of the regenerator at the hot side and at the cold side were equal so that in this case the losses of flow at this side would be largest. According to this suggestion the said large losses of flow at the warm side may be avoided, if the passage of the regenerator at this side is increased. However, the known construction is also responsible for the heat capacity of the loading mass increasing from the warm side to the cold side.

The invention is based on recognition of the fact that it is also desirable for other reasons to manufacture a regenerator the loading mass of which has different thermal capacities in the main direction of flow of the gas, since with hot gas reciprocating engines temperature fluctuations occur both in the space which at the hot side of the regenerator follows immediately thereafter and in the space which at the cold side follows immediately thereafter and due to these temperature fluctuations the gas enters the regenerator at a fluctuating temperature. Tests revealed that a reduction in efficiency of the regenerator with respect to the theoretical efficiency is due to the said temperature fluctuations of the gas. These temperature fluctuations, which occur particularly near and in the entry surfaces of the regenerator and which die down in the parts arranged towards the centre, are found to be responsible for supplementary losses of flow.

These losses may be avoided or at least reduced if according to the invention the thermal capacities per unit of regenerator volume of those parts of the loading mass to which the entry surfaces of the regenerator belong exceed those of the intermediate parts.

The thermal capacities of the two parts of the loading mass to which the entry surfaces of the regenerator belong are substantially similar.

A simple regenerator construction may be obtained if according to an alternative embodiment of the invention the loading mass is constituted by at least three parts arranged across the main direction of flow of the gas.

It has been found that in certain cases highly satisfactory results are obtainable if according to a further

alternative embodiment of the invention the thermal capacity of the loading mass decreases from the entry surfaces towards the centre.

According to a structurally favourable embodiment of the invention those parts of the loading mass which constitute the entry surfaces are constituted by layers of metal band wound with a small amount of intermediate space.

In order that the invention may be more clearly understood and readily carried into effect, it will now be described in detail with reference to the accompanying drawing, in which several embodiments of the invention are diagrammatically shown.

Fig. 1 shows a hot gas reciprocating engine.

Figs. 2 and 3 are on a larger scale, a sectional view and a plan view of a regenerator of the kind housed in the hot gas engine. This regenerator comprises three layers.

Fig. 4 is a sectional view of a regenerator, the variation of the thermal capacity being substantially linear.

The hot gas reciprocating engine shown in Fig. 1 is a displacer engine and comprises a cylinder **1** in which a displacer **2** and a piston **3** reciprocate with a constant phase difference. The displacer **2** is coupled by means of a connecting rod mechanism **4** to a crank **5** of a crank shaft **6**. Similarly, the piston **3** is coupled to a crank **8** of the crank shaft by means of a connecting rod system **7**. The space above the displacer **2** is the hot space **9** and this space communicates via a heater **10**, a regenerator **11** and a cooler **12** with the space **13** between the displacer and the piston. The space **13** is the so-called cold space of the engine. The engine is provided with a burner **14** by means of which thermal energy may be transmitted to the heater. The regenerator is annular and built up from various layers. The outer layers **15** and **16** have a larger thermal capacity than the intermediate layers **17**.

Fig. 2 is a sectional view of the regenerator constituted by three parts. The outer parts **20** and **21** are made from wound metal band, as may be seen from the plan view **3** of Fig. 3. The thermal capacity of these outer layers to which the entry surfaces **22** and **23** belong, is for example 0.25 g. cal./cm.^{3} ° C. The inner part is constituted by a wound metal wire having a diameter of 50 microns and this layer has a thermal capacity of 0.12 g. cal./cm.^{3} ° C. In Fig. 3 part of the wound metal band is shown in the regenerator housing. It will be noted that the openings **25** in wound metal band **20** are staggered circumferentially with respect to each other around the entire regenerator mass.

Fig. 4 shows a regenerator which is built up from a large number of layers and in which the thermal capacity decreases from the outer layers **30** and **31** toward the centre, the central layer **32** having the lowest thermal capacity. Thus for example, the thermal capacities of the layers **30** and **31** may be 0.30 g. cal./cm.^{3} ° C. The thermal capacity of the central layer **32** is 0.08 g. cal./cm.^{3} ° C. and the difference in thermal capacity between the outer layers and the central layers is distributed as far as possible about the other layers.

What I claim is:

1. A regenerator for use in a hot gas reciprocating engine comprising: a plurality of layers of regenerative material of different thermal capacities, the outermost layers defining opposed entry surfaces for the flow of gases therethrough, the thermal capacities of the outermost layers being higher than those of the intermediate layers, the outermost layers being formed of spirally wound metal bands radially spaced from each other to define a series of openings longitudinally thereof, and said openings being circumferentially staggered with respect to each other.

2. A regenerator as defined by claim 1 in which the

layers intermediate the outermost layers are formed of wound metal wire.

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