Nov. 4, 1952 F. L. VAN WEENEN 2,616,246

HOT-GAS RECIPROCATING ENGINE

Filed April 12, 1950

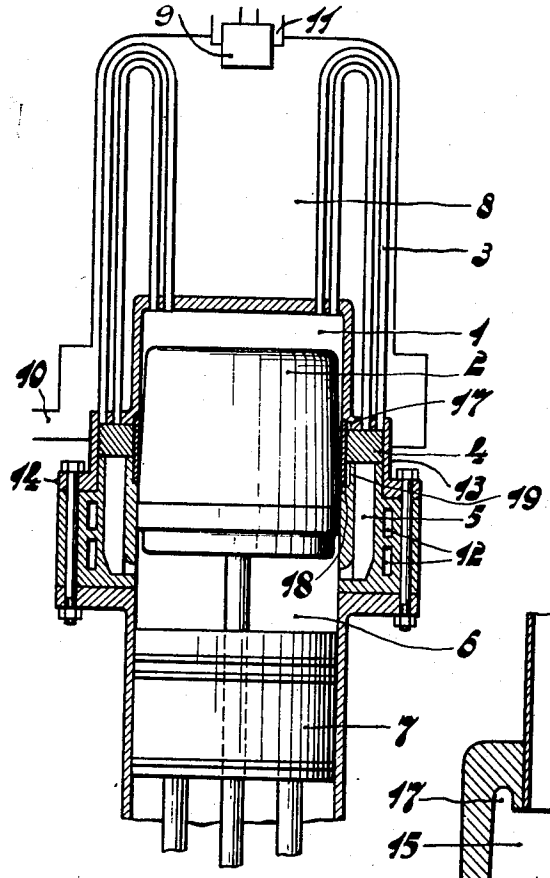


Fig. 1.

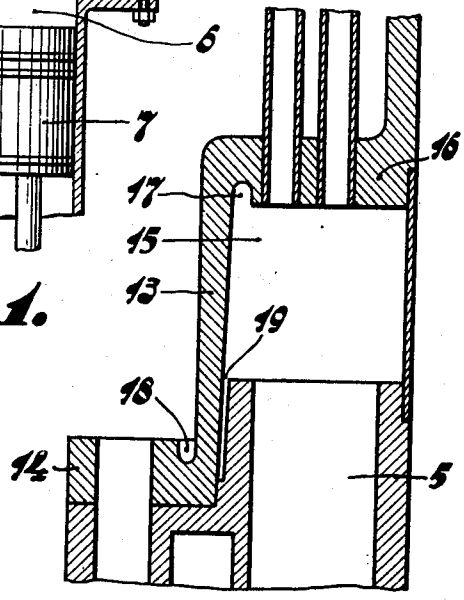


Fig. 2.

INVENTOR.

FRANCISCUS LAMBERTUS VAN WEENEN

BY

AGENT

Patented Nov. 4, 1952 2,616,246

UNITED STATES PATENT OFFICE

2,616,246

HOT-GAS RECIPROCATING ENGINE

Franciscus Lambertus van Weenen, Eindhoven, Netherlands, assignor to Hartford National Bank and Trust Company, Hartford, Conn., as trustee

Application April 12, 1950, Serial No. 155,382
In the Netherlands May 20, 1949

5 Claims. (Cl. 60—24)

1

This invention relates to hot-gas reciprocating engines comprising a regenerator and a cooler. The working medium of a hot-gas reciprocating engine gives off heat in traversing the regenerator in one direction, so that the temperature of the medium falls, and absorbs heat in traversing the regenerator in the other direction so that the temperature of the working medium rises, a comparatively great temperature gradient existing across the regenerator. Thus, for instance, the hot end surface of the regenerator filling material may have a temperature of 600° C., and the cold end surface 100° C.

The regenerator is contained in a space bounded by an outer wall which is generally secured, to one or more parts of the engine at the line of demarcation of the cold end surface of the regenerator filling material. Owing to the great temperature difference across the regenerator filling material a comparatively great temperature difference also exists across this wall. Thus, for example, the temperature of the wall at the height of the hot end surface of the regenerator filling material may approximately be 600° C., and the temperature at the height of the cold end surface of the regenerator filling material is substantially the temperature of the cooler.

As a rule, the optimum height of the regenerator filling material is comparatively small, so that the temperature difference in the wall will prevail over a comparatively small height. However, the expansion of the wall at the end having a higher temperature materially exceeds the expansion at the end having a lower temperature, which results in considerable strains in the material of the wall. Moreover, if the wall surrounding the regenerator space is secured to the cooler, the leakage of heat to the cooler will be comparatively considerable owing to the small height of the wall.

The object of the present invention is to mitigate the aforesaid disadvantages.

According to the invention, a hot-gas reciprocating engine comprising a regenerator and a cooler, is characterised in that the regenerator space is bounded by a substantially cylindrical outer wall which, viewed from the hot end surface of the regenerator filling material, extends past and is secured to one or more parts of the engine beyond the cold end surface of the regenerator filling material. The height of the wall over which the temperature gradient prevails thus exceeds that of the aforesaid known

2

construction and hence the strains in the wall are reduced.

If the cooler adjoins the cold end surface of the regenerator, a simple and compact construction may be obtained.

The distance by which the wall extends past the cold end surface of the regenerator filling material is preferably at least 0.3 times the height of the regenerator filling material. The term "height of the regenerator filling material" is to be understood to mean the distance between the cold end surface and the hot end surface of the regenerator filling material.

In order to reduce the strains in and to ensure even expansion of the wall, the wall may be, viewed from the hot end surface of the regenerator filling material in the direction of the cold end surface thereof, of decreasing thickness.

Since the regenerator filling material should have a substantially uniform cross section throughout its height, it is of importance that the outer surface of the regenerator and, consequently, the inner side of the wall should be substantially cylindrical in the working state of the engine. This is ensured by providing that the inner side of the wall is conical in the cold state, the greater expansion at the upper side of the skirt now being reduced by the greater wall thickness in situ.

As a rule, the wall will merge into another wall of materially greater thickness both at its end adjacent the hot and at its end adjacent the cold end surface of the regenerator filling material. To prevent the wall at the point where it merges into another wall of materially greater thickness from becoming too rigid, it is advisable that at the point where the wall merges into another annular wall at right angles to the axis of the wall, a slot should be provided in the other wall.

The latter may, for example, be a flange by means of which the wall is secured to one or more parts of the engine, or it may be another wall bounding one of the end surfaces of the regenerator space.

In order to reduce the leakage of heat through the wall to the cooler, the part of the wall which extends past the cold end surface of the regenerator filling material, surrounds the cooler substantially throughout that part of its length with a little clearance.

Since the height of the regenerator wall between the hot end surface of the regenerator filling material and the point of attachment to the cooler materially exceeds that of the con-

structions hitherto known, the leakage of heat through the wall is materially smaller than in the known constructions.

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 diagrammatic drawing, given by way of example, showing one embodiment thereof.

Fig. 1 shows part of a hot-gas reciprocating engine according to the invention, and

Fig. 2 is a view of part of Fig. 1 on a larger scale.

In Fig. 1, the volume of the hot space 1 is determined by a displacer 2. Working medium flows between the hot space 1 and cold space 6 through a heater 3, a regenerator 4 and a cooler 5. The volume of the cold space 6 is determined by the displacer 2 and a working piston 7. By means of a rod mechanism, both the displacer 2 and the piston 7 are connected to a crank shaft (not shown) so that they reciprocate with a constant phase difference with reference to one another. Thermal energy is supplied from a burner 9 to the heater which consists of hair-pin shaped pipes arranged around the combustion chamber 8.

The products of combustion leave the heater through an exhaust 10. The required combustion air is supplied to the burner through an annular duct 11. The cooler is cooled by means of a cooling medium which is supplied and carried off through ducts 12.

The regenerator 4 is bounded by a cylindrical outer wall 13 likewise surrounding the cooler, over part of its height. The wall 13 is secured by means of flanges 14 to the cooler and to the frame of the engine. The wall 13 extends past the cold end surface of the regenerator filling material.

In Fig. 2 the cylindrical skirt is shown on a larger scale than in Fig. 1 and the regenerator filling material is not shown. At the upper side, the wall 13 merges into another thicker wall 16 into which the pipes of the heater open, and at the bottom side the wall 13 merges into a flange 14. The inner surface of the wall 13 is conical in the cold state, so that the thickness of the wall at the hot end of the regenerator filling material is greater than at the cold end thereof. To ensure a satisfactory expansion of the wall 13, the other wall 16 is furnished with a slot 17 where it merges into the wall 13. Similarly, the flange 14 has a slot 18 where it merges into the wall 13. The wall 13 surrounds with a little clearance the cooler 5 substantially throughout the part extending past the cold end surface of the regenerator filling material, thus forming the interstice 19. Since the distance between the hot end of the wall 13 and the area of contact with the cooler is increased thereby, the leakage of heat to the cooler will be considerably reduced.

It will be obvious that the construction according to the invention may be applied in various hot gas engines.

What I claim is:

1. A hot gas engine comprising a first cylinder wall forming hot and cold spaces therein, means without said cylinder connecting said hot and cold spaces, said means including a regenerator and a cooler, said regenerator comprising a filler material having a hot end surface and a cold end surface, said cooler being located adjacent said cold end surface, a second cylindrical wall surrounding said regenerator, extending past said cold end surface and surrounding part of the cooler, the end of that part of the wall surrounding said cooler being secured to said first cylindrical wall and that part of said wall surrounding said cooler being slightly spaced therefrom to form a clearance therebetween to reduce the leakage of heat from said wall to the cooler.

2. A hot gas engine comprising a first cylinder wall forming hot and cold spaces therein, means without said cylinder connecting said hot and cold spaces, said means including a regenerator and a cooler, said regenerator comprising a filler material having a hot end surface and a cold end surface, said cooler being located adjacent said cold end surface, a second cylindrical wall surrounding said regenerator, extending past said cold end surface at least a distance 0.3 times the height of said filler material and surrounding part of the cooler, the end of that part of the wall surrounding said cooler being secured to said first cylindrical wall and that part of said wall surrounding said cooler being slightly spaced therefrom to form a clearance therebetween to reduce the leakage of heat from said wall to the cooler.

3. A hot gas engine comprising a first cylinder wall forming hot and cold spaces therein, means without said cylinder connecting said hot and cold spaces, said means including a regenerator and a cooler, said regenerator comprising a filler material having a hot end surface and a cold end surface, said cooler being located adjacent said cold end surface, a second cylindrical wall surrounding said regenerator having an inner conical surface, said second wall extending past said cold end surface and surrounding part of the cooler, the end of that part of the wall surrounding said cooler being secured to said first cylindrical wall and that part of said wall surrounding said cooler being slightly spaced therefrom to form a clearance therebetween to reduce the leakage of heat from said wall to the cooler.

4. A hot gas engine comprising a first cylinder wall forming hot and cold spaces therein, means without said cylinder connecting said hot and cold spaces, said means including a regenerator and a cooler, said regenerator comprising a filler material having a hot end surface and a cold end surface, said cooler being located adjacent said cold end surface, a second cylindrical wall surrounding said regenerator having a gradually diminishing thickness from its hottest to its coldest part, said second wall extending past said cold end surface and surrounding part of the cooler, the end of that part of the wall surrounding said cooler being secured to said first cylindrical wall and that part of said wall surrounding said cooler being slightly spaced therefrom to form a clearance therebetween to reduce the leakage of heat from said wall to the cooler.

5. A hot gas engine comprising a first cylinder wall forming hot and cold spaces therein, means without said cylinder connecting said hot and cold spaces, said means including a regenerator and a cooler, said regenerator comprising a filler material having a hot end surface and a cold end surface, said cooler being located adjacent said cold end surface, a second cylindrical wall surrounding said regenerator, extending past said cold end surface and surrounding part of the cooler, said second cylindrical wall having an integral portion at each end thereof substantially at right angles to said second cylindrical wall, the end of that part of the wall surround-

ing said cooler being secured to said first cylindrical wall and that part of said wall surrounding said cooler being slightly spaced therefrom to form a clearance therebetween to reduce the leakage of heat from said wall to the cooler, and said integral portions of said second cylindrical wall being provided with slots therein at the point of merger of said second cylindrical wall and said integral portions thereof.

FRANCISCUS LAMBERTUS VAN WEENEN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
389,045	Bair	Sept. 4, 1888
650,576	Wickstrom	May 29, 1900

FOREIGN PATENTS

Number	Country	Date
5,636	Great Britain	Dec. 4, 1883
146,620	Great Britain	July 12, 1920