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FIG 5E2



(54) IMPROVEMENTS IN COMBUSTION CHAMBERS

(71) We, STATE OF FRANCE represented by the MINISTER OF STATE FOR NATIONAL DEFENCE, MINISTERIAL DELEGATION FOR ARMEMENT, TECHNICAL DIRECTOR OF TERRESTRIAL ARMAMENTS, CONSTRUCTION PLANT OF ISSY-LES-MOULINEAUX, a French Government Organization, residing at Caserne Sully, 92-Saint Cloud, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to combustion chambers supplied, on one hand, by fuel, and, on the other hand, both by gas rich in oxygen intended for ensuring the combustion and by a gas poor in oxygen intended to be mixed with the gases resulting from the combustion.

The invention relates more particularly, but not exclusively, among these combustion chambers, to those applied to the reheating of exhaust gases (gases poor in oxygen) from an internal combustion engine supercharged by a turbocompressor unit, of which the compressor supplies in parallel to said internal combustion engine and the combustion chamber (gas rich in oxygen).

In a combustion chamber of the type mentioned above, there is risk of producing instabilities during the combustion, even an arrest of combustion, when the ratio between the flow rate of oxygen-poor gas and the flow rate of oxygen-rich gas varies.

It is an object of the invention to overcome this drawback and to obtain a combustion chamber in which the combustion is stable and independent of the ratio between the oxygen-poor gas flow rate and the oxygen-rich gas flow rate, it being understood that the latter remains sufficient to ensure a stoichiometric mixture or substantially stoichiometric.

The combustion chamber according to the invention, includes a burner tube of which the closed end bears at least one fuel

injector and of which burner tube the open end opens into a pipe leading the gaseous mixture towards its position of use, this burner tube including orifices distributed circumferentially in axially spaced groups, and it is characterised by the fact that an outer enclosure is arranged around the burner tube and is connected in sealed manner to the open end of the said burner tube, said outer enclosure being supplied, on one hand, with gas rich in oxygen, by first means, in the neighborhood of said fuel injector, and, on the other hand, with gas poor in oxygen, by second means, more remote from said fuel injector.

It will then be seen that the ratio between the flow rate of the oxygen-rich gas and the flow rate of the oxygen-poor gas can vary without the organisation of the combustion in the burner tube being disturbed, since there is produced in fact in the space bounded by the outer enclosure and the burner tube a zone of separation between the oxygen-rich gas and the oxygen-poor gas, this zone of separation moving when the above-said ratio varies.

The invention consists, apart from the main feature which has just been considered, of certain other features which are preferably used at the same time and which will be more explicitly considered below.

In order that the invention may be more fully understood, several preferred embodiments of combustion chambers according to the invention are described below purely by way of illustrative but non-limiting examples, with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic section of a combustion chamber constructed according to the invention;

Figure 2 is a diagrammatic section of a second embodiment of a combustion chamber constructed according to the invention;

Figure 3 shows diagrammatically a supercharged Diesel engine equipped with a com-

bustion chamber according to a first embodiment of the invention;

Figure 4 shows diagrammatically a supercharged Diesel engine equipped with a combustion chamber according to a second embodiment of the invention.

The combustion chamber shown in Figures 1 and 2 includes a burner tube 1 whose closed end 2 bears a fuel injector 3, and whose open end 4 opens into a pipe leading the gaseous mixture towards its position of use.

In the case, shown in Figures 3 and 4, where this combustion chamber is applied to the reheating of the exhaust gases from a Diesel engine 5 supercharged by a turbo-compressor group 6, the open end 4 of the burner tube 1 opens directly into the distributor of the turbine 6a of the said turbo-compressor group.

The burner tube 1 includes a certain number of orifices 7 distributed circumferentially and along sections staggered axially.

An outer enclosure 8 is arranged around the burner tube 1 and is connected in a sealed manner to the open end 4 of the said burner tube 1.

A first pipe 9 (constituting the first means) supplies, with air emerging from the compressor 6b of the turbo-compressor 6, the portion of this enclosure 8 situated in the vicinity of the fuel injector 3, i.e. near the closed end 2 of the burner tube 1.

A second pipe 10 (constituting the second means) supplies, with exhaust gases emerging from the Diesel engine 5, the portion of this enclosure 8 situated more remote from the fuel injector 3, i.e. in the neighborhood of the open end 4 of the burner tube 1.

Although the outer enclosure 8 can surround the burner tube 1 in the region of its closed end 2, it seems preferable to arrange this outer enclosure 8 so that it is connected in sealed manner on the burner tube 1 at the level of its closed end 2.

In the embodiments illustrated in Figures 1 and 2, the first pipe 9 is connected to the outer enclosure 8 through a distributing tank 11.

As for the second pipe 10, and according to the embodiment illustrated in Figure 1, it is connected to the outer enclosure 8 through a distributing tank 12.

However this second pipe can also, according to the embodiment illustrated in Figure 2, be connected to an annular enclosure 13 through a distributing tank 14; this annular enclosure 13 surrounding the outer enclosure 8 at the portion of its wall neighboring the open end 4 of the burner tube 1, orifices 15, distributed circumferentially and along sections staggered axially, being arranged in the wall of the outer enclosure 8 to ensure the passage of gases from the annular enclosure 13 to the outer enclosure 8. This arrange-

ment enables a better distribution of the exhaust gases in the outer enclosure 8 to be obtained.

As regards the burner tube 1, it is provided, between its combustion zone 1a and its mixing zone 1b, with axial slits 16 through which air cools the walls of the mixing zone 1b.

In the embodiment illustrated in Figure 4, the first pipe 9 is coaxially disposed with the burner tube 1 and surrounds its closed end 2. The second pipe 10 is also coaxially disposed with the burner tube 1 and surrounds the first pipe 9, the effective cross-section of said second pipe being annular.

Finally, the combustion chamber constructed according to the invention is the seat of a combustion which is stable and independent of the ratio between the flow rate of combustion gas and the flow rate of air, which ratio is essentially variable in the case of a supercharged Diesel engine.

It is hence possible to calculate the flow rate of the compressor of the supercharging unit solely as a function of the Diesel engine and of the conditions of stoichiometric combustion in the combustion chamber. On the other hand, the use of a conventional combustion chamber would lead to calculating the flow rate of the compressor with a wide safety margin to ensure the combustion and, for this reason, would have increased the size, hence the price, of the supercharging unit.

WHAT WE CLAIM IS:—

1. Combustion chamber comprising a burner tube of which the closed end bears at least one fuel injector and of which burner tube the open end opens into a pipe leading the gaseous mixture towards its position of use, this burner tube including orifices distributed circumferentially in axially spaced groups, characterised by the fact that an outer enclosure is arranged around the burner tube and is connected in a sealed manner to the open end of the said burner tube, said outer enclosure being supplied, on one hand, with gas rich in oxygen, by first means, in the neighborhood of said fuel injector, and, on the other hand, with gas poor in oxygen, by second means, more remote from said fuel injector.

2. Combustion chamber according to claim 1, wherein the outer enclosure is connected in sealed manner onto the burner tube adjacent its closed end.

3. Combustion chamber according to claim 1 or 2, wherein said first means comprises a first pipe connected to the outer enclosure through a distributing tank.

4. Combustion chamber according to claim 1, 2 or 3, wherein said second means comprises a second pipe connected to the outer enclosure through a distributing tank.



bustion chamber according to a first embodiment of the invention;

5 Figure 4 shows diagrammatically a supercharged Diesel engine equipped with a combustion chamber according to a second embodiment of the invention.

10 The combustion chamber shown in Figures 1 and 2 includes a burner tube 1 whose closed end 2 bears a fuel injector 3, and whose open end 4 opens into a pipe leading the gaseous mixture towards its position of use.

15 In the case, shown in Figures 3 and 4, where this combustion chamber is applied to the reheating of the exhaust gases from a Diesel engine 5 supercharged by a turbo-compressor group 6, the open end 4 of the burner tube 1 opens directly into the distributor of the turbine 6a of the said turbo-compressor group.

20 The burner tube 1 includes a certain number of orifices 7 distributed circumferentially and along sections staggered axially.

25 An outer enclosure 8 is arranged around the burner tube 1 and is connected in a sealed manner to the open end 4 of the said burner tube 1.

30 A first pipe 9 (constituting the first means) supplies, with air emerging from the compressor 6b of the turbo-compressor 6, the portion of this enclosure 8 situated in the vicinity of the fuel injector 3, i.e. near the closed end 2 of the burner tube 1.

35 A second pipe 10 (constituting the second means) supplies, with exhaust gases emerging from the Diesel engine 5, the portion of this enclosure 8 situated more remote from the fuel injector 3, i.e. in the neighborhood of the open end 4 of the burner tube 1.

40 Although the outer enclosure 8 can surround the burner tube 1 in the region of its closed end 2, it seems preferable to arrange this outer enclosure 8 so that it is connected in sealed manner on the burner tube 1 at the level of its closed end 2.

45 In the embodiments illustrated in Figures 1 and 2, the first pipe 9 is connected to the outer enclosure 8 through a distributing tank 11.

50 As for the second pipe 10, and according to the embodiment illustrated in Figure 1, it is connected to the outer enclosure 8 through a distributing tank 12.

55 However this second pipe can also, according to the embodiment illustrated in Figure 2, be connected to an annular enclosure 13 through a distributing tank 14, this annular enclosure 13 surrounding the outer enclosure 8 at the portion of its wall neighboring the open end 4 of the burner tube 1, orifices 15, distributed circumferentially and along sections staggered axially, being arranged in the wall of the outer enclosure 8 to ensure the passage of gases from the annular enclosure 13 to the outer enclosure 8. This arrange-

ment enables a better distribution of the exhaust gases in the outer enclosure 8 to be obtained.

70 As regards the burner tube 1, it is provided, between its combustion zone 1a and its mixing zone 1b, with axial slits 16 through which air cools the walls of the mixing zone 1b.

75 In the embodiment illustrated in Figure 4, the first pipe 9 is coaxially disposed with the burner tube 1 and surrounds its closed end 2. The second pipe 10 is also coaxially disposed with the burner tube 1 and surrounds the first pipe 9, the effective cross-section of said second pipe being annular.

80 Finally, the combustion chamber constructed according to the invention is the seat of a combustion which is stable and independent of the ratio between the flow rate of combustion gas and the flow rate of air, which ratio is essentially variable in the case of a supercharged Diesel engine.

85 It is hence possible to calculate the flow rate of the compressor of the supercharging unit solely as a function of the Diesel engine and of the conditions of stoichiometric combustion in the combustion chamber. On the other hand, the use of a conventional combustion chamber would lead to calculating the flow rate of the compressor with a wide safety margin to ensure the combustion and, for this reason, would have increased the size, hence the price, of the supercharging unit.

WHAT WE CLAIM IS:—

100 1. Combustion chamber comprising a burner tube of which the closed end bears at least one fuel injector and of which burner tube the open end opens into a pipe leading the gaseous mixture towards its position of use, this burner tube including orifices distributed circumferentially in axially spaced groups, characterised by the fact that an outer enclosure is arranged around the burner tube and is connected in a sealed manner to the open end of the said burner tube, said outer enclosure being supplied, on one hand, with gas rich in oxygen, by first means, in the neighborhood of said fuel injector, and, on the other hand, with gas poor in oxygen, by second means, more remote from said fuel injector.

115 2. Combustion chamber according to claim 1, wherein the outer enclosure is connected in sealed manner onto the burner tube adjacent its closed end.

120 3. Combustion chamber according to claim 1 or 2, wherein said first means comprises a first pipe connected to the outer enclosure through a distributing tank.

125 4. Combustion chamber according to claim 1, 2 or 3, wherein said second means comprises a second pipe connected to the outer enclosure through a distributing tank.



5. Combustion chamber according to claim 1, 2 or 3, wherein the second means comprises a second pipe connected to an annular enclosure through a distributing tank, this annular enclosure surrounding the outer enclosure at the level of its part neighboring the open end of the burner tube, orifices distributed circumferentially in axially spaced groups being arranged in the walls of the outer enclosure to ensure the passage of the gases from the annular enclosure to the outer enclosure. 25
6. Combustion chamber according to claim 1, wherein said first means comprises a first pipe coaxially disposed with the burner tube and surrounding its closed end, and said second means comprises a second pipe coaxially disposed with the burner tube and surrounding said first pipe. 30
7. Combustion chamber according to any one of claims 1 to 6, wherein the burner tube includes a combustion zone towards its closed end and a mixing zone towards its open end, axial slits being provided between the said combustion zone and the said mixing zone. 35
8. Combustion chamber substantially as hereinbefore described with reference to the accompanying drawings.
9. Internal combustion engine supercharged by a turbo-compressor unit whose compressor supplies in parallel the internal combustion engine and a combustion chamber constructed according to any preceding claim, for reheating the exhaust gases from said engine. 35

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