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(71) **Applicant** *(for all designated States except US)*: **ROLLS-ROYCE MARINE AS ENGINES- BERGEN** [NO/NO]; PB 924 Sentrum, N-5808 Bergen (NO).

(72) **Inventor; and**
(75) **Inventor/Applicant** *(for US only):* **VALDE, Kurt** [NO/NO]; Vestbygdvegen 248, N-59 19 Frekhaug (NO).

(74) **Agent: ACAPO AS;** P.O. Box 1880 Nordnes, N-5817 Bergen (NO).

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(54) Title: GAS SUPPLY SYSTEM FOR A GAS ENGINE

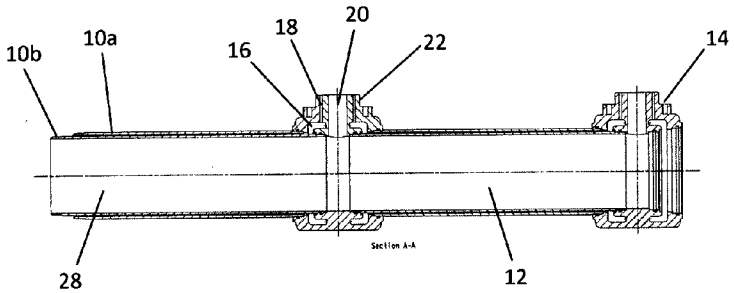

Fig. 3

(57) Abstract: A gas supply system for a gas engine is described, comprising a double-walled pipe (10) with an inner and an outer pipe (10a, 10b) for the supply of fuel gas to the cylinder units of the engine, where said double wall provides an outer, longitudinally running annular space along the whole length of the pipe (10) and where the fuel gas is transported in the inner pipe (10b). The double- walled pipe (10) along the engine is divided into sections (12) between respective cylinders, where a coupling piece (14) is arranged between said sections (12) to link the sections, and the coupling piece (14) is internally open and comprises one or more channels (16) to link the longitudinally running annular space between respective sections (12) and a boring (20) to take out the fuel gas from the inner pipe (10b) and through an outlet (22) to a respective cylinder unit.

Gas supply system for a gas engine.

The present invention relates to a gas supply system for a gas engine, comprising a double-walled pipe with an inner and an outer pipe for the supply of fuel gas to the cylinder units of the engine, where said double wall provides an outer, longitudinally running annular space along the whole length of the pipe and where the fuel gas is transported in the inner pipe.

A gas engine has normally a relatively large pipe for fuel gas along the engine (for V-type engines two pipes are used) . From this pipe a smaller pipe, possibly flexible, runs into each cylinder unit. In addition, there is normally a pipe along the engine for the pre-chamber gas (for V-type engines two pipes are used) . A smaller pipe also runs from this pipe into each cylinder unit. On engines supplied to power production on land these pipes are produced by welding and soldering.

A new market for the gas engine industry over the last years is ships with gas as fuel. This is a new market due to the regulations for release of exhausts, changes in charges and the building of an infrastructure for the filling of gas. When one places a gas engine in a ship it will be subjected to the regulations related to company classification and from the authorities. One of these requirements is that all gas pipes shall be double-walled, where the inner wall is used to carry gas to the engine and the outer pipe is used to detect any leaks from the inner pipe. This can possibly be carried out by a through-flow of air with a gas sensor in the system or a pressurised inert gas system. The space between the inner and the outer pipes must be the same along the whole

length of the main pipe and out to every run to the cylinders. This is the case for the main gas and the pre-chamber gas.

The natural way to make these double-walled pipes is by welding. This is very difficult, time consuming and expensive. The welds on the inner pipe are the most important and these must also be controlled thoroughly. To get the pipe welded and controlled is difficult. In addition the pipes must be held in position toward the brackets on the engine block. These must be solid, machined constructions to be able to withstand the vibrations from the engine in the block and gas pipe. Because of this the brackets are expensive.

A fuel supply system is known from US 4,149,568 A for an engine with a double-walled pipe with an inner and an outer pipe for the supply of fuel to the cylinder units of the engine. The double wall shown in the patent document provides an outer, longitudinally running annular space along the whole length of the pipe and where the fuel is transported in the inner pipe.

Furthermore, reference is made to GB 2281111A, US 5,927,762 A and US 5,401,064 A where all the documents show double-walled pipes that are divided into sections, and that between said sections a coupling piece is placed to join the sections. Furthermore it is described in the documents that the coupling piece is internally open and comprises one or more channels to connect the longitudinally running annular spaces between respective sections, and a boring to bring out the fuel or gas from the inner pipe and through an outlet.

Consequently it is an object of the present invention to provide a safe gas supply system for a gas engine, and which gives a simple and less labour demanding solution for the production, fitting and dismantling of pipes.

Said objects are reached with the system given in the independent claim 1, in that the double-walled pipe along the gas engine is divided into sections between respective cylinders where a coupling piece is inserted between said sections to add on to the sections, and that the coupling piece is open internally and comprises one or more channels to connect the longitudinally running annular space between respective sections and a boring to bring out the fuel gas from the inner pipe and through an outlet of the respective cylinder units.

Alternative embodiments are given in the dependent claims.

A channel in the outlet can be connected to the channel that links the longitudinally running annular space and be formed as a through-going annular space from one or more borings .

The channel can be shaped as an annular space or borings that run through the coupling piece, and the mouth of the channel can comprise one or more gaskets that lie against the outer pipe and one or more gaskets that lie against the inner pipe.

Said annular space can be braced by one or more support points .

The boring for taking out the fuel gas in the inner pipe can run through one of said support points and through the outlet .

In a further variant of the invention the coupling piece on one or both sides can be fitted with a removable coupling flange for connecting and disconnecting a pipe section. The coupling flange can comprise one or more channels to link the longitudinally running annular space between respective sections. Furthermore, the coupling flange can comprise one or more channels that are connected with the channel of the coupling piece.

Correspondingly, the mouth of the channel can comprise one or more gaskets that lie against the outer pipe and one or more gaskets that lie against the inner pipe.

In a further variant of the invention a pipe for the supply of a pre-chamber gas to the cylinder units of the engine can be arranged inside the inner pipe. Gas from the pipe can flow through a boring in an outlet in the coupling piece and to the cylinder unit of the engine.

Furthermore, an annular space channel or boring in the outlet can be connected to the first channel.

The coupling piece can comprise an internally open protrusion to which the pipe for the pre-chamber gas is arranged in. The pipe can be divided into sections that, in the main, correspond to said sections between the cylinder units, and the protrusion can comprise gaskets to receive respective sections.

For all variants the inner pipe at the end of a section can extend further out than the outer pipe, whereby the outwardly extending end of the inner pipe is set up to close between the channel in the coupling piece and the internal run for the fuel gas. Furthermore, the coupling

piece can be cast in one piece, and comprise a fastening bracket for the pipes.

The invention shall now be described in more detail with the help of the enclosed figures, in which:

Figures 1 and 2 show an outline of several pipe sections composed of coupling pieces according to the invention .

Figure 3 shows a section along A-A in figure 1.

Figures 4 and 5 show a section along B-B and C-C, respectively, in figure 3.

Figure 6 shows a section along D-D in figure 5.

Figure 7 shows a section of an alternative coupling flange for the coupling piece according to the invention.

Figure 8 shows a section along A-A in figure 7.

Figures 9 and 10 show an outline of several pipe sections composed of coupling pieces according to a further variant of the invention.

Figure 11 shows a section along A-A in figure 9.

Figures 12 and 13 show a section along B-B and C-C, respectively, in figure 10.

Figure 14 shows a section along D-D in figure 13.

Figure 15 shows a section along E-E in figure 10.

A gas engine is regarded to be known to a person skilled in the arts and is therefore not explained further in the application. Essential aspects and technical features in connection with the present invention of a gas engine are explained in more detail below. Furthermore, it shall be mentioned that although the expression gas engine is used, this does not necessarily mean that the present gas supply system is only directed towards a free standing gas engine but can also be used on an engine set up to be both gas driven and be driven by other fuel types, i.e. a so called

dual fuel engine, as the gas supply system will be alike, regardless .

As the figures 1-3 show, the present gas supply system comprises several sections 12 of double-walled pipes 10, where the sections are linked together with the help of respective coupling pieces 14. The double-walled pipe 10 comprises an internally open pipe 10b with an internal boring 28 for the fuel gas that is to be supplied to the cylinder units of the engine. An outer pipe 10a is arranged around the inner pipe 10b so that it forms a longitudinally running annular space. As mentioned previously, the annular space is used to detect any leaks from the inner pipe, for example, by a through-flow of air with a gas sensor in the system, or a pressurised inert gas system.

From prior art the pipe for the supply of fuel gas typically runs a whole length of the engine block and is fastened with several brackets, normally adjoining the protrusions of the cylinder units. In the present invention the double-walled pipe 10 is divided in sections 12 and joined with the help of several coupling pieces 14. The length of each section 12 is adapted to the distance between the cylinder units and the breadth of the coupling piece. The advantage with the present invention is that one avoids the use of welding as the pipe sections will be simple pieces of pipe with no welds. Furthermore, the coupling piece can be cast in one body and formed so that the annular space between the inner and the outer pipe is carried through to the next section. Another advantage is that the coupling piece can also be used as a fastening bracket for the double-walled pipe 10. An example of a fastening bracket 50 is shown in figure 2 .

The coupling piece 14 shall now be explained in more detail with reference to the figures 3-6, which show different sections of the coupling piece 14. The coupling piece 14 is open internally and comprises a boring 20 to lead the fuel gas from the inner pipe 10b and out through an outlet 22. The gas is then led further through additional double-walled pipes (not shown) and to the cylinder unit. To bring the annular space further between the outer pipe 10a and the inner pipe 10b the coupling piece 14 is comprised of at least one channel 16 that runs through the coupling piece. The channel 16 is preferably made with an angular space form, but can also be formed in other alternative ways. As the figures show, the coupling piece 14 comprises several support points 26 to strengthen the channel 16 in relation to the inner boring 28. The boring 20 to lead out fuel gas preferably runs through one of these support points 26.

As there is a requirement that the annular space in the double-walled pipe 10 shall also be brought further to the cylinder units the outlet 22 can comprise an annular space-formed channel 18 or one or more borings that run to the through-going channel 16 between the sections 12. The channels 18 can, for example, be four borings in the coupling piece 14. Thus, the annular space-formed channel 18 at the outlet can be brought further through the additional double-walled pipe (not shown) and to the cylinder unit.

The inner pipe 10b in the section 12 is preferably longer than the outer pipe 10a. In the fitting of a section 12 in the coupling piece 14 the section is inserted so that the inner pipe 10b ends up at an inner recess, in which one or more gaskets 24 are placed to seal against the pipe 10b. The inner recess and the gaskets 24 lie inside a mouth

opening of the channel 16 so that the outer side of the inner pipe 10b closes between the channel 16 and the inner boring 28 for the fuel gas.

Outside the mouth opening of the channel 16 a corresponding recess and one or more gaskets 24 are provided to seal against the outer pipe 10a. The mouth opening of the channel 16 can be curved such as the figures 3 and 6 show, or alternatively not be curved, and thereby connect the annular space in the double-walled pipe 10 to the preferably annular space-formed channel 16 in the coupling piece 14 and further to the next section 12.

The gaskets 24 that can be used are, in the main, standard gaskets and are not explained in more detail.

With the use of the sections 12 and the coupling pieces 14 according to the invention a solution is provided that makes it possible to dismantle the double-walled pipe 10 such that a section 12 can be replaced in case of faults. However, it can be difficult to replace one section at a time, other than the end sections, as the sections lie against each other and are inserted into the coupling pieces. One solution to this problem is the use of a removable coupling flange. The figures 7 and 8 show a coupling flange 30 according to the invention. The flange 30 can be fitted to the coupling piece 14 on one or both sides, but normally it is sufficient with a flange on one side.

As the figures show the flange 30 is internally open and comprises an outer annular space-formed channel 16a which corresponds to, and is connected to, the channel 16 in the coupling piece 14. The mouth opening of the channel 16a

and the gaskets are correspondingly formed to the description above so that the fastening of a section 12 is carried out in the same way. The flange 30 can be fitted to the coupling piece 14 in a known way with the help of bolts 32 that are screwed in, or fastened in any other known way. Gaskets can be arranged between the flange 30 and the coupling piece 14. It can also be considered as an alternative to use two flanges for the coupling together of sections 12, and two flanges put together can then replace one coupling flange and provide the same form and function .

As mentioned previously, a gas engine normally has, in addition to the pipe 10 for the fuel gas, a pipe along the engine for the pre-chamber gas. This pre-chamber gas pipe has the same requirements for a double wall and also runs to the cylinder units of the engine. A further variant of the invention is shown in the figures 9 to 15 and shows a solution where a pre-chamber gas pipe 40 is placed inside the double-walled pipe 10 for the fuel gas, such as shown in figure 11. With this solution there will be no requirement that the pre-chamber gas pipe shall have a double wall, as the double-walled pipe 10 for fuel gas will take care of this.

The pre-chamber gas pipe 40 is correspondingly divided into sections as described above and is fitted, in the main, in the same way. For that reason the coupling piece 14 is fitted with an internally open protrusion or bead 44 which the sections of the pre-chamber gas pipe 40 are fitted to. In a similar way the protrusion 44 can comprise gaskets .

To distribute the pre-chamber gas to the cylinder units the coupling piece 14 comprises a second outlet 42, and as

in the embodiment shown, is mounted 90° displaced in relation to the first outlet 22 for the fuel gas. A boring 48 for the pre-chamber gas runs from the protrusion 44, and the pre-chamber gas pipe 40, and out through the outlet 42. Correspondingly, the boring 48 can run through one of the support points 26.

As mentioned, it is a requirement that the annular space shall also be carried further to the cylinder units, and the second outlet 42 can therefore comprise an annular space-formed channel 46 or one or more borings that run to the through-going channel 16 between the sections 12. Thus, the annular space-formed channel 46 in the outlet 42 can run further through an additional double-walled pipe (not shown) and to the cylinder units.

C L A I M S

1. Gas supply system for a gas engine, comprising a double-walled pipe (10) with an inner and an outer pipe (10a, 10b) for supply of fuel gas to the cylinder units of the engine, where said double wall provides an outer, longitudinal annular space along the whole of the length of the pipe (10) and where the fuel gas is transported in the inner pipe (10b),
c h a r a c t e r i s e d i n
- that the double-walled pipe (10) along the gas engine is divided into sections (12) between respective cylinders,
- that a coupling piece (14) is arranged between said sections (12) to connect the sections, and
- that the coupling piece (14) is open internally and comprises one or more channels (16) to connect the longitudinal annular space between respective sections (12), and a boring (20) to exit the fuel gas from the inner pipe (10b) and through an outlet (22) to respective cylinder units.

2. System according to claim 1,
c h a r a c t e r i s e d i n that a channel (18) in the outlet (22) is connected with the channel (16) that links the longitudinal annular space in the coupling piece.

3. System according to claim 1,
c h a r a c t e r i s e d i n that the mouth of the channel (16) comprises one or more gaskets (24) that lie against the outer pipe (10a) and one or more gaskets (24) that lie against the inner pipe (10b)

4. System according to claim 1, characterised in that the channel (16) is, in the main, formed as an annular space that runs through the coupling piece (14).

5. System according to claim 2, characterised in that the channel (18) in the outlet (22) is formed as a through-running annular space or one or more borings.

6. System according to claim 4 or 5, characterised in that said annular space is braced by one or more support points (26)

7. System according to claim 6, characterised in that the boring (20) for exiting the fuel gas in the inner pipe (10b) runs through one of said support points (26) and through the outlet (22).

8. System according to claim 1, characterised in that the coupling piece (14) is equipped at one or both sides with a removable coupling flange (30) for the connection and disconnection of a pipe section (12).

9. System according to claim 8, characterised in that the coupling flange (30) comprises one or more channels (16a) to connect the longitudinal annular space between respective sections (12).

10. System according to claim 8, characterised in that the coupling flange (30) comprises one or more channels (16a) that are linked to the channel (16) of the coupling piece.

11. System according to claim 9 or 10, characterised in that the mouth of the channel (16a) comprises one or more gaskets (24) that lie against the outer pipe (10a) and one or more gaskets (24) that lie against the inner pipe (10b).

12. System according to claim 1, characterised in that a pipe (40) for the supply of pre-chamber gas to the cylinders of the engine is placed internally in the inner pipe (10b).

13. System according to claim 12, characterised in that gas from the pipe (40) flows through a boring (48) in an outlet (42) in the coupling piece (14) and to the cylinder unit of the engine.

14. System according to claim 13, characterised in that an annular shaped channel (46) or one or more borings in the outlet (42) are connected with the first channel (16).

15. System according to claim 12, characterised in that the coupling piece (14) comprises an internally open protrusion (44) which the pipe (40) for the pre-chamber gas is placed in.

16. System according to claim 15, characterised in that the pipe (40) is divided into sections which, in the main, correspond to said sections (12) between the cylinder units, and that

the protrusion (44) comprises gaskets to receive the respective sections.

17. System according to one or more of the preceding claims, c h a r a c t e r i s e d i n that the internal pipe (10b) extends further out than the outer pipe (10a) at the end of a section (12), whereby the outwardly extending end of the inner pipe is arranged to close between the channel (16, 16a) in the coupling piece and the internal boring (28) for the fuel gas.

18. System according to one or more of the preceding claims, c h a r a c t e r i s e d i n that the coupling piece (14) is cast in one piece and comprises a fastening bracket (50) for the pipes.

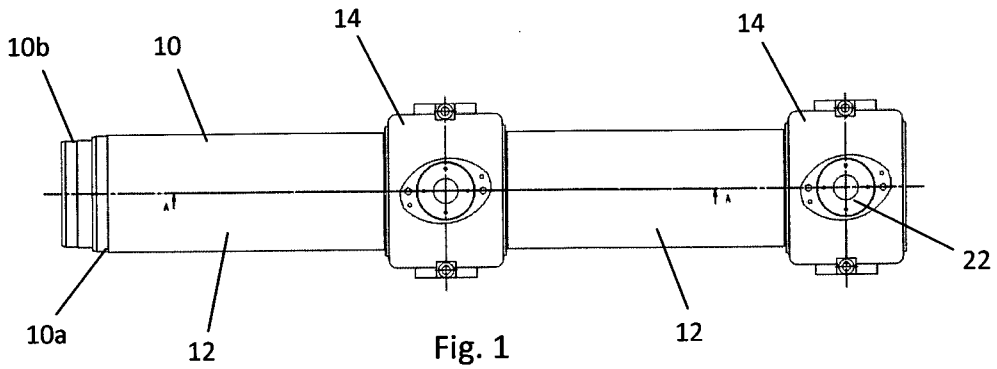

Fig. 1

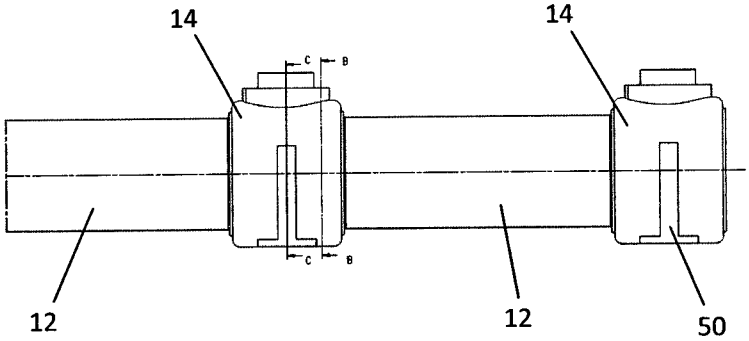

Fig. 2

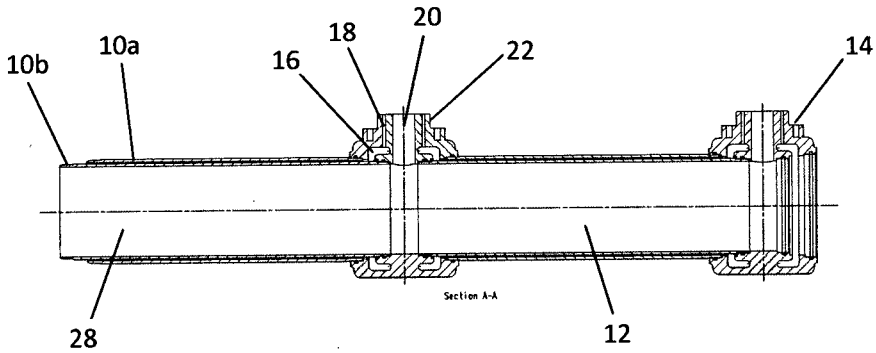

Fig. 3

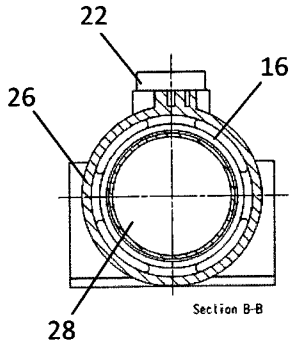

Fig. 4

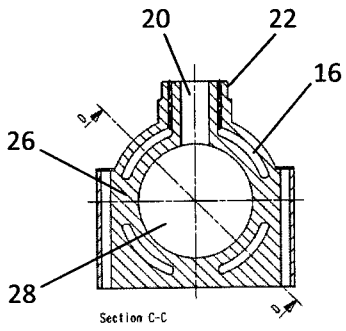

Fig. 5

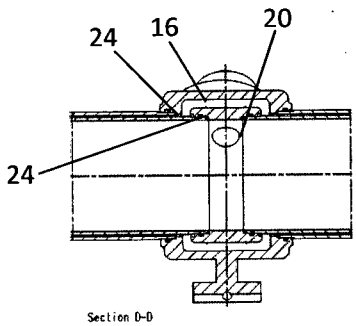

Fig. 6

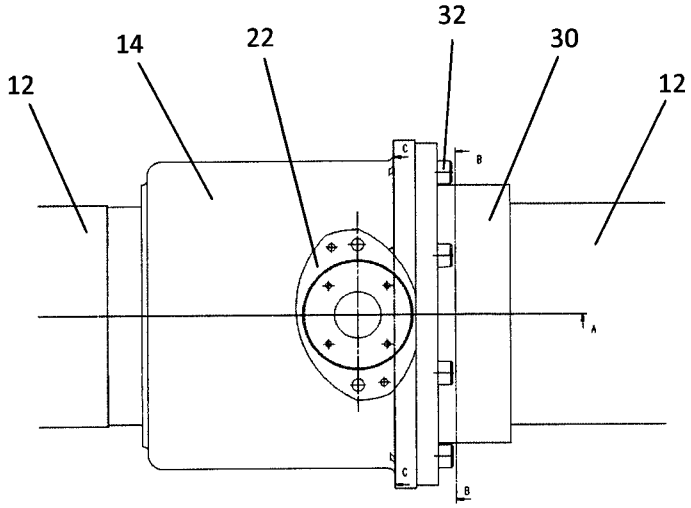

Fig. 7

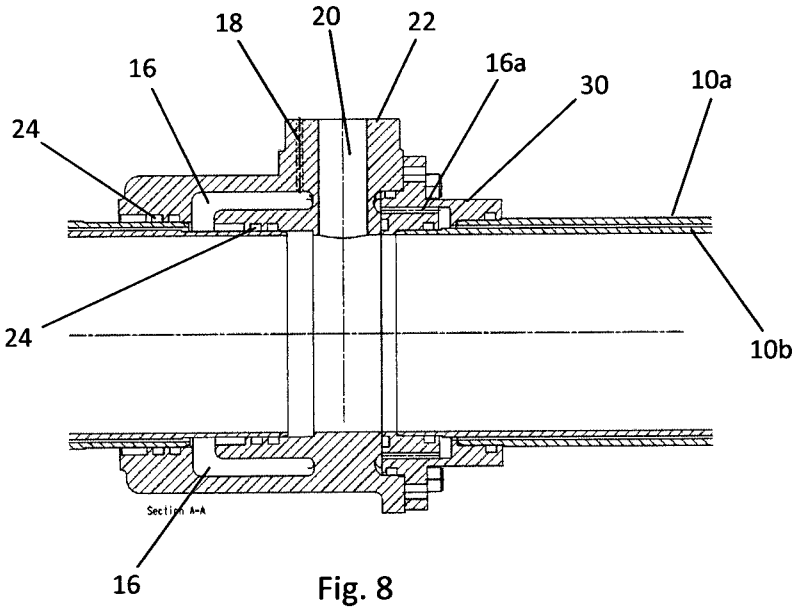

Fig. 8

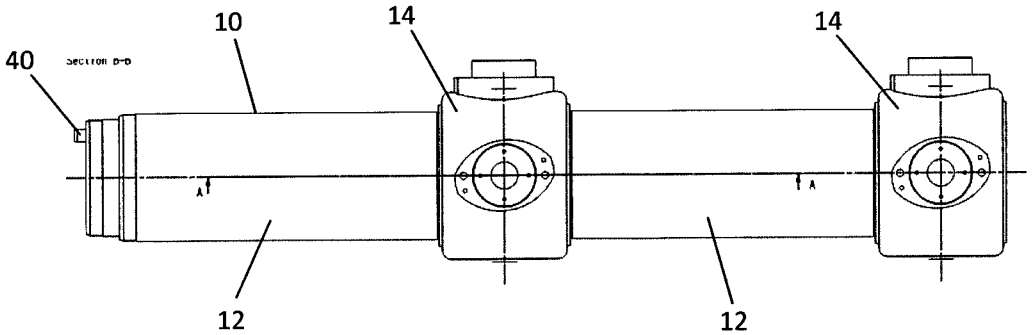

Fig. 9

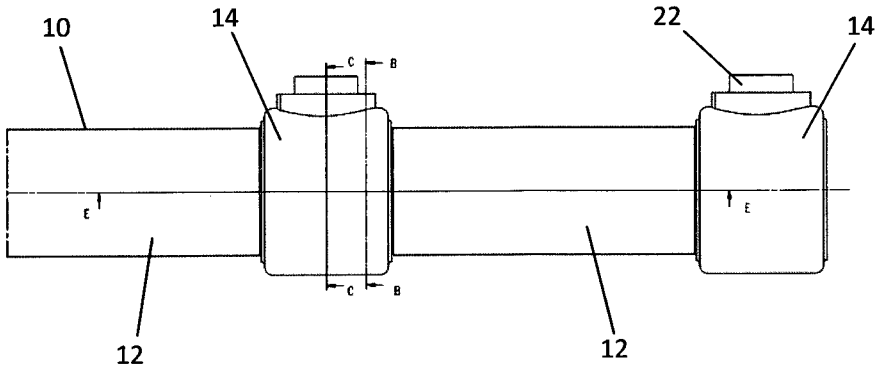

Fig. 10

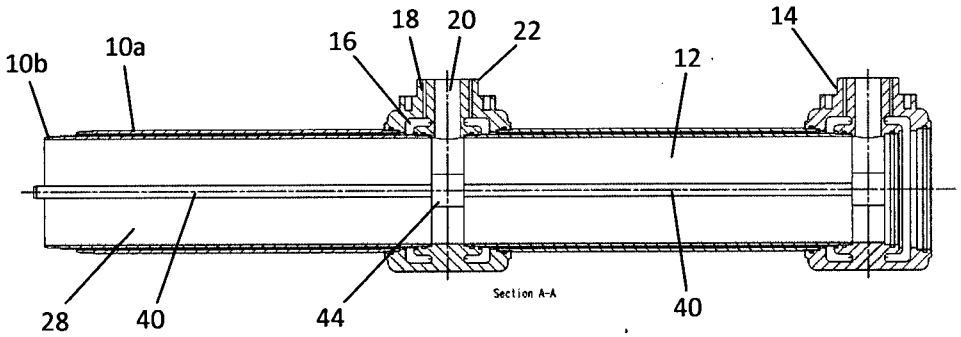

Fig. 11

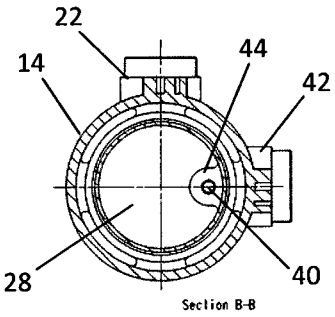

Fig. 12

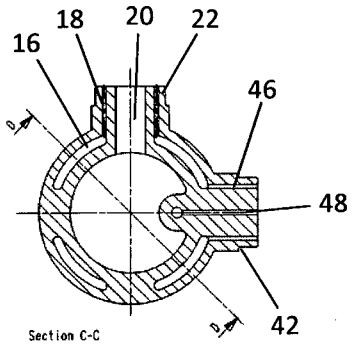

Fig. 13

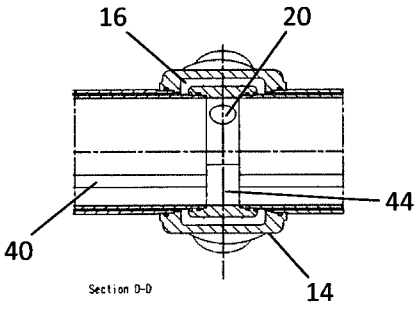

Fig. 14

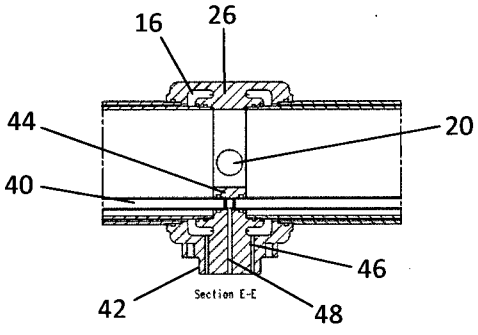

Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO201 1/00031 8

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F02M, F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20040200457 A1 (GOTTEMOLLER PAUL ET AL), 14 October 2004 (2004-10-14); abstract; paragraphs [0012]-[0015]; figure 1 --	1-7, 17, 18
Y	US 7415968 B1 (MATAS SCOTT E ET AL), 26 August 2008 (2008-08-26); abstract; figures 3-4 --	1-7, 17, 18
Y	US 4913119 A (USUI MASAYOSHI), 3 April 1990 (1990-04-03); abstract; column 1, line 50 - line 68; column 4, line 33 - line 45; figures --	1-7, 17, 18

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international fding date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17-02-2012	05-03-2012

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Marianne Dickman Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO201 1/00031 8

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. Ill Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1: Claims 8-1 1 directed to a gas supply system according to claim 1 with a coupling piece including a removable coupling flange. The problem to be solved by this solution is to achieve a possibility to connect and disconnect a pipe section.

2: Claims 12-1 6 directed to a gas supply system according to claim 1 with a further pipe placed internally in the inner pipe for the supply of pre-chamber gas to the cylinders of the engine. The problem to be solved by this solution is that the pre-chamber gas pipe, also having the requirements for a double wall, does not need any double pipe per se, as the double-walled pipe for fuel gas takes care of that.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO201 1/00031 8

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2004090405 A1 (JUHÁSZ LÁSZLÓ), 21 October 2004 (2004-10-21); abstract; paragraphs [0021], [0024]; figure 3 --	1-7, 17, 18
A	US 20040207197 A1 (HOANG STEVE ET AL), 21 October 2004 (2004-10-21); abstract; figure 7 --	1-18
A	US 1389768 A (MCFARLAND OWEN D), 6 September 1921 (1921-09-06); figures --	1-18
A	US 4149568 A (KUNTZ DONALD A ET AL), 17 April 1979 (1979-04-17); abstract; figures --	1-18
A	US 5401064 A (GUEST JOHN D), 28 March 1995 (1995-03-28); abstract; figures --	1-18

Continuation of: second sheet

International Patent Classification (IPC)

F02M 55/02 (2006.01)
F02M 21/02 (2006.01)
F16L 39/00 (2006.01)

Cited literature, if any, will be enclosed in paper form.

US	20040200457	A 1	14/1 0/2004	AU	2004201 491	B8	28/1 0/2004
				DE	60200400141 8	D 1	17/08/2006
				EP	14691 88	A 1	20/1 0/2004
				JP	2008267391	A	06/1 1/2008
				JP	47961 02	B2	19/1 0/201 1
				JP	2004308655	A	04/1 1/2004
				US	6827065	B2	07/1 2/2004
US	741 5968	B 1	26/08/2008	US	7802560	B2	28/09/201 0
				US	20090031 992	A 1	05/02/2009
				WO	20081 34250	A 1	06/1 1/2008
				WO	20081 341 60	A 1	06/1 1/2008
US	491 3 1 19	A	03/04/1 990	JP	704901 1	Y2	13/1 1/1 995
				JP	H0224064	U	16/02/1 990
				JP	2024064	U	16/02/1 990
				KR	960002288	Y 1	19/03/1 996
WO	2004090405	A 1	21/1 0/2004	HU	0300090	VO	30/06/2003
				HU	2592	U	29/09/2003
US	200402071 97	A 1	21/1 0/2004	AT	399287	T	15/07/2008
				DE	60200401 4602	D 1	07/08/2008
				EP	16 13888	A 1	11/01/2006
				ES	2309543	T3	16/1 2/2008
				US	6971 682	B2	06/1 2/2005
				WO	2004092636	A 1	28/1 0/2004
US	1389768	A	06/09/1 921	NONE			
US	4 149568	A	17/04/1 979	CA	10991 65	A 1	14/04/1 981
				DE	2860446	D 1	26/02/1 981
				DE	2860491	D 1	26/03/1 981
				EP	0002384	A 1	13/06/1 979
				EP	0002385	B 1	07/01/1 981
				HK	8284	A	10/02/1 984
				JP	581 321 64	U	06/09/1 983
				JP	6300341 4	Y2	27/01/1 988
				JP	54087328	A	11/07/1 979
US	5401 064	A	28/03/1 995	NONE			