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(54) Engine and exhaust pipe attachment

(57) An internal combustion engine has an exhaust pipe (117) fastened to a cylinder head (111) by a flange (119) secured by studs (127). The end face (126) of the exhaust pipe (117) directly contacts the cylinder head over an area which is no greater than the cross-sectional area of the adjacent pipe end portion (118), thereby reducing the heat conducted from the exhaust pipe to the cylinder head. The flange (119) is secured to the exhaust pipe by three lugs (128) thereby reducing the thermal mass and the heat absorbed immediately following a cold start. In a modification (Figs.10 and 11, not shown) the end of the exhaust pipe is recessed into the cylinder head to reduce the length of the exhaust port and a wear ring of hard material is interposed between the pipe and the base of the counterbore. In this modification the end face of the pipe end portion is chamfered to further reduce the area in contact with the cylinder head.

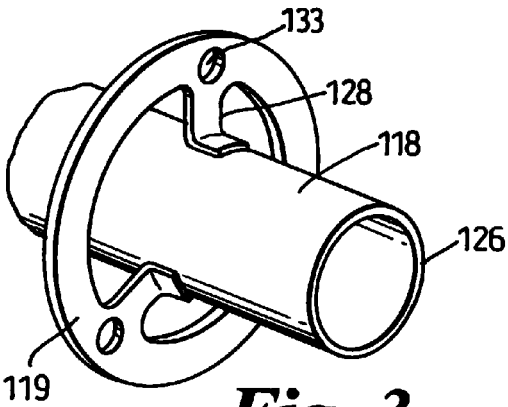

Fig. 3

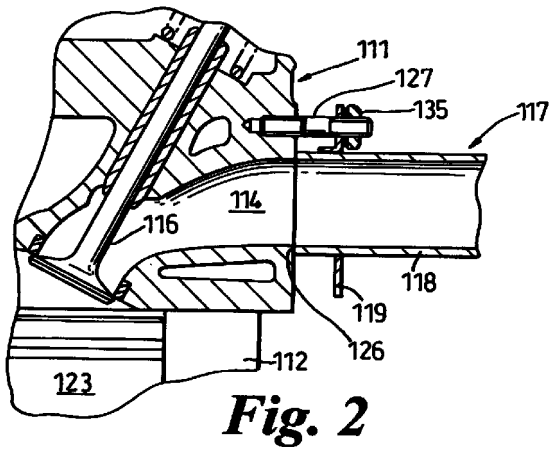

Fig. 2

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Description

[0001] The invention relates to an assembly of an internal combustion engine and an exhaust pipe in which the engine includes an engine component such as a cylinder head having an exhaust port for the passage of hot gases from the engine and the exhaust pipe includes a pipe end portion attached to the engine to duct the hot gases from the exhaust passage away from the engine. A typical example of such an assembly is shown in Fig. 1 of the accompanying drawings which is a cross-sectional view of an internal combustion engine cylinder head connected to part of an exhaust pipe. The cylinder head 11 is secured to a cylinder block 12 and incorporates an inlet port 13 and an exhaust port 14. The cylinder head 11 also incorporates the usual inlet valves 15 and exhaust valves 16, there being two inlet valves and two exhaust valves per cylinder. An exhaust pipe 17 comprises a pipe end portion 18 which forms part of an exhaust manifold and which is attached to a flange 19 by welds 21. The flange 19 is secured to the cylinder head 11 by threaded studs and nuts (not shown) and a gasket 22 is provided to seal between the cylinder head 11 and the flange 19.

[0002] A disadvantage of the arrangement shown in Fig. 1 is that in the period immediately following a cold start the flange 19 acts as a heat sink and reduces the temperature of the hot gases displaced by the piston 23 past the exhaust valve 16 and out of the exhaust pipe 17. This delays the operation of a catalyst downstream of the pipe end portion 18 with a detrimental effect on emissions. A further disadvantage is found when the engine has warned up in that heat from the flange 19 is readily conducted back to the cylinder head 11. This increases the amount of heat that has to be conducted back from coolant passages 24 to a coolant radiator. This not only increases the size of radiator needed but, in the case of a motor vehicle installation, the temperature in the engine compartment is increased which tends to impair engine performance because it increases the temperature of the air drawn into the inlet port 13. This problem is relatively minor on passenger road vehicles where high engine outputs are normally only required at relatively high road speeds but becomes acute on off-road vehicles operating at low speeds.

[0003] It is an object of the invention to provide an improved assembly of internal combustion engine and exhaust pipe in which the above problems are alleviated.

[0004] According to the invention there is provided an internal combustion engine and exhaust pipe assembly, the engine including an engine component such as a cylinder head having an exhaust port defined therein for the passage of hot gases from the engine and the exhaust pipe comprising a pipe end portion attached to the engine to duct the hot gases from the exhaust port away from the engine, the pipe end portion having an end face which abuts the engine component on an area of the end face which is no greater than the cross-sectional area of the adjacent pipe end portion.

[0005] There may be a plurality of pipe end portions each attached to respective one of a plurality of exhaust ports in the engine and joined to an exhaust manifold.

[0006] Preferably, the pipe end portion is recessed into the engine component with a substantial radial clearance. This enables a reduction in the length of the exhaust port and hence the area exposed to the hot exhaust gases.

[0007] Preferably, the engine component incorporates a wear ring interposed between the end face and the main body of the engine component. This helps to prevent the end face from digging into the abutting face of the engine component.

[0008] The end of the pipe end portion incorporating the end face may have a chamfer which substantially reduces the area of the end face. This further reduces the heat conducted from the pipe end portion to the engine component.

[0009] Conveniently, the pipe end portion has attachment means thereon which co-operates with threaded fasteners extending from the engine component. Preferably, such threaded fasteners each extend between the engine component and the attachment means over a substantial length which further impedes heat conduction back to the engine. The attachment means may be joined to the pipe end portion at a positions angularly spaced from each threaded fastener.

[0010] The attachment means may comprises an attachment flange concentric with the pipe end portion, in which case the flange may be attached to the pipe end portion by integral lugs. Alternatively, the attachment flange may be a separate loose component and the attachment means further comprises pegs attached to the pipe end portion and abutting the flange. The pegs may form part of a ring attached to the pipe end portion.

[0011] Each threaded fastener may have a head member which abuts the attachment member over a reduced area.

[0012] The invention will now be described by way of example and with reference to the remainder of the accompanying drawings, of which:-

Fig.2 is a cross-section based part on part of Fig. 1 showing part of an internal combustion engine and exhaust pipe assembly according to the invention;

Fig.3 is a perspective view of an attachment flange on the exhaust pipe shown in Fig.2;

Fig.4 shows part of the attachment flange shown in Figs.2 and 3 on an enlarged scale;

Fig.5 is a cross-section through part of the pipe portion and attachment flange shown in Fig.3;

Fig.6 is a view similar to Fig.3 showing a modification to the attachment flange shown in Figs. 2 to 5;

Fig.7 is a view similar to Fig.3 showing a further

modification;

Fig.8 is a scrap section through part of the pipe portion and attachment flange shown in Fig. 7;

Fig.9 is a view similar to Fig.2 showing a second embodiment of the invention;

Fig.10 is a view similar to Fig.2 showing a third embodiment of the invention;

Fig.11 is an enlarged view of part of Fig.10 showing the end of the pipe end pipe portion in more detail;

Fig.12 is a view on arrow A in Fig. 10 with the exhaust pipe removed showing a first modification to the third embodiment;

Fig.13 is a view similar to Fig.10 showing a second modification to the third embodiment;

Fig.14 is a perspective view of an attachment member shown in Fig.13;

Fig.15 is a view similar to Fig.10 showing a fourth embodiment of the invention;

Fig. 16 is a perspective view of a pipe end pipe portion and an attachment flange forming part of a fifth embodiment of the invention;

Fig.17 is a plan view showing the parts shown in Fig. 16 in an assembled condition;

Fig.18 is a view based on part of Fig.16 showing a modification to the fifth embodiment shown in Figs.16 and 17; and

Fig. 19 is a view similar to Fig.18 but from the opposite direction.

[0013] Referring to Figs.2 to 5, an internal combustion engine has a cylinder head 111 having an exhaust port 114 controlled by an exhaust valve 116. The cylinder head 111 is mounted on a cylinder block 112 in which slides a piston 123. An exhaust pipe 117 includes a pipe end portion 118 having an end face 126 which is held against the cylinder head 111 by threaded fasteners in the form of screwed studs 127. There are three studs 127 substantially equally spaced around the exhaust port 114 and, in the conventional manner, each stud 127 is screwed firmly into the cylinder head 111.

[0014] An attachment means in the form of a pressed metal attachment flange 119 is concentric with the pipe end portion 118 and is attached to it by three integral L-shaped lugs 128. The lugs 128 each include a respective radial leg portion 129 joined to the main body of the flange 119 and a parallel leg portion 131 which is welded to the pipe end portion 118. A stiffening rib or nib 132 is formed at the junction of the leg portions 129 and 131. Holes 133 in the flange 119 are provided for the studs 127 and in the area of these there are small circumferential ribs 134 which project away from the cylinder head 111 and are engaged by nuts 135 screw threaded onto the studs 127.

[0015] It will be appreciated that the end face 126 which abuts the cylinder head 111 has an area which is the same as the cross-sectional area of the adjacent pipe end portion 118. This helps to minimise the heat transfer from the exhaust pipe 117 back to the cylinder head 111 through this contact face. Furthermore, each of the studs 127 extends between the cylinder head 111 and the flange 119 over a substantial length which represents an extended heat path from the pipe end portion 118 through the studs 127 and into the cylinder head 111. Conduction of heat from the pipe end portion 118 through the flange 119 is further impaired by having only three of the L-shaped lugs 128 and conduction from the flange 119 to the studs 127 is impaired by the reduced area of contact between the nuts 135 and the flange 119 provided by the ribs 134. The lower face of each nut 135 may have radial grooves where the face contacts the ribs 134 to help prevent loosening of the nuts due to vibration.

[0016] It will also be appreciated that the mass of the attachment flange 119 can be made very much less than that of the flange 19 shown in Fig. 1 with a consequential much reduced thermal inertia. This helps to reduce the amount of heat lost through the pipe end portion 118 immediately following a cold start and so improves emissions by allowing the catalyst to operate earlier.

[0017] In the modification shown in Fig.6 the attachment flange 119A is arranged so that the fixing holes 133A for the studs 127 are angularly offset from the lugs 128A. This extends the heat path from the pipe end portion 118A to the studs 127.

[0018] In the further modification shown in Figs.7 and 8, the attachment flange 119B is generally similar to the flange 119A shown in Fig.6 but has an annular rim 138B which helps to strengthen and stiffen the flange.

[0019] In the second embodiment of the invention shown in Fig.9 parts identical to or similar to those shown in Figs.2 to 5 have the same reference numeral but with the addition of 100. An attachment flange 219 substantially identical to the flange 119 is fixed to the head 211 by studs 227 and nuts 235. However, the exhaust port 214 has a counterbore 241 so that the end face 226 of the pipe end portion 218 is much closer to the exhaust valve 216. This reduces the length of the exhaust port 214 and hence and the area exposed to the hot exhaust gases. This helps to reduce the heat loss by the exhaust gas in the period immediately following a cold start and also reduces the heat transferred to the coolant in the cooling passages 224. It will be appreciated that where the pipe end portion 218 is recessed into the counterbore 241 in the head 211 that there is a substantial radial clearance to reduce heat transfer from the outside of the pipe portion to the head.

[0020] In the third embodiment of the invention shown in Fig. 10, parts identical to or similar to those shown in Fig.9 have the same reference numeral but with the further addition of 100. The pipe end portion 318 is recessed into a counterbore 341 in the head 311 as shown in Fig.9 but the end face of the pipe section 318 abuts on a wear ring 342 of hard material interposed between the end face and the main body of the cylinder head. In the case of the cylinder head 311

being made of a soft material such as aluminium this helps to prevent the end face 326 from digging into the face of the counterbore 341 by either surface deformation or wear. It should be noted that where there are several cylinders in line and the exhaust pipe 317 forms part of a manifold, then it may be desirable to allow the end face 326 of each pipe end portion 318 to skid across the wear ring 342 to accommodate thermal expansion or contraction. This is helped by the wear ring 342 being hard and not susceptible to wear or distortion, although it my be necessary to ensure that the inner diameter of the pipe end face 326 is larger than the inner diameter of the wear ring 342.

[0021] Fig.11 shows the end face 326 of the pipe end portion 318 in more detail. Whereas in the case of the pipe end faces 126 and 226 shown in Figs.2 to 9 the end face is substantially at right angles to the axis of the pipe end portion 118, 218, in the third embodiment the end face 326 is chamfered so that the area which bears on the wear ring 342 is substantially less than the cross-sectional area of the adjacent pipe end portion 318. This helps to further reduce the heat transfer from the pipe end portion 318 to the cylinder head 311. A sleeve 343 of an insulating material such as ceramic fibre is optionally fitted inside the counterbore 241 to further reduce heat transfer. Alternatively, such a sleeve can be fitted over the pipe end portion 218.

[0022] In the modification shown in Fig.12 the exhaust port 314A is of elliptical cross-section. This suits the common arrangement of two exhaust valves side-by-side serve the same cylinder. Branch ports 320A of generally circular cross-section merge into the single elliptical cross-section exhaust port 314A. The wear ring 342A and the pipe end portion (not shown) are similarly elliptical. The elliptical section on the pipe end portion can be readily achieved by deforming a generally round pipe. This view also shows the studs 327A.

[0023] In the modification shown in Figs.13 and 14, the attachment flange 319 is replaced three separate sheet metal lugs 319C which are welded to the pipe end portion 318C, each lug having a hole 333C for the fixing stud 327C.

[0024] In the fourth embodiment of the invention shown in Fig. 15, the counterbore 341C is angled upward (as viewed in Fig.15) so as to be inclined away from the cylinder head to cylinder block joint face 320 and so make a smaller angle to the axis of the exhaust valve 316C. The pipe end portion 318C is recessed into the counterbore 341C and is similarly angled. This suits the exhaust manifold arrangement of certain engine layouts, particularly V layout engines (e.g. V-6 or V-8) and has the added advantage of enabling further shortening of the exhaust port 314C. In this arrangement the studs 327C are offset by 180° from that shown in Fig.12.

[0025] In the fifth embodiment of the invention shown in Figs. 16 and 17, parts identical to or similar to those shown in Figs.2 to 5 have the same reference numeral but with the addition of 300. An alternative attachment flange 419 is particularly suitable for use where the pipe end portion 418 forms part of an exhaust manifold. Three pegs 428 which are substantially equally spaced are attached to the pipe end portion 418 by conventional means such stud welding or riveting and these cooperate with the attachment flange 419 which is a separate loose component. Holes 433 in the flange 419 are provided for studs 427 and open-ended slots 444 are provided to allow the flange to be assembled over the studs 427 before being turned to bring the holes 433 either into alignment with the studs 427. This arrangement has the benefit that there is only a very small contact area between each peg 428 and the flange 419, there being a substantial clearance between the inner diameter of flange 419 and the outer diameter of the pipe end portion 418. Again there is a minimal thermal mass to absorb heat in the period immediately following a cold start. The arrangement also allows for the possibility of a lateral movement of the pipe end portion 418 relative to the flange 419 to accommodate thermal expansion and contraction as discussed previously.

[0026] Figs.18 and 19 show a modification to the arrangement shown in Figs.16 and 17 wherein the pegs 428 are replaced by V-shaped lugs 428A formed on a pressed ring 446 fixed to the pipe end portion 418A by e.g. welding. As shown in Figs.16 and 17, the lugs 428A are arranged so that the apex of the V abuts the flange 419. However, the ring 426A may be reversed if required so that the two ends of each lug abut the flange 419, this allowing easier assembly of the flange over the lugs 428A.

Claims

1. An internal combustion engine and exhaust pipe assembly, the engine including an engine component (111, 211, 311, 311A, 311C) such as a cylinder head having an exhaust port (114, 214, 314, 314A) defined therein for the passage of hot gases from the engine and the exhaust pipe (117, 217, 317, 417) comprising a pipe end portion (118, 118A, 118B, 218, 318, 318C, 418, 418A) attached to the engine to duct the hot gases from the exhaust port away from the engine, characterised in that the pipe end portion (118, 118A, 118B, 218, 318, 318C, 418, 418A) has an end face (126, 226, 326) which abuts the engine component (111, 211, 311, 311A, 311C) on an area of the end face which is no greater than the cross-sectional area of the adjacent pipe end portion.

2. An assembly according to claim 1, characterised in that there is a plurality of pipe end portions (118, 118A, 118B, 218, 318, 318C, 418, 418A) each attached to respective one of a plurality of exhaust ports (114, 214, 314, 314A) in the engine and joined to an exhaust manifold.

3. An assembly according to claim 1 or claim 2, characterised in that the or each pipe end portion (218, 318, 318C) is recessed into the engine component (211, 311, 311C) with a substantial radial clearance.

4. An assembly according to any preceding claim, characterised in that the engine component (311, 311C) incorporates a wear ring (342) interposed between the or each end face (326) and the main body of the engine component.

5. An assembly according to any preceding claim, characterised in that the end of the or each pipe end portion (318) incorporating the end face (326) has a chamfer which substantially reduces the area of the face.

6. An assembly according to any preceding claim, characterised in that the or each pipe end portion has attachment means (119, 119A, 119B, 219, 319, 319C, 419) thereon which co-operates with threaded fasteners (127, 227, 327) extending from the engine component (111, 211, 311, 311C).

7. An assembly according to claim 6, characterised in that each threaded fastener (127, 227, 327, 427) extends between the engine component (111, 211, 311, 311C) and the attachment means (119, 119B, 219, 319, 319C, 419) over a substantial length.

8. An assembly according to claim 6 or claim 7, characterised in that the or each attachment means (119A, 119B, 419) is joined to the pipe end portion at a position angularly spaced from each threaded fastener (127, 427).

9. An assembly according to any of claims 6 to 8, characterised in that the or each attachment means comprises an attachment flange (119, 119A, 119B, 219, 319, 319C, 419) concentric with the pipe end portion (118, 118A, 118B, 218, 318, 318C, 418, 418A).

10. An assembly according to claim 9, characterised in that the or each flange (119, 119A, 119B, 219, 319, 319C) is attached to the pipe end portion (118, 118B, 218, 318, 318C) by integral lugs (128, 228, 328).

11. An assembly according to claim 9, characterised in that the or each flange is a separate loose component (419) and the attachment means further comprises pegs (428, 428A) attached to the pipe end portion (418, 418A) and abutting the flange.

12. An assembly according to claim 11, characterised in that the pegs (428A) form part of a ring (446) attached to the pipe end portion (418A).

13. An assembly according to any of claims 6 to 12, characterised in that each threaded fastener (127) has a head member (135) which abuts the respective attachment member (119) over a reduced area.

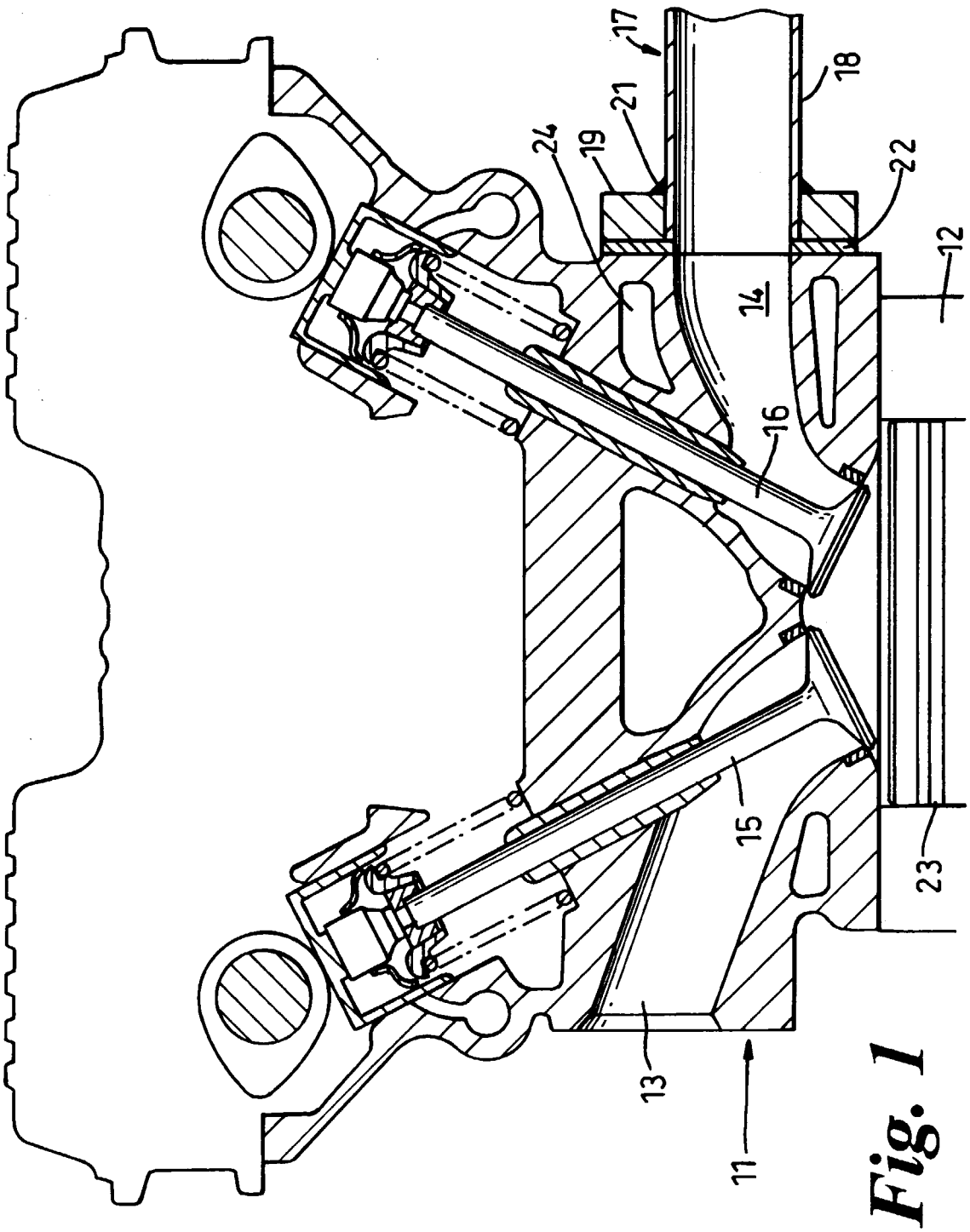

Fig. 1

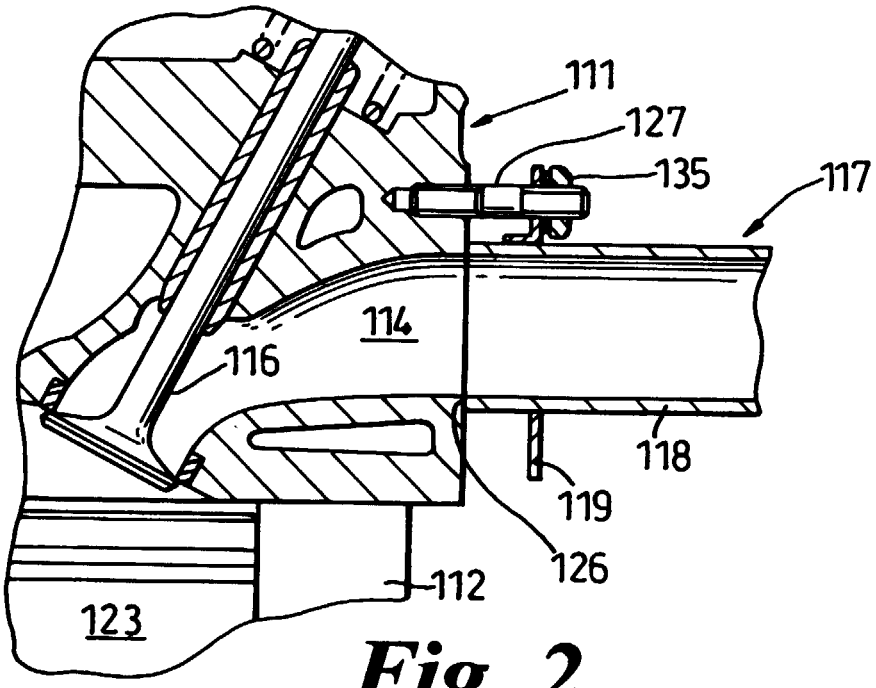

Fig. 2

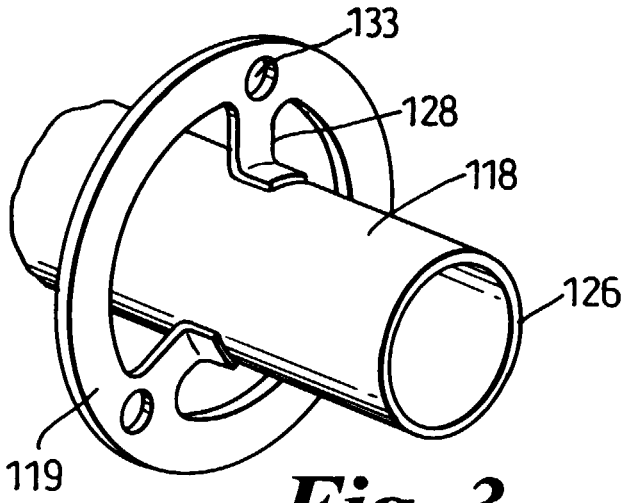

Fig. 3

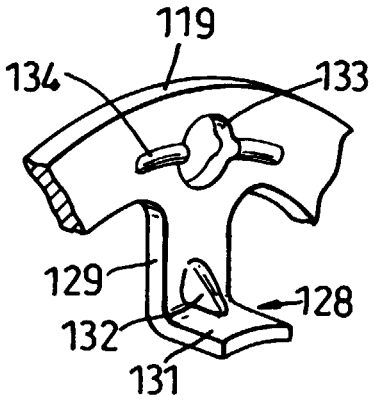

Fig. 4

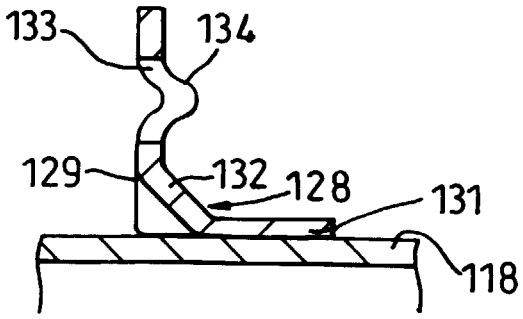

Fig. 5

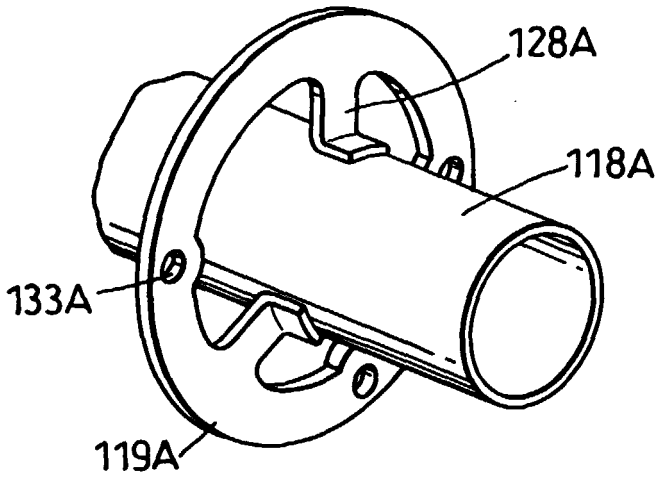

Fig. 6

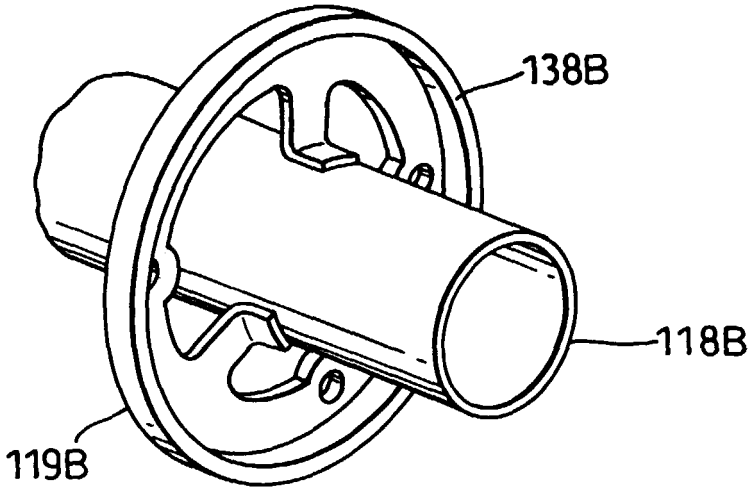

Fig. 7

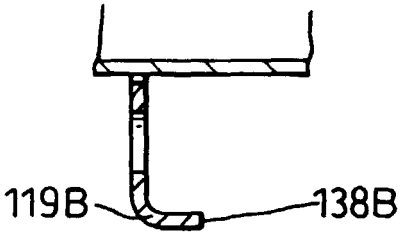

Fig. 8

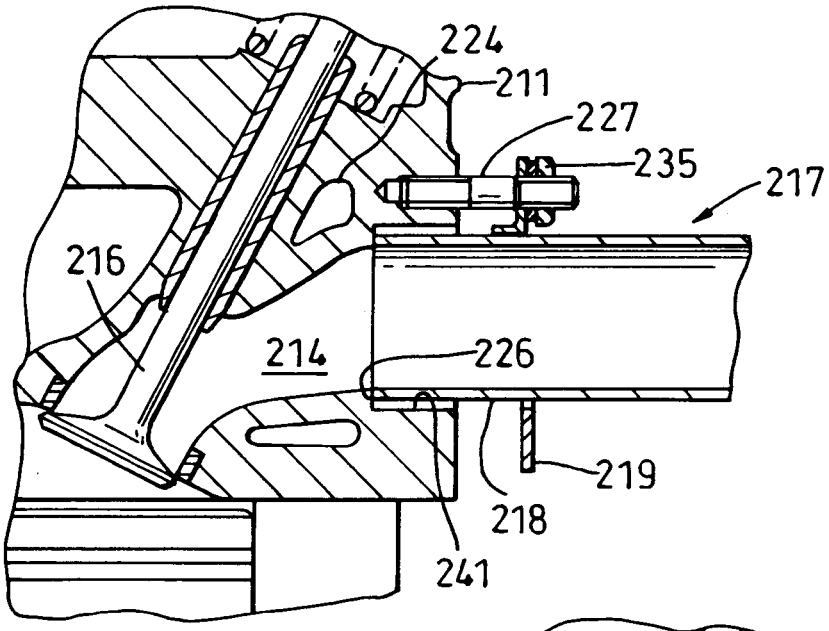

Fig. 9

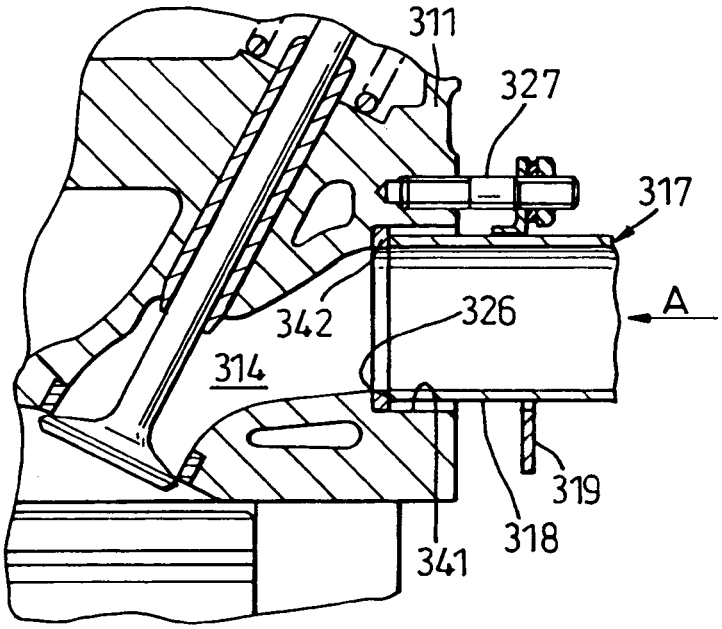

Fig. 10

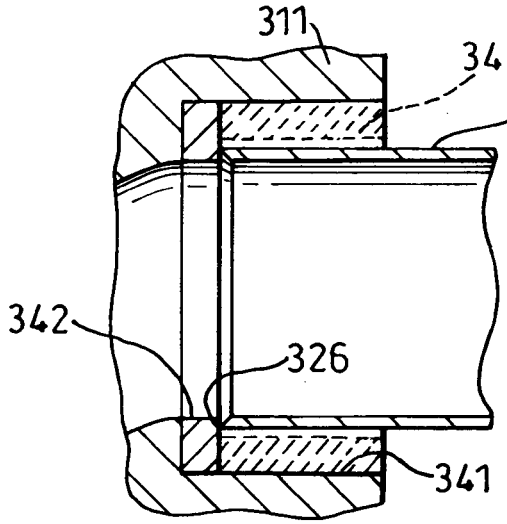

Fig. 11

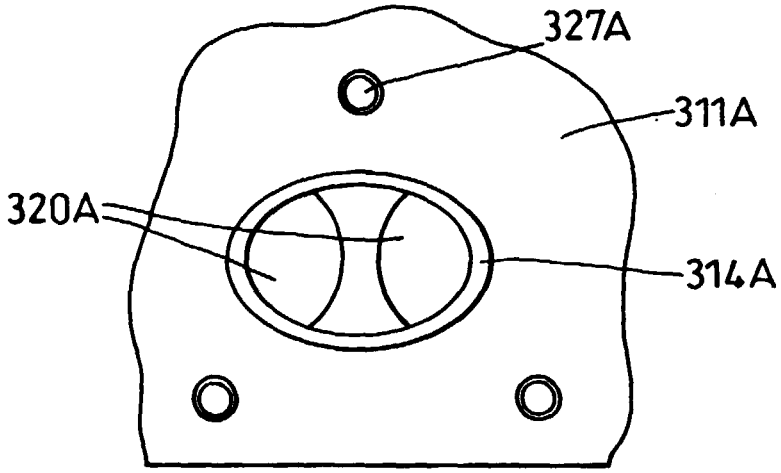

Fig. 12

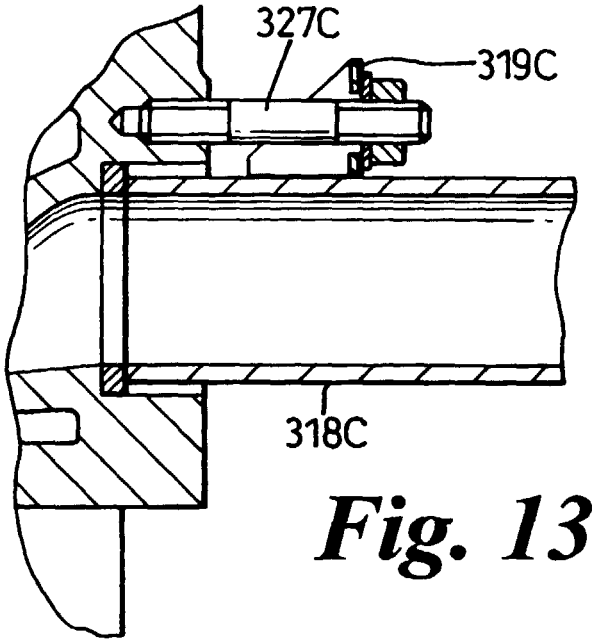

Fig. 13

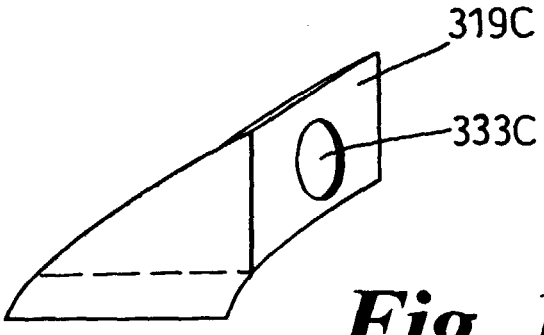

Fig. 14

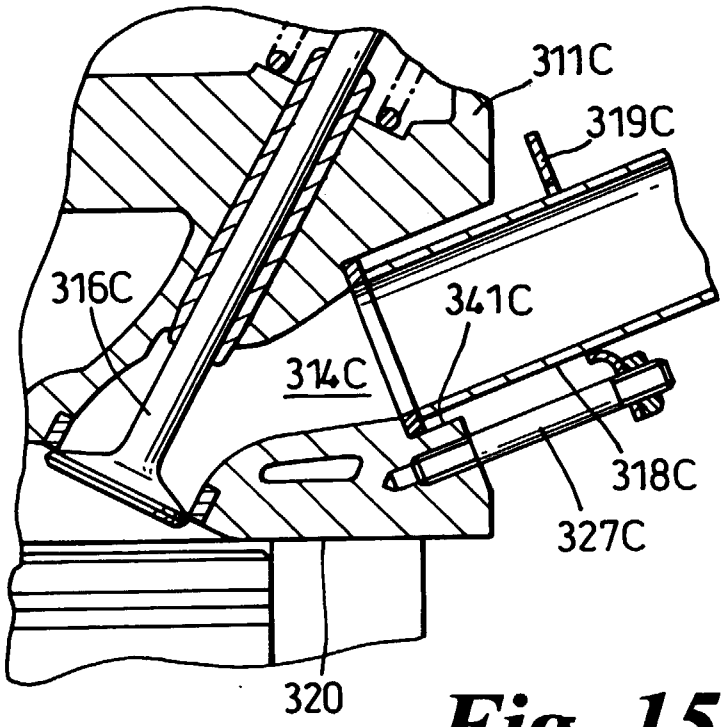

Fig. 15

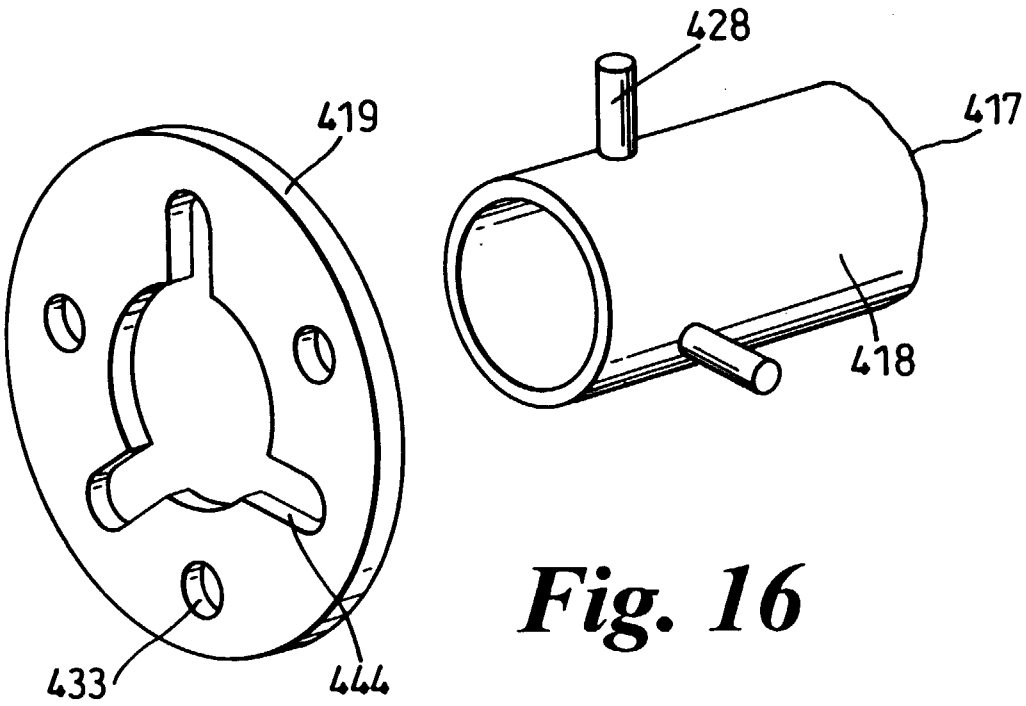

Fig. 16

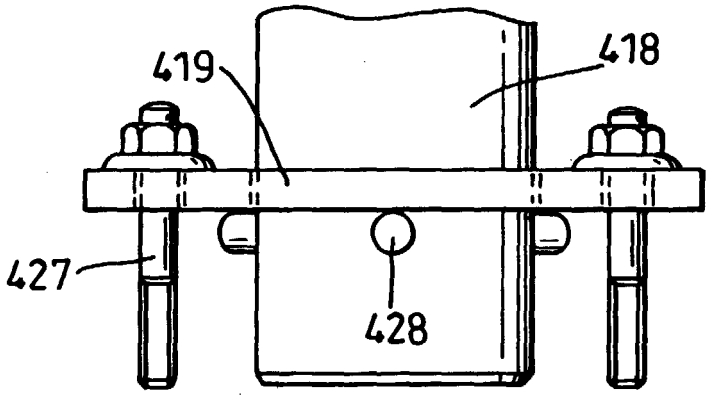

Fig. 17

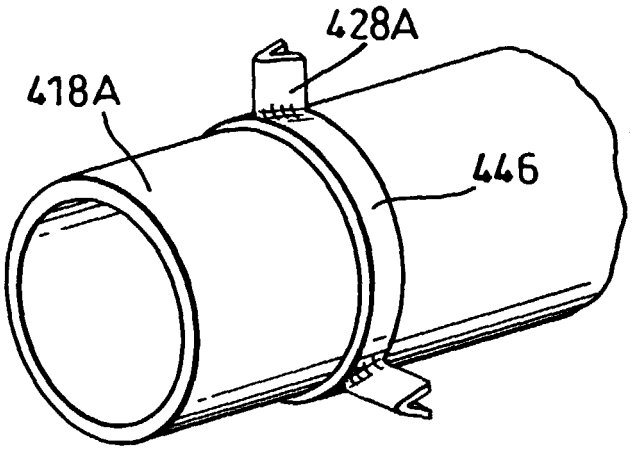

Fig. 18

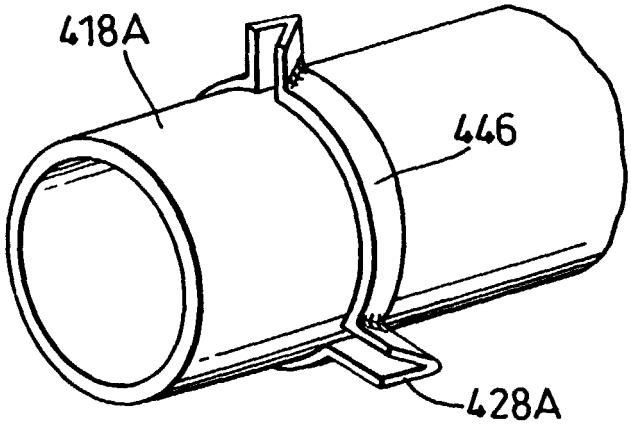

Fig. 19

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 30 1323

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 489 (P-1799), 12 September 1994 (1994-09-12) & JP 06 161948 A (MATSUSHITA ELECTRIC IND CO LTD), 10 June 1994 (1994-06-10) * abstract *	1-4,6-9	F01N7/18
A	US 4 800 719 A (CAMPBELL MONTY A) 31 January 1989 (1989-01-31) * abstract; figure 2 *	1,6-9	
A	US 4 197 704 A (DATE TASUKU ET AL) 15 April 1980 (1980-04-15) * abstract; figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F01N
F16L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	8 June 2000	Tatus, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 30 1323

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-06-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 06161948 A	10-06-1994	NONE	
US 4800719 A	31-01-1989	US 4953352 A	04-09-1990
US 4197704 A	15-04-1980	JP 1061353 C	31-08-1981
		JP 52151409 A	15-12-1977
		JP 56001454 B	13-01-1981
		JP 1014050 C	25-09-1980
		JP 52151410 A	15-12-1977
		JP 55004211 B	29-01-1980
		CA 1071958 A	19-02-1980

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82