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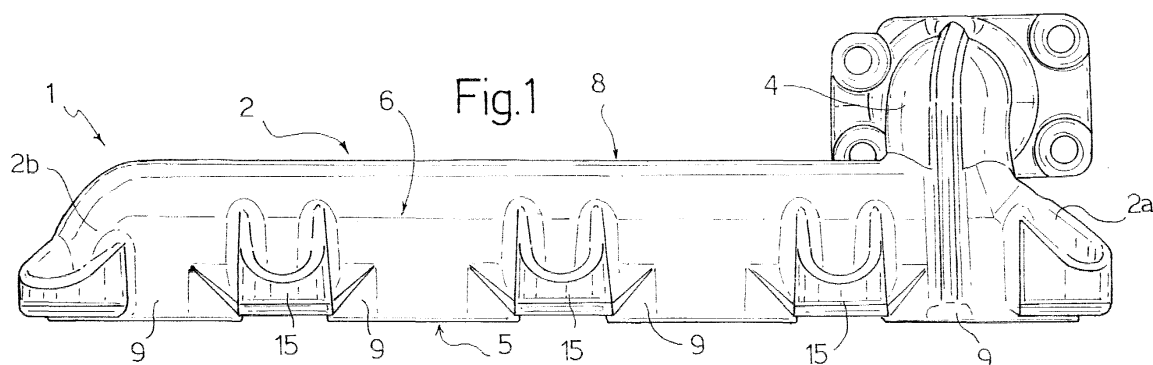
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(54) **Exhaust manifold for an internal combustion engine**

(57) An exhaust manifold (1) for an internal combustion engine of a vehicle comprising a plurality of openings (9) adapted to be connected to respective exhaust ducts (11) obtained on a cylinder head (10) and comprising respective annular sealing surfaces (13) adapted to cooperate in a fluid-tight manner with the cylinder

head (10) about respective exhaust ducts (11), an exhaust outlet (4) adapted to be connected to an exhaust duct of the vehicle, and a plurality of studs (15) for securing the manifold (1) to the cylinder head (10), the annular surfaces (13) being disposed to project with respect to the studs (15) such that they are spaced, in operation, from the cylinder head (10).



Description

[0001] The present invention relates to an exhaust manifold for an internal combustion engine.

[0002] Exhaust manifolds for internal combustion engines comprising an elongate hollow body provided with a plurality of openings that can be connected to respective exhaust ducts obtained on the cylinder head, an exhaust outlet adapted to be connected to an exhaust duct of the vehicle, and a plurality of studs or flanges for securing the manifold to the cylinder head by means of threaded fastening members, are known.

[0003] The openings and the fastening studs or flanges are generally bounded at the front by a common, plane support surface adapted to cooperate in a fluid-tight manner with the cylinder head via the interposition of a gasket. Moreover, the threaded fastening members are, for constructional reasons (in connection with the cylinder head) normally disposed on opposite sides of each opening.

[0004] These known manifolds have, however, a drawback due to the fact that the contact pressure between the manifold and the cylinder head is not uniformly distributed over the contact surface, but tends to be concentrated at the location of the fastening members and to be smaller in the intermediate zones in which, as mentioned above, the openings are typically disposed. This reduction of the contact pressure may cause a loss of fluid-tightness between the openings and the cylinder head with a resultant leakage of exhaust gases.

[0005] In order at least partially to resolve this problem, it has been attempted to bring the points at which the manifold is fastened to the cylinder head as close as possible to the openings and to increase, where possible, the number of fastening members; this entails design constraints when designing the head. As it is necessary to provide appropriate solid walls for the provision of the fastening holes of the manifold adjacent to the exhaust ducts, the cooling ducts have to be designed such that they are at least partially spaced from the exhaust ducts, with adverse effects on the cooling of the head. In addition, increasing the dimensions and number of the fastening members has adverse effects on the thermal behaviour of the manifold which undergoes a heat expansion differing from that of the cylinder head and must therefore be free to move with respect to the latter; this sliding is prevented by the friction between the two bodies which is the greater the higher the force urging the manifold towards the cylinder head with the result, therefore, that higher thermal stresses correspond to greater fastening loads.

[0006] The object of the present invention is to provide an exhaust manifold for an internal combustion engine, whose constructional characteristics make it possible to resolve the problems of the prior art in a simple and economic manner.

[0007] This object is achieved by the present invention which relates to an exhaust manifold for an internal

combustion engine of a vehicle comprising a plurality of openings adapted to be connected to respective exhaust ducts obtained on a cylinder head of the engine and comprising respective annular sealing surfaces adapted to cooperate in a fluid-tight manner with the cylinder head about respective exhaust ducts, an exhaust outlet adapted to be connected to an exhaust duct of the vehicle, and a plurality of studs for securing the manifold to the cylinder head via respective threaded members, which manifold is characterised in that the annular surfaces are disposed to project with respect to the studs such that the studs are spaced, in operation, from the cylinder head.

[0008] Further characteristic features of the present invention are set out in detail in the following description of a non-limiting embodiment thereof, made with reference to the accompanying drawings in which:

Fig. 1 is a side view of a preferred embodiment of the manifold of the invention;

Fig. 2 is a view of the manifold of Fig. 1 from below; Fig. 3 is a cross-section along the line III-III of Fig. 1, on an enlarged scale and with parts removed for clarity, of the manifold secured on a cylinder head; Fig. 1 shows an exhaust manifold 1 for an internal combustion engine of a vehicle, of which a cylinder head 10 is shown partially in Fig. 3.

[0009] The manifold 1 comprises an elongate body 2 provided with a front wall 5, two side walls 6, 7 and a base wall 8 bounding a longitudinal cavity shown by 3 in Fig. 3. In the vicinity of a first end 2a of the body 2, the manifold 1 comprises an exhaust outlet 4 rigid with the body 2 and adapted to be connected to an exhaust duct of the vehicle which is known and is not therefore shown.

[0010] The front wall 5 is provided with a plurality of openings 9, communicating with the cavity 3, each of which is adapted to be connected, in operation, to a respective exhaust duct 11 obtained on the cylinder head 10 (or to a pair of ducts 11 associated with the exhaust valves of a cylinder in the case of an engine with four valves per cylinder). The openings 9, as shown in Fig. 2, are in particular aligned with one another and spaced along the front wall 5 and each opening has a substantially rectangular aperture 12 surrounded externally by a respective annular sealing surface 13. The openings 9 are separated from one another by transverse recesses 14 of the front wall 5 such that the annular sealing surfaces 13 are disposed to project and form the sole support surfaces of the manifold 1 with respect to the head 10.

[0011] A plurality of studs 15 for securing the manifold 1 to the cylinder head 10 by bolts 16 obtained rigidly with the body 2 extend laterally from the side walls 6 and 7 in a projecting manner.

[0012] The studs 15 each have a fastening portion 17 in the form of a circular plate, parallel to the annular seal-

ing surfaces 13 and disposed in the vicinity of the front wall 5, and a stiffening portion 18 which rigidly connects an edge of the fastening portion 17 to the body 2 and is substantially formed by a pair of triangular walls 19 disposed on the sides of the portion 17.

[0013] Each of the studs 15 has, on the portion 17, a through hole 20 adapted to be engaged by a respective bolt 16 (Fig. 3) for fastening the manifold 1 to the cylinder head 10. Fig. 3 also shows how the diameter of the holes 20 is conveniently greater than the diameter of the bolts 16 so as to enable differential heat expansions of the manifold 1 with respect to the cylinder head without generating excess stresses or deformations.

[0014] In further detail, the manifold 1 comprises a first pair of studs 15 disposed at the first end 2a of the body 2, a second pair of studs 15 disposed at a second end 2b of the body 2 and a plurality of intermediate pairs of studs 15 disposed at the location of the respective recesses 14; the studs of each pair are disposed on laterally opposing sides of the elongate member 2, symmetrically with respect to a median longitudinal plane α of the manifold 1.

[0015] The portions 17 of the studs 15 and the annular sealing surfaces 13 are disposed in two different planes; the front surfaces 21 are in particular substantially flush with the recesses 14 so as to remain spaced, in operation, from the cylinder head 10.

[0016] The manifold 1 is mounted on the cylinder head 10 with the interposition of a sealing gasket 22 (Fig. 3) advantageously formed from a single member of sheet material clamped in operation between the annular sealing surfaces 13 and the head 10 and provided with apertures at the location of the apertures 12 of the openings 9.

[0017] The head 10 comprises a plurality of inner cooling ducts 23 which are close to the walls of the head 10 bounding the exhaust ducts 11 (Fig. 3).

[0018] It will be appreciated that, in the manifold of the invention, the load generated by the pull of the bolts 16 on the studs 15 is not discharged directly from the latter to the head 10 as is the case with known manifolds, but is transmitted to the elongate body 2 of the manifold 1 and from there to the annular sealing surfaces 13 of the openings 9, where there is a high and comparable specific contact pressure, thereby improving the behaviour of the component from the point of view of maintaining gas-tightness.

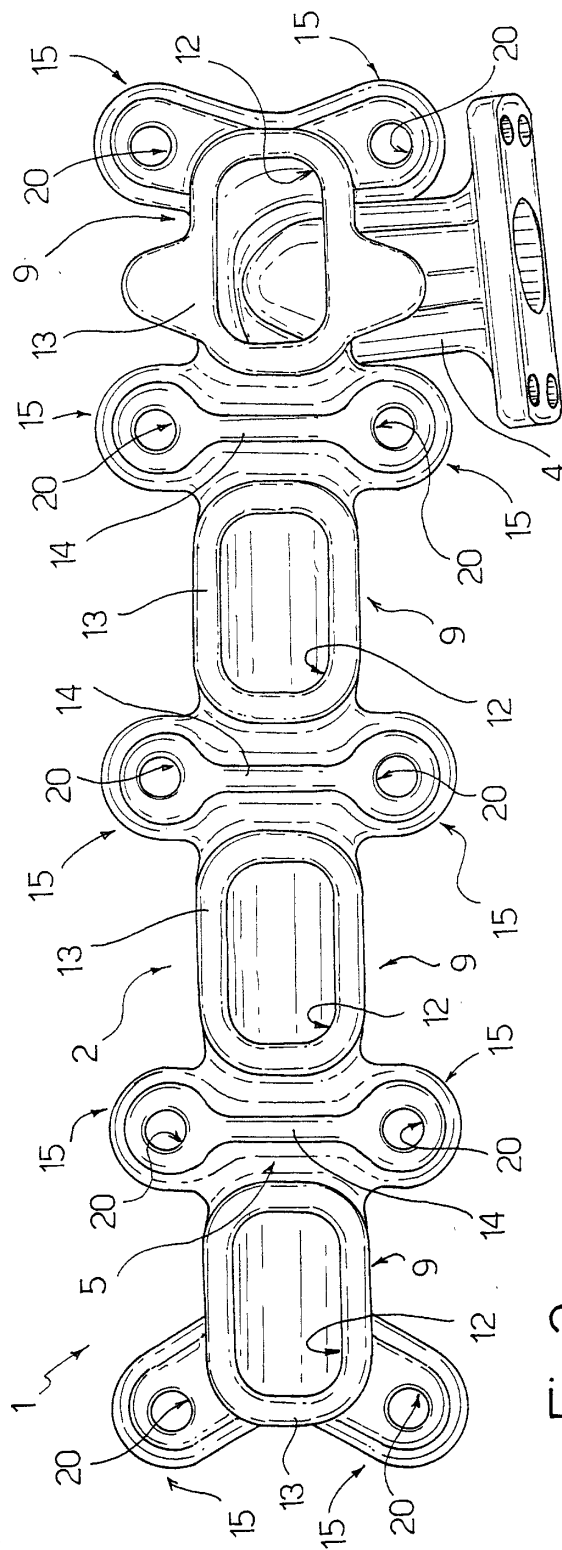
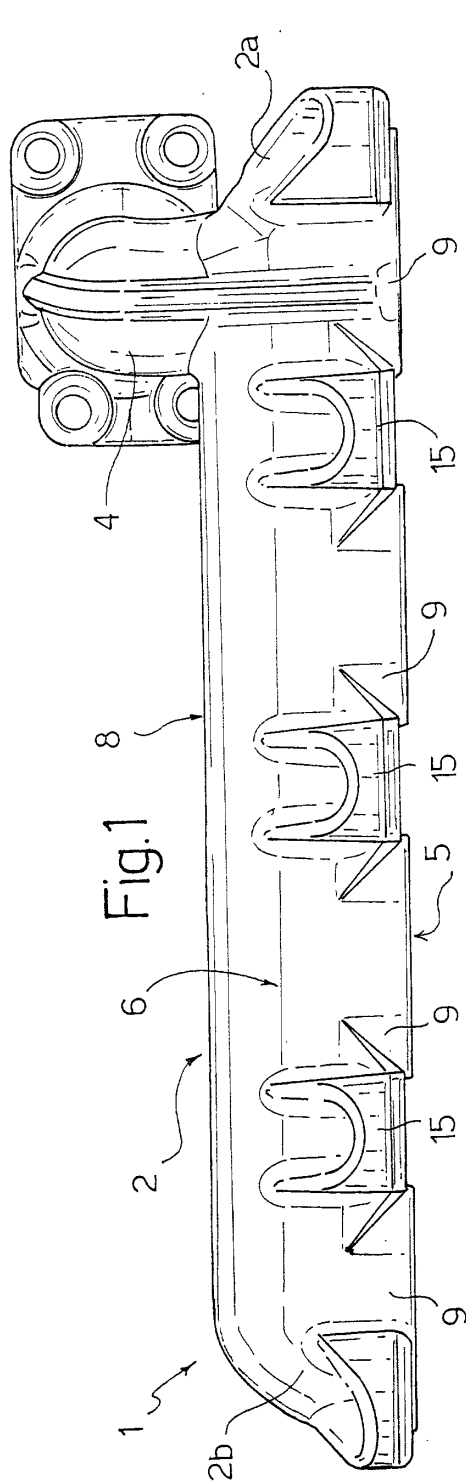
[0019] This also makes it possible to distance the fastening points of the manifold from the openings without increasing their number or dimensions, by means of a projecting arrangement of the studs 15; this gives greater freedom of design of the cylinder heads 10, making it possible to bring the cooling ducts 23 closer to the exhaust ducts 11 and thus to improve the cooling of the cylinder head 10. The smaller number of fastening members also makes it possible to contain the thermal stress state of the manifold.

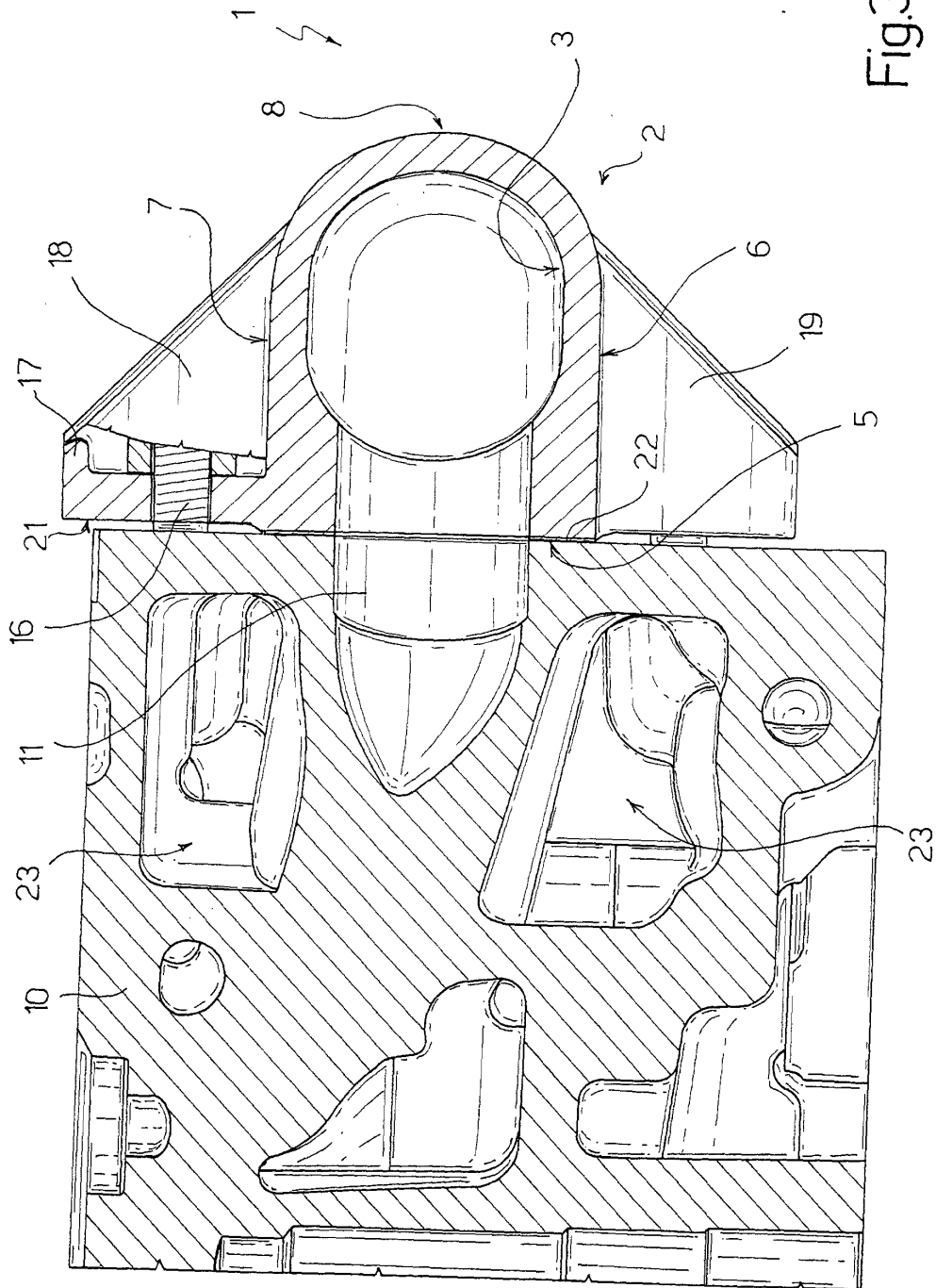
[0020] It is evident, lastly, that modifications and var-

iations that do not depart from the scope of the claims may be made to the exhaust manifold for an internal combustion engine as described.

Claims

1. An exhaust manifold (1) for an internal combustion engine of a vehicle comprising a plurality of openings (9) adapted to be connected to respective exhaust ducts (11) obtained on a cylinder head (10) of the engine and comprising respective annular sealing surfaces (13) adapted to cooperate in a fluid-tight manner with the cylinder head (10) about respective exhaust ducts, an exhaust outlet (4) adapted to be connected to an exhaust duct of the vehicle, and a plurality of studs (15) for securing the manifold (1) to the cylinder head (10) via respective threaded members (16), which manifold (1) is **characterised in that** the annular surfaces (13) are disposed to project with respect to the studs (15) such that these studs (15) are spaced, in operation, from the cylinder head (10).
2. A manifold as claimed in claim 1, **characterised in that** the manifold (1) comprises an elongate body (2) having a front wall (5) and two side walls (6, 7), the annular surfaces (13) being provided on the front wall (5) and separated from one another by recesses (14) of this front wall (5), the studs (15) extending laterally in a projecting manner from the side walls (6, 7).
3. A manifold as claimed in claim 2, **characterised in that** the studs (15) comprise a plate fastening portion (17) parallel to the annular surfaces (13) and disposed in the vicinity of the front wall (5) and a stiffening portion (18) rigidly connecting an edge of the fastening portion (17) to a respective side wall (6, 7) of the elongate body (2).
4. A manifold as claimed in any one of the preceding claims, **characterised in that** the portions (17) for fastening the studs (15) have respective holes (20) engaged with radial play by the respective fastening members (16).
5. A manifold as claimed in claim 2 or 3, **characterised in that** it comprises a first pair of studs (15) disposed at a first end of the elongate body (2), a second pair of studs (15) disposed at a second end of the elongate body (2) and a plurality of intermediate studs (15) disposed at the location of the respective recesses (14), the studs (15) of each pair being disposed on laterally opposing sides of the elongate member (2).







European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 01 10 7925

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
X	US 5 887 428 A (GARISTO ANTHONY) 30 March 1999 (1999-03-30) * column 2, line 15 - column 3, line 25; figures *	1, 4	F01N7/10 F01N7/18
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 09, 31 July 1998 (1998-07-31) & JP 10 110618 A (YUTAKA GIKEN CO LTD), 28 April 1998 (1998-04-28) * abstract *	1	
A	US 5 689 954 A (BLOECKER HENNING ET AL) 25 November 1997 (1997-11-25) * figure 1 *	2	
			TECHNICAL FIELDS SEARCHED (Int.CI.7)
			F01N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10 August 2001	Examiner Torle, E
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 O : non-written disclosure 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			

EPC FORM 1503 03/92 (P4/C61)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 10 7925

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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10-08-2001

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