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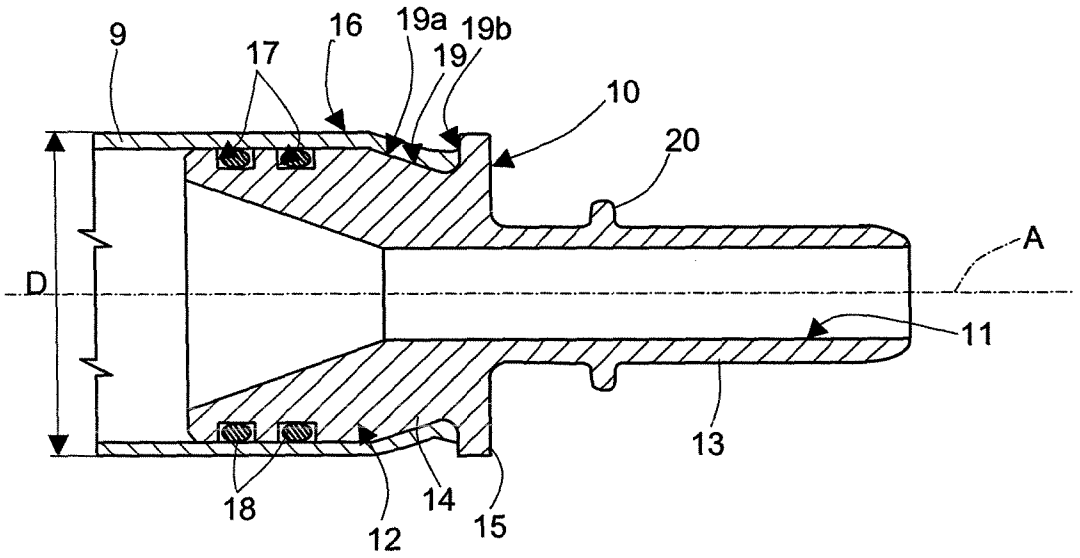
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** HEAT EXCHANGER PROVIDED WITH A CONNECTION ELEMENT



(57) **Abstract:** A heat exchanger for a return circuit of fuel in a diesel engine adapted to connect the engine to a tank of a motor vehicle, comprising a radiating body (2) for exchanging heat with the fuel and at least one metallic end portion (9) adapted to be crossed by the fuel directed towards the tank, and also comprising a connection element (10) rigidly and f luid-tightly connected to the metallic end portion (9) and adapted to be connected to a conduit of the return circuit by means of a tubular portion (13) having an external diameter smaller than the external diameter of the metallic tubular element (9). The metallic end portion (9) defines a narrowing made by plastic deformation to connect to the connecting element (10) and the connecting element (10) is made by moulding a polymeric material.

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HEAT EXCHANGER PROVIDED WITH A CONNECTION ELEMENT

TECHNICAL FIELD

The present invention relates to a heat exchanger for a return branch of a fuel feeding circuit in a diesel engine.

BACKGROUND ART

A return circuit conveys back towards the tank of a motor vehicle the fuel in excess not injected in the combustion chamber and generally comprises a heat exchanger situated upstream of the tank to cool the fuel which is generally at high temperature when it leaves the engine.

When is used a heat exchanger presenting an inlet and an outlet defined by respective metallic tubular portions having larger diameters than those of the conduits used in the return circuit, the heat exchanger must be equipped with appropriate connection elements.

DISCLOSURE OF INVENTION

It is the object of the present invention to make a heat exchanger for the fuel return circuit of a diesel engine, connectable in a simple and cost-effective way to the non-return circuit conduits.

The object of the present invention is achieved by a heat exchanger as defined in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention,

it will now be described a preferred embodiment only by way of non-limitative example, and with reference to the accompanying drawing, in which:

- figure 1 is a frontal view of a heat exchanger according to the present invention;
- figure 2 is a cross-section of figure 1 taken along line II-II in figure 1;
- figure 3 is an axial cross-section of an end portion of the exchanger in figure 1; and
- figures 4 and 5 are axial cross-sections of respective variants of the end portion in figure 3.

BEST MODE FOR CARRYING OUT THE INVENTION

In figure 1, number 1 schematically shows a heat exchanger for a fuel return circuit in a diesel engine. In particular, the return circuit fluidically connects the engine to a tank of the vehicle (not shown) and conveys back towards the tank the fuel which is not injected into the combustion chamber.

The heat exchanger 1 presents a radiating body 2 made of metallic material and integrally comprising an alternating sequence of elbow conduits 3 and of straight conduits 4, each of which presents a side wall 5 of essentially constant thickness and a passage section 6.

The elbow conduits 3 present an essentially circular passage section 6 while the shape of the passage section 6 of the straight conduits 4 presents recesses defined by longitudinal protrusions 7 of the

side wall 5 sunken towards the axis of the respective straight conduit 4 and adapted to cooperate with the fuel through the radiating body 2. On the external surface of the side wall 5 the protrusions define respective grooves 8 forming a "cloverleaf" profile of the passage section itself (figure 2).

The protrusions 7 may be either straight or helical. They may also be made by plastic deformation from a circular section tube, for example by caulking with longitudinal blades.

The grooves 7 improve the efficiency of the heat exchanger. Furthermore, the diameter D of the circumference which surrounds the passage section 6 of the exchanger 1 (figure 2) is higher than the diameter of the tubes of the return circuits in order to maintain low loss of load.

The exchanger 1 also comprises a tubular outlet portion 9 integral with the last straight conduit 4 and a connection element 10 for connecting the tubular outlet portion 9 to a return circuit conduit. The outlet tubular portion 9 presents an external diameter externally equal to the diameter D compatibly with the caulking process for making the grooves 7.

The connection element 10 (figure 3) defines a through hole 11 having an axis A and is made by moulding a polymeric material with glass fillers. For example, either a PA12 or a PA66 both filled at 30%

for withstanding high temperatures may be used.

The connection element 10 comprises a cylindrical body 12 rigidly connected within the tubular outlet portion 9, and a tubular portion 13 protruding from the cylindrical body 12 in axial direction and having an external diameter smaller than the external diameter of the tubular outlet portion 9. In use, the tubular portion 13 is fluid-tightly connected to a conduit of the return circuit according to various connection typologies.

The cylindrical body 12 comprises a connection portion 14 contained within the tubular outlet portion 9 and a flange 15 in radial relief with respect to the connection portion 14.

The connection portion 14 defines a pair of seats 17 accommodating respective o-rings 18 radially compressed against the tubular outlet portion 9 to define fluid-tightness. The o-rings 18 are made respectively of fluorosilicone and fluorocarbon to withstand chemical attacks of diesel fuel and the high thermal excursion characteristic of a diesel fuel circuit.

The connection portion 14 further defines an annular groove 19 arranged between the seats 17 and the flange 15 and joined to the latter. The annular groove 19 presents a tapered side 19a having a profile converging towards the flange 15 and a side 19b joined to the flange 15 and defining an axial

abutment to axially lock an end portion 16 of the tubular outlet portion 9.

During assembly, the connection element 10 is inserted in the tubular outlet portion 9 and arranged abuttingly against the side 19b.

Subsequently, a narrowing is formed by cold plastic deformation of the end portion 16 which assumes a tapered profile and is coupled to the side 19a thus locking the connection element 10 in a fixed manner.

Furthermore, the through hole 11 defines, from the connection portion 14 towards the tubular portion 13, a narrowing of the diameter to reduce the loss of load and subsequently a region in which the diameter is constant. The profile of the diameter choking may be varied at pleasure according to the applications and fluid-dynamic features of the exchanger 1.

The advantages that the device 1 previously described allows to obtain are the following.

The connection element 10 is connected simply to the exchanger by cold plastic deformation, and is of simple and cost-effective construction.

The radiating body 2 and the connection element 10 constitute an exchanger which presents extremely reduced manufacturing and assembly times thanks to the fact that the number of components is low.

Furthermore, the radiating body 2 provided with protrusions 7 is made by plastic deformation of a tube section and therefore presents a high efficiency

and further reduced machining and assembly times.

It is finally apparent that changes and variations can be made to the exchanger 1 described and illustrated without departing from the scope of protection of the accompanying claims.

The tubular element 13 may be shaped to be connected according to various methods to a conduit. A quick-coupling connection may be envisaged by means of a flange 20 carried in an intermediate region of the tubular element 13. Figure 4 shows a connection element 10' in which a single seat 17 is provided for an o-ring 18 either made of fluorocarbon or fluorosilicone. In figure 4, the tubular element 13 presents a cylindrical portion 21 and a rounded or ogive-shaped portion 22. Figure 5 shows a connection element 10'' in which the tubular element defines a reversed pine-tree profile. The connection element 10 may also be mounted in an input tubular portion 9a integral with the first straight conduit 4.

C L A I M S

1. A heat exchanger for a return circuit of fuel in a diesel engine adapted to connect said engine to a tank of a motor vehicle, comprising a radiating body (2) for exchanging heat with the fuel and at least one metallic end portion (9) adapted to be crossed by the fuel directed towards the tank, and also comprising a connection element (10) rigidly and fluid-tightly connected to said metallic end portion (9) and adapted to be connected to a conduit of said return circuit by means of a tubular portion (13) having an external diameter smaller than the external diameter of said metallic tubular element (9) characterised in that said metallic end portion (9) defines a narrowing made by plastic deformation to be connected to said connection element (10) and in that said connection element (10) is made of polymeric material by moulding.

2. An exchanger according to claim 1, characterised in that said connection element (10) presents an annular groove (19) having a first side (19a) converging towards said tubular portion (13) and a second side (19b) defining an axial stop for axially locking said connection element (10) and in that said first narrowing is tapered to couple with said first side (19a).

3. An exchanger according to claim 2, characterised in that said connection element (10) comprises a cylindrical body (12) accommodated within said metallic end portion (9) and defining at least one annular seat (17), also comprising at least one o-ring (18) accommodated in said annular seat (17) to define fluid-tightness.

4. An exchanger according to any of the preceding claims, characterised in that said connection element (10) presents a through hole (11) defining a narrowing of diameter to decrease loss of load.

5. A heat exchanger according to any one of the preceding claims, characterised in that said tubular portion (13) presents either a flanged profile for quick coupling, an ogive profile or a reversed pine-tree profile.

6. An exchanger according to any of the preceding claims, characterised in that said radiating body (2) presents at least one elongated protrusion (7) sunken towards said axis (A) and made by plastic deformation.

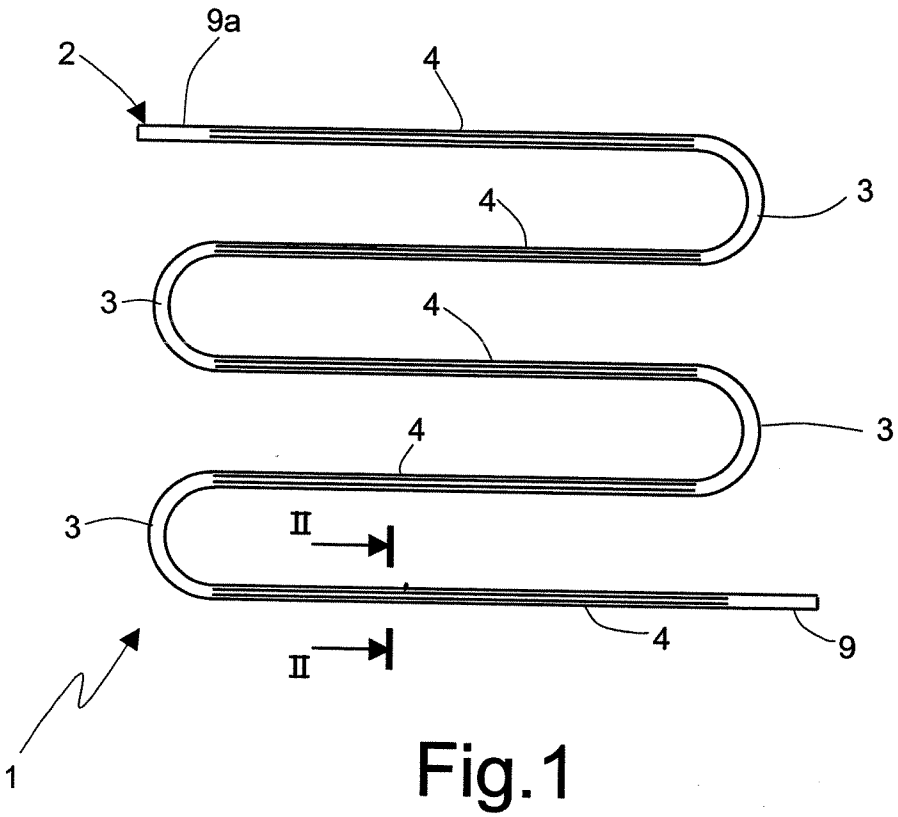


Fig.1

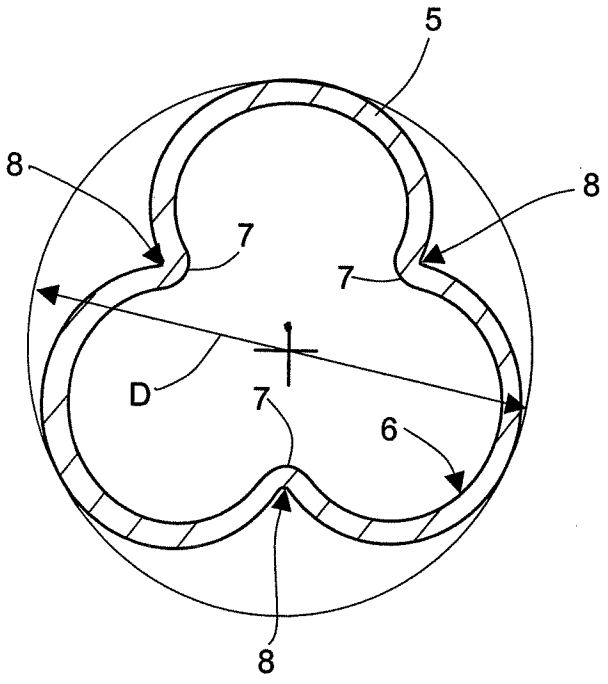


Fig.2

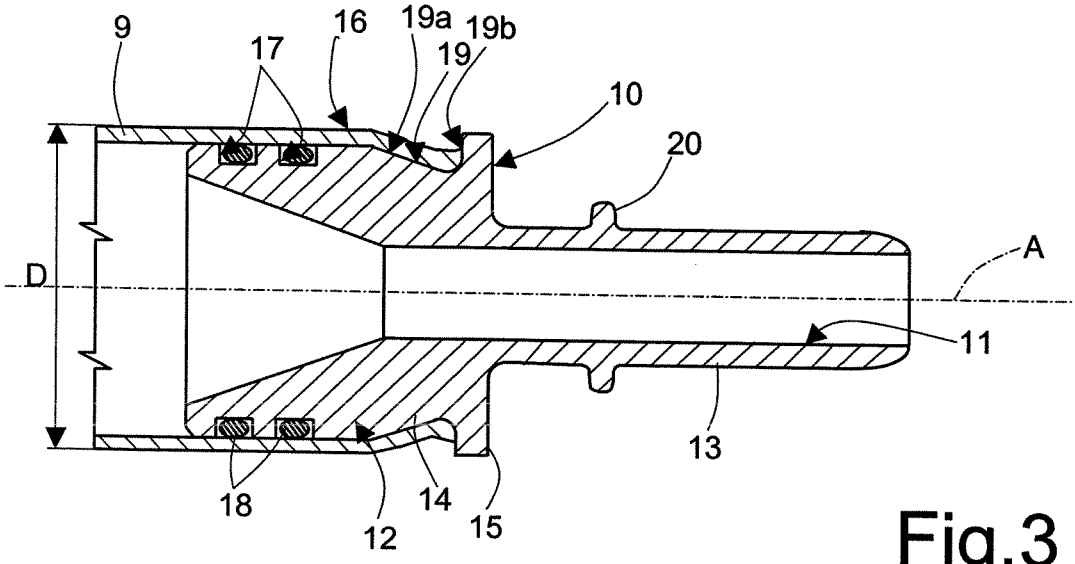


Fig.3

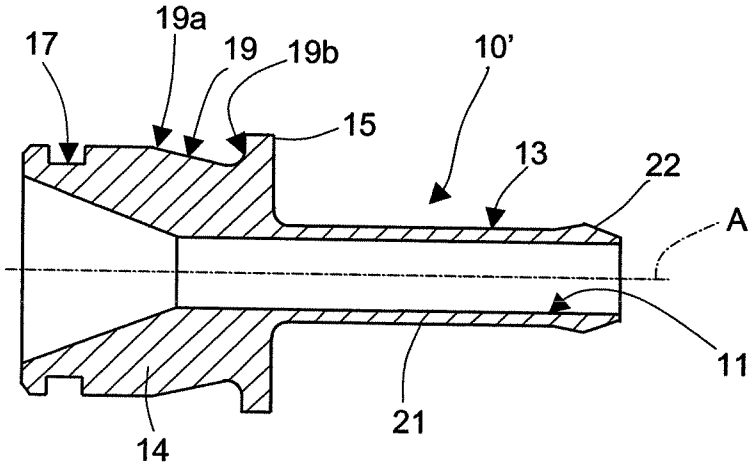


Fig.4

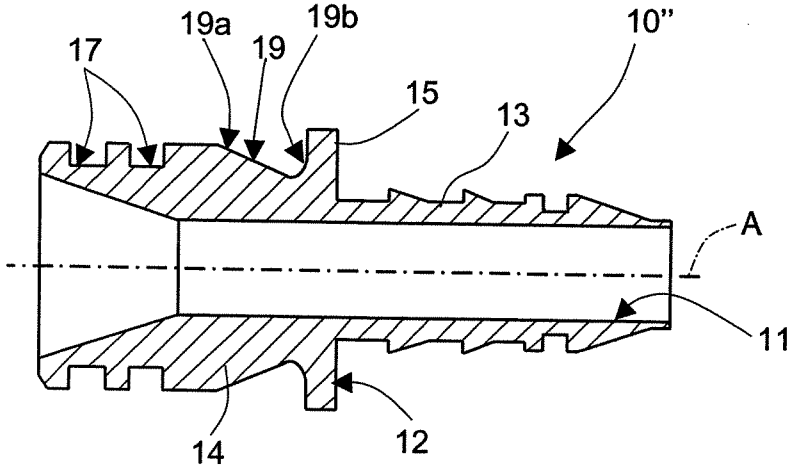


Fig.5

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
INV. F28F9/04 F28F9/26 F28D1/047 F28F1/06 F16L13/14
F02M31/20

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
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Information on patent family members

International application No
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