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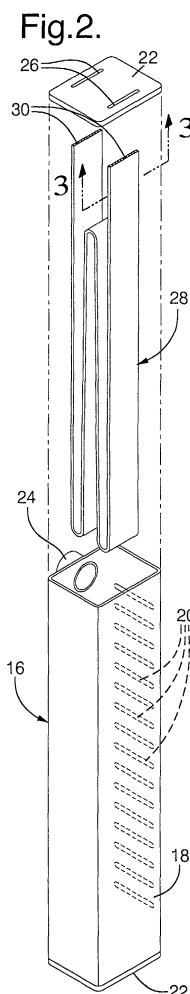
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(54) **Radiator with internal header tank oil cooler**

(57) A vehicle header tank (10) of the type in which most or all of the header tank (16) is metal and brazed concurrently with the rest of the core includes a simplified oil cooler structure integrated with the tank (16) and brazed concurrently with the rest of the core. A section (30) of tubing (28) similar to the radiator coolant flow tubes (12) passes into and out of the header tank (16) through a pair of slots (26) with a geometry similar to that in the regular slotted tank header plate (18) that accommodates the coolant flow tubes (12). Consequently, the oil cooler tube (28) can be installed in leak proof fashion inside the header tank (16) concurrently with the main core braze operation.



Description

TECHNICAL FIELD

[0001] This invention relates to vehicle engine and oil cooling systems in general, and specifically to a radiator with a metal header tank and flat extruded tube oil cooler incorporated in the metal header tank.

BACKGROUND OF THE INVENTION

[0002] Vehicles with often incorporate a transmission fluid or engine oil cooler mounted in the liquid coolant outlet tank of the engine cooling radiator as a convenient means to cool those fluids. Typically, the radiator consists of a basic core with header tanks on each side, and flattened metal coolant flow tubes, generally aluminum, extending between the tanks. Each tank is a plastic box open on one side, the open side being clinched to a metal header plate that receives the ends of the radiator flow tubes. As shown in co assigned USPN 5,645,125, a conventional oil cooler consists of a series of plates stacked into a general box shape, which is installed inside the radiator outlet tank, with sealed inlet and outlet pipes running through the radiator tank wall. This requires very careful sealing not only of the many joints between the oil cooler plates, but also of the metal to plastic interface between the cooler pipes and radiator tank wall. That interface requires mechanical sealing, such as threaded fittings and compressible O rings, which is not as robust as a brazed joint of the type found between the ends of the radiator flow tubes and the radiator tank header plate. Such an oil cooler is also quite massive and heavy, and blocks a good deal of flow area within the radiator tank.

[0003] A relatively newer proposed oil cooler construction is incorporated within all metal (aluminum) header tanks of an all metal core. In effect, the tank and the header plate are one and the same part, or at least formed of the same material. An example may be seen in co assigned USPN 5,823,250. There, the header tank itself has an extruded body, with integral slotted header plate and integral internal oil cooler passage. End caps are brazed on the seal the ends of the header tanks and the internal oil cooler passage simultaneously. This type of integral oil cooler construction depends on the header tank being made as an extrusion, which is not always practical, because of weight and cost considerations.

[0004] In tank oil coolers of differing construction are known, at least in the published patent art. Co assigned USPN 5,645,125 discloses a radiator with header tanks of unspecified material, within one of which a helical round oil cooler tube is arrayed. The ends of the helical tube are sealed through the radiator tank wall in an unspecified fashion. The helical tube is of a round construction not typically used in radiators per se, so it is not clear how such a design would actually be manufactured.

[0005] The manufacture of the radiator itself, or of similar headered heat exchangers, is a well understood and well controlled process, whether the tank is all metal or of plastic with a metal header plate only. The flattened metal flow tubes, typically extruded or fabricated aluminum, with or without internal strengthening webs, are inserted through closely matching slots formed through the header plates. Braze material provided on the surface of either the flat metal tube or the header plate is melted when the core itself is brazed, and drawn into the tube end-slot interface to form a simple, consistent and leak proof joint. If similar materials and techniques could be used to form the oil cooler, as well, maximum design flexibility and minimum cost would be achieved.

SUMMARY OF THE INVENTION

[0006] The invention provides a radiator header tank and oil cooler incorporated within the tank in which the oil cooler itself and its sealed interface with the radiator header tank do incorporate the same material and manufacturing technique as are typically used to make the radiator core.

[0007] In the preferred embodiment disclosed, the radiator core uses typical flattened metal tubes and a metal header tank that can be formed by any desired technique, not just extrusion. The in tank oil cooler consists of a length of the same kind of tubing used in the radiator flow tubes itself, which enters and exits at some point on the tank wall through slots in the tank wall formed with the same geometry as the slots in the header plate. The entire core, with oil cooler, can be brazed in one step, and the sealed interface between oil cooler tube and tank wall is formed in the same way, and is just as robust as, the sealed interface between the ends of the radiator flow tubes and the header plate slots of the basic core. Since it is formed of a single length (or lengths) of seamless tubing, the integral, in tank oil cooler so formed is small in volume, lightweight, low cost, and has no potential oil leak points within the radiator tank. It can be formed with a wide variety of shapes, by simple tube bending, and can enter and exit the radiator tank wall at any desired point, to give maximum design flexibility.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other features of the invention will appear from the following written description, and from the drawings, in which:

Figure 1 is a perspective view of a radiator having all metal header tanks;

Figure 2 is a perspective view of a radiator tank like that shown in Figure 1, modified so as to incorporate an oil cooler made according to the invention;

Figure 3 is an end view of the type of tube used to form the oil cooler;

Figure 4 is a close up of the interface between the

ends of the oil cooler tube and the header tank;
 Figure 5 shows the oil cooler inserted into the header tank, ready for brazing;
 Figure 6 shows an inlet outlet fitting that may be attached to the exposed ends of the oil cooler tube, during or after the basic brazing process.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0009] Referring first to Figure 1, an all metal radiator 1 consists of a basic core of flow tubes 12 and interposed corrugated oil cooling fins 14. Bordering each side of the basic core are a pair of all metal header tanks, indicated generally at 16. Tanks 16 are generally box shaped structures, with an inner side 18 that is regularly slotted at 20, so as to form a header plate to receive the ends of the flow tubes 12. The ends of the header tanks 16 are closed by upper and lower end caps 22. Coolant inlets and outlets 24 admit engine coolant to, and drain engine coolant from, each of the tanks 16. Significantly, the basic construction of the tanks 16 is not limited to any particular material (although it is generally aluminum) or technique. That is, the basic tank shell could be formed as an extrusion, so that the inner side header plate 18 would be integral. Or, the tank shell could be a fabricated series of pieces, with an integral end cap 22 and a separate slotted header plate 18 that was clinched to the tank shell to be brazed later. Each possible construction has its own well known advantages and drawbacks. An extruded shell has an integral header plate 18, but is heavy, and difficult to clad with brazing material. A fabricated shell consists of separated stamped aluminum pieces, which requires more fabrication, but is light and can be easily pre clad with brazing material. Any brazed radiator construction in which the header tank (or some significant portion of it) is brazed along with the rest of the core will have some header tank wall portion, such as the end cap 22, that is suitable to be slotted similarly to the slotted header plate. Accumulated years of brazing process development has assured that the interface between the ends of the flow tubes 12 and the slots 20 in header plate 18, each of which is a potential coolant leak point, has a consistent geometric interface, and a consistent, robust braze joint that is solid and leak proof. Also, years of development in tube fabrication has assured that the tubes 12 themselves are consistent, leak proof, lightweight and cost effective. The invention disclosed takes maximum advantage of these features.

[0010] Referring next to Figure 2, the invention uses the same basic known, all metal radiator construction shown above, with one simple modification. Some point on the body of the header tank 16, here, the end cap 22, has a pair of side by side oil cooler slots 26 cut through it, similar to the regular tube slots 20 in header plate 18. The oil cooler slots 26 would be formed by the same tooling and technique as the header plate slots 20 and, again, the end cap 22 consists of the same material as

the header plate 18. As such, the tank wall slots 26 represent a very minor and simple change in the basic construction of tank 16.

[0011] Referring next to Figures 2 and 3, the other addition, besides the slots 26, consists of a length of oil cooler tube 28, which has two free ends 30. As best seen in Figure 3, oil cooler tube 28 is a typical "flat oval" aluminum extrusion, with internal webs 32 and, as shown, is bent into a generally sinuous shape. Tube 28 is either identical to, or at least has a similar outer geometry to, the radiator flow tubes 12. Radiator flow tubes 12 do not generally require the internal strengthening webs typical in an extrusion, and are most often formed of fabricated sheet metal stock, which is easier to clad on the outside with brazing material. But, again, the outer tube geometry can be consistently held, just as with the oil cooler tube 28. Likewise, oil cooler tube 28 need not absolutely be formed as an integral extrusion, though it would be most practical to do so. In that case, it would be difficult to clad it with brazing material, but it would be relatively simple to clad the end caps 22 in that fashion on their outer surface, even if the body of tank 16 were itself an integral extrusion. So, there is a great deal of flexibility in how the various parts may be formed. However formed, tube 28 will be effectively seamless and sealed, with the same high degree of structural integrity as the flow tubes 12 themselves. It is much easier to assure a leak proof condition for tube

[0012] Referring next to Figure 4, before the end caps 22 are installed to the body of the tanks 16, the oil cooler tube ends 30 are inserted through the end cap slots 26. Their mutual interface would have the same configuration as that between the ends of the radiator flow tubes 12 and header plate slots 20, even if not exactly the same size, although they could be exactly the same size, as well. Both for the flow tubes 12 and the oil cooler tube ends 30, there is a ready supply of braze material, whether clad onto the part surfaces surrounding the tube to slot interface, or clad onto the tube surfaces themselves.

[0013] Referring next to Figure 5, the end cap 22 has been inserted into tank 16, closing the end thereof, and serving to insert the body of the bent oil cooler tube 28 down into the interior of the tank 16. The tube ends 30 remain accessible outside the tank 16. At the same time, the rest of the radiator core would be assembled and stacked, and the ends of the flow tubes 12 inserted into the header plate slots 20 and the entire unit would be ready for the brazing operation. Inside the tank 16, there are no possible leak points out of the unitary tube 28. The only possible leak point out of the tank 16, the interface between tube ends 30 and the end cap slots 26, becomes sealed during the braze process identically to the interface between the ends of the flow tubes 12 and the header plate slots 20. That is, braze material, whether located on the surface of the tube ends 30, or on the surface of the end cap 22 surrounding the slots 26, or both, is melted, drawn into the carefully sized and con-

trolled tube end 30-slot 26 interface, after which it hardens into a leak proof joint. No other seals or mechanical structures are needed to create the oil cooler to header tank seal. The use of the flat tube 28, which is relatively light, and yet relatively stiff (and which is effectively stiffened by virtue of being bent into a U or sinuous shape), in conjunction with the straight slots 26, serves to keep the tube 28 oriented within the header tanks 16, spaced from the interior walls thereof. Concurrently, the fins 14 braze to the tubes 12, and the end caps 22 braze to the tanks 16, leaving a solid, effectively unitized core structure. The oil cooler can thus take advantage of the one shot braze process and technology in a very efficient manner.

[0014] Referring finally to Figure 6, since the oil cooler slots 26 are proximate, a single inlet-outlet block fitting 32 can be attached to the oil cooler tube ends 30, either after the basic braze operation, or during. This allows oil lines to be easily attached, leak free, and any potential leak points, again, would be external to the tank 16. In operation, coolant entering the tank 16 that contains the oil cooler tube 28 (generally the cooler return tank) flows around the tube 28, cooling the oil flowing through it. In the completed unit, there is not only less cost, less weight, and less potential internal tank leakage, there is also less volume occupied inside tank 16, and less potential flow blockage and pressure drop in the coolant flow. If desired, corrugated fins could be brazed between the parallel bends in the oil cooler tube 28, similar to the fins 14 brazed between the radiator coolant tubes 12.

[0015] Other configurations for the oil cooler tube 28 could be used, of differing construction, and incorporating more or fewer bends, or even multiple tubes (which would necessitate multiple slots 26). For example, tubes could be fabricated or folded of clad stock, with an internal configuration similar to the integral, extruded tube 28. Extruded and fabricated tubes of essentially identical configuration have been known alternative constructions in myriad applications for decades. Either construction would work to have its tube ends brazed into the slots 26 during the single braze process and, in the case of fabricated oil cooler tubes, the tubes themselves would be formed as part of the same braze process. The slots 26 could be formed through any suitable wall surface of the tank 16, not just the end caps 22 and need not be proximate to one another. Or, the slots 26 could be proximate to one another and actually joined by a thinner slot, so as to allow an integral, U shaped tube with two enlarged "ends" joined by a central web to be used. The central web would pass through the thinner central slot, and would be brazed thereto. The tank 16 need not be entirely metal, so long as it has some suitable surface, such as the end cap 22, through which the ends of the oil cooler tube or tubes could be passed and brazed. Therefore, it will be understood that it is not intended to limit the invention to just the embodiment disclosed.

Claims

1. In an engine cooling radiator (10) with a brazed core having a series of coolant flow tubes (12) inserted into a slotted (20) header plate (18) of a header tank (16) that are brazed to said slotted header plate (18) to form leak proof joints, the improvement comprising,
 - a wall portion of said header tank (16) having at least a pair of oil cooler slots (26) formed therein of a geometry similar to said header plate slots (20), and,
 - an integrated oil cooler comprising a sealed tube (28) having a pair of ends (30) extending through said header tank oil cooler slots (26) to the exterior of said header tank (16), said oil cooler tube ends (30) being brazed concurrently with said core to form leak proof joints to said header tank (16).
2. A radiator (10) according to claim 1, further **characterized in that** said header tank wall portion is a header tank end cap (22).
3. A radiator (10) according to claim 1, further **characterized in that** said oil cooler tube (28) is formed as a substantially flat metal extrusion.
4. A radiator (10) according to claim 3, further **characterized in that** said oil cooler tube is bent into a sinuous shape.
5. A radiator (10) according to claim 1, further **characterized in that** said oil cooler tube ends (30) are proximate to one another and a single oil inlet-outlet fitting (32) is joined thereto.

Fig.1.

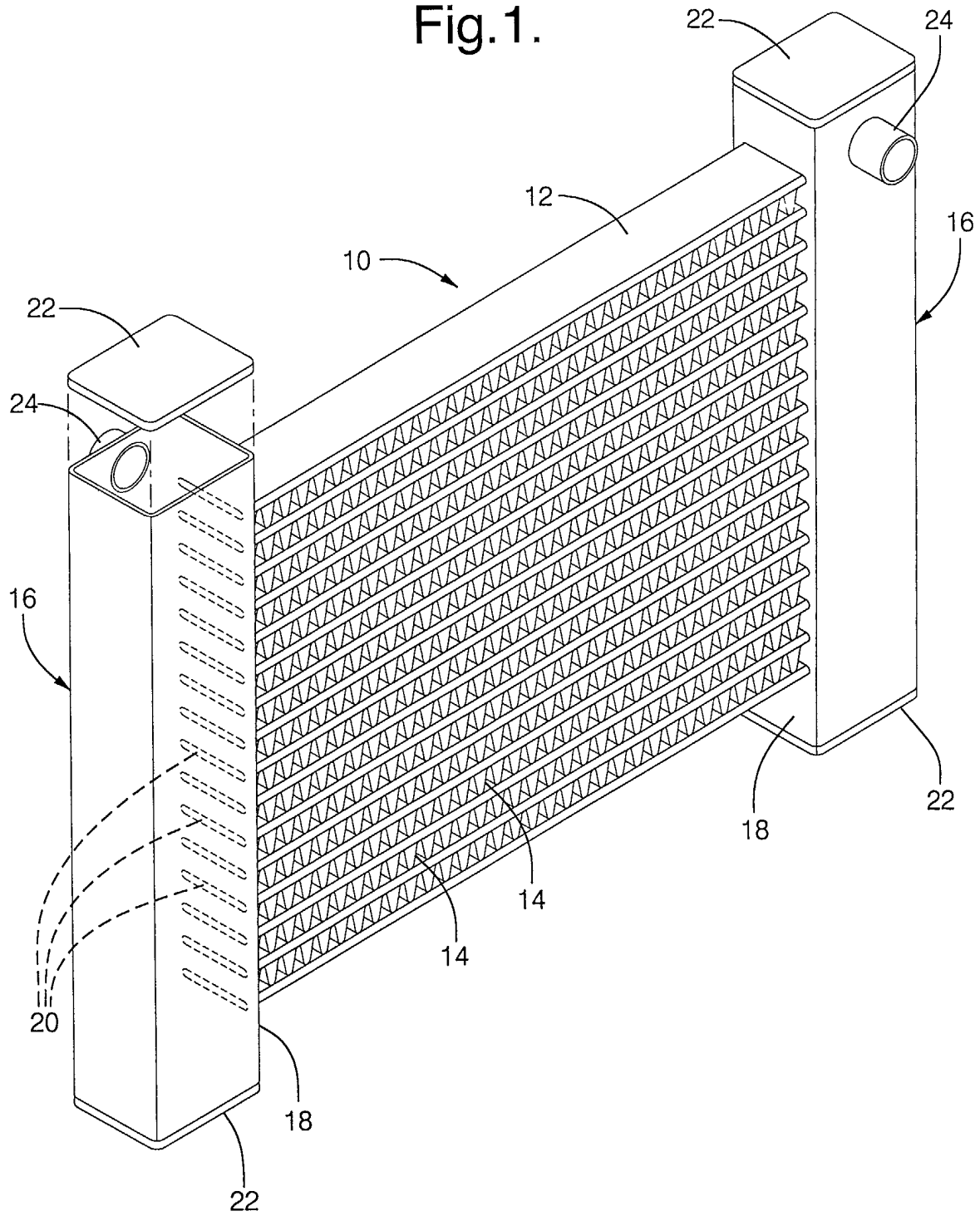


Fig.2.

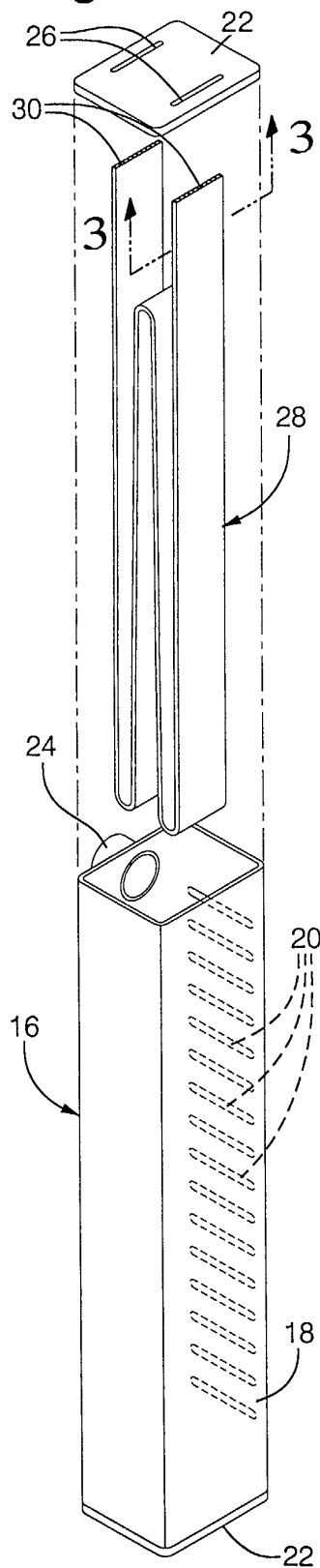


Fig.4.

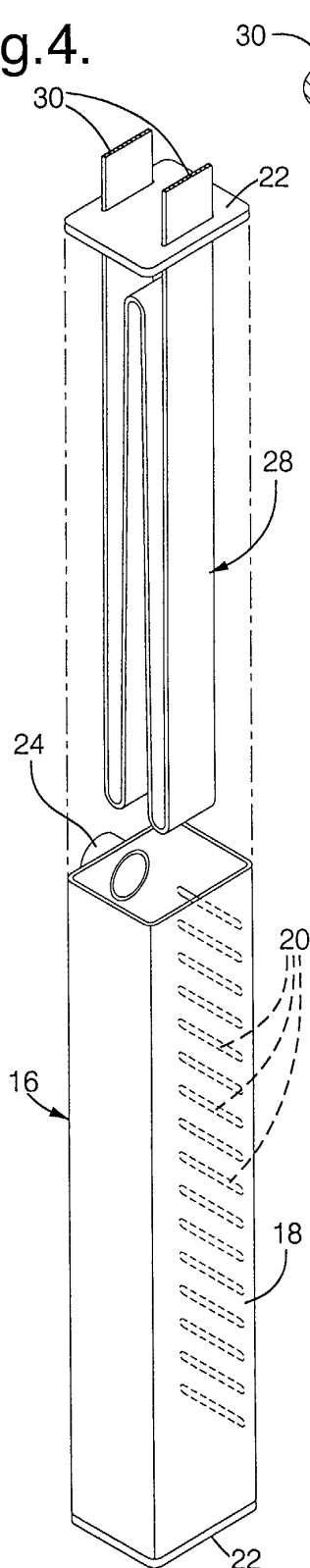


Fig.3.

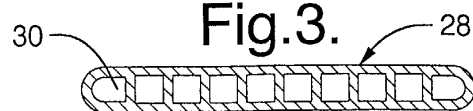


Fig.5.

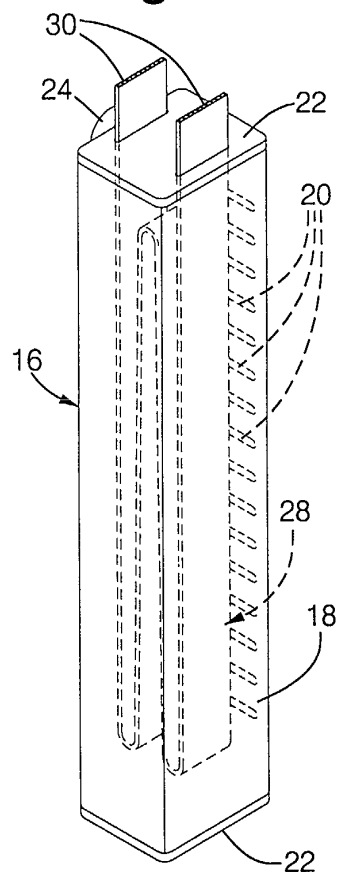
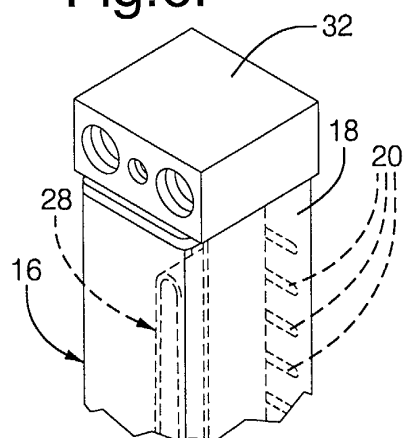


Fig.6.





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 07 5700

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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 12 July 2002	Examiner Bain, D
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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