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(54) Oil pan for automotive engines and method of making same

(57) An oil pan structure for an internal combustion engine, particularly for motor vehicles, comprising a box-like oil receptacle, formed by a tray having side walls, a bottom wall, an upper edge with an attachment portion to be anchored to the engine block by suitable fastening means, an oil suction tube extending from the top of the edge into the receptacle. The tube has a first end and a

second end connected to the box-like receptacle by upper connection means. The structure is characterized in that the box-like receptacle, the tray, the suction tube, the fastening means the connection means are formed in a substantially rigid thermoplastic material, capable of resisting to oil corrosion and mechanical stresses caused by the engine and the roadbed in a temperature range from -40°C to +150°C.

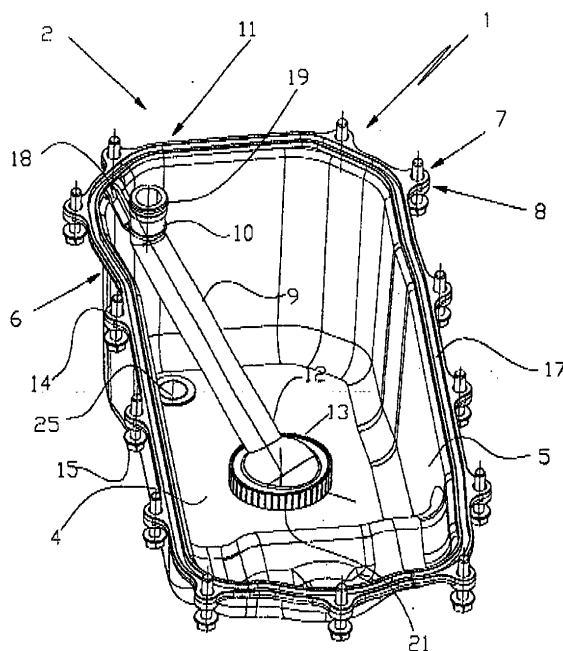


FIG. 1

Description

Field of the invention

[0001] The present invention finds application in the automotive field and relates to an oil pan structure for internal combustion engines of vehicles, particularly motor vehicles, according to the preamble of claim 1.

[0002] A further aspect of the invention relates to a method of making such pan structure.

Background of the invention

[0003] The oil pan of an internal combustion engine is part of lubricating circuit of the same engine and has the specific function of collecting the hot lubricating oil outflowing from the engine and acting as a reservoir wherefrom oil is sucked by the circulation pump, the latter being typically driven directly by the engine by means of a kinematic device.

[0004] The oil pan is generally placed under the engine block thereby closing it.

[0005] During the engine's life, the pan structure has to withstand many stresses, particularly vibrations transmitted from the engine connected thereto, shocks produced by any object on the roadway, e.g. stones, as well as stresses caused by oil itself contained.

[0006] Indeed, lubricating oil is not chemically inert, and particularly can corrode organic materials, such as polymers, against which it is particularly aggressive at typical engine operating temperatures, i.e. above 100°C.

[0007] Other stresses are induced by the variation speed of operating temperatures: for instance, in particularly cold weather conditions, as the engine is started, oil temperature may abruptly change from a few tenths of degrees Celsius below zero to a temperature of more than +120°C.

[0008] For these reasons, prior art oil pans are generally made of a metal material, e.g. of steel sheet, or by aluminum alloys die cast.

[0009] An example of such prior art oil pans for thermal combustion engines is disclosed in European Patent application EP-A-1304451.

[0010] This oil pan is formed with a sheet-metal box-like receptacle attached to the engine block by a "floating" fixation arrangement, to allow relative motion between the block and the oil pan and dampen some of the stresses transmitted from the engine, and with a metal suction tube inside it with an end secured to the bottom wall of the receptacle, so as to be always dipped in oil and the other end having a quick-connect conformation, for easy coupling to the corresponding suction tube of the circulation pump.

[0011] The upper edge of the receptacle is folded back on itself and a housing is formed therein for a seal. The end of the suction tube that is dipped in oil contains a perforated metal sheet filter member, for retaining any foreign bodies.

[0012] A drawback of this prior art pan is its considerable weight, essentially due to its being made of a metal material, as well as the high cost of the assembly.

[0013] In European Patent EP-B-1041253 a polypropylene oil pan with reinforcement webs and ribs having a thermoplastic elastomer coating for taking up external stresses is disclosed.

[0014] A drawback of this prior art oil pan is the poor resistance of polypropylene to mechanical and thermal stresses at high and low operating temperatures.

[0015] International Patent application WO 03/102387 discloses a thermoplastic pan, optionally reinforced with glass, carbon or metal fibers, which is formed by direct molding onto a preferably metal support structure.

[0016] Drawbacks of this prior art solution are the complexity of the molding step, which is performed on a previously prepared support structure and the considerable cost of the process.

[0017] In the US patent US-B-6,705,270 an oil pan made of a polyamide-based thermoplastic material reinforced with glass fibers, and having the oil pump, electrically driven, integrated in the pan structure, is disclosed.

[0018] A drawback of this prior art pan is the fact that it is not well suited for engines of motor vehicles, in which a highly reliable and accessible lubrication system is required.

Summary of the Invention

[0019] The main object of this invention is to obviate the above drawbacks, by providing an oil pan structure for internal combustion engines of vehicles, particularly commercial and industrial vehicles, having high performance, simple construction and low cost properties.

[0020] A particular object is to provide a particularly light-weight oil pan structure.

[0021] A further object of the invention is to provide an oil pan structure that has a minimized number of parts and can be sold in a ready-to-mount preassembled configuration.

[0022] Another particular object of the invention is to provide an oil pan structure that can be easily and quickly un-mounted and remounted for maintenance purposes.

[0023] These and other objects, to be better explained hereafter, are fulfilled by an oil pan structure for internal combustion engines, particularly for motor vehicles, which, as defined in claim 1, comprises a box-like oil receptacle, formed by a tray having side walls, a bottom wall, an edge with an attachment portion to be anchored to the engine block by suitable fastening means, an oil suction tube extending from the top of said edge into said receptacle, having a first end to be connected to said edge by upper connection means, and a second end to be connected to said bottom wall or said side walls by lower connection means, characterized in that said box-like receptacle, said suction tube, said attachment portion and said connection means are made from a substan-

tially rigid thermoplastic mixture, capable of resisting to oil corrosion and to mechanical or thermal stresses caused by the engine and the roadbed in a temperature range from -40°C to $+150^{\circ}\text{C}$.

[0024] According to a further aspect of the invention, there is provided a method for making said oil pan structure which, as defined in claim 19, is characterized in that it comprises a step a) of injection molding of a tray having a bottom wall, side walls, an edge with an attachment portion, lower connection means with a plurality of apertures capable to retain oil impurities; a step b) of insertion of metal bushes in the attachment portion of the pan to the engine block; a step c) of injection molding of a suction tube with upper connection means, having a first quick-connect end for connection to the oil suction tube and a second substantially bell-shaped end for connection to the lower connection means; a step d) of placement of said suction tube in said tray.

[0025] Thanks to this structure and this method, a particularly inexpensive and light-weight oil pan may be provided, which comprises a few parts, resists to oil action, may be easily un-mounted and remounted on engines of commercial vehicles and requires short times for engine maintenance and repair.

Brief description of the drawings

[0026] Further features and advantages of the invention will be more apparent from the detailed description of one preferred, non-exclusive embodiment of an oil pan structure according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is an axonometric view of the oil pan according to the invention;

FIG. 2 is a partial sectional side view, as taken along a vertical plane, of the oil suction tube of the pan of FIG. 1;

FIG. 3 is a sectional side view, as taken along a vertical plane, of the attachment portion and the waste oil drain aperture of the oil pan of FIG. 2;

FIG. 4 is a sectional side view, as taken along a vertical plane, of the second end of the suction tube and the lower connection means of the pan of FIG. 1;

FIG. 5 is a sectional side view, as taken along a vertical plane, of the oil outlet of FIG. 3;

FIG. 6 is a sectional side view, as taken along a vertical plane, of the attachment portion of FIG. 3;

FIG. 7 is a sectional side view, as taken along a vertical plane, of the upper connection means and the suction tube of FIG. 1.

Detailed description of a preferred embodiment

[0027] Referring to the above figures, an oil pan structure for internal combustion engines of vehicles is shown, generally designated by numeral 1, which may be mount-

ed to the underside of an internal combustion engine block in commercial vehicles.

[0028] The oil pan structure 1 essentially comprises a box-like oil receptacle 2, formed by a tray 3 consisting of a bottom wall 4 and side walls 5. The upper edge 6 of the walls 5 is outwardly folded back on itself and has an attachment portion 7 anchorable to the engine block, the latter not being shown in the annexed figures, using suitable fastening means 8.

[0029] The pan structure 1 further comprises an oil suction tube 9 which extends within the perimeter of the edge 6 from the top of said edge 6 into the tray 3 to the bottom wall 4.

[0030] The tube 9 has a first end 10 in the proximity of the upper edge 6, which may be connected thereto by upper connection means 11, and a second end 12 associated to the bottom wall 4, or the side walls 5, and connectable thereto by lower connection means 13.

[0031] According to this invention, the box-like receptacle 2, the suction tube 9, the attachment portion 7 and the connection means 11 and 13 are made of a substantially rigid thermoplastic material capable of resisting to oil corrosion and other mechanical and thermal stresses caused by the engine and the roadbed.

[0032] Particularly, the thermoplastic material of the invention can resist to corrosion and mechanical stresses induced by the engine and the roadbed in a temperature range from -40°C to $+150^{\circ}\text{C}$, that is the temperature range in which the engine is lubricated, even when the top of the range is reached abruptly, for instance after the starting of the engine in particularly cold weather conditions.

[0033] A peculiar feature of the invention is that the thermoplastic mixture is a polyamide-based mixture selected from the group comprising nylon 6 (polycaprolactam) and nylon 66 (poly-1,6-hexamethylene adipamide) and mixtures thereof, and contains glass fibers and/or mineral fillers selected from the group comprising phyllosilicates such as talc or mica and/or carbonates such as calcium carbonate.

[0034] Glass fibers are preferably contained in polyamide in amounts from 5% to 50% by weight and preferably from 30% to 40% by weight.

[0035] In accordance with a preferred embodiment, the edge 6 of the tray 3 is outwardly folded back and has an attachment portion 7 for anchorage to the engine block on which the pan is mounted.

[0036] Such portion 7 comprises ring-like apertures 14 for the passage of the fastening means 8, e.g. bolts 15.

[0037] Conveniently, metal bushes 16 are introduced in the these through apertures to prevent the tightening torque from being weakened, due to relaxation of the plastic material with time, on which bushes the bolts are tightened.

[0038] The upper edge 6 of the tray 3 defines a housing 17 for a seal to be interposed between the oil pan structure 1 and the engine block.

[0039] The upper connection means 11 associated to

the first end 10 of the oil suction tube 9 may be formed with of one or more brackets 18 which are designed to fit the edge 6, thereby connecting the first end 10 of the suction tube 9 to the tray 3.

[0040] A peculiar feature of the invention is that the brackets 18 that form the upper connection means 11 and the suction tube 9 are made from the same plastic material, by a single injection molding step.

[0041] Suitably, to facilitate mounting of the oil pan to the engine block, the first end 10 of the tube 9 comprises means 19 for quick snap connection of the tube 9 to the suction tube of the engine oil pump, not shown.

[0042] The lower connection means 13 for fastening the tube 9 to the bottom wall 4 comprise a wall 20 that has a closed, preferably substantially circular plan shape, and extends substantially perpendicularly from the bottom wall 4 into the receptacle 2.

[0043] To allow the passage of sucked oil and retain any oil impurity, a plurality of substantially vertical apertures 21 is formed in the wall 20.

[0044] To improve the flow of sucked oil, the lower connection means 13 further comprise a substantially flat baffle 22, having an aperture 23 for the passage of oil from the tray 3 to the suction tube 9.

[0045] For easier mounting of the pan, the second end 12 of the suction tube 9 is substantially bell-shaped, with the edge 24 adapted for quick connection with the vertical wall 20.

[0046] A waste oil drain aperture 25 is provided in the bottom wall 4, and is closed by the plug 26.

[0047] According to the invention, the receptacle 27 for the plug 26 may be made of metal or plastic and is inserted or co-molded in the bottom wall 4.

[0048] Conveniently, the closing plug 26 may be also made of a thermoplastic material.

[0049] A method for making the above oil pan structure 1 consists of a plurality of successive steps, comprising a step a) of one-step injection molding of a tray 3 having a bottom wall 4, side walls 5, an edge 6 with an attachment portion 7, lower connection means 13 with a plurality of apertures 21 and the receptacle 27 for the plug 26; a step b) of insertion of metal bushes 16 in the holes 14 of the attachment portion 7 to the engine block; a step c) of forming by one-step injection molding a suction tube 9 with upper connection means 11, having the first end 10 conformed for quick-connection to the oil suction tube and the second end substantially bell-shaped for connection to the lower connection means 13 and a step d) of placement of the tube 9 in the tray 3.

[0050] The method may further comprise an additional step e) of insertion of the metal receptacle 27 for the plug 26 in the opening 25.

[0051] In operation, the oil pan structure of the invention is mounted to the engine block by first positioning the tube 9 between the connections 11 and 13, then fastening the quick snap connection means 19 of the first end 10 of the tube 9 to the oil suction tube of the engine block and finally inserting and tightening the connection

members 15 in the holes 14 at corresponding holes on the engine block.

[0052] The oil pan structure of the invention is susceptible of a number of changes and variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, without departure from the scope of the invention.

[0053] While the device and method for making it have been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

Claims

1. An oil pan structure for an internal combustion engine, particularly for motor vehicles, comprising a box-like oil receptacle (2), formed by a tray (3) having side walls (5), a bottom wall (4), an edge (6) with an attachment portion (7) to be anchored to the engine block by suitable fastening means (8), an oil suction tube (9) extending from the top of said edge (6) into said receptacle (2), and having a first end (10) connectable to said edge (6) by upper connection means (11), and a second end (12) connectable to said bottom wall (4) or said walls (5) by lower connection means (13), **characterized in that** said box-like receptacle (2), said suction tube (9), said attachment portion (7) and said connection means (11, 13) are formed in a substantially rigid thermoplastic mixture, capable of resisting to oil corrosion and to mechanical and thermal stresses caused by the engine and the roadbed in a temperature range from -40°C to +150°C.
2. An oil pan structure as claimed in claim 1, **characterized in that** said thermoplastic mixture comprises glass fibers and/or mineral fillers.
3. An oil pan structure as claimed in claim 2, **characterized in that** said thermoplastic mixture comprises nylon 6 polyamide (polycaprolactam) or nylon 66 polyamide (poly-1,6-hexamethylene adipamide) or mixtures thereof.
4. An oil pan structure as claimed in claim 2 or 3, **characterized in that** said glass fibers and/or said mineral fillers are contained in an amount from 5% to 50% by weight and preferably from 30% to 40% by weight.
5. An oil pan structure as claimed in any one of the preceding claims, **characterized in that** the edge (6) of said tray (3) is outwardly folded back and has an attachment portion (7) for anchorage to the en-

gine block.

6. An oil pan structure as claimed in claim 5, **characterized in that** said attachment portion (7) for anchorage to the engine block has through apertures (14) for the passage of screw fastener means (15). 5
7. An oil pan structure as claimed in claim 6, **characterized in that** metal bushes (16) are inserted in said through apertures (14), screw fastener means (13) acting on said metal bushes (16) for anchorage to the engine block. 10
8. An oil pan structure as claimed in any one of the preceding claims, **characterized in that** said upper edge (6) of the tray defines a housing (17) for a seal to be interposed between said oil pan structure (1) and the engine block. 15
9. An oil pan structure as claimed in claim 1, **characterized in that** said upper connection means (11) associated to said first end (10) of said suction tube (9) comprise one or more brackets (18) for connecting said oil suction tube (9) to said tray (3). 20
10. An oil pan structure as claimed in claim 9, **characterized in that** said first end (10) of said suction tube (9) comprises snap fit means (19) for quick connection of said tube (9) to the suction tube of the engine oil pump. 25
11. An oil pan structure as claimed in claim 1, **characterized in that** said lower connection means (13) of said suction tube (9) comprise a wall (20) extending from said bottom wall (4) into the tray (3), said wall (20) having a plurality of apertures (21) for allowing the passage of sucked oil and retain any oil impurity. 30
12. An oil pan structure as claimed in claim 11, **characterized in that** said wall (20) is substantially perpendicular to said bottom wall (4) and said apertures (21) are substantially vertical. 35
13. An oil pan structure as claimed in claim 12, **characterized in that** said wall (20) as a closed, preferably substantially circular, plan shape. 40
14. An oil pan structure as claimed in claim 11, **characterized in that** said lower connection means (13) further comprise a substantially flat baffle (22), having an aperture (23) for the passage of oil from the tray (3) to the suction tube (9). 45
15. An oil pan structure as claimed in claim 1, **characterized in that** said second end (12) of said suction tube (9) is substantially bell-shaped, with the edge (24) adapted for quick connection with said vertical wall (20) of said lower connection means (13). 50
16. An oil pan structure as claimed in claim 1, **characterized in that** said bottom wall (4) further comprises a waste oil drain aperture (25) with a receptacle (27) made of an inserted metallic material for the closing plug (26). 55
17. An oil pan structure as claimed in claim 16, **characterized in that** said receptacle (27) for the closing plug (26) is made of a plastic material that is either inserted or co-molded with said bottom wall (4).
18. An oil pan structure as claimed in claim 16 or 17, **characterized in that** said closing plug (26) is made of a metal or thermoplastic material.
19. A method of making an oil pan structure as claimed in one or more of the preceding claims, **characterized in that** it comprises the following steps:
 - a) injection molding of a tray (3) with a bottom wall (4), side walls (5), an edge (6) with an attachment portion (7), lower connection means (13) with a plurality of apertures (21) capable to retain oil impurities;
 - b) insertion of metal bushes (16) in the attachment portion for the engine block;
 - c) injection molding of a suction tube (9) with upper connection means (11), a first quick-connect (19) end (10) for connection to the oil suction tube and a second substantially bell-shaped end (12) for connection to the lower connection means (13);
 - d) placement of said suction tube (9) in said tray (3).
20. Method for making an oil pan structure as claimed in claim 19, **characterized in that** it further comprises the step e) of insertion of the metal receptacle (27) for the plug (26) in the opening (25).

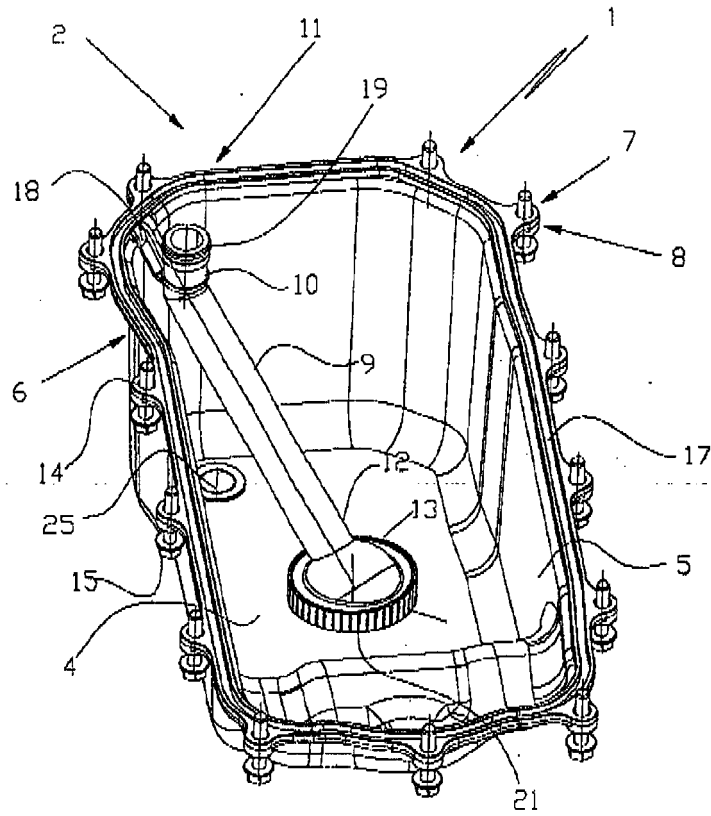


FIG. 1

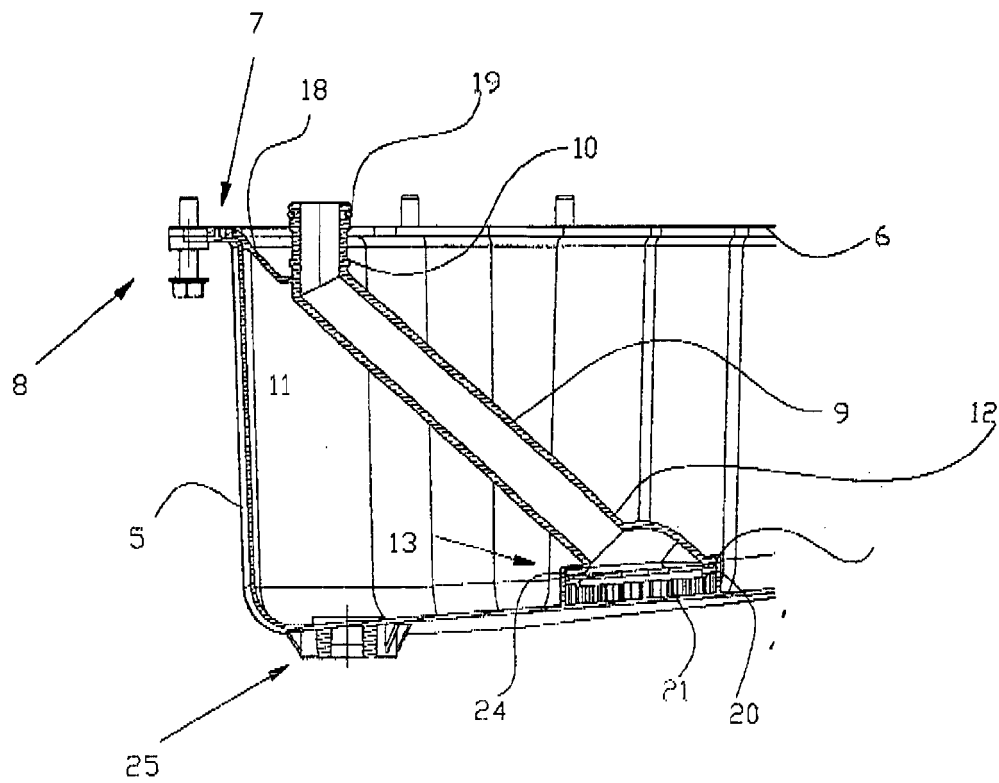


FIG. 2

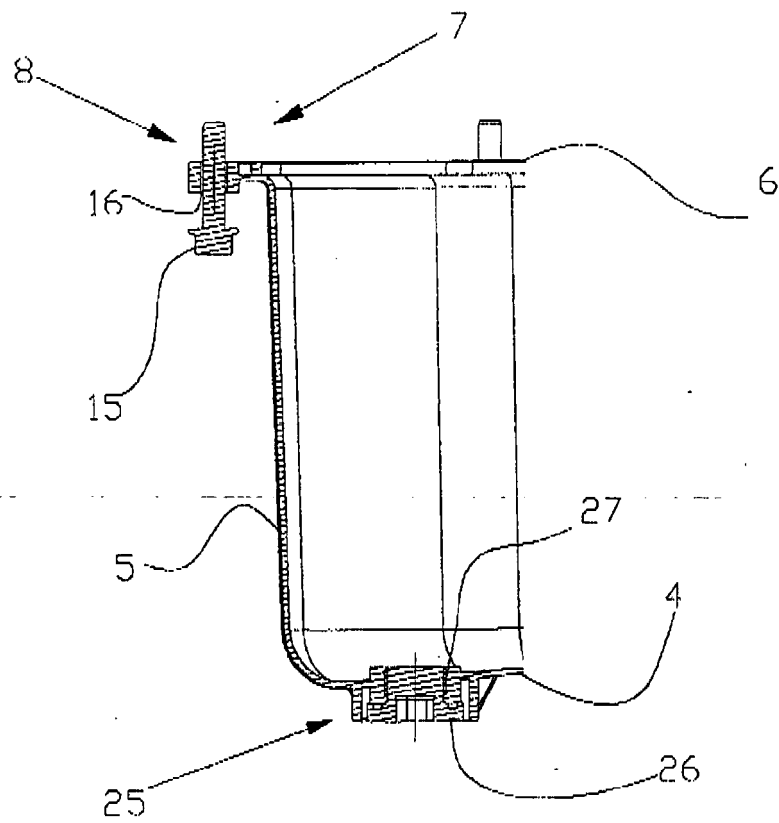


FIG. 3

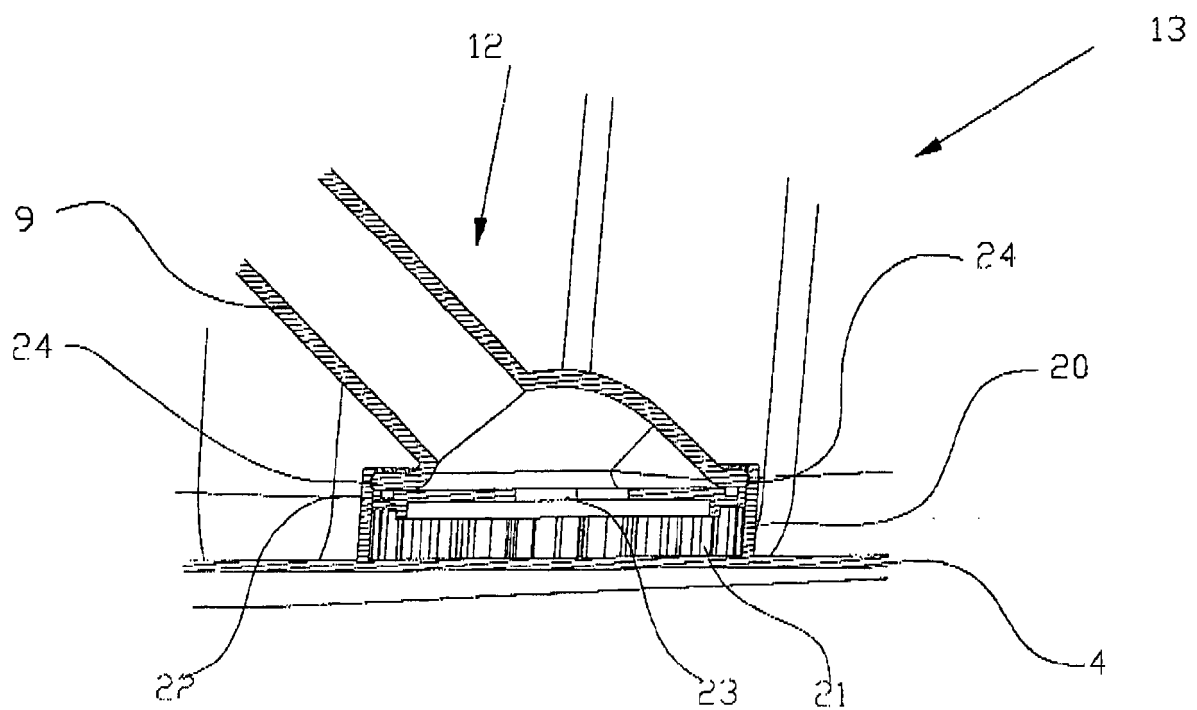


FIG. 4

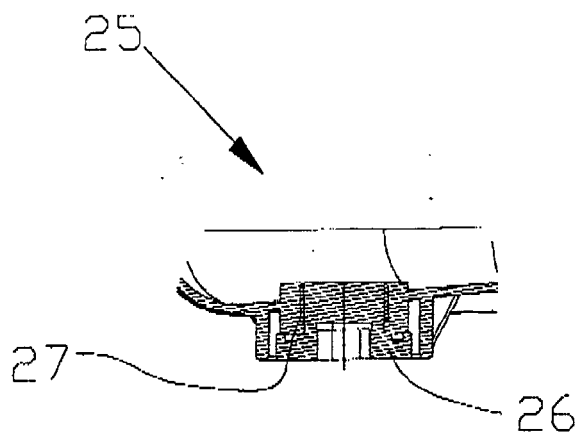


FIG. 5

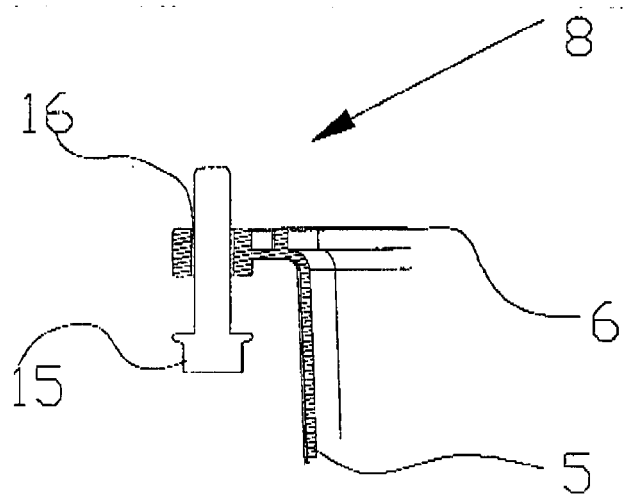


FIG. 6

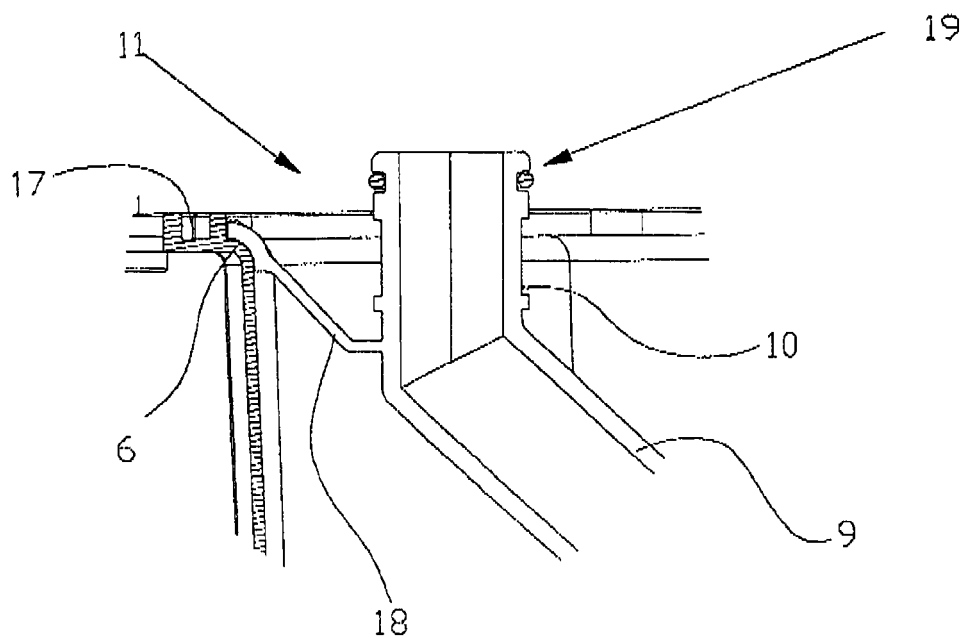


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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