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(72) Inventors:
• **Gnesin, Alexander L.**
Riverwoods, IL 60015 (US)
• **Griffin, Gregory A.**
Glendale Heights, IL 60139 (US)

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(74) Representative: **Kuhnen & Wacker**
Patent- und Rechtsanwaltsbüro
Prinz-Ludwig-Strasse 40A
85354 Freising (DE)

(71) Applicant: **International Engine Intellectual
Property
Company, LLC.**
Warrenville, IL 60555 (US)

(54) **High-pressure oil manifold for a diesel engine**

(57) A cast oil manifold (10) has entrance openings
(28) from a reservoir (18) to cast-in gooseneck outlet

tubes (16) that are substantially elliptical, enabling less
material to be used in the vicinity in comparison to the
amount of material used when the openings are circular.

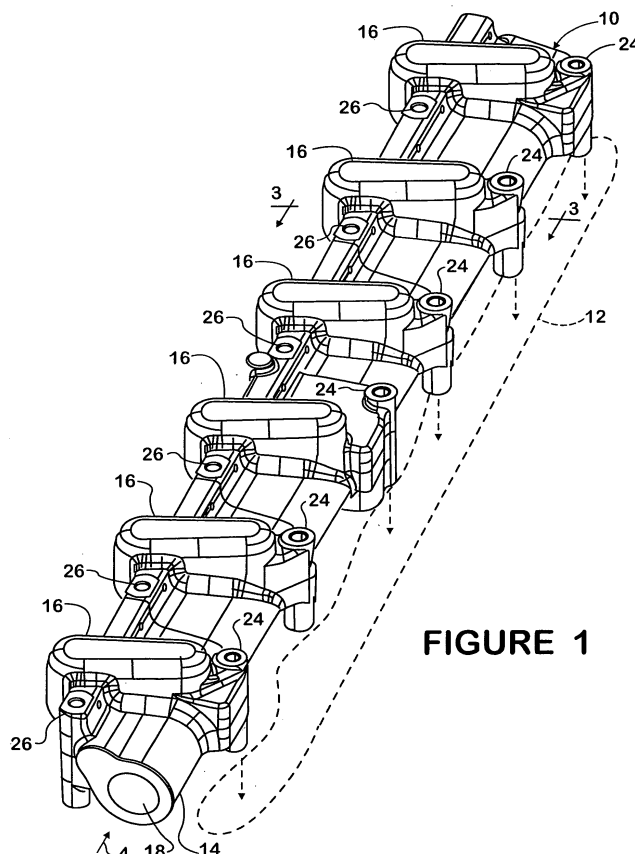


FIGURE 1

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Description

Field of the Invention

[0001] This invention relates to internal combustion engines, particularly to diesel engines that power motor vehicles.

Background of the Invention

[0002] A known diesel engine comprises a processor-based engine controller that processes data from various sources to develop control data for controlling certain functions of the engine, including fueling of the engine by injection of fuel into engine combustion chambers. Such an engine has an oil pump that delivers oil under pressure to an oil rail, or oil manifold, serving electric-actuated fuel injection devices (fuel injectors), that use oil from the oil rail to force injections of fuel. The pressure at the oil rail is sometimes referred to as injection control pressure, or ICP, and that pressure is under the control of an appropriate ICP control strategy that is an element of the overall engine control strategy implemented in the engine control system.

[0003] Certain fuel injectors contain electric-actuated valves that control the delivery of pressurized oil in an oil rail to pistons that are stroked when the valves open to force fuel into the engine combustion chambers via plungers. Certain fuel injectors are capable of amplifying ICP to develop very high injection pressures.

[0004] In order to contain high-pressure oil, an oil manifold is typically a metal casting of suitable shape that is machined at certain locations in order to mate it with other parts of the engine with which it is associated. A typical casting comprises a reservoir having one or more entrances into which oil is pumped to achieve desired ICP. At locations along its length, the casting has outlet tubes through which oil is sourced from the reservoir to the fuel injectors. In a certain oil manifold the cast-in outlet tubes are goosenecks that wrap around portions of the wall that encloses the reservoir.

[0005] Before the present invention, the entrances of the cast-in goosenecks had circular cross sections at the reservoir. A certain minimum wall thickness and a corresponding amount of metal were needed at and adjacent those locations in order to endow the manifold with sufficient strength to assure that stresses in the metal did not exceed specified limits.

[0006] However, thicker walls sections at certain locations of a cast part sometimes make the manufacture of the part more difficult, and the part, as cast, may contain some porosities at those locations. As one would expect, the added material increases the weight of the part, and that increase has unfavorable implications on part cost, and also on vehicle weight when the engine is used in a motor vehicle.

Summary of the Invention

[0007] The inventors have discovered that a differently shaped entrance to a cast-in outlet tube from the reservoir can provide significant weight reduction without compromising compliance with the relevant specification for the oil manifold. The inventors have confirmed this by comparative stress analysis. In a particular example, a weight reduction of about five pounds of iron was achieved.

[0008] Briefly, the present invention is embodied in a cast oil manifold by making the entrance openings from the reservoir to the cast-in outlet tubes substantially elliptical, rather than circular. The passages running through the outlet tubes follow a curved path, transitioning along the path from substantially elliptical entrances to circular exits that lead to fuel injectors at the engine cylinders. Each outlet tube presents the outward appearance of a gooseneck wrapping around a portion of the circumference of the body of the manifold that contains the reservoir.

[0009] One generic aspect of the invention relates to a diesel engine comprising combustion chambers that are fueled by introducing pressurized oil into fuel injectors to cause the fuel injectors to inject fuel and a cast oil manifold comprising a walled body enclosing a reservoir for holding pressurized oil and cast-in outlet tubes through which oil in the reservoir is delivered to the fuel injectors.

[0010] The cast-in outlet tubes comprise walls that wrap around portions of the walled body. Each outlet tube has an entrance at the reservoir and an exit leading to a respective fuel injector. Each entrance has a substantially elliptical transverse cross section.

[0011] Another generic aspect relates to the oil manifold that has been described.

[0012] The foregoing, along with further features and advantages of the invention, will be seen in the following disclosure of a preferred embodiment of the invention depicting the best mode contemplated at this time for carrying out the invention. This specification includes drawings, now briefly described as follows.

Brief Description of the Drawings

[0013] Figure 1 is a perspective view of an oil manifold embodying principles of the present invention.

[0014] Figure 2 is a perspective view of the oil manifold from a different direction.

[0015] Figure 3 is an enlarged cross section view generally in the direction of arrows 3-3 in Figure 1.

[0016] Figure 4 is an enlarged end view generally in the direction of arrow 4 in Figure 1 showing approximately an upper half portion of the oil manifold.

Description of the Preferred Embodiment

[0017] Figure 1 shows an oil manifold 10 that mounts on an underlying portion of an internal combustion engine

12, the engine being only schematically indicated. This particular oil manifold is designed to mount on an in-line, six-cylinder diesel engine.

[0018] Oil manifold 10 is a cast iron part that comprises an elongate body 14 and a series of six cast-in goosenecks 16 at spaced apart locations along the length of body 14. A generally cylindrical reservoir 18 runs lengthwise through body 14 along a longitudinal axis 20. Figure 3 shows one lengthwise end to have an entrance 22 that is communicated by piping (not shown) to an oil pump (also not shown) that pumps oil into reservoir 18. Although the drawings show the opposite end of body 14 to be open because they show manifold 10 as cast and thereafter machined, it should be understood that the opposite end is either plugged in any suitably appropriate way.

[0019] Two series of bosses 24, 26 are present along opposite sides of body 14. Headed screws (not shown) pass through these bosses and thread into holes in engine 12 to fasten the oil manifold to the engine.

[0020] Goosenecks 16 form cast-in outlet tubes through which oil in reservoir 18 is delivered to fuel injectors that are schematically shown by the reference numerals 34 in Figure 2. The walls of the goosenecks wrap around portions of body 14, and each gooseneck comprises a passageway having an entrance 28 at reservoir and an exit 30 leading to a respective fuel injector 34.

[0021] As shown in Figure 3, each entrance 28 has a substantially elliptical transverse cross section with the major axis of the ellipse of each entrance being perpendicular to axis 20 and spanning a distance indicated by the reference numeral 32 in Figure 4. Each exit 30 has a circular transverse cross section.

[0022] As oil manifold 10 is viewed radial to axis 20, entrance 28 of each gooseneck 16 is offset from the respective exit 30 along the length of body 14. Each entrance 28 is arranged such that an imaginary line passing through the center of its substantially elliptical transverse cross section perpendicularly intersects axis 20.

[0023] When the control valve associated with a fuel injector 34 is opened, pressurized oil in reservoir 18 creates flow through the respective gooseneck 16 and into the respective fuel injector to force an injection of fuel into the respective combustion chamber.

[0024] Oil manifold 10 is manufactured by standard sand casting methods, and after casting, is machined by standard machining techniques for proper fitting to engine 12.

[0025] Stress analysis has shown that in comparison to the prior circular cross section of an entrance, an elliptical shape that has been described here and that has about a 10.7% larger open area enables less material to be used in the vicinity of the beginning of the gooseneck while maintaining compliance with the relevant specification for the cast manifold. In the case of the illustrated oil manifold, a savings of approximately five pounds was achieved. It was also discovered that ellipse ratios (long

axis length divided by short axis length) in the range of 1.2 - 1.4 generally perform better than others.

[0026] While a presently preferred embodiment of the invention has been illustrated and described, it should be appreciated that principles of the invention apply to all embodiments falling within the scope of the following claims.

10 Claims

1. A diesel engine comprising:

combustion chambers that are fueled by introducing pressurized oil into fuel injectors to cause the fuel injectors to inject fuel, and a cast oil manifold comprising a walled body enclosing a reservoir for holding pressurized oil and cast-in outlet tubes through which oil in the reservoir is delivered to the fuel injectors, the cast-in outlet tubes comprising walls that wrap around portions of the walled body, each outlet tube having an entrance at the reservoir and an exit leading to a respective fuel injector, and each entrance having a substantially elliptical transverse cross section.

2. A diesel engine as set forth in claim 1 in which the exit of each outlet tube has a circular transverse cross section.

3. A diesel engine as set forth in claim 1 in which the outlet tubes are disposed at intervals along a long dimension of the walled body, and as the oil manifold is viewed radial to that long dimension, the entrance of each outlet tube is offset from its exit in the direction of the long dimension of the walled body.

4. A diesel engine as set forth in claim 1 in which the entrance of each outlet tube is arranged such that an imaginary line passing through the center of its substantially elliptical transverse cross section perpendicularly intersects a central axis of the long dimension of the reservoir.

5. An oil manifold for a diesel engine having combustion chambers that are fueled by introducing pressurized oil into fuel injectors to cause the fuel injectors to inject fuel, the manifold comprising:

and a casting comprising a walled body enclosing a reservoir for holding pressurized oil and cast-in outlet tubes through which oil in the reservoir is delivered to the fuel injectors, the cast-in outlet tubes comprising walls that wrap around portions of the walled body, each outlet tube having an entrance at the reservoir through which oil in the reservoir enters the out-

let tube and an exit through which oil exits the casting, each entrance having a substantially elliptical transverse cross section.

6. An oil manifold as set forth in claim 5 in which the exit of each outlet tube has a circular transverse cross section. 5
7. An oil manifold as set forth in claim 5 in which the outlet tubes are disposed at intervals along a long dimension of the walled body, and as the oil manifold is viewed radial to that long dimension, the entrance of each outlet tube is offset from its exit in the direction of the long dimension of the walled body. 10
8. An oil manifold as set forth in claim 5 in which the entrance of each outlet tube is arranged such that an imaginary line passing through the center of its substantially elliptical transverse cross section perpendicularly intersects a central axis of the long dimension of the reservoir. 15 20

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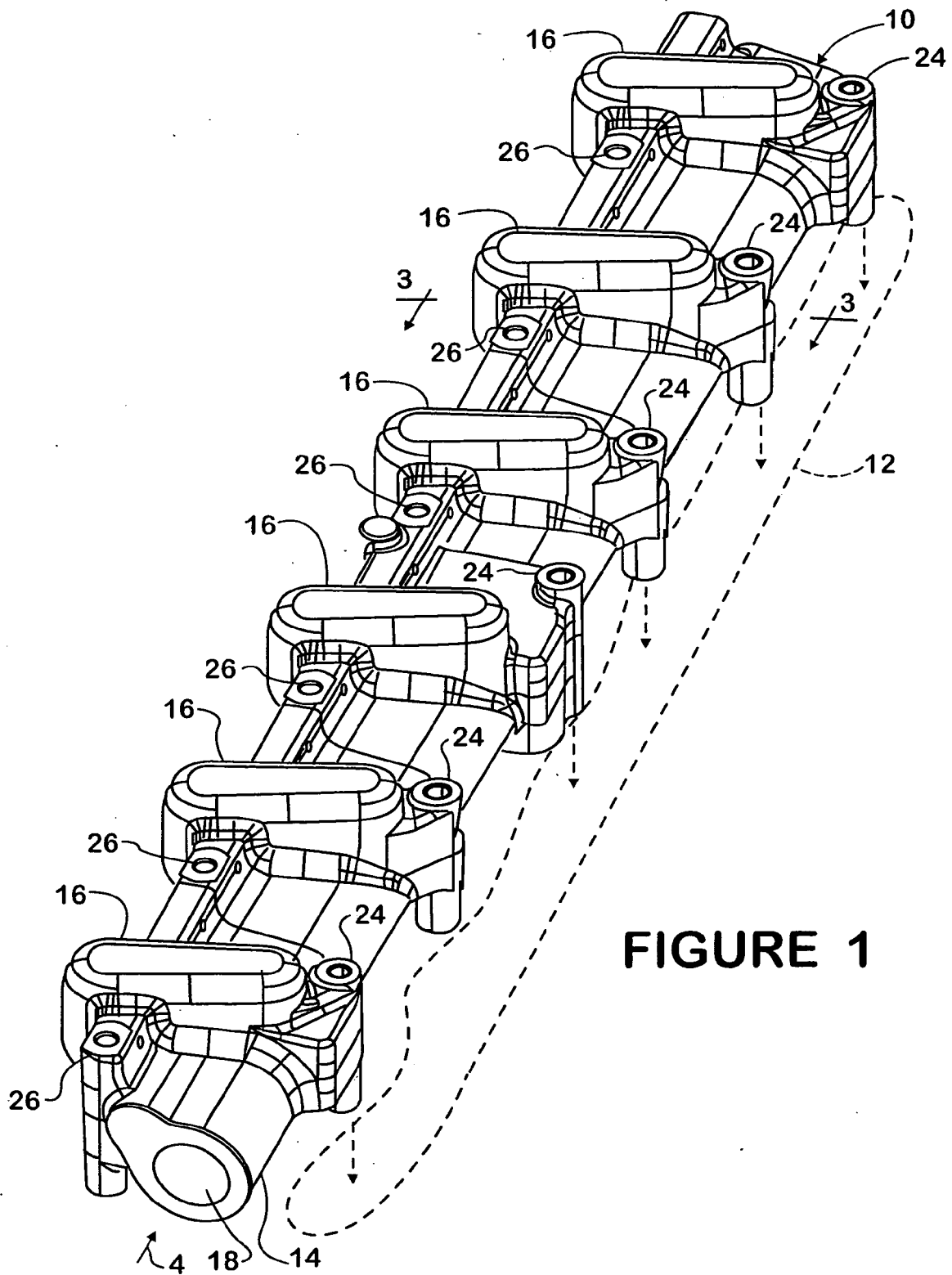
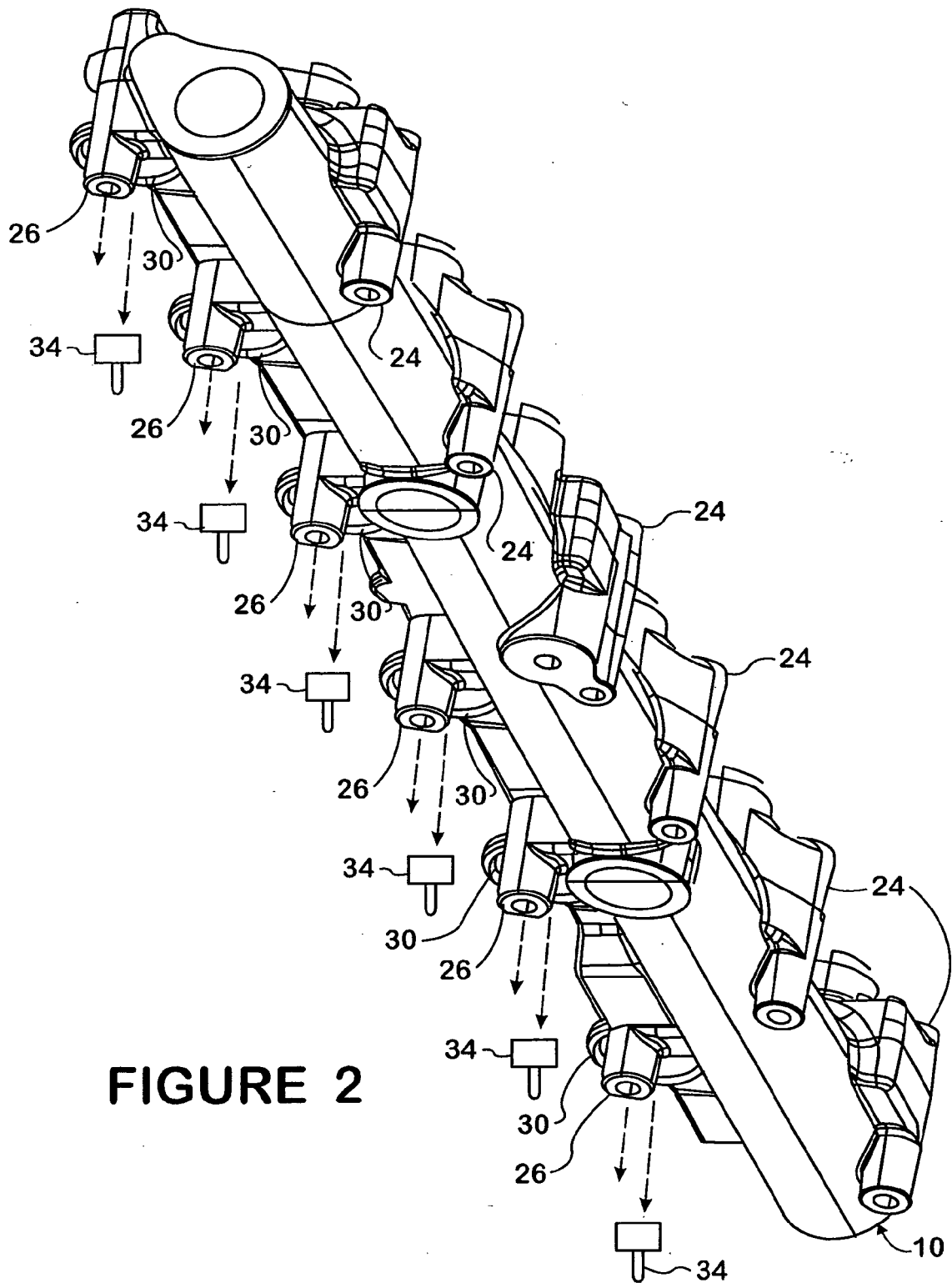


FIGURE 1



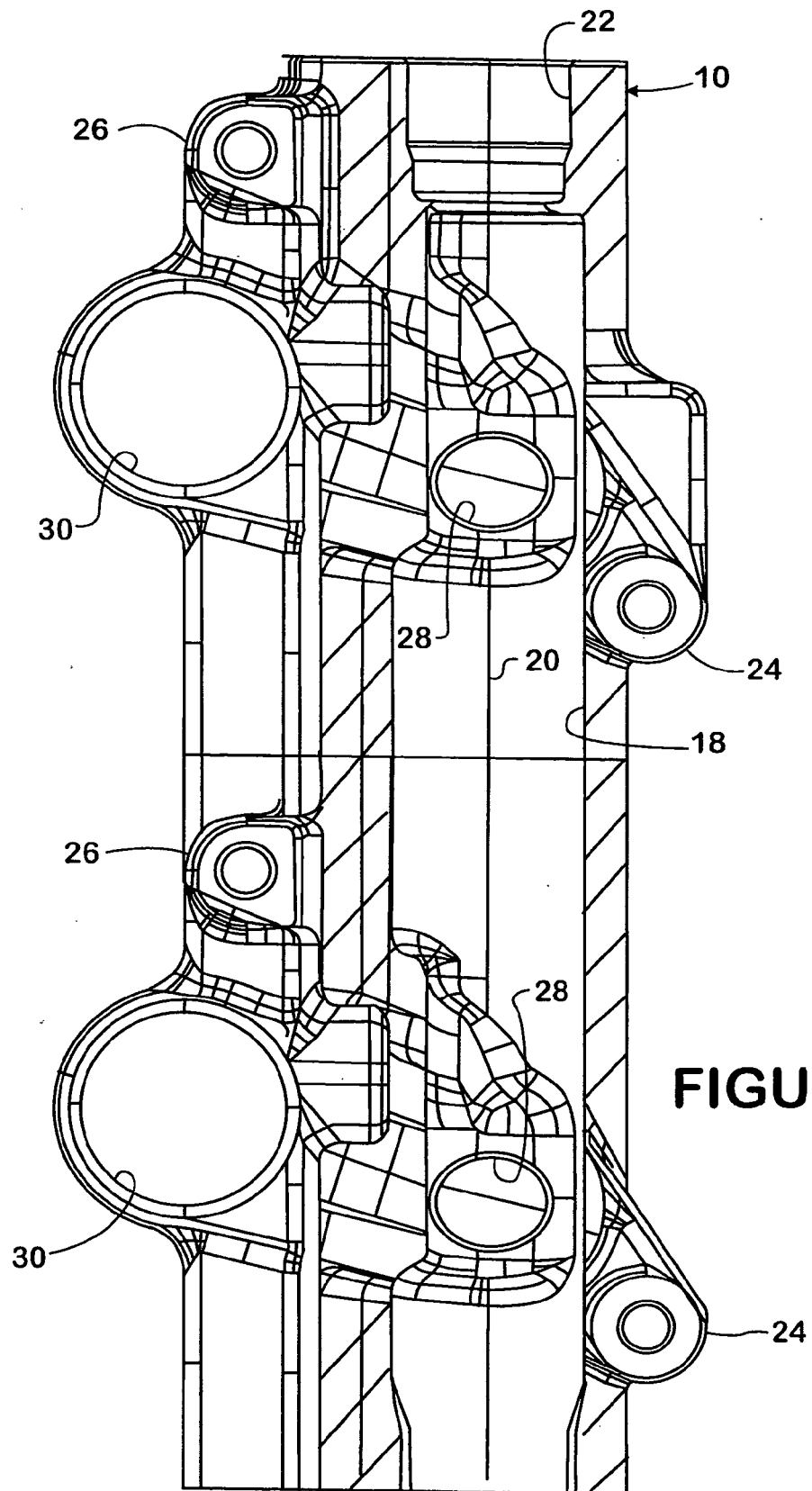


FIGURE 3

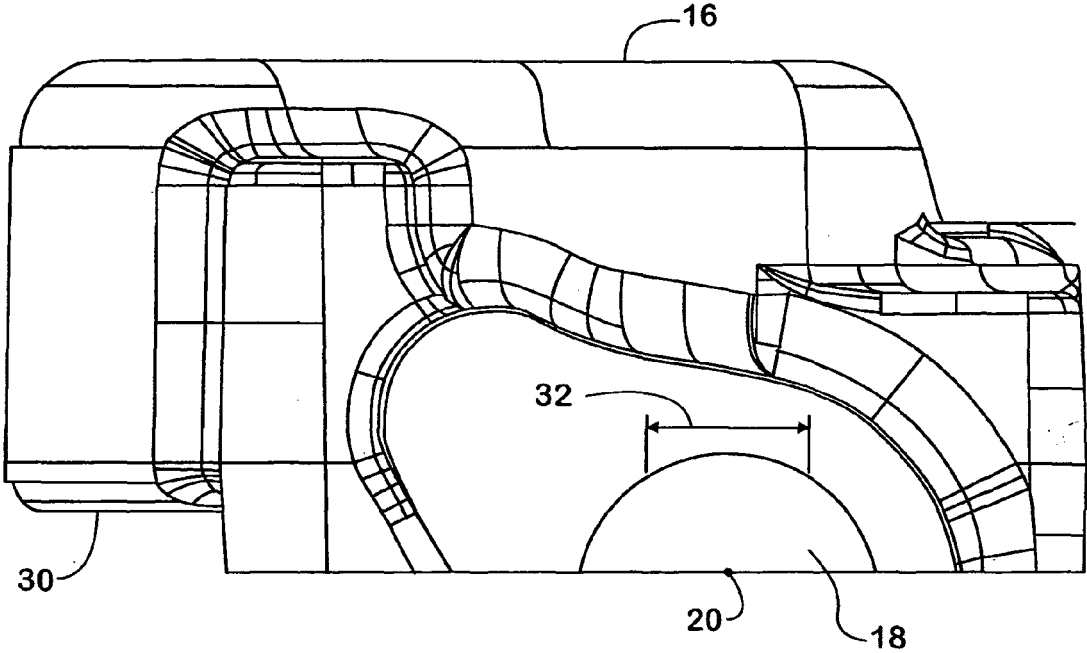


FIGURE 4