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(54) **Wide channel drainage system**

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Description

Background of the Invention

[0001] The present invention relates to channel drainage systems, and more specifically to high capacity channels typically referred to as wide channel drainage systems.

Technical Background

[0002] Robust drainage channels with a high hydraulic capacity are required for surface drainage in large areas such as distribution centres, car parks and airports.

[0003] One such drainage system is provided by Hodkin & Jones Sheffield Ltd and is described in GB-A-2 229 212. This provides an open channel member made of glass fibre reinforced concrete, which is anchored into a concrete backfill surrounding the channel in use by means of a framework of reinforcing bars. This type of channel member is intended to be used with a separate lid. As described in GB-A-2 316 428 and GB -A-2 347 707 (Hodkin & Jones), the lid provides a number of projections that terminate in slots extending transverse to the direction of the channel in the surface. Water enters the channel through these transverse slots. The hydraulic efficiency of wide, transverse slots in collecting water from the surface is not great. In storm situations the water may be carried over the slots.

[0004] A number of technical problems are encountered in the installation of such systems.

[0005] With the Hodkin & Jones system, these are created by the need to align the lids on the channels and ensure that the top of the lid is aligned with the finished surface level. GB - A- 2 316 428 suggests that by forming the lid and the channel in a single unit, the problems of locating the lid relative to the channel *in situ* are avoided. However, apart from suggesting that the separate concrete lid and channel are bonded together, there is no teaching of how such a single unit might be achieved.

[0006] This type of drainage channel is intended for use in areas where there is a heavy surface loading from vehicles. It is therefore necessary to provide for reinforcement of the concrete slab covering the channel. In the system proposed by Hodkin & Jones Sheffield Ltd, the slab reinforcement is provided by a specially designed, manufacturer supplied, reinforcing bar network, which is shaped to co-operate with the projections in the lid. This is a relatively expensive solution.

[0007] An alternative design of drainage system is described in GB-A- 1 456 021 (Chatham De Leeuw Ltd). This describes a pipe that has a series of tubes each arranged to project upwards from the pipe to a point above the surface level and opening into the pipe for drainage flow. Material is then laid over the pipe, with the upper ends of the tubes projecting from the surface. The tubes are moulded with closed ends which are then cut to expose drainage holes. A commercial system of this general type is sold by Marshalls Mono Ltd under the registered trade mark PORCUPIPE. This provides a drainage channel section comprising a longitudinally extending pipe portion and a plurality of longitudinally spaced hollow projections communicating with the pipe portion and is the basis of the preamble of the claims. As with the Hodkin & Jones designs this provides discrete water entry points and provides limited hydraulic efficiency. However the small projecting tubes present relatively little interference with the necessary slab reinforcement.

[0008] It is acknowledged that line drainage is more efficient than point drainage arrangements. Solutions of this type are proposed by Zurn Industries, Inc in US-A-6 000 881, which shows a plastics channel section including a narrow throat drain. Protuberances are provided to secure the channel section into the material in which it is embedded. Support rods and reinforcing rods can also be fixed to the section.

[0009] A similar metal system is produced by Elkington Gatic and is described further in GB-A-2 311 549. It provides a slot drain comprising a polygonal channel portion and a throat portion, the throat portion consisting of two walls extending upwardly from the channel portion to create a slot drain.

[0010] In both these designs there is improved hydraulic efficiency relative to Hodkin & Jones or the Chatham De Leeuw point drainage systems. However the slabs of concrete at either side of the slot are cantilevered out over the channel section and this results in a significant risk of loading damage in this area, especially in the case of plastics channel sections that are clearly not capable of bearing any significant load.

[0011] AU-B-733361 discloses a drainage system with a surface channel in fluid communication with a pipe line via a series of downpipes.

Solution of the Invention

[0012] Accordingly, the present invention provides a drainage channel section comprising a longitudinally extending pipe portion, a plurality of longitudinally spaced hollow projections communicating with the pipe portion, characterised in that a longitudinal channel is supported by and communicates with the projections and defines a continuous longitudinal slot that lies in use in a surface to be drained.

[0013] Alternatively, the present invention provides a drainage channel section comprising a longitudinally extending pipe portion, a plurality of longitudinally spaced hollow projections communicating with the pipe portion, characterised in that a plurality of longitudinally extending channel sections are supported by and communicate with the projections in order to define when installed in a surface to be drained a continuous longitudinal slot that lies in a surface to be drained.

[0014] Supporting a slot drain on a series of projections provides a convenient means of enabling slab reinforcement to pass between the projections and ensures that

a continuous reinforcement is provided when the channel sections are embedded. This system therefore has the advantages of high hydraulic capacity and efficiency of the Zurn and Elkington Gatic systems without creating weakness in the load bearing slab. The system is easy to install without the alignment problems of Hodkin & Jones two part channels.

[0015] In embodiments where the longitudinal channel has gaps between adjacent sections or is notched between at least some projections, a reinforcing mesh can be slid through the channel. This enables the slab covering the channel section to have two dimensional reinforcement. Where the channel is continuous reinforcing rods are preferably installed through arched openings defined between the projections.

[0016] Other features and aspects of the invention are defined in the appended claims.

Brief Description of the Drawings

[0017] In order that the invention may be well understood, some embodiments thereof will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a perspective view of a channel section in accordance with the invention;

Figure 2 shows a perspective view of a channel section provided with means for creating a lateral connection and with a fitted metal rail;

Figure 3 shows a perspective view of a detail of a longitudinal slot channel and supporting projections of the channel section of Figure 1 or 2;

Figure 4 shows an end view detail of the slot channel and projections of Figure 1 or 2;

Figure 5 shows a top plan view of the slot channel and projections of Figure 3;

Figure 6 shows a side view of the slot channel and projections of Figure 1 or 2;

Figure 7 shows a section through the slot channel and projections shown in Figure 6;

Figure 8 shows a perspective view of a second embodiment of a channel section; and

Figure 9 shows a perspective view of a second embodiment of a channel section provided with means for creating a lateral connection.

Description of a Preferred Embodiment

[0018] A high capacity drainage system is intended to be constructed from interconnected plastics channel sections 2 which are laid out in an appropriate configuration before being embedded in concrete. The channel sections serve as a liner in use. The load is borne by a reinforced top slab incorporated during installation of the system.

[0019] Each channel section 2 may be rotationally moulded from medium density polyethylene (MDPE). Two basic designs of channel section are offered as illustrated in Figures 1 and 2. These may be provided in differing cross sectional sizes depending on the capacity required. The channel sections are preferably constructed having a mean ovoid size of 900mm deep by 600mm wide. A smaller system may be provided with a size of 600mm x 400mm. The basic channel section is illustrated in Figure 1 and is preferably a two metre standard length. Figure 2 shows a one metre back-inlet channel section variant which has a spigot 4 with three knock-outs enabling connections with a 150mm, 225mm and 300mm diameter plastics, clay and concrete pipes.

[0020] Each channel section 2 comprises a generally ovoid pipe portion 6 having open end faces 8, 10 so that the sections 2 can be butted together.

[0021] Laterally extending flanges 12 are provided at either side each end face 8 and 10. These flanges define a level base 14 and are provided with holes 16 so that the channel sections can be levelled by means of coarsely screwed feet passing through holes 16 to rest on a base of a trench during installation. Ribs 20 are formed around the pipe portion 6 on its external surface in order to provide greater structural rigidity to the channel section 2 and to grip the surrounding concrete when the channel section 2 is embedded.

[0022] The female end face 8 is indented to provide a deep groove 60, the male end face 10 has a lip 62 which slots into the groove 60, both end faces 8 and 10 are formed with double skinned wings 50. The end faces 8 and 10 are further described and claimed in UK patent application No 0312464.1 filed on 30 May 2003. Other forms of connection between the sections may be employed.

[0023] The pipe portions 6 will preferably be produced in one and two metre lengths.

[0024] As shown in Figure 1, the longer sections 2 have a longitudinal rib 54 along the length of the pipe portion 6 positioned approximately 200mm from the invert of the ovoid channel section 2 in order to increase longitudinal stiffness and to act as a guide for the level of an initial concrete pour.

[0025] Along the upper surface of the pipe portion 6, there are provided a series of hollow projections 22 that support a longitudinal slot channel 24 that terminates in an open slot 26 adapted to be located in a horizontal surface plane in use such that water entering the slot 26 passes down through the projections 22 into the pipe portion 6.

[0026] Each projection 22 has a base 30 which merges into a wall of the pipe portion 6 as best illustrated in Figure

3. The base 30 extends circumferentially around the ovoid pipe portion 6. In a vertical section transverse to the longitudinal direction of the channel section, the hollow projection 22 extends from its base 30 it tapers towards the narrower longitudinal channel 24. The channel 24 has side walls 32 that merge with side walls 34 of each projection.

[0027] The base of the channel 24 is effectively defined by openings into the hollow projections 22 and intermediate arch sections 38 bridging the gaps between adjacent projections. This configuration directs water flow into the hollow interior of the projections 22.

[0028] Each projection 22 has two parallel transverse faces 40 that each taper from the base 30 of the projection towards the channel 24. These transverse faces 40 merge with the arch sections 38 so that in between each pair of projections 22 there is effectively defined an arched opening 42 as best seen in Figures 6 and 7.

[0029] An identical, but shorter slot channel 24 supported on fewer projections 22 is provided on the Figure 2 channel section. The shorter Figure 2 section is provided with a spigot to enable fitting of lateral pipes of various diameters.

[0030] In the longer lengths of pipe section 6 two pairs of rebar supports 56 are disposed externally either side of the base 30 of the hollow projections 22. These rebar supports 56 ensure that longitudinal reinforcement bars can be fitted parallel to the channel 24 and be located in the correct design location. The rebar supports 56 are positioned so that rebars held by them are also supported on upper surfaces of the wings 50 and are therefore retained at the correct level along the length of the channel.

[0031] The slot 26 can also support a rail 58 or metal edge structure, particularly for airport applications for added security. The rail 58 carries tangs 52 to anchor it into the surrounding concrete during installation.

[0032] Where the system is intended to be used in a car park with asphalt or block pavior wearing courses, a heel guard grating structure may be mounted on the slot.

[0033] A ring shaped water seal (not shown) is fitted between end faces 8 and 10 of adjacent channel sections 2 to form a seal. The water seal is placed in the groove 60 provided in the female end face 8, the lip 62 on the male end face 10 of an adjacent pipe portion 6 slots into the groove 60 and abuts against the water seal. The seal may be made of rubber, neoprene or ethylene propylene diene monomer (EPDM) which is highly resistant to water. The seal is preferably a donut section with a hollow centre to allow easy compressibility to absorb tolerance variations on length. Alternative sealing means may be used.

[0034] By moulding the channel section 2 in one piece complete with projections 22 and slot channel 24, this minimises component count and loose items on site as well as creating a stiffer integrated monolithic structure. Alignment problems during installation are also avoided. However, the invention also encompasses a fabricated two part construction as described below.

Installation

[0035] The wide channel system is generally installed by the method outlined below, although variations can be made by contractors to suit their particular circumstances.

[0036] The trenches are dug and channel restraining straps are laid in the trench with free ends left extending over either side. The channels are preferably hung from the top of the trench by the straps or other supporting arrangements via the metal inlet slot edge in order that they do not rest on the base of the trench. These straps are plastics webbing straps that are fitted with buckles to allow them to be fastened around the channel sections. Alternatively, however, holes 16 are provided through which coarse screws may passed in order to adjust and level the assembly against the base of the trenches. Straps are also passed through the arched openings 42 to hold the channel in position in order to prevent flotation during the final concrete pour. A layer of base concrete is then laid in the trench to secure the straps. The rib 54 provides a guide to the depth for this initial concrete pour. Excess concrete poured at this stage would lead to problems in inserting the reinforcement and/or too much upthrust due to excessive buoyancy of the channel produced by the wet concrete during this first pour. The channel sections 2 are assembled end to end to provide the required drainage channel configuration and arranged in the trench.

[0037] Reinforcing mesh is then positioned around the channel and loose bars passed through the openings 42 so that the concrete slab formed over the channel section is continuously reinforced. A blanking rod is placed in the channel 24 to prevent ingress of wet concrete into the channel and into the hollow interior of the channel section 2 during installation.

Variations

[0038] A second embodiment of the channel sections 2 of Figures 1 and 2 is shown in Figures 8 and 9. Like reference numerals are used to designate like parts.

[0039] In this variant, the channel 24 is notched at a centre point of each arch section 38 to provide a small gap 46 through which reinforced mesh fabric can be placed down over the channel section to rest within the arched openings 42. The gaps 46 allow the mesh to slide through whilst still leaving a continuous slot 26 in the surface to be drained. This may require placing a blanking rod in the channel 24 during the final pour to prevent concrete flowing into the channel 24 through the gaps 46. If the gaps are sufficiently fine so that they can effectively close again once the mesh has been pushed through, this may not be necessary.

[0040] This second embodiment of the channel section 2 can also be used with loose rod reinforcements as with the first embodiment. However these may be pushed down through the gaps 46 instead of being slid through

the arched openings transverse the longitudinal direction of the channel section 2.

[0041] In airport installations, it is imperative that there should be no loose components or fragments of pavements and/or drainage products that could be drawn into aircraft engines on the surface. Therefore, a galvanised or stainless steel slotted rail 58 as shown in Figure 2 is applied above the plastic slot 26. This rail 58 is fitted like a saddle over the slot (which may be notched as described above) once the reinforcement has been put in place and secured using suitable fixings to maintain mechanical alignment. The rail 58 is slotted to allow fluid access to the projections 22. Alternatively it may comprise two sections of hot or cold rolled steel angle iron placed back to back with suitable spacers welded in place to maintain the slot geometry.

[0042] The rail 58 or steel sections may be assembled to the channel section 2 at the factory so that they butt one another when the sections assembled. To overcome the problem of alignment for continuity of the slot 26, the rail 58 may be fitted to the assembled sections on site by means of a suitable clamp mechanism. In this way the rail sections 58 may be longer than the channel sections 2 and will aid proper alignment of the sections 2.

[0043] Heavy duty concrete anchors are provided at approximately 500 metres centres on the sides of the angle iron not facing the slot 26 and below the surface. The steel rail 58 or safety edge fabrication may be hot dipped galvanised for corrosion protection. When the final concrete pour is made the concrete anchors are buried deep into the concrete haunch to ensure the assembly stays in place at all times. Such a rail 58 or steel edge is better able to withstand the demands placed on the surface where aircraft towing tractors can achieve wheel loads in excess of 30 tonnes or where jet-blast may aggravate the paved surface.

[0044] Other fittings or gratings may also be supported on top of the slot as required.

Fabricated Construction

[0045] The embodiments described are moulded of plastics as a one piece unit. It is also possible to fabricate the sections 2 from upper and lower parts. The lower part may be any suitable U shaped drainage channel section of polymer concrete, plastics material, galvanised steel or ceramic construction. The upper part requires the arched inlet arrangement and is preferably moulded of plastics material with a suitable lower edge formation to mate with the lower part. Preferably the parts are fabricated together off-site.

Claims

1. A drainage channel section (2) comprising a longitudinally extending pipe portion (6), a plurality of longitudinally spaced hollow projections (22) communicating with the pipe portion (6) and a longitudinal channel (24), wherein said longitudinal channel (24) communicates with the projections (22) and defines a longitudinal slot (26) that lies in use in a surface to be drained, **characterised in that** said longitudinal channel (24) is supported by said projections (22).

2. A drainage channel section as claimed in claim 1, **characterised in that** the longitudinal channel (24) is notched between at least some of the projections (22), the notch (24) providing a gap (46) arranged to allow a reinforcing mesh or loose bars to be slid through the channel.

3. A drainage channel section (2) according to claim 1 or claim 2 in which the longitudinal channel (24) comprises a plurality of longitudinally extending channel sections which, when installed in a surface to be drained, define said continuous longitudinal slot (26) that lies in a surface to be drained.

4. A drainage channel section as claimed in any one of the preceding claims, **characterised in that** it is moulded of plastics material as a single unit.

5. A drainage channel section as claimed in any one of the preceding claims, **characterised in that** it is fabricated from upper and lower parts.

6. A drainage channel section as claimed in any one of the preceding claims, **characterised in that** the hollow projections (22) each have a base (30) which merges with the pipe portion (6) and extends circumferentially around the pipe portion (6), each projection (22, 40) tapering towards the supported channel (24).

7. A drainage channel section as claimed in any one of the preceding claims, **characterised in that** the pipe portion (6) has an ovoid cross section.

Patentansprüche

1. Ein Drainagekanal-Abschnitt (2) mit einem sich längsseits erstreckenden Rohrabschnitt (6), einer Mehrzahl längsseits beabstandeter mit dem Rohrabschnitt (6) kommunizierender hohler Vorsprünge (22) und einem längslaufenden Kanal (24), wobei der längslaufende Kanal (24) mit den Vorsprüngen (22) kommuniziert und einen längslaufenden Schlitz (26) definiert, welcher in Benutzung in einer zu entwässernden Fläche liegt,
dadurch gekennzeichnet, dass der längslaufende Kanal (24) durch die Vorsprünge (22) gestützt wird.

2. Ein Drainagekanal-Abschnitt nach Anspruch 1, **dadurch gekennzeichnet, dass** der längslaufende

Kanal (24) zwischen zumindest einigen der Vorsprünge (22) ausgespart ist, wobei die Aussparung (24) einen Spalt (46) vorsieht, welcher derart angeordnet ist, dass er das Durchgleiten eines Verstärkungsnetzes oder loser Stäbe durch den Kanal ermöglicht.

3. Ein Drainagekanal-Abschnitt (2) nach Anspruch 1 oder Anspruch 2, in welchem der längslaufende Kanal (24) eine Mehrzahl sich der Länge nach erstreckender Kanalabschnitte aufweist, welche, wenn sie in einer zu entwässernden Fläche installiert sind, den kontinuierlichen längslaufenden Schlitz (26) definieren, welcher in einer zu entwässernden Fläche liegt.

4. Ein Drainagekanal-Abschnitt nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** er als eine einzige Einheit aus Plastik geformt ist.

5. Ein Drainagekanal-Abschnitt nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** er aus oberen und unteren Teilen hergestellt ist.

6. Ein Drainagekanal-Abschnitt nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die hohlen Vorsprünge (22) jeweils ein Fundament (30) aufweisen, welches mit dem Rohrabschnitt (6) verschmilzt, und sich entlang des Umfangs um den Rohrabschnitt (6) erstreckt, wobei jeder Vorsprung (22, 40) spitz auf den geschlitzten Kanal (24) zuläuft.

7. Ein Drainagekanal-Abschnitt (2) nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** der Rohrabschnitt (6) einen annähernd eiförmigen Querschnitt aufweist.

Revendications

1. Section de conduit d'écoulement (2) comprenant une portion de tuyau s'étendant longitudinalement (6), une pluralité de saillies creuses espacées longitudinalement (22) communiquant avec la portion de tuyau (6) et un conduit longitudinal (24), dans lequel ledit conduit longitudinal (24) communique avec les saillies (22) et définit une fente longitudinale (26) qui se situe, dans l'utilisation, dans une surface à drainer, **caractérisée en ce que** ledit conduit longitudinal (24) est supporté par lesdites saillies (22).

2. Section de conduit d'évacuation des eaux selon la revendication 1, **caractérisée en ce que** le conduit longitudinal (24) présente des encoches entre au moins certaines des saillies (22), encoches (24) fournissant un espace libre (46) permettant la mise en place d'une maille de renforcement ou de barres séparées à faire coulisser dans le conduit.

3. Section de conduit d'évacuation des eaux (2) selon la revendication 1 ou 2, dans lequel le conduit longitudinal (24) comprend une pluralité de sections de conduits s'étendant longitudinalement qui, lorsqu'ils sont montés dans une surface à drainer, définissent ladite fente longitudinale continue (26) qui se situe dans une surface à drainer.

4. Section de conduit de drainage selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle est moulée à partir d'un matériau plastique pour former une unité monobloc.

5. Section de conduite d'évacuation des eaux selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle est fabriquée à partir de parties supérieures et inférieures.

6. Section de conduit d'évacuation des eaux selon l'une quelconque des revendications précédentes, **caractérisée en ce que** les saillies creuses (22) comportent chacune une base (30) qui débouche dans la portion de tuyau (6) et s'étend circonférentiellement autour de la portion de tuyau (6) chaque saillie (22, 40) allant en s'amenuisant vers le conduit supporté (24).

7. Section de conduit d'écoulement des eaux selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la portion de tuyau (6) présente une section transversale ovoïde.

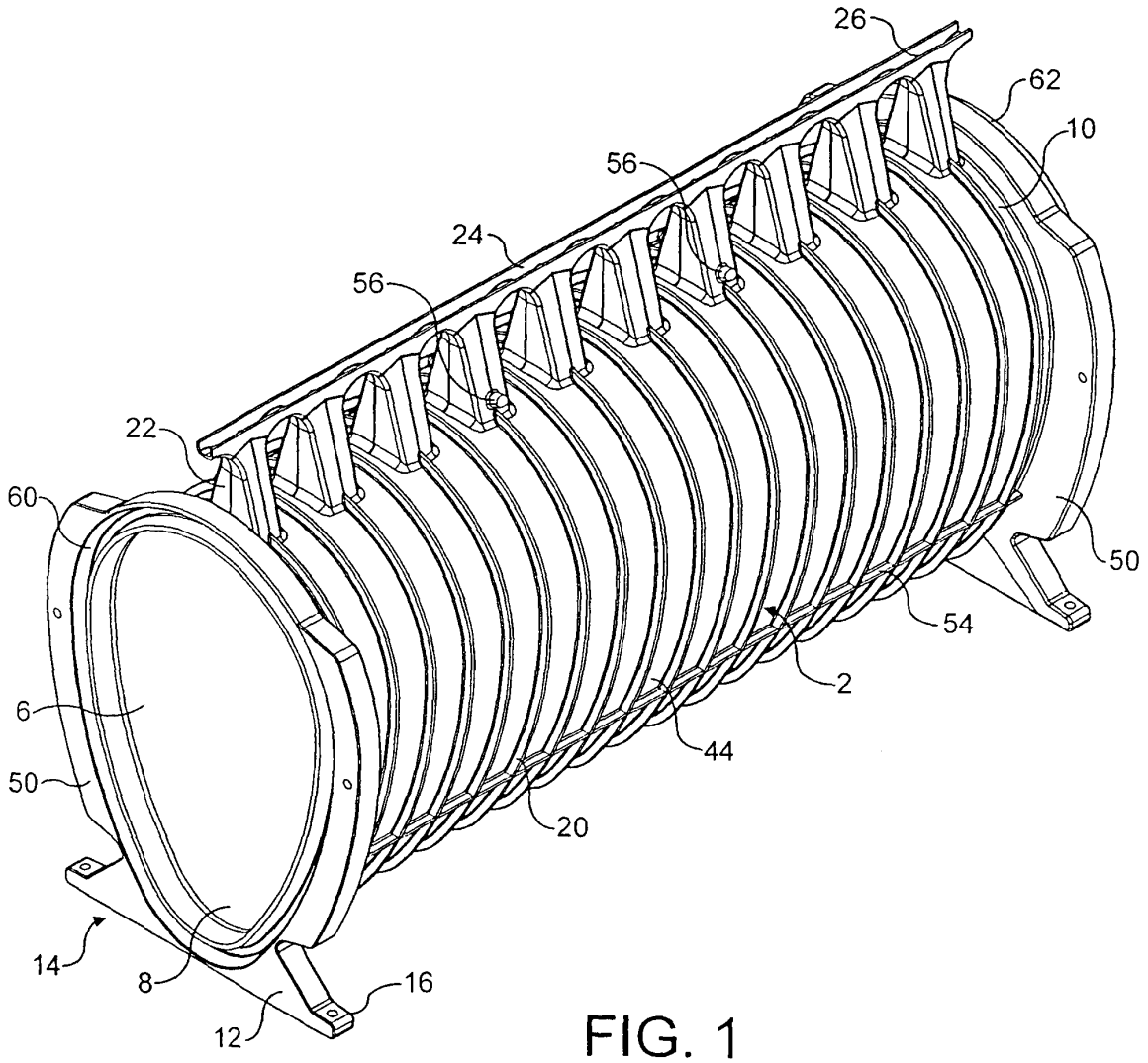

FIG. 1

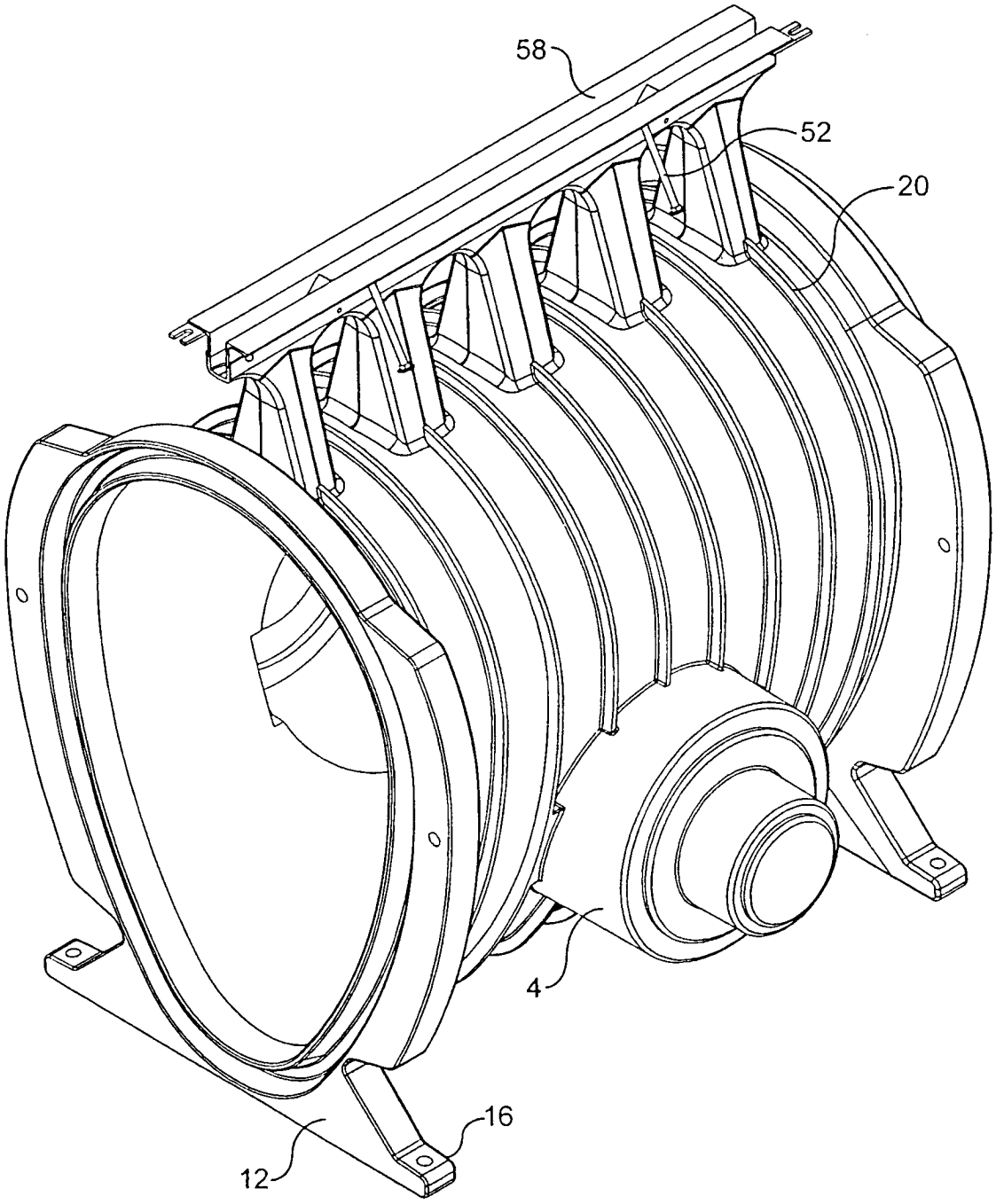

FIG. 2

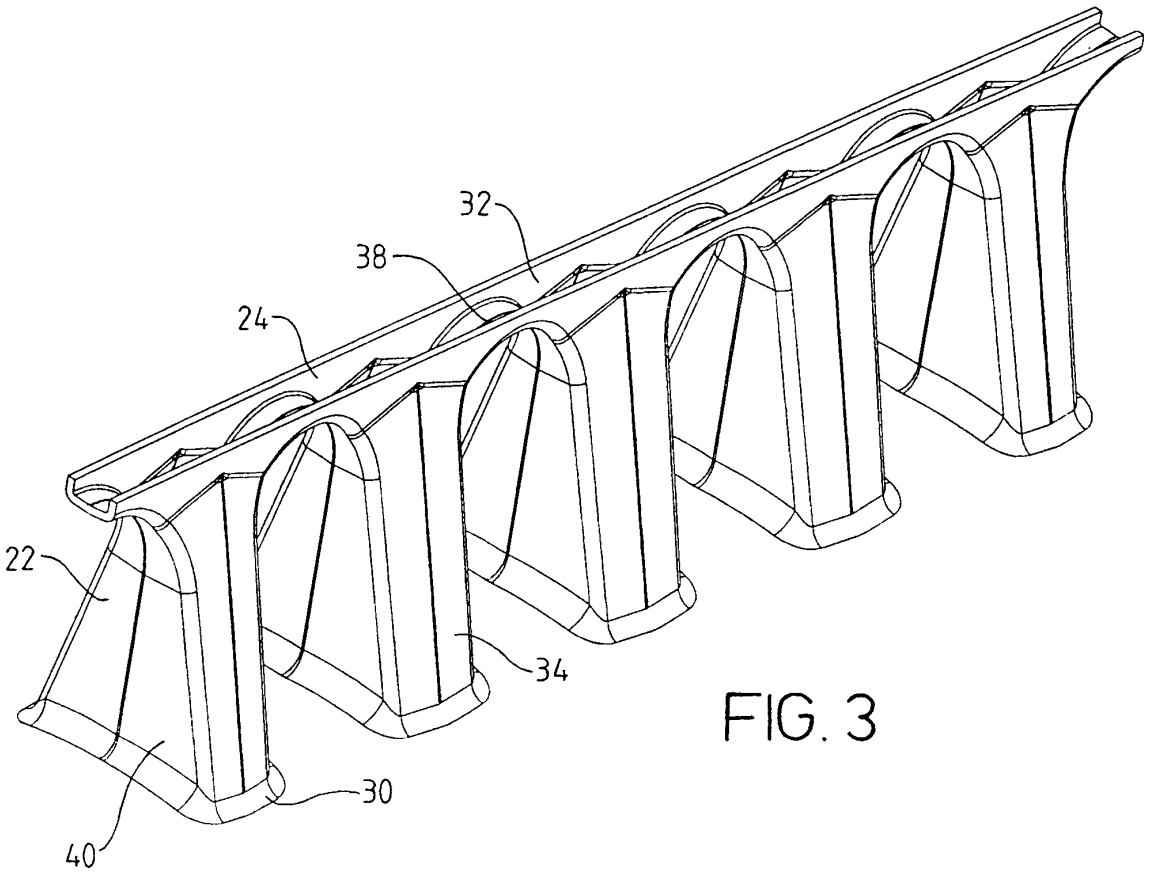

FIG. 3

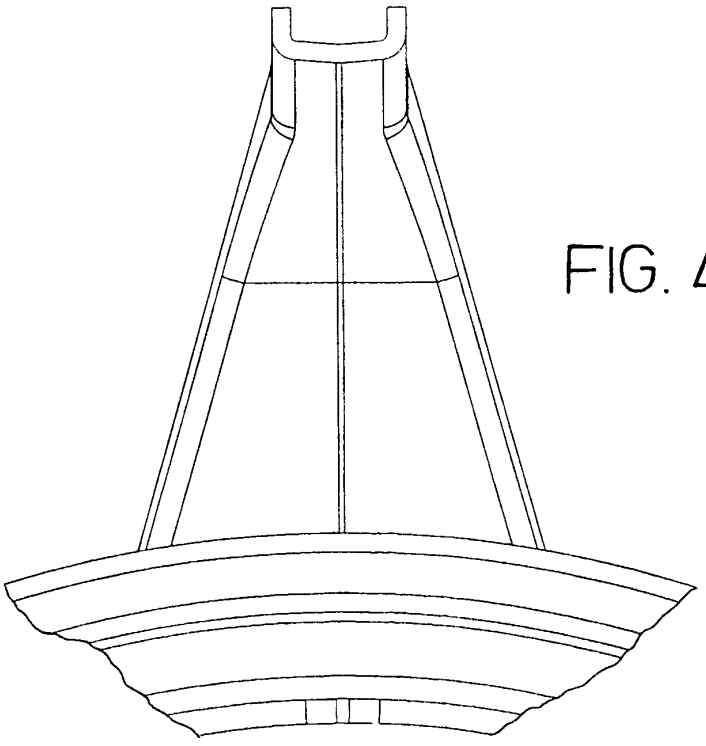

FIG. 4

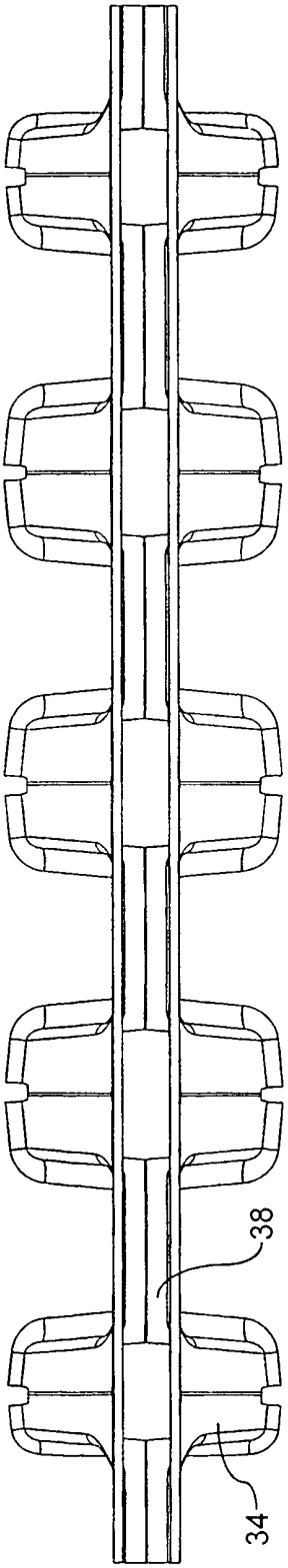

FIG. 5

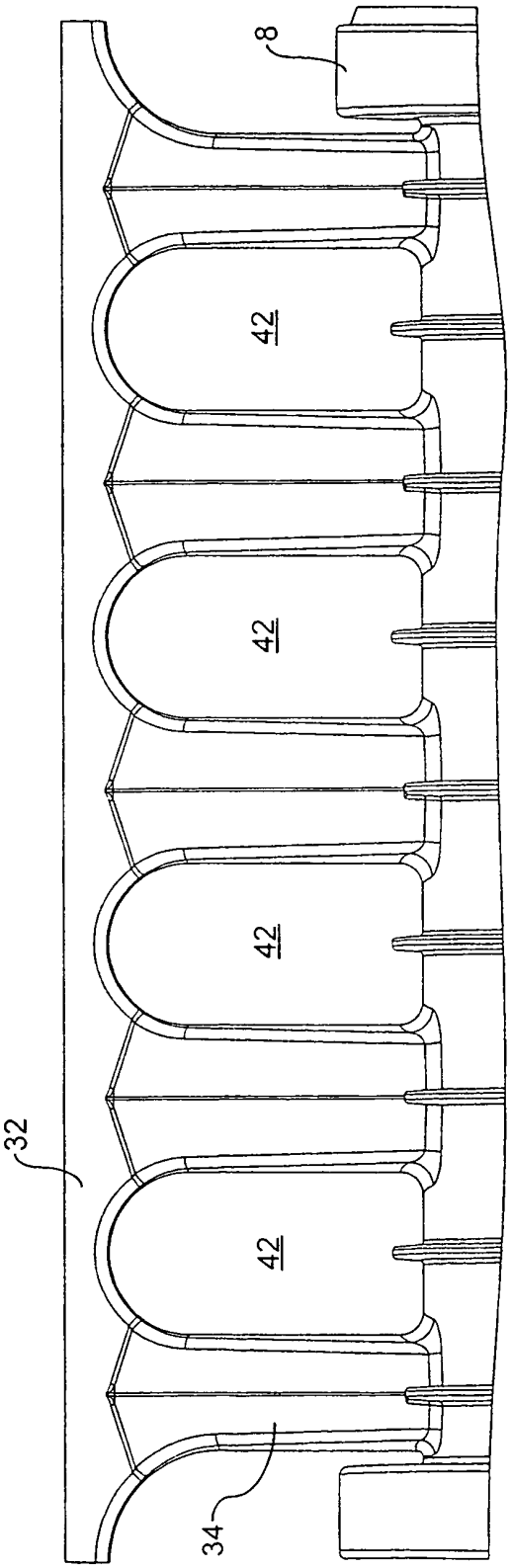

FIG. 6

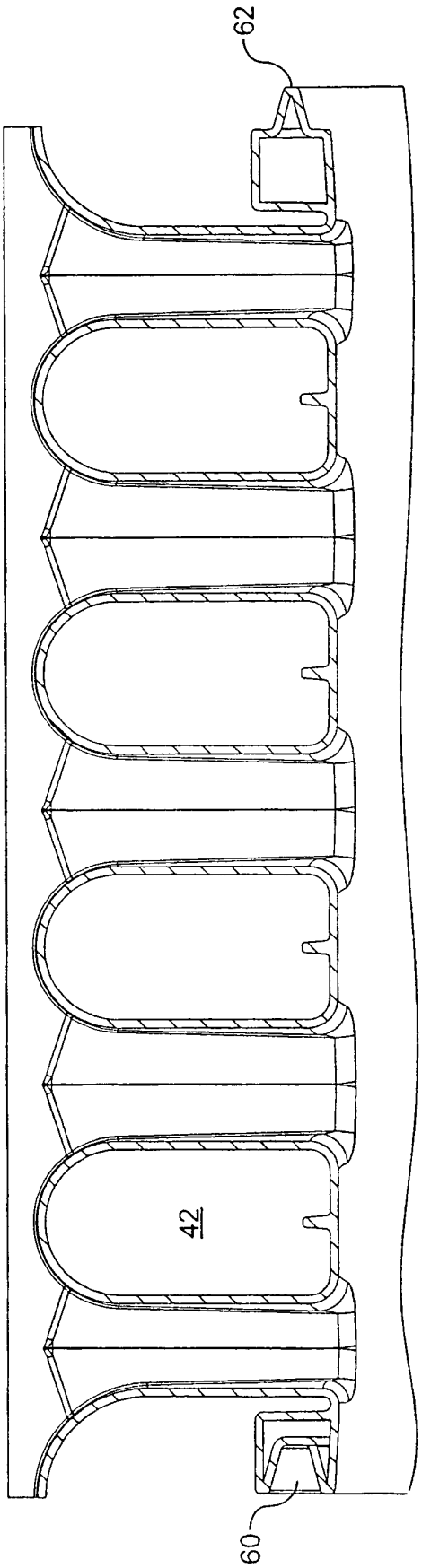

FIG. 7

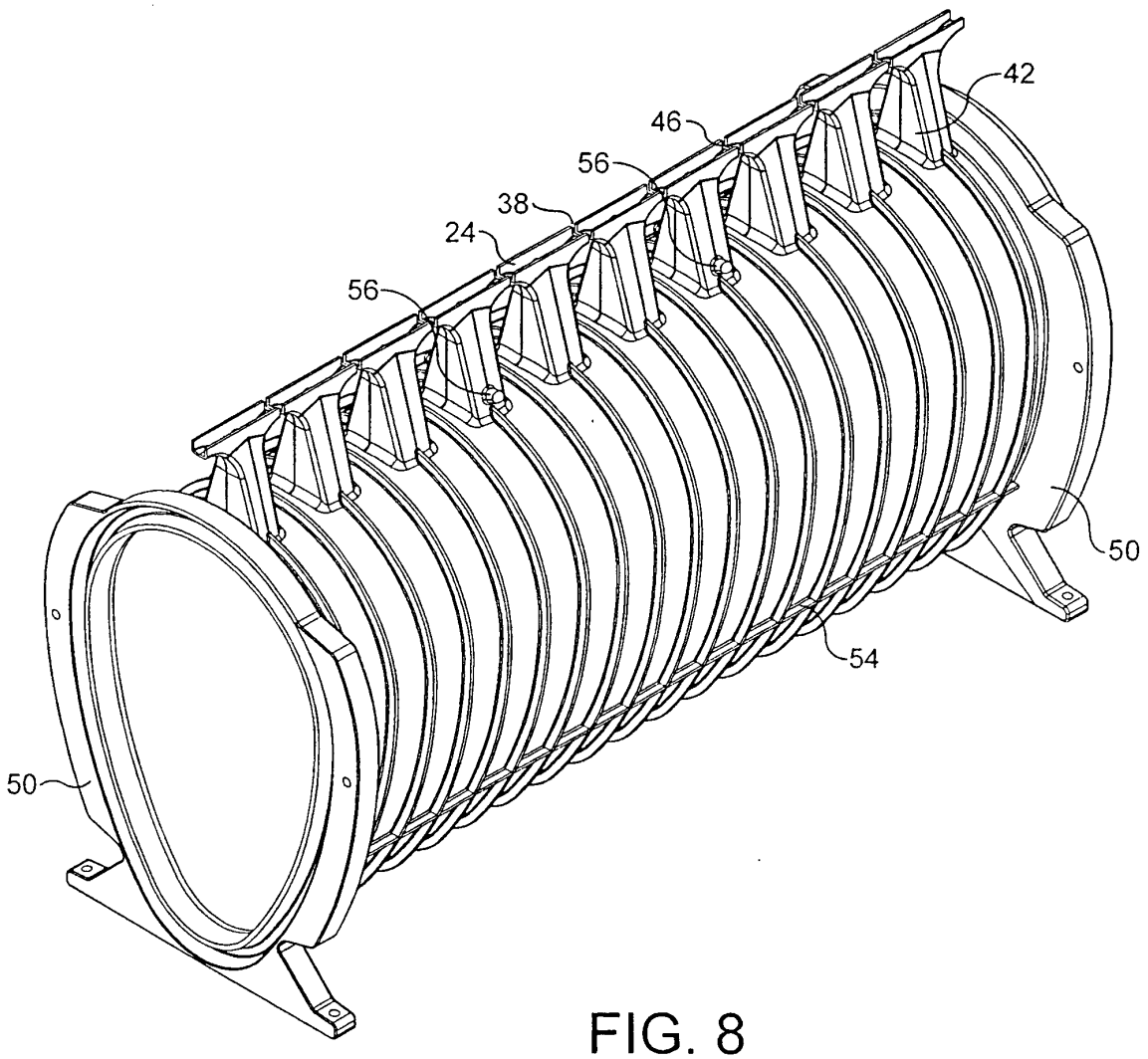

FIG. 8

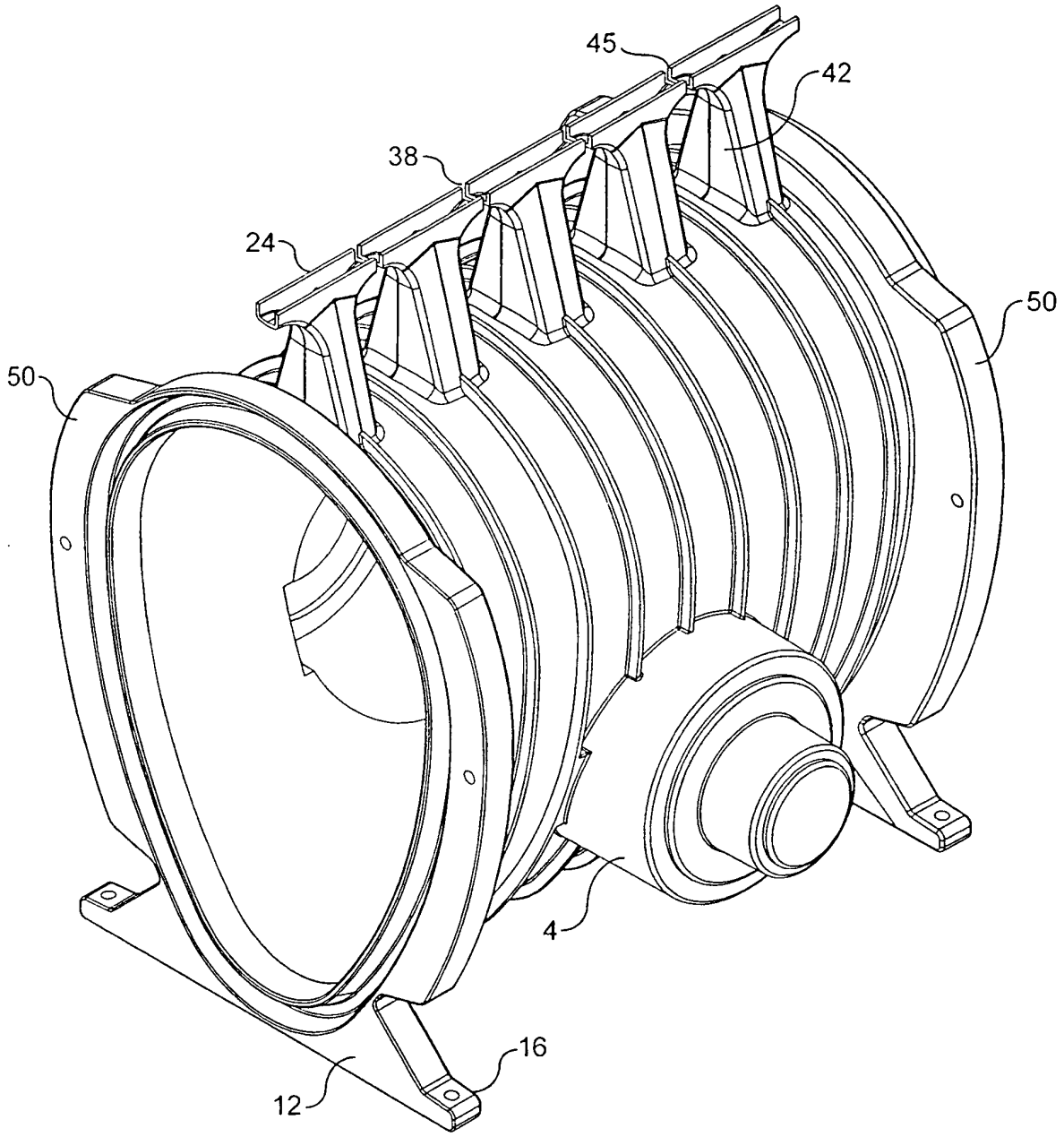

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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