Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2616036 A1 2009/06/21

(21) **2 616 036**

# (12) DEMANDE DE BREVET CANADIEN
# CANADIAN PATENT APPLICATION

(13) **A1**

(22) **Date de dépôt/Filing Date:** 2007/12/21

(41) **Mise à la disp. pub./Open to Public Insp.:** 2009/06/21

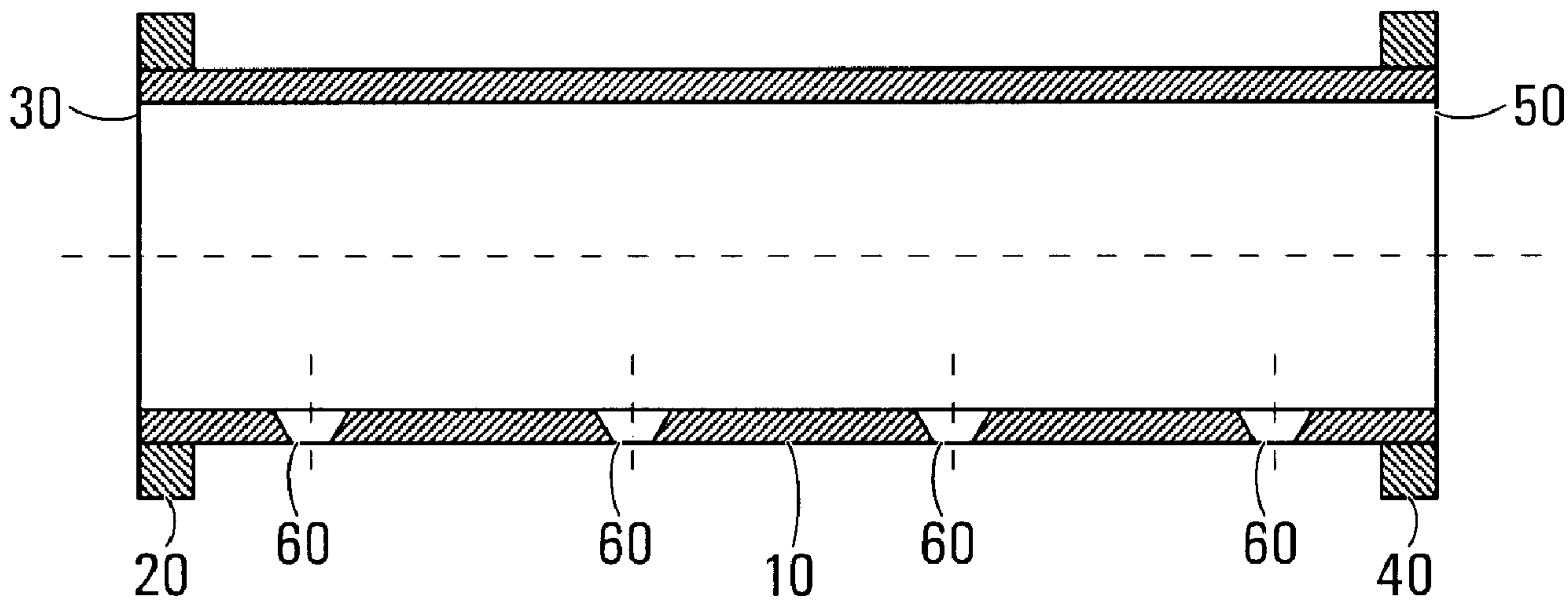
(51) **Cl.Int./Int.Cl.** *B03D 1/12* (2006.01), *B03D 1/02* (2006.01), *C10G 1/04* (2006.01), *C10G 21/28* (2006.01)

(71) **Demandeurs/Applicants:**
SHELL CANADA ENERGY, A GENERAL PARTNERSHIP FORMED UNDER THE LAWS OF THE PROVINCE OF ALBERTA, CA;
CHEVRON CANADA LIMITED, CA;
MARATHON OIL SANDS L.P., CA

(72) **Inventeur/Inventor:**
COLENRANDER, GERT W., CA

(74) **Agent:** SMART & BIGGAR

(54) **Titre :** ENSEMBLE COLLECTEUR ET METHODE D'UTILISATION
(54) **Title:** MANIFOLD ASSEMBLY AND METHOD OF USE




(57) **Abrégé/Abstract:**
The present invention relates to a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets. The manifold assembly may be used in a tailings solvent recovery unit.

63561-48

## ABSTRACT

The present invention relates to a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets. The manifold assembly may be used in a tailings solvent recovery unit.

63561-48

# MANIFOLD ASSEMBLY AND METHOD OF USE

The present invention relates to a manifold assembly and a method of its use, particularly in a tailings solvent recovery unit for recovering solvent from an oil sands tailings stream.

In a typical oil sands operation, the oil sand is mixed with water to obtain a bitumen froth comprising bitumen, water and solids. Bitumen may be recovered from an oil sand froth using a variety of methods. One method employs solvent extraction of the bitumen, including, for example, by using a paraffinic solvent. Paraffinic froth treatment methods have been previously described in, for example, Canadian patent Nos. 2,149,737; 2,217,300; and 2,232,929 and Canadian patent application Nos. 2,521,248; 2,353,109; and 2,502,239, as well as elsewhere.

In a typical solvent extraction, solvent is mixed with the oil sands froth followed by gravity separation of the resulting mixture into a bitumen enriched, water and solids depleted upper fraction and a bitumen depleted, water and solids enriched lower fluid fraction. Fractions may be recovered, and may be subjected to one or more further treatments. For example, the lower fluid fraction may be subjected to further solvent extraction to recover residual bitumen.

Solvent may be recovered at one or more stages in the solvent extraction process, including from the underflow stream of a final separation step. The final underflow stream, or "tailings stream", usually comprises water, solids (e.g., mineral particles, asphaltene particles) and residual solvent.

Solvent may be recovered from a tailings stream in a Tailings Solvent Recovery Unit (TSRU), which typically comprises an inlet means for the tailings stream, a vessel for separation of solvent from the remainder of the tailings stream, an outlet means for solvent recovery, and an outlet means for the remainder of the tailings stream. One or more TSRU in series may be used in solvent recovery.

The tailings stream in a conventional TSRU is normally pressurized and heated to just below the bubble point temperature of the solvent in the inlet means. (The bubble point temperature is the temperature at which solvent begins to boil or bubbles begin to form at a given pressure.) The bubble point temperature increases with increasing pressure. At temperatures below the bubble point temperature, the solvent is a liquid. Also, the solvent is a liquid at pressures above the bubble point pressure. (Bubble point pressure is the pressure at which a solvent begins to boil or bubbles begin to form at a given temperature.) In the vessel, the pressure should be maintained below the bubble point pressure to cause vaporization of the solvent so that it can be separated from other components of the tailings stream.

The inlet means normally comprises one or more manifold assemblies that introduce the tailings stream into the vessel. A manifold assembly typically comprises an inlet and one or more outlets, with the inlet and the one or more outlets being in fluid communication via a chamber. Each outlet normally comprises a nozzle, which may be installed on a retractable lance. The nozzles comprise a nozzle inlet for receiving the tailings stream, a nozzle outlet for introducing the tailings stream into the vessel and usually a swirl chamber disposed between the nozzle inlet and nozzle outlet. The swirl chamber is used to atomize the tailings stream, and create a well-defined spray pattern.

Due to the pressure differential between the TSRU inlet means and the vessel, flashing of the solvent may occur in the manifold assembly, including in the swirl chamber of a nozzle. The skilled person will be able to determine whether flashing is occurring in a manifold assembly using methods known in the art. For example, one nozzle in a manifold assembly can be blinded, and if there is no observed change in the flow rate at a given driving pressure, then this is evidence that flashing is occurring in the manifold assembly.

Nozzles are typically designed to produce the required mass flow rate for single-phase liquid flow. Flashing, however, reduces the mass flow rate of a tailings stream through the outlet of a nozzle to less than the design flow rate. Flashing of solvent creates a gas-liquid flow that can result in choking of the nozzle outlet and reduced mass flow rates. Observed mass flow rates of a tailings stream through a conventional nozzle where the tailings stream is exhibiting gas-liquid flow are smaller than the observed mass flow rate for a reference single-phase liquid where the driving pressure level through the nozzle is the same in both instances. The mass flow rate of a tailings stream has, in some cases, been observed to be reduced by about 30% over nozzle design specifications, which are based on a single-phase liquid in which there is no flashing. This reduction in mass flow rate is largely caused by flashing inside the conventional nozzle. If flashing is prevented, flow rates can be calculated more accurately.

Flashing in the TSRU inlet means may also be compounded by the creation of a low pressure core in the swirl chamber of a nozzle caused by the swirl motion of fluids in the swirl chamber.

Flashing may also result in erosion of the interior surface of the nozzles. It has been observed that levels of erosion in a conventional nozzle are higher than otherwise expected. Without using costly, wear-resistant materials, the lifetime of conventional nozzles is short, usually not exceeding a couple of weeks. The increased erosion of interior surfaces of the nozzles is likely due to mineral solids in the tailings mixture being subjected to a higher velocity than would exist absent solvent flashing. With solvent flashing, the velocity of the tailings stream in the nozzle increases, usually by about an order of magnitude. Solids in the tailings stream are therefore subjected to higher local velocities than absent solvent flashing.

Solvent flashing therefore contributes to decreased TSRU throughput, and equipment wear.

According to one broad aspect of the present invention, a manifold assembly is provided comprising a chamber having a cross-sectional area that is larger than the combined surface area of its outlets. In practice, this would normally be an increase of about a factor of 2, or more. (See, for example, Ref. Equation (6-15) in Perry's Chemical Engineers' Handbook 7th ed. McGraw-Hill, 1997, assuming an orifice discharge coefficient of 0.61.) In an exemplary embodiment, the cross-sectional area is larger by about an order of magnitude or more. By increasing the cross-sectional area of the chamber by, for example, about an order of magnitude or more, then the resulting fluid velocities in the chamber can be decreased by, for example, about an order of magnitude or more compared to the fluid velocity in the outlets. The fluid in the chamber is therefore more evenly distributed over the outlets of the manifold assembly. A design in accordance with this exemplary embodiment provides a pressure drop over the outlets, which, in normal operation, will then be larger by about two orders of magnitude or more than the pressure variations in the chamber of the manifold assembly. A manifold assembly of the present invention can therefore be used to eliminate solvent flashing.

According to one embodiment of the present invention, there is provided a tailings solvent recovery unit comprising: (a) inlet means for receiving a tailings stream containing a solvent; (b) a vessel for inducing separation of the solvent from the tailings stream; and (c) outlet means for recovering the solvent, wherein: the inlet means comprises a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

According to another embodiment of the present invention, there is provided a method for recovering solvent from a tailings stream comprising separating the solvent from the tailings stream using a tailings solvent recovery unit comprising: (a) inlet means for receiving the tailings stream containing the solvent; (b) a vessel for inducing separation of the solvent from the tailings stream; and (c) outlet means for recovering the solvent, wherein: the inlet means comprises a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

According to a further embodiment of the present invention, there is provided a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

In a further embodiment of the invention, the cross-sectional area of the chamber is larger than the combined surface area of the outlets by about an order of magnitude or more.

In a further embodiment, each of the one or more outlets of the manifold assembly comprises a nozzle having a nozzle inlet, a nozzle outlet and a swirl chamber disposed between the nozzle inlet and the nozzle outlet.

An exemplary embodiment of the present invention is shown in Figure 1. Figure 1 is a representative diagram of an inlet means of a TSRU according to one embodiment of the present invention. In Figure 1, the manifold assembly comprises a full bore pipe (10) as the manifold chamber. Flange (20) connects a first end (30) of the pipe (10) to a retractable lance (not shown) though which the tailings stream flows. Flange (40) connects a second end (50) of the pipe (10) to a blind (not shown) to stop fluid flow. One or more nozzles (60) are located along pipe (10) for injection of the tailings stream into a TSRU vessel (not shown).

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes and modifications may be made thereto without departing from the spirit or scope of the appended claims.

It must be noted that as used in the specification, including in the appended claims, the singular forms of "a", "an" and "the" include plural reference unless the context clearly indicates otherwise. By way of example, reference is made throughout this specification to a manifold assembly having "an" inlet—this should be understood as also encompassing a manifold assembly having more than one inlet.

Unless defined otherwise all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill and the art to which this invention belongs.

63561-48

CLAIMS:

1. A tailings solvent recovery unit comprising:

(a) inlet means for receiving a tailings stream containing a solvent;

(b) a vessel for inducing separation of the solvent from the tailings stream; and

(c) outlet means for recovering the solvent,

wherein:

the inlet means comprises a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

2. The tailings solvent recovery unit according to claim 1, wherein the cross-sectional area of the chamber is larger than the combined surface area of the outlets by about an order of magnitude or more.

3. The tailings solvent recovery unit according to claim 1 or 2, wherein each of the one or more outlets of the manifold assembly comprises a nozzle having a nozzle inlet, a nozzle outlet and a swirl chamber disposed between the nozzle inlet and the nozzle outlet.

4. The tailings solvent recovery unit according to any one of claims 1 to 3, wherein the tailings stream is an oil sands tailings stream.

5. The tailings solvent recovery unit according to any one of claims 1 to 4, wherein the solvent is a paraffinic solvent.

6. A method for recovering solvent from a tailings stream comprising separating the solvent from the tailings stream using a tailings solvent recovery unit comprising:

(a) inlet means for receiving the tailings stream containing the solvent;

(b) a vessel for inducing separation of the solvent from the tailings stream; and

(c) outlet means for recovering the solvent,

wherein:

the inlet means comprises a manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

7. The method according to claim 6, wherein the cross-sectional area of the chamber is larger than the combined surface area of the one or more outlets by about an order of magnitude or more.

8. The method according to claim 6 or 7, wherein the tailings stream is an oil sands tailings stream.

9. The method according to any one of claims 6 to 8, wherein the solvent is a paraffinic solvent.

10. A manifold assembly comprising an inlet and one or more outlets, wherein the inlet and the one or more outlets

are in fluid communication via a chamber having a cross-sectional area that is larger than the combined surface area of the one or more outlets.

11. The manifold assembly according to claim 10, wherein the cross-sectional area of the chamber is larger than the combined surface area of the one or more outlets by about an order of magnitude or more.

12. The manifold assembly according to claim 10 or 11, wherein the chamber comprises a full bore pipe.

13. The manifold assembly according to any one of claims 10 to 12, wherein each of the one or more outlets of the manifold assembly comprises a nozzle having a nozzle inlet, a nozzle outlet and a swirl chamber disposed between the nozzle inlet and the nozzle outlet.

14. The manifold assembly according to any one of claims 10 to 13 for use in a tailings solvent recovery unit.

SMART & BIGGAR

OTTAWA, CANADA

PATENT AGENTS

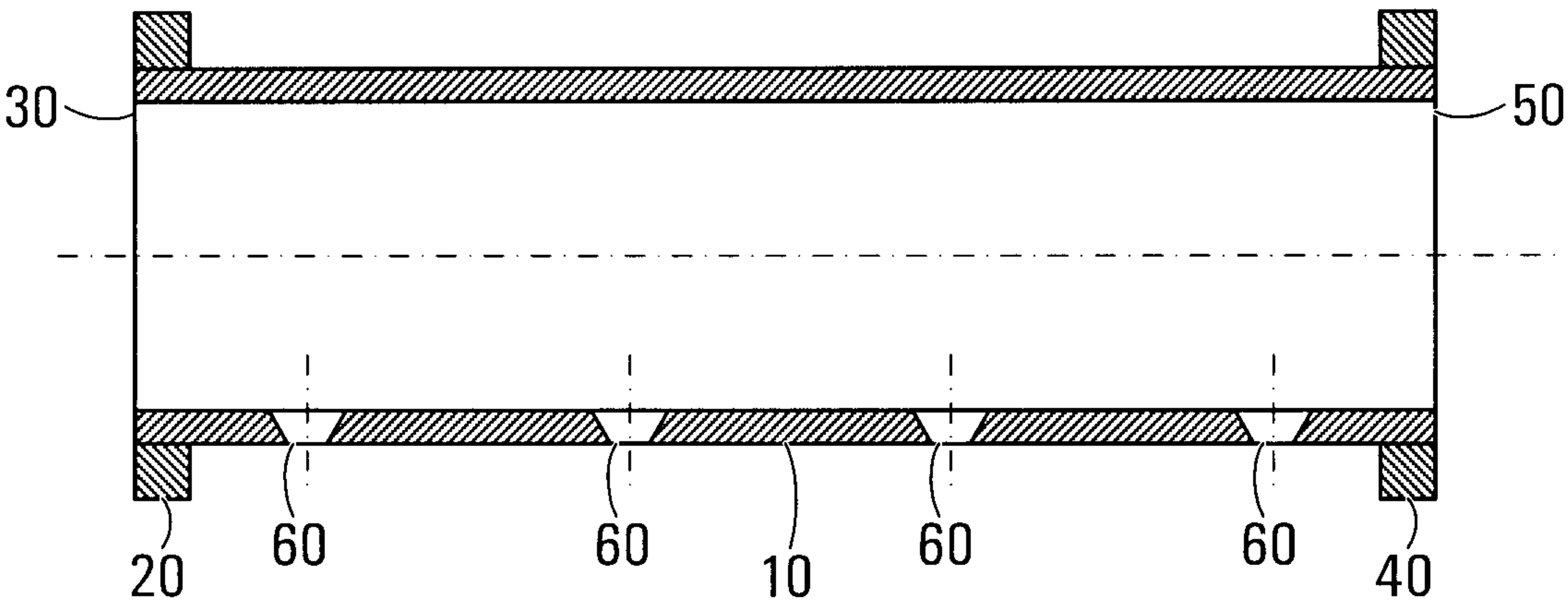



FIG. 1


30
50
20
60
60
10
60
60
40