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(73) Titulaire(s):
ANHUI UNIVERSITY OF SCIENCE AND TECHNOLOGY – 232001 Huainan City, Anhui Province (Chine)

(72) Inventeur(s):
JI Jiadong – 232001 Huainan City, Anhui Province (Chine), ZHANG Jingwei – 232001 Huainan City, Anhui Province (Chine), GAO Runmiao – 232001 Huainan City, Anhui Province (Chine), CHEN Weiqiang – 232001 Huainan City, Anhui Province (Chine)

(74) Mandataire(s):
VAN ESSEN PATENT BV – 6708 PW Wageningen (Pays-Bas)

(54) **PORTABLE HEAT EXCHANGE DEVICE HAVING ARRAYED PLANAR ELASTIC VORTEX TUBES.**

(57) The present invention relates to a portable heat exchange device having arrayed planar elastic vortex tubes, including a left seal head, a right seal head, a tube-side outlet tube, planar elastic vortex tubes, a tube-side inlet tube, mass blocks, a cylinder, flanges, gaskets, a tube sheet-fixing frame, tube-sheet end covers, a tube sheet-fixing collar, a shell-side outlet tube, a shell-side inlet tube, a bracket, and a handle. The planar elastic vortex tubes includes planar red copper vortex tubes and mass blocks. The planar elastic vortex tubes are arranged in an evenly spaced manner to form a tube bundle and are connected to the tube sheet-fixing frame through the fixing collar, and the mass block is connected between the planar elastic vortex tubes. The cylinder is fixedly connected outside the tube sheet and between left and right tube-sheet end covers, and the gaskets are arranged between the end covers and the cylinder for sealing. The left and right seal heads are respectively connected to the other ends of the left and right tube-sheet end covers, and the gaskets are arranged between the left and right tube-sheet end covers and the seal heads for sealing. The heat exchange device enhances heat transfer by using vibrations. The planar vortex tubes are made of red copper, and the copper tube is unlikely to be damaged, which is beneficial to prolonging the service life and reducing noise harm, and can also achieve automatic descaling. Under the action of the mass blocks, inherent characteristics of the tube bundle are changed, so that a vibration characteristic under the induction of the fluid is regulated, thereby further enhancing heat transfer through vibration. A plurality of heat exchange devices may be combined and installed as a one-row array by using the flanges disposed at inlets and outlets, and the

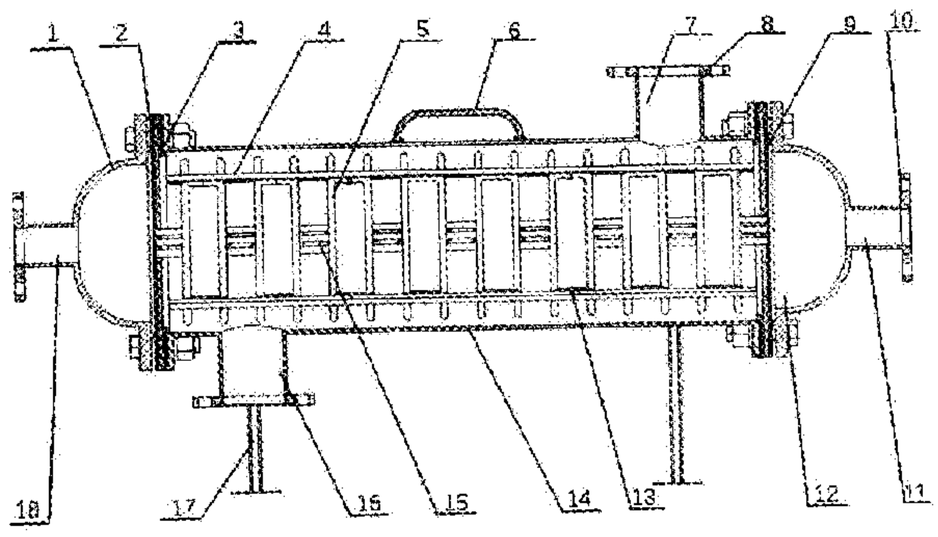

FIG. 1

connecting tube, and may be flexibly assembled and disassembled according to an actual situation.

PORTABLE HEAT EXCHANGE DEVICE HAVING ARRAYED PLANAR ELASTIC VORTEX TUBES

BACKGROUND

Technical Field

The present invention relates to the field of heat exchange device design technologies, and particularly, to a portable heat exchange device having arrayed planar elastic vortex tubes.

Related Art

A heat exchange device is an energy-efficient device that transfers heat between two or more fluids having different temperatures, to transfer heat of a fluid having a higher temperature to a fluid having a lower temperature, so that the temperatures of the fluids reach an indicator specified in a process, to meet the need of technological conditions, is also a major device that improves the energy utilization, and is widely applied to the industrial fields of petroleum, chemical engineering, electric power, refrigeration, and the like.

The internal heat exchange element of a conventional shell-and-tube heat exchange device is made of a plurality of stainless steel straight tubes, and has a relatively large overall structure and low flexibility of assembly. The internal heat exchange element of a conventional tube-in-tube heat exchange device is made of a single stainless steel straight tube, and has a simple structure and low heat exchange efficiency. Since vibrations of a heat transfer element inside a flow-induced heat exchange device may cause fatigue damage, the method of preventing vibrations and avoiding damage by increasing strength of rigid tube bundles is not always effective. An elastic tube bundle heat exchange device has conventional rigid elements (stainless steel tubes) replaced with elastic heat transfer elements (red copper tubes), fully uses vibrations of a flow-induced elastic heat transfer element to enhance heat transfer, and has obvious advantages in preventing damage to a tube bundle, reducing noise, and automatic descaling. However, due to limitations of the arrangement of an internal tube bundle and the overall size, a heat transfer enhancement effect of such an elastic tube bundle heat exchange device is not obvious, and the flexibility of combination and use of a plurality of such heat exchange devices is low. Based on the foregoing problems of the heat exchange device, requirements for high efficiency and flexibility cannot be met.

SUMMARY

To overcome problems in actual engineering applications of existing tubular heat exchange devices, a portable heat exchange device having arrayed planar elastic vortex tubes is provided in the present invention.

The present invention is achieved through the following technical solution.

A portable heat exchange device having arrayed planar elastic vortex tubes is provided, including a left seal head, a right seal head, a tube-side outlet tube, a planar elastic vortex tube bundle, a left tube-sheet end cover, a right tube-sheet end cover, a tube sheet-fixing collar, a tube sheet-fixing frame, a mass block, a cylinder, flanges, gaskets, shell-side outlet and inlet tubes, a connecting tube, and a bracket. Planar elastic vortex tubes includes planar red copper vortex tubes that are arranged in an array and that are nested within each other. For the planar elastic vortex tube bundle, planar elastic vortex tubes are connected to the tube sheet-fixing frame in an evenly spaced manner through the tube sheet-fixing collar, and a mass block is connected between the groups of the planar elastic vortex tubes; the cylinder is fixedly connected between the left and right tube-sheet end covers, and the gaskets are disposed between the cylinder and the tube-sheet end covers; and the left and right seal heads are fixedly connected to the left and right tube-sheet end covers respectively, and the gaskets are disposed between the tube-sheet end covers and the seal heads. The heat exchange device may be individually used in time through a handle and the bracket, or a plurality of heat exchange devices may be combined, installed, and used as a one-row array by using the flanges disposed at inlets and outlets, the connecting tube, and the bracket.

In a preferred technical solution of the present invention, a group of planar elastic vortex tubes including a plurality of planar red copper vortex tubes is fixedly connected to the tube sheet. A plurality of groups of planar elastic vortex tubes form the planar elastic vortex tube bundle, and all the groups of the planar elastic vortex tubes are arranged in an evenly spaced manner between the tube sheet left and right end covers. The mass block is mounted between the groups of planar elastic vortex tubes.

In a preferred technical solution of the present invention, each group of planar elastic vortex tubes includes 4 planar red copper vortex tubes nested within each other, and an outer diameter remains unchanged, thereby saving space and improving the utilization. The whole heat exchange device has a proper size, and the portable heat exchange device having arrayed planar elastic vortex tubes can be directly and individually used through the

handle and the bracket.

In a preferred technical solution of the present invention, the cylinder is fixed between the left and right tube-sheet end covers, the left and right seal heads are connected to the other ends of the left and right tube-sheet end covers, the flanges are connected to the seal heads, the flange is connected to the connecting tube, and the bracket is mounted at the flange, to implement combination, installation, and use of the heat exchange device.

During on-site use, a pressure test and an air-tight test need to be performed on the heat exchange device having arrayed planar elastic vortex tubes before installation. A path through which a hot medium flows in the tube-side inlet tube, the planar elastic vortex tube bundle, and the tube-side outlet tube is referred to as a tube side. A path through which a cold medium flows in the shell-side inlet tube, vortex tubes, and a gap between the outlet tube and the cylinder is referred to as a shell side. The heat exchange device having planar elastic vortex tubes is installed in a horizontal manner. When a plurality of portable heat exchange devices having elastic vortex tubes work, a tube-side hot medium flows in from the tube-side inlet and flows out from the tube-side outlet, and a shell-side cold medium flows in from a bottom shell-side inlet, to fill up the shell body, and then, flows out from a top shell-side outlet. Cross flowing of the shell-side medium and the tube-side medium is achieved, which is beneficial to achieving a better heat exchange effect. According to requirements under actual heat exchange conditions, a single heat exchange device can be directly and individually used by using the handle and the bracket, and a plurality of heat exchange devices may be combined and installed as a one-row array by fixedly connecting the flanges at inlets and outlets.

Compared with prior art, the beneficial effect of the present invention is that copper tubes are used in all tube bundles in the present invention. Copper material is an elastic material. Vibrations of planar red copper vortex tubes generated through induction of the shell-side and tube-side fluid media enhance a turbulence characteristic of a fluid medium near an outer wall insides the tube, thereby enhancing heat transfer. Vibrating copper tubes are unlikely to suffer fatigue damage, have features of noise reduction and automatic descaling, and can be used for a long term. The tube bundle is a vortex tube structure, and a secondary flow generated when the fluid medium inside the tube flows further enhances heat transfer. Under the action of the mass blocks, inherent characteristics of the tube bundle are changed, so that a vibration characteristic under the induction of the fluid is regulated, thereby further enhancing heat transfer through vibration. The heat exchange

device having planar elastic vortex tubes is installed in a horizontal manner, so that pressure drops of inlets and outlets of vortex tubes tend to be consistent, helping to achieve a uniform and consistent vibration effect of rows of vortex tubes. The heat exchange device may be individually and directly used through the handle and the bracket installed on the single heat exchange device, and a plurality of heat exchange devices may be combined and installed as a one-row array by using the flanges disposed at inlets and outlets, and the connecting tube, and may be flexibly assembled and disassembled according to an actual situation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic structural diagram of the present invention;

FIG. 2 is a diagram of an internal structure of the present invention; and

FIG. 3 is a schematic structural diagram of combination and installation of a plurality of heat exchange devices according to the present invention.

In the drawings: 1. left seal head; 2. gasket; 3. left tube-sheet end cover; 4. tube sheet-fixing frame; 5. planar elastic vortex tube bundle; 6. handle; 7. shell-side outlet tube; 8. flange; 9. right tube-sheet end cover; 10. flange; 11. tube-side inlet tube; 12. right seal head; 13. tube sheet-fixing collar; 14. cylinder; 15. mass block; 16. shell-side inlet tube; 17. bracket; 18. tube-side outlet tube; 19. planar red copper tube; 20. connecting tube; 21. portable heat exchange device having arrayed planar elastic vortex tubes.

DETAILED DESCRIPTION

To make the objectives, technical solutions, and advantages of the present disclosure clearer and more comprehensible, the following further describes the present disclosure in detail with reference to the accompanying drawings and embodiments. It should be understood that the specific embodiments herein are merely provided for describing the present invention and not intended to limit the present invention.

Refer to FIG. 1, FIG. 2, and FIG. 3. FIG. 1 is a schematic structural diagram of the present invention. FIG. 2 is a diagram of an internal structure of the present invention. FIG. 3 is a schematic structural diagram of combination and installation of a plurality of heat exchange devices according to the present invention.

A portable heat exchange device having arrayed planar elastic vortex tubes is provided, including a left seal head 1, a gasket 2, a left tube-sheet end cover 3, a tube sheet-fixing frame 4, a planar elastic vortex tube bundle 5, a handle 6, a shell-side outlet tube 7, flanges 8, a right tube-sheet end cover 9, flanges 10, a tube-side inlet tube 11, a right seal head 12,

a tube sheet-fixing collar 13, a cylinder 14, a mass block 15, a shell-side inlet tube 16, a bracket 17, a tube-side outlet tube 18. The planar elastic vortex tube bundle 5 includes planar red copper vortex tubes 19 and mass blocks 15. Four planar red copper vortex tubes 19 form a group of planar elastic vortex tubes. The groups of planar elastic vortex tubes are connected to each other in an evenly spaced manner, where the mass block is connected therebetween, and are fixed on the tube sheet-fixing frame through the tube sheet-fixing collar. The cylinder 14 is fixedly connected between the left tube-sheet end cover 3 and the right tube-sheet end cover 9. The left seal head 1 is fixedly connected to the left tube-sheet end cover 3, the right seal head 12 is fixedly connected to the right tube-sheet end cover 9, and the gaskets 2 are arranged between the cylinder 14 and the tube-sheet end covers 3 and 9, and between the seal heads 1 and 12 and the tube-sheet end covers 3 and 9. The gasket is beneficial to ensuring air tightness of the heat exchange device.

The planar elastic vortex tube bundle includes 64 planar red copper vortex tubes fixed in an evenly spaced manner on the tube sheet. The planar red copper vortex tube 19 is made of copper, which is beneficial to prolonging the service life and reducing noise harm, and can achieve automatic descaling. The tube bundle is in a vortex spiral shape, so that the interior of the fluid inside the tube flows spirally, to generate a secondary flow under the action of a centrifugal force, thereby further enhancing heat transfer. The complex tube bundle structure in such a shape enhances a turbulence characteristic of flowing of a shell-side fluid, thereby further enhancing heat transfer.

The left and right seal heads 1 and 12 are respectively connected to the left and right tube-sheet end covers 3 and 9. The flanges 10 are connected to the seal heads 1 and 12, and the flange 10 is connected to the connecting tube 20. An upper end of the bracket is connected to a lower end of another heat exchange device, to facilitate fixing of a plurality of heat exchange devices, which is beneficial to combining and installing the heat exchange devices in a one-row array.

During on-site use, a pressure test and an air-tight test need to be performed on the portable heat exchange device 21 having arrayed planar elastic vortex tubes before installation. A path through which a hot medium flows in the tube-side inlet tube, the arrayed planar elastic vortex tubes, and the tube-side outlet tube is referred to as a tube side. A path through which a hot medium flows in the tube-side inlet tube, the arrayed planar elastic vortex tubes, and the tube-side outlet tube is referred to as a tube side. A path through which a cold medium flows in the shell-side inlet tube, the arrayed planar elastic

vortex tubes, and a gap between the shell-side outlet tube and the cylinder is referred to as a shell side. The heat exchange device having arrayed planar elastic vortex tubes is installed in a horizontal manner. When a plurality of portable heat exchange devices having planar elastic vortex tubes work, a tube-side hot medium flows in from a tube-side inlet and flows out from a tube-side outlet, and a shell-side cold medium flows in from a bottom shell-side inlet, to fill up the shell body, and then, flows out from a top shell-side outlet. Cross flowing of the shell-side medium and the tube-side medium is achieved, which is beneficial to achieving a better heat exchange effect.

The above are only preferred embodiments of the present invention, and are not intended to limit the present invention. Any modification, equivalent replacement and improvement made within the spirit and rule of the present invention shall fall within the protection scope of the present invention.

CLAIMS

What is claimed is:

1. A portable heat exchange device having arrayed planar elastic vortex tubes, comprising: a left seal head (1), gaskets (2), a left tube-sheet end cover (3), a tube sheet-fixing frame (4), a planar elastic vortex tube bundle (5), a handle (6), a shell-side outlet tube (7), flanges (8), a right tube-sheet end cover (9), flanges (10), a tube-side inlet tube (11), a right seal head (12), a tube sheet-fixing collar (13), a cylinder (14), mass blocks (15), a shell-side inlet tube (16), a bracket (17), a tube-side outlet tube (18), and a connecting tube (20), wherein for the planar elastic vortex tube bundle (5), groups of planar elastic vortex tubes are combined and arranged in an evenly spaced manner, are connected to the tube sheet-fixing frame (4) through the fixing collar (10), and are connected to the left and right tube-sheet end covers (3) and (9) to constitute an internal tube bundle and a tube sheet; the mass block (15) is connected between the groups of planar elastic vortex tubes, and the groups of planar elastic vortex tubes are connected to each other to form the elastic vortex tube bundle (5); the cylinder (14) is fixedly connected between the left tube-sheet end cover (3) and the right tube-sheet end cover (9), and the gaskets (2) are mounted between the cylinder (14) and the tube-sheet end covers (3) and (9); and the left seal head (1) is fixedly connected to the left tube-sheet end cover (3), the right seal head (12) is fixedly connected to the right tube-sheet end cover (9), and the gaskets (2) are disposed between the tube-sheet end covers (3) and (9) and the seal heads (1) and (12).

2. The portable heat exchange device having arrayed planar elastic vortex tubes according to claim 1, wherein the left tube-sheet end cover (3), the tube sheet-fixing frame (4), the tube sheet-fixing collar (13), and the right tube-sheet end cover (9) form a tube sheet fixing elastic vortex tube bundle, the planar elastic vortex tube bundle (5) in which an array combination is fixed by using the fixing collar (13) is fixed on the tube sheet-fixing frame (4), the left and right end covers of the tube sheet are provided with inlets and outlets of the planar elastic vortex tube bundle (5), and the mass block 15 is connected between the planar elastic vortex tubes (5).

3. The portable heat exchange device having arrayed planar elastic vortex tubes according to claim 1, wherein the planar elastic vortex tube bundle (5) comprises a plurality of groups of planar elastic vortex tubes arranged as an array in an evenly spaced manner, a group of planar elastic vortex tubes comprises a plurality of planar red copper

vortex tubes (19), and the planar elastic vortex tube bundle is fixed on the tube sheet.

4. The portable heat exchange device having arrayed planar elastic vortex tubes according to claim 1, wherein the cylinder (14) is fixed between the left tube-sheet end cover (3) and the right tube-sheet end cover (9), the seal heads (1) and (12) are connected to the other ends of the left tube-sheet end cover (3) and the right tube-sheet end cover (9), the flanges (10) are connected to the seal heads (1) and (12), and the flange (10) is connected to the connecting tube (20), to implement combination, installation, and use of the heat exchange device through the bracket (17).

Revendications

1. Un dispositif d'échange thermique portable à matrices de tubes spiralés élastiques plats, caractérisé en ce qu'il comprend une tête de scellement gauche (1), un joint (2), un couvercle d'extrémité gauche de plaque de tube (3), un support de fixation de plaque de tube (4), un faisceau de tubes spiralés élastiques plats (5), une poignée (6), un tube de sortie de trappe (7), une bride (8), un couvercle d'extrémité droite de plaque de tube (9), une bride (10), un tube d'entrée de parcours de tube (11), une tête de scellement gauche (12), un collier de fixation de plaque de tube (13), un cylindre (14), un bloc de masse (15), un tube d'entrée de parcours d'enveloppe (16), un support (17), un tube de sortie de parcours de tube (18), un tube de connexion (20) et un tube spiralé plat en cuivre ; le faisceau de tubes spiralés élastiques plats (5) est composé de rangées de groupes de tubes spiralés élastiques plats ordonnés à intervalles équidistants et reliés au support de fixation de plaque de tube (4) via la bride (10), les couvercles d'extrémités gauche et droite de plaque de tube (3) (9) forment la partie interne du faisceau de tubes et de la plaque de tube ; un bloc de masse (15) est agencé entre chaque groupe de tubes spiralés élastiques, ils sont mutuellement reliés et forment le faisceau de tubes spiralés élastiques (5) ; le cylindre (14) relie de façon fixe le couvercle d'extrémité gauche de plaque de tube (3) et le couvercle d'extrémité droite de plaque de tube (9), entre lesquels en outre sont agencés des joints (2) ; la tête de scellement gauche (1) et le couvercle d'extrémité gauche de plaque de tube (3) sont reliés de façon fixe, la tête de scellement gauche (12) et le couvercle d'extrémité droite de plaque de tube (9) sont reliés de façon fixe, en outre des joints (2) sont agencés entre les couvercles d'extrémité de plaque de tube (3) (9) et les têtes de scellement (1) (12).

2. Un dispositif d'échange thermique portable à matrices de tubes spiralés élastiques plats selon la revendication 1, caractérisé en ce que le couvercle d'extrémité gauche de plaque de tube (3), le support de fixation de plaque de tube (4), le collier de fixation de plaque de tube (13) et le couvercle d'extrémité droite de plaque de tube (9) constituent le faisceau de tubes spiralés élastiques fixes de plaque de tube, ledit support de fixation de plaque de tube (4) est muni d'un collier de fixation de plaque de tube (13) fixant les faisceaux de tubes spiralés élastiques plats (5) groupés en matrices à l'intérieur, les couvercles d'extrémités gauche et droite de la plaque de tube sont munis d'une entrée et d'une sortie de faisceau de tubes spiralés élastiques plats (5), des blocs de masse sont agencés entre les faisceaux de tubes spiralés élastiques plats (5).

3. Un dispositif d'échange thermique portable à matrices de tubes spiralés élastiques plats selon la revendication 1, caractérisé en ce que le faisceau de tubes spiralés élastiques

plats (5) est constitué d'une pluralité de groupes de tubes spiralés élastiques plats agencés de façon équidistante, un groupe de tubes spiralés élastiques plats étant constitué d'une pluralité de tubes spiralés plats en cuivre (19), les faisceaux de tubes spiralés élastiques plats étant fixés sur la plaque de tube.

4. Un dispositif d'échange thermique portable à matrices de tubes spiralés élastiques plats selon la revendication 1, caractérisé en ce que ledit cylindre (14) est fixé entre le couvercle d'extrémité gauche de plaque de tube (3) et le couvercle d'extrémité droite de plaque de tube (9), les autres extrémités dudit couvercle d'extrémité gauche de plaque de tube (3) et dudit couvercle d'extrémité droite de plaque de tube (9) sont munies des têtes de scellement (1) (12), lesdites têtes de scellement (1) (12) sont munies de brides (10), lesdites brides (10) et lesdits tubes de connexion (20) sont mutuellement reliés, le montage, l'installation et l'utilisation du dispositif d'échange thermique sont réalisés via le support (17).

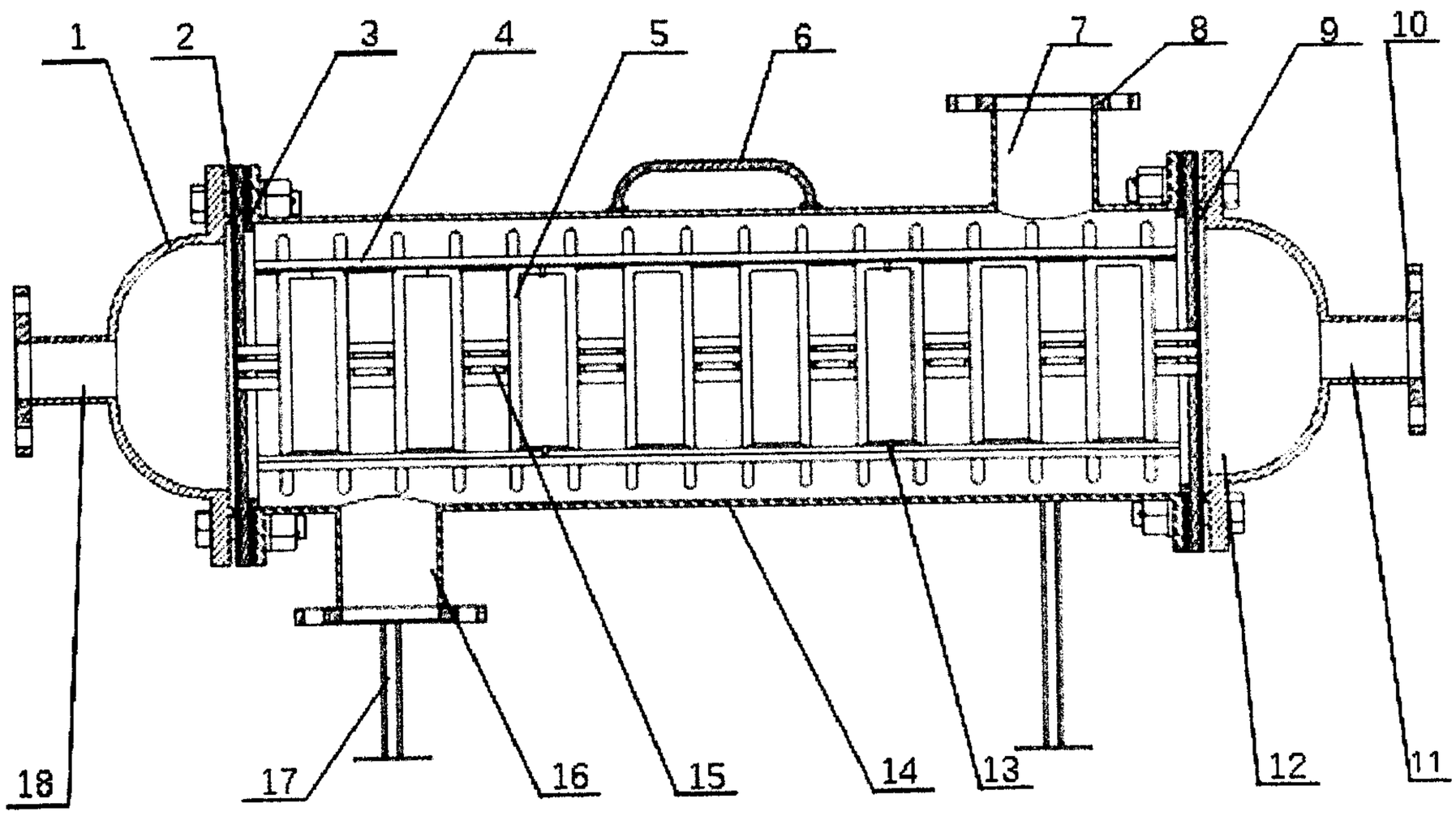

FIG. 1

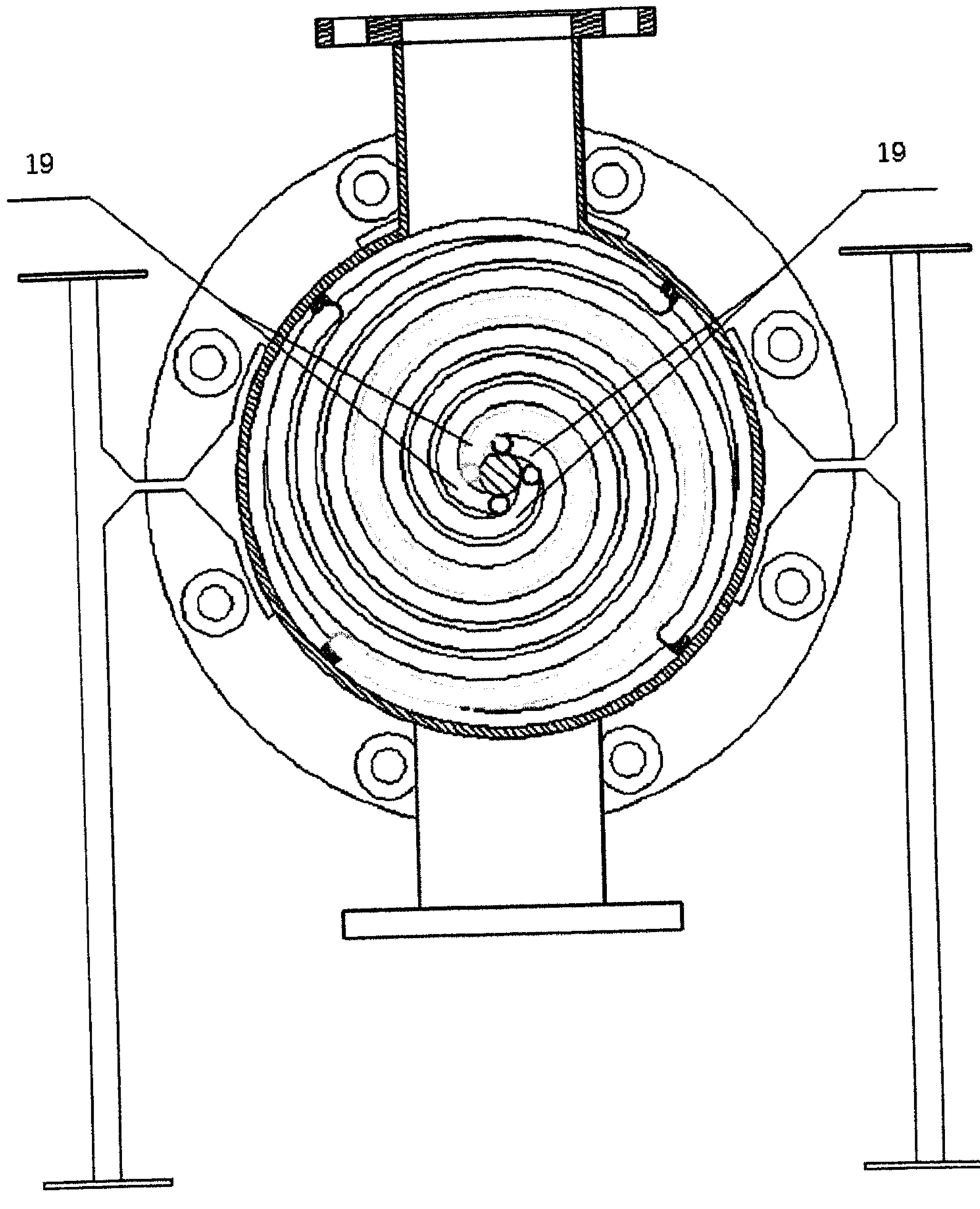

FIG. 2

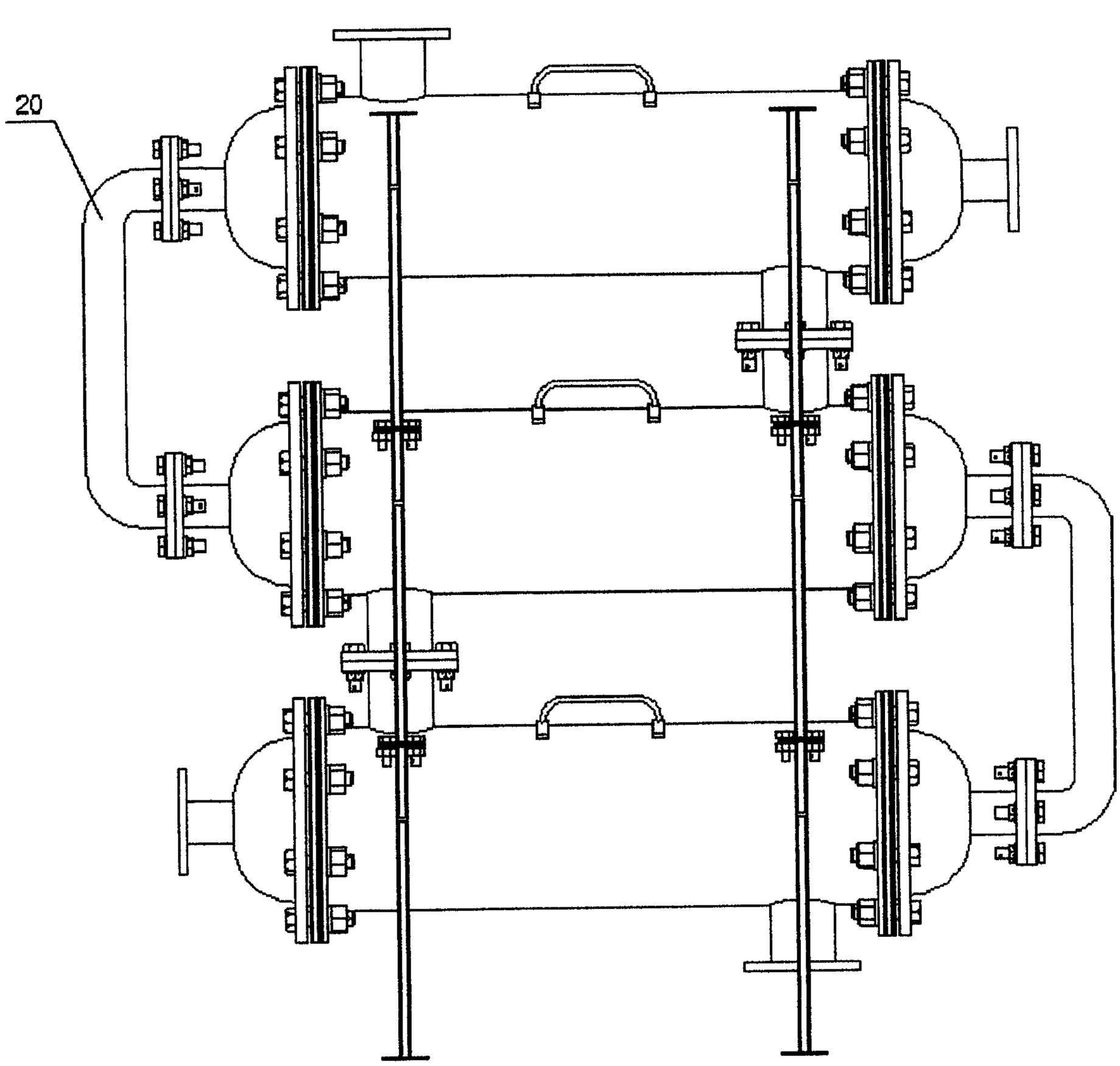

FIG. 3