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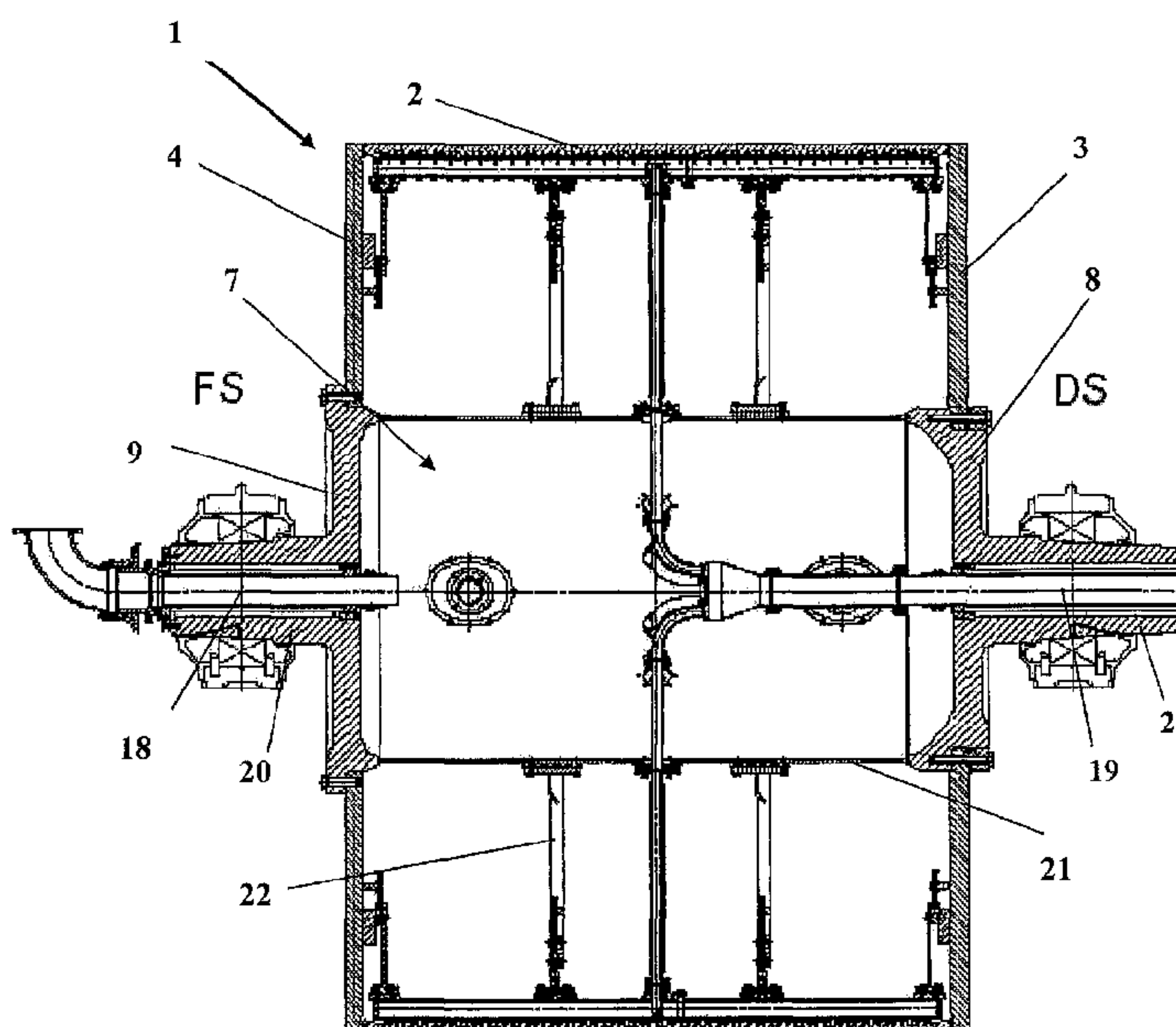
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(54) Titre : SECHEUR YANKEE POUR SECHER UN MATELAS DE PATE

(54) Title: YANKEE DRYER FOR DRYING A PULP WEB



(57) Abrégé/Abstract:

The invention relates to a Yankee dryer (1) made of steel with a cylindrical steel shell (2) that is closed off at each end by a cylinder end cover (3, 4). According to the invention the Yankee dryer (1) has a one-piece central shaft (7) with a first and a second connecting flange (8, 9) to join the central shaft (7) to the end covers (3, 4), where the diameter of the first connecting flange (8) is smaller than the diameter of the opening (6) in the second end cover (4) so that the central shaft (7) can be pushed through this opening (6) into the Yankee cylinder (1). The invention also refers to a manufacturing process for a Yankee dryer (1).

Summary

The invention relates to a Yankee dryer (1) made of steel with a cylindrical steel shell (2) that is closed off at each end by a cylinder end cover (3, 4). According to the invention the Yankee dryer (1) has a one-piece central shaft (7) with a first and a second connecting flange (8, 9) to join the central shaft (7) to the end covers (3, 4), where the diameter of the first connecting flange (8) is smaller than the diameter of the opening (6) in the second end cover (4) so that the central shaft (7) can be pushed through this opening (6) into the Yankee cylinder (1).

10 The invention also refers to a manufacturing process for a Yankee dryer (1).

Yankee dryer for drying a pulp web

The invention relates to a Yankee dryer made of steel for drying a pulp web, with a cylindrical steel shell that is connected to a first and second cylinder end cover at either end, where the cylinder end covers each have an opening at their centre.

The invention also relates to a process for manufacturing the Yankee dryer according to the invention.

10 In production of paper webs, particularly for tissue, it is common practice to use so-called Yankee dryers in the drying process.

Yankee dryers usually have a very large diameter. They are heated with steam and are difficult to manufacture because there are high demands to be met concerning internal pressures, leak tightness, and the large diameters.

Yankee dryers customary in the trade have the following dimensions, for example:

20	Cylinder diameter:	3000 mm to 5500 mm
	Diameter of hollow shaft:	1500 mm to 1800 mm
	Cylinder width:	6000 mm to 7500 mm
	Cylinder mass:	40 t to 95 t

25 These cylinders are made predominantly of cast iron, however Yankee dryers made of steel are also already known from US 4,196,689 and DE 2707923.

Normally a Yankee dryer consists of a cylindrical shell surface that is closed off at the end by means of cylinder end covers of various shapes. Here, the two covers can be bolted or also welded to the cylinder shell.

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A Yankee dryer rotates in bearings by means of journals and contains a hollow shaft or axle through which the steam for heating can be fed to the cylinder and the waste steam and condensate can be removed.

WO2008/105005 discloses a Yankee dryer made of steel with a central shaft in several sections. This means that the two bearing journals of the Yankee dryer are attached to the end covers separately from a hollow shaft inside the dryer, using bolts for example (see Fig. 1). This embodiment has the disadvantage that a large number of bolts and flanges are required additionally, which weaken the component.

Furthermore there are more components with tolerances to be machined, thus there may be imprecise bearing alignment.

Conventional Yankee dryers, as illustrated in WO2008/105005, are manufactured in the following assembly sequence:

1. The cylinder shell is placed on the first end cover and joined to it (bolted or welded);
2. The hollow shaft with the steam and condensate pipes attached to it is placed inside the cylinder.
3. The hollow shaft is welded or bolted to the first end cover.
4. The second end cover is placed on the cylinder shell and joined to the cylinder shell and the hollow shaft.
5. The bearing journals are affixed to the end covers.

Due to the safety regulations for manufacture of pressure vessels, the end covers must be welded to the shell on both sides, i.e. on the inside and on the outside. The conventional assembly sequence has the disadvantage that the root weld between the second cover and the cylinder shell on the inside of the cylinder can only be made by entering the cylinder through the manhole in the end cover. This leads to more difficult working conditions for the welders on the one hand (lack of air, light, and space) and presents a much higher risk of accidents on the other hand.

The aim of the invention is to disclose a Yankee dryer made of steel that is easier to manufacture.

According to an aspect of the invention, the Yankee dryer has a one-piece central shaft with a first and a second connecting flange to join the central shaft to the end covers. The diameter of the first connecting flange is smaller than the diameter of the opening in the second end cover so that the central shaft can be pushed through this opening into the Yankee cylinder.

Due to the one-part central shaft, the steel shell of the Yankee dryer can be joined first of all to the two end covers, preferably welded. Thus, the inside of the Yankee is easily accessible because the two openings in the covers are quite large (approx. 1500 mm), making it easy to perform welding work inside the Yankee.

The one-part central shaft is not inserted into and joined to the cylinder until the end covers have been joined to the steel shell. In addition, handling is easier during assembly because there are fewer components.

Advantageously the diameter of the first connecting flange is larger than the opening in the first end cover. The first connecting flange is thus on the inside of the first end cover after the central shaft has been inserted and can be joined to it easily, by bolting for example.

It is also favourable if the diameter of the second connecting flange is larger than the opening in the second end cover because the second connecting flange then rests on the outside of the second end cover when the central shaft has been inserted and can be joined to it easily (bolted for example).

Thus, the central shaft has connecting flanges at both ends, but with different diameters. It is an advantage if the connecting flange at the operator-side end has a larger diameter than the connecting flange on the drive-side end. Due to this special design of the central shaft and with an appropriate screw joint between the central shaft and the end covers, a facility is also created for changing the central shaft in a non-destructive process. The current state of the art does not disclose any embodiments that make it possible to remove the shaft, if there is a leakage problem for example, without ruining the end covers and usually also the cylinder shell.

It is also the aim of the invention to disclose a simpler manufacturing process for a Yankee dryer.

The manufacturing process according to another aspect of the invention for a Yankee
5 cylinder made of steel comprises the following steps:

- 1.) One end of a cylindrical steel shell is placed on a first end cover and
joined to it, particularly welded;
- 2.) A second end cover is joined to the other end of the cylindrical steel shell,
10 particularly welded;
- 3.) A one-piece central shaft with connecting flanges is inserted into or placed
inside the cylinder through an opening in the end cover;
- 4.) The connecting flanges of the central shaft are then each joined to the
end covers;

15 Thus, the central shaft is not placed inside the cylinder until both end covers
have been joined firmly to the cylinder shell. Welding work to join the shell to the
covers need no longer be performed through the manhole.

20 Essentially, only the two finish-machined components – the central shaft and the
cylinder with end covers – have to be assembled. This also reduces the risk of
errors during assembly compared to dryers consisting of several components.

The connecting flanges of the central shaft can either be bolted or welded to the
end covers. If they are bolted, this provides the option of making the central
25 shaft easy to replace.

According to another aspect of the invention, there is provided a Yankee dryer
made of steel with a cylindrical steel shell that is connected to a first and second
cylinder end cover at either end, where the cylinder end covers each have an
30 opening at their centre, wherein the Yankee dryer has a one-piece rotatable
central shaft extending coaxially through the shell with a first and a second
connecting flange to join the central shaft to the end covers for rotating the

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cylindrical shell, the diameter of the first connecting flange is smaller than the diameter of the opening in the second end cover so that the central shaft can be pushed through this opening into the Yankee cylinder.

5 According to another aspect of the invention, there is provided a process for manufacturing a Yankee dryer made of steel, comprising the following steps:

a) One end of a cylindrical steel shell is placed on a first end cover and joined to it;

10 b) A second end cover is joined to the other end of the cylindrical steel shell;

c) A rotatable one-piece central shaft with connecting flanges is inserted into the inside of the cylinder through an opening in an end cover;

d) The connecting flanges are then each joined to the end covers for rotating the cylindrical shell.

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In the following, the invention is described with the help of drawings, where

Fig. 1 shows a state-of-the-art Yankee dryer made of steel, as is disclosed in WO 2008/105005;

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Fig. 2 shows the cylinder shell according to the invention with the two end covers;

Fig. 3 shows the one-part central shaft according to the invention, which is placed inside the cylinder shell according to Fig. 2;

5 Fig. 4 shows the assembled Yankee dryer according to the invention;

Figure 1 shows a state-of-the-art Yankee dryer 11. It consists of a cylindrical steel shell 12 that is welded to the two end covers 13. The Yankee dryer has a multi-part central shaft 14 comprising the two bearing journals 15 and a
10 cylindrical connecting piece 17 inside the cylinder. The two bearing journals 15 and the connecting piece 17 are bolted to the end covers 13. The two bearing journals 15 rotate in roller bearings 16.

In manufacture of this Yankee dryer 11, the steel shell 12 is joined first of all to one of the two end covers 13. Then the connecting piece 17 (hollow shaft) is
15 placed inside the cylinder and bolted to the end cover 13.

After this the second end cover 13 is placed on the top end of the steel shell 12 and welded to the cylinder shell or bolted to the connecting piece 17. The steel shell 12 must be welded to the end covers 13 from the inside and the outside of the cylinders, thus the second end cover 13 has to be welded to the steel
20 shell 12 through a manhole in the end cover. Subsequently the two bearing journals 15 are bolted to the respective end covers.

Figure 2 shows the cylindrical steel shell 2 of the Yankee dryer according to the invention. Here the steel shell 2 is joined to a first end cover 3 and a second end
25 cover 4. The two end covers (3, 4) each have a circular opening (5, 6) in the centre to hold the central shaft 7.

The central shaft 7 is shown in Figure 3. It has a one-piece design. This means that the central shaft 7 forms a single component after manufacture, made up of several parts if necessary, and this component is then placed inside the steel
30 shell 2. The one-part central shaft 7 consists of the bearing journals 20, the two connecting flanges 8 and 9, and a central part 21. This central shaft 7 is assembled before being placed inside the steel shell 2. The central shaft rotates in the bearings 10. Steam can be supplied to the Yankee dryer during operation

through the steam feed 18. Waste steam or condensate is carried off the through the pipe 19.

Figure 4 shows the Yankee dryer 1 fully assembled. In manufacture of this
5 Yankee dryer 1, one end of the cylindrical steel shell 2 is placed on the first end cover 3 and joined to it, by bolting or welding for example. Then the second end cover 4 is joined to the other end of the cylindrical steel shell 2. The result is a pre-assembled steel cylinder as shown in Fig. 2. The two end covers 3 and 4 each have openings 5 and 6 to hold the central shaft 7. Figure 2 shows that the
10 opening 5 in the first end cover 3 is a little smaller than the opening 6 in the second end cover 4.

In a further assembly step, the pre-assembled, one-part central shaft 7 is placed inside the steel shell 2 through the opening 6 in the second end cover 4.
15 The diameter of the first connecting flange 8 of the central shaft 7 must be smaller than the opening 6 here so that the central shaft 7 can be placed inside the cylinder.

In the present example, the diameter of the first connecting flange 8 is slightly
20 larger than the opening 5 in the first end cover 3. As a result, the connecting flange 8 rests on the inner side of the first end cover 3 after the central shaft 7 has been inserted (see Fig. 4). The first end cover 3 can thus be bolted easily to the first connecting flange 8 from the outside.

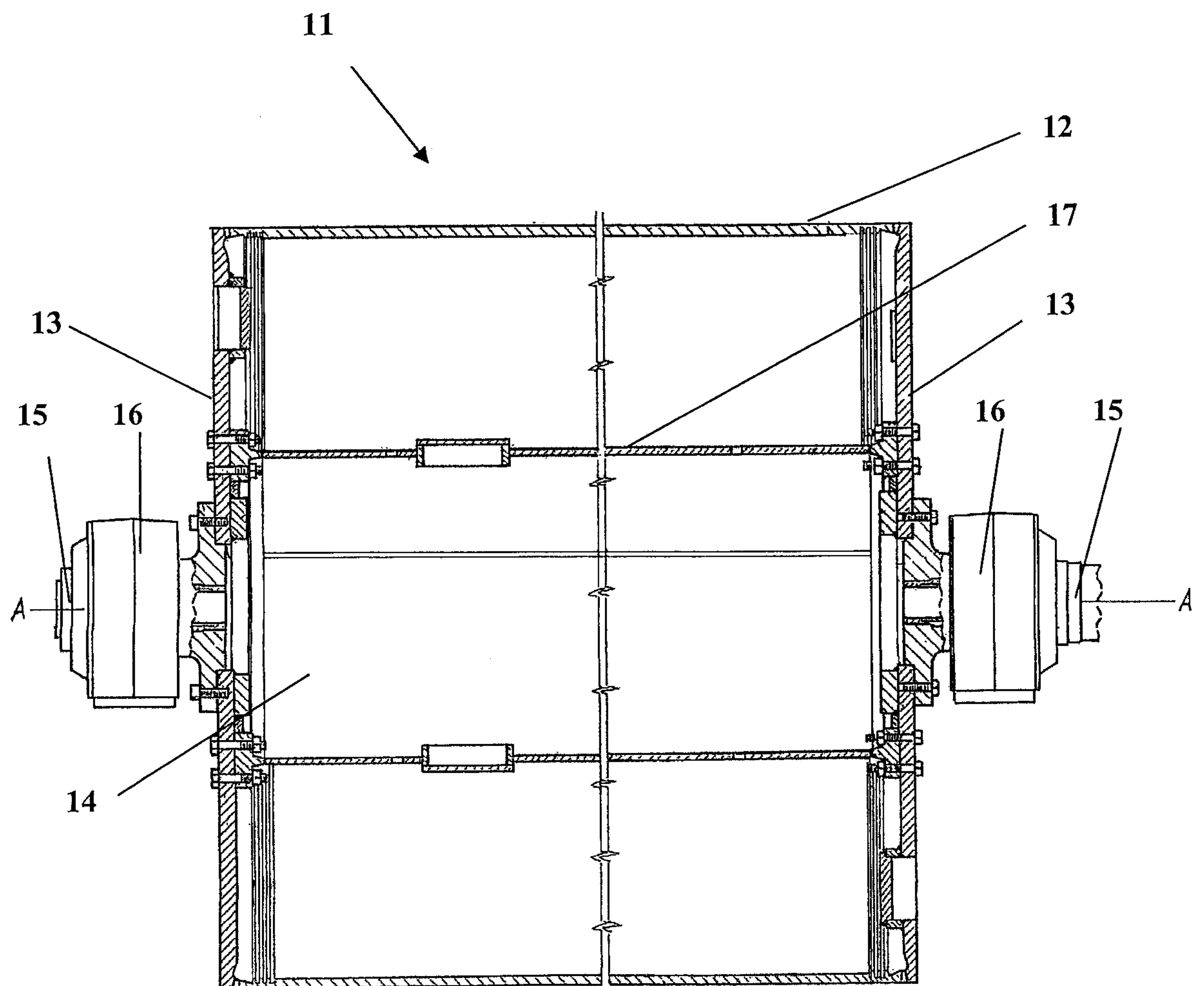
25 Similarly, the diameter of the second connecting flange 9 is slightly larger than the opening 6 in the second end cover 4. As a result, the connecting flange 9 rests on the outer side of the end cover 4 after the central shaft 7 has been placed inside the cylinder and can therefore be bolted to it without any difficulty. This special design also allows the central shaft 7 to be removed easily.

30 The pipes 22 are not mounted until after the central shaft 7 has been installed.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Yankee dryer made of steel with a cylindrical steel shell that is connected to a first and second cylinder end cover at either end, where the cylinder end covers each have an opening at their centre, wherein the Yankee dryer has a one-piece rotatable central shaft extending coaxially through the shell with a first and a second connecting flange to join the central shaft to the end covers for rotating the cylindrical shell, the diameter of the first connecting flange is smaller than the diameter of the opening in the second end cover so that the central shaft can be pushed through this opening into the Yankee cylinder.
2. Yankee dryer according to Claim 1, wherein the diameter of the first connecting flange is larger than the opening in the first end cover.
3. Yankee dryer according to Claim 1 or 2, wherein the diameter of the second connecting flange is larger than the opening in the second end cover.
4. Yankee dryer according to any one of Claims 1 to 3, wherein the connecting flanges of the central shaft are bolted to the end covers.
5. Process for manufacturing a Yankee dryer made of steel, comprising the following steps:
 - a) One end of a cylindrical steel shell is placed on a first end cover and joined to it;
 - b) A second end cover is joined to the other end of the cylindrical steel shell;
 - c) A rotatable one-piece central shaft with connecting flanges is inserted into the inside of the cylinder through an opening in an end cover;
 - d) The connecting flanges are then each joined to the end covers for rotating the cylindrical shell.

6. Process according to Claim 5, wherein the connecting flanges are bolted to the end covers.
7. Process according to Claim 5, wherein the connecting flanges are welded to the end covers.
8. Process according to any one of Claims 5 to 7, wherein joining the one end of the cylindrical steel shell to the first end cover comprises welding the one end of the cylindrical steel shell to the first end cover.
9. Process according to any one of Claims 5 to 8, wherein joining the second end to the other end of the cylindrical steel shell comprises welding the second end to the other end of the cylindrical steel shell.

**Fig. 1**

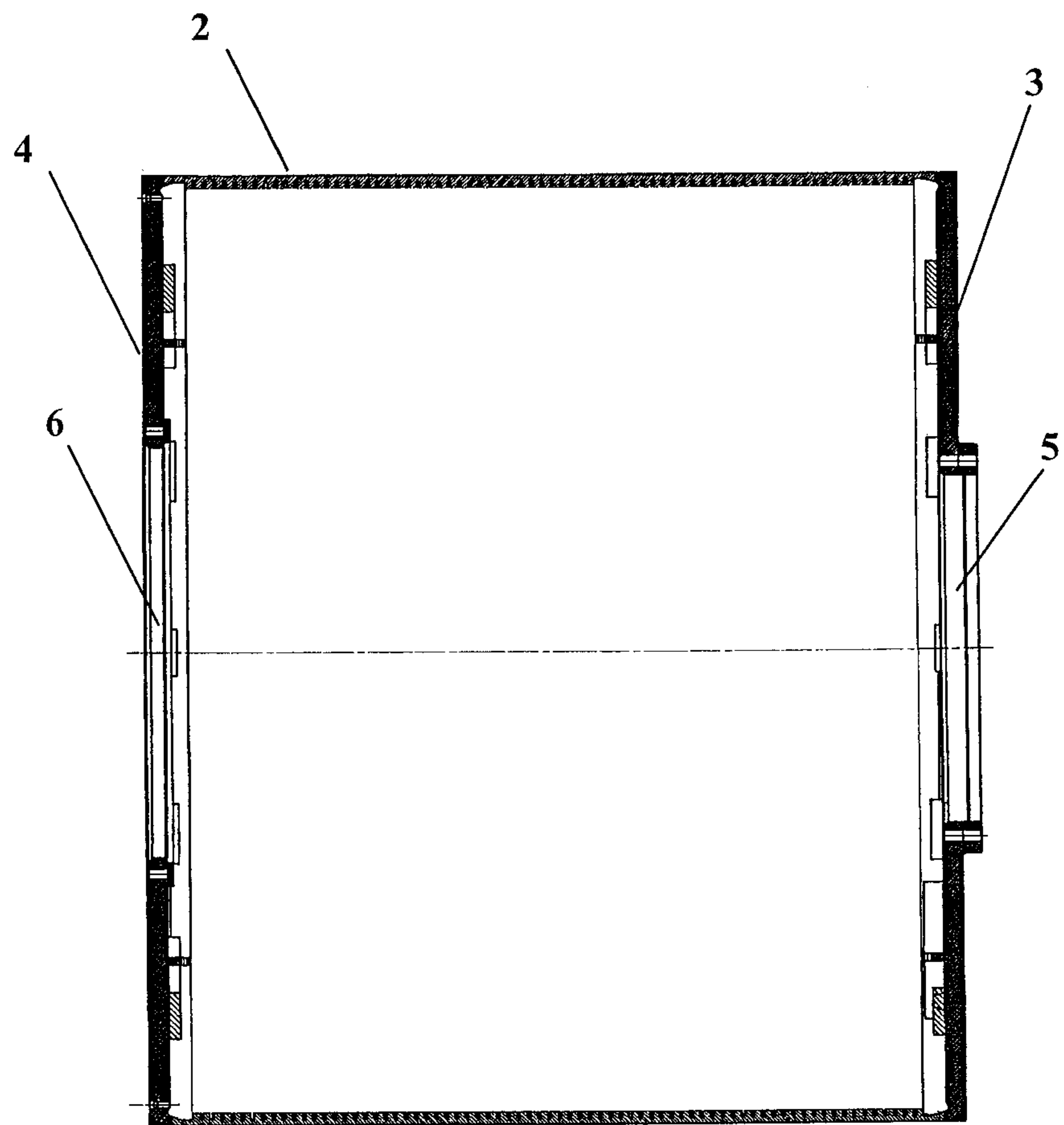


Fig. 2

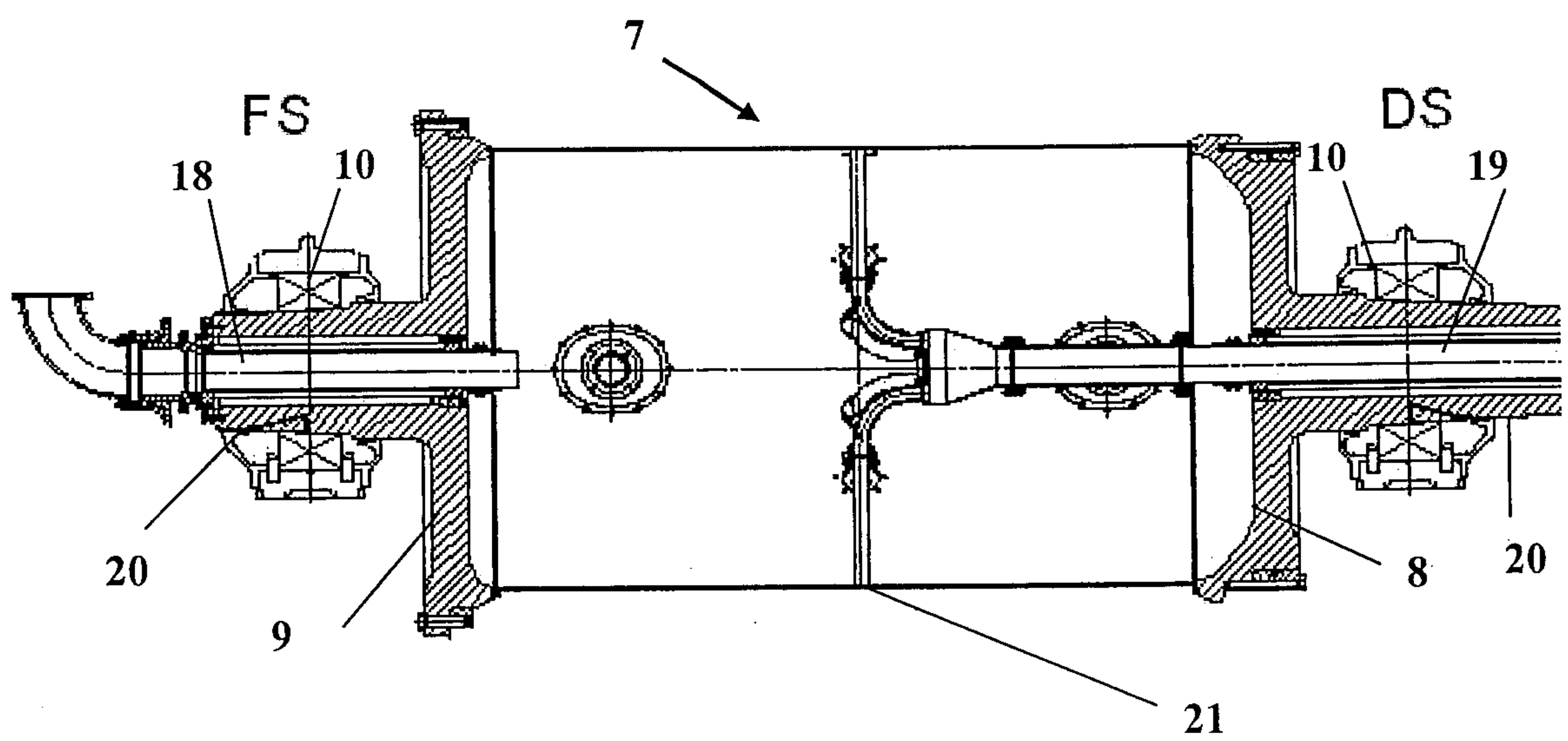
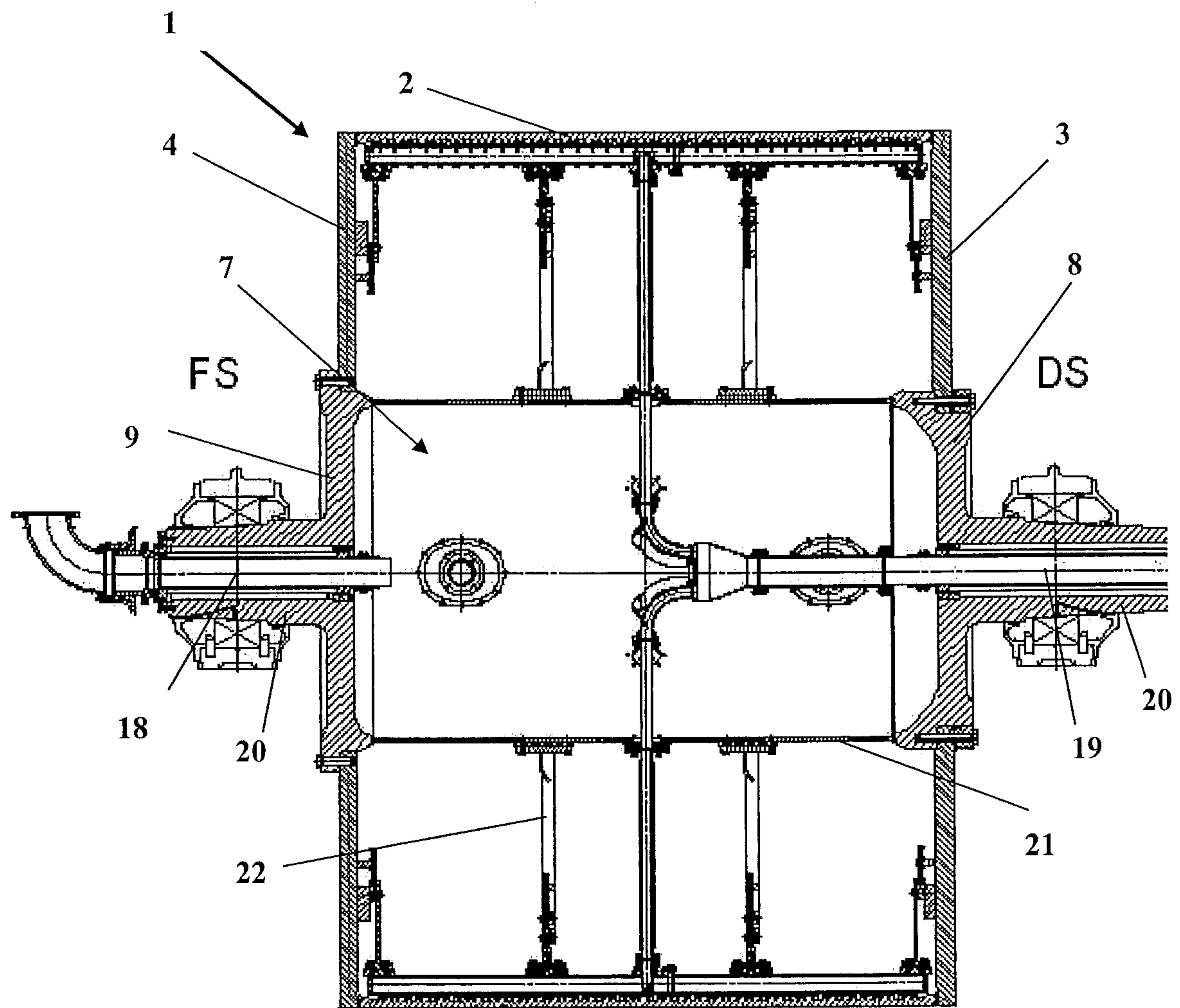


Fig. 3

**Fig. 4**

