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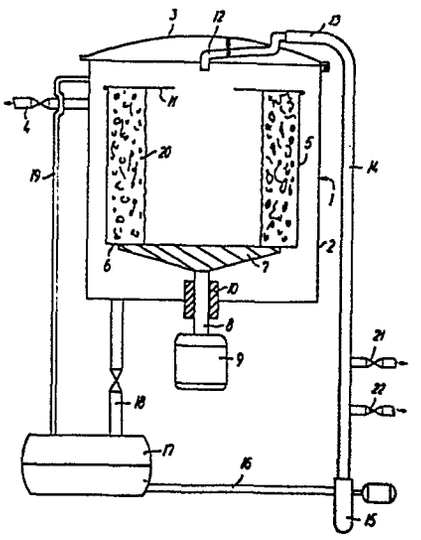
(54) Centrifuge for recovering proteins from bones.

(57) In a pressure centrifuge for recovering protein from bones under recycling of the protein solution, the cover (11) of the centrifuge bowl is provided with an aperture without tightening members through which aperture water or recycled protein solution is introduced into the interior of the centrifuge bowl. This represents a more simple construction of the centrifuge than hitherto regarded as possible for centrifuges for said purpose.

FIG.1



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CENTRIFUGE FOR RECOVERING PROTEINS FROM BONES.

The Danish patent specification No.143 584 deals with a process for recovering protein from bones, in which the collagen of the bones is rendered soluble by treatment with steam at pressure above atmospheric and the process is characterized by the fact that the steam treatment takes place, possibly with addition of water, while the moist crushed bones are in a centrifuge bowl rotating in a pressure vessel, where they are subjected to a centrifugal acceleration of at least 5 g, the treatment being adjusted so as to obtain a protein solution of a concentration of more than 10% by weight, whereafter the protein solution is, if desired, dried in a manner known per se.

This process has hitherto been carried out using a centrifuge having a housing designed as a pressure vessel with a centrifuge bowl having a perforated peripheral wall and secured to a vertical hollow shaft. When the apparatus is operated, steam is led to the centrifuge housing and a liquid,which at the beginning of the process consists of water,is pumped through the vertical hollow shaft, into the interior of the centrifuge bowl. The centrifuge bowl is in this known construction provided with a tight-fitting cover, so that by pumping liquid through the hollow shaft it was possible to establish in the interior of the centrifuge bowl a pressure higher than the pressure in the centrifuge housing outside the centrifuge bowl. In other words, the pressure gradient over the layer of crushed bones during the operation is higher on the internal side of the peripheral wall of the centrifuge bowl. This pressure gradient is regarded as necessary in order to obtain a sufficient flushing of the bone layer and the resulting washing out of the protein solubilized by the process.

The same idea regarding the necessity of being able, by pumping liquid into the centrifuge bowl, to establish a higher pressure in the interior of the

centrifuge bowl than in the part of the centrifuge housing outside the centrifuge bowl appears also in the U.S. patent specification No.728 205. Said patent specification discloses a centrifuge for use in the washing out of gelatin from animal pelts or skins with hot water. This hot water is introduced into the centrifuge bowl not through a hollow shaft, as it is the case in the centrifuge described in the Danish patent specification No.143 584, but through an inlet led centrally through the cover of the centrifuge bowl, provision being made of tightening members between inlet and cover, so that the pressure at which the water is pumped in can contribute to forcing the water through the layer of pelts or skins from which gelatin is to be extracted.

The said hitherto used system for introducing liquid under pressure into the centrifuge bowl, use being made of a hollow shaft or of a top-positioned inlet with appurtenant tightening members, is, however, a complicated and expensive construction which affects the overall cost of manufacture of a centrifuge of the type in question.

It has, however, surprisingly been found that the above-described process, known from Danish patent specification No.143 584, can be carried out using a centrifuge having a bowl which, through an aperture in the cover, is in connection with the rest of the interior of the centrifuge housing, although it is thus impossible to establish a higher pressure in the bowl than in the rest of the housing. Consequently, the liquid to be introduced into the centrifuge bowl need not be pumped through a hollow shaft but can be supplied more simply, without tightening members, through the said aperture in the cover of the centrifuge bowl.

The reason why it was surprising for a skilled person that satisfactory results could be achieved using exclusively the forces produced by rotation of the

centrifuge bowl to provide a sufficient flow of liquid through the layer of crushed bones which, due to the centrifugation, cover the inner side of the centrifuge wall, is that this layer of crushed bones has such a character that it up till now was not believed possible to provide a sufficient liquid flush at the rotation speeds to be considered for the large centrifuges used in processes of the type in question; also with regard to centrifuges for extracting fat from bones by means of organic solvents, it has hitherto been regarded as necessary to pump these solvents through a hollow shaft into a centrifuge bowl provided with a tight-fitting cover.

The recognition of the fact that an introduction of liquid need not take place through a hollow shaft to the interior of a closed centrifuge bowl and, moreover, that it is not necessary to provide a tight barrier between the centrifuge bowl and the housing makes possible a substantially simplified construction, and in accordance therewith, the invention relates to a centrifuge for recovering proteins from bones and having a centrifuge housing designed as a pressure vessel, which is provided with a removable cover and connected with a source of steam at pressure above atmospheric and which comprises a perforated centrifuge bowl also provided with a removable cover, said bowl being secured to a vertical, rotatable shaft passing through the bottom of the centrifuge housing, provision being made in the bottom of the centrifuge housing for a liquid outlet, which centrifuge according to the invention is characterized in that a pipe led through the centrifuge housing or its cover for feeding liquid to the interior of the centrifuge bowl opens above or extends without tightening members through a central aperture in the cover of the centrifuge bowl.

It is most convenient for the liquid-supplying pipe to be led through the cover of the centrifuge

housing and to open above the central aperture of the centrifuge bowl. When the pipe is fastened in the cover, it will be removed together with this and consequently will not complicate the introduction and removal of the centrifuge bowl when it is emptied of washed-out bone mass and filled with a new portion of crushed bones.

The centrifuge according to the invention will in the following be explained in more detail with reference to the drawing, in which

Fig.1 is a schematic view of a plant for protein recovery, which plant comprises a centrifuge according to the invention,

Fig.2 shows in cross section a detail of an amended embodiment of the centrifuge according to the invention, and

Fig.3 shows a section along line III-III in Fig.2.

The plant shown in Fig.1 comprises a centrifuge 1 having a centrifuge housing 2 provided with a removable cover 3.

The centrifuge housing and the cover are given such dimensions and provided with such closing members (not shown) that the centrifuge can withstand an inner pressure of at least 6 bar gauge, and the same applies to the pipe and hose couplings shown in Fig.1 and described in the following.

The centrifuge housing is provided with a feed pipe 4 connected with a steam source (not shown) which is in a position to maintain a pressure of, for instance, 5 bar gauge in the interior of the centrifuge housing.

In the centrifuge housing, provision is made of a centrifuge bowl 5, the peripheral walls of which are provided with perforations (not shown). These perforations may, in typical cases, be drilled holes having a diameter of 2-4 mm and placed at a mutual interval of about 15 mm.

In the embodiment shown, the centrifuge bowl is provided with a flat bottom 6 releasably secured to

a support 7 disposed on a rotatable shaft 8 connected with a suitable driving member, preferably a hydraulic motor 9.

Where the shaft 8 passes through the bottom of the centrifuge housing, provision is made of a liquid and pressure proof bearing 10. This bearing together with the appurtenant shaft 8 and the support 7 constitute a substantially simpler and cheaper construction than the one required when the introduction of liquid must take place under pressure through a hollow shaft as described in the above mentioned patent specification.

The centrifuge bowl 5 is provided with a removable cover 11 which is annular so that provision is made of an aperture in the central part.

Above this aperture opens a pipe 12 secured to the cover 3 of the centrifuge housing and led through said cover.

The pipe 12 is, outside the centrifuge, connected with a hose 13 which via a pipe coupling 14, a pump 15 and a further pipe 16 is in connection with a pressure tank 17.

Via a pipe 18, provided with a shut-off valve, the tank 17 is connected with the lower part of the centrifuge housing 2.

In order to neutralize pressure differences between the interior of the centrifuge and the pressure tank 17, provision is further made of a thin pipe 19 connecting the upper parts of the tank and the centrifuge, respectively.

When the plant is operated, the following measures are taken:

The cover of the centrifuge house is opened and the centrifuge bowl 5 is released from the support 7 and lifted off the centrifuge housing 2.

The cover 11 of the centrifuge bowl is removed and a suitable quantity of crushed bones is inserted in the centrifuge, the cover 11 is replaced and the

centrifuge bowl is lowered back in the centrifuge housing, where it is secured to the support so as to follow its rotation.

After the cover 3 of the centrifuge housing has been fastened, steam is supplied through 4 so as to obtain in the centrifuge a pressure of about 5 bar gauge, and the centrifuge is made to rotate, for instance at a rate of about 150 r.p.m. This results in the crushed bones being spread in a layer 20 on the inner side of the perforated walls of the centrifuge bowl.

Although a certain amount of protein solution can, under these circumstances, be released from the bones without supplying water, it is preferred to initiate the treatment by introducing via a valve 21 some water which via the pipe coupling 14, the hose 13 and the pipe 12 reaches the interior of the centrifuge bowl 5. The water is there spread over the layer 20, without having to take special steps to that effect and so achieving a satisfactory washing out of protein from the bones, although no pressure increase in the centrifuge bowl is achieved by pumping in relation to the pressure outside the bowl in the centrifuge housing, as it is the case in known centrifuges intended for this purpose. When the desired quantity of water has been introduced, the valve 21 is closed and from the bottom of the centrifuge housing the protein solution is led to the tank 17 from which it is recycled via the pipe 16, the pump 15, the pipe coupling 14, the hose 13 and the pipe 12 to the interior of the centrifuge bowl, where it passes again through the bone layer and is thereby further enriched with protein and is again recycled back to the tank.

This process is continued until the liquid has reached the optimum protein concentration, which can, for instance, be found refractometrically. At that moment, a valve 22, through which the protein solution is discharged is opened, the pressure in the centrifuge is released and the centrifuge is opened and emptied.

Optionally, after removal of a first portion of protein solution through 22, fresh water may again be introduced through 21 and the process is repeated with the same charge of bones.

In the embodiment of the centrifuge according to the invention, of which a detail is shown in Figs. 2 and 3, the pipe 12 and the hose 13 shown in Fig. 1 are replaced by other structural parts.

In said embodiment, the centrifuge cover 3 is provided with a lifter 23 comprising two cheeks 24, only one of them being shown in Fig.2.

The lifter 23 is secured to the cover 3 and is actuated pneumatically or hydraulically, as it appears from Fig.2.

The lifter is pivotally supported in a bearing 25 designed as it appears from the section shown in Fig.3.

The bearing 25 is carried by a bracket 26 secured to the centrifuge housing 2 and comprising two cheeks 27, both shown in Fig.3.

When the lifter is raised, the cheeks 24 pivot at the sleeves 28 of Fig.3.

Between the cheeks 24, provision is made of a pipe 29 having one end opening centrally on to the centrifuge housing, i.e. above the aperture provided in the cover of the centrifuge bowl. The other end of the pipe is connected with a central passage in the bearing 25, which passage 30 is also in connection with a pipe coupling 31. When the lifter is actuated to raise the cover, the pipe 29 follows the movements of the cover. This is made possible by using mobile liquid-tight joint 32.

When use is made of the centrifuge according to this embodiment, the pipe coupling 14 is connected with the pipe coupling 31.

This construction represents a somewhat more robust embodiment of the invention than the hose connection shown in Fig.1.

PATENT CLAIMS

1. A centrifuge for recovering proteins from bones and having a centrifuge housing (2) designed as a pressure vessel, which is provided with a removable cover (3) and connected with a source of steam at pressure above atmospheric and which comprises a perforated centrifuge bowl (5) also provided with a removable cover (11), said bowl being secured to a vertical, rotatable shaft (8) passing through the bottom of the centrifuge housing, provision being made in the bottom of the centrifuge housing for a liquid outlet, characterized in that a pipe (12, 29) led through the centrifuge housing (2) or its cover (3) for feeding liquid to the interior of the centrifuge bowl opens above or extends without tightening members through a central aperture in the cover (11) of the centrifuge bowl.

2. A centrifuge as claimed in claim 1, characterized in that the pipe (12, 29) for feeding liquid to the interior of the centrifuge bowl is led through the cover (3) of the centrifuge housing and opens above the central aperture of the centrifuge bowl.

3. A centrifuge as claimed in claim 2, characterized in that a lifter (23) pivoting about a bearing (25) provided with a central passage (30) and supported by a bracket (26) on the centrifuge housing is secured to the cover (3) of the centrifuge housing, and that the pipe (29) for supplying liquid to the interior of the centrifuge bowl (5) is led centrally through the cover (3) of the centrifuge housing and outside the cover is led along the lifter (23) to the bearing (25) and is in connection with the central passage (30) thereof, said bearing (25) has a pipe coupling (31) which remains stationary when the cover (3) and therewith the pipe (29) for supplying the liquid are raised by actuation of the lifter.

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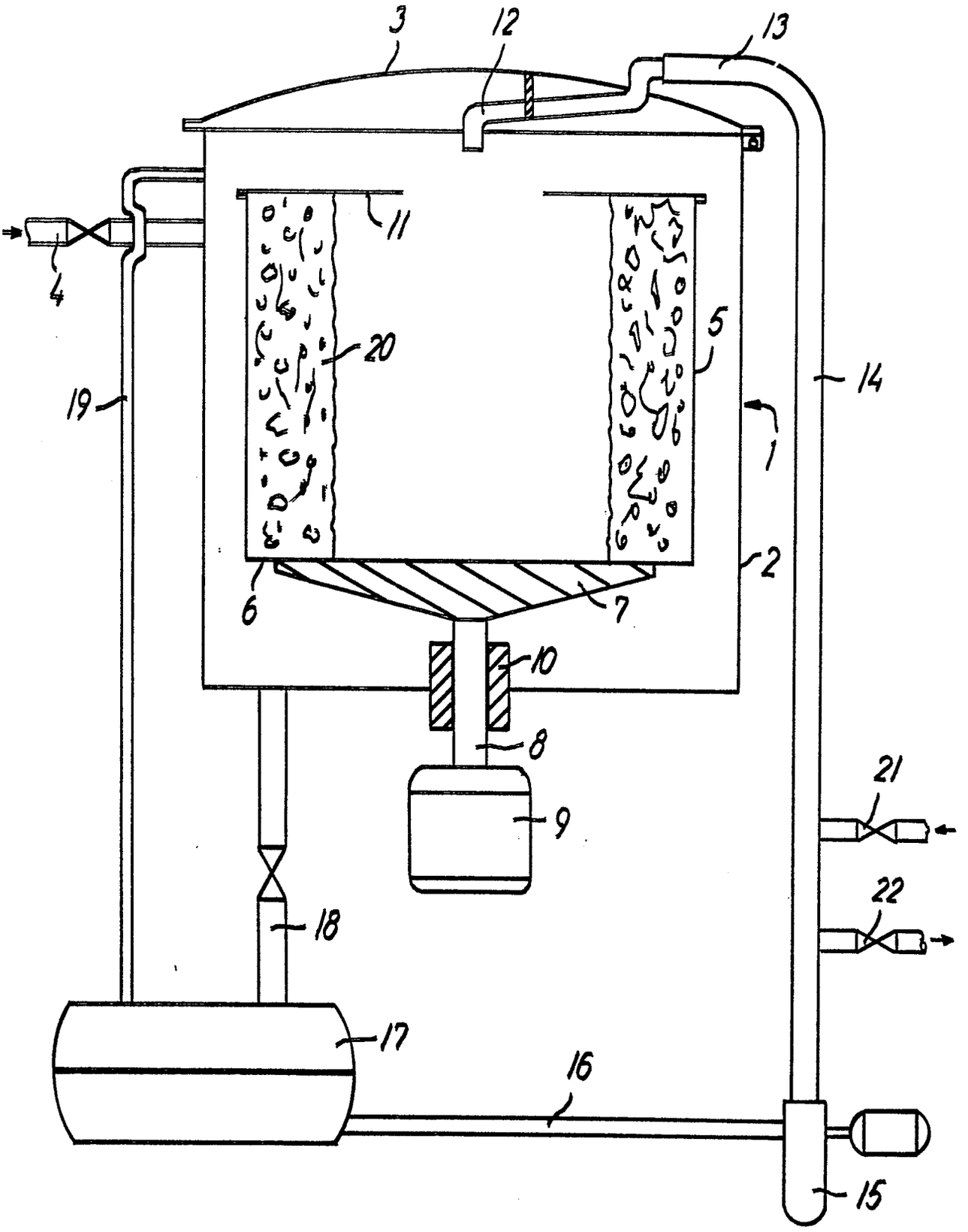
FIG. 1



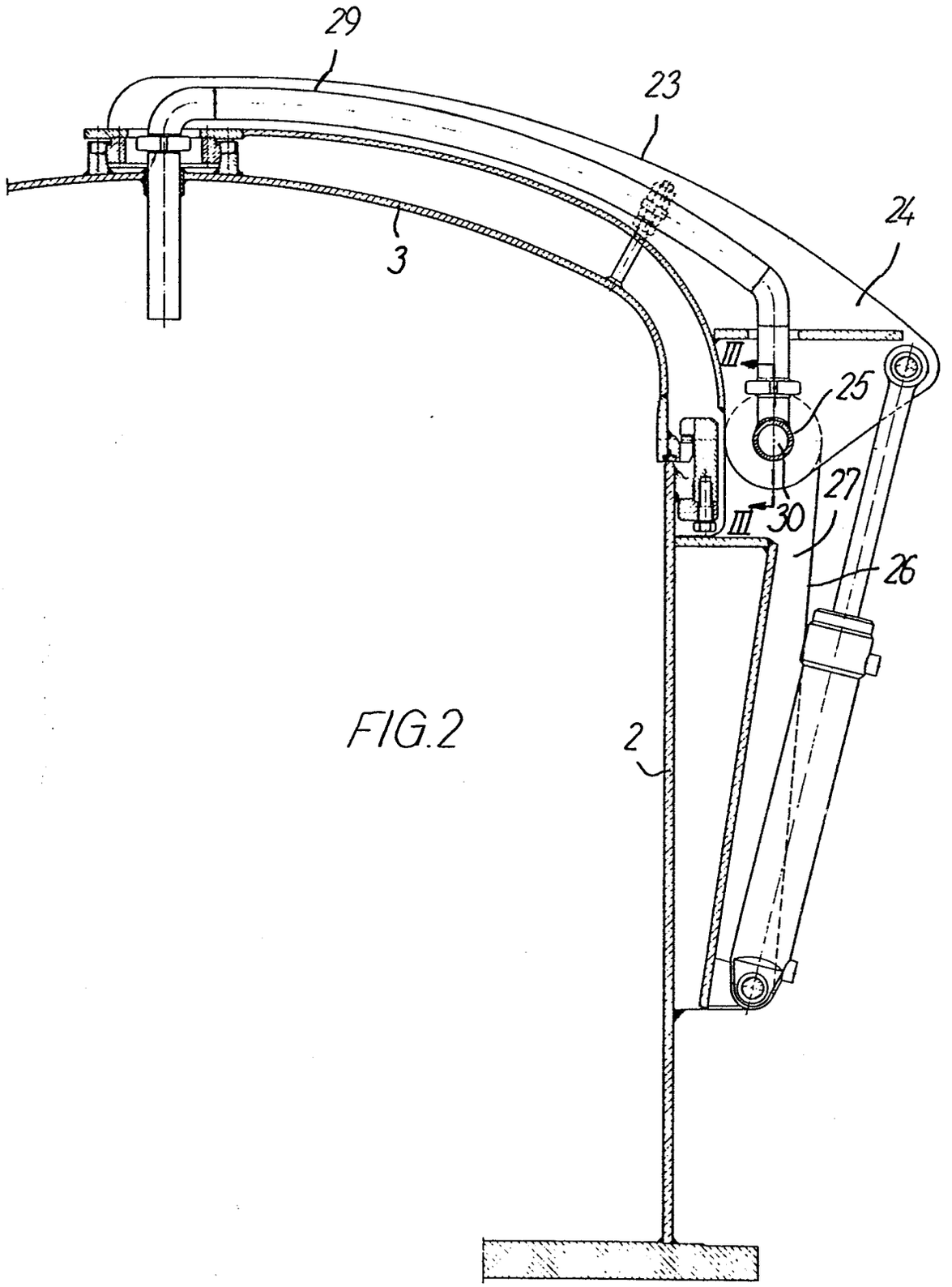


FIG.2

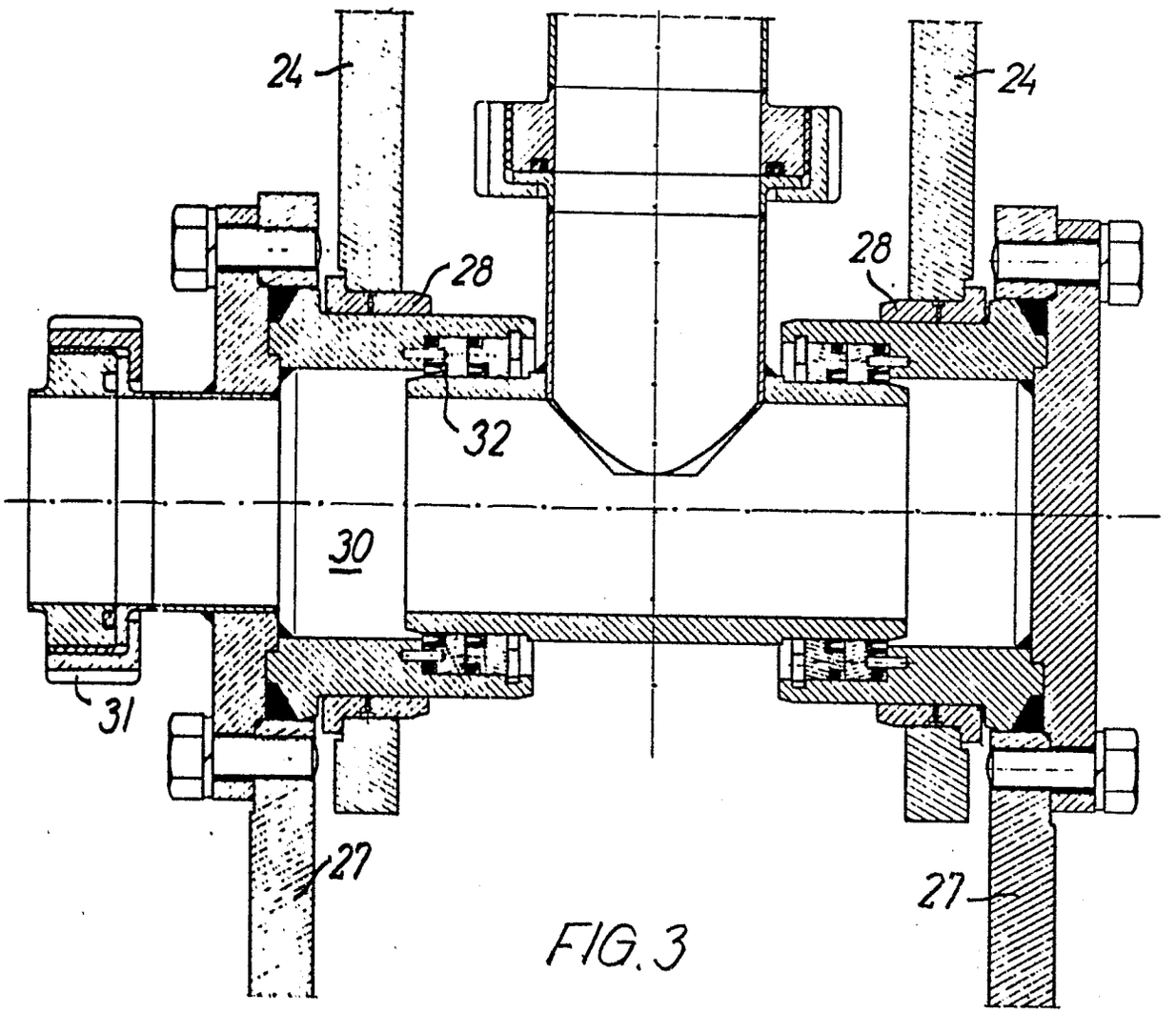


FIG. 3