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(54) **Overflow control valve**

(57) An overflow control valve for use in a liquid sodium coolant pump tank (15) which valve can be remotely engaged with and disengaged from the pump tank wall to thereby permit valve removal. An actuating shaft (12) for controlling the valve also has means for operating a sliding cylinder (3) against spring 4 to retract the cylinder (3) from sealing contact with the pump tank nozzle (17).

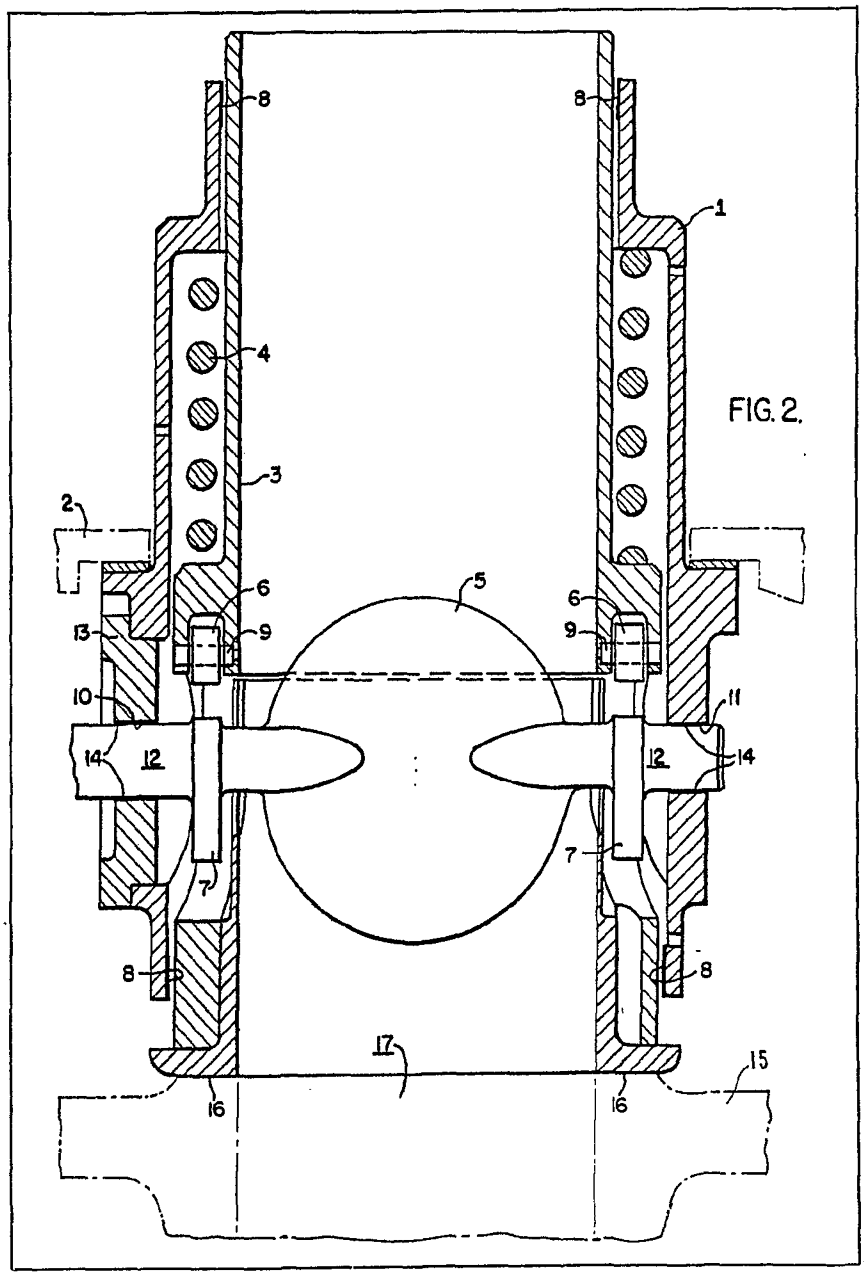

FIG. 2.

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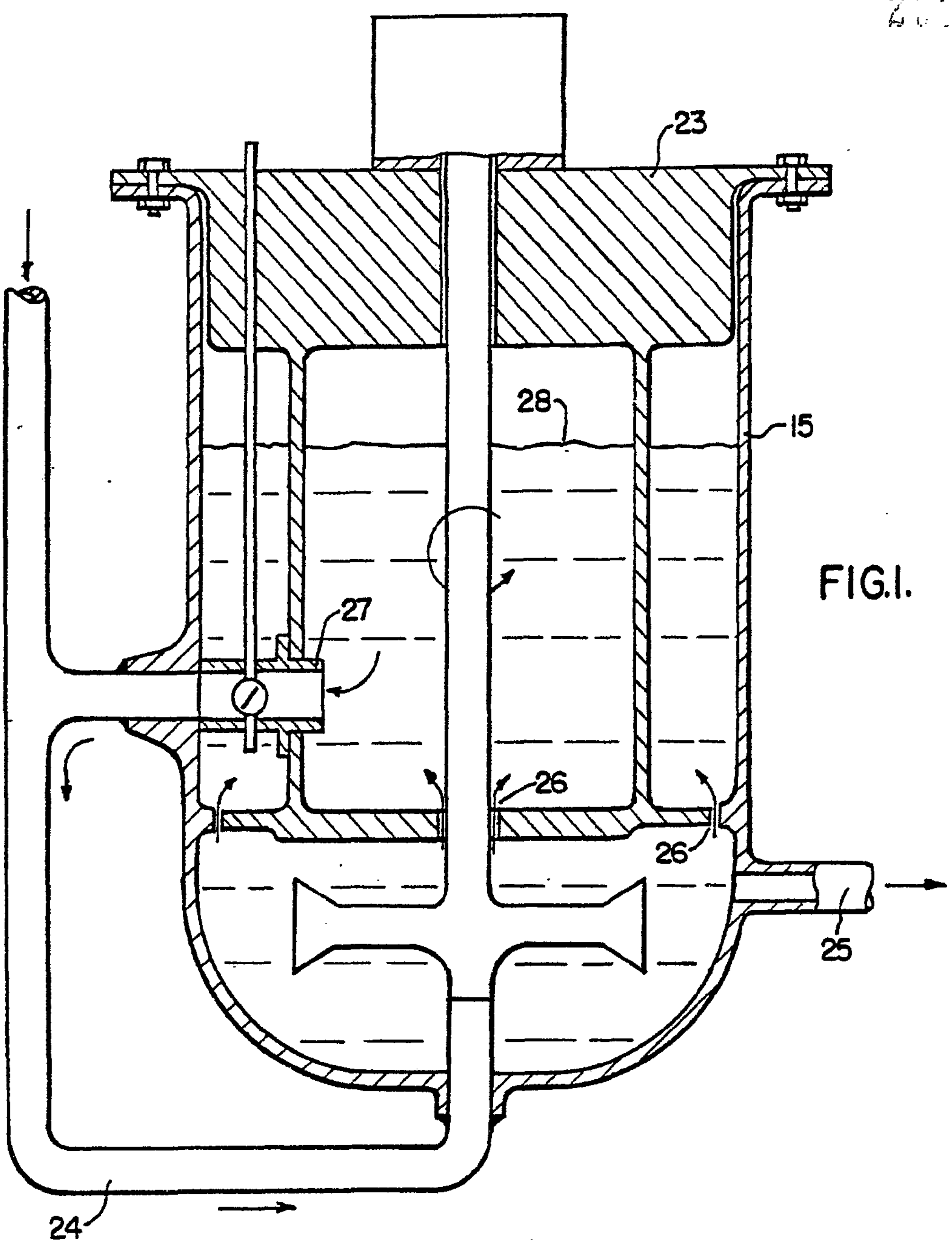

FIG.1.

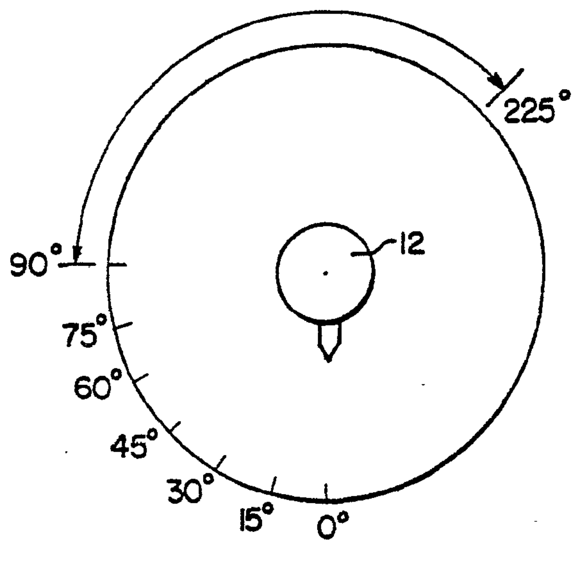

FIG.5.

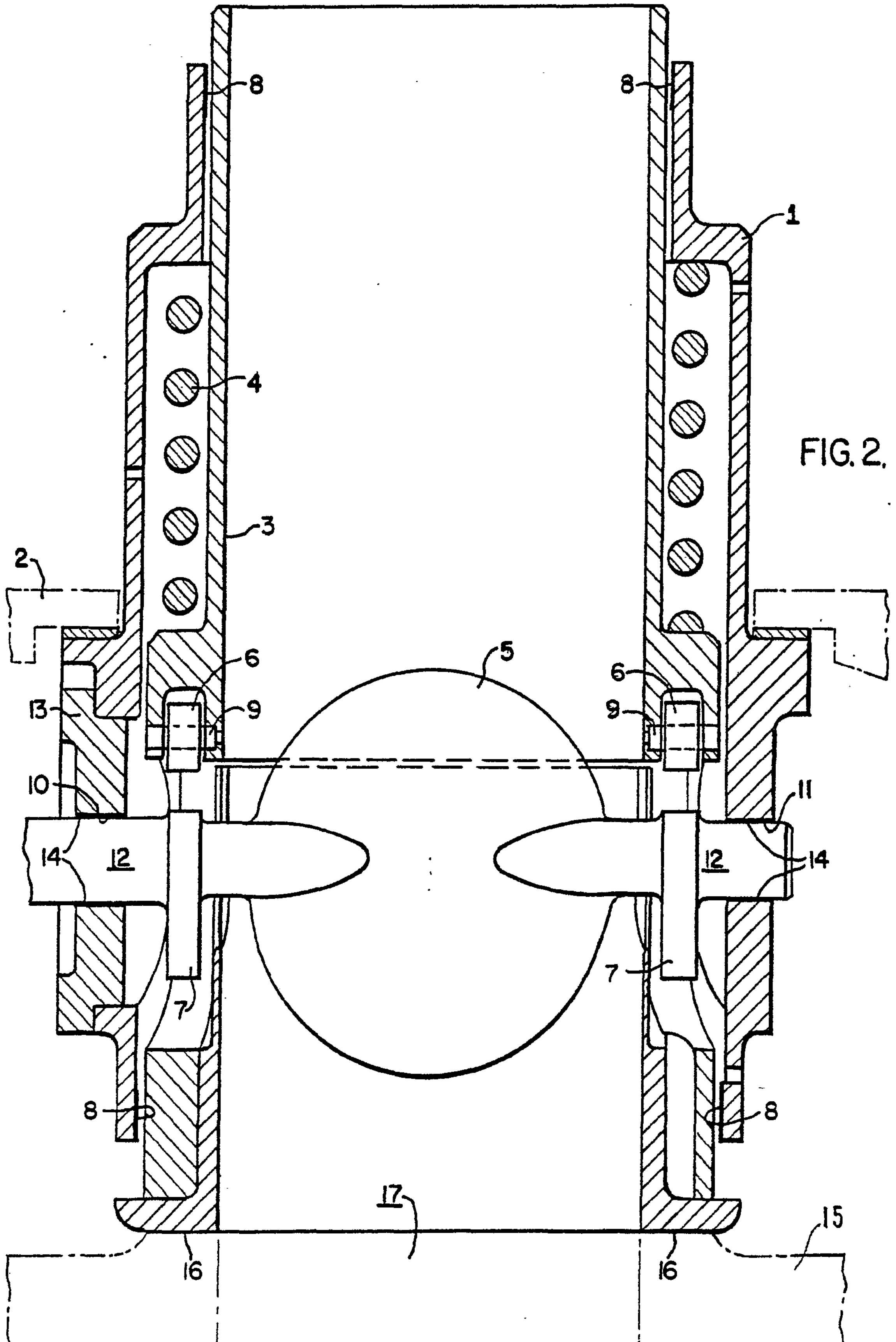

FIG. 2.

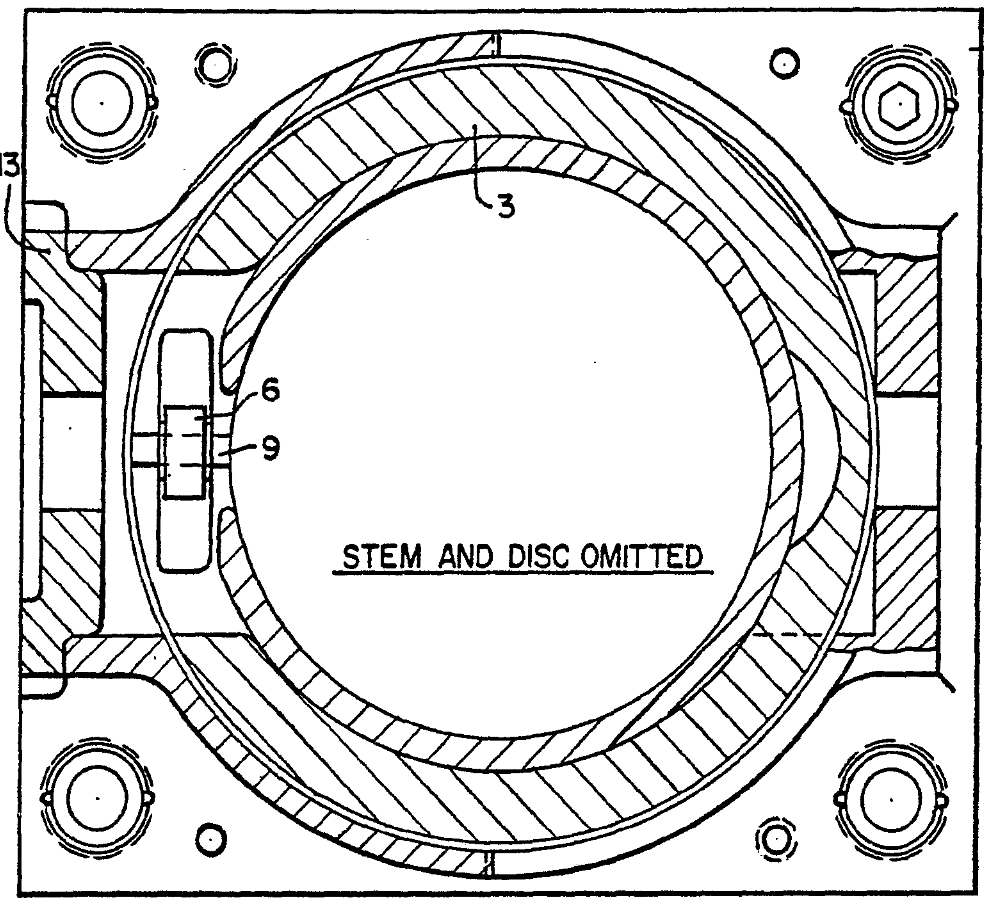

FIG.3.

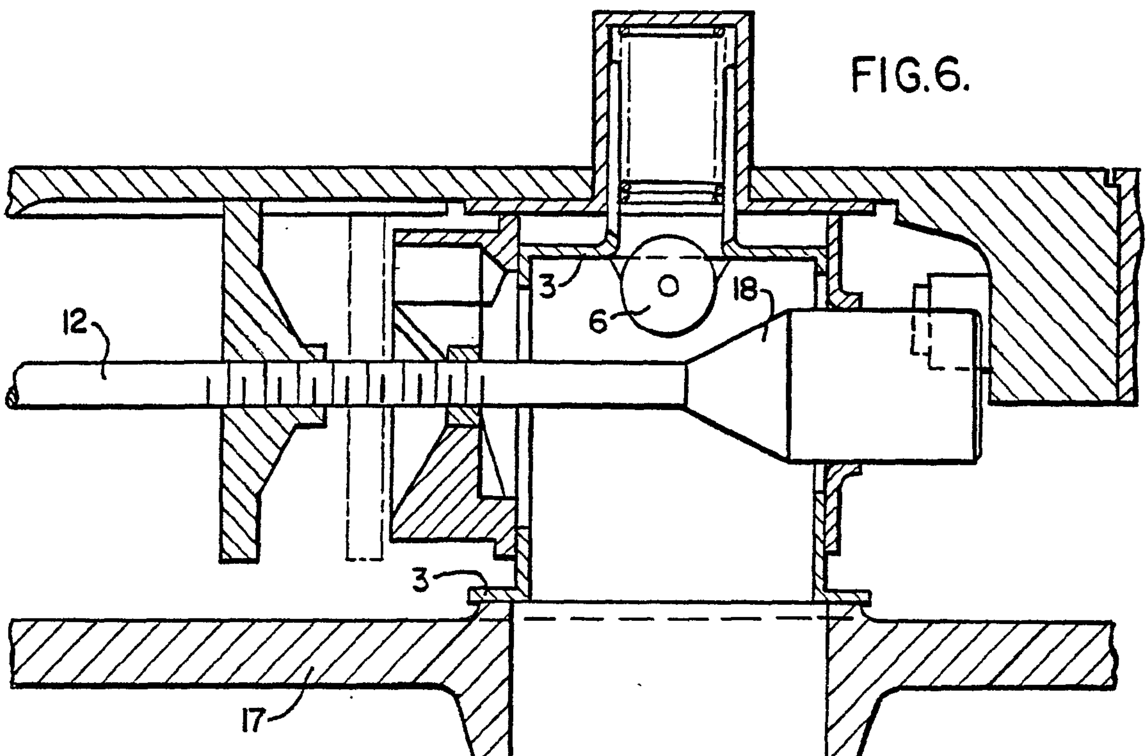

FIG.6.

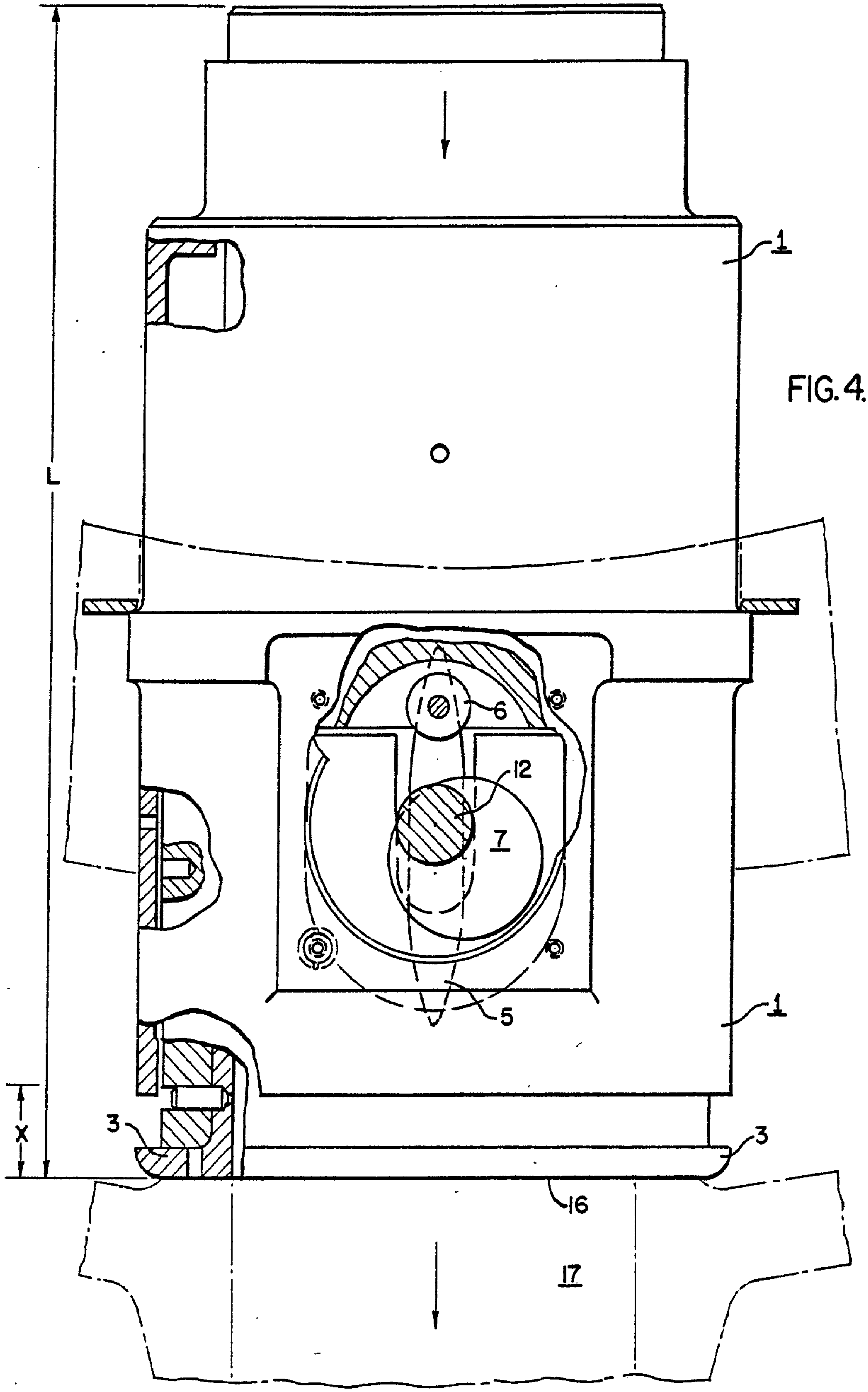

FIG. 4.

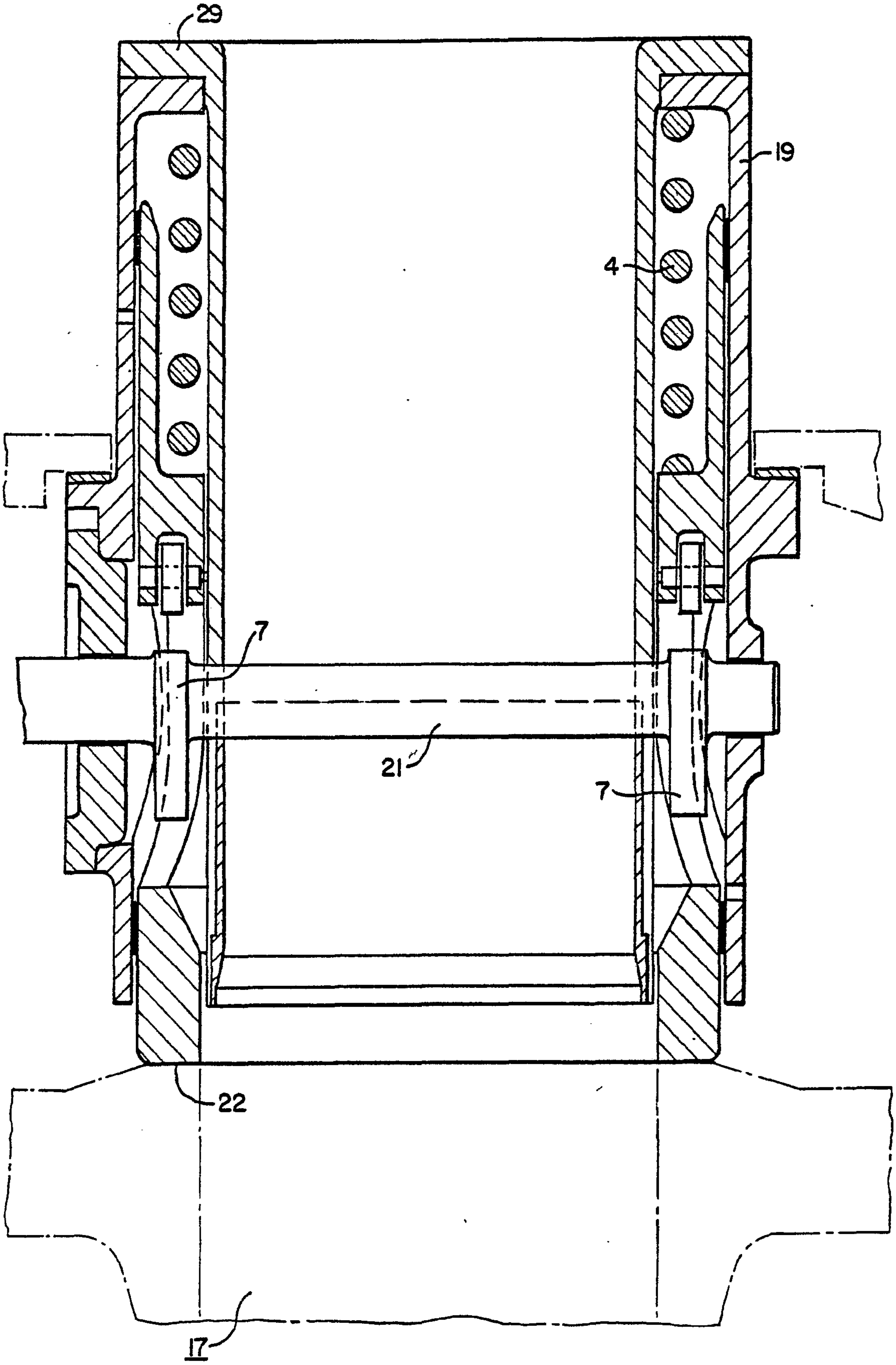

FIG. 7.

SPECIFICATION

Overflow control valve

The present invention was conceived during performance of a contract with the United States Government designated ANL 31—109—38—5001.

The invention relates to valves used to control fluid streams, especially overflow control valves for hot liquid sodium flow.

Coolant pumps associated with liquid sodium fast breeder reactors are located inside a pump tank. Due to leakage around the pump shaft seals, an upper section of the tank is filled with hot liquid sodium. Leakage into the upper pump tank is continuous during pump operation. A steady, safe liquid sodium level in the tank is maintained by an overflow control valve which, if set properly, allows sodium flow equal to seal leakage flow to return to the pump suction via an overflow line. The purpose of the overflow control valve is to adjustably orifice the overflow line such that a safe liquid level in the tank is achieved.

Location of the overflow control valve within the tank is desired since the valve stem seal may then be in a cover gas/sodium vapor region rather than under liquid.

The overflow control valve should be easily removable from the tank for maintenance and inspection, but the valve must maintain a good seal with the tank wall during operation despite pump induced vibrations in the valve and tank.

It is therefore the principal object of the present invention to provide an easily removable overflow control valve with a sealing mechanism that is insensitive to vibrations between the valve and a tank wall or seat, and which is suitable for high temperature applications.

With this object in view, the present invention resides in a valve removably supported in a tank for the control of fluid flow through a passage in said tank and for accomplishing a seal with an adjacent nozzle which comprises a valve body supported in said tank adjacent said nozzle and means for operating said valve, characterized in that a valve cylinder is movably supported within said valve body and has a valve seating surface at its front end adjacent said nozzle, said valve cylinder being spring biased into engagement with said nozzle, and that said valve operating means includes means for moving said spring loaded valve cylinder out of engagement with said nozzle to permit removal of said valve from said tank.

The invention will become more readily apparent from the following description of a preferred embodiment thereof shown, by way of example only, in the accompanying drawings, in which:

Figure 1 is a schematic of a sectioned view of the pump tank and components.

Figures 2 to 4 are sections of a preferred embodiment of the valve.

Figure 5 is a schematic indicating the means of valve control by shaft rotation.

Figure 6 is a section of a second embodiment of the valve.

Figure 7 is a sectioned view of a third embodiment of the invention.

In a preferred embodiment, the overflow control valve is designed to adjust hydraulic impedance, for example 2.5 to 4.3 kg/cm^2 for an overflow of up to 11,350 l/min. for a liquid sodium breeder reactor pump of 322,000 l/min. capacity. The general arrangement is illustrated in Figure 1 which shows a pump 23 located within pump tank 15. Inlet line 24 delivers liquid sodium to the suction side of the pump which has a discharge pipe 25. Leakage of sodium passing seals 26 fills pump tank 15. Overflow valve 27 maintains a safe level 28 in tank 15 by returning overflow to inlet line 24.

Refer to Figures 2 and 3. These are sections of the valve which show butterfly valve disc 5 in an open position, disposed to pass sodium flow. The valve is encased by a valve body 1 which is mounted to and supported by a pump support cylinder 2.

Valve body 1 has penetrations 10 and 11 for a valve shaft 12 at the top and bottom. Bottom penetration 11 is lined with stellite and provides a radial bearing for shaft 12. Upper penetration 10 is covered by a bearing housing 13 which also has a stellite coated bearing. The inside surface of valve body 1 has stellite coated 1-inch wide bands 8 at both ends. These bands 8 provide bearing surfaces for a valve cylinder 3.

Valve cylinder 3 is located inside valve body 1, with a valve spring 4 captured between valve body 1 and valve cylinder 3. Two rollers 6 and pins 9 are mounted in valve cylinder 3 to provide reduced friction during operation of cams 7. Valve cylinder 3 also has 7.5 cm wide bands of stellite on the outside surface at both ends to reduce friction. These bands will slide on stellite surfaces 8 on valve body 1. Rollers 6 and pins 9 are manufactured from stellite to provide low friction and preclude self welding.

Butterfly 5 is a circular disc which is located 0.25 inch eccentric to the centerline of shaft 12. This eccentricity will generate a hydraulic torque on butterfly 5 which will tend to open the valve during pump operation. A failure condition for shaft 12 will accordingly result in the valve going fully open, instead of closed, which would be the failure mode of a symmetric butterfly. Cams 7 are circular discs located eccentric on shaft 12. These will provide approximately 2.5 cm. travel of valve cylinder 3 from the nominal sealed position during opeartion. Upper and lower shaft journals 14 are stellite coated to provide wear resistance for long term operation in sodium. Butterfly disc 5 has no seat but effects a variable hydraulic impedance by mere disposition in the fluid stream.

The valve is approximately rigid with respect to pump tank 15 because the valve is supported by valve body 1 which is affixed to pump support cylinder 2. However, vibrational motion between pump tank 15 and pump support cylinder 2 causes valve cylinder 3 to slide in valve body 1, maintaining integrity of the seal at junction 16 between tank nozzle 17 and valve cylinder 3 due to the action of spring 4.

Refer to Figure 4. Cams 7 are disposed on shaft 12 such that the surface of cam 7 bears on roller 6, applying a force thereto during a portion of the arc of circular rotation of shaft 12. This action of cam 7 (see Figure 1) will retract valve cylinder 3 away from junction 16, breaking the seal and reducing the overall valve length "L" by an amount "X", about 2.5 cm. In the retracted position, the valve is free for easy removal from tank 15 (Figure 1).

The upper regions of shaft 12 may have a circular plate scribed with angular delineations as illustrated in Figure 5. A 90° range of shaft 12 circular rotation is sufficient to encompass complete butterfly disc 5 (Figure 2) travel from fully open to fully closed. The fully open position has been arbitrarily assigned 0° in Figure 5, and results in a counterclockwise position at 90° being fully closed. Valve cylinder 3 is fully extended in this range because cams 7 do not bear on rollers 6 from 0° to 90°. Further rotation beyond 90° brings cams 7 into contact with rollers 6 and begins to retract valve cylinder 3, compressing spring 4. Rotation to 225° in Figure 5 is sufficient to fully retract valve cylinder 3. Shaft 12 may be provided with ratchets and retaining locks at intervals as desired. For example, a lock at 225° may be desired to maintain the retracted configuration during valve removal.

Refer to Figure 6, which is a section of a second embodiment of the valve in which cylinder retraction is done by shaft movement in a direction which is axial to the shaft rather than radial. Cone 18 at the lower portion of shaft 12 engages roller 6 and moves spring loaded valve cylinder 3 away from tank nozzle 17. The valve disc adjustment for this concept is accomplished by shaft rotation.

The scope of this invention is not limited to an overflow control valve but can be a device for many functions, useful anywhere a seal is to be made between a removable device and a wall or valve seat. Figure 7 is an example of a third embodiment of the invention in which the device is useful as a sealing unit having a device body 19, device cylinder 20, device shaft 21, and device seating surface 22. Other components are numbered as in Figure 2. Figure 7 also illustrates a refinement which is intended to minimize coolant leakage in the area around the shaft 21 penetrations. Device cylinder 20 contains a liner 29 which is attached to device body 19 and which surrounds shaft 21 closely. Liner 29 reduces coolant leakage at shaft 21 penetrations. While shown in Figure 7 applied to a device adapted for use as a seal at surface 22, naturally liner 29 can be used with the configuration shown in Figure 2 in which a valve is disclosed.

Numerous modifications can be made to the valve as disclosed in the specification and drawings without departure from the true spirit and scope of the invention. For example, numerous means for controlled motion of the valve cylinder other than shaft axial or rotational motion can be envisioned. The valve cylinder could have a separate actuating shaft. Therefore the disclosure should be interpreted as illustrative rather than limiting.

CLAIMS

1. A valve removably supported in a tank for the control of fluid flow through a passage in said tank and for accomplishing a seal with an adjacent nozzle which comprises a valve body supported in said tank adjacent said nozzle and means for operating said valve, characterized in that a valve cylinder (3) is movably supported within said valve body (1) and has a valve seating surface (16) at its front end adjacent said nozzle (17), said valve cylinder (3) being spring biased into engagement with said nozzle (17), and that said valve operating means (12) includes means (7, 18) for moving said spring loaded valve cylinder (3) out of engagement with said nozzle (17) to permit removal of said valve from said tank.

2. A valve as claimed in claim 1, wherein said means for operating said valve cylinder is a cone (18) mounted on said shaft (12) and so disposed as to cause valve cylinder motion disengagement when moved axially with said valve shaft (12) which, when rotated controls the position of the disc (5) of said valve.

3. The valve as claimed in claim 1, characterized in that said means for moving said valve cylinder (3) out of engagement with said nozzle (17) comprises cams (7) mounted on said shaft and aid valve cylinder (3) has cam followers (6) associated therewith, said cams (7) being so arranged as to engage said cam followers (6) during a predetermined valve shaft position outside its valve controlling range for disengaging said valve cylinder (3) from said nozzle (17).

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