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(54) Pressure relief device.

(57) A pressure relief device (1) for use on electrical power transformers, which device utilizes two valve plates (21, 25) for maintaining pressurized medium in a transformer tank (3), each of said valve plates (21, 25) being maintained in a seated position by helical springs (27, 35) acting upon the valve plates (21, 25) in a manner which allow the valve plates (21, 25) to move independently to each other to effect rapid opening and re-seating action.

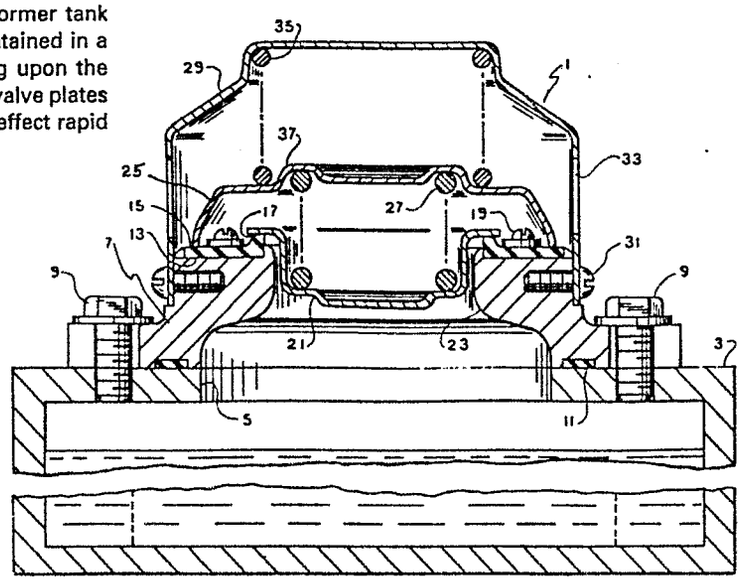

FIG. 1

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PRESSURE RELIEF DEVICE

This invention relates to an improvement in a pressure relief device of the type generally used on electrical power transformers.

A device of the type under consideration is disclosed in U.S. Patent No. 3,217,082, which issued on November 9, 1965. This patent discloses two embodiments, the first as shown and described with reference to Figs. 1 to 8, the second as shown and described with reference to Fig. 9. The difference between the two embodiments is that the first utilizes two valve disks 41 and 51, while the latter utilizes a single valve disk 41a. In both embodiments, the valve disks are exposed simultaneously to the action of compression springs 39 and 49, which results in a fixed rate of discharge and reclosing time for any pre-set maximum pressure within the container on which the device is mounted.

The device of the present invention by contrast utilizes two valve disks each of which is exposed to a separate compression spring. In such manner, the rate of discharge and reclosing time may be independently varied, which satisfies installations wherein speed and volume of discharge is of paramount importance, as well as in other installations wherein rapid reclosing is important to reduce loss of costly gases or liquids in the container on which the device is mounted. Means are also provided in a second embodiment disclosed herein where the compressive force of one of the springs may be adjusted after the device is assembled, thereby affording flexibility in establishment of operational characteristics.

The features and operational characteristics which the device of U.S. Patent No. 3,217,082 have in common with the device of the subject invention, are considered pertinent background for this specification.

The primary purpose of this invention is to provide an improvement in a pressure relief device wherein opening and reclosing rate of valve means may be independently regulated.

An additional purpose is to provide means in such a device wherein the action of incorporated valve means may be adjusted after the device has been assembled.

These and other purposes and features of the present invention will be realized from an understanding of the following description and the accompanying drawings, wherein:

Fig. 1 is a sectional elevational view of a pressure relief device of the invention shown in closed condition and mounted upon a liquid containing enclosure;

Figs. 2 and 3 form part of the same, showing parts of the device in various operative positions;

Fig. 4 is a half sectional elevation view of a second embodiment of the invention showing parts of the devices in closed condition;

Figs. 5 and 6 are the same, but showing parts of the device in various operative positions, and

Figs. 7, 8 and 9 are sectional elevation views of three additional embodiments of the invention.

Referring now to Fig. 1, numeral 1 identifies a pressure regulating device incorporating an embodiment of the invention, which device is mounted atop a transformer tank 3, shown in fragmented section, and having an opening 5 which exposes the contents of the tank, liquid or gas, to the device. Device 1 includes a base plate 7, preferably circular in cross-section, which is affixed by fastener means such as machine bolts 9, to the top of the tank 3. A gasket 11 may be used to provide a leak tight joint between the device and the tank.

On the upper surface of the base plate a circumferential groove 13 is provided for receipt of a seating means in the form of a flat circular gasket 15 having a

raised lip portion 17 extending about the inner edge portion of the gasket. A plurality of screw and washer assemblies 19 retain the gasket 15 in seated condition in the groove 13.

A first cup valve 21 is arranged to project into an opening 23 formed in the base plate 7, the upper periphery of the valve resting upon the raised lip portion 17. A second cup valve 25, concentrically arranged relative valve 21, is positioned above the first cup valve 21 with the lower outer periphery of valve 25 seated upon the gasket 15. Compressively arranged between the cup valves 21 and 25, is a helical spring 27. A cover 29 encloses the second cup valve 25, the lower end of the cover being affixed to an outer surface of the base plate 7 by a plurality of screws 31 arranged about the periphery of the base plate. The cover 29 has a plurality of openings 33 which provide for a flow of liquid or gasious medium from within the cover 29. Compressively arranged between the second cup valve 25 and the cover 29, is a helical spring 35.

It will be noted that second cup valve 25 is formed with a circular groove, or recess 37 which serves to maintain the springs 27 and 35 in concentric alignment, while the top surface of the cover 29 is formed to stabilize the upper end of the spring 35 against lateral movement.

Spring 35 must have a greater compressive force than spring 27, so that it will maintain the valve 25 in seated condition upon the gasket 15 until pressure relief action occurs. The discharge rate and volume discharge of the tank liquid can be established by proper selection of compressive force of spring 35. Initial pressure value to unseat the valve 21 is controlled by the compressive force of spring 27. Values of pressure release can be set for any desired figure, a common range for use on power transformers being 0,2812 to 1,4061 kg/cm^2 (4 to 20 p.s.i.g.) which satisfies most operational requirements on such equipment.

In operation the valve 21 is moved upwardly and is unseated (Fig. 2) when the pressure in the tank 3 attains predetermined value, allowing the gas or liquid to flow into the region below the valve 25. The pressure of the gas, or liquid involved, is exerted upon the valve 25, which, together with the added lifting force developed by the further compressed spring 27, causes the valve 25 to be unseated (Fig. 3) from the flat gasket 15 whereupon the pressurized medium will be released to atmosphere by way of the opening 33 of the cover 29. Once the pressure of the medium returns to a predetermined value, the spring 35 will force the valve 25 to be seated upon the flat gasket 15.

Simultaneously, the valve 21, will be reseated upon the gasket lip 17 by action of the spring 27, whereupon the device is returned to initial position (Fig. 1). The action of the device to provide a release of gas pressure, is extremely rapid, such action being more fully described in the operational theory set forth in patent 3,217,082.

A second embodiment, illustrated in Figs. 4 to 6, incorporates certain modification in structure, over that of the first embodiment described above. More particularly, the second embodiment utilizes a disk-like first valve plate 41 having a peripheral groove 43 in which is seated a compression spring 45. The valve plate 41 seats upon a valve seating means, namely, a circular gasket 47 positioned in a base plate 49, similar in structure and function to base plate 7 of the first embodiment.

A valve seat 51 surrounds an upper portion of the base plate 49, and supports a circular gasket 53. A second valve 55, which is a cup-like configuration, and concentrically arranged relative the valve 41, engages the gasket 53 and has a peripheral shoulder 57 upon which a compression spring 59 is seated. The upper end of the spring 45 abuts the inner surface of the valve 55. A top plate 61 is arranged above the valve 55, and has a circum-

ferential recess 63 in which the upper end of the spring 59 is seated. A plurality of bolts 65 are arranged to positionally maintain the spring 59, and allow adjustable compression thereof.

It will be seen that the amount of fluid pressure in the transformer tank 7 to unseat the valve 41 will depend upon certain variables, such as relative pressure sensitive areas of the valves 41 and 55, as well as the compressive force of the springs 45 and 59. In one pressure relief device made in accordance with the invention, areas of valves 41 and 55 were 148,38 cm^2(23 sq.in.) and 294,83 cm^2 (45.7 sq.in.) respectively, and springs 45 and 59 had a compressive force of 4,5699 kg/cm^2 (65 lbs/sq.in.) and 5,0621 kg/cm^2 (72 lbs/sq.in.)respectively when compressed 7,62 cm (3 inches). Such design constants, allowed unseating of the valve 41, when the fluid pressure reached 0,5625 kg/cm^2 + 0,0703 (8 p.s.i.g. + 1).

Fig. 4 illustrates the non-operative, or closed condition of the device. Fig. 5 illustrates the initial stage of operation when the valve 41 is forced off the sealing gasket 47 by reason of fluid pressure within the transformer tank 3 reaching preset unseating pressure. Fig. 6 illustrates unseating of the valve 55, by reason of fluid passing valve 41, in which condition the fluid is released to atmosphere, as shown. Once the pressure in the tank 3 falls to a predetermined value, i.e., below preset value operational value, the springs will function to return the valve to the closed condition illustrated in Fig. 4.

The embodiment illustrated in Fig. 7 incorporates a flat disc valve 69 arranged to seat upon a valve seating means in the form of a circular gasket 71 positioned in a base plate 73, which is mounted atop a transformer tank in the manner of the predescribed embodiments. A second valve 75 concentric with valve 69, is arranged to extend about the periphery of the valve 69, an outer region 77 of the valve extending downwardly and in sealing contact

with a flexible seal 79 supported in the base plate 73. The flexible seal 79 is disclosed and claimed in our co-pending European patent application No. 82201568.1. An inner part 81 of valve 75 extends upwardly adjacent a helical spring 83. The latter is compressively arranged between the valve 75 and a cover 85 affixed to the base plate 73 by screws 87. One or more openings 89 are provided in the cover for release of pressure fluid, as will later be described.

Affixed to the upper surface of the valve 69 is a shield 91 which encircles a helical spring 93 compressively arranged between the valve 69 and the cover 85. Spring 93 is stronger compressively than spring 83.

Like the previous described embodiments, the amount of fluid pressure in transformer tank 7 to unseat the valve 69, will depend upon valve ratio variables and spring rate variables, all of which can be arrived at using well known design techniques.

It is to be noted that reseating action of the valve 69 is maximized since the more powerful spring 93 is working against a smaller area, compared with the total area of valves 69 and 75. During seating movement the valves will be briefly separated. Fast closing action of the valve 69 serves to reduce fluid e.g., oil, loss in the transformer tank 7.

The embodiment of Fig. 8 is similar to that of Fig. 7 except for minor design changes, such as a purge valve 95, which is used to allow escape of air in the transformer tank during filling, and an access plate 97 arranged in an opening of a cover 99, and positionally maintained by a plurality of clip means 101. The access plate provides access to the purge valve 95.

The embodiment of Fig. 9 is similar to that of Figs. 7 and 8 except it incorporates a valve 103 which is cup-shaped. A second valve 105 seats upon the valve 103, and is concentric therewith, while helical spring 83

is compressively arranged between the valve 105, and a cover 107.

Spring 93 is compressively arranged between the valve 103 and the shoulder of a sleeve 109. An adjusting screw means 111 is arranged in the cover 109 to seat upon the shoulder of the sleeve 109 whereby compressive adjustment of the spring 93 can be achieved.

It is to be noted that the embodiment of Figs. 7, 8 and 9 have basic features in common, namely, both valves used in each embodiment are in physical contact prior to pressure release operation, and the compression springs used in each will operate to reseat the primary, or inner valve, before the outer valve is seated because of area and spring pressure factors, as discussed above.

It is also to be noted that all five embodiments disclosed herein, have a central operative theme in common, namely the two valves in each move independently during certain operation phases. In the Fig. 1 and 4 embodiments, the inner valve unseats prior to unseating of the outer valve, while in the Fig. 7, 8 and 9 embodiments, the inner valve seats prior to the seating of the outer valve. Such action is generated by the differing compression factors of the springs bearing upon each valve. As a result, more efficient operational results are obtained with the pressure relief device of the subject invention as compared with such devices of the prior art.

CLAIMS

1. A pressure relief device (1) for mounting upon a container (3) holding a pressurizable medium, characterized by concentrically arranged valves (21, 25; 41, 55; 69, 77), seating means (17, 15; 47, 53; 71, 79) engageable by the valves to prevent release of pressurized medium from a container (3) on which the device is mounted, and compression means (27, 35; 45, 59; 93, 88) acting upon the valves and arranged so that the valves may move independently of one another when disengaged from the seating means.

2. A pressure relief device as in claim 1, characterized in that said device includes a base plate (7) having a central opening (23), a flat gasket (15) mounted upon the base plate (7) and surrounding said opening (23), a first valve (21) positioned in the opening (23) and having a peripheral portion seatable upon said gasket (15), a second valve (25) positioned above said first valve (21) and concentric therewith, said second valve (25) having a peripheral portion seatable upon said gasket (15), a first helical spring (27) compressively positioned between said valves (21, 25), a cover (29) secured to the base plate (7) and having a fluid escape opening (33), and a second helical spring (35) compressively positioned between the second valve (25) and the cover (29), said springs (27, 35) being further compressible upon attainment of a predetermined medium pressure in the container whereby the valves (21, 25) are unseated from the gasket (15).

3. A pressure relief device as in claim 2, characterized in that the first valve (41) covers the central opening and is seatable upon the flat gasket (47), a valve seat (51) supported upon the base plate (49), a second gasket (53) mounted upon the valve seat (51), a top plate (61) positioned above said second valve (55) and secured to the base plate (49), and said springs (45, 59) being further compressible upon attainment of a predetermined medium pressure in the container whereby the first valve (41) will be unseated from the first gasket (47), following which the second valve (55) will be unseated from the second gasket (53).

4. A pressure relief device as in either of claims 2 or 3, characterized in that said second spring (35, 59) is of greater compressive strength than said first spring (27, 45).

5. A pressure relief device as in either of claims 2 or 4, characterized in that a flexible seal (79) is mounted in the base plate (73) and is in rubbing contact with a downwardly extending portion (77) of the second valve (75); a cover (85, 99) is secured to the base plate (73) and has a fluid escape opening (89), and a circular shield (91) is affixed to the upper surface of the first valve (69).

6. A pressure relief device as in claim 2, characterized in that a purge valve (95) is positioned in the first valve (69) so that the container may be open to atmosphere during filling of the container with liquid medium.

7. A pressure relief device as in claim 2, characterized in that an access plate (97) is provided in the cover (99) which access plate (97) may be removed to provide access to the purge valve (95).

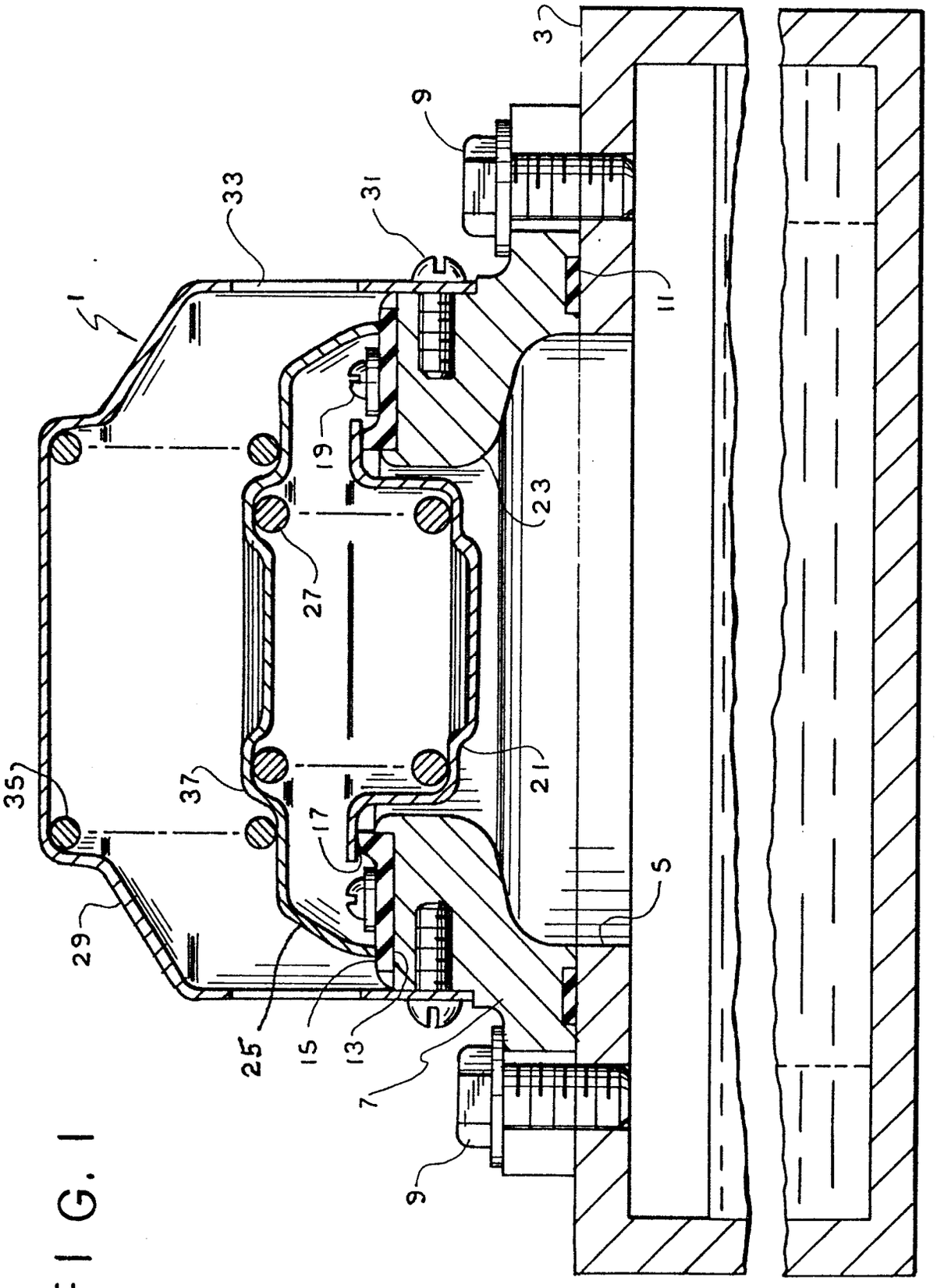

FIG. 1

FIG. 2

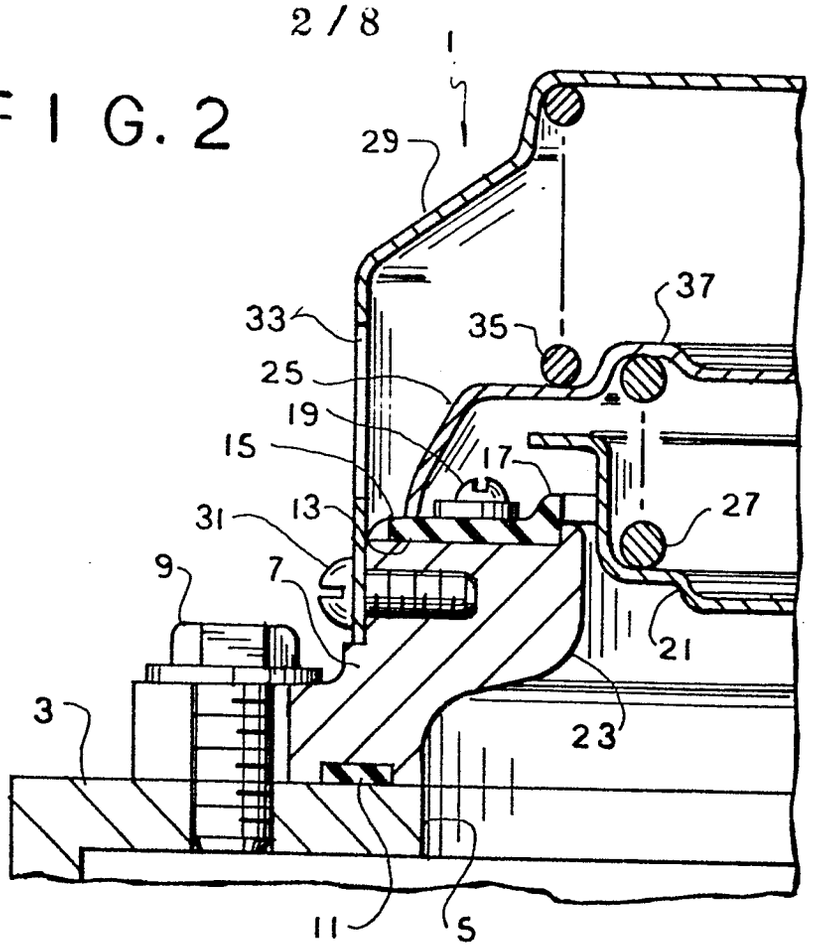
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FIG. 3

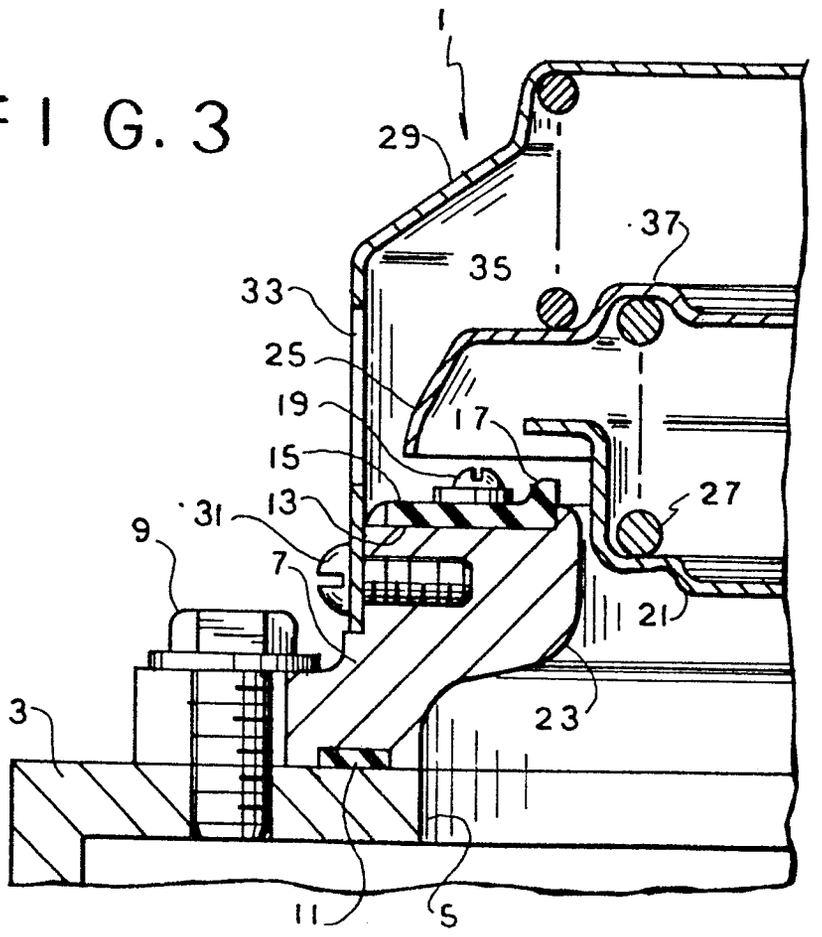
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FIG. 4

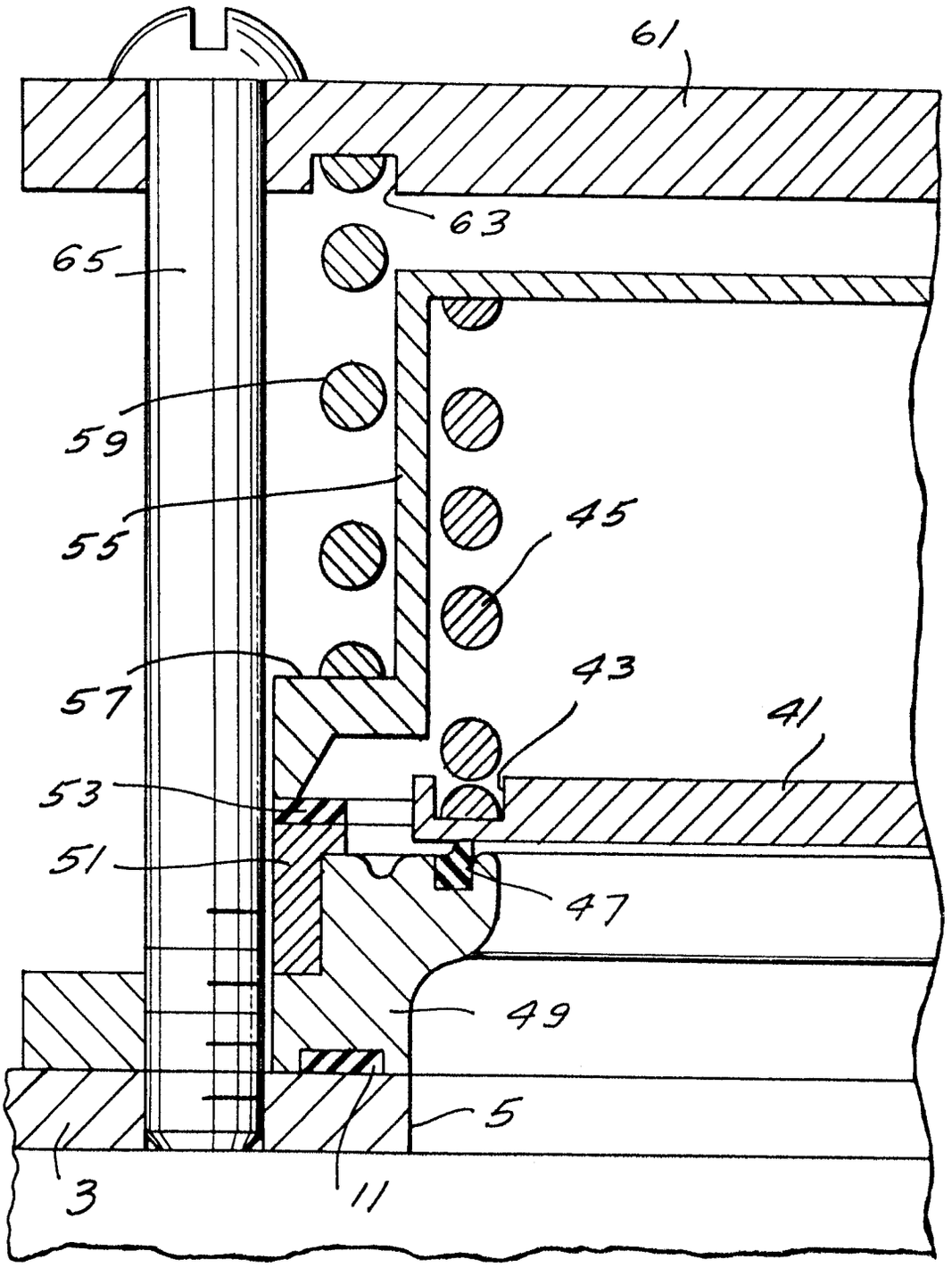


FIG. 5

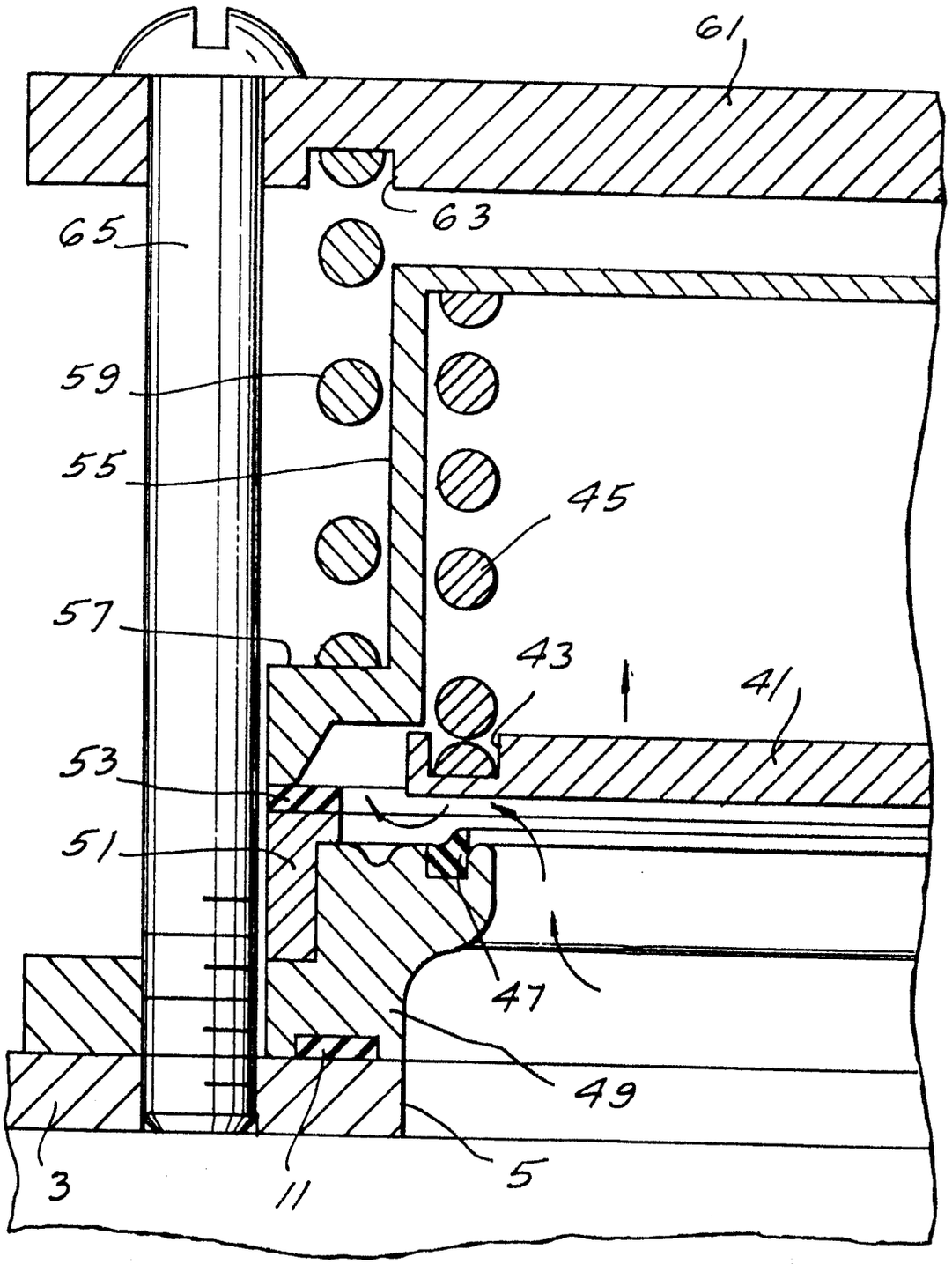


FIG. 6

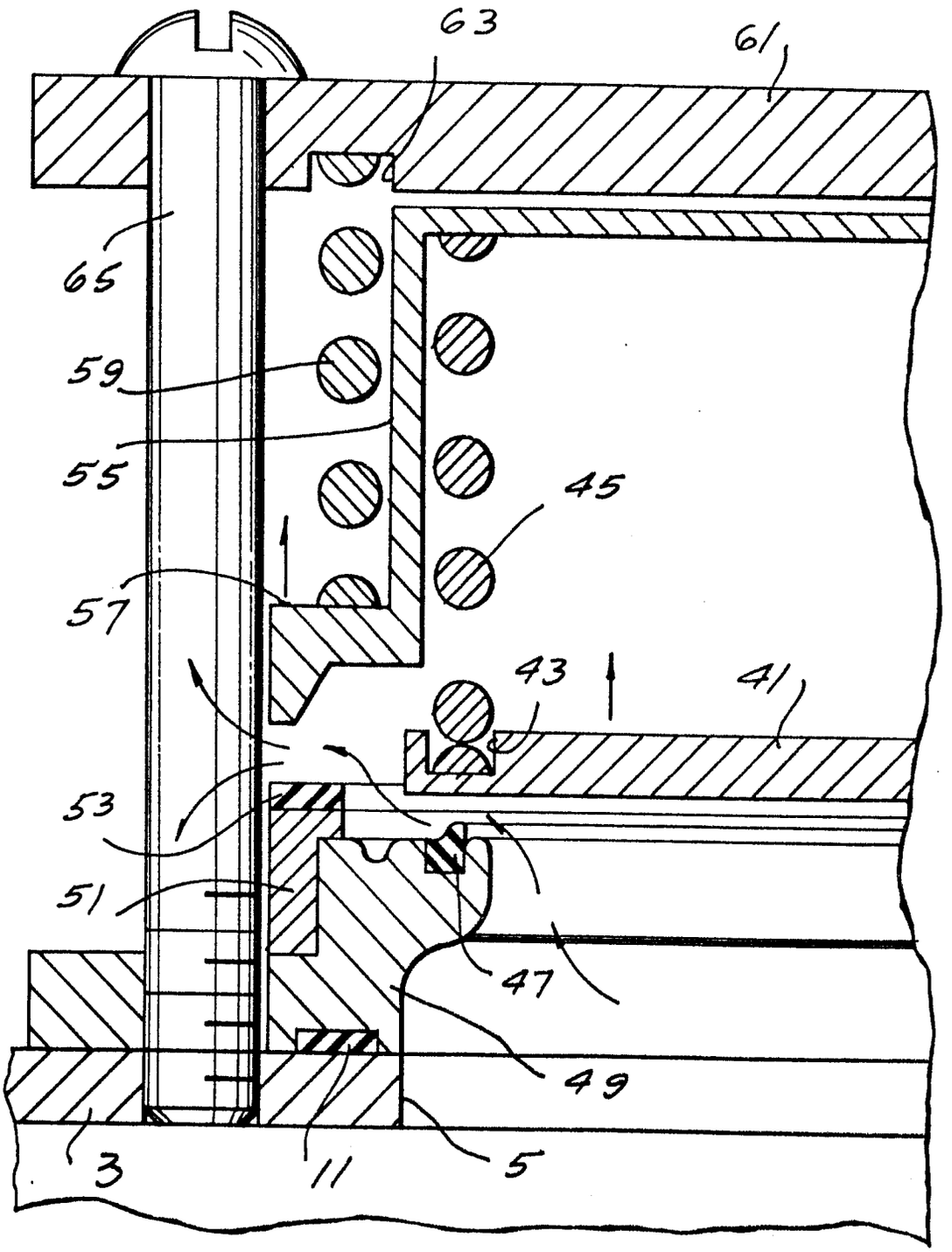


FIG. 7

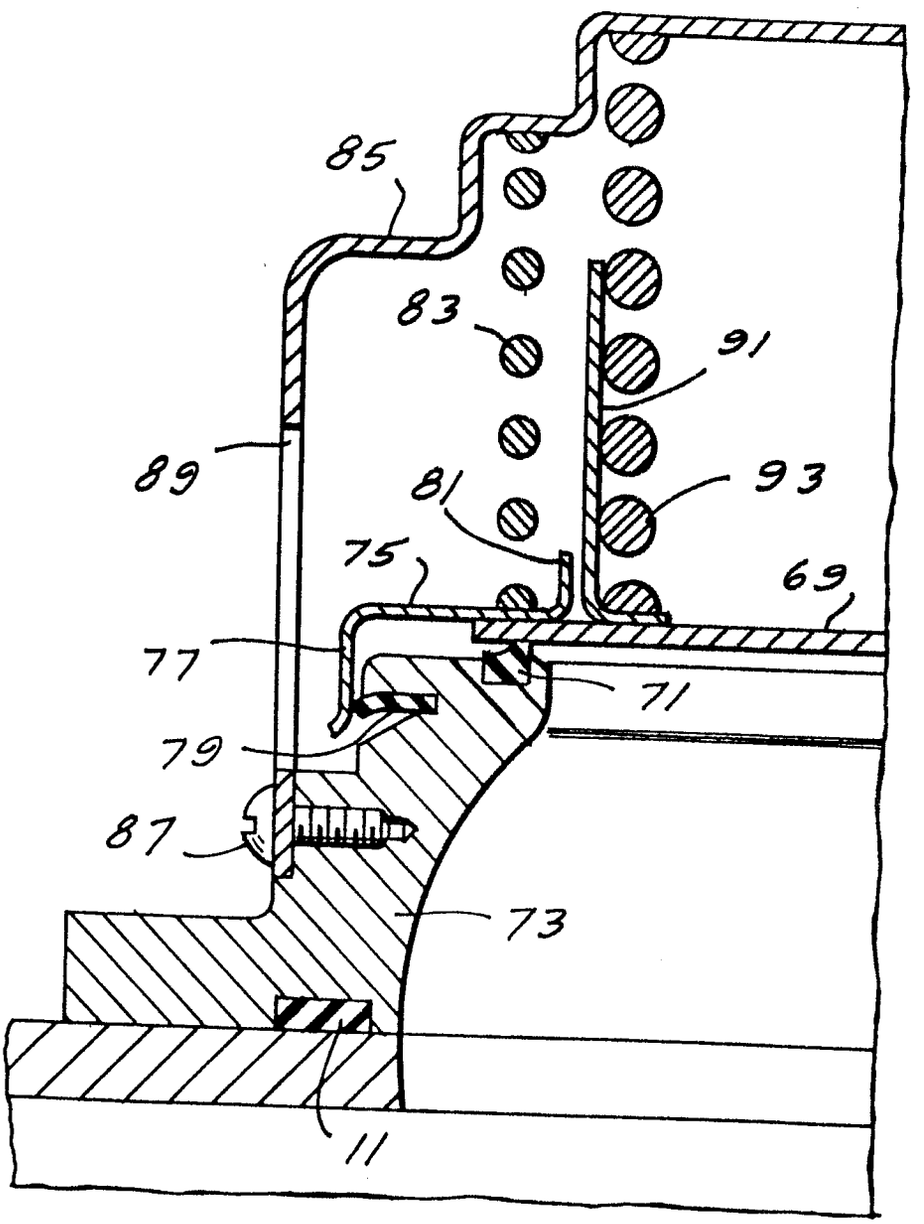


FIG.8

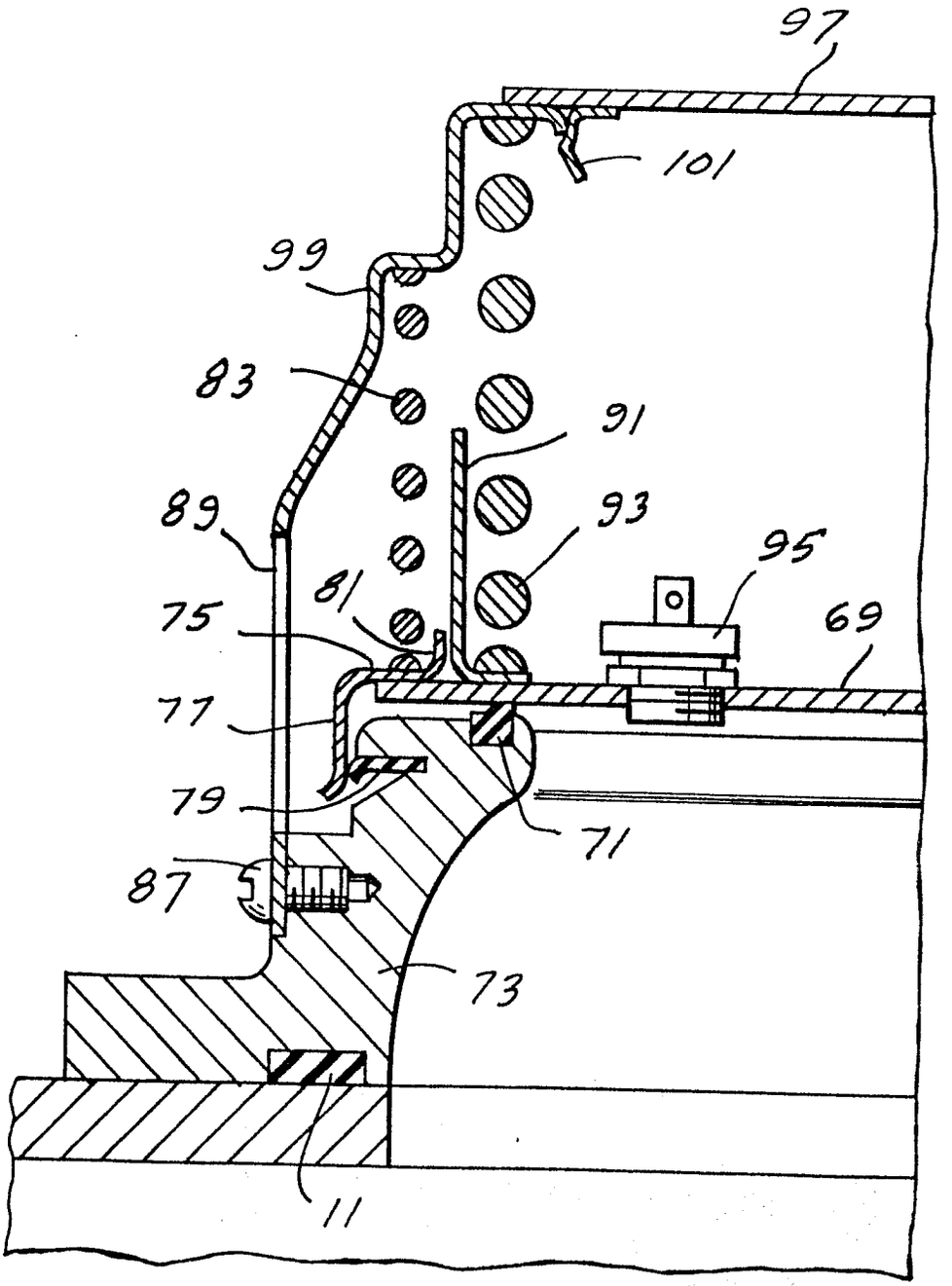
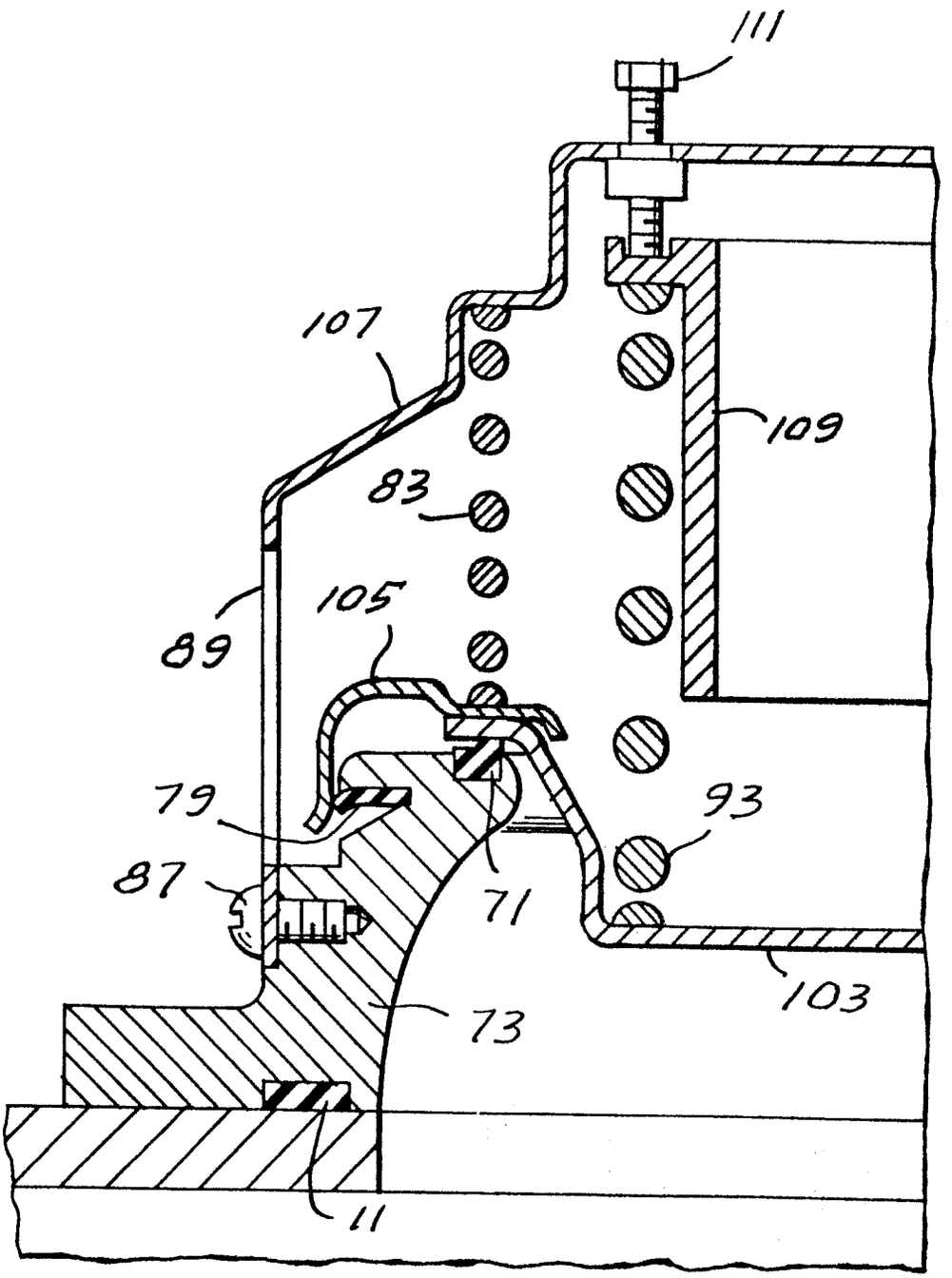


FIG. 9



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EUROPEAN SEARCH REPORT

0094702
Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 83200615.9

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
D,Y	US - A - 3 217 082 (C.R. KING et al.) * Column 4, line 19 - column 6, line 42; fig. 1-4 *	1	H 01 F 27/14 F 16 K 17/04
Y	AT - B - 237 091 (MICAFIL AG) * Claims 1-6; fig. 1,2 *	1	
A	US - A - 3 914 528 (JOHNSON)		
A	DE - A - 2 301 590 (QUALITROL CORP.)		
A	US - A - 2 904 616 (J.F. KOEPKE et al.)		
A	US - A - 2 989 073 (H.A. GOODWIN)		
D,A, E	EP - A1 - 0 083 814 (QUALITROL CORP.)		

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
H 01 F 27/00 F 16 K 17/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	26-08-1983	TSILIDIS

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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