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Gustafsson

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[54] **THROTTLE VALVE MECHANISMS**

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[52] **U.S. Cl.** **137/45,** 91/419, 251/57

[51] **Int. Cl.** **F16k 17/36**

[58] **Field of Search** 137/38, 39, 45, 46; 91/419

[56] **References Cited**

FOREIGN PATENTS OR APPLICATIONS

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Primary Examiner—Robert G. Nilson

Attorney—John Lezdey et al.

[57] **ABSTRACT**

In a throttle valve mechanism having a housing in which a pendulum depending from the housing is universally swingable around a geometrical axis of the housing and in which a plurality of throttle valves are arranged and each have one displaceable throttling valve member for varying the throttling effect of the respective throttle valve, the throttling valve member is displaceable by means of an actuating piston movable in an actuating cylinder connected with a control cylinder in which a control piston is displaceable, a liquid body being enclosed and filling the space between the actuating piston and the control piston, the control pistons for the throttle valves being spaced around said geometrical axis adjacent the upper end of the pendulum which has means engaging the control pistons for displacing them in the control cylinders as a result of swinging movement of the pendulum, the effective cross-sectional area of the actuating pistons being smaller than that of the control pistons so that the actuating pistons will be displaced a greater distance than the distance through which the control pistons are displaced by the pendulum.

3 Claims, 4 Drawing Figures

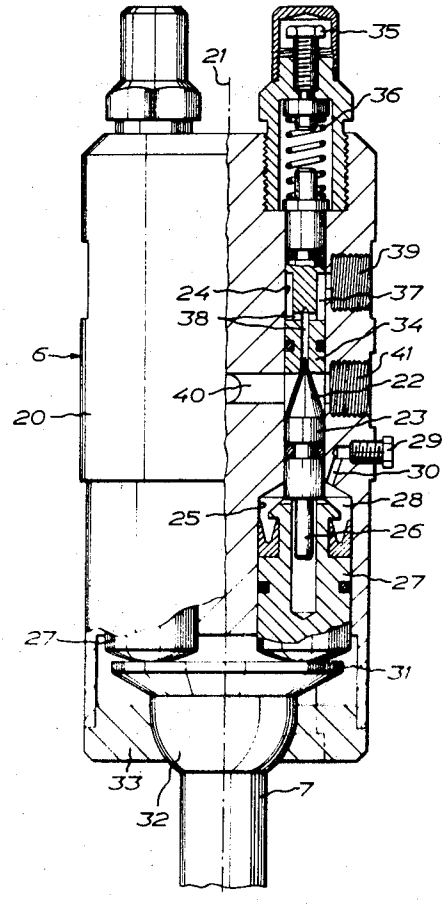


FIG. 1

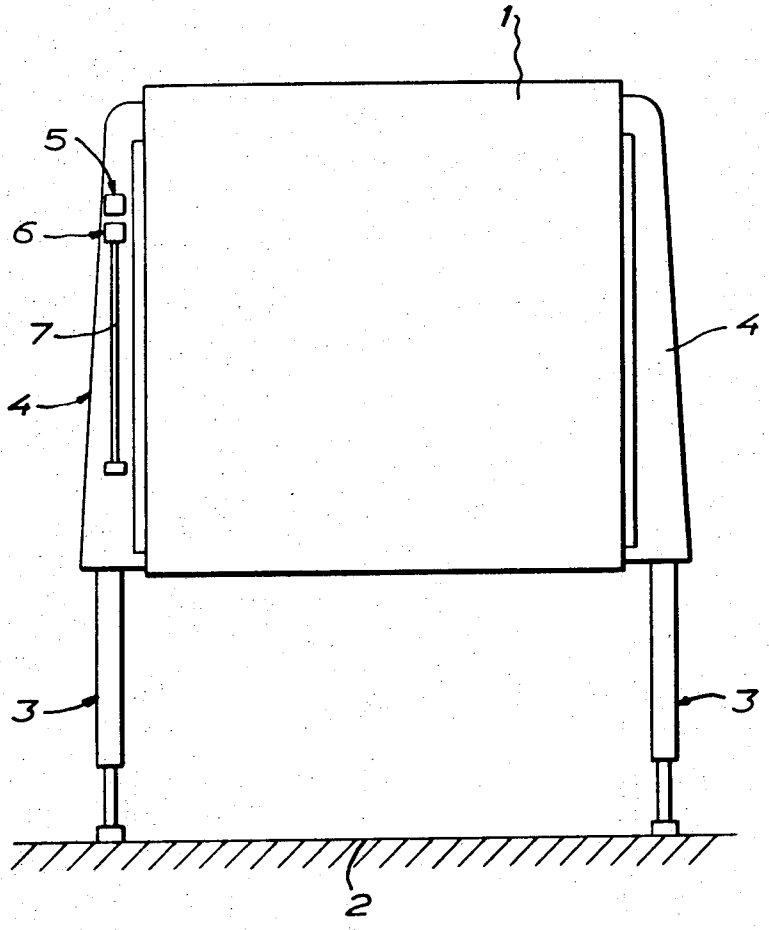
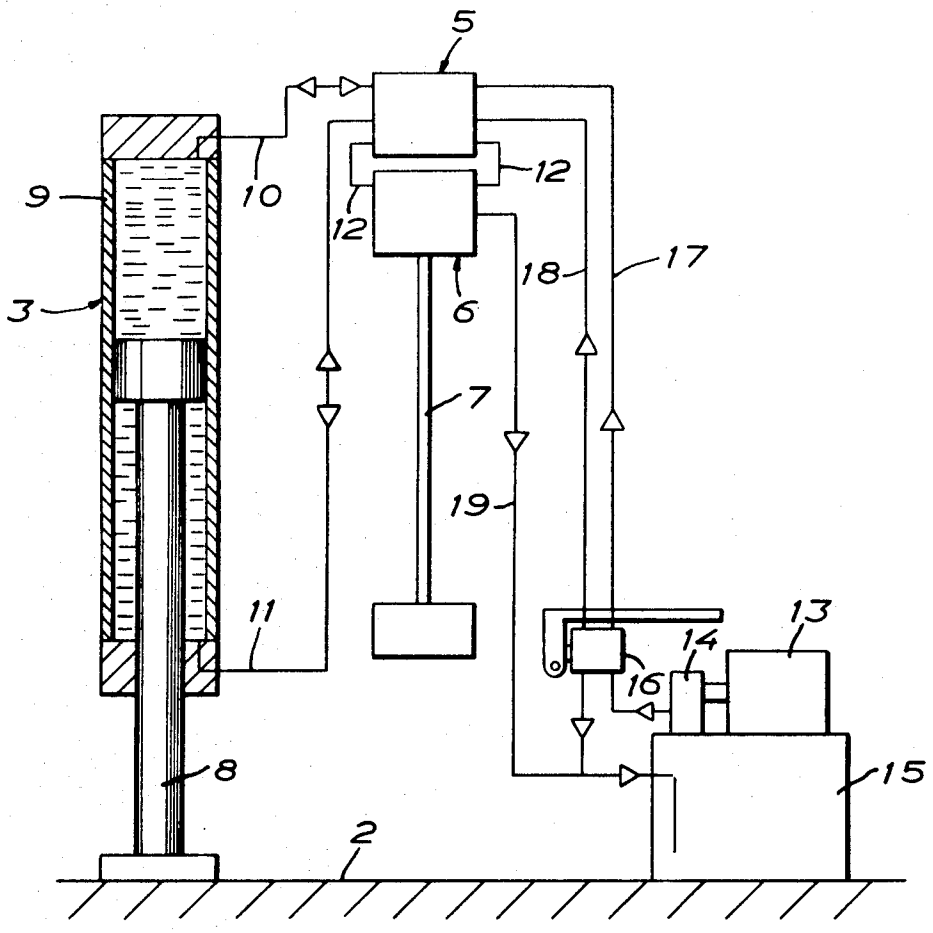


FIG. 2



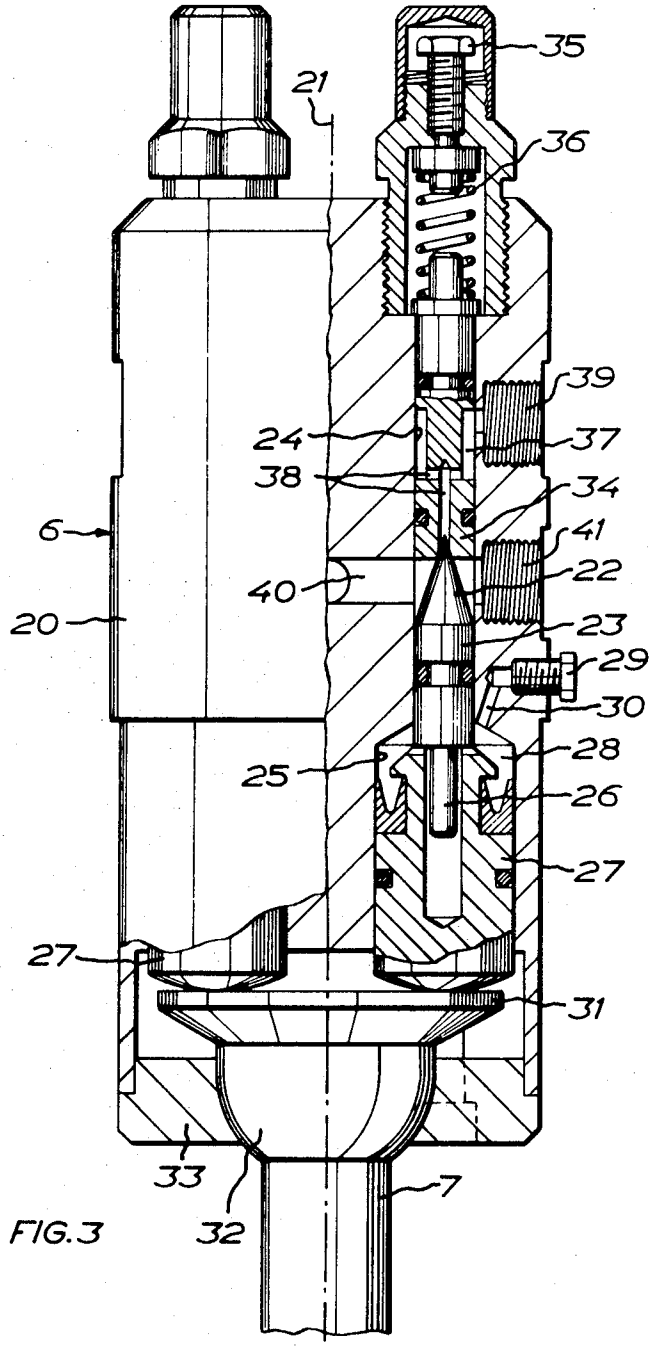


FIG. 3

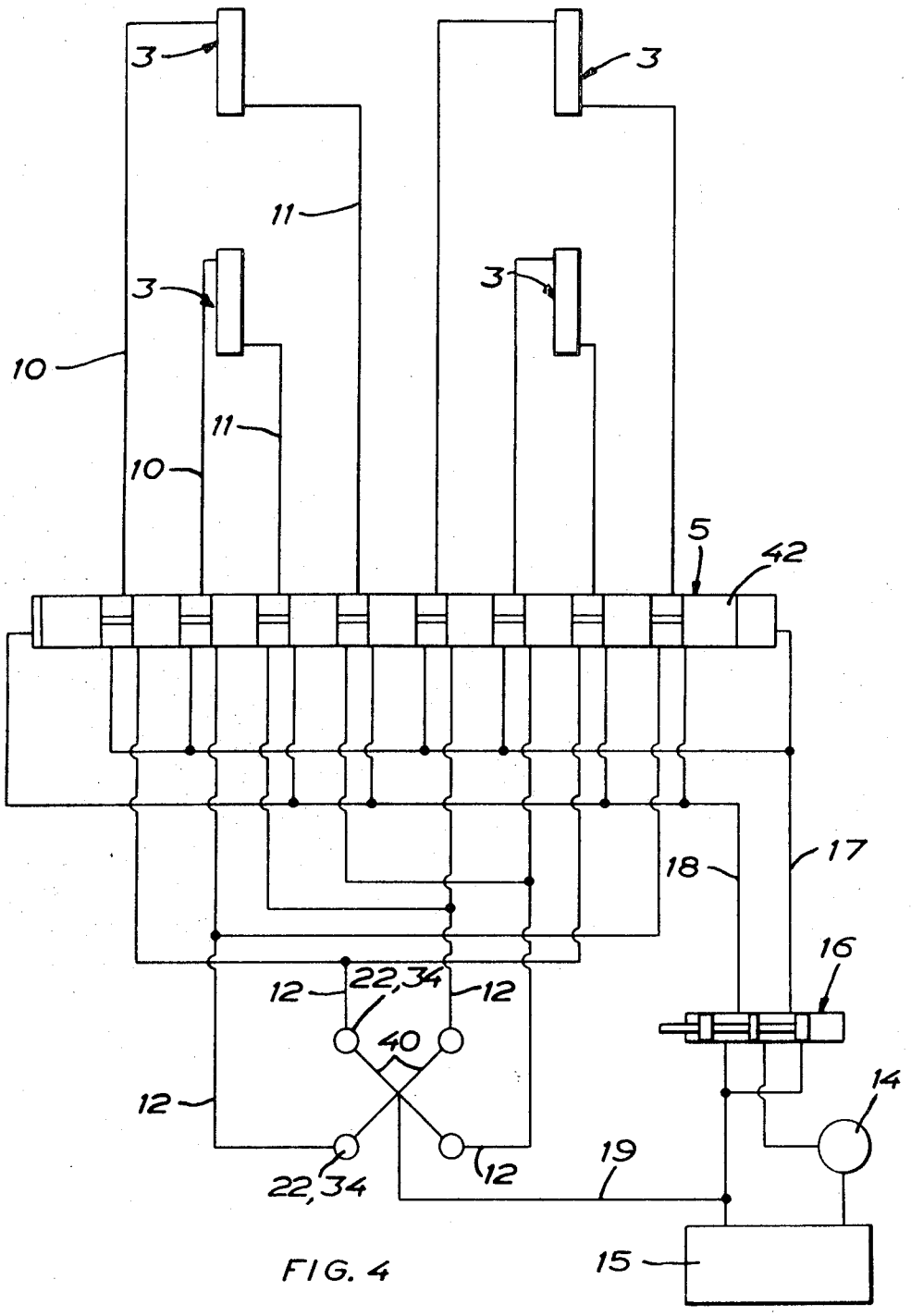


FIG. 4

THROTTLE VALVE MECHANISMS

This invention relates to a throttle valve mechanism having a housing in which a pendulum depending from the housing is mounted for universal swinging movement around a centre on a geometrical axis of the housing and in which a plurality of throttle valves are arranged and each have one displaceable throttling valve member which is adjustable by means of the pendulum into different throttling states in response to the position taken by the pendulum in relation to the geometrical axis.

Such throttle valve mechanisms are used in devices for lifting and lowering heavy objects, such as transport containers, to control pressure fluid driven lifting elements placed around and connected to the object, so that these devices will lift and lower the object to a uniform extent and the object is not subjected to any precarious tilting movement when lifted or lowered. The throttle valve mechanism can be placed on the container with the above mentioned geometrical axis in vertical position. If the object during lifting or lowering begins to tilt because some lifting element operates more rapidly or more slowly than the other lifting elements the pendulum will swing away from said geometrical axis, thereby actuating the throttle valves in such a way that the speeds of the lifting or lowering movements of the lifting elements are altered to compensate for the upsetting tendency.

Prior art throttle valve mechanisms of the type outlined in the foregoing suffer from the drawback that a relatively large swinging amplitude of the pendulum and thus a heavy obliquity of the object is required before the throttle valve mechanism is able to compensate for the upsetting tendency of the object to an appreciable extent. Where very large and very heavy objects are concerned it is imperative, however, that a throttle valve mechanism of the type outlined in the foregoing already at very small swinging amplitudes of the pendulum provides a large compensation of the upsetting tendency of the object.

The present invention has for its object to provide a throttle valve mechanism of the type outlined in the foregoing which is very sensitive to positional changes and thus realizes a large variation of the throttling effects of the throttle valves at a small change in position of the pendulum.

According to the invention, the valve member of each throttle valve has an actuating piston which is sealingly displaceable in a cylinder and defines a liquid filled chamber which has a cylinder portion of larger cross sectional area than that of the cylinder of the actuating piston, a control piston being sealingly displaceable in said cylinder portion of the liquid filled chamber, and the actuating pistons of the throttle valves are arranged in the throttle valve mechanism housing spaced around the geometrical axis of said housing and displaceable in their cylinder portions by means of the pendulum.

One embodiment of the invention will now be more fully described hereinbelow with reference to the accompanying drawings in which:

FIG. 1 shows a transport container raised from the ground by means of a lifting device which is equipped with a throttle valve mechanism according to the invention;

FIG. 2 shows a lifting element used in the lifting device shown in FIG. 1, a reversing valve mechanism, the throttle valve mechanism according to the invention, a control valve mechanism, and a pressure fluid source with appertaining pressure fluid lines;

FIG. 3 shows a partial side view and partial sectional view of a throttle valve mechanism according to the invention with the lower portion of the pendulum cut away;

FIG. 4 shows a hydraulic circuit diagram.

FIG. 1 shows a parallel-epipedical transport container 1 which is raised from the ground 2 by means of four hydraulic lifting elements 3. The lifting elements 3 each have one bracket 4. These brackets are in a known manner detachably hooked to the side walls of the transport container 1 in the vicinity of each container end wall. Secured to one of the brackets 4 is a reversing valve mechanism 5 and a throttle valve mechanism 6. As will be more fully described in the following, the throttle valve mechanism 6 has a housing in which a pendulum 7 depending from the housing is universally swingable around a geometrical axis of the housing. The housing is so fastened to the bracket 4 that said geometrical axis of the housing, when the bracket is hooked to the transport container 1, is parallel with the vertical centre axis of the container 1.

As will appear from FIG. 2 each lifting element 3 is a double-acting cylinder and piston assembly the piston rod 8 of which rests on the ground 2 and the cylinder 9 of which is fixed to the bracket 4 shown in FIG. 1 but not in FIG. 2. The upper and lower ends of the cylinder 9 are connected via lines 10 and 11 to the reversing valve mechanism 5. Separate lines 10 and 11 pass from the cylinder 9 of each lifting element 3 to the valve mechanism 5. Four lines 12 lead from the valve mechanism 5 to four throttle valves in the throttle valve mechanism 6. The valve mechanisms 5 and 6 could be built together in a single housing so that the lines 12 may be internal passages in the housing. A pressure fluid source in the form of a pump 14 driven by a motor 13 supplies pressure fluid from a receptacle 15 to a control valve 16. Two lines 17 and 18 connect the valve 16 to the reversing valve mechanism 5. The valve 16 can be set in a known manner into a position in which pressure fluid from the pump 14 flows through the line 17 to the valve mechanism 5 while the line 18 is in communication with the supply receptacle 15, and into another position in which pressure fluid flows from the pump 14 through the line 18 to the reversing valve mechanism 5 while the line 17 is in communication with the supply receptacle 15. Besides, the throttle valve mechanism 6 is connected via a line 19 to the supply receptacle 15.

The throttle valve mechanism 6 is shown in detail in FIG. 3. It has a substantially cylindrical housing 20 which is fastened by fastening devices (not shown) in such a way to the bracket 4 (shown in FIG. 1) that the geometrical centre axis 21 of the housing is parallel with the central height axis of the transport container 1. The housing comprises a number of throttle valves corresponding to the number of lifting elements 3 (FIG. 1), i.e. in the embodiment chosen four throttle valves which are spaced around the centre axis 21 in such a way that the throttle valves in horizontal projection are at the corners of a quadrangle. The housing 20 shall be fastened to the bracket 4 (FIG. 1) in such a way that said quadrangle is oriented in the same way as

the horizontal quadrangle at the corners of which the four lifting elements 3 are placed.

The four throttle valves in the housing 20 are identical, and FIG. 3 shows one of the throttle valves in axial section and partly in side elevation. This throttle valve will now be described, and the description applies to all four throttle valves. In the embodiment chosen, the throttle valve is of the needle valve type. Thus it has a conical valve member 22 which is integral with an actuating piston 23 which is sealingly displaceable in a cylinder 24 formed by a bore in the housing 20 and having its axis parallel with the axis 21 of the housing 20. The lower end of the actuating piston 23 projects into a cylinder 25 formed by a bore in the housing 20 and coaxial with the cylinder 24 but having a considerably larger diameter than said cylinder. The lower end of the actuating piston 23 has a pin 26 which is guided in a bore formed in a control piston 27 which is sealingly displaceable in the cylinder 25. The pistons 23 and 27 define between them in the cylinder 25 a chamber 28 which is entirely filled with liquid. The filling of liquid into the chamber 28 can take place through a fill passage 30 which is normally closed by means of a screw plug 29.

The lower ends of the control pistons 27 of the four throttle valves project from a lower end wall of the housing 20 and engage a disk 31 on the upper end of the pendulum 7. Beneath the disk 31 the pendulum has a spherical portion 32 by means of which the pendulum is mounted for universal swinging movement in a spherical bushing in a cover 33 screwed into the lower end of the housing 20. The pendulum 7 is so mounted that it can swing around a centre on the centre axis 21.

The conical valve member 22 cooperates with a valve seat at the lower end of a piston 34 which is movable in the cylinder 24. A spring 36 interposed between the upper end of the piston 34 and a set screw 35 tends to move the piston 34 downwards to urge the seat of the piston against the valve member 22. The piston 34 has an annular groove 37 which via passages 38 in the piston is in communication with the valve seat of the piston. Within the region of the groove 37 the housing 20 has a connecting bore 39 for one of the lines 12 (FIG. 2) from the reversing valve mechanism 5 so that liquid supplied through this line and being under a given pressure can flow into the groove 37 and pass through the passages 38 to the valve seat. Within the region of the conical valve member 22 the cylinder 24 is intersected by a bore 40 which is radial with respect to the cylindrical housing 20 and is in communication with a connecting bore 41 for the line 19 (FIG. 2) leading to supply receptacle 15. There is one radial bore 40 for each of the four throttle valves and these bores are in communication with each other at the centre of the housing. Only one of the bores 40 need have a connecting bore 41 for leading off liquid from all four throttle valves to the supply receptacle 15.

FIG. 4 shows a complete circuit diagram of the hydraulic circuits. The control valve 16 is shown in FIG. 4 in the form of a slide valve the piston of which is set in FIG. 4 into a position to connect the line 17 to the pump 14 and the line 18 to the supply receptacle 15. This is the position of the valve 16 in which it causes the lifting units 3 to lift the container 1. The reversing valve mechanism 5 is shown in FIG. 4 in the form of a slide-type valve member 42 which is movable in a cylinder and has a plurality of annular grooves for establishing various connections between the lines opening into the cylinder wall of the valve mechanism, said slide-type valve member being settable into two extreme positions in the cylinder with the aid of pressure fluid from the lines 17 and 18, respectively, which lines are each connected to one end of the cylinder. Since the line 17 in FIG. 4 is connected to the pump 14, the valve member 42 in FIG. 4 is moved into its left end position so that pressure fluid from the line 17 according to the line connections illustrated is supplied to the upper end of the cylinders of the lifting units 3, whereby said lifting units 3 will lift the container 1. This will force out pressure fluid from the lower end of the cylinders of the lifting units 3, said pressure fluid flowing through the lines 11 to the reversing valve mechanism 5 and through the lines 12 to the throttle valves 22, 34. It will appear from the circuit diagram in FIG. 4 that the lines 11 of the lifting units 3 are connected by means of the reversing valve mechanism 5 individually to the respective throttle valves 22, 34 which are diagonally opposed in horizontal projection.

The pressure fluid arriving from the respective lifting unit 3 during the lifting operation and flowing through a line 11 and a line 12 to the respective throttle valve 22, 34 enters the throttle valve housing 20 through a connecting bore 39 (FIG. 3) and penetrates from the groove 24 of the piston 34 through the passage 38 to the valve seat. The pressure fluid is under a certain pressure and by reason of the described construction of the piston 34 is capable of raising the piston 34 slightly from the valve member 22 against the action of the spring 36. The pressure fluid thus flows, while being throttled, through the valve seat around the valve member 22 to the passage 40 and through the connecting bore 41 and the line 19 connected therewith to the supply receptacle 15. The throttling effect in the valve seat has a braking effect on the lifting movement of the respective lifting unit. If for instance the left lifting unit 3 which is the upper one in FIG. 4 tends to lift more rapidly than the other lifting units 3 the height axis of the container 1 and thus the axis 21 of the throttle valve housing will take an oblique position so that the axis of the vertically depending pendulum 7 is set in an oblique position to the axis 21 in such a direction that the disk 31 of the pendulum 7 urges the control piston 27 of the throttle valve shown to the lower right in FIG. 4 some further distance into the cylinder 25, the pressure fluid in the chamber 28 urging the piston 23 to a considerably higher level in the cylinder 24 due to the difference in size between the effective cross sectional areas of the pistons 27 and 23, whereby the valve member 22 is moved towards the seat in the piston 34 and heavily increases the throttling effect in the valve seat, thereby increasing the braking of the lifting movement of the lifting unit 3 positioned to the upper left with regard to the lifting movements of the other lifting units. As a consequence, the container 1 will be rapidly straightened so that its height axis is again vertically directed and upsetting of the container is avoided.

For a lowering of the container 1 by means of the lifting units 3 the control valve 16 is so adjusted that the line 18 will be put in communication with the pump 14 and the line 17 will be put in communication with the supply receptacle 15. As a result the reversing valve piston 42 will be set into its right end position so that pressure fluid from the line 18 will be supplied to the lower end of the cylinders of the lifting units 3 through

the lines **11** and the upper ends of the cylinders of said lifting units **3** will each be connected through the lines **10** to one of the throttle valves **22, 34.** In this case, however, the reversing valve mechanism **5** has connected the different lifting units to the respective throttle valves **22, 34,** i.e. in such a way that for instance the upper left lifting unit **3** in FIG. **4** is connected to the upper left throttle valve. If for instance the upper left lifting unit **3** in FIG. **4** tends to lower the container **1** more rapidly than the other lifting units the container and thus the centre axis **21** of the throttle valve housing **20** will be put in an oblique position so that the disk **31** of the vertically depending pendulum **7** will urge the control piston **27** of the upper left throttle valve in FIG. **4** a small distance inwardly in the cylinder **25,** whereby the piston **23** will be urged a considerably larger distance upwardly in the cylinder **24.** As a result, the throttling effect in the throttle valve in question will be heavily increased so that the lowering movement of the upper left lifting unit in FIG. **4** will be braked in relation to the lowering movement of the other lifting units to readjust the height axis of the container into a purely vertical position.

What I claim and desire to secure by Letters Patent is:

1. A throttle valve mechanism, comprising a housing, a pendulum depending from said housing, means mounting the upper end of said pendulum in said housing for universal swinging movement around a centre on a geometrical axis of said housing, a plurality of throttle valves in said housing, inlet means and outlet means of said valves in said housing, said valves each comprising a throttling valve member displaceable for varying the throttling effect of said valve, an actuating piston connected to said throttling valve member for displacing said member, an actuating cylinder in said housing in which said actuating piston is sealingly displaceable, a control cylinder in said housing, a control piston sealingly displaceable in said control cylinder, said actuating cylinder and said actuating piston having a smaller effective cross-sectional area than said control cylinder and said control piston, and said actuating cylinder and said control cylinder being interconnected, a liquid body being enclosed and filling the space between said actuating and control pistons in said actuating and control cylinders, said control pistons of said throttle valves being spaced around said geometrical axis of said housing adjacent the upper end of said pendulum, and means on the upper end of said pendulum engaging said control pistons for displacing said control pistons in said control cylinders as a result of swinging movement of said pendulum.

2. A throttle valve mechanism according to claim **1** in which said throttle valves are needle valves.

3. A throttle valve mechanism according to claim **1** in which said throttling valve member, said actuating piston and said control piston of each throttle valve are coaxially arranged in said housing on an axis parallel to said geometrical axis of said housing.

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