Dec. 6, 1949 H. S. DIEBEL 2,490,258

HYDRAULICALLY CONTROLLED HINGE

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FIG. 4.

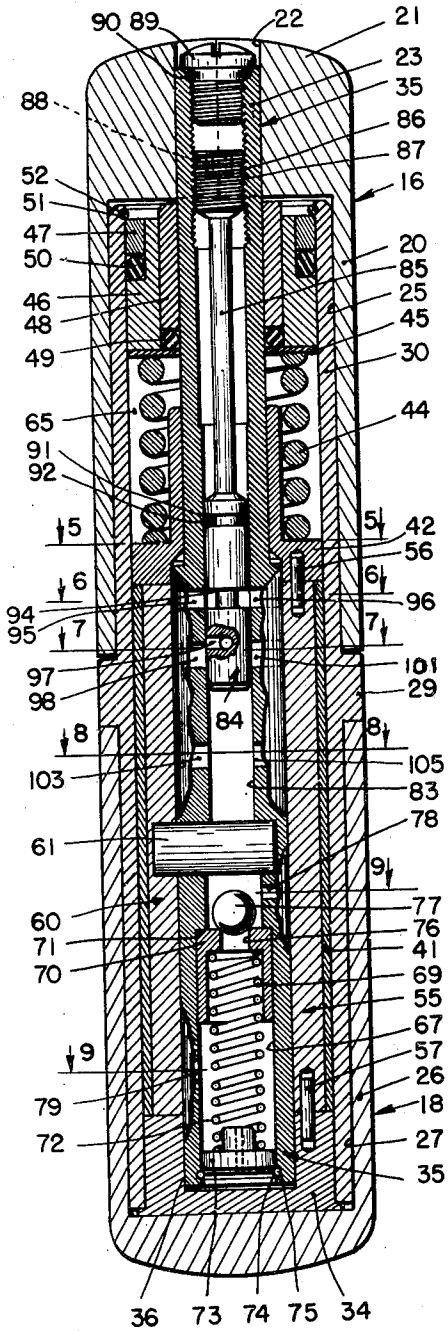


FIG. 2.

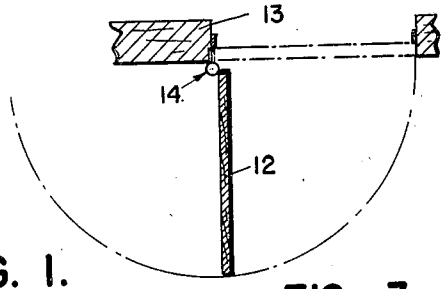


FIG. 1.

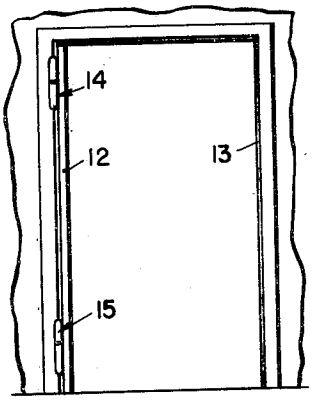
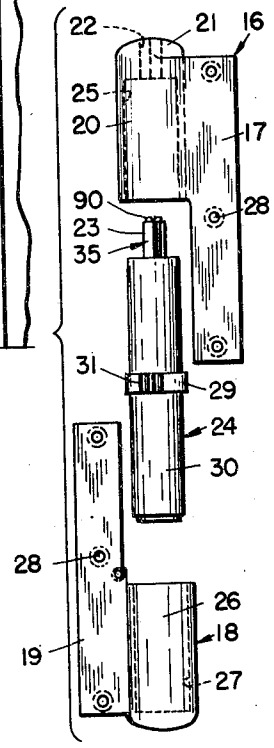


FIG. 3.



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FIG. 5.

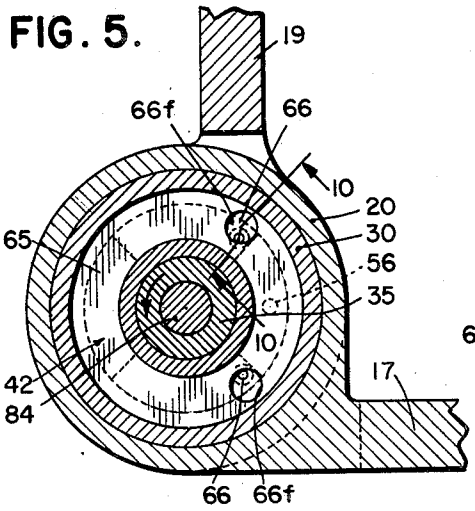


FIG. 6.

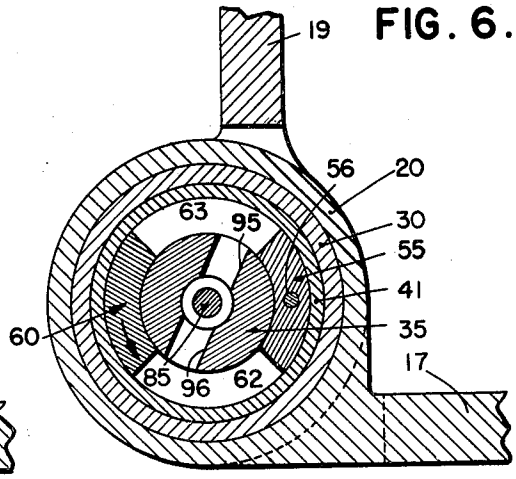


FIG. 7.

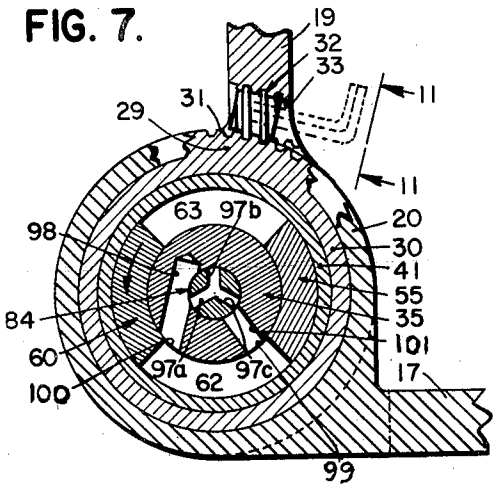


FIG. 8.

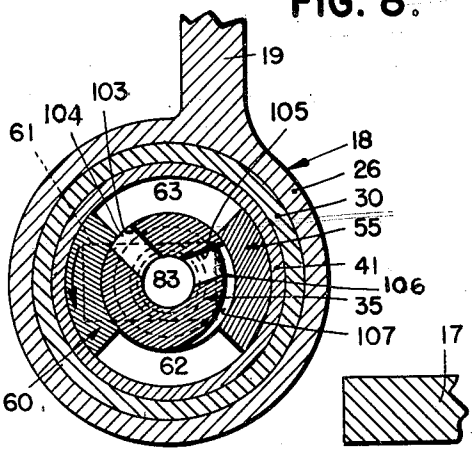


FIG. 9.

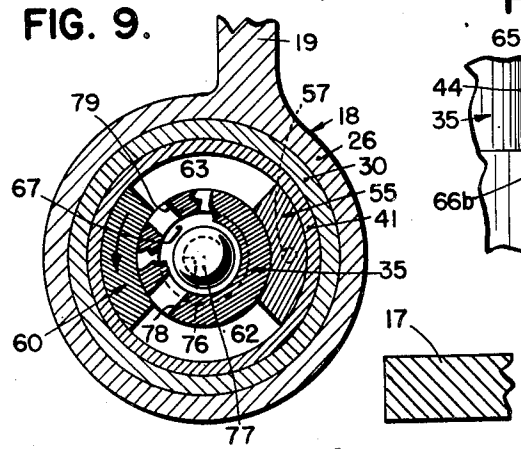


FIG. 10.

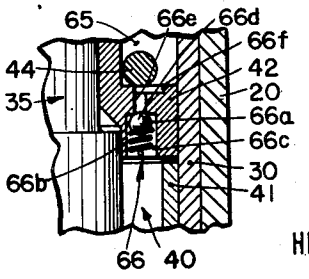


FIG. 11.



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HYDRAULICALLY CONTROLLED HINGE

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Application May 24, 1948, Serial No. 28,816

5 Claims. (Cl. 16—54)

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This invention relates to an hydraulically controlled door hinge.

One object of my invention is to provide a door hinge having hydraulic means for controlling the frictional resistance to movement. Another object is to provide a replaceable hydraulic control unit in a door hinge. Another object is to provide means for relieving overload and excessive pressures in the hydraulic fluid in an hydraulically controlled hinge. A further object is to provide a high precision hydraulically controlled hinge whose parts may be economically produced and assembled. A still further object is to provide means readily accessible in a mounted hydraulically controlled hinge, for adjusting the hydraulic resistance through the closing and final latching zones.

These and other objects are attained by my invention which will be understood from the following description and the accompanying drawings in which:

Fig. 1 is a side elevational view of a door mounted in a door frame by means of hinges;

Fig. 2 is a top elevational view of the door shown in Fig. 1 opened to 90°.

Fig. 3 is a disassembly view of the parts of a cartridge type hydraulically controlled door hinge;

Fig. 4 is a vertical cross-sectional view with parts broken away of the assembled cartridge hinge arranged with the door opened to 90° as in Fig. 2;

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 4, showing the check valves between the reservoir and the working chamber;

Fig. 6 is a cross-sectional view taken on the line 6—6 of Fig. 4, showing the metering valve and parts;

Fig. 7 is a cross-sectional view taken on the line 7—7 of Fig. 4, showing the latching valve and parts;

Fig. 8 is a cross-sectional view taken on the line 8—8 of Fig. 4, showing the retarding valve and parts;

Fig. 9 is a cross-sectional view taken on the line 9—9 of Fig. 4, showing the door opening valve and parts;

Fig. 10 is a cross-sectional view taken on the line 10—10 of Fig. 5; and

Fig. 11 is an elevational view of the worm gear for adjusting the cartridge in relation to the lower hinge leaf.

In general, my invention relates to a door hinge having an hydraulic checking mechanism for controlling the angular movement of the door, said checking mechanism being enclosed in a removable and replaceable cartridge unit which is operatively encased in the cavities of the outer half casings attached to or integral with the two leaves of each hinge.

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In the illustrative installation of my device, as shown in Figs. 1 and 2, a door 12 is hingedly mounted in a door frame 13 by means of an hydraulically controlled hinge 14 and a spring actuating hinge 15, the latter furnishing the torsional power to close the door after it has been manually opened, and the hydraulically controlled hinge 14 automatically providing the required amount of hydraulic friction to cause the door to first close rapidly, then to be gradually retarded in the zone approaching the latching position, and finally to be substantially free as the door latch engages the keeper in the latched position. On the door opening movement, substantially no hydraulic friction is imposed.

In Fig. 3 is shown a preferred form of my invention. The upper half casing 16 of the hydraulically controlled hinge consists of a hollow cylindrical portion 20 having a closure 21 at the upper end in which is provided an axial hole 22 adapted to slide over and non-rotatably engage the protruding end 23 of the shaft 35 of the separable hydraulic unit 24, the cylindrical cavity 25 and the cylindrical portion 20 being adapted to rotate freely upon the upper portion or half of the cylindrical housing 30 of the hydraulic unit 24. The upper hinge leaf 17 is preferably integral with the cylindrical portion 20 and extends tangentially therefrom. The lower half casing 18 is similarly provided with a hollow cylindrical body portion 26 having a cylindrical cavity 27 in which the lower end of the hydraulic unit 24 is adapted to be seated. The lower hinge leaf 19 is preferably integral with the lower half casing 18 and is also arranged tangentially thereto. Both hinge leaves are provided with suitable screw holes 28 by means of which the hinge leaves are attached to the door on the door frame. The cylindrical hydraulic unit 24 is adapted to be non-rotatably enclosed within the upper cylindrical cavity 25 and to be enclosed within the lower cavity 27. An adjusting collar 29 is permanently fastened to the cylindrical housing 30 of the hydraulic unit 24 midway between its ends, and is provided with teeth 31 which are arranged to be engaged by the threads of the helical pin or worm 32 which is mounted in the cylindrical hole 33 (Fig. 7) in the juncture of the casing 18 with the lower leaf 19.

In Figs. 4 to 9 are shown vertical and horizontal cross-sectional views of the separable hydraulic unit 24 arranged with the parts in position as shown in Fig. 2. This unit consists of the cylindrical housing 30 which is closed at the bottom by means of a plug 34 which is preferably soldered or welded to the inside walls of the cylindrical housing 30. A shaft 35 extends from a bearing seat 36 axially positioned in the plug 34, and extends upwardly to the top of the cylindrical housing 30, protruding beyond the top in the shaft

end 23 which is non-circular and makes non-rotatable engagement with a correspondingly shaped aperture 22 in the upper half casing 16.

The hydraulic working chamber 40 is defined by the top surface of the plug 34, by the inside wall of the cylindrical liner 41, by the radial edges of the partition 55, and by the closure member 42. The member 42 has a circumferential flange on its lower end which is pressed against the upper face of the ends of the liner 41 and the fixed partition 55 by the heavy coiled spring 44 which at its opposite end abuts a reservoir closure disk 45, which in turn presses against the telescoping collars 46 (inside) and 47 (outside) which fit within the cylindrical housing 30 and are coaxial with the bearing bushing 48 around the shaft 35 at the upper end of the hydraulic unit 24. Seal rings of resilient material such as rubber composition, commonly known as O rings, are provided, one marked 49 being shown around the shaft 35 between the end of the bushing 48 and the disk 45, and another O ring 50 being shown between the abutting ends of the telescoping collars 46 and 47. The sizes of the O rings and the spaces provided for them are selected so that the pressure of the spring 44 compresses them to form non-leaking seals. A spring locking ring 51 is provided on the upper edge of the telescoping collar 47 being set in a groove 52 on the inside wall of the housing 30 at the upper end thereof.

An elongated segmental fixed partition 55 in the working chamber 40 between the shaft 35 and the inside wall of the cylindrical liner 41 is held by an upper keying pin 56 to the closure member 42; and a lower keying pin 57 holds the partition 55 to the plug 34 at the bottom of the working chamber. An elongated segmental rotary piston 60 attached to the shaft 35 by the pin 61 divides the working chamber into two sides which are called for convenience a high compression side 62 and a low compression side 63 corresponding to the general conditions during closing. A reservoir 65 for a reserve supply of hydraulic liquid is provided in the space between the closure member 42 and the disk 45, and two check valves 66 are provided through the closure member to permit the hydraulic liquid to enter the working chamber when needed to keep it completely filled from the reservoir on one or the other side of the piston 60 but which prevent the passage of liquid from the working chamber to the reservoir. The check valves 66 may be arranged as shown in Fig. 10, with a ball 66*a* held by the spring 66*b* in the hole 66*c*, on the seat 66*d* at the lower end of the hole 66*e* leading to the reservoir 65, an enlarged outlet 66*f* being provided to avoid interference by the spring 44.

A cylindrical opening 67 is provided in the lower end of the shaft 35 below the piston keying pin 61, this opening being preferably larger in diameter than the bore 83 hereinafter described and adapted to contain a longitudinally movable accumulator sleeve 69 normally having its upper end 70 abutting the shoulder 71 formed between the larger and smaller openings, said sleeve being held in this position by the coiled spring 72 abutting a closure plug 73 affixed to the lower end of the opening 67 by the locking ring 74 in the groove 75 in the wall of the opening 67. The upper end of the sleeve 69 is provided with an aperture 76 which forms a seat for the check ball 77 normally resting on top of the sleeve 69 and closing the aperture. A port 78 is provided in the wall of the shaft 35 adjacent the check ball 77 and communicating with the working chamber as shown particularly in Fig. 9. The space around the coil spring 72 within the opening 67 below the sleeve 69 communicates with the opposite side of the working chamber by means of the port 79. During the movement of the door in opening it (clockwise, as shown), the liquid flows freely into the port 79 from the low compression side 63 and out of the port 78 to the high compression side 62. When the door moves in the opposite direction, in closing, the ball check closes the passage.

Above the cylindrical pin 61, the shaft is also provided with a cylindrical coaxial bore 83 in which the cylindrical valve body 84 is adapted to be moved longitudinally by the valve stem 85 whose upper end is provided with threads 86, making threaded engagement with the threads 87 in the wall of the bore 83 adjacent the protruding end 23 of the shaft 35. A socket 88 is provided in the end of the valve stem which is accessible after the hinge is mounted, for adjustment by a socket wrench after the closing cap 89 has been removed from the upper end of the shaft bore, this closing cap being also provided with an O ring 90 for sealing against leakage.

The valve body 84 is provided at its upper end with a groove 91 in which an O sealing ring 92 is fitted. An annular groove 94 is provided in the valve body 84 which groove communicates with the apertures 95 and 96 through the shaft 35 forming an adjustable metering duct through the shaft from the high compression side 62 of the working chamber to the low compression side 63. The size of the opening through this duct is variable by the longitudinal setting of the valve body by means of the threaded engagement at 86 and 87 in the upper part of the shaft bore. This controls the frictional resistance during the initial closing movement of the door.

Another aperture 97, for controlling the latching, is also provided in the valve body 84. This aperture consists of three (3) holes 97*a*, 97*b*, 97*c*, spaced 120° apart and meeting at the axis of the valve body. A non-radial hole 98, forming a part of port 100 is tangentially located relative to the shaft bore 83 adjacent the valve body 84 and communicating with one hole 97, is provided in the shaft, the port 100 being adjacent the edge of the rotary piston 60, and in communication with the high compression side 62 of the working chamber. Another port 99 communicates through the radial hole 101 at its inner end with one of the holes 97 as shown particularly in Fig. 7. This arrangement permits the adjustment of the size of the duct, irrespective of the longitudinal position of the valve body, which may be changed in the adjustment of the metering duct at groove 94. Less than one third of a revolution will effect control of the latching duct, while not seriously affecting the metering duct. After the door passes through a zone of retarded movement near the closed position, to be described below, the hydraulic friction is momentarily decreased so that the door latch will be engaged in its keeper. This is provided by the relief of hydraulic pressure when the port 99 has passed beyond the fixed partition 55 and liquid flows from port 100 through hole 98 through one hole 97 and out through hole 101 at port 99 in the low pressure side 63 of the working chamber.

Between the principal closing zone and the latching zone, the hydraulic friction is gradually increased to cause the door as it approaches the latching position to be retarted without jerking or chattering, by means of the tapered port

shown particularly in Fig. 8. The radial outlet hole 103 extending from the port 104 in the low compression side 63 of the working chamber, communicates with the lower end of the bore 83 below the valve body 84. A radial inlet hole 105, is provided from the bore 83 to the inlet port 106, which communicates with a tapered groove 107 cut in the shaft 35. As the piston moves anticlockwise (Fig. 8) the flow of hydraulic liquid from the high compression side 62 of the working chamber, through the groove 107, the hole 105, the bore 83 (below the valve body 84) and the hole 103 to the low compression side 63 is gradually restricted. As noted above, when this position is reached, the latching control (Fig. 7) becomes effective and the hydraulic friction is reduced sufficiently to allow the latch to engage the keeper, without slamming.

The manner of operation of the hydraulic checking hinge has been indicated in the detailed description of the parts. When the door is opened manually, the hydraulic piston 60 moves clockwise, as represented in Figs. 5 to 9, the hydraulic liquid flowing freely from the low compression side 63 to the high compression side 62. During the closing cycle of the door, torsional force is applied through, for example, the companion spring actuated hinge 15. In the initial closing cycle, the hydraulic liquid is metered through the valved ducts 95 and 96, whose effective opening is regulated by positioning of the groove 94 in the valve body by means of the adjusting screw turned through the socket 88 and a suitable tool applied through the opening for the closing cap 89. The door closes with more or less unretarded movement until it is gradually brought almost to a stop by the tapered groove 107 cooperating with the ports 104 and 105, as the door approaches the closed position. Just before the latching position is reached the hydraulic friction is partly released by the opening through the shaft, of the ports 99 and 100, the opening being adjustable by the positioning of the holes 97*a*, 97*b*, or 97*c*, relative to the holes 98 and 101, through close adjustment circumferentially of the valve body 84. This permits the latching of the door without any slamming, under the torsional force from the spring hinge.

The many advantages of my improved hydraulically controlled hinge will be apparent. The arrangement of the sleeve 69 and the coil spring 72 operative in the hole 67 in the shaft 35 acts as an emergency release in the event that too high hydraulic pressures are developed by manual pressure on the door which may be applied in an attempt to accelerate the closing. The several parts of the hydraulic mechanism are designed on lines which permit economical production with high precision in the dimensions. The parts may be accurately assembled with a minimum amount of labor. The compression spring 44 holding the parts together longitudinally has the advantage of simplifying the assembly, and also serves as a safety relief if the hydraulic pressures become too high at any time during the operation of the hinge. In addition, the positive pressure of the spring 44 on the telescoping collars 46 and 47, causes compression of the resilient sealing rings 49 and 50, and thus stops all leakage of hydraulic liquid from the unit. The ready availability of the valve stem for regulating the resistance to flow of liquid during the initial closing and during the pre-latching movement permits the easy adjustment of the hinge for each installation.

While I have described my invention as applied to separable unit type hinges, other forms of hinge elements may be employed with the hydraulic mechanism herein described and claimed below.

I claim:

1. In an hydraulically controlled door hinge, an elongated casing having a cylindrical cavity, said casing including means for operative attachment thereto of a hinge leaf; a closure means at the bottom end of said casing including a thrust bearing for a shaft; a shaft extending from said thrust bearing and protruding from the top end of said casing, said protruding end being adapted for operative attachment to a second hinge leaf, said shaft having an axial bore extending from its upper end; a closure cap at the top end of said casing, including a bearing sleeve for said shaft; a partition disk dividing the annular cavity around said shaft in said casing into a reservoir and a working chamber; a fixed segmental partition in said working chamber; a movable segmental rotary piston attached to said shaft and adapted to move with said shaft in said working chamber from one edge of said fixed partition to the other; conduit means including check-valves connecting said reservoir to said working chamber, one said conduit means being disposed on each side of said movable piston and adapted to admit liquid to one or the other side of said piston in said working chamber; a one-way valved passage through said shaft adapted to transfer liquid from a first side to a second side of said working chamber; a metering duct arranged transversely through said shaft adjacent the upper portion of said shaft bore, said duct being adapted to transfer liquid from said second side to said first side of the working chamber through the central zone of movement of said piston; a latching duct arranged transversely through said shaft adjacent the upper portion of said shaft bore, said latching duct being adapted to transfer liquid from said second side to said first side of the working chamber through the final movement to a fully closed position; and valve means within the upper portion of said shaft bore operable by a common threaded stem threaded into the upper end of the shaft for regulating the fluid resistance through said metering duct and said latching duct.

2. In an hydraulically controlld door hinge, an elongated casing having a cylindrical cavity, said casing including means for operative attachment thereto of a hinge leaf; a closure means at the bottom end of said casing including a thrust bearing for a shaft; a shaft extending from said thrust bearing and protruding from the top end of said casing, said protruding end being adapted for operative attachment to a second hinge leaf, said shaft having an axial bore extending from its upper end; a closure cap at the top end of said casing, including a bearing sleeve for said shaft; a partition disk dividing the annular cavity around said shaft in said casing into a reservoir and a working chamber; a fixed segmental partition in said working chamber; a movable segmental rotary piston attached to said shaft and adapted to move with said shaft in said working chamber from one edge of said fixed partition to the other; conduit means including check-valves connecting said reservoir to said working chamber, one said conduit means being disposed on each side of said movable piston and adapted to admit liquid to one or the other side of said piston in said working chamber; a one-way valved passage through said shaft adapted to transfer liquid from a first side to a second

side of said working chamber; a metering duct arranged transversely through said shaft adjacent the upper portion of said shaft bore, said metering duct being adapted to transfer liquid from said second side to said first side of the working chamber through the central zone of movement of said piston; a latching duct arranged transversely through said shaft adjacent the upper portion of said shaft bore, said latching duct being adapted to transfer liquid from said second side to said first side of the working chamber through the final movement to a fully closed position; valve means within the upper portion of said shaft bore operable by a common threaded stem in the upper end of the shaft for regulating the fluid resistance through said metering duct and said latching duct; and a retarding duct arranged transversely through said shaft, said duct including a hole through said shaft, and a tapered groove in the periphery of said shaft communicating with one end of said hole, the size of opening of said groove into the working chamber being gradually decreased as the shaft turns, whereby the fluid resistance through said duct is gradually increased in the zone intermediate that controlled by said metering duct and said latching duct.

3. In an hydraulically controlled door hinge, an elongated cylindrical casing having a cylindrical cavity, said casing including means for operative attachment thereto of a hinge leaf; a closure means at the bottom end of said casing including a thrust bearing for a shaft; a shaft extending from said thrust bearing and protruding from the top end of said casing, said protruding end being adapted for operative attachment to a second hinge leaf, said shaft having an axial hole extending from its upper end to its lower end; plug means separating said hole into an upper bore and a lower bore; a closure cap at the top end of said casing, including a bearing sleeve for said shaft; a partition disk dividing the annular cavity around said shaft in said casing into a reservoir and a working chamber; a fixed segmental partition in said working chamber; a movable segmental rotary piston attached to said shaft and adapted to move with said shaft in said working chamber from one edge of said fixed partition to the other; conduit means including check-valves connecting said reservoir to said working chamber, one said conduit means being disposed on each side of said movable piston and adapted to admit liquid to one or the other side of said piston in said working chamber; a one-way valved passage through said shaft communicating with said lower shaft bore, a spring pressed accumulator sleeve in said lower bore, a ball-check valve at the upper end of said accumulator sleeve, and inlet and outlet holes through the walls of said lower shaft bore, one positioned above and one below said ball-check valve, to provide a passage adapted to transfer liquid from a first side of said piston to a second side of said working chamber during the opening of the hinge and door, said accumulator spring being compressed at times to relieve unusually high pressures acting against said ball-check valve, and valved transverse passages through said shaft adjacent said lower shaft bore, adapted to transfer liquid at times from said second side to said first side of the working

chamber at varying rates; and valve means within said lower shaft bore for adjusting said valved passages.

4. In an hydraulically controlled door hinge, an elongated casing having a cylindrical cavity, said casing including means for operative attachment thereto of a hinge leaf; a closure means at the bottom end of said casing including a thrust bearing for a shaft; a shaft extending from said thrust bearing and protruding from the top end of said casing, said protruding end being adapted for operative attachment to a second hinge leaf; a closure cap at the top end of said casing, including a pair of telescoping rings in end abutting relation and a bearing sleeve for said shaft; a partition disk dividing the annular cavity around said shaft in said cylindrical casing into a reservoir and a hydraulic piston working chamber; a resilient sealing ring around said shaft between said bearing sleeve and said disk; a resilient sealing ring between the abutting ends of said telescoping rings adjacent the inside casing wall; and a compression coil spring between said disk and said closure cap adapted to hold said parts and said sealing rings under pressure in excess of the normal working pressures in said working chamber.

5. In an hydraulically controlled door hinge, an elongated casing having a cylindrical cavity, said casing including means for operative attachment thereto of a hinge leaf; a closure means at the bottom end of said casing including a thrust bearing for a shaft; a shaft extending from said thrust bearing and protruding from the top end of said casing, said protruding end being adapted for operative attachment to a second hinge leaf; a closure cap at the top end of said casing, including a pair of telescoping rings in end abutting relation and a bearing sleeve for said shaft; a partition disk dividing the annular cavity around said shaft in said cylindrical casing into a reservoir and a hydraulic piston working chamber; a resilient sealing ring around said shaft between said bearing sleeve and said disk; a resilient sealing ring between the abutting ends of said telescoping rings adjacent the inside casing wall; a compression coil spring between said disk and said closure cap adapted to hold said parts and said sealing rings under pressure in excess of the normal working pressures in said working chamber; a segmental partition in said working chamber having dowel pins at its ends engaging said partition disk and said bottom closure means; a movable segmental rotary piston keyed to said shaft by a transverse pin and adapted to move with said shaft in said working chamber from one edge of said fixed partition to the other; and a plurality of valved passages through said shaft adapted to control the movement of said piston in said working chamber.

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