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FLUID PRESSURE SYSTEM

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This invention relates to fluid pressure systems and particularly to the type of system which includes a plurality of fluid actuated motors adapted to be supplied with fluid under pressure from a single source.

An object of the invention is to provide novel control means for selectively connecting the several motors either individually or in groups with the source of fluid supply.

A further object is to provide fluid distributing means of novel construction and particularly involving the housing of a plurality of valve units in a single unitary structure of compact dimensions and relatively simple design.

Another object of the invention is to provide novel means for sealing such a valve mechanism to minimize the possibility of leakage therefrom.

A further object is to provide automatic valve mechanism for permitting a diversion of the fluid back to the source after the fluid motor to which the fluid has been directed has moved through a predetermined range of movement, and even though the valve associated therewith remains in the position previously selected therefor.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawing wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing:

Fig. 1 is a top plan view of a unit containing a plurality of direction controlling valves adapted to control the delivery of fluid to a corresponding plurality of motors to be actuated in accordance with the invention;

Fig. 2 is a side or elevational view of the unit shown in Fig. 1;

Fig. 3 is a horizontal sectional view through the unit of Figs. 1 and 2, and also shows diagrammatically the connections from the source of fluid supply to the several units to be actuated, in the relationship of said connections to the valve mechanism which controls the flow thereto;

Fig. 4 is another view of the valve mechanism showing the mechanism partly in elevation and partly in vertical section; and

Fig. 5 is a sectional view (along line 5—5 of Fig. 1) of one of the individual valve units as it appears when there is incorporated therein the automatic flow diverting means above referred to.

In the drawing, reference character 11 designates a fluid reservoir from which there is an outlet conduit 12 leading to a pump 13 adapted to supply actuating fluid for a group of servomotors indicated at 14, 15, 16 and 17 in Fig. 3; the flow of fluid to said units and the return of fluid therefrom being dependent upon the settings of the individual valve units corresponding thereto.

As shown, these individual valve units include rotatable elements 21, 22, 23 and 24, of which the unit 24 is shown more completely in the sectional view shown in Fig. 4.

Referring to said Fig. 4 it will be seen that valve element 24 is rotatable in a tapered recess formed in the central section 27 of the valve housing, there being similar tapered recesses to receive each of the valves 21 to 24, inclusive. The element 24 is integral with a valve stem 31 which extends through the upper member 28 of the valve housing and has keyed thereto an operating handle 32 having an indicating point 33 thereon for registry with one or another of the several markings appearing on the upper surface of the valve housing as indicated in Fig. 1; there being similar markings to guide the operator in shifting the valve elements 21, 22 and 23 by means of the handles 41, 42 and 43, respectively, said handles corresponding to the handle 32 of valve 24. There is a coiled compression spring 44 mounted in a pocket in the lower section 29 of the valve housing and adapted to bear at its upper end against the inner end of a recess 46 in the valve element 24 to yieldably urge the said element 24 against its tapered seat in plate 27; there being a spring acting correspondingly on each of the valve elements 21, 22 and 23. A packing gland 47 occupies the annular space between the valve stem 31 and the upper section 28 of the valve housing. Ports 51 and 52 are cut through the tapered surface of the valve element 24 at diametrically opposite points thereon and are sufficiently deep so that when the dial handle 32 is in either extreme position (as represented by the placing of the legends "up" and "down" on the upper surface of the valve housing) there is a path established for fluid flow to the associated servo-motor to be actuated and a similar path established for fluid flow from said servo-motor back to the reservoir by way of the single outlet port 61 which serves all four valve units 21, 22, 23 and 24 just as the single inlet conduit 60 serves to feed fluid to all valve units from the pump 13 by way of the channel 63 which extends centrally through the valve hous-

ing to the depth indicated at 64, and has branching therefrom a group of transversely disposed passages 67, 68, 69 and 70, the latter being shown in Fig. 4 as connecting with either the port 52 or the port 51 of the valve element 24, depending upon whether the handle 32 is in the "up" position indicated in Fig. 1, or in the opposite extreme position indicated by the placing of the legend "down" on the upper surface of the valve housing. The passages 67, 68 and 69 have corresponding communication with the corresponding ports 81, 82, 83, 84, 85 and 86 of the valve units 21, 22 and 23, respectively, and there is a corresponding plurality of outlet passages 91, 92, 93 and 94 extending transversely of the valve housing from the units 21, 22, 23 and 24, respectively, for a sufficient distance to establish communication with the vertically extending passages 96, 97, 98 and 99, respectively, the latter passages leading down to the lower section 29 of the valve housing where they register with transversely extending passages (such as that indicated at 101 in Fig. 4) leading to the single outlet port 61 which is also located in said lower section 29 of the valve housing; the fluid passing through said outlet port 61 being delivered back to the reservoir 11 by way of conduit 102 as indicated diagrammatically in Fig. 3.

In addition to the packing glands corresponding to the gland shown at 47 as a sealing means for the valve unit 24, further protection against leakage is provided by the sealing gaskets 105 and 106 interposed between the central section 27 of the valve housing and the upper and lower sections 28 and 29, respectively; the three sections being clamped together by the pressure applied thereto when the assembly screws (such as the one indicated at 108 in Fig. 4) are inserted in the various screw receiving holes, of which two are indicated by the reference characters 109 and 110 in Fig. 3. In addition to the foregoing sealing means, there are sealing gaskets 111 provided between the under surface of each of the valve handles 32, 41, 42 and 43, on the one hand, and the upper surface of the valve housing on the other, and pressure is applied to these individual gaskets 111 by the act of tightening the individual screws 112 by which each valve handle is firmly secured against longitudinal displacement with respect to its associated valve stem.

Referring now to Fig. 5 there is disclosed therein a construction for the valve unit 22, for example, whereby the said valve may act automatically to divert fluid from the associated propeller brake controlling unit 15 (Fig. 3) whenever the moving element of said unit has reached either extreme position. As shown in Fig. 5, this result is made possible by drilling a hole 116 transversely through the valve element 22 at a point somewhat above the upper limits of the direction controlling ports 83 and 84 of said unit, and by changing the contour of the element 22 from conical to cylindrical with different diameters, to allow downward movement of the valve unit under the urge of the increasing pressure of the fluid which develops by reason of the continued operation of the pump 13 after the movable element of the propeller brake actuating unit 15 has reached its extreme position of movement, assuming that all other outlets for fluid from the pump 13 are closed off by reason of the setting of the valve handles 41, 43, and 32 in their respective central, or "off" positions as indicated in Fig. 1; it being understood that when any of the said valve units are in the "off" position, all

flow therethrough is prevented by reason of the blocking off of the diametrically opposed passages in the manner in which the valve element 21 is shown in Fig. 3 as blocking off the diametrically opposed passages 67 and 91, this being the "off" position of the said valve unit. At this point it should be noted that certain types of mechanism to be actuated, such as landing gear, wing flaps and tail wheels of an airplane, may have neutral or central, as well as extreme positions; while other units such as a propeller brake, for example, have no corresponding central position and move only from an extreme position to an opposite extreme position. Thus with such an installation as is indicated, it will frequently happen that the three valve units 21, 23 and 24 will be in the central positions in which all flow therethrough is blocked off while the fourth valve 22, controlling the application of the propeller brake, will be in the position indicated, for example, in Fig. 3 in which there is communication between the inlet passage 68 and the outlet passage 140 leading to the propeller brake applying unit 15 by way of the conduit 141, and also communication back to the reservoir 11 from the opposite side of the unit 15 by way of the conduit 142, return passage 143, the port 83 of the valve 22, and the return passages 92 and 97 leading to the outlet port 61, and thus back to the reservoir by way of conduit 102.

It will be apparent that when the unit 15 is moved to its extreme position corresponding to the setting of the valve 22, as shown in Fig. 3, no more fluid can be accepted by the said unit and accordingly there will be a pressure build-up in the line 141 and in the passage 140 leading thereto, which pressure will be exerted against both the upper and lower faces of the valve port 84; but as the lower face of the valve port is of greater area than the upper face (due to the different diameters of the valve) the tendency of the valve will be to move downward against the yielding opposition of the spring 44. When the pressure build-up has continued for a sufficient period to produce a downward movement sufficient to expose the transverse passage 116, the fluid will then have an opportunity to pass directly through the valve by way of passage 116 and in this manner it will find a return path to the reservoir 11 by way of the return passages 92 and 97 leading to the outlet port 61. Thus the fluid supply will be diverted from the servo-motor 15 and allowed to pass directly back to the source 11 by the automatic action of the valve 22 in response to the build-up of pressure in the line leading thereto.

A clamp 42a (Fig. 1) may be provided to hold the flange 22b of handle 42 against the sealing gasket 211, although permitting rotary movement thereof. Such rotary movement will be communicated to valve 22 by reason of the splined connection with the shank 22a of the valve. This splined connection permits relative axial movement between elements 22 and 22b.

What is claimed is:

1. A valve mechanism including a plate and a plurality of openings extending through said plate to form valve seats, a valve element rotatable in each of said openings, each of said valve elements having outlet means associated therewith and also a handle for rotation thereof, means including a passage extending centrally of said plate to feed fluid directly to any selected one of said valve elements when said selected valve element is rotated to its fluid feeding position, one

of said valve elements having opposing exposed areas of different sizes, and means coacting with said exposed areas to divert fluid flow from said passage, thereby short-circuiting all of said valves, in response to a rise in pressure beyond a certain point.

2. A valve mechanism including a plate and a plurality of openings extending through said plate to form valve seats, a valve element rotatable in each of said openings, each of said valve elements having outlet means associated therewith and also a handle for rotation thereof, and means including a passage extending centrally of said

5 plate to feed fluid directly to any selected one of said valve elements when said selected valve element is rotated to its fluid feeding position, one of said valve elements having opposing exposed areas of different sizes, means coacting with said exposed areas to divert fluid flow from said pas-
10 sage, thereby short-circuiting all of said valves, in response to a rise in pressure beyond a certain point, and means for preventing such diversion prior to a rise in pressure to said predetermined point.

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