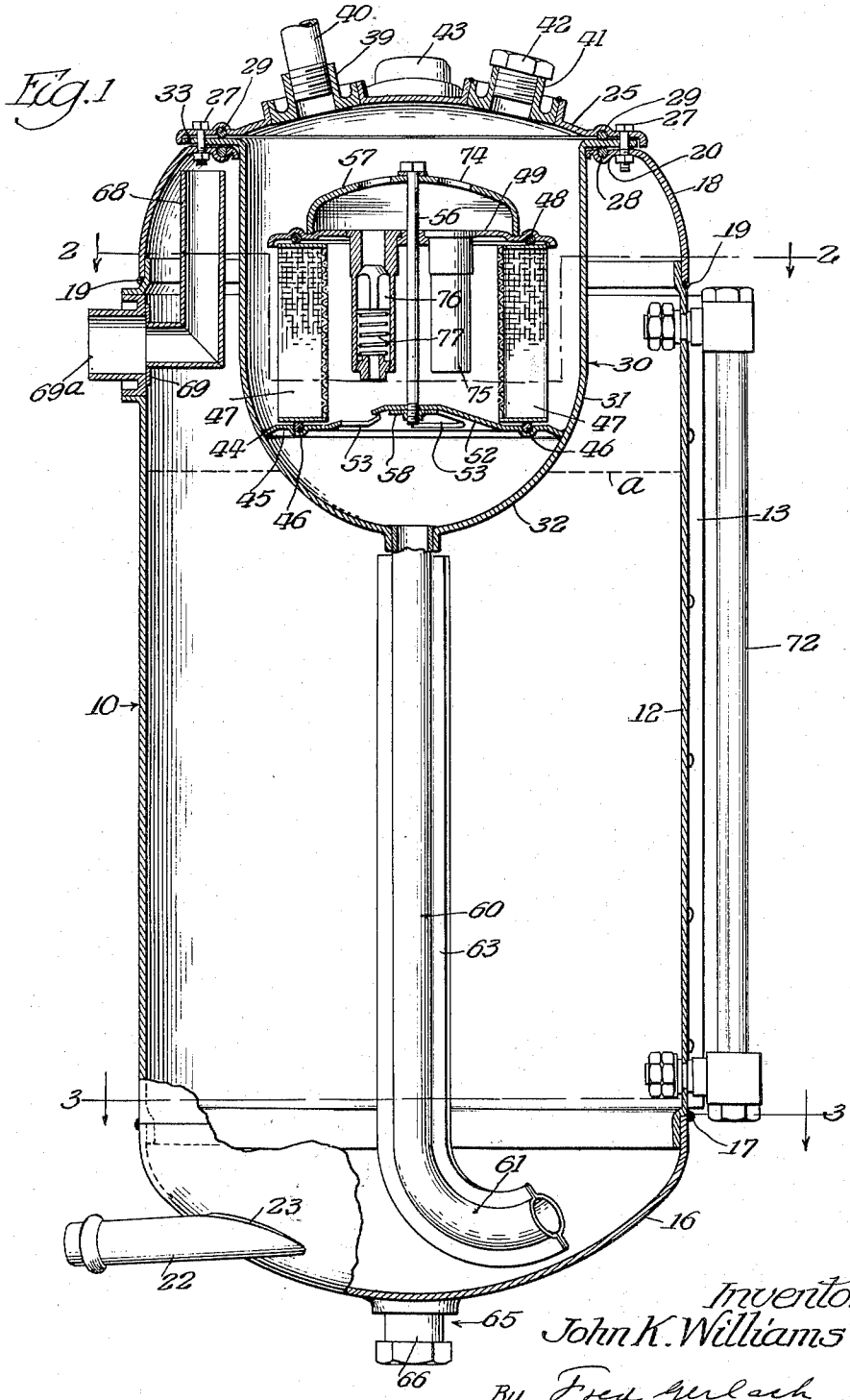
Aug. 1, 1950 J. K. WILLIAMS 2,517,518

HYDRAULIC APPARATUS

Filed May 29, 1945 2 Sheets-Sheet 1

Fig. 1



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Filed May 29, 1945 2 Sheets-Sheet 2

Fig. 2

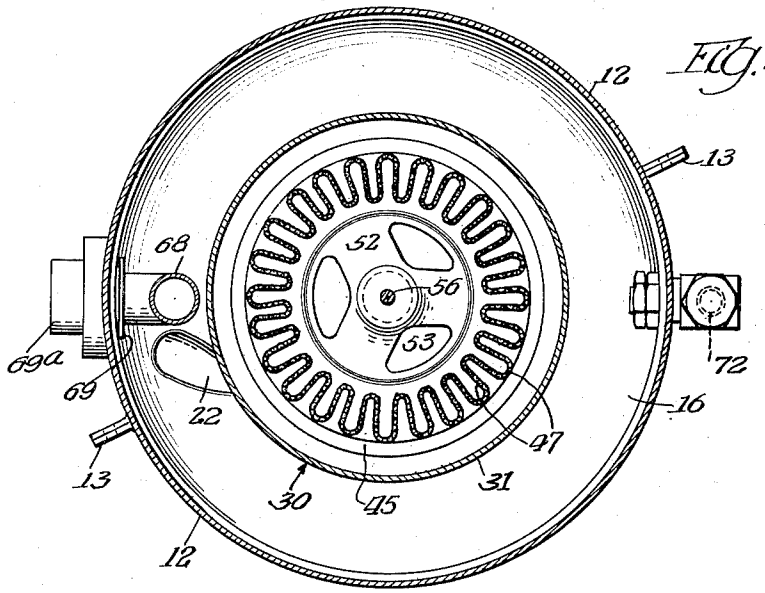
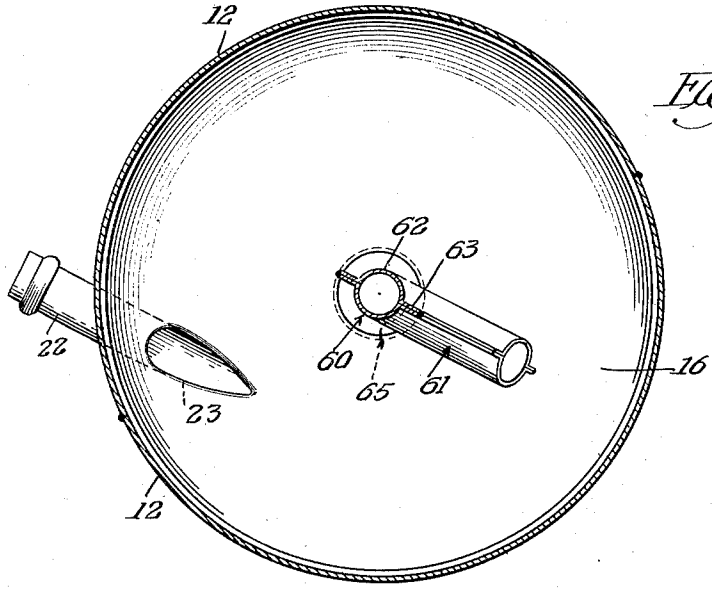


Fig. 3



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2,517,518

HYDRAULIC APPARATUS

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2 Claims. (Cl. 183—2.5)

1

The invention relates to hydraulic systems provided with means for removing air from the fluid.

In hydraulic systems, such as those used in aircraft, it is desirable and advantageous to provide a reservoir for the hydraulic fluid from which fluid is drawn and forced under pressure to the actuating device and to which it is returned from the actuating device with means for de-aerating or eliminating air from the fluid to prevent cavitation in the hydraulic system. In aicraft weight, simplicity and compactness in construction, and adaptability of being easily serviced are desiderata.

One object of the invention is to provide apparatus including a reservoir for the hydraulic fluid and de-aerating means, and which is light in weight, simple and compact in construction.

Another object of the invention is to provide apparatus for this purpose in which the de-aerating means includes a filter which is contained in a separate receptacle in the upper portion of the reservoir and a depending tube for delivering filtered fluid into the lower portion of the reservoir, in such manner that the fluid will be de-aerated before it is drawn into the hydraulic system.

Another object of the invention is to provide improved means for by-passing return fluid around the filter in the event that the return fluid exceeds the capacity of the filter.

Another object of the invention is to provide apparatus of this character which may be constructed, mainly of sheet or plate metal, for lightness in weight.

Another object of the invention is to provide apparatus of this character in which the parts are readily removable for servicing, replacement and repair.

Other objects of the invention will appear from the detailed description.

The invention consists in the several features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

In the drawings:

Fig. 1 is a vertical section of apparatus embodying the invention.

Fig. 2 is a horizontal section taken on line 2—2 of Fig. 1.

Fig. 3 is a horizontal section taken on line 3—3 of Fig. 1.

The invention is exemplified in apparatus which comprises a tank or reservoir, generally designated 10, which is constructed so that it may be formed of suitable sheet or plate metal for lightness in weight. Reservoir 10 comprises a cylindrical body-portion which is formed of semi-circular plates 12 provided with flanges 13 and welded together to form a completely cylindrical body-portion; a concavo-convex bottom 16 lapping the lower ends of plates 12 and welded thereto as at 17; and an upwardly and inwardly curved annular top-member 18 which is welded to the body-portion of the reservoir as at 19 and provided with an inturned horizontal top-flange 20. The reservoir is adapted to retain a column of oil or of hydraulic fluid which is drawn therefrom, usually by a pump, through an outlet-nipple 22 which is welded as at 23 to the concavo-convex bottom 16 and has its axis extending tangentially to the axis of reservoir 10. Preferably, these parts of the reservoir are formed of plate-metal, for lightness in weight. The flanges 13 which project from the cylindrical body-portion 12 of the reservoir 10 are provided with holes for screws whereby the reservoir may be conveniently installed on a permanent support. A fitting 65 for a drain 66 is welded in the central portion of bottom 16.

2

A receptacle, generally designated 30, extends into the upper portion of the receptacle into which the fluid returned from the system is discharged, for passage through a filter from which it is conducted into the column of fluid in the lower portion of the reservoir. Receptacle 30 comprises a cylindrical wall 31, a concavo-convex or approximately hemispherical bottom 32, and an upwardly and initially sloping upper portion with an integral out-turned flange 33 on the upper end which laps the top-flange 20 on the reservoir. This construction of the receptacle 30 makes it possible to form it of sheet or plate metal and light in weight. The receptacle forms a removable closure for the top of the reservoir. The cylindrical side wall 31 of receptacle 30 is spaced from the surrounding wall of the reservoir so that the annular space between may be utilized for the air separated from the hydraulic fluid in the lower portion of the reservoir. This provides for compactness in construction and lightness in weight.

A concavo-convex cover-plate 25 is provided for the upper end of, and forms a detachable closure for the top of, the receptacle. The rim of cover-plate 25 extends over the annular flange 33 on receptacle 30, a packing-ring or elastic gasket 28 is interposed between flange 33 on receptacle 30 and top flange 20 on the reservoir. A packing-ring or elastic gasket 29 is also interposed between flange 33 on receptacle 30 and the rim of cover-plate 25. Preferably, these packing-rings are circular in cross-section and con-

fined in annular grooves formed in bends in the flanges between which they are confined and form seals between reservoir 10 and receptacle 30 and between receptacle 30 and cover-plate 25, respectively. Bolts 27 extend through holes in the cover-plate 25, flanges 20 and 33, and detachably secure cover-plate 25, receptacle 30 and reservoir 10 in assembled relation. Upon removal of the bolts 27 the cover-plate 25 may be removed for access to the chamber in receptacle 30 and the receptacle may be removed from the reservoir for access to the latter.

A suitable fitting 39 is welded in an out-turned flange formed on cover-plate 25 and connected to a pipe 40 for the fluid returned from the hydraulically actuated device. A similar fitting 43 may be similarly welded in the cover-plate 25 for by-passing excess fluid from the pump which draws fluid from the reservoir and forces it to the hydraulically actuated device, into receptacle 30. A filler-plug 41 is screwed into a fitting 42 which is welded in the cover-plate 25.

A plate 45 extends across and is fixed and welded as at 44 in the lower portion 32 of receptacle 30 and divides the space within the receptacle 30 into upper and lower chambers. The central portion 52 of plate 45 is upwardly convergent and provided with openings 53 through which the hydraulic fluid from the filter flows into the lower chamber between plate 45 and the concavo-convex bottom of receptacle 30.

An annular filter-element 47 is disposed in the upper chamber in receptacle 30 for the hydraulic fluid returned to said chamber and through which the fluid passes to the central space within the filter which communicates with the openings 53 in central-portion 52 of plate 45 so that the fluid which has passed through the filter will flow into the lower chamber in receptacle 30. The filter element 47 may be of any suitable construction to form larger bubbles in the fluid passing through the filter so that when the fluid is discharged into the column of fluid in the lower portion of the reservoir, the bubbles will be released and separated from the fluid. The filter-element 47 has an annular end which is seated on an elastic gasket 46 which is confined in an annular groove in plate 45. A top plate 49 extends over the upper end of the filter-element 47 and an elastic gasket 48 is confined in an annular groove in said plate and engages the upper end of the filter-element 47. Plate 49 forms a closure for the upper end of the filter-element 47 so that the fluid will pass from the chamber in receptacle 30 around said element through the filter to the central chamber therein from which it will flow through the openings 53 in plate 45 into the lower chamber of receptacle 30. A dome-like plate 57 overlies the top-plate 49. A bolt 56 extends through dome-plate 57, plate 49, and is screw-threaded to a collar 58 which is welded to the central portion of the bottom face of plate 49 and is adapted to clamp the filter-element 47 between plates 45 and 49. Upon withdrawal of bolt 56 from plate 45, dome 57, plate 49 and filter-element 47 may be removed from receptacle 30 for servicing, replacement or repair. This construction provides means for readily removing from, and reassembling these parts in, the receptacle 30.

The fluid which passes through the filter-element 47 into the space in the center thereof is conducted through openings 53 in fixed plate 45 into the chamber below said plate and is conducted by the concavo-convex bottom 32 of receptacle 30 to a tube 60 which depends from the center of said bottom, and extends into the column of fluid maintained in the lower portion of reservoir 10. Tube 60 is provided at its lower end with a curved terminal 61 which extends radially outward and upwardly. The fluid is directed away from the discharge connection 22 through which fluid is drawn from the reservoir. Tube 60, for lightness in weight and stiffness, is preferably formed of plates 62 which are semi-circular in cross-section and provided with abutting flanges 63 which are welded together. The bubbles formed in the hydraulic fluid as a result of the fluid flowing through filter 47, expand by reason of the reduced pressure of the fluid in the reservoir and will pass upwardly to the top of the fluid column, which may be at the level indicated at *a*, where they are released into the space above the liquid column in the reservoir. The fluid returned from the actuating device to the receptacle 30 is usually under pressure so that there will be a drop of pressure in the reservoir. By providing a tube 60 depending from receptacle 30 and discharging the fluid radially outward and upwardly in the concavo-convex lower portion of the receptacle and away from the outlet connection 22, the separation of the air from the liquid is accelerated.

A vent-pipe 68 is provided in the upper portion of the reservoir for the escape of air separated from the hydraulic fluid. This pipe, for lightness of weight, is formed of tubular, horizontal and vertical sections which are welded together with a flange 69 on the horizontal section which is welded to a fitting 69a which is welded in a flange on one of the semi-cylindrical portions 12 of the reservoir 10. This vent-pipe 68 permits escape of air from and reduces the pressure of the fluid in the reservoir. Dome-plate 57 is provided with openings 74 through which fluid can pass from the upper portion of receptacle 30 into the space between said dome-plate and plate 49. A pair of relief valves are provided for by-passing fluid from the upper portion of the receptacle 30 into the space within the filter-element 47, in the event that the surge of fluid returned from the actuated device exceeds the capacity of the filter. Each of these comprises a cylindrical casing 75 welded in and depending from plate 49, an upwardly closing valve-member 76, and a spring 77 urging valve-member 76 to its closed position and loading it so it will remain closed until the surge of fluid becomes excessive.

A sight-glass 72 is communicatively connected to the reservoir for observing the heighth of the column of fluid therein.

The operation of the apparatus will be as follows: return fluid from the hydraulically actuated device will be delivered under pressure into the upper end of the receptacle 30 from which it will flow through the filter-element 47 which will cause the vesicles of air to form bubbles in the fluid. From the chamber inside the filter-element 47, the fluid will flow onto plate 45 and through openings 53 into the chamber in the lower portion of receptacle 30 and thence downwardly through tube 60 and be discharged into the column of fluid in reservior 10. The curved terminal 61 directs the fluid radially outward from the center of the reservoir and away from the outlet connection 22 and also upwardly. The bubbles in the fluid discharged from tube 60 flow upwardly through the column of fluid, and expand by reason of the reduced pressure in the reservoir. When the bubbles reach the surface of the col-

umn of fluid they join the air in the upper portion of the reservoir and are carried off through vent-pipe 68. The fluid drawn through nipple 22 is taken from a portion of the column of fluid which is remote from the bubbles discharged from the tube 60. In the event that the surge of the fluid delivered into the upper portion of 36 in receptacle 30 exceeds the capacity of the filter-element 47, the fluid will open one or both of the valve-members 76 and by-pass the excess into the chamber inside the filter-element 47 so it will flow through openings 74 in dome-plate 57 in plate 45 and tube 60 into the column of fluid in reservoir 10.

The construction described is adapted to be fabricated of metal sheets or plates so that it will be relatively light in weight for advantageous use in aircraft. The receptacle 30 containing the filter to which the discharge pipe is connected may be readily removed from the reservoir upon removal of cover-plate 25. The filter-element 47 may be readily removed from the receptacle for servicing upon removal of bolt 56 which clamps it between plates 49 and 45. The depending tube 60 for conducting the filtered fluid into the lower portion of the column of fluid in the reservoir with its lower terminal adapted to direct the fluid away from the outlet duct and upwardly through the column of fluid accelerates the release of the entrained air to the upper portion of the reservoir and the vent-pipe 68. Flanges 13 on plates 12 forming the cylindrical portion of the reservoir provide simple means for supporting the reservoir in airplanes. The tube 60 delivers fluid from the filter into the column in the reservoir without substantial decrease in the capacity of the reservoir and the embodiment of the receptacle for the filter within the upper portion of the reservoir contribute to compactness in the apparatus. The apparatus can be fabricated mainly of sheet or plate metal for saving of weight. The relief valves provide for by-passing the fluid delivered into the filter receptacle to the reservoir when the fluid is in excess of capacity of the filter.

The invention is not to be understood as limited to the details described, since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. Combined apparatus for filtering and deaerating hydraulic fluid for actuating a hydraulically operable device, comprising: a cylindrical tank for retaining a column of fluid, having a top opening and a cancavo-convex bottom; a receptacle separably supported on and forming a closure for the top opening of the tank and having a cylindrical wall of lesser diameter than and depending into the tank to provide an annular air space in the upper portion of the tank around the receptacle; a cover separable from and forming a closure for the top opening of the receptacle; a filter completely contained in the receptacle and removable therewith from the tank; an inlet connection in the cover for delivering fluid to the filter in the receptacle; a pipe removable with and depending from the bottom of, the receptacle and having a curved lower end for tangentially delivering fluid from the bottom of the receptacle over the concave bottom of the tank, an outlet connection for the filtered fluid from the lower portion of the tank; and a vent for air in the annular space between the upper portion of the tank and the receptacle.

2. Combined apparatus for filtering and deaerating hydraulic fluid used for actuating a hydraulically operable device, comprising: a cylindrical tank for retaining a column of fluid having an upwardly and inwardly sloping upper end portion provided with an integral, inturned flange and a top opening; a receptacle forming a closure for the top opening of the tank having a cylindrical wall of lesser diameter than and depending into the tank to provide an annular air space in the upper portion of the tank around the receptacle and provided with a top flange separably supported on the inturned flange of the tank, and having a concavo-convex bottom; a cover having its rim extending over and separably supported on the outturned flange on the receptacle, means demountably securing together the cover, the flange on the receptacle, and the flange on the tank; a filter completely contained in the receptacle and removable therewith from the tank; an inlet connection in the cover for delivering fluid to the filter in the receptacle; a pipe removable with and depending from the bottom of the receptacle and having a lower, curved end for tangentially delivering fluid from the concave bottom of the receptacle over the concave bottom of the tank; an outlet connection for the filtered fluid from the lower portion of the tank; and a vent for air in the upper portion of the annular space between the tank and the receptacle.

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