

20

1 519 286

PATENT SPECIFICATION

(11) 1 519 286

- (21) Application No. 12456/77 (22) Filed 24 March 1977
(31) Convention Application No. 719 005
(32) Filed 30 Aug. 1976 in
(33) United States of America (US)
(44) Complete Specification published 26 July 1978
(51) INT CL² B01D 27/08//27/10
(52) Index at acceptance
B1D 154 164 182 221 223 232 234 242 246 323 331 334 338
604 624 639 691 694 712 713 751 752 753 754 761
(72) Inventor JOHN BOYD WAGGONER



(54) FILTER ARRANGEMENT WITH BAFFLES

(71) We, CATERPILLAR TRACTOR CO., a corporation organized and existing under the laws of the State of California, United States of America, of 100 N.E. Adams Street, Peoria, State of Illinois 61629, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—
This invention is concerned with hydraulic reservoirs having improved internal filter means.
Existing hydraulic reservoirs with filter means usually have filter elements which are of the spin on or screw on type and are attached externally to the reservoir and are connected to a hydraulic system which contains a hydraulic fluid. Generally, flow of the hydraulic fluid takes place through the filter element and then from the filter element into the reservoir. A typical prior art external filter element of this nature is disclosed for example in U.S. Patent No. 3,685,658. Some prior art filter assemblies of this nature are provided for by-pass flow which takes over in case of clogging of the filter element. U.S. Patent No. 3,374,892 for example discloses such an arrangement. Some filter elements are also provided within hydraulic reservoirs such as those disclosed in for example U.S. Patents Nos. 3,886,072 and 3,900,400 but these are of considerably different structure, operation and mounting than are the structures of the present invention.
It can be very desirable to place filter means for a hydraulic system within a hydraulic reservoir of the system so as to obtain more resistance to flow and protection of the filter elements from damage from external sources. However, with such an internal filter means it has been found that it is necessary to ensure that excessive foaming of the hydraulic fluid

does not occur as the fluid leaves the filter means and is introduced into the interior of the hydraulic reservoir.
The aim of the present invention is to provide a hydraulic reservoir with an internal filter means wherein such foaming is avoided and, further, in a preferred embodiment of the invention bypass valve means are provided whereby hydraulic fluid is introduced to the reservoir generally via the filter means even when the filter elements themselves are partially or completely clogged, the bypass valve being arranged to direct the hydraulic fluid which bypasses the clogged filter elements into the reservoir in such a manner that foaming still does not occur within the reservoir.
According to this invention we provide a hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter elements means extending between the first and second sides of the tank and means adjacent the first side of the tank for introducing hydraulic fluid from outside the tank to the interior of the filter element means, wherein a tube surrounds the filter element means within the tank and extends substantially along the length of the filter element means, the tube including exit means through which the hydraulic fluid passes after passage from the interior to the exterior of the filter element means, a first end of the tube being sealed to the second side of the tank and a second end of the tube being sealed to the first side of the tank, and baffle means is provided in the tank to receive substantially all the hydraulic fluid which leaves the tube through the exit means, the baffle means conducting the hydraulic fluid to an outlet below the designed lower fluid level limit of the tank.
An example, together with a modification, of a hydraulic reservoir in

21

accordance with the invention are illustrated in the accompanying drawings, in which:—

5 Figure 1 is a sectional partial side view of the hydraulic reservoir;

Figure 2 is a view taken along the line II—II of Figure 1;

Figure 3 is a view taken along the line III—III of Figure 1;

10 Figure 4 is a side elevation of the reservoir to a somewhat smaller scale;

Figure 5 is a view taken along the line V—V of Figure 4;

15 Figure 6 is a section through bypass valve means forming part of the reservoir shown in Figures 1 to 5; and,

Figure 7 is a section similar to Figure 6, but of alternative bypass valve means.

20 Turning first to Figure 1 there is illustrated therein a hydraulic reservoir 10 which comprises a tank 12 having internally thereof filter means 14 attached longitudinally between a first side 16 and a second generally parallel side 18 of the tank 12. The filter means 14 includes generally tubular filter element means 20 which in the particular embodiment illustrated comprises four filter elements 22 which are shown most clearly in Figures 1 and 2. Hydraulic fluid introducing means 24 shown most clearly in Figures 1 and 3 provide means for introducing a hydraulic fluid from an exterior of the tank, generally from a hydraulic system 26 as illustrated schematically in Figure 3 to an interior 28 of the filter element 20 from adjacent the first side 16 of the tank 12.

40 The invention is particularly concerned with a tube within the tank 12 which surrounds the filter element means 20 and extends longitudinally generally the length of said filter element means 20. The tube 30 includes exit means 32 therefrom generally from the bottom thereof through which the hydraulic fluid passes after passage of the hydraulic fluid from the interior 28 of the filter element means 20 to an exterior 34 of the filter element means 20. More particularly the exit means 32 leads from a chamber 36 formed between the filter element means 20 and the tube generally to the inside of the hydraulic reservoir 10. The exit means 32 generally forms the exclusive exit from the tube 30.

55 The tube 30 is compressibly sealed by compressible sealing means 38 in such a manner that a first end 40 of the tube 30 is held adjacent the second side 18 of the tank 12. The compressible sealing means of the present invention preferably comprises a flange 42 which extends peripherally outwardly from the tube 30 adjacent the first end 40 thereof and a compressible elastomeric gasket 44 which is compressed

65 between the flange 42 and the second side 18 of the tank 12.

The reservoir includes rigid attaching means 46 for rigidly attaching a second end 48 of the tube 30 adjacent the first side 16 of the tank 12. Holding means 50 for the filter element means 20 also preferably form a part of the improvement of the present invention. The holding means can simply comprise a recess 52, in which the ends of the filter elements fit, in a port closure means 54 which covers a port 56 in the first side 16 of the tank 12. Two of the four filter elements 22, one of which is shown in Figure 1, are thus rigidly held by the recess 52.

70 An opening 58 through the second side 18 of the tank 12 provides access to an interior 60 of the tube 30 adjacent the first end 40 thereof. The opening 58 is sized to allow entry of the filter element means 20 and more particularly of the four filter elements 22 to the interior 60 of the tube 30. Cover means 62 is provided which is sealingly attachable, as for example by using a seal ring 64, over the opening 58. The cover means 62 is attachable longitudinally through the tube 30 to adjacent the first side 16 of the tank 12 and more specifically is attachable to the port closure means 54 as by being screwed into the port closure means 54 via an elongated bolt means 66. The bolt means 66 pass through the cover means 62 and are sealed thereto by a seal ring 67.

85 Compressible positioning means 68, in the embodiment illustrated a plurality of axially compressible resilient washers 70 which bear against a retaining washer 72, serve to compressibly hold the filter element means 20 between the first side 16 and the second side 18 of the tank 12. A retaining ring 74 generally serves to hold the plurality of resilient washers 70 and the retaining washer 72 from escaping from an extension 76 which extends from the cover 62 towards the first side 16 of the tank 12.

100 The tank 12 of the preferred embodiment includes means for disassembling it into a first part 78 which includes the first side 16 as part thereof and a second part 80 which includes the second side 18 of the tank 12 as a part thereof. The disassembling means for the tank generally includes the pair of flanges 82 and 84 extending respectively from the first part 78 and the second part 80 of the tank 12 and a plurality of bolt-nut means 86 fastening the first flange 82 to the second flange 84. Because of this disassembleability of the tank 12, the tube 30 can be readily placed therewithin and the port closure means 54 can be attached from the interior of the tank 12 when the first part 78 thereof is separated from the second part 80 thereof. After the tube 30 has been at-

22

5 tached to the first part 78 and more particularly to the first side 16 of the tank 12, the gasket 44 can be put in place adjacent the flange 42 and the bolt-nut means 86 can be fastened in place. The filter element means 20 can be put in place either when the tank 12 is disassembled into the first part 78 and the second part 80 thereof or can be put in place through the opening 58 before or after removal of the cover 62.

10 Referring now most particularly to Figures 4 and 5 there is illustrated therein baffle means 90 which extends generally downwardly from the exit means 32 of the tube 30. Further, the exit means 32 of the tube 30 forms the exclusive exit therefrom. The baffle means 90 which in the embodiment illustrated comprises a hollow flattened tubular member 92 serves to conduct fluid from the exit means 32 of the tube 30 to below a normal liquid level located beneath the tube 30 and generally falling between a fill level 94 and a full level 96 indicated on a sight gauge 97. The baffle means 90 includes egress means 98, generally a plurality of holes 100, which egress means 98 is below said normal fluid level. Thus, the egress means 98 or more particularly the plurality of holes 100 is normally below the fill level 94 within the tank 12. Generally, the holes 100 are placed in the sides 102 of the flattened tubular member 92 whereby fluid leaves the plurality of holes 100 generally perpendicularly to it's direction of flow within the flattened tubular member 92 thus leading generally to a smooth and even introduction of hydraulic fluid into the interior of the tank 12.

40 Because of the spaced arrangement of the filter arrangement of the filter element means 20 from the interior 60 of the tube 30 the chamber 36 is defined therebetween. This chamber 36 serves a very important function in providing fluid flow into the hydraulic reservoir 10 even when the filter element means 20 are obstructed as by being filled with dirt or the like. In particular, bypass valve means 104 seen most clearly in 50 Figures 1 and 6 and shown in an alternate embodiment in Figure 7 is provided in flow communication with the hydraulic system 26 from which hydraulic fluid is introduced via the hydraulic fluid introducing means 24 to the interior 28 of the filter element means 20. A pressure sensed by the bypass valve means 104 as via a passage 106 which applies pressure to a top 108 of a spool 110 leads to the spool 110 being forced downwardly whereby fluid flow can occur about an annulus 112 and thence via a bore 114 and a passage 115 to the chamber 36. The fluid from the chamber 36 then flows in the same manner as it would have flowed through the filter element means 20. In other words, the 65

fluid from the chamber 36 then flows into the baffle means 90 and is released via the egress means 98 below the normal liquid level and generally below the fill level 94 of the tank 12.

In the alternate embodiment of the bypass valve means 104 as illustrated in Figure 7 a pressure is still applied in the same manner via the passage 106 to the top 108 of the spool 110. In this embodiment, however, the fluid flows into a well 116 in the spool 110 and flows from the well 116 via a plurality of passages 118 and thence to the annulus 112. In this arrangement, the flow through the bypass valve means 104 is modulated by the plurality of passages 118.

It is clear that in both embodiments of the bypass valve means 104 of the present invention the pressure sensed by the bypass valve means 104, i.e., the pressure in the passage 106, is proportional to a pressure of hydraulic fluid at the interior 28 of the filter element means 20. Thus, as the pressure within the interior 28 of the filter element means 20 builds up due to clogging of the filter element means 20 as it becomes dirty with particulate matter brought to it from the hydraulic system 26, the pressure at the top 108 of the spool 110 will become sufficient to overcome biasing means, generally spring means such as a spring 120 which biases the bypass valve means 104 into a closed position. The pressure value within the interior 28 of the filter element means 20 which is sufficient to move the spool 110 of the bypass valve means 104 is thus a value determined by the strength of the spring 120 or other biasing means used in place thereof. The compressible positioning means 68 acts in concert with the bypass valve means 104 by assuring that fluid in the interior 28 of the filter element means 20 has no other escape route to the interior of the tank 12.

The hydraulic reservoir described with reference to the drawings is also described and illustrated in our co-pending Applications Nos. 12457/77 and 12458/77 (Serial Nos. 1519287 and 1519288), in which respectively we claim:—

A hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter element means extending between the first and second sides of the tank, and the reservoir further comprising means for introducing a hydraulic fluid from outside the tank to the interior of the filter element means from adjacent the first side of the tank, wherein a tube surrounds the filter element means within the tank and extends along substantially the length of the filter element means, the tube including exit

70

75

80

85

90

95

100

105

110

115

120

125

130

28

means therefrom to the tank through which, in use, hydraulic fluid passes after passage from the interior to the exterior of the element means, and means resiliently compressibly sealing a first end of the tube adjacent the second side of the tank; and,

A hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter element means extending between the first and second sides of the tank, and the reservoir further comprising means for introducing a hydraulic fluid from outside the tank to the interior of the filter element means from adjacent the first side of the tank, wherein a tube surrounds the filter element means within the tank and extends substantially along the length of the filter element means, the tube including: exit means therefrom through which, in use, the hydraulic fluid passes to the tank after passage from the interior to the exterior of the filter element means, a first end of the tube being in sealing relationship with the second side of the tank and the second end of the tube being in sealing relationship with the first side of the tank, the second side of the tank has an opening leading to the interior of the tube adjacent the first end thereof, the opening being sized to allow insertion of the filter element means into the interior of the tube, removable cover means is sealingly mounted over the opening and is connected by means extending through the tube to the first side of the tank, extension means extends from the cover means towards the first side of the tank within the tube, compressible spring means is supported by the extension means and presses the filter element means towards the first side of the tank, and means is provided for preventing the spring means from sliding off the extension means.

WHAT WE CLAIM IS:—

1. A hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter element means extending between the first and second sides of the tank and means adjacent the first side of the tank for introducing hydraulic fluid from outside the tank to the interior of the filter element means, wherein a tube surrounds the filter element means within the tank and extends substantially along the length of the filter element means, the tube including exit means through which the hydraulic fluid passes after passage from the interior to the

exterior of the filter element means, a first end of the tube being sealed to the second side of the tank and a second end of the tube being sealed to the first side of the tank, and baffle means is provided in the tank to receive substantially all the hydraulic fluid which leaves the tube through the exit means, the baffle means conducting the hydraulic fluid to an outlet below the designed lower fluid level limit of the tank.

2. A reservoir according to claim 1, in which the filter element means are located above the designed lower fluid level limit of the tank and the baffle means conducts the hydraulic fluid downwardly in the tank.

3. A reservoir according to claim 2, wherein the tube is spaced from the filter element means to form a chamber between the element and the tube and further comprising bypass valve means arranged to communicate with a hydraulic system from which hydraulic fluid is introduced via the hydraulic fluid introducing means to an interior of the filter element means whereby fluid pressure acting on the bypass valve means is dependent upon the hydraulic fluid pressure in the interior of the filter element means, said bypass valve means including biasing means biasing it into a closed position until the pressure within the filter element means reaches a value determined by the strength of the biasing means, said bypass valve means opening to allow the hydraulic fluid to flow therethrough when the pressure within the filter element means exceeds the determined value, and a passage arranged to conduct the hydraulic fluid from the bypass valve means when open, to the chamber.

4. A reservoir according to claim 3, wherein the first side of the tank includes a port therethrough in alignment with the second end of the tube and including closure means sealingly fixed over the port, and wherein the bypass valve means is incorporated in the port closure means.

5. A reservoir according to claim 4, wherein the bypass valve means includes hydraulic fluid flow modulating means.

6. A reservoir according to claim 5, wherein the tank has an opening through the second side thereof leading to the interior of the tube adjacent the first end thereof, the opening being sized to allow insertion of the filter element means into the tube and including cover means sealingly mounted over the opening and connected longitudinally through the tube to the first side of the tank, extension means extending from the cover means towards the first side of the tank within the tube, and compressible means supported by the extension means and pressing the filter element means towards



23
4
means therefrom to the tank through which, in use, hydraulic fluid passes after passage from the interior to the exterior of the element means, and means resiliently compressibly sealing a first end of the tube adjacent the second side of the tank; and,

5 A hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter element means extending between the first and second sides of the tank, and the reservoir further comprising means for
10 introducing a hydraulic fluid from outside the tank to the interior of the filter element means from adjacent the first side of the tank, wherein a tube surrounds the filter element means within the tank and extends substantially along the length of the filter
15 element means, the tube including exit means therefrom through which, in use, the hydraulic fluid passes to the tank after passage from the interior to the exterior of the filter element means, a first end of the tube being in sealing relationship with the second side of the tank and the second end
20 of the tube being in sealing relationship with the first side of the tank, the second side of the tank has an opening leading to the interior of the tube adjacent the first end thereof, the opening being sized to allow insertion of the filter element means into the interior of the tube, removable cover means
25 is sealingly mounted over the opening and is connected by means extending through the tube to the first side of the tank, extension means extends from the cover means towards the first side of the tank within the tube, compressible spring means is supported by the extension means and presses the filter element means towards the first side of the tank, and means is provided for preventing the spring means from sliding off the extension means.
30
35
40
45

WHAT WE CLAIM IS:—

1. A hydraulic reservoir which comprises a tank having within it filter means which extends and is mounted between first and second generally parallel sides of the tank, the filter means including generally tubular filter element means extending between the first and second sides of the tank and means adjacent the first side of the tank for introducing hydraulic fluid from outside the tank to the interior of the filter element means, wherein a tube surrounds the filter element means within the tank and extends substantially along the length of the filter
50 element means, the tube including exit means through which the hydraulic fluid passes after passage from the interior to the
55
60

exterior of the filter element means, a first end of the tube being sealed to the second side of the tank and a second end of the tube being sealed to the first side of the tank, and baffle means is provided in the tank to receive substantially all the hydraulic fluid which leaves the tube through the exit means, the baffle means conducting the hydraulic fluid to an outlet below the designed lower fluid level limit of the tank.

2. A reservoir according to claim 1, in which the filter element means are located above the designed lower fluid level limit of the tank and the baffle means conducts the hydraulic fluid downwardly in the tank.

3. A reservoir according to claim 2, wherein the tube is spaced from the filter element means to form a chamber between the element and the tube and further comprising bypass valve means arranged to communicate with a hydraulic system from which hydraulic fluid is introduced via the hydraulic fluid introducing means to an interior of the filter element means whereby fluid pressure acting on the bypass valve means is dependent upon the hydraulic fluid pressure in the interior of the filter element means, said bypass valve means including biasing means biasing it into a closed position until the pressure within the filter element means reaches a value determined by the strength of the biasing means, said bypass valve means opening to allow the hydraulic fluid to flow therethrough when the pressure within the filter element means exceeds the determined value, and a passage arranged to conduct the hydraulic fluid from the bypass valve means when open, to the chamber.

4. A reservoir according to claim 3, wherein the first side of the tank includes a port therethrough in alignment with the second end of the tube and including closure means sealingly fixed over the port, and wherein the bypass valve means is incorporated in the port closure means.

5. A reservoir according to claim 4, wherein the bypass valve means includes hydraulic fluid flow modulating means.

6. A reservoir according to claim 5, wherein the tank has an opening through the second side thereof leading to the interior of the tube adjacent the first end thereof, the opening being sized to allow insertion of the filter element means into the tube and including cover means sealingly mounted over the opening and connected longitudinally through the tube to the first side of the tank, extension means extending from the cover means towards the first side of the tank within the tube, and compressible means supported by the extension means and pressing the filter element means towards
125

24

5

1,519,286

5

the first side of said tank.

7. A reservoir according to claim 1, substantially as described with reference to Figures 1 to 5, and Figure 6 or Figure 7 of the accompanying drawings.

For the Applicants:—
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
53/64 Chancery Lane,
London, WC2A 1HN.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.

