

Oct. 6, 1942.

B. G. CARLSON
HYDRAULIC DRIVEN AIR PUMP

2,298,106

Filed April 27, 1942

2 Sheets-Sheet 1

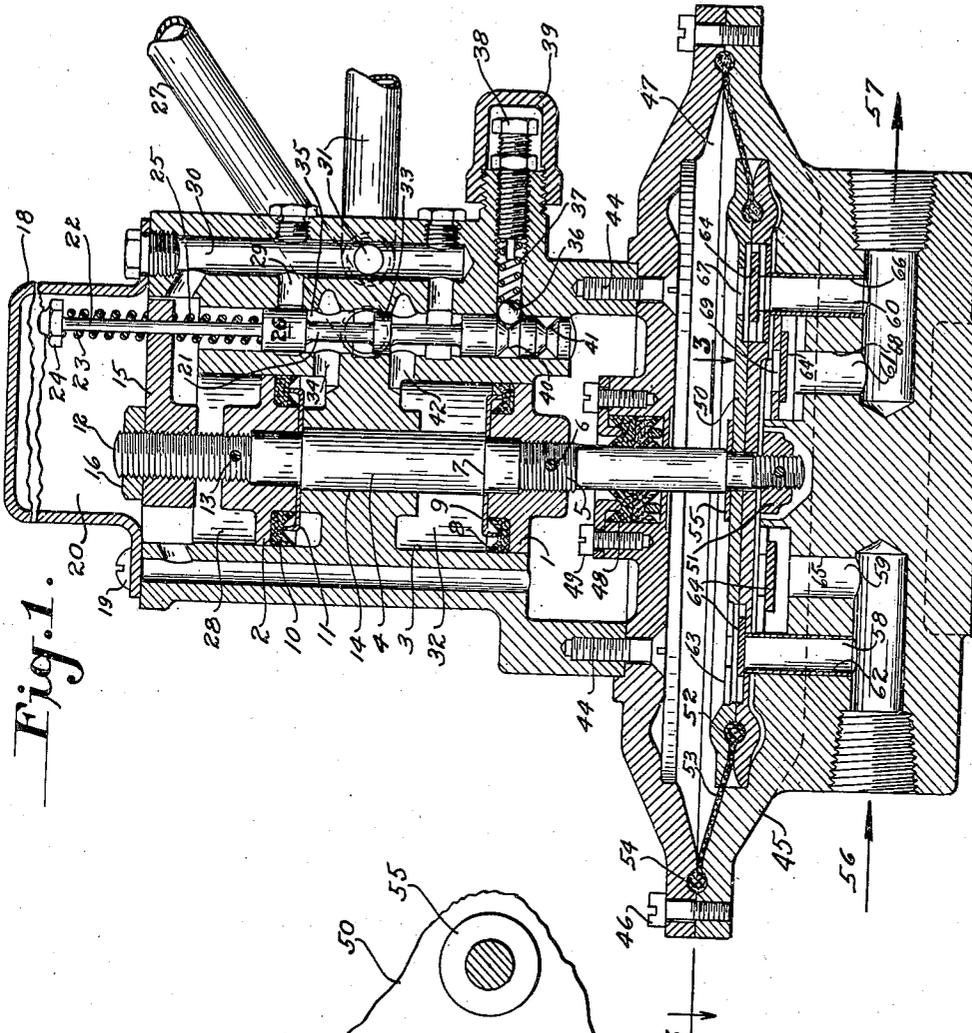


Fig. 1.

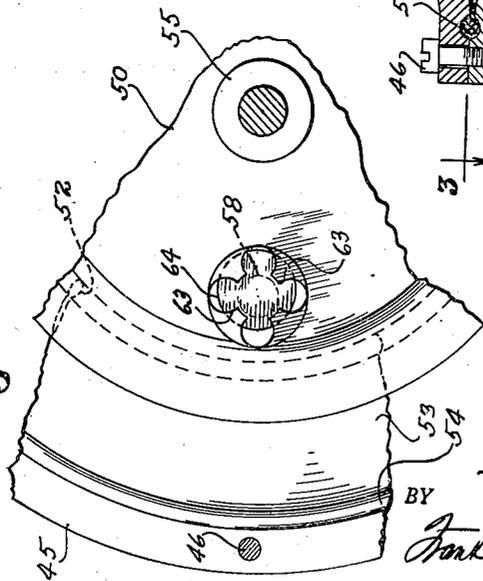


Fig. 3.

INVENTOR.
BERT G. CARLSON.

BY
Frank H. Harmon
ATTORNEY.

Oct. 6, 1942.

B. G. CARLSON
HYDRAULIC DRIVEN AIR PUMP

2,298,106

Filed April 27, 1942

2 Sheets-Sheet 2

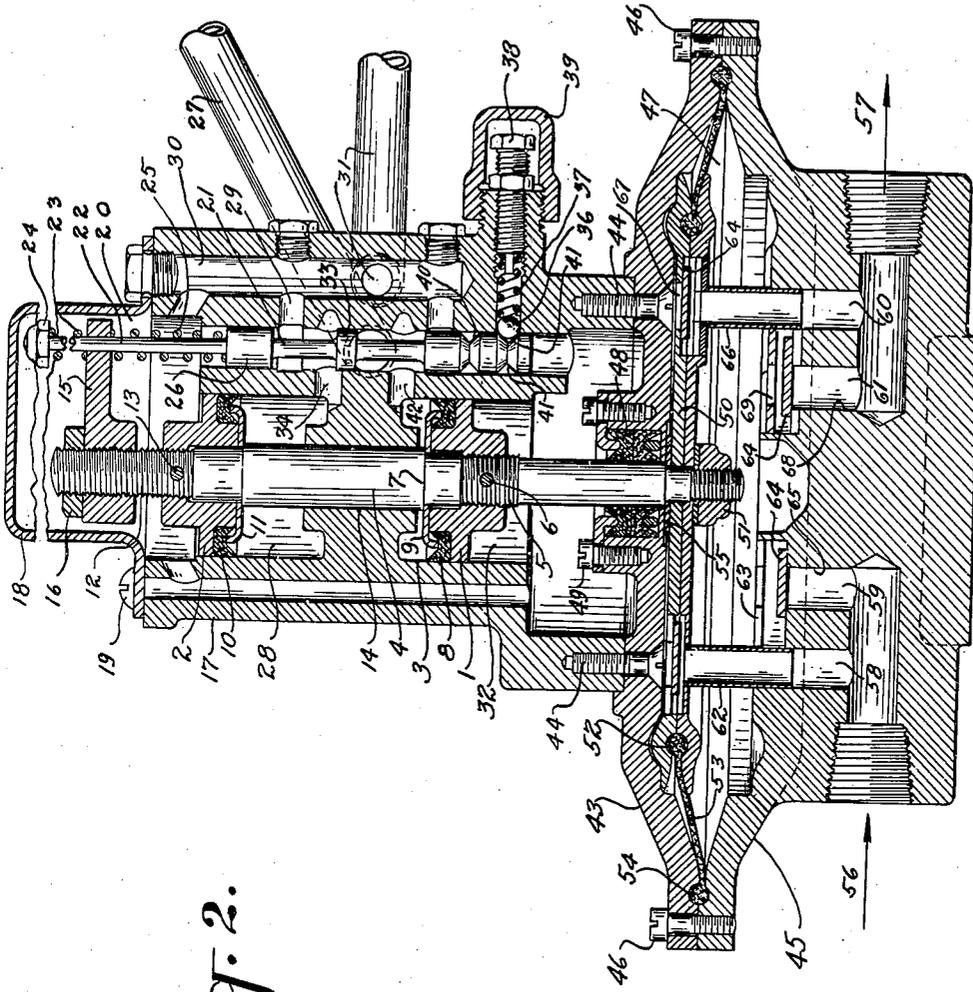


Fig. 2.

INVENTOR.
BERT G. CARLSON.

BY

Frank H. Harmon
ATTORNEY.

UNITED STATES PATENT OFFICE

2,298,106

HYDRAULIC DRIVEN AIR PUMP

Bert G. Carlson, Erieside, Ohio, assignor to Jack & Heintz, Inc., Cleveland, Ohio

Application April 27, 1942, Serial No. 440,655

2 Claims. (Cl. 230—171)

This invention relates in general to hydraulic motors and more particularly to a new and novel hydraulic motor and air pump for pumping air under pressure.

Although the principles involved in the invention about to be described and its field of application and utility are wide in range, the particular problem at hand which suggests it is that of providing a suitable air pump for placing air under pressure and making it available for use as a power means for driving a spinning gyro, such as is found for instance in an automatic pilot.

It is a primary object to provide such a pump and more particularly a new and novel hydraulic motor and air pump that will preferably be a self-contained and closed system and which may utilize the lubrication oil of the aircraft engine under pressure as the force for driving the hydraulic pump.

It is a further object to provide a new and novel air pump which will constitute a complementary part of a compact pump unit but which will be readily removable and replaceable with respect to the hydraulic part of the assembly.

With the foregoing and other objects in view, the invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments thereof being illustrated in the accompanying drawings in which:

Figure 1 is a view in vertical section taken through the motor assembly showing the hydraulic pump and air pump and the operative connection therebetween and showing the motor assembly at the completion of its down stroke;

Figure 2 is a view similar to Figure 1, showing the pump assembly at the completion of the up stroke; and

Figure 3 is a view in section taken on the line 3—3 of Figure 1.

Referring more particularly to the drawings, the hydraulic motor generally comprises two opposed pistons 1 and 2 slidable vertically, as shown in Figures 1 and 2, in a cylinder 3 and carried by a piston rod 4. The lower piston 1 is screw threadedly connected to the piston rod 4 at 5 and keyed at 6 so that the upper end of piston 1 abuts the shoulder 7 of the rod. A suitable piston ring 8 is held in place by a resilient element 9 lying between the piston and shoulder for insuring a leak-proof fit. The same arrangement is provided for the upper piston 2, it being similarly provided with a piston ring 10 and expanding element 11 and which is screwthreaded to the

piston ring at 12 and keyed thereto at 13. The casing for the hydraulic motor which will first be described is shown at 17 and is provided with a cap 18 which is releasably secured by means of bolts 19. In communication with and adjacent to the main cylinder is an auxiliary cylinder 20 in which is arranged for vertical reciprocation a piston whose rod is shown at 21. This rod has an extension 22 that extends slidably through plate 15 and is provided with a compression coil spring 23 confined between the plate 15 and a nut 24 above the plate and also a compression spring 25 arranged below the plate 15 to be confined between the same and an auxiliary piston 26.

The oil from some source, such as an engine of the aircraft carrying the automatic pilot, is forced under pressure into the hydraulic motor through an inlet 27. As shown in Figure 1 the hydraulic pistons 1 and 2 are in the down position, or in other words, at completion of the down stroke. In this position an auxiliary piston 26, carried by rod 21, has closed the outlet from the pressure chamber 28 above the upper piston 2 to the outlet 29 into the passage 30 to the outlet 31 leading to the sump. Likewise, inasmuch as the down stroke has been completed there is no further necessity for drawing in oil under pressure to the top side of the lower piston 1. Therefore the passageway from the inlet 27 to the pressure chamber 32 above the lower piston 1 has been closed by the auxiliary piston 33. However, inasmuch as oil pressure on the under side of the upper piston 2 is needed in order to initiate and continue the up stroke of the piston assembly, communication between the inlet 27 and the chamber 28 below the upper piston 2 has been established through the passageways 34 and 35. The vertical movement of the rod 29 and its auxiliary pistons 26 and 33 is resiliently brought about by the vertical movement of the plate 15 carried by the piston rod 4 through the springs 23 and 25 and these pistons are resiliently maintained in the extreme upper and lower positions corresponding to the upper and lower limits of travel of the main pistons by means of a spring detent in the form of a ball 36 urged to the left as shown in Figures 1 and 2 by means of a spring detent in the form of a ball 36 urged to the left as shown in Figures 1 and 2 by means of a spring 37 a compression of which is adjustably maintained by means of a screw bolt 38 contained in a screw threaded cap 39. The auxiliary piston rod 26 is provided with two bevel shaped restricted portions 40 and 41 to receive the spring pressed ball 36. As shown in Figure 1 the ball 36 engages the upper recess 40 to keep the auxil-

ary piston assembly including the pistons 26 and 33 in proper adjusted position as shown in Figure 1. Figure 2 shows the assembly at the completion of the up stroke at which time the spring pressed ball 36 is in engagement with the lower beveled recess 41 to maintain the auxiliary piston assembly in proper position for regulating the inlet and exhaust the oil from the upper and lower main cylinder pressure chambers.

Referring to Figure 2, which represents the piston assembly at completion of the up stroke it will be seen that inasmuch as all the oil above the upper piston in chamber 28 has been exhausted, there is no further necessity for any oil to be delivered to this chamber and accordingly the auxiliary piston 33 has closed the flow of oil from the inlet 27 to chamber 28. However, inasmuch as delivery of oil under pressure into the pressure chamber 32 above the lower main piston 1 is essential in order to initiate and complete the down stroke of the main piston assembly, the position of auxiliary piston 33 shown in Fig. 2 permits the flow of oil under pressure from the inlet 27 and through the passage 42 into chamber 32. The continued flow of such oil under pressure forces the lower main piston 1 and consequently the main piston assembly downwardly and this continues against the resilient action of spring 23. This spring 23 maintains the auxiliary pistons 26 and 33 in the position shown in Fig. 2 for regulating the flow of oil into and out of the main cylinder pressure chambers and until the compression force of spring 26 overcomes that of detent spring 37. This occurs at the completion of the down stroke at which time the detent ball 36 snaps over from its engagement with recess 41 into recess 40 of the auxiliary piston rod in position as shown in Fig. 1.

The foregoing has to do with main essentials of the hydraulic motor and there will now be described in detail the air pump and its connection with the hydraulic motor. As shown in Figures 1 and 2 the air pump may comprise a casting 43 releasably secured by screw bolts 44 to the casing 17 of the hydraulic motor. As a complementary part of the air pump there is also provided a lower casting 45 secured to the upper casting 43 by means of screw bolts 46 in such a manner as to provide an air chamber 47 therebetween. The lower portion of the main piston rod 4 extends through a stuffing box 48 secured in place by screw bolts 49 through the upper casting 43 of the air pump and carries at its lower end a diaphragm 50 which is secured thereto by means of a nut 51 and a washer 55 engaging a shoulder of the piston rod. This diaphragm 50 engages a bead 52 of a resilient suspending member 53 which also has a bead 54 fitting in complementary grooves of the upper and lower castings 43 and 45 to be held in proper position by the tightening of the screw bolts 46. It will be readily understood from the foregoing that an upward and downward movement of the main piston rod 4 correspondingly carries the air pump diaphragm 50 downwardly and upwardly into the positions shown in Figures 1 and 2, respectively.

The air pump is provided with a main inlet 56 and outlet 57. Generally speaking, the casting 45 is provided with an air inlet 58 to the upper side and an inlet 59 to the lower side of the diaphragm and an air outlet 60 from the upper side and an outlet 61 from the lower side of the diaphragm. For the inlet passage 58 there is provided a cylinder 62 that is secured to the diaphragm 50 so as to be slidable vertically in

the casing 45. Referring to Figure 3, the diaphragm 50 also has formed therein a plurality of retaining fingers 63 for retaining a floating disk 64 in engagement with the upper extremity of the cylinder 62 to perform the function of a check valve for permitting air to be drawn upwardly through the cylinder 62 into the chamber 47 above the diaphragm under pressure and prevent its escape through the passageway 58. In order to provide for intake of air through the passage 59 to the underside of the diaphragm a similar cylinder 65 is provided and an identical arrangement of fingers 63 and floating disk 64 to act as a check valve so as to allow intake of air under pressure to the lower side of the diaphragm and prevent its escape through the passageway 59. On the exhaust side of the air pump and for exhaust of the air from the upper and lower side of the diaphragm through the passageways 60 and 61, respectively, there are provided cylinders 66 and 68. In the case of cylinder 66 the floating disk 64, arranged within the diaphragm, closes the port 67 from the chamber 47 above the diaphragm when it is urged upwardly to close the port 67 in the diaphragm. When the disk 64 is resting on the top of the cylinder 66, as shown in Figure 1, air is free to escape through the port 67 and around the disk 64 through suitable slots near the upper extremity of cylinder 66 so that the air is free to escape through the passageway 60 and out of the casing outlet 57. In the case of cylinder 68 a similar floating disk 64 is provided so as to close a port 69 to prevent escape of air from the underside of the diaphragm through the outlet 61. In the position shown in Fig. 1 where the floating disk is resting on the top of cylinder 68 air is free to escape through the port 69 and into suitable slots in the cylinder 68 through the passageway 61 and out through the outlet 57.

As mentioned, Figure 1 shows the position of the hydraulic motor and the air pump at the completion of the down stroke and shows the position of the air intake and exhaust valves in readiness for initiation of the up stroke to draw air into the air chamber both above and below the diaphragm 50. It will be readily understood that when the diaphragm is drawn upwardly the floating disks 64 on the cylinders 62 and 65 will permit the inrush of air into the air chamber 47 both above and below the diaphragm. It will also be seen that during this up stroke of the diaphragm any tendency on the part of air to enter the chamber 47 either above or below the diaphragm will be prevented by the automatic setting of disk 64 with the ports 67 and 69, respectively, in the diaphragm. Likewise, during the down stroke of the air pump assembly from its position shown in Figure 2, which represents the full upstroke position, downwardly to its full down stroke position, shown in Figure 1, any tendency for intake of air under pressure through the passageways 58 or 59, either above or below the diaphragm, respectively, will be avoided by a setting of disk 64 on the upper ends of cylinders 62 and 65, respectively.

From the foregoing it will be seen that there has been provided a fully closed and compact hydraulic motor assembly which may readily utilize an hydraulic force of the pressure lubrication system of an engine of an aircraft carrying the automatic pilot or other device to be actuated. It will also be seen that there has been provided a compact complementary air pump unit that may be readily and replaceably

secured to the hydraulic motor unit so as to be operated thereby for furnishing air under pressure to a point where it may be available for use as a prime mover for such devices as an air spun gyro that may be used for instance in connection with an automatic pilot.

I claim:

1. In an air pump having an air chamber and an inlet and outlet, a diaphragm and check valve means for said inlet and outlet, means for reciprocating said diaphragm in said air chamber, said check valve means comprising cylinders with caged floating discs and being carried by said diaphragm so as to shut off the entrance of air through said inlet into said air chamber both above and below said diaphragm during the exhaust stroke of said diaphragm and shut off the

entry of air into said air chamber both above and below said diaphragm through said outlet during the intake stroke of said diaphragm.

2. In an air pump having an air chamber and an inlet and outlet, a diaphragm and check valve means for said inlet and outlet, means for operating said diaphragm within said chamber, said check valve means being carried by said diaphragm so as to shut off the entrance of air through said inlet into said air chamber both above and below said diaphragm during the exhaust stroke of said diaphragm and shut off the entry of air into said air chamber both above and below said diaphragm through said outlet during the intake stroke of said diaphragm.

BERT G. CARLSON.