Jan. 12, 1954 E. W. PATTERSON 2,665,901

LUBRICATING SYSTEM FOR UNITS OPERATED BY COMPRESSED AIR

Filed Aug. 15, 1949

FIG. 1.

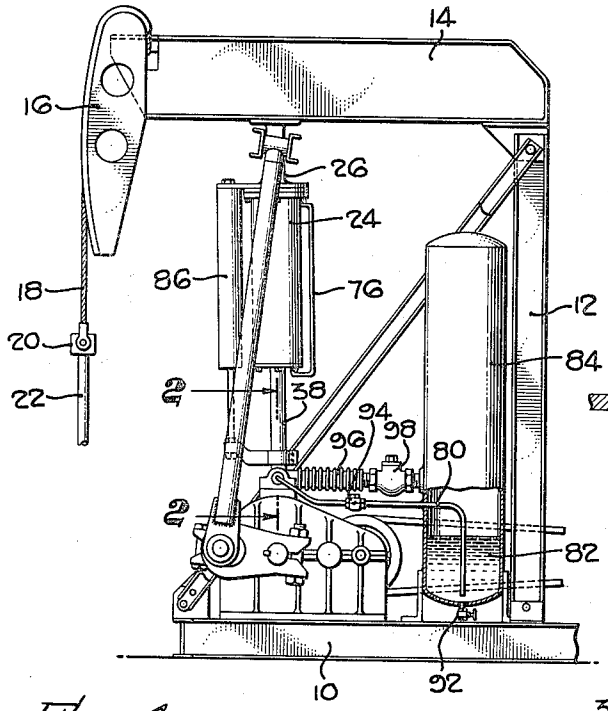
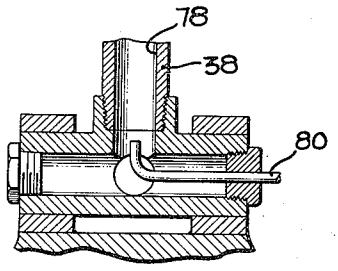


FIG. 2.



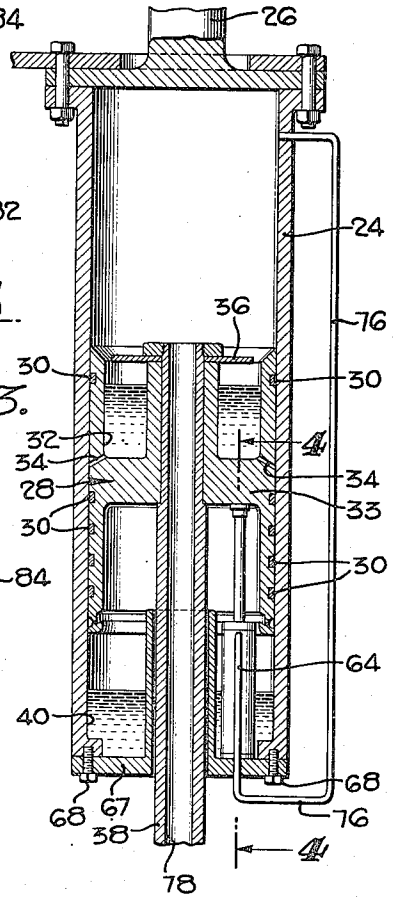


FIG. 3.

FIG. 4.

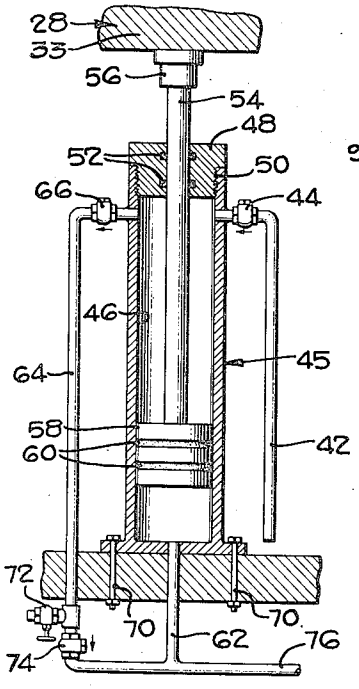
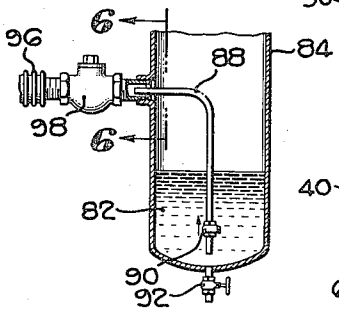


FIG. 5.



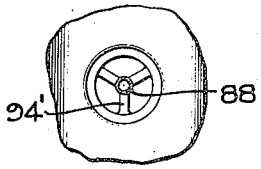


FIG. 6.

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LUBRICATING SYSTEM FOR UNITS OPERATED BY COMPRESSED AIR

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Application August 15, 1949, Serial No. 110,357

13 Claims. (Cl. 267—1)

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This invention relates to means for automatically replenishing the lubricating and sealing oil in pressure operated units such as air balanced pumping units.

Such an air balanced oil well pumping assembly was shown in my United States Patent No. 2,293,916, and is described in my co-pending application, Serial No. 758,127, for a "Pressure Control System for Air Balanced Pumping Units," now abandoned.

Due to defects in manufacture or otherwise the space between the piston and cylinder in my unit becomes great enough to cause leakage and this leakage is prevented by supplying sealing oil of a suitable quality. This oil is dipped up from a reservoir located at the bottom of the air balancing cylinder and when this reservoir is filled sufficiently to enable the oil pump to take up sufficient quantities of this oil the sealing is effected.

However, due to one reason or another, this oil reservoir sometimes becomes depleted and the seal is broken.

It is an object of my present invention to provide means whereby this oil is constantly provided to the surfaces to be sealed and will not become depleted or insufficient.

Other objects and advantages of this invention will be apparent from the following description and claims, the novelty consisting in the features of construction, combination of parts, the unique relations of the members and the relative proportioning, disposition, and operation thereof, all as is more completely outlined herein and particularly pointed out in the appended claims.

In the accompanying drawings, forming a part of this present specification,

Figure 1 is a side elevational view of a pumping unit embodying the present invention.

Figure 2 is a detail sectional view of one embodiment of my present invention taken along the lines 2—2 in Figure 1.

Figure 3 is a vertical sectional view showing the piston, its cylinder and one embodiment of my present invention for assuring sufficient sealing oil between the piston and the cylinder.

Figure 4 is a vertical elevation along the lines 4—4 in Figure 3.

Figure 5 is a detail view of another embodiment of my present invention, and

Figure 6 is a detail view taken along the lines 6—6 in Figure 5.

Referring to the drawings I will now describe the general features of the usual air balanced

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pumping unit which has been used as an illustration of my invention.

The pumping unit is mounted on a base 10, which supports a Sampson post 12, its attached walking beam 14 and horsehead 16. The hanger strap 18, carrier bar 20 and polish rod 22 are shown and actuated in the same manner that is fully described in my above patent and application. Cylinder 24 is raised and lowered by the action of walking beam 14 to which it is connected by connector 26. This cylinder 24 moves up and down, over and with respect to a piston 28 which is mounted on the mechanism affixed to base 10, so as to be relatively immovable, excepting for slight oscillatory movement, in its relation to base 10. Piston rings 30 are mounted at suitable intervals on piston 28 to act as a seal between piston 28 and the inner wall of cylinder 24.

To assure this seal I provide a sealing oil reservoir 32 in the upper part of this piston 28, the bottom of said reservoir being formed by a radial piston wall 33. This reservoir 32 has ducts 34 leading from the bottom of the reservoir to an annular space between piston 28 and the inner wall of cylinder 24. These ducts 34 feed the oil from the reservoir 32 to the inner wall of the cylinder 24 in sufficient quantities to assure a seal between the inner wall of the cylinder 24 and piston 28.

My present invention relates to the means for maintaining the oil in this reservoir 32 to provide this seal and I have shown several alternative means for assuring the replenishment of this oil.

I will first describe the means shown in Figures 3 and 4 hereof.

The replenishment means shown in Figures 3 and 4 consists in an oil pump 45 which pumps oil from a source of supply to a point above the piston 28, permitting it to fall down past baffle plate 36 into sealing oil reservoir 32. In my preferred embodiment the source of this oil supply is compartment 40 located in cylinder 24 and this oil passes through supply line 42. This oil also passes through an input check valve 44, which permits the oil to go only in the direction of entrance into the oil pump cylinder 46. At the top of cylinder 46 is a head 48, which is connected to cylinder 46 by means of a screw threaded connection 50. Sealing rings 52 in head 48 serve to maintain pressure within cylinder 46. A piston rod 54 extends through head 48 and has an enlarged portion or bumper 56 at the top thereof. Fixed upon the lower end of this piston rod 54 is a piston head 58, having piston rings 60

to effect a seal against the inner walls of the cylinder 46.

There is always pressure in the chamber of the cylinder 46 below the piston head 58, which causes the piston rod 54 and its bumper 56 to be urged upwardly against the wall 33 of piston 28 during the part of the cycle when piston 28 is in the lower portion of cylinder 24. This pressure comes from line 62, which opens into the bottom of cylinder 46 below piston head 58.

Leading from the upper end of cylinder 46 is a feed line 64, having an output check valve 66, which opens outwardly from the interior of cylinder 46.

Downward movement of piston 58 with relation to cylinder 46 causes oil to be drawn from reservoir 40 through intake line 42 into the interior of cylinder 46, and that same oil is pumped out through discharge line 64 when piston head 58 moves upwardly with relation to cylinder 46. This oil movement is accomplished by the check valves 44 and 66, respectively.

Reciprocation of piston head 58 in cylinder 46 is effected by the following means.

Cylinder 24 is connected to walking beam 14 by connector 26 so that every time that the walking beam 14 rises and falls during the pumping operation it raises and lowers connector 26 and cylinder 24.

At the bottom of cylinder 24 a closure 67 is bolted to cylinder 24 by bolts 68.

Oil pump 45 is similarly bolted to closure member 67 by bolts 70.

By this construction the reciprocal motion of walking beam 14 is transmitted through connector 26 to cylinder 24 and its closure member 67 to oil pump 45. Therefore, every time that the walking beam 14 moves up or down oil pump 45 likewise moves up or down, respectively.

However, piston 28 is stationary and when oil pump 45 raises, bumper 56 is in contact with piston 28 due to the pressure on the under side of piston 58 which holds piston 58 against piston wall 33 while cylinder 46 moves upwardly or downwardly with relation to piston 58. In this manner, reciprocating movement between piston 58 and cylinder 46 is effected and oil is pumped from the source of supply through line 42 into cylinder 46 and out of cylinder 46 past one way valve 66 into line 64. The upper face of piston 58 has a lesser area than the lower face of piston 58, the difference being the cross-sectional area of the piston rod 54, and therefore it can discharge against a pressure greater than the pressure in the cylinder 24, which is also exposed to oil pump piston 58.

At the bottom of line 64, which goes through closure member 67, is test valve 72, which can be opened to see if the pump is working, and one way check valve 74, which permits oil to go out but not come back along line 64.

At the opposite side of check valve 74 is line 76, which is really a continuation of line 64, and which is connected by an open connection with line 62.

Line 76 has a vertical bend and is led upwardly by an open connection into the interior of cylinder 24 above piston 28 in its uppermost position.

In this manner oil is pumped from compartment 40 through line 42 into cylinder 46 and out through lines 64 and 76 to the interior of cylinder 24 above piston 28. There the oil flows down onto piston 28 and past baffle plate 36 into oil reservoir 32.

In this manner it is automatically assured that the oil in reservoir 32 will be constantly replenished from an adequate source of supply through line 42 and the train described above.

As a result of its unique design, the oil pump 45 is capable of efficient operation throughout a varied range of stroke lengths.

It is to be understood that the piston 58 of oil pump 45 does not move as great a distance with reference to cylinder 46 during one complete cycle of operation as the cylinder 24 of the pumping unit to which it is attached does with reference to its piston 28. Furthermore, it is to be understood that piston 28 may be caused to operate at various pre-determined stroke lengths within the main balancing cylinder 24.

Attention is called to the unique combination of functions performed by the single oil line 76. Connecting as this does with both the upper and lower ends of the cylinder 46 the pipe 76 must not only supply oil under pressure to the bottom of piston 58 to accomplish the upward return of said piston following a downward stroke thereof, but must also conduct oil from pump 45 to and discharge it into the upper portion of air cylinder 24. The manner in which it performs these two functions may be explained as follows:

Considering a reciprocating cycle of cylinder 24 as starting with the latter in its uppermost position, the lower end of cylinder 24 containing the pump 45, then has an elevated position in which said pump has approached close enough to the radial wall 33 of piston 28 so as to cause the pump piston 58 to have been pushed to its lowermost point in the pump cylinder 46, approximately as shown in Fig. 4. When the cylinder 24 starts downward, the pump cylinder 46 carried thereon moves with it and only the differential pressure applied to the bottom of piston 58 keeps this from moving downwardly with the cylinder 46. This differential is adequate, however, to hold the bumper head 56 pressed upwardly against the radial air piston wall 33 as the cylinder 46 moves downwardly thereby causing a relative movement between pump piston 58 and pump cylinder 46, with the cylinder head 48 approaching said pump piston until it engages the latter which marks the limit of said relative movement between said piston and said cylinder head.

During this relative movement between pump piston 58 and pump cylinder 46, the oil in said cylinder above said piston is forced through the check valve 66, pipe 64 and check valve 74 into oil line 76. At the same time that this is being done, of course, a slightly larger volume of oil is being forced under pressure from pipe 76 through pipe 62 into the lower end of pump cylinder 46. Thus there is a net discharge of a given volume of oil from the pipe 76 into the pump 45 during the downward movement of the air cylinder 24. It is thus clear that no pumping of oil by the pump 45 through the oil line 76 and into the air cylinder 24 takes place during the initial stroke of said oil pump just described.

The upward stroke of air cylinder 24, to complete the cycle of operation being described, begins with the piston 58 of the oil pump 45 engaging the cylinder head 48 thereof, that is, with the piston rod 54 at its maximum point of extension from pump cylinder 46, and with the bumper head 56 a substantial distance downward from the air piston wall 33. As the air cylinder 24 rises, the pump 45 rises with this, the preponderance of pressure against the bottom face

of the piston 58 holding it against the pump cylinder head 48 until bumper head 56 comes into engagement with the air piston radial wall 33 as shown in Fig. 3. Said radial wall being stationary, the upward movement of the piston 58 is halted and cylinder 46 continues to slide upwardly over the piston 58 to cause a suction stroke of the latter, sucking oil through pipe 42 and the valve 44 into the portion of cylinder 46 disposed above piston 58. This stroke is also an exhaust stroke, however, as all the oil received in the cylinder 46 below piston 58 in the first stroke thereof above described is, in the second stroke, exhausted through pipe 62 into pipe 76. Check valves 66 and 74 prevent this oil recirculating into the upper end of cylinder 46. Thus, the oil discharged by the second piston stroke into line 76 displaces a sufficient amount of oil therein to cause a volume of oil equal to that delivered through pipe 64 into line 76 during the first piston stroke to be discharged into the upper end of said air cylinder from the upper end of oil line 76.

I will now describe an alternative means of replenishing the oil in reservoir 32 that is shown in Figure 2 of the drawings hereof. Also both means may be used in combination with each other to more effectively seal the piston.

In practice the manufacturing tolerances of the cylinders and pistons vary. In order to meet these conditions it sometimes requires a flood of oil on top of the piston 28. This flood of oil passes down between piston 28 and cylinder 24 and accumulates in compartment 40. As long as there is oil on top of piston 28 it is possible to maintain air pressure in the balancing system. When this oil is depleted air will pass by the piston 28 faster than the compressor 86 can replenish the air in the balancing system, the result being a gradual loss of balance pressure. To overcome this deficiency I have provided a pump in compartment 40 to pick up the oil from compartment 40 and return it to reservoir 32 in piston 28. In some instances the fit between the piston 28 and the cylinder 24 is close enough that relatively little oil accumulates in compartment 40. However, due to air velocity in piston tube 78, oil is sucked over baffle plate 36 into piston tube 78 and thence through line 96 into air tank 84 where it comes to rest at point 82. In order to return such migratory oil to reservoir 32 in piston 28 I provide an aspirator tube 80 as shown in Figures 1 and 2 or an aspirator tube 88 as shown in Figure 5, which accomplishes the same purpose as tube 80 in Figure 2.

The flow of air past the open ends of tubes 80 or 88 sucks oil from these tubes and atomizes the same so that the particles of oil thus formed are entrained in the air stream and thus carried into the air cylinder 24 above the piston 28 as this cylinder rises in its upward stroke. The aspirated oil accumulates in cylinder 24 above piston 28 and runs down the side walls of cylinder 24 into reservoir 32 of piston 28. In this combination if oil leaks by piston 28 to compartment 40, or if the oil blows over baffle plate 36 down tube 78 into reservoir 82 it is returned to reservoir 32 in the manner above described. Thus the oil seal is maintained at all times on piston 28 to effectively seal it against air loss. Both systems are effective to maintain an oil seal on piston 28. However in the combination of the aspirator and the oil pump it is only necessary to fill the system with oil once as the oil is sealed in the unit and cannot escape to the atmosphere

or outside the unit. If only the aspirator is used oil can leak by the piston and into compartment 40 and finally overflow and escape from the system. If the oil pump is used as the sole lubricating means oil may be blown over into tube 78 and into reservoir 82, where it cannot be returned to reservoir 32, requiring the addition of oil to compartment 40 at frequent intervals to insure proper lubrication to piston 28 and cylinder walls 24.

In Figure 2 the piston rod 38 has a hollow bore 78 leading to the interior of cylinder 24 above piston 28. Oil is fed through this hollow bore 78 to the interior of cylinder 24 above piston 28 through line 80.

The oil that is thus fed through line 80 into bore 78 comes from reservoir 82, located in the bottom of tank 84.

Pressure is maintained in the balancing system and tank 84 by compressor 86 and the usual connections, which are not shown.

As beam 14 oscillates cylinder 24 is reciprocated over stationary piston 28. Piston 28 is free to rock but cannot move vertically. In the movement of cylinder 24 over piston 28 air is moved from the interior of cylinder 24 through hollow piston rod 78 and line 96 to reservoir 84. This is on the down stroke of the beam. On the up stroke of the beam, air moves from reservoir 84 through line 96 and through hollow piston rod 78 into cylinder 24. The aspirator functions on the up stroke of cylinder 24. Aspirator tube 80, as shown in Figure 2, is directed into piston tube 78. As air passes by aspirator tube 88 going to cylinder 24 the velocity of this air picks up oil from reservoir 82, as shown in Figure 1. Check valve 94 prevents the return of oil through line 80 to the reservoir 82 on the down stroke of cylinder 24.

Check valve 94 opens only in the direction toward bore 78 and prevents return of the oil after it has passed valve 94. In this manner oil from reservoir 82 is constantly fed through bore 78 to the walls of cylinder 24 above piston 28 whence it drops down past baffle plate 36 into oil reservoir 32. In this manner the permanent reservoir 82 supplies the oil to the lubricating reservoir 32 in piston 28. I will now describe the other alternative method of supplying oil to reservoir 32 that is shown in Figures 5 and 6 hereof.

The bottom of tank 84 is provided with the same oil reservoir 82 and a line 88 drops down into this oil. Near the bottom of this line is a one way check valve 90 that permits the oil to be removed from reservoir 82 but prevents it from returning thereto. At the bottom of cylinder 84 is a drain plug 92, present both in Figure 5 and in Figure 1, for draining off any water that may accumulate in the bottom of reservoir 82, as it is heavier than the oil.

A spider 94', as shown in Figure 6, is provided adjacent the port in tank 84 and a flexible line 96 that can compensate for the oscillatory movement of the piston tube 38 is similarly provided. This carries valve 98. The action of the air surging back and forth between the balancing cylinder 24 and the tank 84 will cause oil to be picked up out of the reservoir 82 in the bottom of tank 84. This oil is then fed through line 88 to bore 78 in piston rod 38 to the interior of cylinder 24 above piston 28 and thereafter the action is the same as in the variation hereof shown in Figure 2.

It is to be understood that the form of my invention herein shown and described is my pre-

ferred embodiment and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the appended claims.

I claim:

1. In a unit operated by compressed air the combination of a cylinder, a piston reciprocally mounted in said cylinder, an oil reservoir in said piston spaced from the inner wall of said cylinder, an opening connecting said oil reservoir with the space above the top of said piston, there being a duct leading from said oil reservoir to the clearance space between said piston and the inner wall of said cylinder, a source of oil supply independent of said piston, an oil pump and supply lines from said source of supply through said pump to the interior of said cylinder at a point above the top of said piston when it is in its highest position relative to said cylinder and a fluid drainage connection from said clearance space to said source of oil supply.

2. In a unit operated by compressed air the combination of a cylinder, a piston reciprocally mounted in said cylinder, an oil reservoir in said piston spaced from the inner wall of said cylinder, an opening connecting said oil reservoir with the space above the top of said piston, there being a duct leading from said oil reservoir to the clearance space between said piston and the inner wall of said cylinder, a source of oil supply independent of said piston, an oil pump and supply lines from said source of supply through said pump to the interior of said cylinder at a point above the top of said piston when it is in its highest position relative to said cylinder and a fluid drainage connection from said clearance space to said source of oil supply, whereby the oil leaving said oil reservoir through said duct is returned to said oil reservoir.

3. In a unit operated by compressed air the combination of a cylinder, a piston reciprocally mounted in said cylinder, a piston rod connected to said piston, an oil reservoir in said piston having an opening communicating with the space above the top of said piston, there being a duct leading from said oil reservoir to the clearance space between said piston and the inner wall of said cylinder, a hollow bore in said piston rod, means forming a passageway connecting a source of air pressure to said hollow bore, an aspirator tube having an opening in said passageway, a check valve mounted in said aspirator tube and a source of oil supply for said aspirator tube.

4. In a unit operated by compressed air the combination of a cylinder, a piston reciprocally mounted in said cylinder, a piston rod connected to said piston, an oil reservoir in said piston having an opening communicating with the space above the top of said piston, there being a duct leading from said oil reservoir to the clearance space between said piston and the inner wall of said cylinder, a source of oil supply, an oil pump and supply lines from said source of supply through said pump to the interior of said cylinder at a point above the top of said piston when it is in its highest position relative to said cylinder, a hollow bore in said piston rod, means forming a passage way between said hollow bore and a source of air pressure, an aspirator tube having an opening in said passage way, a check valve mounted in said aspirator tube and a second source of oil supply connected to said aspirator tube.

5. In a unit operated by compressed air the combination of a cylinder, a piston reciprocally mounted in said cylinder, a piston rod connected to said piston, an oil reservoir in said piston having an opening communicating with the space above the top of said piston, there being a duct leading from said oil reservoir to the clearance space between said piston and the inner wall of said cylinder, a source of oil supply, an oil pump and supply lines from said source of supply through said pump to the interior of said cylinder at a point above the top of said piston when it is in its highest position relative to said cylinder, a fluid drainage connection from said clearance space to said source of supply, whereby the oil leaving said oil reservoir through said duct is returned to said oil reservoir, a hollow bore in said piston rod, a passage way between said hollow bore and a source of air pressure, an aspirator tube having an opening in said passage way, a one-way check valve mounted in said aspirator tube and a second source of oil supply connected to said aspirator tube.

6. In a device of the class described the combination including an air balance cylinder member, a piston member in said air balance cylinder member, one of said members being fixed against longitudinal movement, an air reservoir, means forming an air passage between the balancing cylinder member and said air reservoir, said air reservoir having a supply of oil therein, a conduit from said oil supply to a point in said air passage, and valve means in said conduit permitting flow of said oil only in the direction of said balance cylinder member.

7. In a device of the class described the combination including an air balance cylinder member, a piston member in said air balance cylinder member, one of said members being fixed against longitudinal movement, an air reservoir, means forming an air passage between the balancing cylinder member and said air reservoir, said air reservoir having a supply of oil therein, a conduit from said oil supply to a point in said air passage, valve means in said conduit permitting flow of said oil only in the direction of the said balance cylinder member, an oil reservoir, a pump, an intake line for said pump communicating with said oil reservoir and a discharge line from said pump having a discharge opening at a point above said piston in said cylinder member.

8. In a device of the class described the combination including an air balance cylinder member, a piston member in said air balance cylinder member, one of said members being fixed against longitudinal movement, an air reservoir, means forming an air passage between the balancing cylinder member and said air reservoir, said air reservoir having a supply of oil therein, a conduit from said oil supply to a point in said air passage, valve means in said conduit permitting flow of said return only in the direction of the said balance cylinder member, a flow of oil being induced along said conduit in said direction by the high velocity of the air flowing through said air passage from said air reservoir to said balance cylinder member, an oil reservoir, a pump, an intake line for said pump communicating with said oil reservoir and a discharge line from said pump having a discharge opening at a point above said piston in said cylinder member.

9. In an oil sealing mechanism the combination of a cylinder, a piston movably mounted in said cylinder, a sealing oil reservoir spaced from the inner wall of said cylinder, a passageway leading from said sealing oil reservoir to the space

between said cylinder and said piston and means to replenish the sealing oil to said reservoir including a sealing oil collecting reservoir located beneath said piston and in the lower portion of said cylinder so that oil leaking past said piston drains into said oil collecting reservoir and pump means associated with said reservoirs and operable by the relative motion between said cylinder and said piston to continuously transmit sealing oil from said collecting reservoir to said reservoir in said piston.

10. In an oil sealing mechanism the combination of: a cylinder, a piston movably mounted in said cylinder, a sealing oil reservoir in said piston, there being a duct leading from said reservoir to the outside of said piston whereby said sealing oil can flow from said reservoir through said duct to the space between said piston and said cylinder to effect a seal between the exterior of said piston and the interior of said cylinder, means forming a passageway connecting a source of air under pressure to the interior of said cylinder above said piston, the interior of said cylinder above said piston communicating freely with said sealing oil reservoir, a sealing oil storage reservoir, an aspirator tube connecting said storage reservoir to the interior of said passageway and a check valve in said aspirator tube limiting flow in said tube to flow from said storage reservoir to the opening of said tube into said passageway.

11. In an oil sealing mechanism the combination of: a cylinder, a piston movably mounted in said cylinder, a sealing oil reservoir in said piston, there being a duct leading from said reservoir to the outside of said piston, a sealing oil storage reservoir, means forming a passageway connecting a source of air pressure to the interior of said cylinder above said piston, the interior of said cylinder above said piston communicating freely with said sealing oil reservoir, an aspirator tube having an opening in said passageway, a source of oil supply for said aspirator tube, a check valve in said aspirator tube preventing a reverse flow of oil therein towards said source of supply, and pump means to transmit sealing oil from said oil storage reservoir to said reservoir in said piston.

12. In an oil sealing mechanism the combination of: a cylinder, a piston movably mounted in said cylinder, a sealing oil reservoir in said piston, there being a duct leading from said reservoir to the outside of said piston, and means to replenish the sealing oil in said reservoir including a sealing oil storage reservoir, pump means to transmit sealing oil to said reservoir in said piston, a source of oil supply for said pump means, means forming a passageway connecting a source of compressed air to the interior of said cylinder above said piston, the interior of said cylinder above said piston communicating freely with said sealing oil reservoir, an aspirator tube connecting said storage reservoir to the interior of said passageway, and a check valve in said aspirator tube limiting the flow of oil therealong to a flow from said storage reservoir to said passageway.

13. In an oil sealing mechanism the combination of: a cylinder, a piston movably mounted in said cylinder, a sealing oil reservoir on said piston having a duct leading to the space between said cylinder and said piston whereby said sealing oil can move from said reservoir to the space between said piston and said cylinder to effect a seal between the exterior of said piston and the interior of said cylinder, and means to replenish the sealing oil in said reservoir including means forming a passageway connecting a source of compressed air to the interior of said cylinder above said piston, there being a communication between the interior of said cylinder above said piston and said sealing oil reservoir, an aspirator tube opening into said passageway, a check valve in said aspirator tube limiting the flow of oil in said tube to a flow towards said passageway, a source of oil supply for said aspirator tube, pump means to transmit sealing oil to said piston reservoir and a source of oil supply for said pump means.

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