

Jan. 3, 1967

S. S. SMITH

3,295,371

LEASE AUTOMATIC CUSTODY TRANSFER UNIT

Filed Feb. 21, 1964

4 Sheets-Sheet 1

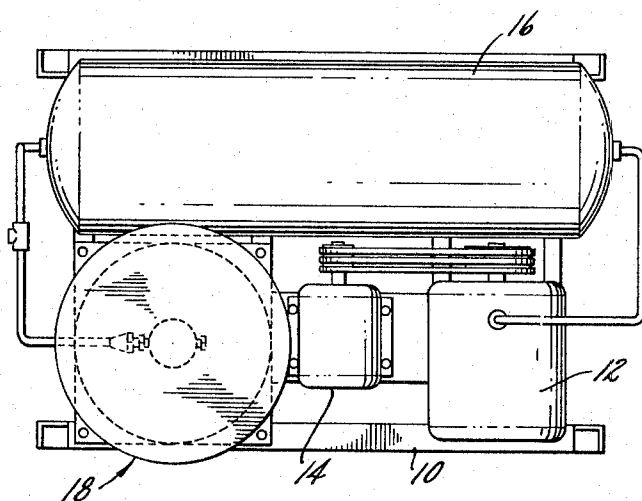


Fig. 2.

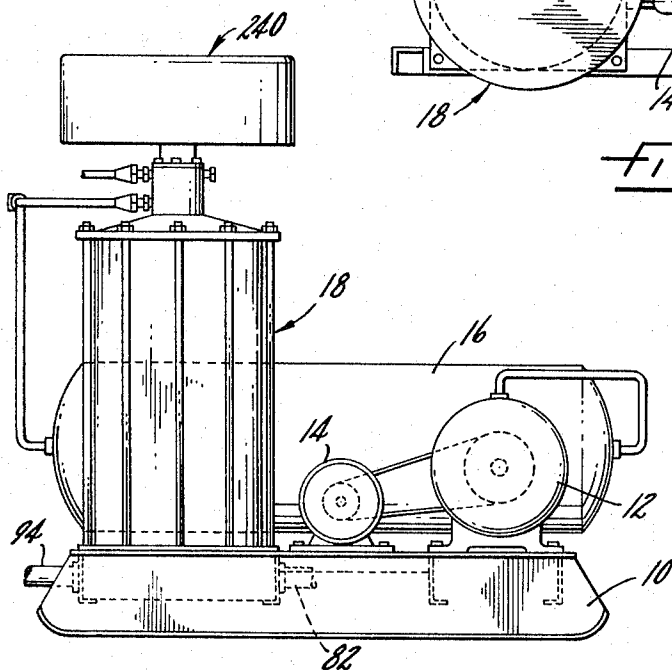


Fig. 1.

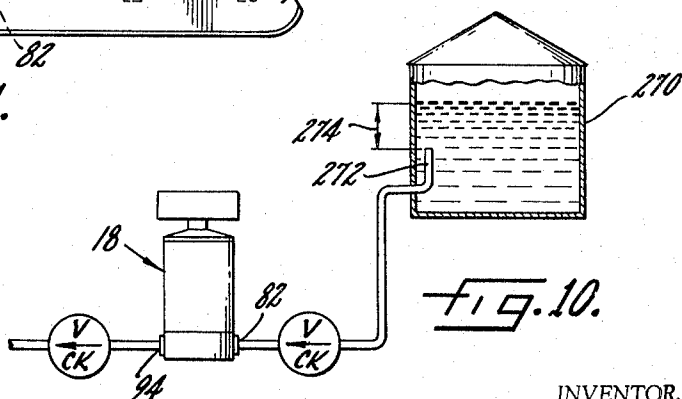


Fig. 10.

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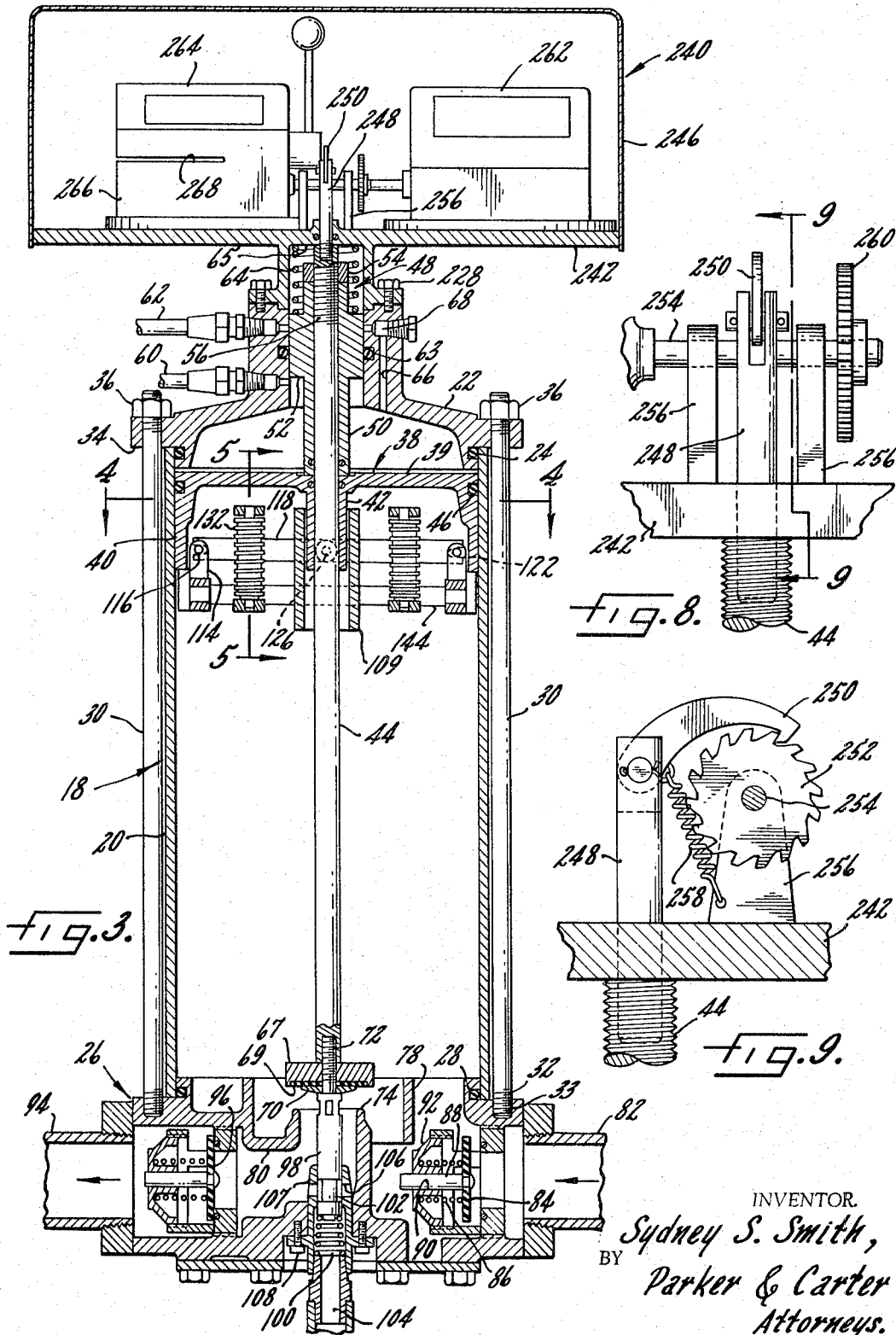
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

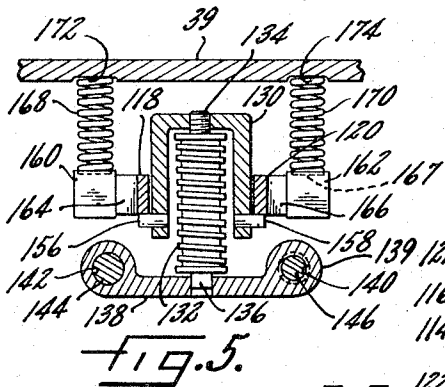


Fig. 5.

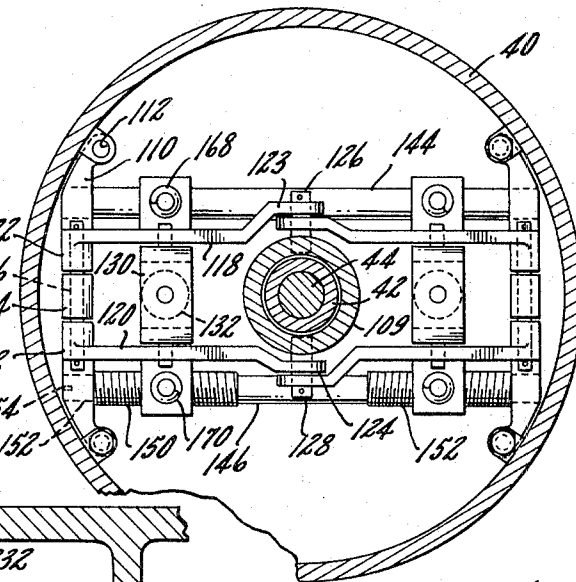


Fig. 4.

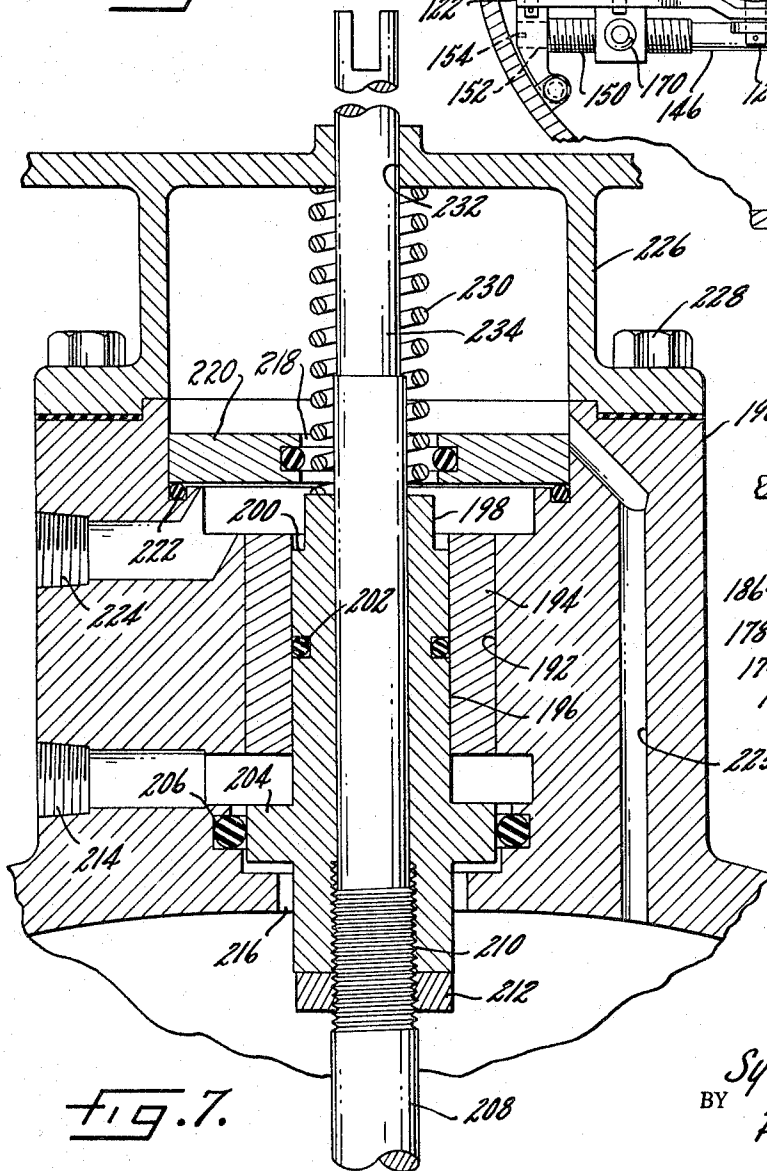


Fig. 7.

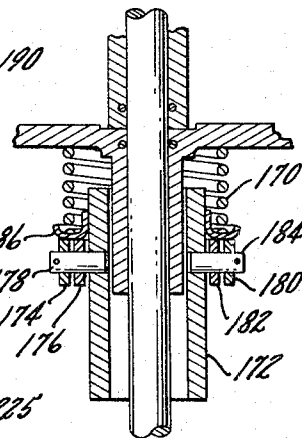


Fig. 6.

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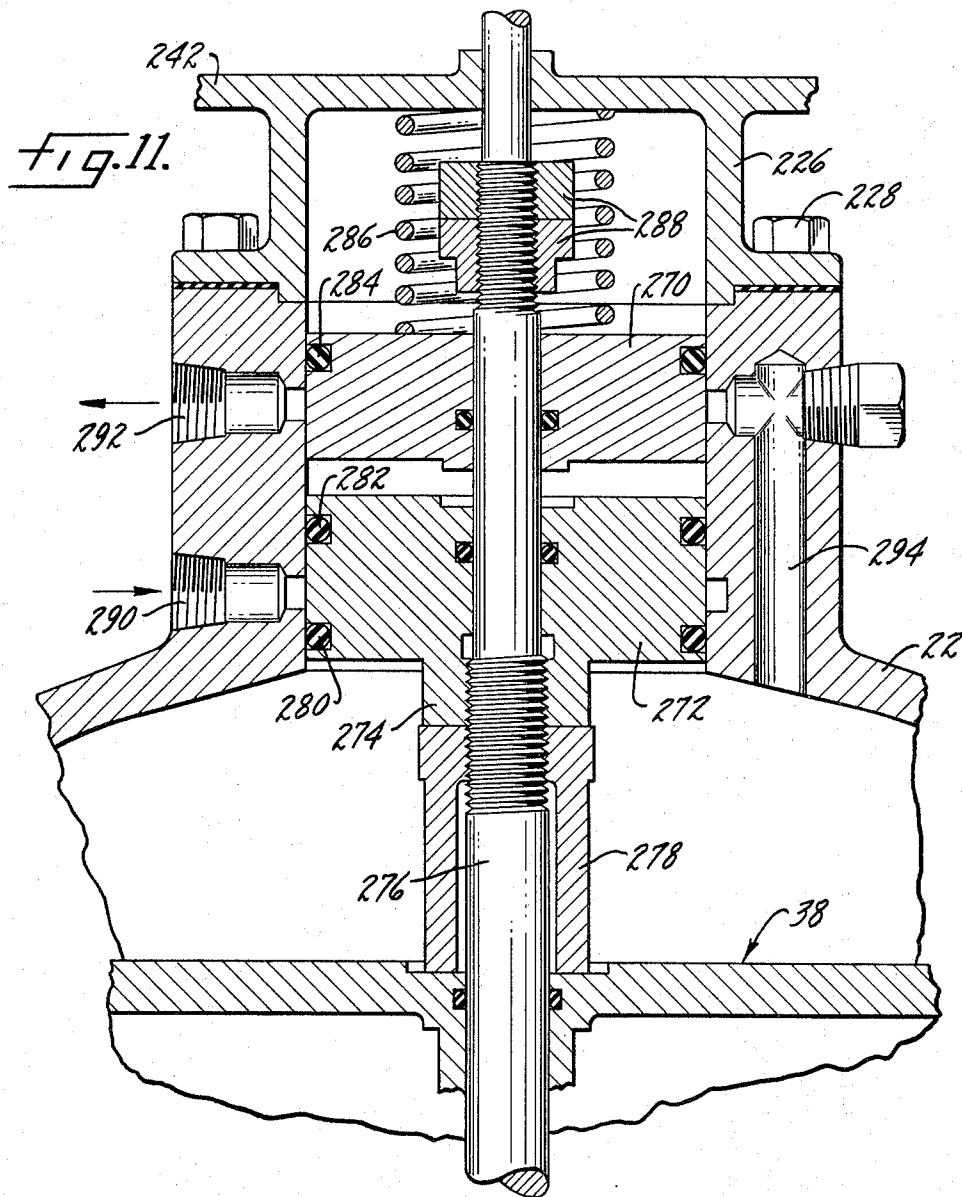
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LEASE AUTOMATIC CUSTODY TRANSFER UNIT

Filed Feb. 21, 1964

4 Sheets-Sheet 4



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3,295,371

**LEASE AUTOMATIC CUSTODY TRANSFER UNIT**  
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Filed Feb. 21, 1964, Ser. No. 346,513

12 Claims. (Cl. 73-250)

This is a continuation-in-part of my copending application Serial No. 56,747, filed September 19, 1960, now abandoned.

This invention is in the field of lease automatic custody transfer units and is in the nature of a metering pump for pumping and measuring crude oil from a lease tank to a pipeline gathering system.

A primary object of the invention is an inexpensive lease automatic custody transfer unit which may be manufactured and supplied as a package with its own power source.

Another object is a transfer unit which pumps a predetermined quantity of crude oil, for example a barrel, for each stroke or cycle and automatically compensates for temperature variation.

Another object is a transfer unit which is operated by an air compressor.

Another object is a transfer unit of the above type with a null-balanced piston.

Another object is a transfer unit of the above type which automatically samples each pumping stroke without subtracting from the volume pump.

Another object is a transfer unit of the above type which is constructed to prevent oil from flowing directly through without operating the pumping unit.

Another object is a transfer unit of the above type adapted to be connected to a water separation or other storage tank constructed so that the transfer unit will go through a complete inlet and pumping cycle if it operates at all.

Another object is a transfer unit of the above type which may have its cycle easily adjusted.

Another object is a package transfer unit, including a counter, compressor and transfer unit.

Another object is a transfer unit operated by compressed air and constructed so that air will not leak into the oil.

Another object is a unit of the above type which does not require close tolerances.

Another object is a transfer unit of the above type which does not require close supervision and constant checking once it is in operation.

Another object is a transfer unit of the above type which is easy to calibrate.

Another object is a lease automatic custody transfer unit of the above type in which a piston moves up and down in a housing to displace a predetermined volume on each stroke with an automatic compensation built in to adjust for temperature change to vary the effective stroke of the piston so that the amount pumped will be automatically varied to compensate for the difference in temperature of the crude oil at a predetermined temperature.

Another object is a package transfer unit including a compressor, transfer unit and an automatic counter, totalizer and printer to report the number of units which have been pumped or delivered.

Other objects will appear from time to time in the ensuing specification and drawings in which:

FIGURE 1 is a side view of the transfer unit;

FIGURE 2 is a top view of FIGURE 1;

FIGURE 3 is an axial section through the transfer unit of FIGURES 1 and 2, on an enlarged scale;

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FIGURE 4 is a section along line 4-4 of FIGURE 3, on an enlarged scale;

FIGURE 5 is a section along line 5-5 of FIGURE 3, on an enlarged scale;

FIGURE 6 is a fragmentary vertical view, partly in section, showing a variant form of the spring mountings;

FIGURE 7 is a vertical view, partly in section and on an enlarged scale, of a variant form of the air valve;

FIGURE 8 is an enlarged front view of a connecting mechanism between the tank and the counter;

FIGURE 9 is a view along line 9-9 of FIGURE 8;

FIGURE 10 is a schematic view of the metering unit with the storage tank; and

FIGURE 11 is a section of a further variation.

In FIGURES 1 and 2, a suitable base in the form of a sled or pallet may be used to hold or support a conventional air compressor 12 driven by an electric motor 14 or the like. The air compressor supplies air under pressure to a suitable tank or reservoir 16 which in turn operates a lease automatic custody transfer unit 18 in a manner which will be described. The particular arrangement of the pallet or support is not important and the piping and connections which may be conventional for the various units has only been shown in FIGURES 1 and 2.

In FIGURE 3, the lease automatic custody transfer unit 18 may be considered as a tank assembly and includes a generally upright cylindrical housing 20 joined to a head portion 22 which is kept in fluid tight engagement against the wall of the housing by O ring 24. A base portion, shown generally at 26, is connected to the bottom of the housing and held in fluid tight engagement by O ring 28. A plurality of tie rods, such as at 30 securely hold parts of the tank assembly together by having one threaded end 32 engaged in a threaded socket, such as at 33, of the base portion, and the other end locked in passageway 34 of the head portion by means, such as lock nut 36.

A piston, shown generally at 38, is disposed to move within the tank. The piston has a top wall 39, an outer continuous wall 40 which rides along the interior of the housing and an inner continuous wall 42 which rides along a rod 44. An O ring 46 may be used to prevent leakage between the outer continuous wall 40 of the piston and the wall 20 of the housing.

Movably positioned around the upper part of the rod is an air valve element 48 which has a lower extension 50 and a continuous lateral projection 52. The air valve is variably positioned on the rod by a lock nut 54 meshing with threads 56 on the upper part of the rod. The lateral projection of the air valve is adapted to alternately open and close air inlet 60 and air outlet 62. An O ring 63 prevents leakage. The air valve is moved by top wall 39 of the piston contacting and moving lower extensions 50 to open the air inlet against an urging spring 64. The upward movement of the air valve is stopped when the end of the rod extending beyond lock nut 54 hits wall 65 of a superstructure counter which will be later described. The air valve is adapted to be moved down in a manner to be described. This closes the air inlet, opens the air outlet, and the interior of the tank communicates with the air outlet by venting means, such as passages 66 and 68.

The bottom of the rod 44 is joined to a plate or valve 67 which preferably has a resilient insert 69. A retainer 70 may be fixed to the bottom of the plate by a screw or the like 72 which secures the plate 67 to the end of the rod. This plate is adapted to be contacted by the piston whereupon the rod is lowered and the valve moves against valve seat 74. At the same time, the air valve fixed to the top of the rod will move to close the inlet

and open the outlet. The spring 64 keeps valve 67 on seat 74 during the intake stroke of the piston. The valve seat is preferably an integral part of the cast base 26.

The base portion is seen having a generally centrally placed well 78 which is connected to the raised valve seat by lateral arms, such as at 80. An inlet 82 is connected to the base portion to admit fluid through a one way check valve 84 which is urged by a spring 86 around a shaft 88 towards a closed position. The shaft is movably seated in a passageway 90 of member 92 which may be mounted in the base portion. Fluid moves out of the tank through an outlet 94 after moving through a one way check valve 96 which is urged towards a closed position by a spring in the same way as described for the inlet check valve. When the plate or valve 67 moves onto valve seat 74, the fluid outlet will be closed.

The full seating of this valve will also actuate a sampler to permit a small volume of the fluid to be withdrawn at the bottom of the base. The retainer 70 on the valve moves pin 98 down against a spring 100 to allow a small volume of fluid accumulated around reduced portion 102 of the pin to escape through outlet 104. This small sample will leave the tank through port 106 of a body portion 107 fixed to the base by bolts, such as at 108.

The interior of the piston has a temperature control system shown in FIGURES 3, 4 and 5. This system variably governs the stroke of the piston in response to changing temperature of the fluid.

A continuous sleeve 109 is adapted to be moved up and down inside the piston. The different positions of this sleeve will result in the valve 67 being contacted at different times to thereby close against the valve seat at different times. The temperature system is fixed within the piston by a pair of opposed brackets, such as at 110, with apertures, such as at 112, positioned so that the apertures are aligned with similar apertures in projections on the inside of continuous wall 40 of the piston. Suitable screws or the like may then be used to fix the brackets to the projections. Such projections and apertures are shown in FIGURE 4. The temperature control system is doubled up so that there is a working unit on each side of the rod. I will describe one side but the description will apply equally to the other side.

Each bracket has a raised portion 114 with a bore to hold a pin 116 extending from both sides of the raised portion. A pair of arms 118 and 120 have slots 122 at their outer ends which engage the ends of the pin 116, serving as a pivot. The other offset ends of the arms, such as at 123 and 124, are connected to pins 126 and 128 which are embedded in or otherwise connected to sleeve 109. Between the pair of arms is a yoke 130. The yoke is positioned by a bellows 132 sensitive to temperature changes. The bellows is connected at the top to the yoke, as at 134, and at the bottom, as at 136, to a carriage 138. The bellows are preferably filled with a gas which is responsive to temperature change in the crude. The unit may be adjusted by moving the bellows in or out on the arms to change the lifting point relative to the outer pivot.

The carriage has opposed lobes, such as at 139, and one lobe has a threaded bore 140 and the other a smooth bore 142. A smooth rod 144 is inserted through the smooth bore and a threaded rod 146 through the threaded bore. The threaded rod has a left-hand thread 150 at one end and a right-hand thread 152 at the other end. The ends of both rods are journaled in passageways, such as at 152 in the mounting brackets. The threaded elongated rod has a screwdriver slot 154 which may be turned so that both carriages move towards or away from each other, as the case may be.

Pins 156 and 158 extend from the bottom legs of the yoke and are adapted to contact the arms 118 and 120. Positioned alongside each arm are blocks 160 and 162 which are connected to the adjoining arms by webs, such

as at 164 and 166. Each block has a well, such as at 167, to seat coil springs, such as at 168 and 170. The final turns at the other end of the spring are seated in grooves 172 and 174 in the top of the piston. The springs are under compression so that they urge the arms 118 and 120 downward.

When the bellows expand due to an increased temperature in the crude, pins 156 and 158 on the legs of the yoke will pivot the arms up against the springs, thereby raising the sleeve 109. When the bellows contract, the springs will move the arms downward, thereby lowering the sleeve to a new position.

In FIGURE 6 another arrangement is shown in which a single coil spring 170 is positioned around a sleeve 172. The spring is normally urged against arms 174, 176 connected to pin 178 on one side, and arms 180, 182 connected to pin 184 on the other side. The bottom turn of the spring is shown seated in the dished bottom of ring or retainer 186. Other schemes are possible. Various types of temperature systems may be associated with the piston to accommodate for temperature change, and the present disclosure refers to one preferred form.

A modified air valve element is shown in FIGURE 7. The head 190 has a passageway 192 and a sleeve 194 is press fitted into this passageway so that it closely coacts with the air valve element 196. This air valve has a reduced upper wall 198 with a shoulder 200. An O-ring seal 202 keeps the fluid in tight engagement between the valve and the sleeve. The air valve has a flange 204 which coacts with O ring seal 206. The air valve element is fixed to rod 208 by threaded engagement 210 and a lock nut 212. The lock nut is adapted to be contacted by the top wall of the piston so that the air valve will move until flange 204 abuts the bottom of sleeve 194. This will open air inlet 214 to admit air through passageway 216 to the top of the piston. At the same time, upper wall 198 of the air valve element will enter passage 218 of plate 220 sealed by O ring 222. The air valve starts to move downward as previously described, whereupon air outlet 224 is opened and the interior of the tank communicates with the outlet by conduits 225. After the air valve has been lowered enough so that air from the inlet can exert pressure to the top of the flange 204, the air valve will "pop" to its lowermost position as flange 204 moves past seal 206.

A superstructure 226 is shown fixed to the head portion by bolts, such as at 228. A spring 230 has its final turns at one end pressed against the top of the superstructure and this spring urges the air valve to hold the rod and plate against the valve seat in the base portion. A passageway 232 in the superstructure permits a reduced portion 234 of the rod to pass therethrough and connect with a counter mechanism, as shown in FIGURES 3, 8 and 9.

The counter 240 has a floor portion 242 which is attached to the head portion of the tank assembly by bolts 228. A cover 246 is preferably hinged to permit access to the units within the counter. A counting rod 248 is fixed at its lower end to the rod 44 of the tank. The counting rod is actuated by the moving air valve which advances a pawl 250 to engage a succeeding tooth of ratchet 252 which rotates about an axis 254 fixed between arms, such as at 256. After the tooth of the ratchet has been engaged, a spring 258 urges the counting rod downward to start the ratchet and actuate a gear train 260 which then operates a counter 262, a totalizer 264 and a printer 266. A slot 268 receives a special card on which a printed record is made of the fluid delivered or pumped in the lease automatic custody transfer unit. The principles and operation of such predetermining counters, totalizers and printers are well known and shall not be described.

In FIGURE 11 I have shown a variant form of air valve in which the piston itself is divided into two, an upper piston 270 and a lower piston 272, the lower piston

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having a threaded lower sleeve or extension 274 which is threaded onto a threaded portion 276 on the piston rod. An extension 278 is also threaded onto the piston rod and is engaged at its lower end by the main piston. The lower piston 272 has two spaced O rings 280 and 282, one above the other, while the upper piston has one O ring toward the top at 284. The upper piston is engaged and biased downwardly by a spring 286 and the top of the piston rod is provided with a stop in the form of jam nuts 288 threaded onto the piston rod and adjustable thereon.

As the main piston comes up while the cylinder is filling with crude, it engages the extension 278 forcing both pistons 270 and 272 upwardly until the bottom O ring 280 on the lower piston rises above the inlet 290 allowing air to enter the top of the cylinder. At the same time that the bottom O ring 280 opens the inlet, the O ring 284 on the upper piston rises above and closes the outlet 292. As air pressure builds in the main cylinder, it also increases under the upper piston through bypass 294 which, when it reaches a point where it overcomes the spring 286, will snap the upper piston up against the stop 288. The forces upward across 270 are balanced by the downward force on 272, but 272 also is influenced by the same upward pressure on its lower face, so that the total force on the valve stem is upward to overcome the load of spring 286.

When the main piston reaches the bottom of its downstroke, it will contact the bottom valve and move the piston rod down. At this point, the upper and lower air pistons 270 and 272 are separated by the air pressure in the main cylinder, which comprises a larger force than spring 286. As the piston rod starts down, the lower piston 272 will move down with it, due to the threaded connection 274, 276 until the lower O ring 280 covers and closes the inlet. Since the upper air piston 270 is against its stop 288 and the stops are connected to the piston rod which moves down, the upper piston will start down too. The dimensioning is such that when the bottom O ring 280 on the lower piston 272 covers the inlet, the O ring 284 on the upper piston will just barely pass below the outlet. It would be more accurate to say that it just clears the outlet port. This will cause a release of the pressure in the main cylinder, and air bleeding back through the bypass 294 and across the top of the upper piston 270 and out the outlet 292. The air in the cylinder continues to expand, since it is under pressure, and this serves to fully seat the main outlet valve 69 in FIGURE 1 against its seat 74. When the air pressure has dropped sufficiently, the spring 286 will take over and will force the upper air piston 270 down against the lower piston 272. This allows the residual air in the main cylinder to be discharged rapidly. Thus, there is no resistance to the crude coming in under the main piston. At the same time, the top spring 284 will hold the valve stem down while the cylinder is filling. And the cycle starts over again.

The use, operation and function of the invention are as follows:

A package lease automatic custody transfer unit is provided which may include a conventional air compressor driven by an electric motor or gasoline engine or any suitable power source. Compressed air may be stored in a suitable tank and supplied on demand to the air valve controlling the lease automatic custody transfer unit.

The unit itself is connected to a lease or gauge tank, for example at 270 in FIGURE 10, and I prefer to have a standpipe 272 in a tank which extends sufficiently high up so that it is above the normal B.S. and W. level. The inlet spring-loaded check valve 84 will require a certain tank pressure head before the crude oil will flow into the housing, for example as indicated at 274, in FIGURE 10. Crude oil flowing in raises the piston and the air valve is in position to vent the top of the piston.

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When the piston reaches the top of the cylinder, it hits the lower extension 50 of the air valve element and raises the center rod 44 thereby reversing the air valve and opening the crude outlet 94. The high pressure air forces the piston down and the check valve 84 in the inlet closes at the same time that the outlet check 96 opens. When the piston reaches the bottom, it will strike the valve plate 67 and the expanding air in the cylinder will close the outlet and at the same time the air valve on top will be reversed. Thus, the top of the piston will be vented at the same time that the crude oil outlet is closed.

The unit should be calibrated to a standard unit of measuring, for example one barrel. This may be done by letting the unit cycle several times after it is connected and adjusting the air valve element on the rod 44 until precisely one barrel is pumped per stroke. Crude oil is always sold at a predetermined temperature, for example 60° F. If it varies from this, the temperature sensing device will automatically sense the temperature of the crude in the housing and the expanding or contracting bellows will move the arms 118 and 120 and thereby lower or raise the sleeve 109. This temperature sensing device in effect determines the extent of the piston travel. In short, the temperature sensing device will make the effective stroke of the piston either slightly longer or shorter than the predetermined volume, for example one barrel, if the crude oil temperature is above or below 60° F.

The air valve is important since it holds the valve in either open or closed position during the up or down stroke of the piston. The counter 240 will register each stroke since the volume displaced by the piston will be a given unit of liquid, for example one barrel. The total volume pumped over an extended period of time will be shown on the counter. A sampler is important since it takes a small volume, say a few cc. from each stroke and collects these in a jar. After an extended period of time, the samples in the jar may be taken and analyzed and the volume pumped by the unit compensated for water content, etc.

The spring-loaded check valves have a differential loading, the outlet valve being somewhat more heavily loaded than the inlet, so that fluid cannot simply flow through without operating the piston. The outlet valve is also sufficiently heavily spring loaded so that it will not open even in the event of suction in the gathering line.

While I refer to the unit displacing one barrel per stroke, it should be understood that it might be any suitable unit of measure. The spring loaded inlet valve guarantees a certain head and gauge or separation tank before the unit will operate. It also limits the need for any sort of an air accumulator ahead of the unit. For example, when the pump from the well stops, the head in the gauge of the separation tank will drop. When it gets to a certain head above the standpipe, the spring-loaded inlet valve will close and the transfer unit will stop. For example, I might set the spring-loaded inlet check valve for a 12 foot head in the tank.

The spring-loaded outlet check valve has a sufficiently heavy spring-loading so that it will prevent flow-through in the event of a vacuum in the gathering line. I also spring-load it sufficiently so that if the air pressure fails and the main piston stops at the top of the stroke, the pressure from the separation or gauge tank will not cause flow-through.

The speed of cycling may be easily and simply varied by throttling either the air inlet or outlet for the air valve to either slow down or speed up the intake and discharge strokes.

The unit also has the advantage that the air will not leak past the main piston into the oil. Leakage can only be the other way and can be easily detected since oil will come out through the air outlet.

Whereas I have referred to crude oil only, it should be

understood that the unit may be used as a meter for any liquid, such as natural gasoline or the like. In that case, the inlet would not be connected to a plant lease tank, but would be connected to a plant run-down stop tank. In general, the unit can be used with petroleum products other than crude oil.

The foregoing invention can now be practiced by those skilled in the art. Such skilled persons will know that the invention is not necessarily restricted to the particular embodiments presented herein. The scope of the invention is to be defined by the terms of the following claims as given meaning by the preceding description.

I claim:

1. In a transfer unit for pumping and measuring crude oil from a lease tank to a gathering system, a housing, a single piston adapted to move back and forth freely in the housing to define intake and discharge strokes, a fluid inlet in the housing communicating with one side of the piston and adapted to be connected to the lease tank, a fluid outlet in the housing communicating with the same side of the piston and adapted to be connected to the gathering system, a source of pressure air connected to the housing communicating with the other side of the piston, an air valve controlling the air supply from the source to the piston, and said air valve also controlling the venting means so that the other side of the piston will be supplied with pressure air for its discharge stroke and will be vented to allow the pressure of the oil in the lease tank to cause its intake stroke, and means responsive to the extremes of piston movement for reversing the air valve at each end of the stroke.

2. The structure of claim 1 further characterized by and including spring loaded check valves in both the fluid inlet and outlet with the loading of the outlet check-valve greater than the loading of the inlet valve so that oil from the lease tank will not go directly from the inlet to the outlet without moving the piston through its intake stroke.

3. The structure of claim 1 further characterized by and including means for varying the effective discharge stroke of the piston, said means automatically responsive to changes of temperature of the oil.

4. In a transfer unit for pumping and measuring crude oil from a lease tank to a pipeline gathering system, a housing, a single piston adapted to move back and forth freely in a housing between inner and outer positions, a fluid inlet in the housing to one side of the piston adapted to be connected to the lease tank, a fluid outlet in the housing to the same side of the piston adapted to be connected to the pipeline gathering system, a source of pressure air connected to the housing on the other side of the piston, means to vent the air from the housing on the other side of the piston, an air valve controlling the air supply from the source to the piston, means responsive to the movement of the piston for operating the air valve when the piston reaches its inner and outer positions so that air from the pressure source will be supplied to the other side of the piston when the piston reaches its outer position to move the piston towards its inner position and for venting the top of the piston when the piston reaches its inner position, so that oil pressure from the tank will move the piston towards its outer position.

5. In a transfer unit for pumping and measuring crude oil from a lease tank to a pipeline gathering system, a housing, a single piston adapted to move back and forth freely in the housing between inner and outer positions, a fluid inlet in the housing to one side of the piston adapted to be connected to the lease tank, a fluid outlet in the housing to the same side of the piston adapted to be connected to the pipeline gathering system, a source of pressure air connected to the housing near the other side of the piston, means to vent the air from the housing on the other side of the piston, an air valve controlling the air supply from the source to the piston, and an extension of the air valve responsive to the movement of the piston

for operating the air valve when the piston reaches its inner and outer position so that air from the pressure source will be supplied to the other side of the piston when the piston reaches its outer position to move the piston towards its inner position and for venting the top of the piston when the piston reaches its inner position so that oil pressure from the base tank will move the piston towards its outer position.

6. In the transfer unit for pumping and measuring crude oil from the lease tank to a pipeline gathering system, a housing, a single piston adapted to move back and forth freely in the housing between inner and outer positions, a fluid inlet in the housing to one side of the piston adapted to be connected to the lease tank, a fluid outlet in the housing to the same side of the piston adapted to be connected to the pipeline gathering system, a source of pressure air connected to the housing on the other side of the piston, means to vent the air from the housing on the other side of the piston, an air valve controlling the air supply from the source to the piston, an elongated rod fixed to the piston, means extending from the air valve responsive to an inner movement of the piston for operating the air valve to connect the source of pressure to the other side of the piston, means on the rod responsive to an outer position of the piston for operating the air valve to close off the source of pressure and to close off the fluid outlet.

7. In a transfer unit, a housing defining a pump chamber, a piston adapted to move back and forth freely in the chamber, an air valve at one end of the housing controlling the movement of the piston and adapted to be connected to a source of pressure air, the air valve including an air inlet for pressure air and an air outlet, a movably mounted valve element constructed to cover the inlet and open the outlet in one position and vice versa, passages connecting the air inlet and outlet to one side of the piston so that the piston will be either supplied with pressure air or vented to the outlet, and a spring biasing the valve element to cover the air inlet and vent the air outlet and calibrated to the force of the air pressure on the valve element when the air inlet is uncovered, such that the valve element will stay in either its open or closed position.

8. In a lease automatic custody transfer unit, a housing, a piston in a housing adapted to reciprocate to define intake and pumping strokes, means for operating the piston, a fluid inlet adapted to be connected to a source of supply, a fluid outlet, means in the piston responsive to changes in fluid temperature to vary the effective pumping stroke of the position, said means comprising a bimetallic bellows, a movable member, linkage means between the movable member and the bimetallic bellows, and a valve adjacent the fluid outlet so that the bimetallic bellows expands or contracts in response to changes in fluid temperature, and actuates the linkage means to raise or lower the movable member whereupon it contacts the valve at different times to close the fluid outlet at different times to change the effective pumping stroke of the piston.

9. A lease automatic custody transfer unit as in claim 8 further characterized in that the bimetallic bellows is gas filled and is adjustably positioned relative to the linkage means to compensate for differences in atmospheric pressure.

10. A lease automatic custody transfer unit as in claim 8 further characterized in that the bimetallic bellows is urged by means within the piston to normally contract.

11. In a lease automatic custody transfer unit, a housing, a piston in a housing adapted to reciprocate to define intake and pumping strokes, means for operating the piston, a fluid inlet to be connected to a source of supply, a fluid outlet, temperature control means associated with the piston, said means including an arcuate member in the piston, a bimetallic bellows, linkage means connecting the bimetallic bellows to the arcuate member,

means urging the bellows towards a contracted position, and a valve adjacent the fluid outlet, so that the bimetallic bellows expands or contracts in response to changes in fluid temperature, and actuates the linkage means to raise or lower the arcuate member whereupon it contacts the valve at different times to close the fluid outlet at different times to change the effective pumping stroke of the piston.

12. In a lease automatic custody transfer unit, a housing, a single piston adapted to move back and forth freely in the housing to defined intake and pumping strokes, means to move said piston through pumping strokes, a fluid inlet in the housing to one side of the piston adapted to be connected to the lease tank, a fluid outlet in the housing to the same side of the piston adapted to be connected to the pipeline gathering system, means in the piston responsive to changes in fluid temperature for varying the effective pumping strokes of the piston, a valve controlling the fluid outlet, an abutment on the piston for contacting the fluid outlet valve to close it at

the end of the piston's pumping stroke, and said means responsive to changes in the temperature of the fluid in the housing being formed and adapted to variably position the abutment so that the time of closing of the outlet valve and therefore the effective pumping stroke of the piston, will depend on fluid temperature.

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