At the present time there is being used large quantities of a liquid fuel known as propane and formed by the compression of natural gases and the like. This liquid is ordinarily compressed at the source of supply of the gas and forced into tank cars and from there shipped to the distributing points. At the distributing points this liquid fuel is pumped into cylindrical containers and in this manner is delivered to the consumers.

With the apparatus now in use there is a very substantial loss, and this loss occurs for the following reason. With the pumping apparatus now in use and as the liquid fuel is being pumped from the tank car a space is thereby formed within the tank car and the liquid fuel expands in the form of a gas and fills the entire interior of the car when the liquid has been removed, and with the apparatus for pumping the liquid now in common use it is impossible to pump the gas from the tank car. These tank cars in some instances contain ten thousand gallons of liquid fuel, and with my improved pump device I can re-condense approximately two hundred gallons of the liquid from the expanded gases within such tank cars.

With the pumps now in common use for this purpose, and after the liquid contents of the tank car have been removed and it is attempted to use the same pump for compressing the remaining gas into liquid, I have found that the heat generated by such compression soon dries up the lubricants necessary for the operation of a piston pump of this character and thereby causes the piston rings to score the interior of the cylinder, and for this reason the operators of these devices at the present time do not make any attempt to re-condense the gas within the tank car.

The object of my invention is to provide a pump of simple and inexpensive construction which may be operated in the ordinary manner to remove liquid from the interior of a tank car, and then it may continue to operate as a compressor for re-compressing the gas within the tank car, thus effecting a substantial saving in the handling of such liquid fuels.

In the accompanying drawing Figure 1 shows a vertical longitudinal sectional view of a pump embodying my invention;

Figure 2 shows an enlarged detail sectional view on the line 2—2 of Figure 1;

Figure 3 shows an enlarged detail sectional view of a portion of the cylinder and piston and illustrating a section of the packing and lubricating device;

Figure 4 shows a view similar to Figure 3 except that the piston is omitted, and illustrating a modification; and

Figure 5 shows a sectional view on the line 5—5 of Figure 4.

The reference numeral 10 indicates a pump cylinder of ordinary construction having a cylinder head 11 at each end. The cylinder and the cylinder heads are formed with water jackets 12 of ordinary construction. At one end of the cylinder there is an intake valve device indicated generally by the reference numeral 13, and adjacent thereto is an exhaust valve device indicated by the numeral 14. These valve devices are of ordinary construction and communicate through the passageways 15 with the interior of the cylinder.

In the drawing I have shown a cylinder head at each end of the cylinder, and intake and exhaust valve devices in both cylinder heads, thus making a double-acting pump, but, obviously, the cylinder head at one end need not be provided and the device would then operate as a single-acting pump.

A piston rod 16 is extended through the cylinder head 11 and passes through a packing gland 17 of ordinary construction. This piston rod, or at least that portion which enters the cylinder head, is formed hollow, as shown at 18, and communicating with this hollow portion is a discharge passageway 19. The piston is driven by the usual connecting rod 20 and crank shaft 21. The piston 22 is cylindrical and is formed hollow, and is closely fitted to the interior of the cylinder. Its end adjacent the cylinder head is flat, and the corresponding surface of the cylinder head is also flat, and the parts are so arranged that there is a closed clearance between the cylinder head and the adjacent end of the piston when the piston reaches the effective end of its stroke.

At the opposite end of the piston there is a pipe 23, preferably connected to the piston extended through the opposite cylinder head, and this pipe is designed to conduct cooling liquids from the exterior of the cylinder to the interior of the piston. I have not shown any means for causing the circulation of this cooling liquid as that may be done with any of the devices now in common use for such purposes.

At a point at the longitudinal center of the cylinder on its interior I have formed a packing groove 24, and a passageway 25 extends through this packing groove to the exterior of the cylinder, and a lubricating fitting 26 of any ordinary type...
is placed in said passageway 25. Within the interior of the groove are two packing rings 27. These rings are preferably made of rather flexible yielding packing material. The packing rings 28 are spaced apart a considerable distance, and a fibre ring 29 is placed in engagement with the inner edge of each of the packing rings, and between the fibre rings 29 I have placed an extensible coil spring 30 which normally forces the fibre rings 28 against the packing rings 27 to compress them in the packing groove and hold them in tight-fitting engagement with the smooth outer surface of the piston 20.

In the modification shown in Figures 4 and 5 I have shown only one flexible packing ring 27 at one end of the annular groove formed on the interior of the cylinder 10 at its central portion instead of the two rings shown in Figure 3. Instead of the expansible coil spring 29 shown in Figure 3 I have shown in Figures 4 and 5 a manually operable positive acting packing ring compressor, as follows: Within said groove in the cylinder; and at one side of the packing ring 22 I provide an annular collar 30 having on its outer surface a screw-threaded rib 31, in mesh with a worm gear 32 on a rod 33 which is extended to the exterior of the cylinder where it may be reached for manual manipulation. The inner surface of the collar 30 is circumferentially screw-threaded. Mounted within the collar 30 is a second annular collar 34, screw-threaded to cooperate with the screw-thrads of the collar 30. At one end thereof is a head 35 which engages the adjacent surface of the packing ring 27. This head 35 is provided with ports 36 leading from the lubricant passageway 25 to the packing ring 27.

In practice, with this form of my invention and in the event of leakage past the packing ring 27 the operator turns the worm gear 32 in the direction for screwing the head 35 toward the packing ring 27, and this is continued until leakage is reduced to a workable minimum. In view of the fact that this adjustment may be made while the pump is operating, the operator, when he discovers a substantive leakage, may make this adjustment and continue the compression of the packing 27 until the leakage is controlled and without danger of compressing the packing too tight as to cause the piston to stick.

In practice use the operator first connects the pump with the interior of the tank car or other receptacle from which the liquid fuel is to be pumped, and then proceeds to pump it in the ordinary manner from the receptacle and force it into smaller receptacles. During this operation, and as the amount of space within the large receptacle increases, the liquid fuel will gasify and fill the space with expanded gas. With my improved pump, and when the liquid has all been pumped from the receptacle, the operator simply continues the operation of the pump and, as is well known, when the gases are compressed by a pump into liquid form a great amount of heat is thereby generated. With my pump a large amount of this heat is carried away by the cooling liquids within the piston and cylinder jacket, and this cooling of the piston and cylinder jacket aids in the compression or condensation of the gas, and, furthermore, this re-compression of the gas is made possible and commercially practicable because the packing is all contained within a groove in the cylinder, to which lubricating oil may be constantly supplied through the ordinary lubricating devices, and this is not possible where the packing devices are provided in the pistons, such as ordinary piston rings.

Furthermore, this compression of the gases is made commercially practicable because with the use of the cylinder and piston kept constantly under compression and expanded against the piston, the tight fit required for gas compression is obtained. At the same time, even though considerable heat is generated, the piston and cylinder would not be scored or injured by the packing devices.

I claim as my invention:

1. A pump for compressing gas to liquid form, comprising a cylinder, an inlet valve device and an exhaust valve device communicating with the interior of the cylinder at its ends, a hollow piston in the cylinder, a hollow piston rod extended through the head fixed to and communicating with the hollow interior of the piston, a pipe communicating with the opposite end of the piston, said parts being so arranged that liquids for cooling purposes may be circulated through the interior of the piston, the piston rod and said pipe during the operation of the piston, said cylinder having formed on its interior a packing groove, adjacent the central portion of the piston when at the central portion of its stroke, a piston packing in said groove, and means for conducting lubricants to said groove.

2. A pump for compressing gas to liquid form, comprising a cylinder, an inlet valve device and an exhaust valve device communicating with the interior of the cylinder at its ends, a hollow piston in the cylinder, a hollow piston rod extended through the head fixed to and communicating with the hollow interior of the piston, a pipe communicating with the opposite end of the piston, said parts being so arranged that liquids for cooling purposes may be circulated through the interior of the piston, the piston rod and said pipe during the operation of the piston, a packing between the cylinder and piston, and means for conducting lubricants to said packing.

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