Sept. 4, 1945. W. L. ALBERT, JR 2,384,227

HYDRAULIC GOVERNOR VALVE

Filed Jan. 3, 1944

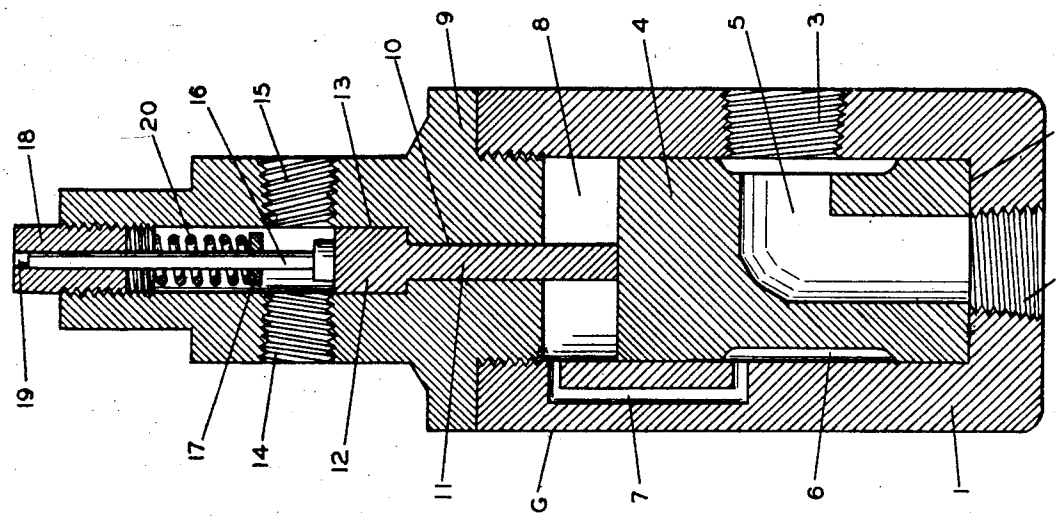


FIG. - 2

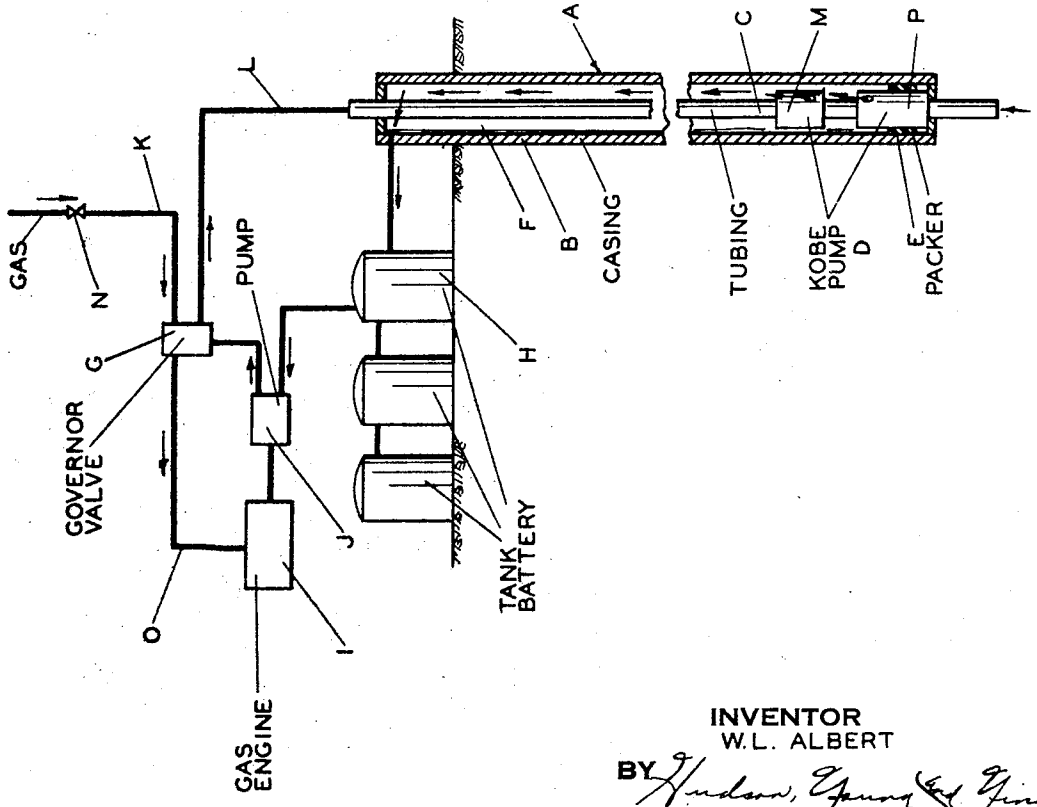


FIG. - 1

INVENTOR
W.L. ALBERT

BY Hudson, Young & Linger

ATTORNEYS

Patented Sept. 4, 1945

2,384,227

UNITED STATES PATENT OFFICE

2,384,227

HYDRAULIC GOVERNOR VALVE

Walter L. Albert, Jr., Seminole, Okla., assignor to Phillips Petroleum Company, a corporation of Delaware

Application January 3, 1944, Serial No. 516,798

6 Claims. (Cl. 103—22)

This invention relates to a mode of operation for a "Kobe" pump and provides a governor valve which operates to close off the supply of fuel to the engine operating the pump to force liquid down the well to operate the pump within the well in the event of a break anywhere in the system.

In the production of wells at certain periods of the oil well's life it is economical to use a Kobe pump in lifting the oil to the surface of the ground. This period is generally immediately after the well has ceased to lift the fluid to the surface of the ground by its own energy. The well will have a high fluid level and it will be necessary to use some secondary means to lift the oil from the well. Various pumping means are employed, some of which are pumps operated on a gas-lift principle, the Reda pump which is a submerged electrically operated pump, a fluid operated pump such as the Kobe and sucker rod pumps. The present invention deals only with the Kobe pump.

In the operation of the Kobe pump, the pump is placed in the well suspended from tubing and a packer seals the space between the pump and the casing. Generally the pump comprises a fluid motor to which a pump of the reciprocating type is attached, the motor being operated by fluid forced down through the tubing from the surface of the ground. The motive fluid used is the crude oil being produced from the well after it has had a thorough cleaning on the surface of the ground to remove sand and grit, and also any water being produced along with the oil. The exhaust from the fluid motor is discharged into the flow line leading from the pump in the well bore and comes back to the surface of the ground with the fluid being pumped from the well bore.

The present invention adds a governor valve to the flow system of a Kobe pump to slow or shut down the prime mover on the surface of the ground on a single well or to act as a pilot valve to actuate a pilot operated valve to decrease or stop the flow of power oil to a Kobe pump operating in a well bore or to stop a Kobe pump operating from a manifold system in which several pumps are being powered from a single prime mover in the event that any one of several abnormal conditions occur.

The abnormal conditions which can occur in a well's operation are many and in every case, it is desirable to close off the operation of the Kobe pump when these abnormal conditions occur. It is desirable that this be done automatically since the operation of the Kobe pump does not require that an attendant be present at all times. Some of the abnormal conditions which may occur in the operation of a well are listed:

(1) The power oil tubing leading from the surface of the ground to the pump in the well bore may become broken;

(2) The production tubing leading from the pump in the well bore to the surface of the ground may become broken;

(3) The liner in the pump in the well bore may become broken;

(4) A split pump dash pot may occur in the pump in the well bore;

(5) The pump in the well bore may develop a broken middle rod;

(6) The seats of the pump in the well bore may cut out.

(7) The liquid level in the well bore may become pumped down and go below the level of the pump in the well bore;

(8) A sudden burst of gas may come into the well bore and either gas lock the pump in the well bore or produce a highly gaseous liquid;

(9) The well may suddenly develop enough pressure in the formation to lift the fluid in the well bore to the surface of the ground without the aid of the pump;

(10) Any condition causing decrease in the pressure or increase in the volume required during regular operations of the pump within the well bore.

It is an object of the invention to provide a control means in the closed circuit of the operation cycle of a Kobe pump, to close off the prime mover on the surface of the ground in the event of a drop of pressure in the circuit.

It is a further object to provide a governor valve in the closed circuit of the operation cycle of a Kobe pump, which governor valve operates to close off the supply of fuel to the prime mover on the surface of the ground when a break occurs anyway in the closed circuit which in turn reduces the pressure in the closed circuit.

Other objects and advantages will be apparent from a study of the annexed specification when taken in conjunction with the accompanying drawing of which,

Figure 1 is a schematic diagram showing the closed circuit of the operation cycle of the Kobe pump;

Figure 2 is a sectional view of the governor valve shown at G in Figure 1.

Referring to Figure 1, A represents generally the well bore having casing B and tubing C

extending into the well bore A within the casing B. The tubing C carries the Kobe pump D which is made up of the motor M and the pump P. A packer E seals the space between the casing B and the tubing C, to provide a space F to conduct the fluid from the well to the tank batteries H. From tank batteries H, clean oil is taken to pump J which is actuated by the gas engine I and said oil is pumped down the tubing C to actuate the motor M of the Kobe pump.

The outlet of the pump J connects with the governor valve G, the flow from pump J going into the bottom of the valve and out the side into line L which connects with the tubing C. Gas as fuel to operate the gas engine I comes through line K and valve N into the top of the valve G where it leaves by line O and goes to the gas engine I for use as fuel.

Turning now to Figure 2, the valve G is shown in detail and comprises a housing 1 having a screw threaded opening 2 to receive the connection between the surface pump J and the valve G. The screw threaded opening 3 connects with the line L. A piston 4 is slidable up and down within the housing 1 and has the port or conduit 5 therein which connects the openings 2 and 3 so as to extend the conduit for the pressure oil through the valve G. The piston has an annular space 6 entirely surrounding the piston 4 which annular space connects with a passageway 7 in the housing 1. The space 6 connects with the opening 3 which allows the pressure fluid to flow around the space 6, thence into the passageway 7, and into the space 8 above the piston 4. The top of the housing is closed by the bonnet member 9 which screw threads into the top of the housing 1. The bonnet member 9 has a central bore 10 which receives the projection 11 which is an integral part of the piston 4. The projection 11 is enlarged at the point 12 and seats in an enlarged socket 13 in the bonnet 9. Above the socket 13 are two screw threaded openings 14 and 15; the opening 14 receiving the pipe K and the opening 15 receiving the pipe O and carrying the gas fuel through the governor valve G to the gas engine J.

The projection 11 with enlarged portion 12 continues as an integral projection at 16; however, the projection is greatly reduced in diameter over the enlargement 12 and is about half the diameter of the projection 11. Above the openings 14 and 15, the projection 16 has a shoulder portion 17. The top of the bonnet 9 is closed by the cap 18 which has a bore 19 to receive slidably the top of the projection 16. Between the bottom of the cap 18 and the shoulder 17 is placed a coil spring 20. The tension on coil spring 20 can be varied by screwing up and down on the cap member 18. The ends of the coil spring 20 are rigidly attached, one end to shoulder 17 and the other end to the bottom of the cap 18. When the piston 4 is pushed all the way downward, the lower end of the piston seals on the seat 21 in the lower portion of the housing 1.

In operation, before the pump J and the gas engine I are started, the cap 18 is screwed down, thus compressing the spring 20 against the shoulder 17 and forcing the enlarged portion into the socket 13 and the piston 4 onto the seat 21. The cap 18 thus locks the piston 4 on the seat 21 and insures that the passage 5 in piston 4 connects the jump J and conduit L. Likewise, the enlarged portion 12 is in the socket 13, thus insuring that the passageway between the connections 14 and 15 is open to allow the gas to pass from conduit K to conduit O. After the pump J is operating for a period of time, the cap 18 is unloosed and the governor valve is unlocked. The cap 18 is adjusted, regulating the tension on the spring 20 so as to have a balanced condition in the upper part of the valve.

Oil under pressure to operate the Kobe pump D in the well bore A is now flowing into the valve G at 2 through the passageway 5 in the piston 4 and out the outlet 3 into the line L. The oil under pressure enters the annular space 6 between the piston 4 and the housing 1, travels through the port or passageway 7 and enters the space 8 above the piston. The area on top of the piston 4 is exposed to the same pressure as exists in the passageway 5. The area on top of the piston is greater than the area in passageway 5 exposed to the same pressure, hence the resultant force acts to force the piston 4 onto the seat 21 in a sealed relationship. The cap 18 is adjusted so that the tension in spring 20, which tension force acts in an opposite direction to the hydraulic force operating on the top of piston 4, is just sufficient to allow the piston 4 to "float" or be in hydraulic balance. At the same time, the gas passage is unimpeded by the enlarged portion 12 which allows the gas to flow to the gas engine I.

If for any reason the pressure in the oil lines L and C declines suddenly or the volume demanded by the pump D increases, the differential in pressure across the space 6 of the ported piston 4 increases rapidly resulting in a decreased force on top of the piston 4, inasmuch as the pressure in the chamber 8 is the same as that at the point 3. Since the system was in hydraulic balance, the spring tension is sufficient to overcome the decreased force acting on the top of piston 4, hence the piston 4 now rises, which movement is transmitted through the extension 11 and enlargement 12 to close off the entrance 14 and exit 15 for the gas flowing to the gas engine I which ceases to operate due to the lack of fuel. The equipment can then be inspected to determine what has gone wrong. In a like manner, a gradual pressure decline or volumetric increase in the downstream side of the oil under pressure would result in throttling the fuel supply to the engine I, thereby reducing its speed to a point where the damage to the subsurface pump would be minimized.

While the description of a particular embodiment of the invention has been limited to one Kobe pump in a well with one surface unit to supply said Kobe pump, it is to be understood the principles of this invention can be applied to a series of Kobe pumps in a series of wells with only one surface unit to service all the pumps.

Having thus described the invention, I wish to claim:

1. In the production of oil from an underground reservoir through a cased well bore, the combination comprising a fluid motor having a pump attached thereto suspended from tubing within the cased well bore, a packer between the pump and the casing thus closing off the space between the casing and tubing at the bottom of the well bore and making a conduit to the surface of the ground, storage tanks connecting with the space between the casing and the tubing, a pump on the surface of the ground actuated by an engine pumping oil from the storage tanks into the tubing to actuate the fluid motor in the well bore, a governor valve in the

line between the pump outlet on the surface of the ground and the tubing, a line supplying fuel to the engine also passing through said governor valve, each passage through the governor valve being controlled by a close off valve, and means within the governor valve which operates to close off the valve in the fuel flow line in the governor valve upon a decrease of pressure in the fluid flow line passing through the governor valve which in turn causes the engine to cease operation.

2. In the production of oil from an underground reservoir through a cased well bore, the combination comprising a fluid motor having a pump attached thereto suspended from tubing within the cased well bore, a packer between the pump and the casing thus closing off the space between the casing and tubing at the bottom of the well bore and making a conduit to the surface of the ground, storage tanks connecting with the space between the casing and the tubing, a pump on the surface of the ground actuated by a gas engine pumping oil from the storage tanks into the tubing to actuate the fluid motor in the well bore, a governor valve in the line between the pump outlet on the surface of the ground and the tubing, a gas line supplying gas to the gas engine also passing through said governor valve, each passage through the governor valve being controlled by a close off valve, the pressure of the fluid under pressure passing through the governor valve operating to hold the valve controlling this passageway open and spring means in the governor valve under tension operable upon a decrease in pressure in the pressure fluid line to close off the valve controlling the gas flow line and thus in turn cause the gas engine to cease operating.

3. In the production of oil from an underground reservoir through a cased well bore, the combination comprising a fluid motor having a pump attached thereto suspended from tubing within the cased well bore, a packer between the pump and the casing thus closing off the space between the casing and tubing at the bottom of the well bore and making a conduit to the surface of the ground, storage tanks connecting with the space between the casing and the tubing, a pump on the surface of the ground actuated by a gas engine pumping oil from the storage tanks into the tubing to actuate the fluid motor in the well bore, a governor valve in the line between the pump outlet on the surface of the ground and the tubing, a gas line supplying gas to the gas engine also passing through said governor valve, each passage through the governor valve being controlled by a close off valve, said valves being mounted on a common shaft and operating in conjunction, the pressure of the fluid under pressure passing through the governor valve operating to hold the valves open and spring means in the governor valve under tension operable upon a decrease in pressure in the pressure fluid line to close off the valves controlling the passages in the governor valve thus cutting off the supply of gas to the gas engine which ceases operation.

4. A governor valve structure comprising a housing, openings in the housing to connect a fluid pressure flow line through the governor valve, a piston slidable in the housing having a passage in the body of the piston to align with the openings in the housing to carry the fluid pressure flow through the governor valve, a bonnet attached to the top of the housing having a passageway through the bonnet, a valve means in the bonnet attached to the piston in the housing and movable therewith to close off the bonnet passageway, passageways in the housing connecting the top of the piston with the fluid under pressure flowing through the housing openings and piston, said fluid under pressure holding the piston in open position to allow flow of pressure fluid through the bonnet passageway, and means within the bonnet operable upon a decrease in the fluid under pressure flowing through the passageway in the piston to close the valve controlling the passageway in the bonnet.

5. A governor valve structure comprising a housing, openings in the housing to connect a fluid pressure flow line through the governor valve, a piston slidable in the housing having a passage in the body of the piston to align with the openings in the housing to carry the fluid pressure flow through the governor valve, a bonnet attached to the top of the housing having a passageway through the bonnet, a valve means in the bonnet attached to the piston in the housing and movable therewith to close off the bonnet passageway, passageways in the housing connecting the top of the piston with the fluid under pressure flowing through the housing, said fluid under pressure holding the piston in open position to allow flow of pressure fluid through the bonnet passageway, and spring means within the bonnet under sufficient tension to be operable upon a decrease in the fluid under pressure flowing through the passageway in the piston to close the valve controlling the passageway in the bonnet.

6. A governor valve structure comprising a housing, openings in the housing to connect a fluid pressure flow line through the governor valve, a piston slidable in the housing having a passage in the body of the piston to align with the openings in the housing to carry the fluid pressure flow through the governor valve, a bonnet attached to the top of the housing having a passageway through the bonnet, a valve means in the bonnet attached to the piston in the housing and movable therewith to close off the bonnet passageway, passageways in the housing connecting the top of the piston with the fluid under pressure flowing through the housing, said fluid under pressure holding the piston in open position to allow flow of pressure fluid through the bonnet passageway, a cap member on top the bonnet to mechanically hold both valves open, a spring means between the cap member and the valve in the bonnet placed under tension by the cap member and said spring acting to close the valve in the bonnet upon a decrease in the fluid under pressure flowing through the passageway in the piston.

WALTER L. ALBERT, Jr.