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SELF-COOLED OIL WELL POLISH ROD STUFFING BOX

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ABSTRACT OF THE DISCLOSURE

A cooling chamber is disposed coaxially between two polish rods to form a housing adapted to receive a moving polish rod. Input and output supply lines having oppositely opening one-way valves communicate between the cooling chamber and the interior of the production tubing in an oil well to circulate the production fluid through the cooling chamber as the pressure in the production tubing is altered by the pumping motion of the polish rod.

BACKGROUND OF THE INVENTION

Field of the invention

The invention pertains generally to oil well production equipment and in particular to a new and improved oil well polish rod stuffing box employed in oil well pumping installations.

After completion of an oil well, it is usually necessary to pump the oil up from its subsurface deposit through the production tubing. For this purpose, a pump is generally positioned within the tubing below the level of the oil. The pump is driven from the surface by a "pumping jack" through a reciprocating linkage of "sucker rods" moving through the tubing. The upward movement of the sucker rods co-operates with the pump to lift the oil through the tubing and push it into an above surface flow line which is secured to the wellhead by a pumping T. The pumping T is equipped with means which provides packing about the reciprocating sucker rods to permit the sucker rod linkage to communicate between the pumping jack and pump through the pumping tee without the loss of any of the oil which is being produced. That attachment or portion of the pumping T which provides the packing around the reciprocating rod is called a "stuffing box," while that portion of the reciprocating sucker rod linkage which slides through the packing is called a "polish rod."

In many of the known stuffing boxes, the sliding movement of the polish rod through the packing in the stuffing box generates a great deal of harmful frictional heating which may cause leakage through rapid wear or destruction of the packing material and which may also cause damage to the polish rod. Periodic inspection of such stuffing boxes is required to reduce production loss and damage to the pumping equipment which may occur when a rod has been destroyed or the packing begins to leak from wear. The frequent need to inspect and replace damaged rods or worn packing increases production expenses and contributes to costly periods of nonproduction.

Description of the prior art

Certain prior art devices have attempted to reduce the undesirable frictional heating and wear by lubricating the stuffing box. Such prior art devices have generally been relatively complex and have not satisfactorily achieved the desired cooling and lubrication. Some of such devices have required external reservoirs of lubricating fluid which required frequent refilling or have required periodic inspection and attendance due to the relatively complicated apparatus employed. Another drawback in many of the prior art devices which have attempted to reduce frictional heating and wear has been that the pumping equipment must be shut down for an undesirably long period during the initial installation of the equipment or for any subsequent maintenance.

SUMMARY OF THE INVENTION

The self-cooled stuffing box of the present invention uses the high pressure in the production tubing to cause the production fluid to flow into a cooling chamber through an inlet supply line which is equipped with a one-way valve. A return line is connected to the production tubing to provide an outlet for the fluid contained in the cooling chamber when the well pressure is reduced during the low pressure portion of the pumping cycle. A second one-way valve in the return line co-operates with the valve action in the inlet line to provide circulation of fluid through the cooling chamber to carry away the frictional heat generated in the stuffing box. The stuffing box is also designed to leave a reserve of fluid in the cooling chamber to lubricate the polish rod during periods when the well is pumped dry or when the pump fails or where for any other reason there is no fluid present within the pumping T.

The relative simplicity of the stuffing box of the present invention as well as its use of readily available components reduces the total cost of the box and also assures ease of installation as well as a lower frequency of repair rate. Due to the self-contained aspect of the stuffing box of the present invention, periodic restocking of the lubricating fluid is not required. The stuffing box of the present invention has an increased life and provides a minimum of lost production time during the replacement of the packing or during the repair or initial installation of the equipment.

It is therefore an object of the present invention to provide an improved stuffing box which is self-lubricating and self-cooled. This object and other objects will become more apparent from the following description and drawings.

DESCRIPTION OF THE DRAWING

The figure is an elevation partially in section illustrating the self-cooled oil well polish rod stuffing box of the present invention mounted in position on a pumping T.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in the figure of the drawing, the stuffing box of the present invention comprises a hollow metal body or housing indicated generally at 10 which is coaxially mounted about a section of polish rod R. Two packing chambers 10a and 10b are formed at the axial ends of the housing 10 and a cooling chamber 10c is centrally disposed between the packing chambers 10a and 10b. The packing chambers 10a and 10b have an interior cylindrical wall with threads 10a and 10b, respectively, formed on their outermost ends. The innermost ends of the packing chambers 10a and 10b abut packing stops 10f and 10g. The stops 10f and 10g are centrally apertured at 10h, and 10i, respectively, with the openings having diameters greater than the diameter of the rod R to prevent any metal to metal contact between the housing 10 and the moving rod R. The cooling chamber 10c is cylindrical shaped with the diameter of the interior cylindrical surface of the chamber 10c being greater than the internal diameter of the packing chambers 10a and 10b.

The packing chambers 10a and 10b contain several stacked sections of split ring asbestos packing P which firmly engage the polish rod R to form a seal between the moving rod R and the housing 10. The packing P is held in compression in the chamber 10a by a packing collar 11 to force the packing P to bear tightly against the
The packing collar 11 is equipped with threads 11a which mate with the internal threads 10a of the packing chamber 10a. The collar 11 may be backed off from the housing 10 or adjusted to alter the compression of the packing P with the assistance of a wrench or the like acting on a wrench surface which is provided on the collar at 11b. A lock ring 12 with internal threads 12a engages the threads 11a of the collar 11 to prevent undesired movement of the collar 11 with respect to the housing 10. The lock ring 12 is equipped with an external wrench surface 12b to assist in tightening the ring against the housing 10.

The packing P in the packing chamber 10b is held in position with a threaded adapter nipple 13 having threads 13a which engage the internal threads 10c of the lower packing chamber 10b. The adapter nipple 13 is locked in position by a lock ring 14 having threads 14a which engage the threads 13a of the adapter nipple 13. The lock ring 14 is provided with wrench surfaces 14b to which a wrench may be applied to assist in securing the ring 14 against the housing 10.

The lower end of the adapter nipple 13 is provided with threads 13b which engage internal threads 114a formed in the upper end of a pumping T 114. A central unthreaded body portion of the adapter nipple 13 is tapped by two smaller threaded nipples 15 and 16. One end of the nipples 15 and 16 communicates with the interior of the adapter nipple 13 to provide a space between the fluid contained within the adapter nipple 13 and the cooling chamber 10 while the second ends, respectively, of the nipples 15 and 16 engage the control valves 17 and 18. The opening through the valve 17 may be adjusted or entirely closed by rotating the handle 17a. Similarly, rotation of the handle 18a adjusts or closes the valve opening in the valve 18.

The valve 15 and valve 17 form the first part of an inlet supply line indicated generally at 19. The supply line 19 carries the production fluid contained within the adapter nipple 13 to the upper portion of the cooling chamber 10c. A one-way check valve 20 is connected between the valve 17 and a small T fitting 21 to permit the production fluid to flow only in the direction of the arrow. The T fitting 21 carries a standard grease fitting 22 for a purpose to be hereinafter described. The upper end of the T fitting 21 is connected to a high pressure, flexible line 23 which in turn is connected to an elbow 24. The elbow 24 opens into the approximate mid point of the interior of the cooling chamber 10c.

The nipple 16 and valve 18 form a portion of a return line, indicated generally at 25, which conducts fluid from the interior of the cooling chamber 10c to the interior of the adapter nipple 13. The valve 18 is connected to a one-way check valve 26 which permits the production fluid to flow only in the direction of the arrow. The upper end of the check valve 26 is connected to a high pressure, flexible line 27 which in turn is connected to an elbow 28. The elbow 28 opens through the housing 10 into the upper end of the interior of the cooling chamber 10c.

In the operation of the self-cooled stuffing box 10 of the present invention, the pump placed in the oil well is driven by a pumping jack (not shown) causing the polish rod R to reciprocate vertically through the box 10. As the rod R moves on the upward stroke of its cycle, the pressure of the fluid (which includes gas and air bubbles) within the pumping T 114 increases and forces fluid through the check valve 20 in the supply line 19 and into the cooling chamber 10c. On the downward stroke of the pump cycle, the pressure in the pumping T decreases without altering the pressure of the gas and fluid in the cooling chamber 10c causing a portion of its contents to flow back into the pumping T.

The fluid in the chamber 10c lubricates a section of the rod R as it reciprocates through the chamber. The lubrication is carried along the rod to reduce the friction and resultant frictional heating and wear caused by the rubbing seal action of the packing P against the rod R. The stuffing box 10 and rod R are cooled by fluid from the production tubing which enters the chamber 10c through the supply line 19 where it is heated by the fric tionally generated heat in the box 10 and rod R and is then carried away from the chamber 10c through the return line 25.

The valves 17 and 18 may be adjusted as desired to regulate the rate of fluid circulation through the cooling chamber 10c. The valves 17 and 18 may be completely closed to permit testing, inspection or repair.

As illustrated in the drawing, the return line 25 communicates with the upper end of the interior of the cooling chamber 10. When for any reason the pumping action shall fail to provide fluid at the interior of the nipple 13, the fluid below the level of the upper end of the line 25 in the cooling chamber 10c forms a reservoir of fluid which continues to provide lubrication for the moving rod.

The grease fitting 22 is a standard fitting having a one-way action which permits fluid to be introduced into the T fitting 21 and supply line 19 but prevents an opposite escaping flow of the contents of the T. The grease fitting 22 is used to prime the chamber 10c with a lubricating fluid after the initial installation of the stuffing box 10, or it may be employed to supply the cooling chamber 10c with a lubricant when there is no production fluid in the chamber 10c.

Replacement of the worn packing P in the upper packing chamber 10a is easily effected by simply closing the valve 17 releasing the lock ring 12 and unscrewing the packing collar 11 from the housing 10. The collar 11 and ring 12 are lifted up along the rod R; the worn packing is removed from the packing chamber 10a and replaced with new packing. The packing P is preferably in the form of semicircular ring segments so that the packing may be placed in the packing chamber without removal of the rod R. When the desired number of layers of new packing P have been placed in the packing chamber 10a, the collar 11 is threaded back into the housing 10 and secured by the lock ring 12.

The replacement procedure for the packing P in the lower packing chamber 10b requires that the pumping action be stopped, the flow line closed off, and the pressure in the production tubing reduced. The supply line 19 and return line 25 are separated to break the linkage between the adapter nipple 13 and the housing 10. The lock ring 14 is then loosened and the housing 10 is unscrewed from the threads 13a of the adapter nipple 13. The housing 10 may then be lifted up along the rod R to permit the worn packing P to be replaced. The housing 10 is then rethreaded onto the adapter nipple 13 and secured by tightening the lock ring 14.

While only the preferred form of the invention has been described herein, it is understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention. Thus, by way of example rather than limitation, by minor adaptation, the nipples 15 and 16 may be connected into the lower portion of the housing 10 rather than the adapter nipple 13 so that the packing in the lower chamber 10b may be removed without first separating the supply line 19 and the return line 25; the elbows 24 and 28 may be introduced into the cooling chamber 10c at different levels to alter the amount of fluid exchange during each pumping cycle to thereby change the rate of cooling or the level of the lubricating reservoir.

Certain elements of the described structure may be omitted or varied in the operation of the device although in the preferred embodiment all of the basic elements described are desirable.

I claim:

1. A self-cooled stuffing box comprising:
(a) a housing means disposed above a pumping T for receiving a polish rod reciprocably movable therein;
(b) first and second longitudinally spaced packing chambers formed in said housing means and each having packing therein for sealing engagement with said polished rod;
(c) a central cooling chamber formed in said housing means disposed between said first and second packing chambers;
(d) a supply line having first and second ends with said first end of said supply line communicating with the interior of said cooling chamber and with said second end communicating with the interior of said pumping T for supplying fluid therefrom upon longitudinal movement of said polished rod in one direction;
(e) a return line having first and second ends with said first end of said return line communicating with the interior of said cooling chamber and with said second end communicating with said interior of said pumping T for returning fluid from said chamber to said pumping T upon longitudinal movement of said polished rod in the opposite direction;
(f) one-way check valve means between said first and second ends of said supply line for permitting fluid flow through said supply line in only the one direction from said pumping T to said cooling chamber; and
(g) one-way check valve means between said first and second ends of said return line for permitting fluid flow through said supply line in only the one direction from said cooling chamber to said pumping T.

2. The self-cooled stuffing box as defined in claim 1, including:
(a) adapter nipple means secured to the lower end of said housing means for connecting said housing means to said pumping T;
(b) means for communicating said second end of said supply line with the interior of said pumping T through said adapter nipple means; and
(c) means for communicating said second end of said return line with the interior of said pumping T through said adapter nipple means.

3. The self-cooled stuffing box as defined in claim 2, including:
(a) internally threaded surfaces on said first and second packing chambers;
(b) a packing collar having external threads engaging the internal threads of said first packing chamber; and
(c) external thread means formed on said adapter nipple means for engagement with the internal threads of said second packing chamber.

4. The self-cooled stuffing box as defined in claim 3, including:
a control valve means between the first and second ends of said supply line for manually regulating the rate of fluid flow through said supply line.

5. The self-cooled stuffing box as defined in claim 3, including:
a control valve means between the first and second ends of said return line for manually regulating the rate of fluid flow through said return line.

6. The self-cooled stuffing box as defined in claim 4, including:
a control valve means between the first and second ends of said return line for manually regulating the rate of fluid flow through said return line.

7. The self-cooled stuffing box as defined in claim 6, including:
(a) first and second lock rings having internal threads engaging the external threads of said packing collar and the external threads of said adapter nipple means, respectively; and
(b) a grease fitting between said first and second ends of said supply line.

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