USES AND OPERATION OF ON-OFF TOOL

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ABSTRACT

The scope of this paper includes a brief introduction about On-Off tool, design and construction, their applications, operational procedures, and general load carrying capabilities. The paper discusses some advantages gained by installing an On-Off tool such as, the ability to repair or replace the rod string without unseating the pump, the ability to break the sucker rod string just above the pump eliminating stripping job and the ability to run oversized tubing pumps.

ON-OFF TOOL

The On-Off tool provides an operator with a means of connecting to or disconnecting from a sucker rod string, at any point, based on the location of the tool in the rod string. The On & Off tool is attached directly to the sucker rod string, and located in a well at a point where the operator wishes to make the disconnection. The tool is disconnected by turning the rod string, and picking up, it is connected by setting down weight in the bottom latch section and rotating the rod string, in the opposite direction.

ADVANTAGES & APPLICATION

The use of the On-Off Tool offers the following operational advantages;

- Virtually eliminating stripping jobs which always result in higher cost due to increased rig time and damaged equipment.
- Providing a means of running oversize tubing pumps permitting the use of larger plunger for displacing more fluid without replacing the entire tubing string.
- In crooked holes, metal plungers for tubing pumps may be run in the well in the barrel assembly eliminating the possibility of damaging the plunger while lowering it through the tubing on the sucker rod sting.
- Permits the operator to “fish” broken rods without unseating the pump, and dumping the fluid “head” on the producing formation. This may result in damage to the reservoir.
- Many operators should periodically run scrapers in wells with severe paraffin conditions. This is best accomplished by unseating the pump and raising and lowering the rod string to assist in removing paraffin from the tubing wall. This normally results in damaged seating cups resulting in removal of the pump from the well for repairs. The On-Off Tool permits this operation without unseating the pump, without dumping the fluid in the tubing string, and also assists in reducing rig time.
- It may be used with “Bottled Up” Pumps. It helps in reducing the cost of having bigger tubing above the pump location. Still a larger pump bore can be used by having bigger tubing just at the pump location.
- Can be used in sandy wells, where it is difficult to pull the pump assembly.
- It may also be used as a Safety Joint.

DESIGN & FUNCTIONALITY

The On-Off tool is an assembly of six different components: Top Bushing (Figure 1), Body (Figure 2), Locking Pawl (Figure 3), Balls (Figure 4), Bottom Latch (Figure 5), Spring (Figure 6).

These parts can be manufactured in different metallurgies as required by different well conditions. This tool can be produced for both right hand as well as left hand operation. The outer diameter of the assembly is designed to match with the outer diameter of the sucker rod coupling (with few exemptions) for the free movement of the tool along the tubing.

The body of the tool has a spiral like profile as shown in the figure 2; it has ball guides machined above the profile. The locking pawl with the inserted balls inside is inserted in to the body by letting the balls roll along the ball guides

that are machined in the body. The balls in the guides help keep the locking pawl from rotating during the latching and unlatching operations of the tool. A spring of sufficient strength is dropped on top of the locking pawl in the body (more than one spring can be used for extra compressive strength (Figure 8)). This spring is compressed against the locking pawl with the help of a bushing (Figure 1). This bushing is provided with a sucker rod thread at the top, which is connected to the sucker rod string. During the latching operation, the body assembly (consisting of the top bushing, spring, balls and the locking pawl) is lowered so the head of the bottom latch may enter the body and strike the spiral like profile. This profile guides the bottom latch into the oval shaped hole in the body. The head strikes the locking pawl and the spring gets compressed as the pawl is pushed further. As soon as the shoulder of the head of the bottom latch passes the body ledge, the locking pawl rotates the bottom latch by turning the head 90° thus locking the shoulder against the ledge.

To unlatch the tool, pickup the weight of the rods in fluid to reduce the friction between the body and the bottom latch. Now by rotating the body assembly, the head of the bottom latch drives the locking pawl upwards compressing the spring. This rotation aligns the oval shaped hole in the body with the head of the bottom latch eliminating contact between the head and the ledge, disengaging the tool.

OPERATING PROCEDURES:

Positioning of the Tool

- When used as a "Safety Joint" it should be positioned a minimum of three to four sucker rods above the pump or higher should sandy conditions exist.
- When used to run oversize tubing pumps, a pony rod of sufficient length to place the "On & Off" tool up in the tubing string should be attached with the plunger in the bottom most position.

Running the Tool

- If used as a "Safety Joint", it is made up in the sucker rod string with the sucker rod pin up.

Latching the Tool

- Lower the sucker rod string until the upper section engages the bottom latch of the tool and starts to take weight. You will notice a decrease in the hook weight.
- Turn the sucker rod string to the right (approximately one complete revolution per 1000 feet of setting depth to work the torque down the hole) to correctly position the latch in the milled spiral.
- Apply 1000 pounds (this load varies depending on the compressive strength of the spring used) of rod weight. The bottom latch compresses the spring and rotates to latched position.
- To make sure that the latch is in locked position turn the sucker rod string to the left making sure the rotation is sufficient to reach the tool. This rotates the lugs into the locked position. Release all the torque if any before lifting the rods.
- The pump assembly, tubing or insert, should always be in the clutched position when using the tool. In case of insert pumps this can be achieved by engaging valve rod bushing in the clutch slot of the valve rod guide. In case of oversize tubing pumps this can be achieved by engaging slotted seat plug with the clutch bar on the standing valve cage or by engaging the plunger assembly in the J-slot.
- If an oversize tubing pump is employed, the operator may choose to run a Standing Valve Puller so that the standing valve may be unseated and fluid column dumped, eliminating wet strings. This provides a means of pulling both the plunger and standing valve completely out of the barrel assembly – latching them in a J-slot located in the tubing string prior to actuating the "On and Off" Tool.
- Spiral Rod Guides or standard type rod guides are recommended for use immediately above and below the "On and Off" tool to assist in correctly centering it in the tubing string.

Unlatching the Tool

- During the unlatching operation, friction is exerted at two places. One is between the bottom latch and the body and the other is between the head of the bottom latch and the ledge of the body. In order to lower the friction at these two locations, pickup the weight of rods in the fluid, simultaneously keeping the pump clutches engaged.
- Rotate the sucker rod string to the right, approximately one complete revolution per 1000 feet of setting depth to work the torque down the hole should be sufficient; however this may be increased when either 5/8" sucker rods are used or if the well is particularly crooked.

- One quarter turn at the “On and Off” Tool will disengage the tool.
- Raise the rods while maintaining the torque until the body of the On-Off tool clears the bottom latch.
- The rod string is then free to be pulled.

Load Ratings and Failures

Most of the failures that are observed in On-Off tools are on the bottom latch of the tool. This is due to the improper selection of the size and the metallurgy of the tool. It is observed that the failures are also due to improper operation while latching and unlatching the tool. When the connecting parts are rammed together, the latching profiles are distorted resulting in the inability to latch the tool. Improper selection of the tool size will lead to overloading and results in the failure of the bottom latch. The tool undergoes fatigue stresses due to the cyclical nature of the applied loads during the pumping cycle. The tool size and metallurgy should be carefully selected to keep it from overloading. The load ratings of the tool can be found by the Modified Goodman Diagrams. These load rating values vary between manufacturers. It is highly recommended that the operator obtain dynamometer readings to determine the applied load at the tool, prior to the installation.

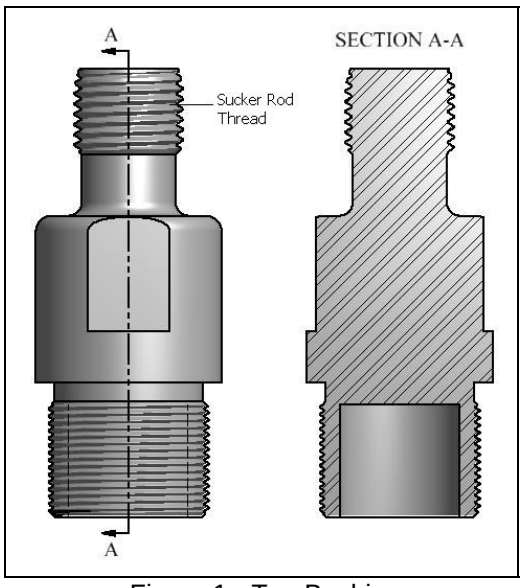

Figure 1 - Top Bushing

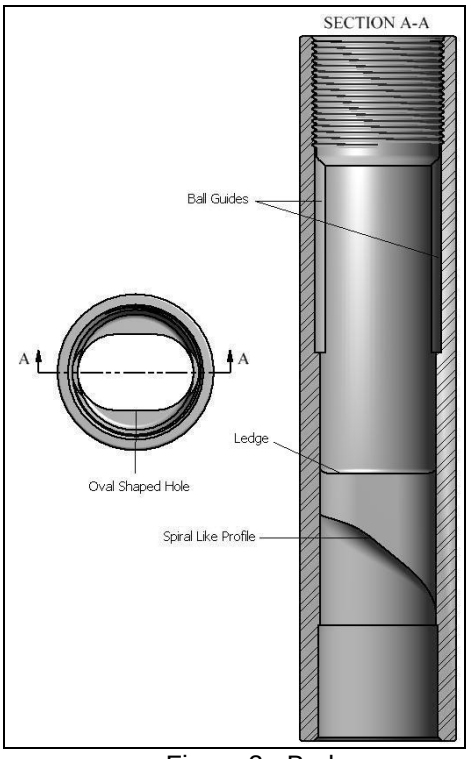

Figure 2 - Body

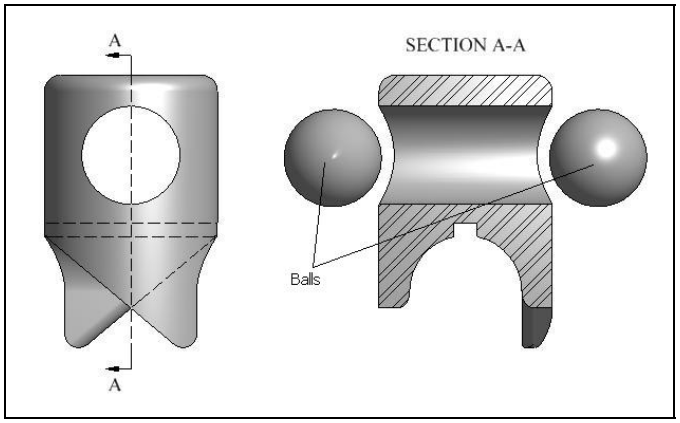

Figure 3 and 4 -- Locking Pawl with Balls

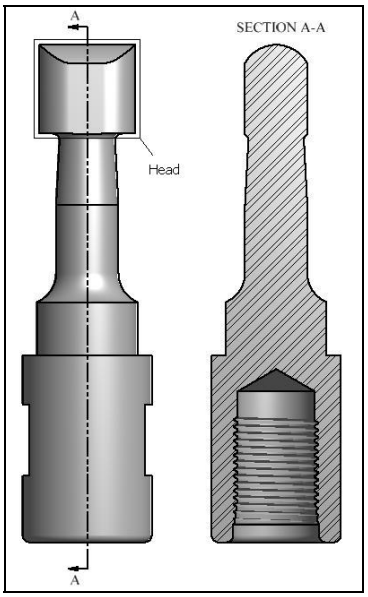

Figure 5 - Bottom Latch

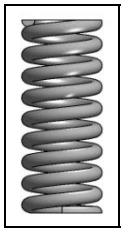

Figure 6 - Spring

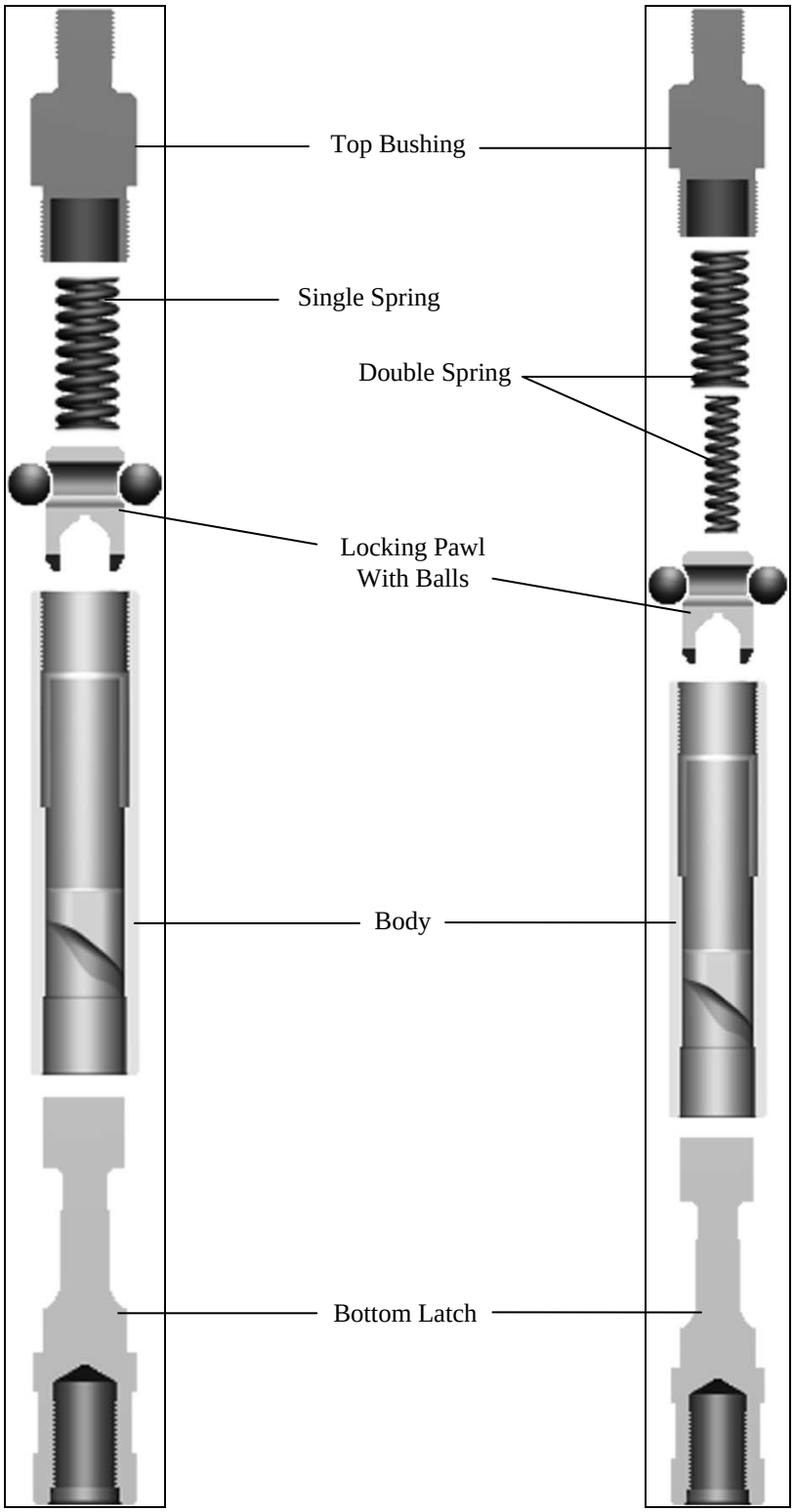

Figure 7- Assembly with single spring

Figure 8 - Assembly with double spring