UNITED STATES PATENT OFFICE.

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GAS-ESCAPE VALVE FOR OIL WELLS.

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To all whom it may concern:

Be it known that I, PATRICK H. MACK, a citizen of the United States, residing at Bradford, in the county of McKean and State of Pennsylvania, have invented certain new and useful Improvements in a Gas-Escape Valve for Oil Wells, of which the following is a specification.

This invention relates to a gas relief valve for use in connection with oil well tubing for permitting the escape of gas from the bore below the anchor or lowermost packer.

After an oil well is drilled, a tubing is inserted through which the sucker rod operates and up through which the oil is pumped. A packer is inserted in this tubing somewhere between the lower end and the surface of the ground, usually a relatively short distance above the oil bearing sand.

This packer serves to anchor the tubing against movement when pumping and to exclude water and dirt from coming down around the pump at the lower end of the tubing.

It frequently happens that natural gas will accumulate in the well below the packer and the pressure thereof will prevent proper functioning of the valves of the pump. It is accordingly necessary to provide some means for permitting the escape of gas, preferably into the tubing. Various methods of accomplishing this result have been tried, but, for various reasons, could not be used. Difficulty is most frequently encountered in very deep wells where the hole is necessarily of a minimum diameter.

The present invention has for its principal object to provide a gas relief valve at any point below the packer for permitting the escape of gas into the well tubing and which will be sufficiently compact and yet strong enough to sustain the weight of the pipe above it or below it. It is designed for use as a part of the packer and in combination therewith, or as a separate unit in the string of pipe.

My invention may be readily understood by reference to the accompanying drawings, in which:

Fig. 1 is a vertical section through a string of pipe and packer when set in the well, the valve being also shown in section and in combination with the packer;

Fig. 2 represents a side elevation of the pipe and packer set in a well with the gas relief valve shown in elevation and separate from the packing, a portion of the pipe and coupling between the pipe and valve being shown in section;

Fig. 3 represents a vertical section on a larger scale of the relief valve;

Fig. 4 shows a horizontal section taken on line IV—IV of Fig. 3.

In the drawings, A represents the well and B designates generally the tubing. C indicates the packer, and D is the relief valve.

The packer may be of any known or preferred construction. As shown, it comprises a tubular central member 5 having an inside diameter at least equal to the diameter of the tubing B with which it is connected through coupling 6, the lower end of which sets into a counter-bore in a compressing collar 7 slideable on the upper end of the central tube 5. The under face of the collar is recessed to receive the upper end of an annular packing member 8 of rubber or other suitable material surrounding the member 5 on which it is also slideable. Slideable on the lower portion of the central member 5 is disc 9 having flanges on the upper and lower faces thereof at its periphery. The lower end of the packing member 8 is received by the upper face of disc 9, while a packing or sealing ring 10 of similar material is received by the lower face. Telescoping within the flanged inner face of disc 9 for compressing the sealing ring 10 is a gland member 11 slideable on the tube 5. This member is adapted to compress the sealing ring to prevent gas or oil under pressure from working up the inside of the packing member 8, which is necessarily somewhat loose on tube 5, to prevent injury to the packer.

The lower end of tube 5 has a shoulder 5 thereof and a key adapted to extend into a recess in the gland for normally holding the parts against relative rotation before the packer is set. Threaded to the gland is a tubular casing 12 into which the lower end
of tube 5 projects when the packer is set. The lower end of this casing must be connected with the lower portion of the tubing B. The relief valve D may be here inserted for providing the coupling.

The packer herein described is merely illustrative of the use of my invention, but the relief valve D may obviously be applied to any preferred or suitable form of well packer having a central passage through, through which the oil is pumped.

The relief or escape valve D preferably comprises an integral body having an upper reduced portion 15 which is exteriorly threaded to extend into the lower end of housing or casing 12. The central part of the body has a maximum diameter and has a diameter equal to the diameter of the member 12. The lower end portion 16 is reduced and interiorly threaded to receive the end of the bottom section of the well tubing B. An annular flat surface 17 is preferably provided on the bottom of the central portion, while a tapered surface 18 is formed between it and the reduced portion 16.

A passageway 19 extends through the body and has a diameter equal to that of the tubing B. Spaced between the outer edge of the body and the wall of the central opening are one or more vertically extending holes 20. I have shown four such holes. They extend only part way through the body, as shown. Communicating with the bottom of each hole is a restricted passageway 21 of smaller diameter that opens out into the tapered surface 18. The body is counterbored between its ends to provide a chamber 22 of slightly greater diameter than the central bore or passageway 19, the counterbored being of such a depth as to extend into holes 20 and form elongated vertical parts 23.

Screw plugs 20' are inserted in the tops of holes 20. These holes serve as a cage for a ball valve or check valve comprising a ball 24 adapted to normally seat over the top of passageway 21. A spring 25 may, if desired, be inserted in each hole. This spring normally is under no compression and is very light and yieldable. Its purpose is to insure seating of the balls after they have been lifted.

The annular flat surface 17 may rest on the top of a bottom casing 26 without tending to spread it, while the inclined or conical face 18 serves to properly center the tubing relatively thereto. The bottom casing rests on the bottom of the well and resists the downward pressure of casing member 12 and the packer due to the weight of the superimposed tubing to effect the compression of the packing member 8 in a manner well understood. This bottom casing is not always used, but its use is often desirable.

Such casings are perforated some distance above the bottom of the well so that oil and gas may pass therethrough into the pump.

With the apparatus as described, the gas pressure accumulating in the well below the packer, lifts the balls 24 and escapes into the up-flowing stream of oil. Upon the pressure being relieved, the balls seat themselves and prevent the back-flow of oil from the pipe to the well.

The construction is such that there is a substantial body of metal in the packer to support the weight of the suspended string of pipe or to resist any crushing strain that may be transmitted downwardly. This is due to the shape of the body member, particularly in providing a portion of a diameter which may be substantially the same as that of the packer and a reduced portion of sufficient diameter to receive the tubing, with an intervening shoulder through which the gas-escape passages extend.

In Fig. 2, the relief valve is shown as a separate unit, rather than a part in combination with the packer. In this instance, the relief valve is coupled in the tubing at some distance below the packer. The construction of the valve is no different than that described. Instead of screwing into the casing member 12 at the bottom of the packer, the upper end of the body is threaded into a coupling member 30 having a reduced upper portion into which the tubing is threaded and an enlarged lower portion threaded over the valve carrying body. The coupling is so shaped as to clear the heads of the screw plugs 20'. It will be apparent, therefore, that the gas relief valve may be placed at any suitable point in the tubing below the casing.

The valve can be made for use in wells of the smallest size now generally drilled and in the successively larger sizes. Inasmuch as the smallest size of packers is generally not more than four and five-eighths inches in diameter while the standard tubing has an inside diameter of two inches, and the diameter of the valve body must not exceed the diameter of the packer, it will be obvious that the valve is very compact, and yet provides an ample body of metal at every point without unduly restricting or limiting the sizes of the various passageways.

I claim:

1. A gas-escape valve for wells comprising a body having a central opening therethrough and having a reduced upper portion which is threaded exteriorly, a downwardly extending reduced portion threaded for connection with tubing, a conical shoulder between the reduced lower extension and the body, a gas passage from the shoulder to the central opening, and an inwardly opening check valve in the passageway.
2. A gas-escape valve for wells comprising a body having a central opening through and having a reduced upper portion which is threaded exteriorly, a downwardly extending reduced portion threaded for connection with tubing, a conical shoulder between the reduced lower extension and the body, a flat surface at the outside of the conical surface, a gas passage from the shoulder to the central opening, and an inwardly opening check valve in the passageway.

In testimony whereof I affix my signature.

PATRICK H. MACK.