Aug. 24, 1948. G. F. TURECHEK 2,447,827

AUTOMATIC SHUTOFF DEVICE FOR OIL WELLS

Filed March 30, 1942

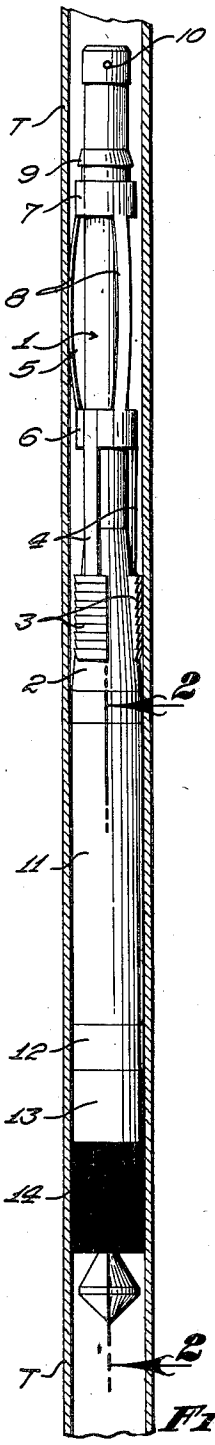


FIG. 1

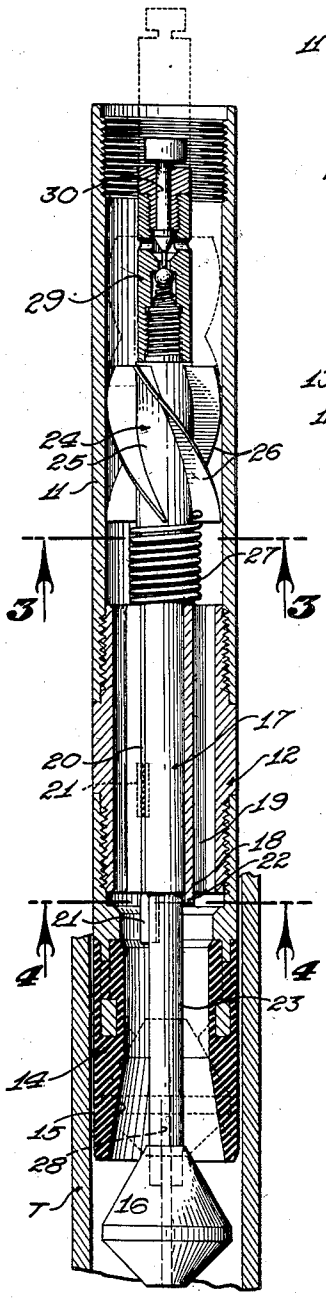


FIG. 2

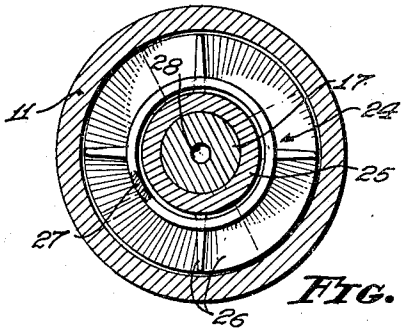


FIG. 3

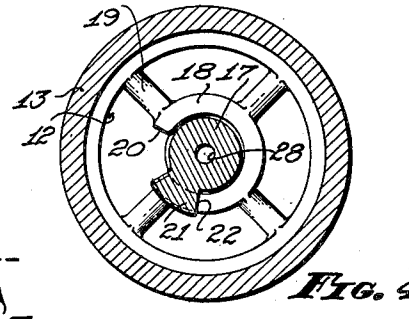


FIG. 4

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AUTOMATIC SHUTOFF DEVICE FOR OIL WELLS

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Application March 30, 1942, Serial No. 436,734

8 Claims. (Cl. 166—2)

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My invention relates to automatic shut-off devices for oil wells; that is, to control means for valves which are set within a tubing string near the top of the well and are intended to seal the tubing string should the surface connections be broken and the well caused to flow unrestricted. Among the objects of my invention are:

First, to provide a shut-off device which employs a reaction blade controlled latch so arranged that when the torque exerted on the reaction blade by the flow of well fluids through the tubing exceeds a predetermined value the latch is caused to release a valve which closes the tubing;

Second, to provide a shut-off device of this character which is easily lowered to position or retrieved, and, in particular, may be lowered or removed without shutting in the well, that is, the well may continue to flow while installing or removing the control means and its safety valve;

Third, to provide a shut-off device for well tubing safety valves which is readily reset or opened after the valve has closed; and

Fourth, to provide a shut-off device for well tubing safety valves which is capable of remaining exposed to the flow of fluids through the tubing for long periods of time without danger of fouling, but remain free for operation in the event of damage to the surface connections of the well which would cause uninterrupted flow.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is an elevational view of my device shown in association with a safety valve set within a well tubing;

Figure 2 is an enlarged longitudinal sectional view through 2—2 of Figure 1; and

Figures 3 and 4 are further enlarged transverse sectional views through 3—3 and 4—4, respectively, of Figure 2.

The safety valve construction in which my control means is incorporated includes a tubular mandrel 1 having an upwardly converging conical portion 2 at its lower end which receives slips 3. The slips have upwardly directed reins 4 which are attached to a slip cage 5. The slip cage 5 has lower and upper collars 6 and 7 which are connected by bow springs 8. The upper collar includes an upwardly directed ring 9 having a shoulder over which a suitable retrieving tool, such as an overshot fishing tool, may be extended in order to pull up on the cage and slips to release the slips from the cone. The mandrel is initially

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connected by a shear pin 10 to a suitable cable head (not shown) or other means for lowering the safety valve into the well bore. The apparatus so far described may, for the purposes of this application, be considered conventional and serves to lock the safety valve against upward movement in the tubing T in which it is inserted and frictionally restrain the safety valve from dropping in the tubing.

My control means is contained within a shell 11 which is screw-threaded to the lower end of the mandrel 1. The shell 11 in turn is connected by screw threads to a nipple or tubular body member 12 which is threadedly connected at its lower end to a valve sleeve holder 13, all of these members being tubular and comprising the housing for the valve structure hereinafter described. Molded or otherwise secured to the valve sleeve holder 13 is a packing ring or valve sleeve 14 formed of rubber or analogous flexible material, preferably one of the so-called synthetic rubbers which are not affected by oil. The valve sleeve is in the form of a flexible, approximately annular-shaped member which extends downwardly from the valve sleeve holder 13. Initially the outer diameter of the flexible valve sleeve is sufficiently smaller than the tubing in which it fits to permit ready insertion therein and its lower portion is preferably internally flared slightly, or tapered to provide a valve seat, as indicated by 15. The packing ring or valve sleeve 14 is adapted to be urged against the surrounding tubing and the opening therethrough closed by a valve member or head 16, which is initially held below and clear of the lower end of the valve sleeve by a valve stem 17. The upper side of the valve head 16 is conical and larger in diameter than the flared opening through the valve sleeve, so that when urged upwardly it closes the opening and at the same time forces the outer periphery of the packing ring against the surrounding tubing to form a seal.

The valve stem 17 extends upwardly through the tubular body member 12. The tubular body member is provided with a centrally disposed sleeve or guide tube 18 which accommodates the stem 17, the guide tube being held in centered relation with the body member by means of radiating webs 19. One side of the guide tube 18 is provided with a longitudinal slot 20 and below the guide tube the stem 17 is provided with a key lug or boss 21, which is adapted to bear against the lower end of the guide tube 18 or slide in the slot 20. The lower end of the guide tube 18 is provided with a vertical shoulder which

forms a stop 22 to limit the arcuately offset relation between the boss 21 and slot 20, as best shown in Figure 4. The boss 21 and slot 20 in the guide tube 18 comprises a structure hereafter referred to as a latch means. Below the guide tube 18 the valve stem 17 is preferably relieved or of reduced diameter, as indicated by 23, so that there is clearance between the normally extended portion, or relieved portion 23, of the stem and the guide tube 18.

The valve stem 17 protrudes above the guide tube 18 and receives a reaction unit 24 which comprises a hub portion 25 fitting over and secured to the stem 17, and radiating helical reaction vanes 26 which extend to the walls of the shell 11. Between the reaction unit 24 and the upper end of the guide tube 18 there is positioned a torsion and compression spring 27, one end of which is anchored to the guide tube for stem 17 and the other end to the lower side of the reaction unit 24. The torsion and compression spring 27 is so arranged that it urges the boss 21 against its stop 22, and the vanes of the reaction unit are so arranged that the fluid flowing through the annular passage between the tubular body member 12 and the sleeve 18 tends to rotate the reaction unit 24 and therefore the valve stem in opposition to the spring 27; that is, in a direction to bring the boss 21 into registry with the slot 20. In addition, the torsion and compression spring urges the reaction unit 24 upwardly so that once the boss 21 aligns with the slot 20 the valve head is moved upwardly into engagement with the valve sleeve 14.

The valve stem 17 is tubular, forming a release passage 28 therethrough. The upper end of the valve stem receives a relief valve 29, preferably in the form of a ball check valve, which seals against upward flow through the valve stem. Above the relief valve is a small plunger 30 which is adapted to be engaged from the upper end of the valve stem to open the relief valve.

Operation of my control means is as follows: The entire assembly is lowered into a well tubing by means of a wire rope to which is attached a suitable weight bar in order to force the safety valve downwardly against the friction of the bow springs 8. When the desired location is reached the cable is pulled upwardly, causing the cone 2 to wedge between the slips 3, locking the safety valve in place; thereupon the shear pin 10 gives way and the wire rope may be removed.

Initially and normally, the valve head 16 is open and the well production flows upwardly through the valve sleeve 14, tubular body member 12, shell 11 and mandrel 1. The tension of the spring 27 is so adjusted and the shape of the reaction blades 26 is such that the torque exerted by the well fluid under normal conditions, that is, under the predetermined flow conditions, is insufficient to rotate the reaction unit against the action of the spring 27, so that the boss 21 remains seated against the lower end of the guide tube 18. When, however, the flow of fluids through the tubing exceeds a predetermined value, as would be the case if the connections at the top of the well were broken, the well fluids impinge upon the reaction blades 26 with sufficient force to overcome the spring 27 and cause the boss 21 to move into the slot 20, whereupon the tension spring raises the valve head 16 into engagement with lower end of the valve sleeve 14. The pressure differential created above and below the valve sleeve, upon being closed by the valve head, forces the valve sleeve into sealing engagement with the surrounding tubing and the valve head is jammed tightly within the packing ring or valve sleeve so that the tubing is completely sealed.

It is contemplated to use safety valves in wells in which there is considerable tubing pressure so that there is adequate pressure to maintain the valve closed once it has engaged the sleeve. Furthermore, a comparatively loose fit may exist between the packing sleeve and the surrounding tubing, and still insure sufficient pressure differential above and below the sleeve once its internal passage is closed to urge it outwardly against the tubing.

It should be noted that the particular embodiment of the packer or valve sleeve 14 and valve 16 disclosed is by way of illustration only, being the subject matter of a copending application of Lloyd Spencer, entitled "Automatic shut-off apparatus for oil wells," filed March 30, 1942, Serial No. 436,733.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention.

I claim:

1. An automatic shut-off device for oil wells, comprising: a valve structure including a valve member movable from an open to a closed position in the direction of flow of fluids through the valve structure; a latch means having a first position holding said valve member open and rotatable to a second position to release said valve; a combined torque and compression spring for urging said latch means into said first position and for urging said valve to its closed position when said latch means is moved to its second position; and reaction means disposed in the flow stream of fluid passing through said valve structure and acted upon by said flow stream to turn said latch means from said first to said second position.

2. An automatic shut-off device for oil wells, comprising: a valve structure including a valve member movable from an open to a closed position in the direction of flow of fluids through the valve structure; a latch means having a first position holding said valve member open and rotatable to a second position to release said valve; a combined torque and compression spring for urging said latch means into said first position and for urging said valve to its closed position when said latch means is moved to its second position; and reaction vanes disposed in the flow stream of fluid passing through said valve structure in angular relation thereto whereby the fluid exerts a torque in opposition to said yieldable means tending to move said latch means from said first to said second position.

3. A well shut-off device adapted to be secured within a tubing and comprising: a tubular body member; an expansible valve sleeve at the lower end of said body member; a valve member located below the valve sleeve and adapted to move upwardly to close said sleeve and urge said sleeve against a surrounding tubing, said valve member including a stem extending through said sleeve into said body member; a guide tube for said stem within said body member, said guide tube having a longitudinal slot therein intersecting its lower end and a shoulder at its lower end offset arcuately from said slot; said stem having a boss adapted to bear against the lower end

of said guide tube and move from said shoulder to said slot; a torque spring around said stem and positioned to urge said boss away from said slot and against said shoulder; and a reaction means on said stem adapted to be impinged upon by fluid passing around said valve member, to exert a torque tending to move said boss into said longitudinal slot against the action of said spring.

4. A well shut-off device adapted to be secured within a tubing string and comprising: a tubular body member; a valve seat at the lower end of said body member; a valve member depending below said body member, including a stem extending upwardly into said body member; a guide tube for said stem within said body member, said guide tube having a longitudinal slot therein intersecting its lower end and a shoulder at its lower end offset arcuately from said slot; said stem having a boss adapted to bear against the lower end of said guide tube and move from said shoulder to said slot; a torque spring around said stem and positioned to urge said boss away from said slot and against said shoulder; and a reaction means on said stem adapted to be impinged upon by fluid passing around said valve member to exert a torque tending to move said boss into said longitudinal slot against the action of said spring.

5. A shut-off device adapted to be secured within a tubing and comprising: an expansible valve sleeve; a valve member associated with said valve sleeve and adapted to move between an open and a closed position with respect to the opening through said valve sleeve and in the closed position to expand said valve sleeve into sealing engagement with a surrounding tubing; and means normally restraining said valve member to an open position and responsive to a predetermined fluid flow in the tubing for releasing said valve member for movement into the said closed position.

6. A shut-off device adapted to be secured within a tubing and comprising: an expansible valve sleeve; a valve member associated with said valve sleeve and adapted to move between an open and a closed position with respect to the opening through said valve sleeve and in the closed position to expand said valve sleeve into sealing engagement with a surrounding tubing; means urging said valve member into the closed position; and means normally restraining said valve member to an open position and responsive to a predetermined fluid flow in the tubing for releasing said valve member for movement into the said closed position.

7. A shut-off device adapted to be secured within a tubing and comprising: an expansible valve sleeve; a valve member associated with said valve sleeve and adapted to move between an open and a closed position with respect to said valve sleeve and in the closed position to expand said valve sleeve into sealing engagement with a surrounding tubing; a latch means having a first position holding said valve member in the open position and a second position releasing said valve member for movement to the closed position, and means responsive to a predetermined fluid flow in the tubing for moving said latch means from said first position to said second position.

8. A shut-off device adapted to be secured within a tubing and comprising: an expansible valve sleeve; a valve member associated with said valve sleeve and adapted to move between an open and a closed position with respect to said valve sleeve and in the closed position to expand said valve sleeve into sealing engagement with a surrounding tubing; a latch means having a first position holding said valve member in the open position and a second position releasing said valve member for movement to the closed position; means responsive to a predetermined fluid flow in the tubing for moving said latch means from said first position to said second position; and means urging said valve member into the closed position.

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