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VALVE FOR WELL TESTING TOOLS

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18 Claims. (Cl. 166-1)

This invention is a valve assembly of a type especially for combination and use with deep well testing tools.

It is very desirable in such tools to incorporate a valve which may be readily closed before the lower section of the tool is lowered into a well hole or well casing so that the tool may be lowered in a dry or empty state. Additionally an object is to provide that the valve may be readily opened by a conventional right-hand rotation of the tool string for the up-flow of such liquid or gas as may be present at a given level at which the packer of the testing tool may be set in the hole or casing as the situation may involve. Also it is an object to provide that the valve closing element may, by the same right-hand rotation of the string section which extends to the head of the well hole, be shifted to engage and close on a second valve seat for the purpose of trapping thereabove a specimen of such fluid as may have passed up through the open valve.

Further, an object is to provide in a valve assembly a pair of axially spaced seat members each of which may be readily assembled and removed and replaced as undue wear may require, and a purpose is to provide a single, simple valve element including a bulbous part with opposite end areas complementary to respective, adjacent faces of the said seat members. Particularly, an object is to provide, in a combination of this type, for the arrangement of the valve seat members as portions of the upper, rotary section of the tool, that is, the section upwardly of the subjacent packer-carrying and foot end of the tool string, and to which the closure device of the valve is operatively attached.

The invention consists of certain advancements in this art as set forth in the ensuing disclosure and having, with the above, additional objects and advantages as hereinafter developed, and whose construction, combination and details of means and the manner of operation will be made manifest in the following description of the embodiment shown in the annexed drawing; it being understood that modifications, variations and adaptations may be resorted to within the scope, principle and spirit of the subjoined claims.

Figure 1 is an elevational, axial section showing the valve as closed for lowering the upper string section empty or dry.

Figure 2 is a side elevation of the separate valve closure device.

As here illustrated, a barrel 2 has a nipple 3

screwed into its lower end, and turnably fitted in the nipple is a mandrel 4 having a stop shoulder 5 contiguous to the upper end of the nipple 3.

The mandrel 4 screws at 6 into a tool joint 7 to which any suitable packer or other apparatus may be attached.

Between the joint 7 and the nipple 3 there is an anti-friction swivel bearing 8 to take the load of the imposed, upper string section when the lower section attached to the joint 7 is on bottom or the packer (not shown) is set. In this specification all parts connected to the joint 7 will be considered as of the lower section of the string comprising a testing tool, and those parts connected to and turning with the barrel 2 will be considered the upper section of the string, that is the tool as a whole.

The mandrel 4 has external, right-hand threads 4^a complementary to the internally threaded portion of an elongated, hollow stem 9, Fig. 2, having splines 10 slidably guided in the bore of the barrel 2 and rotative thereby to move down from the position in Fig. 1, along the threads 8 of the mandrel 4 whilst the barrel 2 is turned right-hand and the mandrel is stationary, as when the packer is set.

The hollow stem 9 has a bore wall 11 receiving packing 12 carried in an extension or sleeve 13 screwed at 14 onto the upper end of the mandrel 4. Packing 15 is provided between the mandrel 4 and the nipple 3.

The stem 9 has a dome 9^a with flow ports 9^b outwardly of a stem neck 9^c on which is a removable, bulbous head 18 somewhat of egg-shape with the smaller end upward, Fig. 1. The larger, lower end of the head 18 is designed to close down on an annular seat member 19 screwed at 20 onto the upper end of the barrel 2, and screwed at 21 into the lower end of a box joint 22 to which is attachable suitable upper string parts of a tool.

To provide for fluid flow the neck 9^c of the valve element reciprocates in and well clear of the axial port 19^a of the seat 19.

The upper, smaller end of the valve head 18 engages and closes on a complementary seat member 23 here shown as removably screwing at 24 into the bore of the box 22.

When the test tool has been lowered into the hole or casing and the packer set so that the joint 7 and the mandrel 4 will not rotate, and the valve head 18 is standing closed on seat 23, the valve may now be opened by right-hand rotation of the upper string section and thereby the barrel 2 with the result that the stem 9

will screw downwardly on the standing mandrel 4 and valve head 18 will descend from its seat 23 to suitable degree and allow upflow through the hollow mandrel 4 and the ports 9^b of the valve dome 9^a, thence through the valve seat rings 19—23 and around the intermediately shifted head 18. The splines 10 cause co-rotation of the valve stem 9 with the barrel 2 and permit relative, axial shift of the valve device 9—18.

The well may be flowed as long as desired under careful control of the valve 18 through the port 23^a of the seat ring 23, or the valve 18 can be moved down by the further right-hand turn of the barrel 2 so as to close on the lower seat 19 and shut off upflow if it be so desired, and the string may now be pulled from the well and the trapped specimen lifted to the well head for intended disposition.

The present invention is an improvement in the type of well tool structures as clearly shown in U. S. Patent No. 263,330, issued to Benjamin Franklin Aug. 29, 1882, and showing the same general mode of operation.

What is claimed is:

1. A well testing tool valve including a mandrel section, a rotative, tubular housing section, the latter having coaxial, spaced inner, annular seat members, and a valve head connected to the mandrel section and having axially spaced, closing faces respectively complementary to said seats and being movable from a closing position on either seat to an intermediate open position.

2. A valve as set forth in claim 1, and in which said seats have differential ports and said valve having a stem reciprocative clear in the larger port.

3. A well testing tool valve assembly including swivelled, coaxial sections one of which has a mandrel; spaced, coaxial seat members arranged in the other section, and a valve device operatively mounted on the mandrel and having a dual faced head closable on and movable to an open position between said seat members.

4. A valve assembly as set forth in claim 3, and right-hand thread means for axially shifting the valve device upon relative rotation of said sections from one seat to the other.

5. A valve assembly including a mandrel section and a valve seat section swivelled thereto and having coaxial, ported seat members, and a valve device mounted on the mandrel section and operative upon relative rotation of said sections to shift between the seat members.

6. A well testing tool valve assembly including an upper string section and a lower string section coaxially swivelled therewith, one of said sections having a pair of spaced, coaxial valve seat members, and the other section having a valve to shift between and close on either of the seats upon relative rotation of the sections.

7. A well testing tool valve assembly including an upper string section and a lower string section aligned and swivelled therewith, one section having a pair of coaxial valve seat members, and the other section having a valve movable between and closeable on either of said members; said valve having a right-hand threaded connection with one section and a splined connection with the other section whereby upon a right hand rotation of one section as to the other the valve will be moved from a closed position on one seat to an open position and on further similar ro-

tation the valve will close on the other seat member.

8. A well testing tool valve assembly including aligned, swivelled, upper and lower sections one of which has spaced ported seat members, and a valve element splined on one of the sections and threaded on the other section so as to be axially shiftable by rotation of the sections relatively; said valve element having a head shiftable between the seat members to open position and to selectively close on either.

9. A valve as set forth in claim 8, and in which the head has a reduced neck coaxial with and working concentrically clear in, and through, the port of one of the seat members and attached to the said other section.

10. A well testing tool valve assembly including aligned, swivelled, tubular sections one of which has coaxial, spaced, ported seat members, and a valve head disposed between said members and operatively connected to each of said sections so as to be shifted thereby to an open position between or a closed position on either of said members upon rotation of said sections relatively.

11. In a valve assembly of the class described, a mandrel section and a barrel section, the latter having coaxial, spaced valve seats, and a valve element slidably keyed to one of said sections and screw threaded on the other and having a head disposed between said seats and being shiftable to open between or to close on either of said seats.

12. In a valve assembly of the class described, swivelled mandrel and barrel sections, coaxial, spaced valve seats in one of said sections, and a coaxial valve element having operative connection with each of said seats and provided with a closure part arranged between and movable from one to the other of the seats by unidirectional rotation of one of said sections as to the other.

13. In a valve of the class described, swivelled mandrel and barrel sections, coaxial, spaced, valve seats in the barrel section, and a valve element having a hollow stem between and operatively connected to each of said sections and apertured for fluid flow through the sections and having a neck passing through and clear of one of the seats and a head on the end of the neck movable between and closeable on either of the seats and having an intermediate open position.

14. A valve as set forth in claim 13, and in which stem is slidably keyed on one of the sections and is screw threaded on the other section.

15. A valve as set forth in claim 13, and in which the mandrel is provided with means engaging the bore of the stem and of the barrel section to pack the same.

16. In a valve assembly, a tubular valve stem having a reduced neck connected thereto by a dome provided with flow ports from the space about the said neck to the stem bore, and a bulbous head on the stem having port closure faces on each end.

17. A valve as in claim 16, and including a tool string section provided with a ported seat forming an annular flow passage about the neck and a second ported seat at the distal end of the head.

18. A valve as in claim 16, the distal end of said head having an elongate tapered shape to form a flow-bean control with a coordinate seat part.

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