

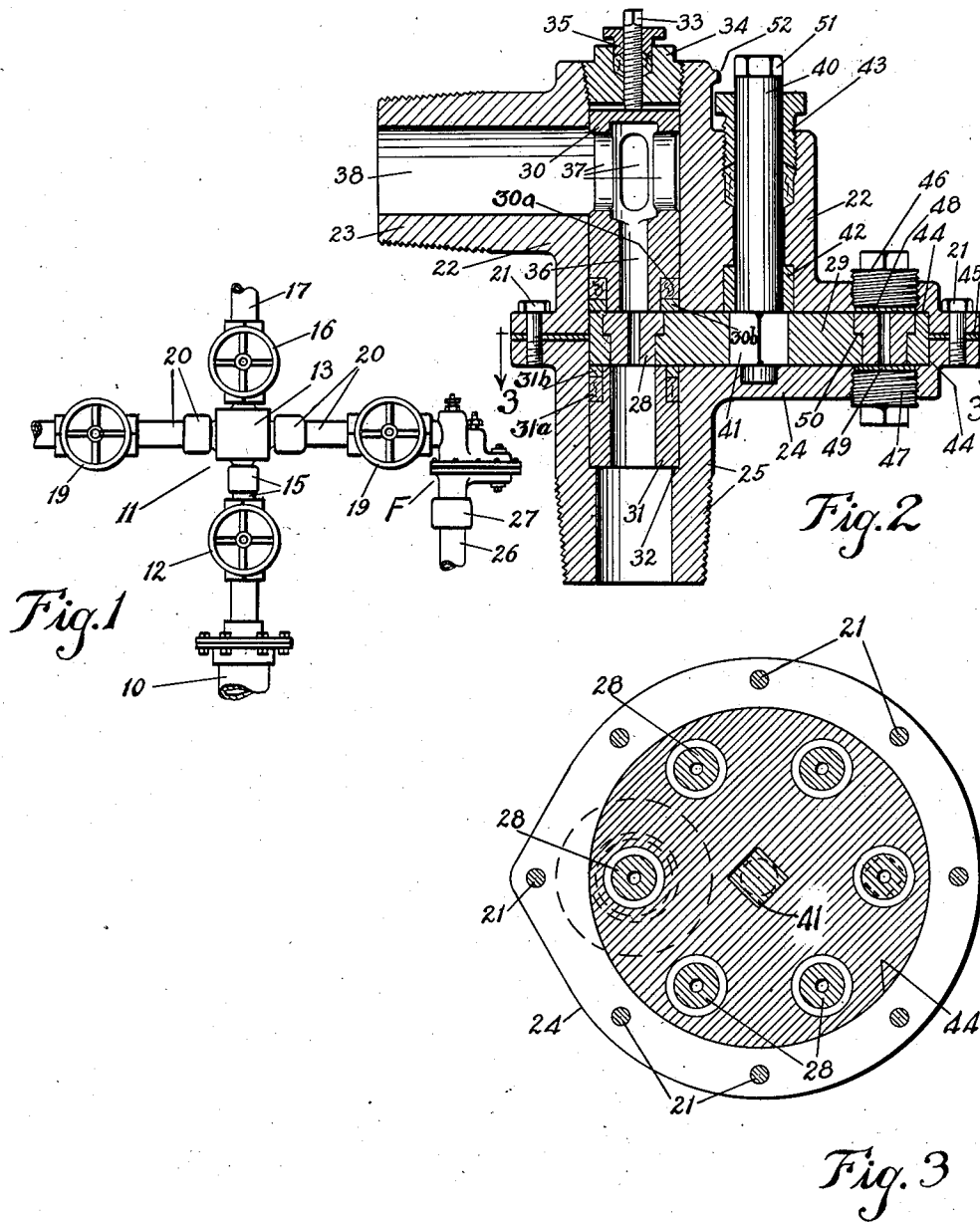
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FLOW CONTROL DEVICE

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FLOW CONTROL DEVICE

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5 Claims. (Cl. 138—45)

The present invention relates to flow control devices and more particularly to devices capable of controlling the production of flowing oil wells.

It is customary to restrict the flow of oil and gas in wells, by throttling the flow at or near the surface through a restricted passage, commonly known as a flow bean. This course is pursued to avoid danger of the liner and casing of the well being sand cut by too large and rapid a flow which might cause them to collapse, and also to maintain sufficient pressure on the structure to prevent loss of the well due to caving, collapsing, or shifting of the subterranean structure. The commonly employed flow bean is an effective instrumentality for controlling the production of a well, but it possesses the disadvantage of a relatively short life, which necessitates its frequent renewal. The necessary substitution usually requires material disassembly of parts before a new bean may be replaced.

It has heretofore been proposed to eliminate the need for disassembling parts in order to render the flow bean accessible, by providing a rectilinearly movable support carrying a plurality of flow beans which can be selectively positioned in the path of fluid flow for producing the desired throttling action. However, this construction possesses the disadvantage of permitting leakage of fluid between it and its guide support, and also an undesirable exposure of the unselected beans, whereby they may be subjected to injury. Moreover, the mode of supporting the beans is such as to provide a relatively yieldable construction, tending towards distortion and amplification of the leakage between the bean support and its guide.

Under certain operating conditions, the effective throttling area of the flow bean is made variable by the use of an adjustable needle valve cooperating with the flow bean inlet. These valves are manually controllable, their setting determining the pressure in the well and the flow through the bean. Such manual control might be effective under fairly steady operating conditions; but variations in factors within the well might require a different valve setting to insure a proper flow. The necessary adjustments, being dependent upon a human factor, might not be made at the proper time, thus introducing the possibility of a diminished or abnormally increased flow, which latter condition might decrease the well pressure sufficiently to cause its loss due to caving in of the subterranean structure.

It therefore becomes an object of the present invention to provide a flow control device for oil wells and the like, which includes a plurality of throttling elements, each of which can be selectively positioned in the path of fluid flow; the elements being protected by an enclosure.

Another object of the invention is to provide a flow control device for oil wells and the like, which includes a plurality of throttling elements, each of which can be selectively positioned in the path of fluid flow, while the remaining elements are supported in a housing structure in a manner permitting their easy replaceability.

Still another object of the invention is the provision of a flow control device including a plurality of throttling elements selectively positionable in the path of fluid flow, each element being rigidly supported in a housing structure in a manner permitting ease of its replacement, and obviating the danger of damaging the parts carrying and housing the elements.

A further object of the invention resides in the provision of a flow control device including a plurality of throttling elements selectively positionable in the path of fluid flow, the elements being entirely enclosed by a leak proof housing structure.

A still further object of the invention contemplates a flow control device including a plurality of throttling elements selectively positionable in the path of fluid flow, the elements being carried by a movable member completely enclosed within a sealed housing, which eliminated the necessity for a packing structure between the movable member and its support.

This invention possesses many other advantages and has other objects which will be made more easily apparent from a consideration of the embodiments thereof shown in the accompanying drawing and forming a part of the present specification: I shall now proceed to describe these forms in detail which illustrate the general principles of my invention; but it is to be understood that this description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Figure 1 is an elevational view showing the invention applied to a flow control mechanism of an oil well.

Figure 2 is an enlarged vertical sectional view through the throttling structure of the invention.

Figure 3 is a transverse sectional view taken as indicated by line 3—3 of Figure 2.

An illustration of the utility of the invention is indicated in Figure 1, wherein the oil produc-

tion pipe 10 extends from the well casing (not shown), and has attached to it a Christmas tree 11, which can be assembled in various forms to suit various conditions encountered in the fields.

5 In Figure 1, the flow through the pipe 10 is controlled by the master valve 12 connected thereto at one end, and at its other end to the cross piece 13 by means of the fittings 15. The vertical outlet of the cross piece may have a valve 16 secured thereto for controlling the flow through the tube 17 which usually connects with a pressure gauge (not shown). The horizontal outlets of the cross piece 13 are connected to control valves 19 through the fittings 20. The improved flow control device (F) provided by the present invention, may be attached to the outlets of either or both of the valves 19.

The flow control device includes a two part housing structure held together by a plurality of bolts 21 (Figures 2 and 3). The upper housing section 22 is provided with an outwardly extending nipple 23 carrying pipe threads for connection with the outlet end of either of the valves 19. The lower housing section 24 is also provided with a threaded nipple 25 adapted for connection with the pipe line 26 through the coupling 27.

The fluid passing from the well and through the nipple 23 must flow through a bean 28 carried in a disc 29. The bean and disc are held securely in proper position by opposed cooperating pressure sleeves 30 and 31 and by the packings 30a and 31a and packing rings 30b and 31b. The lower sleeve 31 seats upon a shoulder 32 formed in the interior of the nipple 25, being of reduced diameter at its upper end to accommodate the packing ring 31b, which is engageable with the underside of the disc and is adapted to expand the packing 31a against the nipple 25 upon application of pressure between it and the disc. Similarly, the upper sleeve 30 is of reduced diameter at its lower end, which is encircled by the packing ring 30b engageable with the upper side of the disc, and by pressure incident to such engagement, being adapted to expand the packing 30a into fluid tight engagement with the reduced end of the sleeve and upper housing 22. The upper end of the sleeve 30 is acted upon by a set screw 33 threadedly carried by a plug 34 threaded into an upper portion of the housing section. Adjustment of this set screw will cause the reduced end of the upper sleeve and the packing ring encircled thereby to press against the upper surfaces of the flow bean and disc. It will also produce a similar action between the underside of the disc and the reduced end of the lower sleeve and the packing ring encircled thereby. In this manner, turning of the set screw can effect a clamping of the bean and disc between the sleeves and packing rings. Conversely, retraction of the set screw will free the bean and disc, permitting their rotary movement to any desired extent. The plug 34, will permit access to the upper sleeve 30 for its removal or replacement. Leakage past the set screw 33 is prevented by the provision of the packing gland 35.

Upon insertion of the upper sleeve 30 into the housing section 22, communication between the bore 36 in the sleeve 30 and the upper nipple 23 is ensured by providing a plurality of generally radial slots 37 in the nipple 23, one of which must align with the nipple passage 38. The fluid can therefore flow from the upper nipple 23 through at least one of the radial slots 37 and into the longitudinal bore 36 in the upper nipple

from where it can be throttled in passing through the hole in the flow bean 28 and into the lower sleeve 31 and nipple 25 to the pipe line 26.

In addition to performing their function of clamping disc 29 and flow bean 28 securely in place, the sleeves 30 and 31 possess the property of preventing the erosion of housing parts caused by the action of abrasive laden fluid, particularly upon increase in its velocity of flow due to expansion through the bean. Instead of wearing away the housing parts, the abrasive action is upon the sleeves, which are renewable at a minimum of expense.

The necessity of disassembling the entire housing F to replace a flow bean is obviated by this invention. It is contemplated that the beans be replaceable at will without material interference with the assembly. To accomplish this object, a plurality of flow beans 28 are inserted in the disc 29 at spaced intervals therearound and substantially at the same radius from the axis, about which the disc is adapted to be moved for positioning a selected flow bean between the sleeves 30 and 31 and in the path of fluid flow. The beans can each have the same bore to provide the same throttling capacities; or can have bores of different sizes to provide various throttling effects that might become desirable with changes in pressure of the fluid entering the housing.

The disc 29 is turnable by being coupled to an operating shaft 40 having a squared portion 41 contained within a complementary portion in the disc 29. One end of the shaft 40 is journaled in the lower housing portion 24, an additional bearing being provided by the bushing 42 surrounding the shaft adjacent its squared portion 41 and held within the upper housing section 22. Leakage along the shaft 40 is prevented by a packing gland 43.

It will be noted that the housing sections 22 and 24 are provided with complementary cupped portions forming a cylindrical chamber 44 snugly receiving the disc 29. Leakage of fluid from the disc chamber 44 to the housing exterior is prevented by the gasket 45 disposed between the housing sections 22 and 24. Through this arrangement it is unnecessary to provide packing between the movable disc and the housing to prevent fluid leakage as in the prior art structures.

The flow beans 28 can be removed and replaced without interruption in the flow of fluid through the device. This is accomplished by providing a pair of plugs 46 and 47 in aligned housing openings, which plugs normally abut gaskets 48 and 49 engaging opposite sides of a flow bean which will be coaxial with the openings when another flow bean is properly positioned between the sleeves 30 and 31 in the path of fluid flow. Thus, without interrupting such flow, a flow bean can be replaced by the expedient of removing the plugs 46 and 47, and by the use of a suitable tool, forcing it upwardly from the disc 29 and through the upper plug opening. Its snug engagement with the chamber walls will prevent the disc 29 from distorting under the pressure applied to the lower end of the bean. The rigidity associated with this mode of support will assist in the removal of the bean.

A different bean can then be inserted through the upper opening into the socket from which the previous one was removed. All of the sockets are similar and include a shoulder 50 against which a cooperative shouldered portion on the bean is adapted to abut to limit its movement through the disc. The plugs and washers are replaced to

completely enclose the disc containing chamber.

Whenever it is desired to position a different bean in the flow path, the set screw 33 is loosened to relieve the clamping action of the sleeves 30 and 31 and the packing rings 30b, 31b upon the disc 29 and a suitable tool, such as a wrench, is applied to the polygonal end 51 on the operating shaft 40 for turning it and the disc the angular distance required for proper positioning of another bean in the flow path. Thereafter, the set screw 33 is again tightened to clamp the sleeves 30 and 31 and the packing rings 30b, 31b against the bean and disc. Suitable indicator means can be supplied for designating the positions of the flow beans. A simple expedient involves the formation of the upper end of the shaft 40 so that the meeting edges of the wrench engaging surfaces point toward the axes of the various flow beans contained in the disc. A suitable reference mark 52 can be placed or formed on the upper section 22 of the housing, which when aligned with any one of the aforementioned meeting edges, will indicate that the corresponding bean is in proper position between the sleeves 30 and 31 in the path of fluid flow.

I claim:

1. In a fluid flow control device of the type including a plate having a multiplicity of orifices and located within a housing, said orifices adapted to be selectively interposed in a fluid-flow passage, a sleeve in said passage on the upstream side of said plate, sealing means between said sleeve and the wall of said passage, one end of said sleeve adapted to contact and seal against the surface of the plate around a selected orifice, and means to hold said sleeve in contact with said plate.

2. In a fluid-flow control device of the type including a plate having a multiplicity of orifices and located within a housing, said orifices adapted to be selectively interposed in a fluid-flow passage, and sleeves in said passage on opposite sides of said plate, sealing means between said sleeves and the wall of said passage, one end of each of said sleeves adapted to contact and seal against a surface of the plate around a selected orifice, and means to hold said sleeve in contact with said plate.

3. In a fluid-flow control device of the type including a plate having a multiplicity of orifices and located within a housing, said orifices adapted to be selectively interposed in a fluid flow passage, a sleeve in said passage on the upstream

side of said plate, sealing means between said sleeve and the wall of said passage, one end of said sleeve adapted to contact and seal against the surface of the plate around a selected orifice, means to hold said sleeve in contact with said plate, said means comprising an adjustable element for holding said sleeve in positive engagement with said plate, and the pressure in said line acting to hold said sleeve in wiping engagement with said plate upon release of said positive means.

4. A flow control device comprising a housing having an inlet passage and an outlet passage disposed angularly with respect to said inlet passage, a plate enclosed within said housing, said plate having a plurality of orifices, means for moving said plate for selectively positioning one of said orifices in line with said outlet passage, a replaceable sleeve contained in said outlet passage on the upstream side of said plate and intercepting fluid flow from said inlet passage, sealing means between said sleeve and the wall of said passage, one end of said sleeve adapted to contact and seal against the surface of the plate around a selected orifice, said housing having an opening in line with said outlet passage, removable closure means for said opening to permit access to said sleeve and its removal from the housing, said closure means having means to clamp said sleeve in sealing engagement with said plate.

5. A flow control device comprising a housing having an inlet passage and an outlet passage disposed angularly with respect to said inlet passage, a plate enclosed within said housing, said plate having a plurality of orifices, means for moving said plate for selectively positioning one of said orifices in line with said outlet passage, means providing a sealing surface on one side of said plate adapted to contact and seal against a surface of the plate around a selected orifice, a replaceable sleeve contained in said outlet passage on the other side of said plate, sealing means between said sleeve and the wall of said outlet passage, one end of said sleeve adapted to contact and seal against a surface of the plate around a selected orifice, said housing having an opening in line with said outlet passage, removable closure means for said opening to permit access to said sleeve and its removal from the housing, and common means to hold said plate in contact with said surface and the end of said sleeve.

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