April 16, 1940. R. A. AUCION 2,197,064

DUAL CONTROL LIFT MECHANISM

Original Filed Nov. 21, 1936 3 Sheets-Sheet 1

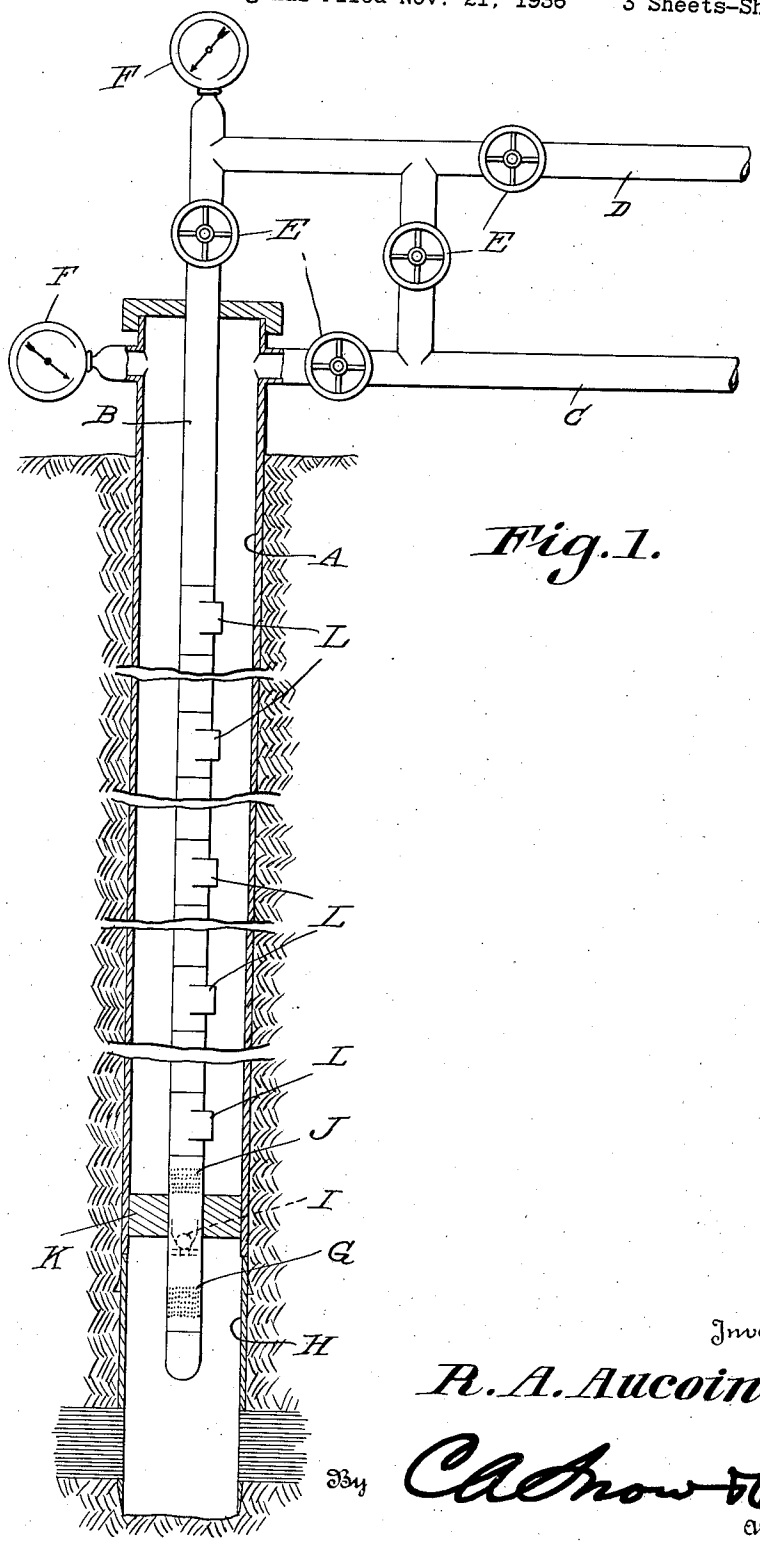


Fig. 1.

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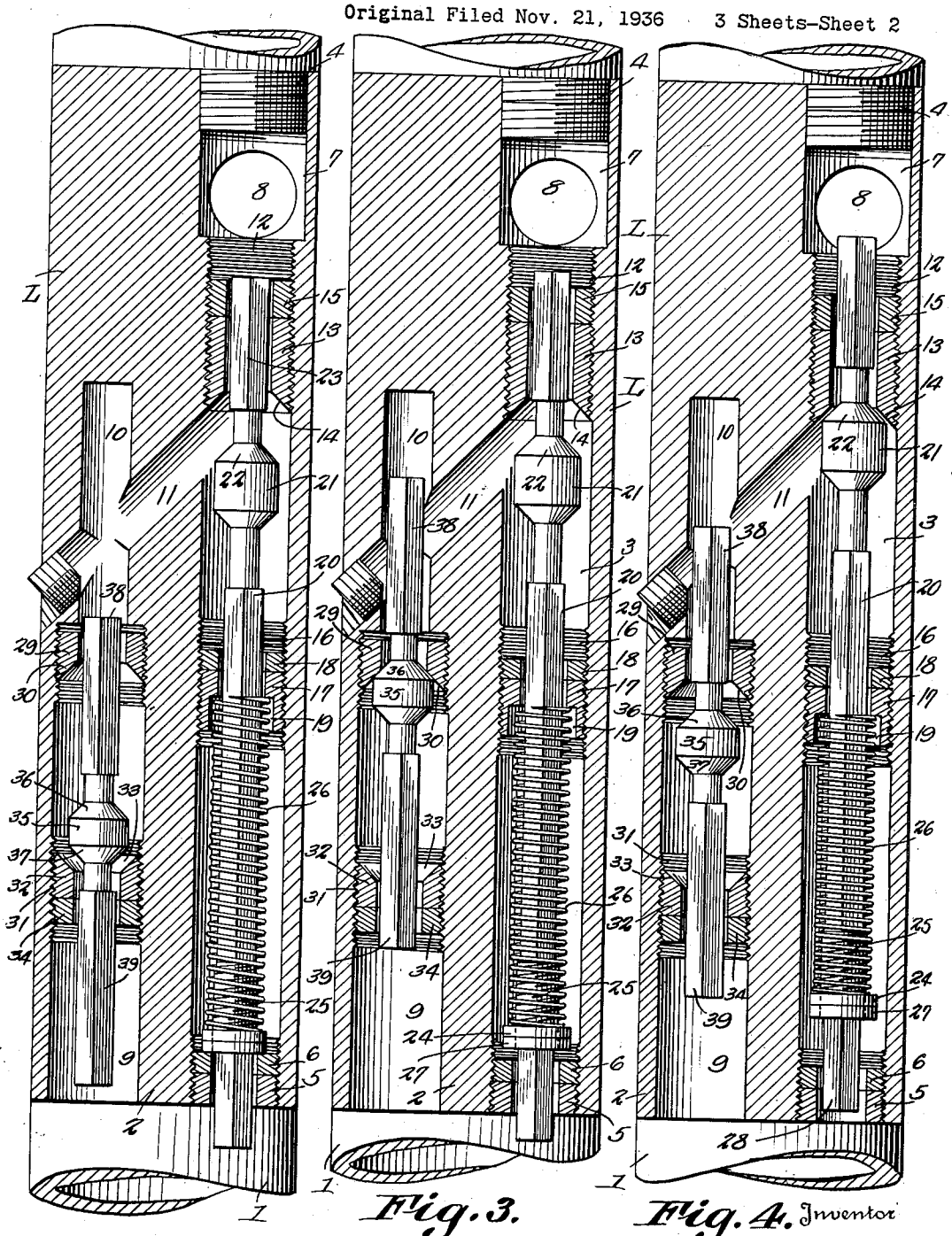


Fig. 2. Fig. 3. Fig. 4.

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Fig. 5.

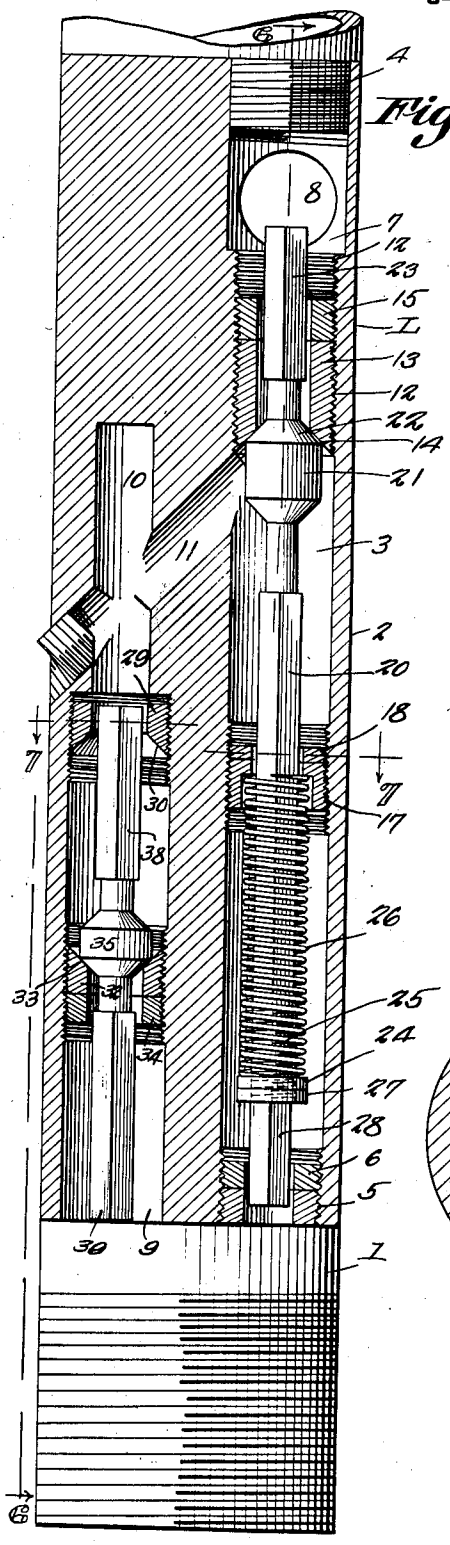


Fig. 6.

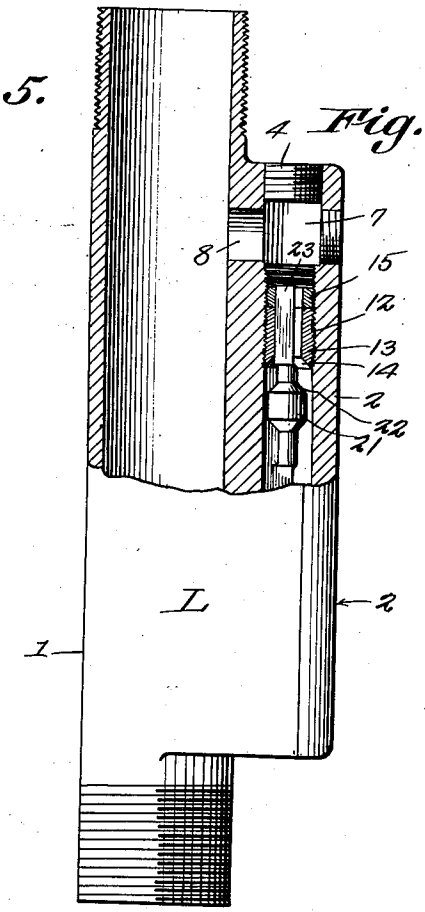
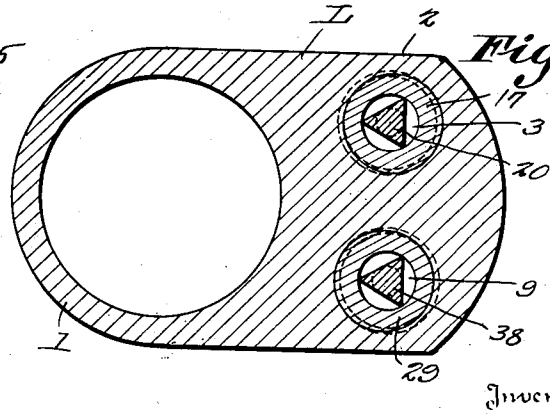


Fig. 7.



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2,197,064

DUAL CONTROL LIFT MECHANISM

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Application November 21, 1936, Serial No. 112,135
Renewed September 26, 1938

7 Claims. (Cl. 103—232)

This invention relates to mechanism for use in oil wells whereby oil at low fluid levels can be made to flow by the application of air or gas under pressure and supplied to the interior of the tubing string from the annular space between the tubing and the casing, a dual valve of new and novel construction being utilized for controlling the action of the air or gas.

With the foregoing and other objects in view which will appear as the description proceeds, the invention consists of certain novel details of construction and combinations of parts hereinafter more fully described and pointed out in the claims, it being understood that changes may be made in the construction and arrangement of parts without departing from the spirit of the invention as claimed.

In the accompanying drawings the preferred form of the invention has been shown.

In said drawings

Figure 1 is a view partly in section and partly in elevation with parts broken away and illustrating, more or less in diagram, the application of the invention to an oil well.

Figure 2 is an enlarged vertical section through the dual control valve showing the parts in one position.

Figure 3 is a similar view showing the parts in another position.

Figure 4 is a similar view showing the parts in a third position.

Figure 5 is another view similar to Figure 4 and showing the parts in a fourth position.

Figure 6 is a section on line 6—6, Figure 5.

Figure 7 is an enlarged section on line 7—7, Figure 5.

Referring to the figures by characters of reference A designates a well casing in which is suspended a string of tubing indicated at B, the said well being equipped with the usual connections, such as a gas input C, a flow line D, and valves and pressure indicators, etc., as indicated at E and F respectively.

In the structure shown in Figure 1 the lower perforated end of the string of tubing, known as the tail pipe and indicated at G is surrounded by a liner H and is provided above the perforations with a standing valve I. Perforations J are formed in the tubing above the standing valve and a packer K can be seated in the casing A and around the tubing below the perforations J. It is to be understood that this described construction is only one of several which can be used and with which can be associated the present improvements which, as illustrated at L, can be located at different elevations along the tubing.

Each of the structures constituting the present invention is in the form of a coupling 1 adapted to be interposed between two sections of tubing so as to join them. This coupling has a casing 2 extending outwardly therefrom and longitudinally thereof, and extending longitudinally through this casing near one side thereof is a bore 3 which can be closed at its upper end in any suitable manner, as by means of a removable plug 4 while seated in its lower end is a lock nut 5 in the form of a ring on which bears a ring 6 screwed into the bore and constituting a bumper.

The upper portion of the bore 3 is enlarged or counterbored as indicated at 7 and communicates through a port 8 with the interior of the coupling 1.

A second bore 9 is extended upwardly into the casing 2 at one side of the bore 3. The upper end portion of this bore is reduced in diameter as indicated at 10 and terminates within the casing 2. A port 11 connects the upper portion 10 of bore 9 with the bore 3 and that portion of the bore 3 between port 11 and the counterbore 7 is screw-threaded as shown at 12 for engagement by a tubular member 13 the lower end of which is flared to provide a valve seat 14 a portion of which alines with a portion of the wall of the port 11. A lock nut in the form of a ring 15 engages the threads 12 and bears on the tubular member 13 for the purpose of holding it in proper position.

At an intermediate point between bumper 6 and port 11, the bore 3 has its wall threaded as shown at 16 and this threaded portion is engaged by a guide ring and abutment 17 on which is also seated a lock nut 18 in the form of a ring. This combined guide and abutment 17 has a socket 19 in its lower face.

Mounted to slide within the guide 17 is an angular stem 20 carrying the main valve 21 which is tapered, as at 22, to fit tightly against its seat 14. Another angular stem 23 extends upwardly from the valve so as to work within the tubular member 13 and lock nut 15.

An adjusting nut 24 is mounted on a threaded portion 25 of the stem 20. This nut is engaged by one end of a coiled spring 26 mounted on the stem and the other end of which projects into socket 19 and bears against the guide member 17. By means of a lock nut 27 the adjusting nut 24 can be held in any position to which it may be moved. The lower portion of stem 20 is angular as indicated at 28 and works within the bumper 6 and its lock nut 5.

Seated in the upper end of the enlarged portion of bore 9 which is below port 11, is a screw-threaded ring 29 having a flared lower end 30 forming a valve seat.

At a point below the valve seat 30, the bore 9 has its wall screw-threaded, as shown at 31 and this screw-threaded portion is engaged by a ring 32 flared at the top to provide a tapered seat 33. A lock nut in the form of a ring 34 is seated under the ring 32 as shown.

An auxiliary valve 35 is located between the two seats 30 and 33 and has its upper and lower portions tapered as shown at 36 and 37 respectively. An angular stem 38 extends upwardly from the valve into the reduced portion 10 of bore 9 while another angular valve stem 39 extends downwardly from the valve and is guided within ring 32 and nut 34.

As before stated a series of these valves can be placed along the string of tubing from the surface downward in a well and are indicated at L. In describing the operation of the device it is to be understood that the word "gas" used is not intended to limit the use of the valve to the control of gas but it is to be considered as sufficiently broad to apply to either air or gas.

Assuming that the valves are open as shown in Figure 2, gas is introduced into the annular space between the casing A and the tubing B. Thus there will be set up a flow of gas through the ports or openings in the rings 34 and 32 and around auxiliary valve 35 to port 11 and thence over the open valve 22 and along stem 23 to the upper portion 7 of the bore where it can flow through port 8 into the coupling 1. When the gas reaches a predetermined velocity, due to the difference in pressures on the inside of the tubing and between the tubing and the casing, the auxiliary valve will be moved against its seat 30, as shown in Figure 3.

It might be stated that while the auxiliary valve 35 was open, as in Figure 2, the main valve 22 was also open as shown in said figure and gas was not only flowing upwardly through the bore 9 to port 11 but was also flowing upwardly within bore 3 and around the main valve 21 to the port 8, the pressure of the gas serving to hold the nuts 24 and 27 slightly away from the bumper 6 but the tension of the spring 26 serving to maintain valve 21 away from its seat 14. Consequently this valve 21 will remain open longer than will valve 35 the movement of which is resisted solely by its weight. The action of the spring in keeping valve 21 open will be supplemented by the pressure of the gas admitted past the open auxiliary valve 35.

Ultimately the pressure of gas against the auxiliary valve 35 will raise it to its seat 30. Consequently the difference between the pressure inside of the tubing and that outside of the tubing will be increased with the result that the main valve H will be caused to move upwardly against the action of spring 25 until it reaches its seat 14 whereupon gas will be cut off from the port 8. During this upward movement of the main valve 21 it will reach a point opposite port 11, as shown in Figure 3, at which time the pressure exerted will cause the auxiliary valve 35 to move downwardly from its seat 30. This is shown in Figure 4. Consequently a large charge of gas is rushed around the valve 21, causing it to snap against its seat 14 as shown in Figure 5. The auxiliary valve 35, which has dropped to its lower seat 33, will remain in this position until a fluid head is built up within the tubing, causing sufficient pressure to be exerted on the main valve 21 to cause it to leave its seat 14. The pressure thus exerted, supplementing the tension of spring 26, must exceed the pressure in the space between the casing and the tubing before the main valve 21 will leave its seat 14.

Following the foregoing action the cycle of operation will be repeated as gas rushes around the auxiliary valve and causes the main valve 21 to move away from its seat.

It will be noted that the tension of the spring is adjustable so as to vary the amount of pressure necessary to force valve 21 to its seat. While either the main or auxiliary valve might be used separately as a flow valve, nevertheless the two valves have been combined in the present instance in order to obtain a wider range of closing pressure differentials. When both valves, numbers 21 and 35, are in their opened positions and gas pressure is applied, the gas will first pass through the auxiliary valve, forcing valve number 35 away from its lower seat, because there is less resistance through this side than passing through the ports numbers 5 and 6 and forcing up the lock washer number 27, which is held against the port in number 6 by the tension in the spring number 26. Other hindrances to the passage of gas through the main valve are: the spring, number 26, spring support and valve stem guide, number 17, and clearance between valve number 21 and the side walls.

Since gas will first pass through the auxiliary valve and enter the main valve chamber through port number 11, a turbulence is created above valve number 21 and valve seat number 14. This causes enough force to keep valve number 21 away from its seat until valve number 35 is seated in its upper position. This insures a set differential in pressure before the main valve functions in closing, regardless of the tension in the spring number 26. Immediately after valve number 35 closes and the turbulence above valve number 21 is stopped, then valve number 21 moves upward against its upper seat and seals off the only port entering the tubing column. At this time, the pressures are equalized in the two valves and the auxiliary valve will drop open.

The cycle will repeat itself as soon as a predetermined differential pressure on each side of the main valve number 21 is reached, and this valve leaves its upper seat.

What is claimed is:

1. A dual control valve including a coupling for well tubing having a liquid flow passage therethrough, an extension therein having a main bore opening at its upper end into the coupling and at its lower end into the space outside the coupling, there being a supplemental bore in the extension opening at its lower end into said space and at its other end into the main bore, a normally open spring restrained valve in the main bore, an auxiliary valve in the supplemental bore, and upper and lower seats cooperating therewith, said auxiliary valve normally engaging its lower seat by gravity.

2. A dual control valve including a coupling for well tubing having a liquid flow passage therethrough, an extension therein having a main bore opening at its upper end into the coupling and at its lower end into the space outside the coupling, there being a supplemental bore in the extension opening at its lower end into said space, a valve seat in the main bore, upper and lower valve seats in the supplemental bore, there being a port opening into the main

bore below the valve seat therein and into the supplemental bore above the upper valve seat therein, a spring restrained main valve in the main bore below and normally removed from its seat, and an auxiliary valve in the suplemental bore between the seats in said bore and normally resting by gravity on its lower seat.

3. A dual control valve including a coupling for well tubing having a liquid flow passage therethrough, an extension therein having a main bore opening at its upper end into the coupling and at its lower end into the space outside the coupling, there being a supplemental bore in the extension opening at its lower end into said space, a valve seat in the main bore, upper and lower valve seats in the supplemental bore, there being a port opening into the main bore below the valve seat therein and into the supplemental bore above the upper valve seat therein, a main valve in the main bore below and normally removed from its seat and movable across the port below the seat, an adjustable spring for holding the main valve normally spaced below its seat, and an auxiliary valve in the supplemental bore between the seats in said bore and normally resting by gravity on its lower seat.

4. A dual control valve including a coupling for well tubing having a liquid flow passage therethrough, an extension therein having a main bore opening at its upper end into the coupling and at its lower end into the space outside the coupling, there being a supplemental bore in the extension opening at its lower end into said space, a valve seat in the main bore, upper and lower valve seats in the supplemental bore, there being a port opening into the main bore below the valve seat therein and into the supplemental bore above the upper valve seat therein, a main valve in the main bore below and normally removed from its seat and movable across the port below the seat, a stem depending therefrom, a spring on the stem, means adjustably mounted on the stem and in the bore respectively for varying the normal tension of the spring, said spring constituting means for holding the valve normally spaced downwardly from its seat, an adjustable bumper in the bore for limiting the downward movement of the valve from its seat, and an auxiliary valve in the supplemental bore between its seats and normally resting by gravity on its lower seat.

5. The combination with a well casing and tubing sections suspended therein forming an annular space between the casing and tubing, of a series of superposed couplings each joining two sections of tubing, each coupling including a side extension having main and supplemental bores extending upwardly therein and opening at their lower ends into said space, there being a port connecting the upper portion of the main bore with the interior of the casing, a valve seat in the main bore below said port, upper and lower valve seats in the supplemental bore, there being a port extending from the main bore below and close to the seat therein to the supplemental bore above the upper seat therein, a spring restrained valve in the main bore normally below and spaced from its seat, and an auxiliary valve in the supplemental bore between the upper and lower seats and normally resting by gravity on the lower seat.

6. The combination with a well casing and string of tubing sections therein forming an annular space between the casing and tubing, a series of superposed couplings each joining two sections of tubing, each coupling including a housing having a lateral extension, a vertical passage thru said extension, means to close one end of said passage, an inlet from the passage in the extension into the interior of the coupling, a valve stem slidable in said passage, a valve on said stem, a valve seat in said extension below said inlet to receive said valve to close said passage in the coupling, a valve spring about said stem below said inlet, means on the stem to receive one end of said spring, means in said extension and below said valve seat to receive the other end of said valve spring so that said spring normally exerts a force to hold said valve open, and an entry into the vertical passage in said extension at the bottom thereof for fluid under pressure from the annular space between the casing and tubing which fluid passes said valve so that the valve may control the flow of fluid.

7. The combination with a well casing and string of tubing sections therein forming an annular space between the casing and tubing, a series of superposed couplings each joining two sections of tubing, each coupling including a housing having a lateral extension, a vertical passage thru said extension, means to close one end of said passage, an inlet from the passage into the interior of the coupling, a valve stem slidable in said passage in the extension, a valve on said stem, a valve seat in said extension below said inlet to receive said valve to close said passage in the coupling, a valve spring about said stem below said inlet, means on the stem to receive one end of said spring, means in said extension and below said valve seat to receive the other end of said valve spring so that said spring normally exerts a force to hold said valve open, and an entry into the vertical passage in said extension at the bottom thereof for fluid under pressure from the annular space between the casing and tubing which fluid passes said valve so that the valve may control the flow of fluid, said means on the valve stem being adjustable to vary the force of the spring.

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