MEANS FOR CONTROLLING THE FLOW OF FLUIDS UNDER PRESSURE

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This invention relates to new and useful improvements in means for controlling the flow of fluids under pressure.

One object of the invention is to provide certain improvements in well fluid lifting systems and apparatuses and particularly upon my Patents No. 2,171,478, No. 2,171,812, No. 2,171,480 and No. 2,202,462; and my co-pending application, Serial No. 317,073, filed February 3, 1940.

It is pointed out that a very great portion of all wells vary in the quantity of fluid produced, the constituency of the fluid and the rate at which the wells produce their fluid. Contributing factors to this variance are fluctuation of the casing pressure, the bottom hole pressure of the well and the back pressure maintained on the flow line and the tubing. Of course, the flow of a well may vary to a great extent and then to a small extent and on the other hand many wells may not vary at all. With the wells that fluctuate to any great extent, a time-actuated cut off of the lifting fluid would be unsatisfactory; while on the other hand, a well that produces relatively at the same rate, amount and kind of fluid, a fluid pressure actuated cut off of the lifting fluid would not be as satisfactory an operation as the time controlled cut off.

It is a known fact that fresh water, salt water, oil and various mixtures composed of these ingredients, plus the varying quantity of gas in solution in the oil, will materially affect the lifting of liquid from a well, because salt water requires a much greater volume of a lifting medium, such as pressure gas, in order to be lifted from a well than does oil. Due to the fact that salt water is much heavier than oil, a well that produces salt water in addition to oil, or produces substantially all salt water, would require the introduction of pressure fluid for a greater length of time than would be required for the same quantity of oil. A well producing salt water usually varies in the volume of salt water produced and frequently goes to the extreme of periodically producing oil, then salt water and/or a mixture thereof.

From the foregoing it will be apparent that where the flow of a well fluctuates, it is more economical to utilize the pressure of the flowing fluid to control the production because of the varying lengths of time required to produce the different "slugs" or loads of fluid. On the other hand, a time controlled cut off would be more economical in the saving of lifting fluid, where a well produces substantially an even rate of flow and a known quantity of fluid; because the time controlled cut off can be adjusted to terminate the admission of lifting fluid to said well fluid when sufficient lifting fluid has been introduced, which is usually before said load reaches the surface and is still in the flow string of the well. In other words, with time control cut off where the weight of each slug is substantially the same, the admission of lifting fluid beneath said slug may be cut off while said slug is several hundred to several thousand feet below the surface of the well. This practice conserves said lifting fluid as well as reduces the operating costs.

However, when a well produces light and heavy slugs of well fluid, the time control cut off would not be economical or practical because, if the timing was set to introduce a sufficient quantity of fluid to lift the heavy slugs, then such fluid would be wasted when light slugs were produced; and if the timing was set for the light slugs, sufficient pressure would not be provided to handle the heavy slugs and the production of the well would be terminated, which would necessitate the unloading or removing of the excess fluid before the well could again be operated by the intermittent control mechanism. By using the well fluid pressure release of the intermittent control mechanism on fluctuating wells, each slug actuates the fluid pressure releasing means so that sufficient lifting fluid is introduced for each slug to lift the same from the well. Therefore, the lighter slugs would discontinue the operation of said control mechanism to terminate the admission of lifting fluid sooner than a heavy slug would, which makes for more economical operation for this type of well.

It is a particular object of the invention to provide an improved intermittent control device which is so arranged that the duration of admission of lifting fluid may be controlled by the timing mechanism or by the flow of the well fluid per se, whereby a control device is provided which will handle all well flowing conditions and requirements, economically and satisfactorily.

An important object of the invention is to provide an intermittent actuating fluid control device so constructed that not only is the spacing of the periods of time during which said device is in actuation, controlled, but the duration of the time interval said device is actuated, is also predetermined, whereby a positive and definite time regulation and duration of operation is obtained.

A particular object of the invention is to provide an intermittent control mechanism of the character described, whereby time controlled...
means is employed to cause said mechanism to periodically operate, and wherein by means of simple adjustments, which may be readily made in the field without special tools, the operation of said device for the supply of operating fluid may be terminated by said time controlled means or by the pressure of the well fluid.

Still another object of the invention is to provide an improved intermittently actuated control mechanism which may be completely time operated, both as to the admission of lifting fluid to the well tubing, as well as to discontinue such admission; whereby the amount of pressure fluid so introduced and the time of introduction may be predetermined so as to be sufficient to expel or lift the well fluid from said well.

A further object of the invention is to provide an improved system of producing fluids from a well under varying flowing conditions and involving an improved intermittent fluid control mechanism which includes, a supply of pressure fluid, means for by-passing a low pressure actuating fluid around a spring-loaded valve for controlling said supply, applying said low pressure fluid against said valve to maintain a predetermined fluid pressure, together with timing means for intermittently applying the by-passed low pressure fluid to a spring-loaded feed valve to feed the low pressure fluid to an actuator for admitting the supply of high pressure actuating fluid to the well fluids, in combination with means for releasing the low pressure fluid from the actuator to cut off the supply of low pressure lifting fluid to said actuator, said release means being arranged to be actuated either by the flowing pressure of the well fluids or by the timing mechanism.

A construction designed to carry out the invention will be hereinafter described, together with other features and objects of the invention.

The invention will be more readily understood from the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a diagrammatic view showing how the control mechanism, constructed in accordance with the invention, may be connected on a well;

Figure 2 is a plan view taken on the line 2-2 of Figure 1;

Figure 3 is a view, partly in section and partly in elevation, of the intermittent control mechanism and its housing;

Figure 4 is a longitudinal, vertical sectional view of a portion of the operating mechanism of the intermittent control mechanism;

Figure 5 is an enlarged detailed view of the time-controlled valve for regulating the actuation of said mechanism, showing said valve in its closed position;

Figure 6 is a detailed view of said valve in its open position;

Figure 7 is a view, partly in section and partly in elevation, showing the lower portion of the regulator valve of said mechanism;

Figure 8 is an enlarged detailed view of the release valve of said mechanism, showing said valve adjusted to be actuated by the pressure of the flowing well fluid; and

Figure 9 is a horizontal, cross-sectional view taken on the line 9-9 of Figure 6.

In the drawings, the numeral 10 designates the usual well casing which has a well tubing string 11 depending axially therethrough. The upper end of the casing is screwed into the usual casing head 12, mounted above the ground level, and the upper end of the tubing string is supported within the casing head in the regular manner. I have shown several of my flow or kick-off valves 13, similar to the valves shown in my Patent No. 2,171,480, mounted in said tubing string and as these form no essential part of this invention, they will not be described in detail. The lower end of said tubing may be provided with a suitable standing valve 14 and perforated bull plug 15.

The casing head 12 is provided with the usual outlet openings 16 and 16' and the regular field line or pressure fluid supply line 17 is connected to the outlet 16 for maintaining a reservoir of pressure fluid in said casing 10. A pipe 18 is connected to the outlet 16' and extends to a suitable housing 19. This housing comprises a water-tight, dust-proof enclosure for the intermittent control mechanism. This mechanism controls the flow of a pressure fluid to a suitable operating mechanism or a servo-motor, which will be more fully hereinafter described.

As will be seen in Figures 3 and 4, an elongate, rectangular body 20 is mounted above one or more stud bolts 21 and 21' engaging in threaded sockets 22 in the underside of said body. This body is spaced from the bottom of said housing by a number of bosses on the underside of said body. The purpose, function and operation of the intermittent control mechanism positioned within said housing 19 and mounted upon said body 20 is somewhat similar to the intermittent control mechanism shown in my Patent No. 2,171,478, and my co-pending application, Serial No. 317,073, filed February 3, 1940.

The pressure fluid supply pipe 18 is threadably connected into the lower end of a vertical port or passageway 24 extending transversely through said body from its lower edge to its upper edge. This port 24 is connected to one end of an elongate, horizontally extending passageway 25 lying longitudinally of said body 20 and terminates in a vertical port or passageway 28 similar to said port 24. This port 28 also extends from the upper edge of said body to its lower edge and has a clean-out and valve replacement plug 26 threaded into its lower end. One end of an elongated, horizontally extending passageway 27, similar to the passageway 25, is connected to said vertical port 26 intermediate its ends and above where said passageways 25 and 27 intersect each other. The other end of said passageway 27 terminates in a vertical, transverse port or passageway 28, similar to said ports 24 and 26. The lower edge or end of said vertical port 28 has a pipe 29 extending out of said housing 19 (Figures 1, 2, 3 and 4) to the lower end of an elongate, tubular housing or cylinder 30 of an actuating mechanism or servo-motor, as shown in Figure 1.

This cylinder is suitably suspended over the well by a wire or rope 31 which may be fastened in a derrick or other structure (not shown). This cylinder is similar to the one shown in my above-mentioned patents and co-pending application and as it is not an essential feature of the invention, it will not be described in detail. It is sufficient to say that the cylinder contains a
suitable piston (not shown) for actuating the piston rod 32 depending from said cylinder on the lower end of said cylinder. In one form of the invention, there is a wire or supporting element 33 for suspending and actuating the weight or operating bar 34, which actuates the flow valves 13 (Figure 1).

In Figures 3 and 4, it will be seen that said valve body member 28 in the lower end of said cylinder is screwed into its upper side three pairs of upright, externally screw-threaded stud bolts or posts 35, 35'; 36, 36'; and 37, 37'. The threaded bolts comprising each pair of posts are spaced equidistantly from their respective vertical post 24, 25 and 26. Thus, such as said posts 35 and 35' from said post 24, said posts 36 and 36' from said post 25, and said posts 37 and 37' from said post 26. All of said posts are threaded into the upper surface of said valve body 20 and are secured thereto and braced thereon by a lock or retaining nut 38 on the foot of each post, which is tightened on the external threads of said posts against the upper surface of said valve body. Each pair of posts and their respective port therein constitutes a separate valve in function and purpose, and while all three are similar in construction, I will describe only one valve in detail, which description will suffice for all.

The upper end of said posts 35 and 35' are formed with upright, coaxially extending, reduced pins 39 having external screw-threads on their upper ends. A diaphragm cap and piston chamber structure is mounted upon the upper end of said threaded posts 35 and 35' on said reduced pins 39 and are aligned with said vertical port 24. This diaphragm cap and piston chamber structure is very similar to that shown and used in my other forms of intermitters, such as my Patent No. 2,171,812, No. 2,202,442, and No. 2,171,478, and my co-pending application, Serial No. 317,073.

This structure consists of a concavo-convex, annular cap or head 40 having an outwardly directed flange 41 on its perimeter. The annular piston chamber or cylinder 42 has a similar flange 43 and these two flanges are clamped together by a plurality of bolts 44 and nuts 45 for gripping and clamping a diaphragm disk 46 therebetween. It is pointed out that a diaphragm chamber 47 is formed above said diaphragm within said cap 46. This diaphragm is provided with an axial opening, so that the upper end of a piston rod 48 may extend therethrough, in order that said diaphragm and a flat, circular piston 49 mounted thereon may be securely connected together by a nut 50 engaging the threaded upper end of said piston rod on the upper side of said diaphragm 46; whereby said diaphragm, said piston 49 and said piston rod 48 are clamped together and move as a unitary structure.

It will be noticed in Figures 3, 4 and 8, that intermediate the ends of each of said threaded bolts, an adjusting nut 51 is mounted therewith and these nuts are arranged to support an oblong web member 52, whereby upon the rotation of said nut 51, may be raised or lowered as desired. A suitable coiled spring 53 is interposed between and bears against the upper surface of said web 52 and the lower surface of said piston 49, so that an upward tension or thrust is placed or exerted upon said piston, said piston rod 48 and said diaphragm 46.

Thus, it will be apparent that by adjusting said nuts 51, this tension is regulated and may be increased or decreased as is needed. The port 24, posts 35 and 35' and related structure is termed and serves the purpose of a regulator valve A, while said port 26, posts 36 and 36' and their related structure constitute a motor or control valve B, and said port 28, posts 37 and 37' is termed and serves as a release valve C. The lower end of said piston rod 48 of said regulator valve A structure depends within said vertical port 24 and a suitable stuffing box 54 is provided for closing the upper end of said port and packing around the lower end of said piston rod. This stuffing box may comprise a threaded nipple 55 having an axial opening 55' therethrough, the upper portion of which is counterbored to provide a packing area or chamber for a suitable packing means 57. The usual follower block 58 rides upon the packing 57 and is engaged and actuated by a threaded cap 59 screwed upon the upper end of said nipple 55.

It will be seen in Figure 7, that said piston rod 48 is provided with an axial bore or passage-way 60 which extends entirely through said rod so that fluid may flow through said piston rod from one end to the other. The lower portion of said bore 60 is counterbored at 61, in order to provide an entrance or admission chamber. A small, annular dart orifice piece 62 is positioned at the lower end of said piston rod and has a conical valve tip or face on its lower end and an upstanding, short, cylindrical pin 63 on its upper end extending up into the admission chamber or counterbore 61. This pin 63 has a loose fit within the lower portion of said counterbore 61 and the upper end of said pin abuts the lower edge of a small coiled spring 64, which exerts a slight tension downwardly on said dart 62. A small hole or opening 65 is provided within the wall of said piston rod 48, adjacent the lower end of said piston rod, for providing additional communication between said counterbore 61 and the outside of said piston rod.

It is pointed out that said port 24 is provided with an internal web or partition 66 into which is fitted a replaceable bushing 67 that is an axial port or passage-way 68 extending therethrough. The upper end of said passage-way 68 is formed with a ground, tapered seat 69 to receive the conical valve tip 62, so as to close said passage-way through said bushing. Attention is called to the fact that when pressure fluid enters said valve body 20 from said pipe 18 through said vertical port 24 and said dart is in its lower or seated position, said pressure fluid has to flow through said axial passage-way 68 of said bushing 67, where said pressure fluid will engage and lift said dart 62 against the tension of said spring 64, as well as lifting said piston rod 48 to open said regulator valve A to admit pressure fluid. This pressure fluid admitted through said passage-way 68 will flow into the longitudinal passage-way 25, as well as into said counterbore 61 both through said hole 65 and around said pin 63 of said dart. Then said pressure fluid will flow through said bore 60 of said piston rod 48 and out the upper end thereof, on top of said diaphragm 46, into said diaphragm actuating chamber 47 within said cap 40.

A pipe 70 leads from said chamber 41 and said cap 40 to the lower end of a clock valve body D, which is normally closed. While said spring 53 beneath said piston 45 tends to keep said passage-
way 68 open, the filling up of said passageway 25, said port 24 above said bushing 67, said chamber 41 and pipe 10 will build up a pressure on said diaphragm. This diaphragm is to the point that the pressure in said chamber 41 builds up to a predetermined point to overcome the tension of said spring 53, then said piston rod will be moved downwardly and said dart will engage its seat 65 to close said passageway 68. Thus, it will be noted that by adding the tension of said spring 58 may be regulated to maintain any desired pressure in said pipe 70, said chamber 47 and said passageway 25. Of course, the pressure will be substantially the same throughout said pipe 10, said chamber 41, said bore 68, said counterbore 61, said port 24 above said partition 66, in said passageway 25 and the lower end of said vertical port 26 and these parts serve as a reservoir for the control mechanism.

The valve A as has been pointed out is termed and serves the purpose of a regulator valve, because the pressure in said pipe 18 is always greater than that used and desired for operating said controlling mechanism, whereby said pressure fluid is reduced at this point to the pressure desired and a reserve of this pressure fluid is maintained by means of said pipe 18, said chamber 41, said bore 68, said counterbore 61, said port 24 above said partition 66, said passageway 25 and the lower end of said vertical port 26. Upon any withdrawal from this reservoir, the pressure maintained within said chamber 41 upon said diaphragm 46 will be reduced, so that said spring 53 will lift said piston rod 48 and again open said passageway 66 to replenish the reserve of pressure fluid maintained in said reservoir. Therefore, upon any withdrawal of pressure fluid from the pipe 70 or from the lower end of said port 26, the pressure maintained within said reservoir will be reduced substantially simultaneously, so that said passageway 66 will be opened in accordance with said reduction and maintain the desired pressure in said reservoir, whereby a predetermined pressure may be had on which to operate said control mechanism.

The valve B is termed and serves the purpose of a motor or gate valve, as it controls the flow of pressure fluid from said passageway 25 through said port 26 into said passageway 21. It will be noticed that the structure of said valve B is very similar to valve A with the exception that the stem 11 is solid and has a reduced portion 72 on its lower end that terminates in an enlarged foot or valve member 73. The structure and action of valve B is also different in that the passageway 14 is larger in diameter than said passageway 58 and is opened upon the downstroke or travel of said piston rod 71 and closed upon the upstroke of said piston rod.

The valve C is termed and serves the purpose of a release or control valve and this valve and port 28 are similar to said valve B and port 26 in structure and action, with the exception that the valve stem or piston rod 75 is adjustable longitudinally and an additional valve face 76 is provided at the upper end of the reduced portion 71. The bushing 68 has seats on both the upper and lower end of the axial passageway 18 extending through. When this valve C is set for time controlled discontinuation or releasing, as shown in Figures 3 and 4, the valve face 76 will engage the seat at the upper end of said passageway 19 of said bushing 68 and move the travel of said piston rod 75 and opens the same upon its up-ward travel. The downward and upward travel of said piston rod is caused by the accumulation and bleeding off of pressure fluid in the cap 88, acting upon the diaphragm 61 against the tension of the spring 87. When said piston rod 75 is in its upper position, as shown in Figure 4, any fluid in said passageway 21 or pipe 29 will flow through said passageway 79 into the passageway 83, into the threaded socket 22, through the bore 84 of said threaded bolt 21' and vented to the atmosphere. Wherein said piston rod is in its lower position and pressure fluid from said passageway 28, entering said passageway 21 through said open passageway 74, will flow into said pipe 29 through which it will be led to the lower end of said cylinder 36 beneath the piston therein (not shown). This introduction of pressure fluid will lift or force this piston to the upper end of said cylinder and carry therewith said piston rod 32, said wire line 33 and said weight bar 34. When said valve B has been closed and said valve C is opened, said passageway 79 of said bushing 88 is opened, so that the pressure fluid in said passageway 21, said pipe 29 and said cylinder 30 beneath the piston therein, will bleed through said passageway 79 and said passageway 83 and said bore 68, so that said lock nut 71 will be released; whereby the piston (not shown) in said cylinder 30 is free to return to the lower end of said cylinder and lower said piston rod 32, said wire line 33 and said weight bar 34 to the position shown in Figure 1.

The piston rod 75 has the major portion of its upper end externally screw-threaded to engage in an elongated boss 85 formed on the under side of said piston 88. An elongated lock nut 87 is mounted on said threads of said piston rod 75 to lock said piston and said piston rod 75 together and it is preferred that the lower end of said nut extend below the normal operating position of the spring supporting web 88. It will be seen in Figures 3, 4 and 8, that a short distance below the lower end of said nut 87, a knurled band or ring 95 is formed on said piston rod 75.

In order to change the operation of said release valve C from time control releasing to fluid pressure releasing, the lock nut 87 is screwed downwardly until the lower end thereof is on a line with the upper edge of said knurled band 95, then said piston rod 75 and said lock nut 87 and said boss 85 are screwed upwardly into said boss 85, until the upper end of said lock nut abuts the lower end of said boss 85. The foot piece or valve member 95 on the lower end of the reduced portion 71 of said valve stem 75 has now engaged the seat at the lower end of said passageway 19 of said bushing 78, whereby said passageway is now closed when said valve stem 75 is in its uppermost position. With said valve C in this position and valve B then is opened, pressure fluid flowing from said passageway 28, through said passageway 21 and into said passageway 27 will flow into said pipe 29 to said cylinder 30 and actuate the piston (not shown) therein as has been described.

The lifting or pulling of said weight bar 34 into one of said flow valves 13, will open the same so that pressure fluid is admitted to the lower end of the tubing 14 extending from said tubing 14 to the well head and lower said wire line 42 down the tubing string. The other end of the pipe 140 is connected to a well fluid manifold 123 mounted on
the upper end of said cap 80 to transmit the pressure of said well fluid to said diaphragm 81 within said cap 80 and depress the same and said piston rod 75, as will be described later. This downward travel of said piston rod (Figure 8) will move said valve stem 95 downwardly through said passageway 78, whereby the pressure fluid in said passageway 21 and pipe 29 will escape through said passageways 79 and 83, out of said bore 84 of said bolt 21' and vented to the atmosphere. The valve B has been closed before said valve C is actuated to release said pressure fluid from said passageway 27 and pipe 29.

As has been pointed out, a more or less constant pressure is supplied to said pipe 18 from said casing head 12 or field line (not shown), or any other suitable source. The spring 53 of said regulator valve A is set so as to maintain a predetermined pressure within said reservoir and this pressure will also be present in said pipe 70 up to said clock or time operated valve D. This clock valve D is preferably constructed of a rectangular block or valve body 91 having a vertical bore 92 therein. This bore extends downwardly through said valve body 91 and is provided with an axial bore 98 there-through, the upper end of which is threaded to receive a removable valve seat 96.

A laterally directed opening or passageway 97 extends outwardly from said bore 92 of said valve body 91, intermediate the threaded portions of said bore and preferably just below said removable valve seat 96. The outer end of said opening 97 is also threaded to receive a short length of pipe 98. Thus, it will be seen that a passageway from said pipe 70 to said pipe 98 is provided through said valve body 91.

The thimble 93 at the upper end of said bore 92 is provided with an axial bore 99, the lower portion of which is counterbore at 100 and a small, cylindrical valve member or dart 101 is positioned within said counterbore 100. The lower end of the valve member 101 is pointed or tapered, so as to engage and seat upon said removable valve seat 96 for closing said passageway through said valve body 91, whereby the flow of fluid from said pipe 70 to said pipe 98 through said valve body may be controlled. It is pointed out that this valve member 101 may undergo a limited sliding movement within said counterbore 100.

A thin valve rod or stem 102 extends downwardly through said bore 99 of said thimble 93 and the lower end of said valve stem 102 rests upon the upper end of said valve member 101, but has no fixed connection therewith. Manifestly, when said valve stem is moved downwardly, its lower end engaging the upper edge of said valve member will move said valve member downwardly so that the conical point on its lower end engages on said removable seat 96 and closes said passageway through said valve body 91. So long as said valve stem is held in its lowest position, it will hold said valve member in a seated position which positively prevents a flow of fluid from said pipe 70 and said bore 99 of said coupling member 94, into said bore 92 or into said pipe 98. However, when the pressure on the upper end of said valve stem is released or removed, the pressure of said fluid in said pipe 70 and said bore 99 of said coupling member 94, acting against the underside of said valve member 101, will move said member and said valve stem upwardly in said counterbore 100 and said bore 99 of said thimble 93 respectively. It is pointed out that the upward movement of said valve member will be limited, if not terminated sooner, by the upper end of said valve member striking the shoulder between said counterbore 100 and said bore 99, and as the upward movement of said valve member ceases, the upward movement of said valve stem will also be terminated.

For controlling the operation of said valve stem 102, to regulate the seating and unseating of said valve member, said valve stem has its upper end contacting the underside of a knurled head 103 of an adjustable stop bolt 104, but has no fixed connection therewith. This bolt is threaded into the underside of a horizontally extending lever 105 and a lock nut 106 is threaded onto the upper end of said bolt above the lever to lock said bolt in its adjusted position. This lever has one end curved downwardly which is pivoted to said valve body 91 on a pin or bolt 107, so that said lever extends upwardly on one end. Said lever and said fulcrum of said valve body and overhangs the same.

In Figures 3, 5 and 6, it is pointed out that due to the pivotal mounting of said lever 105, the same tends to swing downwardly at all times and is supported only by said valve stem 102 and said valve member 101, whereby the weight of said lever and its attachments is imposed upon said valve stem and said valve member to hold said member in its seated position. In order for said lever 105 to be lifted, the pressure of the fluid below said valve member must be sufficient to lift said lever and its attachments; although, it is true that said valve member and said stem exert or transmit the lifting action of said pressure fluid at a spaced point from said pivot pin 107 or the fulcrum of said lever, and this spacing to some extent facilitates the lifting of said lever.

An operating crank or curved finger 108 is pivoted at one end to an ear or lug 109 depending from the underside of said lever. The outer end of said finger 108 is upturned and slotted to form a bifurcated yoke in which a small roller 110 is mounted that it is free to revolve therein. It will be noticed in Figures 3, 5 and 6, that said roller rides on the periphery of a suitable escapement or revolvable wheel 111, which has one or more notches 112 cut or formed in its circumference. This escapement wheel is mounted on a shaft 113 extending from a suitable housing 114 containing a time or clock mechanism (not shown) for driving said shaft 113 and said wheel 111. This wheel revolves in a counter-clockwise direction (Figures 3, 5 and 6) and said roller 110 rides on the periphery of said wheel, so that when said wheel has revolved and one of the notches 112 has come over said roller, the same is free to enter said notch, due to the pressure of said pressure fluid beneath said valve member 110, as will be described later.

The outer end of said lever 105 is provided with a depending bolt or pin 115 which extends through a slot (not shown) in said finger 108 and the lower end of said pin 115 is threaded to receive a knurled nut 116. A small, coiled spring 117 is mounted on said pin 115 between said nut 116 and the underside of said valve lever 105 to exert a lifting action on said finger 108 and the tension of said spring 117 may be regulated by said knurled nut 116, whereby said finger and said lever are so connected together as to co-act and
form a flexible connection from said roller 110 to the upper end of said valve stem 102. The flexibility or rigidity of this connection, thus formed, may be regulated by the tension placed on said spring 117 by said knurled nut 116. Thereby, when one of the notches 112 is above said roller 110, said pressure fluid beneath said valve member 101 will lift said valve member, said valve stem 99, said lever 105, said finger 108 and said roller 110 until said roller engages the bottom of said notch, which terminates the upward movement or travel thereof. However, said roller may drop slightly from contact with the bottom of said notch, depending upon the setting of said clock valve as will be described later.

It is pointed out that when the actuation of said valve C is time controlled, said valve is actuated at a lower pressure than is required to actuate said valve B (Figures 3 and 4), so that when said valve member has been moved upwardly to open the passageway through said valve body 81, the pressure fluid from said pipe 70 entering said pipe 98 will flow into a T 118. One leg of this T 118 is connected by a short length of pipe 119 to the cap 120 of said valve B and the other leg of said T is connected by a short length of pipe 122 to a pet cock 122. The lower end of said pet cock 122 is mounted in the upper side of said fluid manifold 123 which is threaded into the upper end of said cap 80.

When said release valve C is time actuated, said pet cock is in an open position and said piston rod 100 has been screwed out of said boss 65 until a line or shallow groove 124, formed on said stem, is on a line with the lower end of said lock nut 81, as is shown in Figures 3 and 4. With said valve C in this position, the pressure fluid from pipe 98 will not only enter said T 118, said pipe 119, said diaphragm cap 120 and said pipe 121, but will also flow through said pet cock 122, said flow manifold 123 and into said cap 80 on top of said diaphragm 81. The piston rod 75 of said valve C will be moved downwardly, so that said valve face 76 will engage the seat at the upper end of said passageway 76 and close the same, before said piston rod 71 of said valve B is moved downwardly to open said passageway 74. The pressure fluid from said passageway 25 may now flow through said passageway 27 and into said pipe 29. It will be apparent that, said clock valve D regulates the entire actuation of said valves B and C, which makes them completely timed operated valves. The regulating mechanism of said clock valve D is the knurled bolt 104 and its lock nut 106 threaded through said lever 105.

The finger 108 has a short, upstanding lug 125 on its upper surface near said pin 115 and spaced from said lug 109 for engaging the undersurface of said lever 105. Attention is directed to Figures 3 and 5, wherein it will be seen that there is a small space between the upper end of said lug 125 and the underside of said lever. The amount of space between said lug and said lever is regulated by said bolt 104 and this space, together with the adjustment of said bolt 104, controls the length of time said valve member 101 remains open; as well as the length of time said valves B and C are actuated and then released or returned to their normal positions.

Whenever the adjustment of said regulator valve A is changed, so that a greater or lesser pressure is carried in said reservoir, as set out above, said bolt 104 and said spring 115 have to be adjusted in accordance, to regulate the tension of said roller 110 on said wheel 111. This bolt 104 and spring 115 take care of any slight inaccuracies or irregularities in said wheel 111, in said shaft 113, or in the timing mechanism (not shown) driving said shaft.

The longitudinal adjustment of said bolt 104 and the amount of space between said lug 125 and said lever 105, control the depth to which said roller 110 enters one of said notches 112 in said timing or escapement wheel 111 before said lug engages said lever to lift the same. As soon as said lug 125 engages said lever or substantially so to reduce the tension held on said lever, the pressure fluid beneath said valve member 101 will lift said valve member, said valve stem 102, said lever 105 and said roller 110, whereby said pressure fluid will flow through said pipes 98, 119 and 121 to said motor valve B and said release valve C.

When said roller has entered said notch to the point where said lug 125 engages said lever 105, such as is illustrated in Figure 5 by the dotted line position X of said roller, the opening of said valve member 101 begins and this valve will remain open while said roller completes its entrance into said notch until the bottom of said notch is reached. However, said roller may immediately fall away from the bottom of said notch a short distance, or it may ride the bottom or inclined surface of said notch, or it may fail to approximately the same point X in its upward travel at which said valve member was opened. In any event, the revolving of said wheel 111 will engage the inclined side of said notch 122 with said roller, so that said roller will ride on said inclined side and be carried up and out of said notch onto the perimeter of said wheel. As soon as said roller reaches the point illustrated by the dotted line position Y on said inclined surface, where said lug 125 engages said lever 105 and said valve member 101 was opened in the upward travel of said roller; said valve member will be closed and said lug will move away from said lever to substantially its original spacing. If said roller is not out of said notch when this point Y is reached, said roller will continue riding up the inclined surface of said notch, until it reaches the periphery of said wheel.

In the illustration shown by the dotted lines in Figure 5, the space on said inclined surface from dotted positions of said roller from Y to T would be for spreading the spacing of said lug 126 from said lever 105 to its original setting. It is pointed out that the depth to which said roller 110 may enter said notch before said valve member 101 is opened, may be controlled and this point may be anywhere from the very bottom of said notch, as shown by dotted line position S, to just within said notch, such as is illustrated by the position Z. Of course, this adjustment of said bolt 104 to obtain this variance is very slight as the difference in the various possible positions is a matter of seconds, depending on the speed said wheel 111 is operated by the timing mechanism (not shown) in said housing 114. The reason for the various positions or settings of said roller is that the length of time said valve member is held open may be regulated.

The valves B and C are actuated to move their respective piston rods 71 and 75 downwardly when said valve member 101 is opened and are held in this position as long as said valve mem-
ber is open. Thus, by regulating the length of time said valve member is open, will control the opening and closing of said valves B and C. The length of time said valve member is open, depends on the depth that said roller enters said notch before said valve member is opened, because said valve is closed when said roller reaches the same depth in said notch at which it opened said valve member. By adjusting said bolt 104 to increase or decrease the space between said hub 125 and said roller 105, the depth to which said roller enters said notch is easily regulated and the length of time said piston rods 71 and 75 of said motor valve B and said release valve C respectively are held in their lowermost positions.

When said valve member 101 has been closed, the pressure fluid trapped in said caps 120 and 80, said pipes 98, 119 and 121, said T 118, said pet cock 122 and said flow manifold 123 up to its cut-off valve 135 will leak or bleed around said valve stem 102 and said bore 95 of said thimble 83 and escape to the atmosphere. This bleeding of the trapped pressure fluid will permit said piston rods 71 and 75 to be lifted by said spring 53 of said valve B and said spring 82 of said valve C. Due to the different tensions placed on said springs 53 and 82, said piston rod 71 of said motor valve B will move upwardly first and close said passageway 74 and then said piston rod 75 of said valve C will move upwardly and open said passageway 79. When this occurs, the pressure fluid trapped in said passageway 27, said pipe 29 and in said cylinder 39 beneath the piston therein (not shown) will be vented through said passageways 79, 83 and 84 to the atmosphere.

As has already been pointed out (Figures 3 and 4), said passageway 25, said port 24 above said bushing 67, said counterbore 61, said bore 60 of said piston rod 48, said chamber 47, said pipe 70 and said bore 95 of said coupling member 94 to said valve member 101 form a pressure fluid reservoir, which will be filled with a predetermined pressure that is regulated by the tension placed on said spring 98 by said nuts 51 on said posts 35 and 35'. When the clock mechanism (not shown) in said housing 114 drives said shaft 113 for revolving said wheel 111 in a counterclockwise direction and one of said notches 112 comes over said roller 110, the pressure of fluid in said reservoir beneath said valve member 101 will then lift said valve member, said valve stem 102 and said lever 105, so that said roller will enter said notch. Thus, it will be seen that in this position, the pressure fluid in said reservoir is free to flow into said pipe 98, said T 118, said pipe 121 and into said cap 80 of valve C. This pressure fluid in said cap 80 will act on said diaphragm 81 and move said piston 86 and piston rod 75 downwardly against the tension of said coiled spring 82, so as to seat the valve face 76 in the seat at the upper end of said passageway 79 of said bushing 76 and close said passageway. This pressure fluid will also flow from said T 118 into said pipe 119 and into said cap 120 of said valve B, where the diaphragm 46 will be actuated upon by the pressure fluid in said cap and move said piston 49 and said piston rod 71 downwardly to open said passageway 74. Due to the difference in the spring tension of said valves B and C, said release valve C will be actuated to close said passageway 79 before said motor valve B is actuated to open said passageway 74. The opening of said passageway 74 will permit the flow of pressure fluid from said passageway 25 into said passageway 27 and pipe 29. However, the pressure of the fluid in said diaphragm actuating chamber 47 and said reservoir first will be reduced by way of flow through said valve body 91 from said pipe 70, which reduction will open said regulator valve A to replenish and build up the pressure of said pressure fluid reserve. Also, the flow of pressure fluid through said passageway 74 from said passageway 25 will reduce the pressure in said reservoir. Any reduction in pressure in said reservoir will permit said spring 53 to lift said piston rod 48, and the pressure fluid in said passageway 68 of said bushing 67 and the lower portion of said port 24 from pipe 18 will unseat said conical tip 62 from its seat 69, so that additional pressure fluid may then flow from said pipe 18 into said reservoir to maintain the predetermined pressure desired therein. This same predetermined pressure will also be present in said said cap 80 and said cylinder 39, when said valve B is open; as well as in said pipes 98, 119 and 121, when said clock valve D is open.

When it is desired to change said release valve C from time actuation to fluid pressure release actuation, said pet cock 122 is closed, as shown in Figure 8, and said lock nut 87 is screwed downwardly on said stem 75, so that the lower end thereof is moved downwardly from said line or groove 124 and even with the upper edge of said knurled band 89 on said stem. This stem is rotated and screwed up into said boss 85, preferably by using the knurled band 89 as a wrench surface, until the upper end of said lock nut 87 again abuts the lower end of said boss 85. As will be noticed, the foot piece or valve face 61 has been brought into contact and sealed in the seat at the lower end of said passageway 79 of said bushing 78. By this change or adjustment, said release valve C now opens said passageway 79 on the downward travel of said piston rod 76 and closes the same upon the upward travel thereof.

When said valve member 101 has been opened, as shown in Figure 6, the pressure fluid flowing through said valve body 91 will not enter said cap 80, because said pet cock 122 is closed. However, said pressure fluid will enter pipe 119 and said cap 120 of said diaphragm 46 and actuate said piston rod 71 to open said passageway 74. Pressure fluid will flow from said passageway 25, into said passageway 27, through said pipe 29 and into said cylinder 30 to lift the piston therein (not shown) which will lift said weight bar 34 into one of said flow valves 13 (Figure 1). When this occurs, the pressure fluid in said casing string 10 will be admitted to the column of well fluid standing in said tubing string 11 above said opened flow valve 13 to lift said column of well fluid.

When this well fluid reaches the surface of the well, it will enter the usual flow T 125 from which it will flow into the regular flow line 142. This flow line is provided with a suitable T 141 which has connected thereto a fluid by-pass line 140 that has a manually operated gate valve 135 connected therein intermediate line 141 to line 140 preferably near said housing 19. The well fluid flowing through said flow line 142 will partially flow into and exert a pressure in said by-pass line 140, the other end of which is connected to said flow manifold 123 and the pressure, so
exerted, will be transmitted to said diaphragm 81 of said release valve C. The motor valve B in the meanwhile has been closed, due to the bleeding of the pressure fluid from said cap 120 and said pipes 119 and 98, out of said bore 99 around said valve stem 102. The exertion of a pressure on said diaphragm 81 of said valve C will move said piston rod 78 downwardly and carry valve face 80 away from its seat on the lower end of said passageway 79. Thereby, the pressure fluid trapped in said passageway 27, said pipe 29 and said cylinder 30 will be vented to the atmosphere through said passageways 79, 83 and 84. The venting of this pressure fluid from said cylinder 30 will permit the lowering of the piston (not shown) therein and the dropping of said weight bar 34 from the flow valve 13, which it has been holding open. Thus, the admission of pressure fluid to the flow tubing string 41 is terminated and the intermittent control mechanism is ready for the clock mechanism to bring another notch over said roller 110.

Various changes, alterations and modifications may be made in the size, shape and arrangement of the herein described elements, within the scope of the appended claims.

What I claim as my invention is:

1. A device for controlling the supply of pressure fluid including, a pressure fluid admitting and by-passing valve, a by-pass conductor extending from said valve, a pressure fluid conductor extending from said valve, a time controlled valve connected in said by-pass conductor, a feed valve connected in said pressure fluid conductor and having actuating means connected with said by-pass conductor beyond the valve therein, a release valve connected with said pressure fluid conductor beyond said feed valve and connecting said pressure fluid conductor with a vent to the atmosphere, said release valve having operating means connected with said by-pass conductor beyond the valve therein.

2. A device for controlling the supply of pressure fluid including, a pressure fluid admitting and by-passing valve, a by-pass conductor extending from said valve, a pressure fluid conductor extending from said valve, a time controlled valve connected in said by-pass conductor, a feed valve connected in said pressure fluid conductor and having actuating means connected with said by-pass conductor beyond the valve therein, and a release valve connected with said pressure fluid conductor beyond said feed valve and connecting said pressure fluid conductor with a vent to the atmosphere, said release valve having operating means connected with said by-pass conductor beyond the valve therein, and a release valve connected with said pressure fluid conductor beyond said feed valve and connecting said pressure fluid conductor with a vent to the atmosphere, said release valve having operating means connected with said by-pass conductor beyond the valve therein, said release valve being set to operate at a higher pressure than the operating means of the release valve.

3. A device for controlling the supply of pressure fluid as set forth in claim 1 and means for cutting off the by-pass fluid conductor from the release valve, and means for conducting an auxiliary pressure fluid directly to said release valve, whereby said valve is actuated when said pressure fluid reaches a predetermined pressure, and means whereby said release valve may be actuated either by pressure fluid from said by-pass conductor or by said auxiliary pressure fluid.

4. An apparatus for controlling the admission of lifting fluid to a well tubing for providing a column of liquids to be elevated, means for controlling the admitting and cutting off the admission of lifting fluid to said tubing, fluid operated means for actuating said admitting and cut-off control means, a source of pressure fluid supply, control mechanism connected with said pressure fluid supply and said fluid operated means for controlling the supply of pressure fluid thereto, time controlled means for admitting pressure fluid to said control mechanism and regulating the supply of said pressure fluid to said fluid operated means, means set to operate and controlled solely by said time controlled means for releasing the supply of pressure fluid to said fluid operated means, fluid pressure operating means for the releasing means, and means for converting the operating means of said releasing means from a timed supply of actuating fluid to a pressure controlled supply of actuating fluid, and means whereby said releasing means may be operated either by said time controlled means or by the pressure controlled supply.

5. A device for controlling the supply of pressure fluid including, a pressure fluid admitting and by-passing valve, a by-pass conductor extending from said valve, a pressure fluid conductor extending from said valve, a time controlled valve connected in said by-pass conductor, a feed valve connected in said pressure fluid conductor and having actuating means connected with said by-pass conductor beyond the valve therein, a release valve connected with said pressure fluid conductor beyond said feed valve and connecting said pressure fluid conductor with a vent to the atmosphere, said release valve having operating means connected with said by-pass conductor beyond the valve therein, and means for converting the operating means of said release valve from a timed supply of actuating fluid to a pressure controlled supply of actuating fluid, and means whereby said release valve may be operated either by said timed supply of actuating fluid or by the pressure controlled supply.

6. In a control unit for a well fluid lifting system the combination of, a well pipe for conducting fluids from a well, means for admitting a pressure fluid to the well pipe, a control valve admitting the well fluid upwardly in said pipe, means controllable from the surface of said well for admitting said admitting means, and time controlled means for operating said surface controlled actuating means including releasing the control valve means, and means whereby the releasing means is actuated either by the time controlled means or by the flowing well fluids.

7. A system of controlling the flow of well fluid from a well which includes, a well pipe for conducting fluids from a well, means controllable from the surface of the well for admitting a pressure fluid into the well pipe for displacing the well fluid upwardly therein, operating means for said admitting means, a time controlled apparatus for controlling the admitting means and having a supply of pressure fluid connected thereto, a flow conduit connected to the pressure fluid supply, means connected in said conduit for controlling the flow of said pressure fluid from said supply means including means for by-passing a small quantity of said flow of fluid at a reduced pressure, valve means connected in said conduit and controlled by the pressure of said by-passed fluid to feed said pressure fluid at a reduced pressure to the operating means for actuating said pressure fluid admitting means, and means for releasing the reduced pressure fluid from a portion of said flow conduit.
and the actuating means of said admitting means, means releasing means being actuated by said by-passed fluid.

8. A system of controlling the flow of well fluid from a well which includes, a well pipe for conducting fluid from a well, means controllable from the surface of the well for admitting a pressure fluid into the well pipe for displacing the well fluid upwardly therein, operating means for said admitting means, a time controlled apparatus for controlling the admitting means and having a supply of pressure fluid connected thereto, a flow conduit connected to said supply means, means connected in said conduit for controlling the flow of said pressure fluid from said supply means including means for by-passing a small quantity of said pressure fluid at reduced pressure, valve means connected in said conduit and controlled by the pressure of said by-passed fluid to feed said pressure fluid at a reduced pressure to the operating means for actuating said pressure fluid admitting means, and means for releasing the reduced pressure fluid from a portion of said flow conduit and said actuating means of said admitting means, and means whereby said releasing means may be operated either by said by-passed fluid or by said flowing well fluids.

9. In combination in a well flowing control apparatus, a pressure fluid supply conductor, an inlet valve connected with said conductor, a feed valve connected with said inlet valve and receiving pressure fluid therefrom, a pressure fluid feed conductor leading from the feed valve, a release valve connected with the feed conductor and communicating with the atmosphere for releasing pressure fluid therefrom, and time controlled means for periodically operating both the feed valve and the release valve.

10. A well fluid lifting system which includes, a supply of pressure fluid, a well fluid conductor for flowing well fluids therethrough, a valve connected to the supply of pressure fluid, means for by-passing a low pressure acting fluid around the valve for controlling said supply and applying said low pressure liquid against said valve to maintain a predetermined fluid pressure, means for admitting the supply of pressure fluid to the well fluid conductor for elevating the well fluid in said conductor, an actuator for controlling the admission of pressure fluid and the elevation of the well fluid, a valve for controlling the operation of the actuator, together with timing means for intermittently applying the by-passed low pressure fluid to the feed valve to feed the low pressure fluid to said actuator for admitting the supply of high pressure acting fluid to the well fluids, in combination with means for releasing the low pressure fluid from the actuator to cut off the supply of low pressure fluid to said actuator, and means whereby said release means may be actuated either by the flowing pressure of the elevated well fluids or by the by-passed fluid.

11. A control unit for a well fluid flowing apparatus including, a pressure fluid supply conductor, a regulator valve having a metering seat for reducing the pressure fluid from said conductor, a fluid flow conduit extending from said regulator valve, a feed valve connected in said conduit for controlling the flow of fluid through said conduit, means for controlling the actuation of said feed valve, means for by-passing a portion of the reduced pressure fluid to the actuating means of the feed valve, means for intermittently actuating the control means for supplying the by-passed fluid, said feed valve, and a release valve for venting the pressure fluid from said conduit admitted thereto by said feed valve, and means whereby said release valve may be actuated by the by-passed fluid operating said feed valve or to be actuated by the pressure of an extraneous fluid.

12. In a well fluid lifting system, a well fluid conductor in the well, a lifting fluid conductor in the well separate from the well fluid conductor, time controlled and pressure fluid-operated means for admitting lifting fluid from its conductor to the well fluid conductor through a time controlled period, pressure fluid-operated means connected to the well fluid conductor for controlling the supply of lifting fluid from the pressure fluid-operated means for rendering the same ineffective to admit lifting fluid from the lifting fluid conductor to said well fluid conductor, in combination with time controlled means for releasing the operating pressure fluid from said pressure fluid-operated means for rendering the same ineffective to admit lifting fluid from said lifting fluid conductor to said well fluid conductor, and means whereby the releasing may be either well fluid pressure controlled or time controlled.

13. In a well fluid lifting system, a well fluid conductor in the well, a lifting fluid conductor in the well separate from the well fluid conductor, time controlled and pressure fluid-operated means for admitting lifting fluid from its conductor to the well fluid conductor through a time controlled period, pressure fluid-operated means for controlling the supply of pressure fluid to actuate the first named pressure fluid-operated means to control the admission of lifting fluid from the lifting fluid conductor to the well fluid conductor, pressure fluid-operated means connected to the well fluid conductor for releasing the operating pressure fluid from the first named pressure fluid-operated means for rendering the same ineffective to admit lifting fluid from the lifting fluid conductor to said well fluid conductor, said releasing means being also time controlled for releasing the operating pressure fluid from said first-named pressure fluid-operated means for rendering the same ineffective to admit lifting fluid from said lifting fluid conductor to said well fluid conductor, and means whereby the releasing may be either well fluid pressure controlled or time controlled.

14. A control unit for a pressure fluid flowing apparatus including, a pressure fluid supply inlet, means for controlling the flow of fluid at the inlet at a reduced pressure, means for by-passing a portion of the pressure fluid at a reduced pressure from said inlet and utilizing such fluid to close said inlet, an automatic actuating valve controlling the flow of the by-passed fluid, means for controlling the flow of fluid from said inlet connected with said valve for actuation by the released by-passed fluid, pressure fluid-operated means connected to the control unit for receiving the reduced fluid from said last-named control means, means for controlling the pressure from said inlet at the reduced pressure arranged to trap such reduced pressure fluid...
to operate said pressure fluid-operated means, means for utilizing the pressure of a flowing extraneous fluid to release the trapped fluid to disconnect the operation of the pressure fluid-operated means, said releasing means being adapted also to be actuated by the by-passed fluid for releasing the trapped fluid from said pressure fluid-operated means, and means whereby said trapped pressure fluid may be released either by the pressure of the flowing extraneous fluid or by said released by-passed fluid.

15. In a well fluid control apparatus the combination with a well and a flow line in said well for providing a column of well fluid and means for admitting pressure fluid to said column of well fluid and means for supplying pressure fluid to the point of admission to said column and an actuator for controlling said admission means, a conductor for conveying said pressure fluid from said pressure fluid supply means, means connected in said conductor for regulating the flow of pressure fluid from said conductor and for reducing the pressure of the same, a conduit extending from said regulating means to said actuator, means connected in said conduit for cutting off the flow of pressure fluid through said conduit to control the operation of said actuator, means for by-passing a portion of said pressure fluid from said regulating means to said cut-off means to actuate both said regulating means and said cut-off means, a timing device for controlling the flow of said by-passed fluid from said regulating means to said cut-off means, means connected to said conduit and actuated by the pressure of the flowing well fluid for building up a pressure differential between said reduced pressure fluid and the pressure of said well fluid and arranged to release said reduced pressure fluid to control the termination of the admission of pressure fluid to said column of well fluid, said releasing means adapted to permit the actuation of said releasing means by said by-passed fluid from said time controlled device to release said reduced pressure fluid to control the termination of the admission of pressure fluid to said column of well fluid, and means whereby the operation of said releasing means may be completely time controlled or may be controlled by the pressure of the flowing well fluid.

16. In a well fluid control apparatus the combination with a well and a flow line in said well for providing a column of well fluid and means for admitting pressure fluid to said column of well fluid and means for supplying pressure fluid to the point of admission to said column and an actuator for controlling said admission means, a conductor for conveying said pressure fluid from said pressure fluid supply means, means connected in said conductor for regulating the flow of pressure fluid from said conductor and for reducing the pressure of the same, a conduit extending from said regulating means to said actuator, means connected in said conduit for cutting off the flow of pressure fluid through said conduit to control the operation of said actuator, means for by-passing a portion of said pressure fluid from said regulating means to said cut-off means to actuate both said regulating means and said cut-off means, a timing device for controlling the opening and said closing of said valve means to control the flow period of the by-passed fluid, means connected to said conduit and actuated by the pressure of the flowing well fluid for building up a pressure differential between said reduced pressure fluid and the pressure of said well fluid and arranged to release said reduced pressure fluid to control the termination of the admission of pressure fluid to said column of well fluid, said releasing means adapted to permit the actuation of said releasing means by said by-passed fluid from said valve means to release said reduced pressure fluid to control the termination of the admission of pressure fluid to said column of well fluid, and means whereby the operation of said releasing means may be completely time controlled or may be controlled by the pressure of the flowing well fluid.

17. A control unit for a pressure fluid flowing apparatus including, a pressure fluid supply inlet, means for controlling the flow of fluid from the inlet at a reduced pressure, means for by-passing a portion of the pressure fluid from said inlet and utilizing such fluid to close said inlet, an automatic actuating valve controlling the flow of the by-passed fluid, means for controlling the flow of fluid from said inlet connected with said valve for actuating the released by-passed fluid, pressure fluid-operated means connected to the control unit and operated by the flow of fluid from the last-
named flow controlling means, means for conducting the pressure fluid from said inlet at the reduced pressure arranged to trap such reduced pressure fluid to operate the pressure fluid-operated means, and means for releasing the trapped fluid arranged to be actuated by said released by-passed fluid to discontinue the operation of said pressure fluid-operated means.

19. In combination in a well flowing control apparatus, a pressure fluid supply conductor, an inlet valve connected with said conductor, a feed valve connected with said inlet valve and receiving pressure fluid therefrom, a pressure fluid feed conductor leading from the feed valve, a release valve connected with the feed conductor and communicating with the atmosphere for releasing pressure fluid therefrom, time controlled means for periodically operating both the feed valve and the release valve, means for utilizing the pressure of an extraneous fluid to operate the release valve, and means whereby said release valve may be operated by the time controlled means or by the extraneous fluid.

20. In an apparatus for controlling the admission of lifting fluid to a well tubing for providing a column of liquids to be elevated, means for controlling the admitting and cutting off the admission of lifting fluid to said tubing, fluid operated means for actuating said admitting and cutting-off control means, a source of pressure fluid supply, control mechanism connected with said pressure fluid supply and with said fluid operated means for controlling the supply of pressure fluid thereto, time controlled means for admitting pressure fluid to said control mechanism and regulating the supply of said pressure fluid to said fluid operated means, means set to operate and controlled solely by said time controlled means for releasing the supply of pressure fluid to said fluid operated means, means for shutting off the control of the release means by the time controlled means, means for by-passing the elevated fluid to the release means for actuating the same to release the supply of pressure fluid to the fluid operated means, and means whereby said releasing means may be operated either by the time controlled means or by the elevated fluid.

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