

May 28, 1935.

J. D. NIXON

2,003,009

METHOD AND APPARATUS FOR PRODUCING LIQUID FROM WELLS

Filed June 10, 1932

3 Sheets-Sheet 1

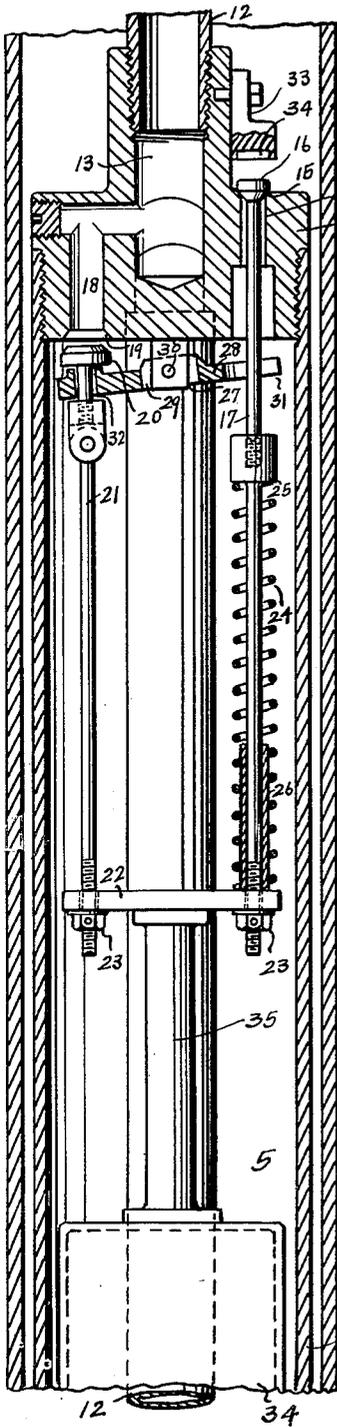


Fig. 1.

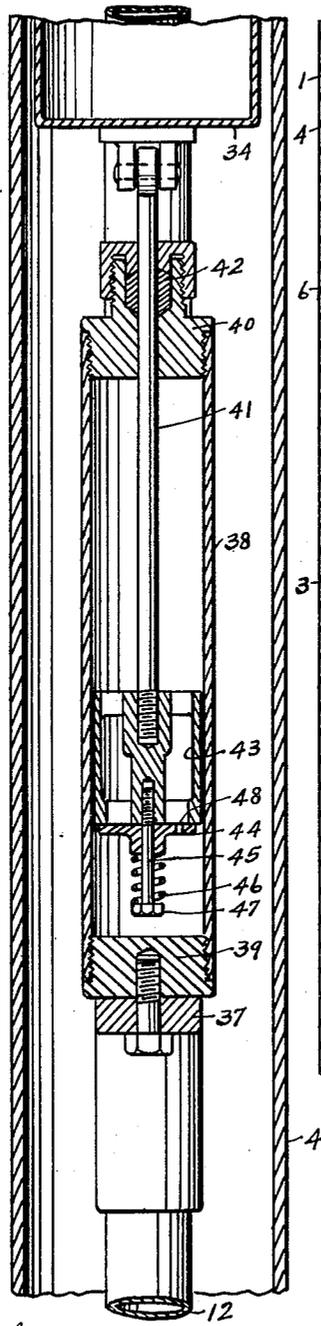


Fig. 2.  
334

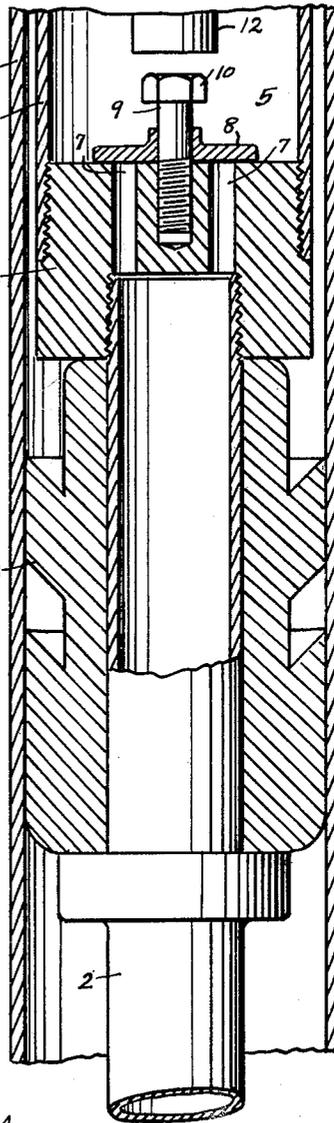


Fig. 3.

Inventor  
Jeddy D. Nixon

Hardway T. Cathey  
Attorneys

May 28, 1935.

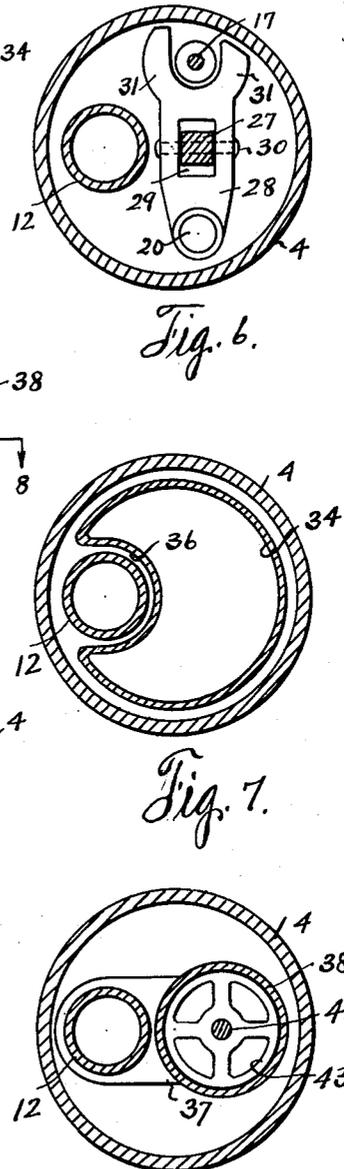
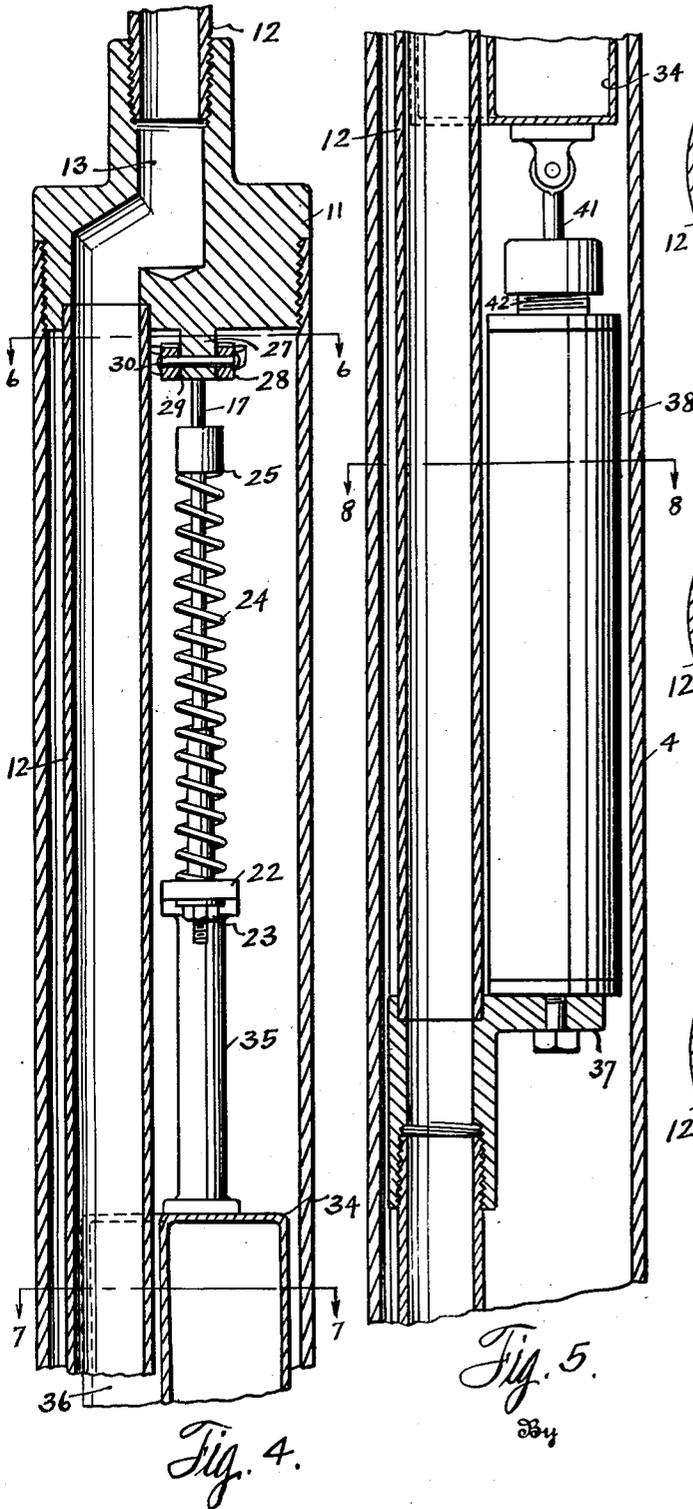
J. D. NIXON

2,003,009

METHOD AND APPARATUS FOR PRODUCING LIQUID FROM WELLS

Filed June 10, 1932

3 Sheets-Sheet 2



Inventor  
Jeddy D. Nixon

Hardway Cathey  
Attorneys

May 28, 1935.

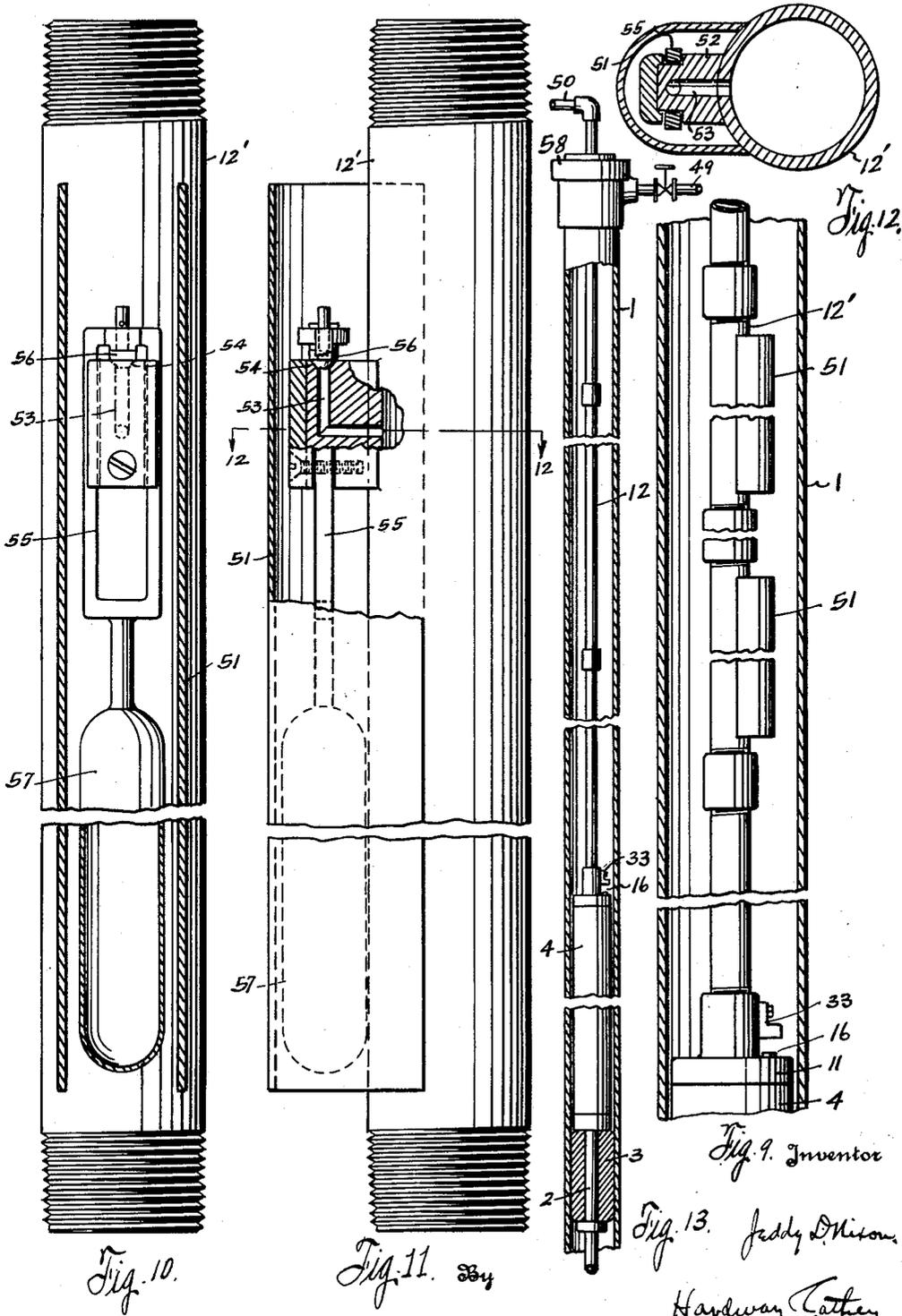
J. D. NIXON

2,003,009

METHOD AND APPARATUS FOR PRODUCING LIQUID FROM WELLS

Filed June 10, 1932

3 Sheets-Sheet 3



# UNITED STATES PATENT OFFICE

2,003,009

## METHOD AND APPARATUS FOR PRODUCING LIQUID FROM WELLS

Jeddy D. Nixon, Houston, Tex., assignor to S. S. McClendon, Jr., Houston, Tex., trustee

Application June 10, 1932, Serial No. 616,487

13 Claims. (Cl. 103—248)

This invention relates to a method and apparatus for producing liquid from wells.

An object of the invention is to provide novel apparatus whereby liquid in a well may be delivered from the well to the ground surface through the agency of an operating fluid, under pressure.

Another object is to provide apparatus of this character of such construction that the liquid to be recovered from the producing formation may be trapped, or separated, from the cognate liquid, in successive loads or quantities and an operating fluid, under pressure, applied to said trapped, or separated, quantities, or loads to expel them successively from the well; an important feature of the invention resides in the novel means for restraining, or cutting off, the operating fluid, so that the same will be expended only while actually expelling a load of liquid from the well.

Another object is to provide an apparatus for delivering the liquid from a well by the use of an operating fluid, under pressure and whereby the pressure of the operating fluid will at all times be excluded from the producing formation of the well. Another object is to provide apparatus of the character described of such construction that the application of the operating fluid will be automatically controlled.

Another object is to provide apparatus for entrapping loads of liquid, successively, from the cognate liquid in the producing formation in a well, and expelling said entrapped loads from the well by the successive application of an operating fluid, under pressure, thereto said apparatus having means controlled by the entrapped liquid and controlling said application of the operating fluid.

Another object is to provide novel means for lowering, or reducing, the head pressure in case the normal level of the liquid in the well is above a predetermined level relative to the apparatus.

The invention also comprehends a novel method of producing liquid from a well.

The apparatus and method relate chiefly to the production of oil from wells but the same are applicable for use generally for delivering liquid of any character from wells.

With the above and other objects in view this invention has particular relation to certain novel features of construction, operation and arrangement of parts, and to a novel method, an example of which is described in this specification and illustrated in the accompanying drawings, wherein:—

Figure 1 shows a vertical sectional view of the upper portion of the float chamber showing the valves and the valve operating mechanism.

Figure 2 shows a vertical sectional view of an intermediate portion thereof showing the dash pot.

Figure 3 shows a vertical sectional view of the lower end of the float chamber showing the inflow line beneath and the packer between said inflow line and the casing.

Figure 4 shows a vertical sectional view of the upper portion of the float chamber taken at right angles to that shown in Figure 1.

Figure 5 shows a vertical sectional view of an intermediate portion thereof taken at right angles to the view shown in Figure 2 and showing the dash pot in elevation.

Figure 6 shows a cross sectional view taken on the line 6—6 of Figure 4.

Figure 7 shows a cross sectional view taken on the line 7—7 of Figure 4.

Figure 8 shows a cross sectional view taken on the line 8—8 of Figure 5.

Figure 9 shows a fragmentary elevational view of a modified form of eduction tube equipped with float controlled inlet valves which in some instances may be employed.

Figure 10 shows an enlarged fragmentary elevational view partly in section of a section of said eduction tube.

Figure 11 shows an elevational view of a section of said tube partly in section taken at right angles to the view shown in Figure 10.

Figure 12 shows a transverse sectional view taken on the line 12—12 of Figure 11, and

Figure 13 shows an elevational view of the complete apparatus in a well, showing the casing in section.

In the drawings the numeral 1 designates the well casing which is set at the desired depth in the well above the producing formation. There is an inflow pipe 2 whose lower end extends down the required distance into the liquid to be lifted and a suitable packer 3 is set between the casing 1 and the inflow pipe 2 adjacent the upper end of the latter. Above the packer 3 there is a suitable housing 4 within which there is the float chamber 5. The lower end of the housing 4 may be connected to the upper end of the inflow pipe 2, said connection being preferably made by a reducing nipple 6 which is screwed into the lower end of the housing 4 and into which the upper end of the inflow pipe may be threaded, and leading upwardly from said inflow pipe through said nipple 6 there may be one or more

inflow ducts 7 through which the liquid from beneath may flow up into the float chamber. These ducts may be controlled by the upwardly opening valve 8, which is mounted to slide vertically on a valve rod 9 which is attached to the nipple 6 and whose upper end has the retaining head 10 thereon.

Attached to the upper end of the housing 4, and closing the same there is a head 11 and leading upwardly from this head to the ground surface there is the eduction tube 12 which continues on down into and through the chamber 5 and whose lower end terminates above, but adjacent the lower end of said float chamber. The portion of the eduction tubing 12 within the chamber is offset and located adjacent one side of said chamber as shown in Figures 4 to 8 inclusive and there is an offset bore 13 through the head 11 which connects that portion of the eduction tube 12 beneath the head 11 with that portion thereof above said head.

The head 11 has the inlet passageway 14 there-through whose upper end is formed into a valve seat 15 which is controlled by the upwardly opening valve 16 which is attached to the upper end of the stem 17. This stem works through the passageway 14 and extends down into the float chamber. The head 11 also has the relief passageway 18 which connects the bore 13 with the chamber 5 and whose inner or lower end is flared forming a seat 19 which is controlled by the inwardly opening valve 20 which is attached to the upper end of the jointed stem 21 located within the chamber 5. The lower ends of the stems 17, 21 work loosely through bearings in the corresponding ends of the cross yoke 22 and are retained therein by means of the adjusting nuts 23, 23 which are screwed onto the outwardly threaded lower ends of said valve stems. Around the stem 17 there is a coil spring 24 whose lower end is seated on the yoke 22 and whose upper end rests against an external shoulder 25 on the stem 17. This stem may be composed of sections screwed together as shown in Figure 1 if desired. Located within the lower end of the spring 24 and fitted around the stem 17 and upstanding from the yoke 22 there is the valve actuator 26 provided for a purpose to be hereinafter stated.

Depending from the head 11 there is a lug 27 and a transverse valve actuating lever 28 is pivotally mounted on said lug. This lever has a bearing 29 to receive said lug and the lever is retained in place by a suitable cross pin 30 extending through the lever and lug as shown in Figures 1, 4 and 6. One end of the lever 28 is provided with the spaced fins 31, 31 between which the stem 17 extends and the opposite end of said lever has a bearing 32 through which the stem 21 fits loosely.

The head 11 has a lateral shield 33 secured thereto above the valve 16 and whose underside is provided with a recess 34 aligned above and shaped to snugly receive the valve 16 when the latter is open.

Within the float chamber 5 there is a suitable float 34 of the required buoyancy and this float is suspended from the yoke 22 by any suitable means provided for the purpose, the tubing 35 being shown for this purpose. One side of the float 34 is longitudinally corrugated as at 36 to provide space for the eduction tube 12, said tube forming also a guide for the float.

Beneath the float the eduction tube 12 has a laterally extending bracket 37 on which a dash pot is supported and secured. This dash pot com-

prises a cylinder 38 closed at its lower end by the head 39 and at its upper end by the head 40 and a stem 41 has a pivotal connection to the lower end of the float 34 and works through a suitable stuffing box 42 in the head 40. Working in the cylinder 38 there is a skeleton plunger 43 to which the inner end of the stem 41 is attached, said plunger having fluid passageways therethrough which are normally closed by the downwardly opening valve 44 which is slidably mounted on the rod 45. This rod is attached to and depends from the plunger 43 and there is a coil spring 46 surrounding said rod and whose lower end is seated on the head 47 on the lower end of the rod and whose upper end presses against the valve 44 and normally holds said valve closed. The valve 44 has a leak port 48 therethrough for a purpose to be hereafter stated.

In use the apparatus is lowered into a producing well to the required distance beneath the liquid level so that the liquid in the well will rise and enter the chamber 5, as the liquid is expelled therefrom, as hereinafter stated.

An operating fluid such as gas or air is introduced into the casing 1 through the pressure line 49 and said operating fluid is maintained under pressure in said casing. The liquid rising through the pipe 2 will lift the valve 8 and enter the float chamber 5 and the float 34 will be lifted, carrying the yoke 22 upwardly with it, placing the spring 24 under compression and the valve actuator 26 will eventually strike the shoulder 25 and thereupon the valve 16 will be lifted from its seat, overcoming the pressure of the operating fluid against said valve and seating said valve in the recesses 34 thus admitting the operating fluid under pressure in the chamber 5. The current of the operating fluid entering said chamber will strike against the fins 31 and will actuate the lever 28 which in turn will operate to close the valve 20. Thereupon the pressure of the operating fluid against the liquid in the chamber 5 will drive said liquid into and through the eduction tube 12, to the ground surface, where the liquid will be discharged through a suitable discharge line 50 provided for the purpose.

As the liquid is expelled from the chamber 5 the float 34 will descend but it is necessary that the descent of the float be retarded so that the valve 16 will not be prematurely closed and the operating fluid cut off from the chamber 5 before the load of liquid has been expelled to the ground surface and for this purpose the dash pot hereinbefore mentioned has been provided. The cylinder 38 of the dash pot is filled with liquid, preferably a light oil, and as the float 34 ascends, the valve 44 will open so that the ascent of the float will not be retarded but as the float 34 descends, the valve 44 will remain closed and the liquid beneath said valve will pass through the restricted port 48 into the cylinder 38 above said valve thus retarding the descent of the float. After the liquid has been expelled from the chamber 5 the float will accordingly descend gradually and the valve 16 will be held open by the spring 24 to permit the continued application of the operating fluid until the load is discharged from the tube 12 and at which time the yoke 22 strikes the nut 23, carried by the lower end of the stem 17, and thereupon the valve 16 will be suddenly closed and at the same time the yoke 22 will also strike the nut 23 carried by the stem 21 and the valve 20 will be opened. It will be noted that while the valve 16 is open it will be seated in the recess 34

so that it will not be liable to be prematurely closed by the pressure of the operating fluid in the casing 1.

When the valve 16 is closed and the valve 20 open the liquid from the producing formation of the well may again enter the chamber 5 until another load of liquid has entered said chamber and meanwhile the operating fluid will be cut off so that there will be no waste of said operating fluid while the float chamber is filling with the liquid. The float will accordingly again be lifted as before and when another load of liquid has been entrapped in the chamber 5 the valve 16 will again be opened and the valve 20 closed as above explained and the operating fluid will again enter the chamber 5 and expel the load of liquid entrapped therein and the operation of entrapping the load of liquid in the float chamber and expelling the same from the chamber to the ground surface will be automatically repeated in succession so long as the operating fluid is maintained under the required pressure in the casing and so long as the well produces sufficient liquid to collect in successive loads in the float chamber as the same is expelled therefrom.

It sometimes happens that the apparatus hereinabove described is located in the well at a considerable distance beneath the level at which the liquid to be recovered stands in the well and in such case it is desirable to reduce the liquid level in the well and to reduce the head pressure before the apparatus begins to operate in the normal way as hereinabove explained. In such cases the eduction tube 12', as illustrated in Figures 9 to 12 inclusive should be used in the place of the eduction tube 12 leading from the head 11 to the ground surface. The eduction tube 12' is equipped with a number of shields 51 spaced apart one above the other therealong and secured in any preferred manner to the outside of said tube 12'. These shields are open at their upper and lower ends so that the liquid in the well may readily enter the same. Within each shield 51 and secured to the tube 12' there is a valve body 52 having a restricted duct 53 leading downwardly from the upper end thereof and turned inwardly into said tube. The upper end of each duct 53 is flared forming the valve seat 54 and there is a yoke 55 which embraces and is slidable on the corresponding valve body 52 and the upper end of this yoke carries a depending tapering valve 56 arranged to control said seat 54. Each yoke 55 has a float 57 depending therefrom and confined in its movements by the corresponding shield 51.

When the apparatus is used in wells in which it is necessary or desirable to reduce the head pressure and lower the level of the liquid in the well before the float controlled mechanism begins to operate the apparatus should be equipped with the eduction tube 12' and when lowered into the well to the desired depth the packer 3 should be set to form a fluid tight seal between the casing 1 and the inflow pipe 2 and the operating fluid should then be introduced through the line 49 into the casing. The floats 57 which are submerged beneath the liquid will be elevated and their corresponding valves 56 held open. Any of said floats 57 that may be above the liquid will, of course, maintain their corresponding valves 56 closed, as is obvious. The pressure of the operating fluid against the liquid in the casing will force said liquid through the upper duct 53 which is open and will force the liquid in the eduction tube 12' above up out of said tube until the liquid

level on the outside of said tube has been lowered and as said level is lowered beneath said upper duct 53 only a portion of the operating fluid will enter through said uncovered duct 53 and the pressure of the operating fluid against the liquid outside of the tube 12' will continue to lower the liquid level, forcing the liquid through the next succeeding duct 53 beneath, and when the liquid level is reduced below the corresponding float 57 said float will descend and close the corresponding valve 56. The liquid in the casing will continue to be forced through the next succeeding duct 53 below and into and up through the eduction tube 12' and will continue to do so until the level of the fluid in the casing has been lowered beneath said next succeeding duct 53 below whereupon it will be closed and the head pressure will thus be reduced, a step at a time, without the necessity of increasing the pressure of the operating fluid until the head pressure has been sufficiently reduced to permit the float operated mechanism to operate in its customary and intended manner, and thereafter the liquid in the well will be successively entrapped in and expelled from the chamber 5, a load at a time.

The casing is closed at the top by the conventional casing head 58 into which the pressure line 49 is connected and through which the eduction tube leads, and the packer 3 and valve 8 prevent the operating fluid from reaching the producing formation; so that the required pressure of the operating fluid may be at all times readily maintained in the casing above said packer.

The drawings and description disclose what is now considered to be a preferred form of the apparatus for carrying out the novel process herein disclosed. The disclosure however is intended for the purpose of illustration and it is obvious that various mechanical changes may be made without departing from the principle of the invention as defined by the appended claims.

What I claim is:

1. Apparatus for producing liquid from a well which includes a collector, means for successively entrapping loads of liquid in said collector, an outlet conduit leading out from said collector, means for supplying an operating fluid, under pressure, into the well, means for automatically applying said operating fluid, successively, into the collector to completely expel each collected load through said conduit as the load is collected, means under the influence of the fluid being so applied and excluding the entrance of a load into the collector until the next preceding load has been completely expelled, means for communicating the collector with said conduit while load is being entrapped, and means for automatically suspending the application of said operating fluid successively upon the completion of the expulsion of each successive load.

2. Apparatus for producing liquid from a well which includes a collector, means for successively entrapping loads of liquid in said collector, an outlet conduit leading out from said collector, means for supplying an operating fluid, under pressure, into the well, means for applying said operating fluid, successively, into the collector to completely expel the collected loads, as collected in succession through said conduit, means for suspending the application of said operating fluid successively only upon the expulsion of each successive load and for communicating the collector above the entrapping load with said conduit.

3. The combination with a casing in a well, of a housing in the casing having a float chamber therein and having an inlet into said chamber from the well beneath for the inlet of liquid from the well, an inwardly opening valve controlling said inlet, an eduction tube leading from said chamber up through said casing, means closing the upper end of the casing, means closing the casing beneath said housing, means for maintaining an operating fluid under pressure in said casing between said upper and lower closing means, a float in said chamber arranged to be moved in one direction by said liquid, means whereby the rate of the movement of the float, in the other direction, may be predetermined, said chamber having passageways for fluid, one into said eduction tube and one into the casing, valves for controlling said passageways and means connecting said valves with said float whereby said valves may be actuated simultaneously, one into open position and the other into closed position, in accordance with the movement of said float.

4. The combination with a casing in a well, of a housing in the casing having a float chamber therein, said chamber having an inlet opening from the well beneath and an inlet passageway from the casing, means closing the casing between said inlet and passageway, means closing the upper end of the casing, means for introducing an operating fluid into the casing between said closing means, an inwardly opening valve controlling said inlet, an eductor tube leading from said chamber up through said casing, said chamber having a relief passageway leading into said eductor tube, valves arranged to control said passageways, a float in said chamber operatively connected with the valves and effective to simultaneously cause the valves to operate to open said relief passageway and close the inlet passageway upon the descent of said float and means for timing the descent of the float.

5. Apparatus for producing liquid from a well including a float chamber having an inlet for the liquid, a valve permitting the inflow of separate loads of liquid into said chamber through said inlet but preventing the back flow of said liquid through said inlet, a discharge conduit leading from said chamber, means for supplying an operating fluid, under pressure, into the well, means including a float in said chamber for alternately restraining the application of said fluid while the liquid is entering the chamber and for applying said operating fluid to the load of liquid after it has entered said chamber to completely expel said load, from said chamber and from said conduit, before the admission of another load, said chamber having a relief outlet into said conduit and a valve arranged to close said outlet upon said application of said fluid and to be opened by the float.

6. Apparatus for producing liquid from a well including liquid entrapping means having a float chamber in which loads of liquid may be successively entrapped from the cognate liquid in the well, said chamber having an inlet for an operating fluid and a relief outlet, an eduction tube leading from said chamber, means for supplying said operating fluid into the well, an inlet valve controlling said inlet and a relief valve controlling said outlet, a float in said chamber operatively connected with said valves and arranged to be actuated by the entrapped liquid in said chamber to open said inlet valve to per-

mit the application of said operating fluid to said entrapped liquid whereby said liquid will be expelled from the well, through said tube, means arranged to be actuated by said operating fluid, as so applied, and effective to close said relief valve, said float being effective by its gravity movement to close said inlet valve and open said relief valve.

7. Apparatus for producing liquid from a well including liquid entrapping means having a float chamber in which loads of liquid may be successively entrapped from the cognate fluid in the well, said chamber having an inlet for an operating fluid and a relief outlet, an eduction tube leading from said chamber, means for supplying said operating fluid into the well, an inlet valve controlling said inlet and a relief valve controlling said outlet, a float in said chamber operatively connected with said valves and arranged to be actuated by the entrapped liquid in said chamber to open said inlet valve to permit the application of said operating fluid to said entrapped liquid whereby said liquid will be expelled from the well, through said tube, means arranged to be actuated by said operating fluid, as so applied, and effective to close said relief valve, said float being effective by its gravity movement to close said inlet valve and open said relief valve, and means for retarding the gravity movement of said float.

8. In apparatus of the character described having a float chamber provided with an inlet for operating fluid and a relief outlet, a valve controlling said inlet, a valve controlling said outlet, a float in said chamber, valve controlled means for admitting liquid to said chamber to actuate said float, operative connections between said float and valves whereby the inlet valve is closed and the relief valve is opened by the gravity movement of the float and whereby the inlet valve is opened, to admit an operating fluid into said chamber, upon the liquid actuation of the float, and means arranged to be actuated by the operating fluid entering said chamber and effective to close said relief valve.

9. Apparatus for producing liquid from a well including liquid entrapping means having a float chamber in which loads of liquid may be successively trapped from the cognate fluid in the well, said chamber having an inlet for an operating fluid and a relief outlet, an eduction tube leading from the said chamber, means for supplying said operating fluid into the well, an inlet valve controlling said inlet and a relief valve controlling said outlet, a float in said chamber operatively connected with said valves and arranged to be actuated by the entrapped liquid in said chamber to open said inlet valve to permit the application of said operating fluid to an entrapped load whereby said load will be expelled from the well through said tube, means for closing the relief valve, said float being effective by its gravity movement to close the inlet valve and open the relief valve and means for retarding the gravity movement of the float to maintain the inlet valve open to elevate one load a predetermined distance above the chamber before the inlet valve is closed.

10. Apparatus for producing liquid from a well, including liquid entrapping means shaped to be lowered into the well and having a chamber in which loads of liquid may be successively entrapped from the cognate liquid in the well, said chamber having an inlet for an operating fluid and a relief outlet, an eduction tube leading from said chamber, means for supplying said operating fluid into the well, an inlet valve controlling said inlet, 75

and a relief valve controlling said outlet, a float in said chamber arranged to be actuated by the entrapped liquid in the chamber, operative connections between the float and inlet valve through which the inlet valve may be caused to open upon such actuation of the float to permit the application of said operating fluid to said entrapped liquid whereby said entrapped liquid will be expelled from the well through said tube, means for closing the relief valve upon the opening of the inlet valve, said float being effective by its gravity movement to cause the closing of the inlet valve and opening of the relief valve and means unaffected by the entrapped liquid for retarding the gravity movement of the float.

11. The method of producing liquid from a well, which consists in successively entrapping loads of the liquid in a chamber located in the well, said chamber having a discharge conduit leading from the well, applying an operating fluid under pressure successively to the loads as they are entrapped and thereby elevating the liquid in separate isolated loads through said conduit, and discharging the liquid in separate isolated loads from the well, continuing the application of the operating fluid into said chamber for a time after the discharge of each load from the chamber and communicating said chamber with the conduit while the next succeeding load is being entrapped.

12. The method of producing liquid from a well which consists in entrapping a load of the liquid

in a chamber located in the well, said chamber having a discharge conduit leading from the well, applying and operating fluid under pressure to the load upon the entrapping thereof and continuing such application continuously until the load is completely discharged from said chamber and elevated a predetermined distance along the conduit, relieving the pressure of the operating fluid in said chamber after said load has been so discharged and elevated so as to induce the inflow of another load from the well into said chamber, entrapping said other load in said chamber, communicating the chamber with said conduit while the load is being entrapped in the chamber.

13. Apparatus for producing liquid from a well, which includes a collector, means for successively entrapping loads of liquid in said collector, an outlet conduit leading out from said collector, means for supplying an operating fluid, under pressure, into the well, means for applying said operating fluid successively into the collector to completely expel the collected loads, upon collection thereof, in succession, from the collector into said conduit and for continuing each application of said operating fluid for a predetermined length of time after each such expulsion of each successive load and means for communicating the collector with said conduit while a load is being entrapped.

JEDDY D. NIXON. 30