Feb. 7, 1933. R. P. SIMMONS 1,896,112

METHOD OF CONSTRUCTING AND OPERATING OIL WELLS

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Fig. 1

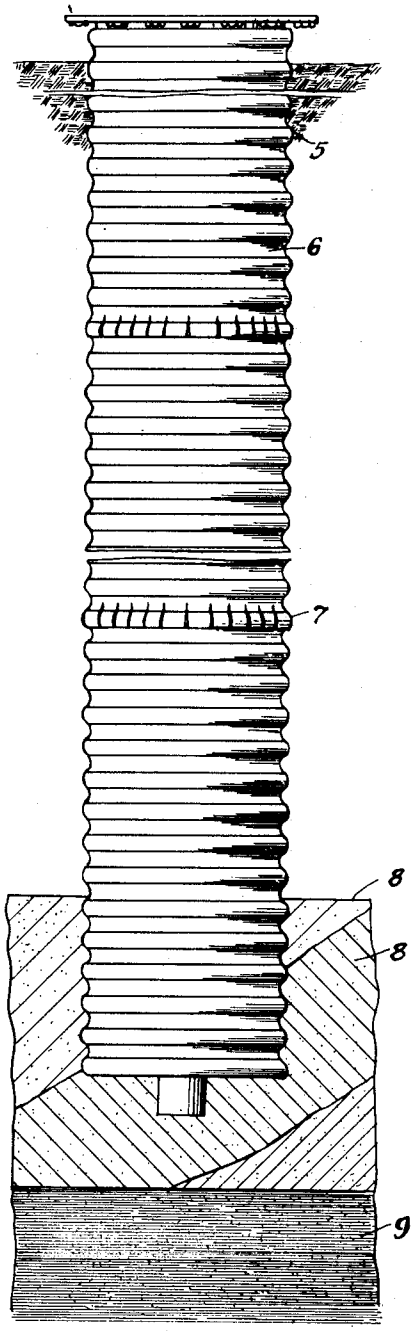
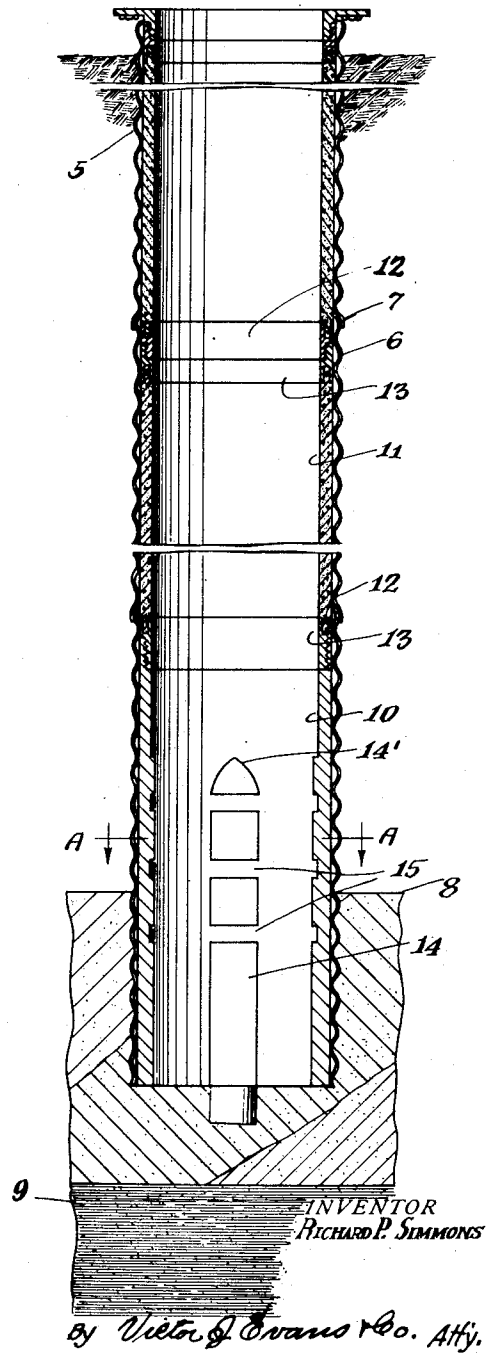



Fig. 2




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Fig. 3

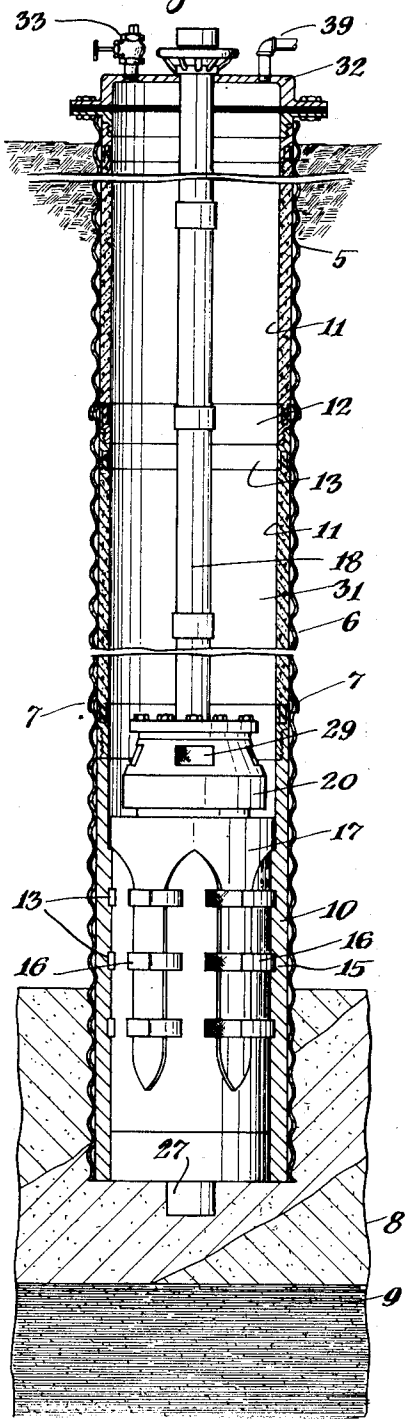
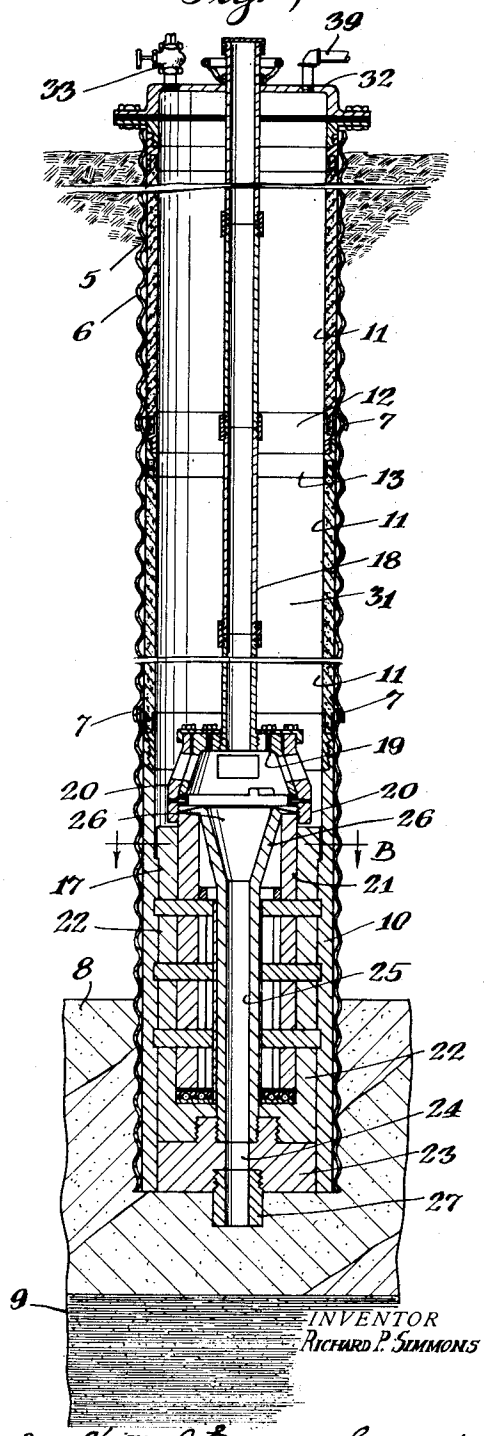



Fig. 4




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Fig. 5

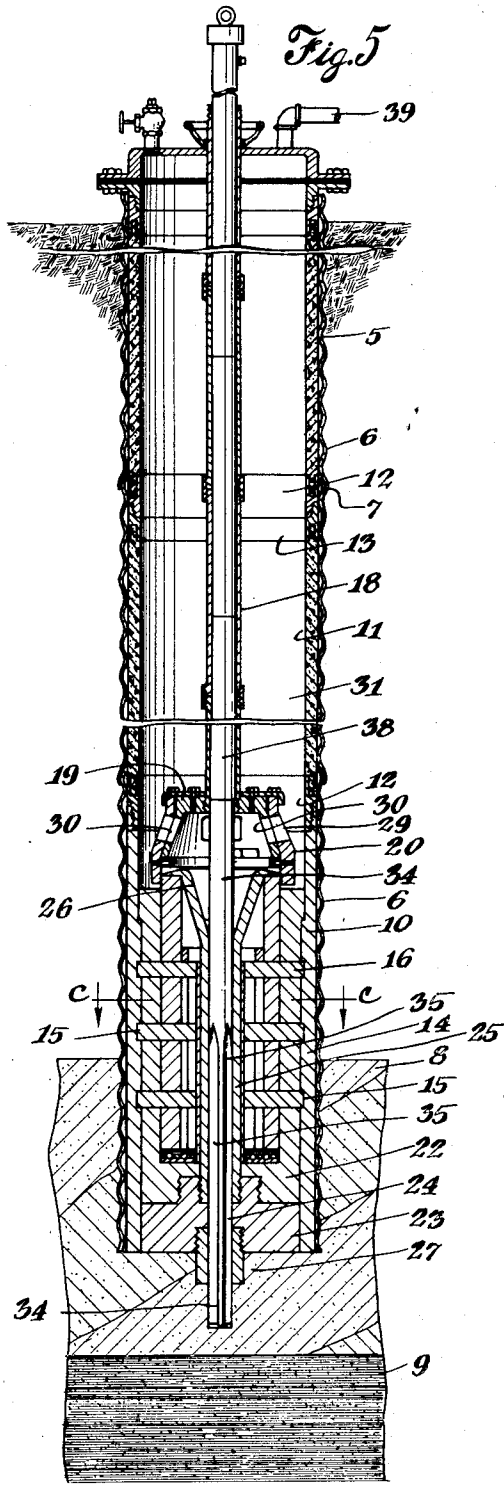
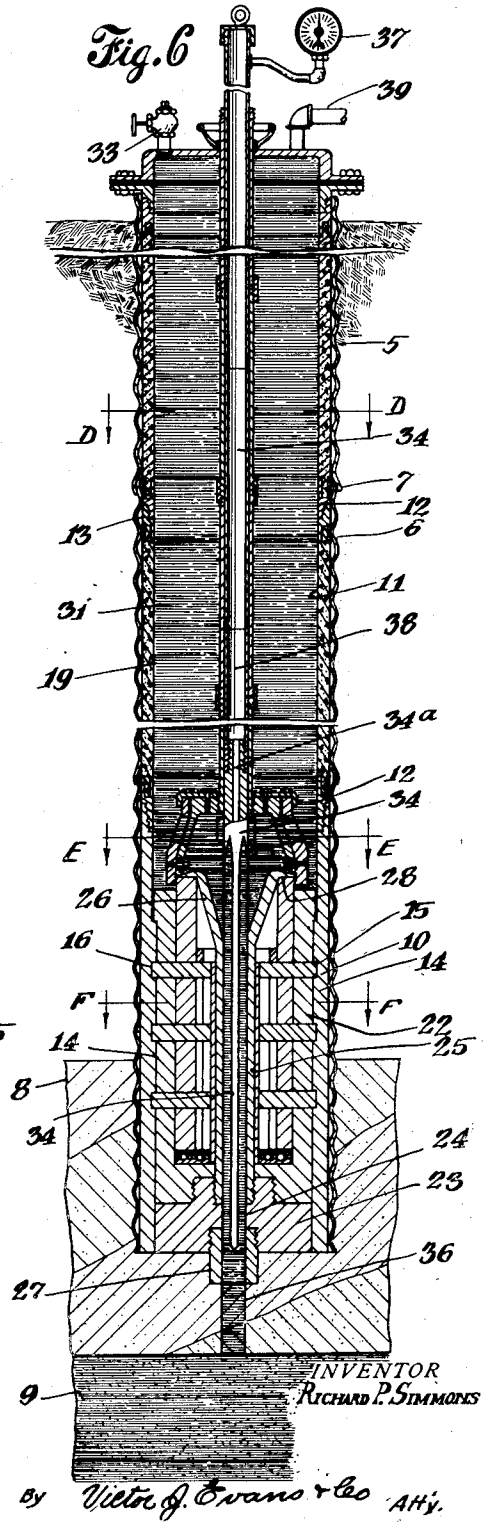



Fig. 6




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# UNITED STATES PATENT OFFICE

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## METHOD OF CONSTRUCTING AND OPERATING OIL WELLS

Application filed April 25, 1931. Serial No. 532,814.

The object of the present invention, is to provide a method of constructing and operating oil wells, so that waste during the initial period of operation, is prevented, by the controlled discharge of oil and gas, and increased production of oil is obtained during the working life of the oil wells.

A further object of the invention is the provision of an oil well with a flow controller, which can be operated at the base of the oil well, for establishing communication with the natural oil and gas reservoir and for controlling such communication, so that the discharge of oil and gas from the natural reservoir may be regulated at will.

A further object of the invention is the provision of a pressure regulator for oil wells, through which the flow controller may operate, first to drill an intake passage for the well, and second to control flow through that intake passage.

A still further object of the invention is the provision of a method for controlling the flow and discharge of the oil and gas so that the flow condition of both through the oil sands will be least disturbed, and flowage continued through the sands of the natural reservoir, with a minimum separation of the gas and oil while flowing through the sands.

A still further object of the invention is the provision of a method for constructing and operating an oil well, which will start the discharge of the oil and gas from the natural reservoir under conditions of controlled flow of both, so that the gas saturated condition of the oil in the natural reservoir sands will be maintained as long as possible, with a minimum reduction of pressure, so that the energy of the gas under high compression will be retained in the reservoir and oil well to make possible the complete withdrawal of all of the oil supply from the natural reservoir.

A still further object of the invention is the provision of a method of constructing and operating oil wells, so that oil and gas may be withdrawn through an oil well, so that there will be gradual displacement of the whole mixed mass of gas and oil in the sands of the natural reservoir, by the associated waters, and an approximately complete withdrawal of the oil and gas supply will be possible through the well.

A still further object of the invention is the provision of a method for constructing and operating oil wells, whereby all oil and gas withdrawn from the natural reservoir will be reduced to complete possession, thereby eliminating gusher waste, and securing the controlled flow of both gas and oil, so that efficient operation of the oil wells is obtained.

A still further object of the invention is the provision of a method for operating oil wells, whereby the intake passage is formed and controlled at the time of its completion, so that controlled inflow of gas and oil is obtained, by the means employed for forming the intake passage.

With the above and other objects in view the invention comprises certain new and useful combinations of parts, method steps and combinations of method steps, and in general organization of operating details and functions, clearly described in the following specification, and fully illustrated in the accompanying drawings, in which:—

Fig. 1 is a view taken through an oil well being constructed according to my invention, showing the intermediate metal lining in position, for an oil well of large diameter, and also showing the ground formation before the oil well intake is drilled.

Fig. 2 is a vertical sectional view through the oil well, showing the heavy steel casing section and a series of precast cement casing sections in place, within the metal well lining, with the intake for the well still to be completed.

Fig. 3 is a similar view, showing the combined locking head and pressure regulator locked in place in the heavy steel well casing section, the same being shown in elevation, and an erosion limiting bushing bored to place in the rock covering of the natural oil and gas reservoir.

Fig. 4 is a vertical sectional view thereof.

Fig. 5 is a similar vertical sectional view, showing the combined intake passage drill and flow controller in position, partly advanced through the rock covering of the natural oil and gas reservoir.

Fig. 6 is a similar view, showing the intake passage completed and the oil well filled with oil and gas, the controller being elevated for this purpose.

Referring to the drawings, the method of operating oil wells, and the controlling steps for the construction of oil wells to carry the method will be described in detail. In these views 5 designates the well bore, the wall of which is shown to be lined with a corrugated steel lining 6, consisting of a plurality of tubular sections having coupled adjacent ends 7. The well bore 5 is constructed of relatively large diameter, in excess of twenty-four inches, and is shown to be of uniform diameter from the ground surface to a point below the upper level of the rock cover 8, above the natural oil and gas reservoir 9.

The well bore 5 is extended partly into the rock covering 8, but terminates above the natural gas and oil reservoir 9. The lining 6 is progressively placed in position as the oil well is progressively deepened, and as this work is continued the well casing is progressively placed in position, within the steel lining 6.

In this case the permanent, rigid, well casing includes the main bottom casing section 10, of heavy steel casting, and the precast cement sections 11, which are coupled to the upper end of the steel section 10 and to each other, and provide a continuous well casing of a corresponding diameter to that of the steel well lining 6.

The precast cement well casing sections 11 are each provided with a steel sleeve coupling element 12 on one end, having a male coupling thread or element formed thereon, and 13 on the opposite end, having a female thread or coupling element formed thereon.

The bottom steel well casing section 10 is formed with internal longitudinal coupling ribs 14, which are formed with transverse keyways or grooves 15, spaced longitudinally in each rib from each other. The ribs 14 are also spaced circumferentially from each other, leaving cylindrical surfaces between the ribs. The upper end of each rib 14 is rounded at 14', so that it will readily deflect any object engaging the same.

The resistance of the steel well lining 6 to the crushing pressures developed by the ground formations through which the well is drilled, is sufficient to withstand crushing, and to also exclude water from entering the well. The precast cement well casing sections are placed in position within the steel well lining 6, in close contacting engagement therewith, and increase the support developed for holding the wall of the well against collapse, and for excluding water therefrom. The compressive strength of the precast casing sections is thus greatly increased, and is sufficient to satisfy the requirements of the well being constructed.

After the composite well casing, composed of the outer steel lining and the inner steel casing, has been placed in position within the oil well chamber, as completed down to the level indicated in Figs. 1 and 2, above the natural oil and gas reservoir, a combined locking head and pressure regulator is placed in position within the well casing, as shown in Figs. 3 and 4. This locking head and pressure regulator consists of a massive steel head, having radially shiftable locking keys 16, capable of being shifted into the grooves or keyways 15, by the turning of the body 17 of the combined locking head and pressure regulator, from the head of the well, through the manipulation of the tubing 18, coupled to the conical valve 19 which works in the conical ring 20, coupled to the cylindrical member 21. The tubing 18 consists in sections coupled to each other and extending to the head of the well. The cylindrical member 21 is constructed to shift the keys 16 into and out of the grooves 15, so that the locking head and pressure regulator will be locked to the well casing section 10, to resist any expulsive forces developed against it by the discharging gas. The keys 16 work through another cylindrical member 22, which is coupled to the base ring 23, having a small or reduced oil and gas inlet passage 24. A discharge tube 25 is connected at its lower end to this base ring 23 and is provided on its upper end with a gas expansion cone 26. The base ring 23 is equipped with a hardened steel bushing 27, which extends below the base ring 23, and fits into a small hole drilled in the rock. The cone 26 is provided with a flange 28 which extends radially thereof and works under the lower edge of the rotary valve 19.

The fixed valve ring 20 is provided with a series of oil and gas discharge ports 29, which are adapted to register with similar ports 30 formed in the rotary valve 19. When the two sets of ports are in registration, then full discharge of oil and gas from the central discharge tube 25 to the main chamber 31 of the oil well, will occur. By turning the valve ring 19, by manipulating the tubing 18, the discharge area of these ports may be regulated at will, and this will have the effect of varying the mass or volume of oil and gas entering the oil well chamber.

During the flowing period of the well the oil and gas passes through the bushing 27 into the discharge tube 25, and then flows through the expansion cone and the discharge ports of the regulator into the well chamber 31. Due to the fact that the diameter of the well chamber 31 is proportioned to be about 16 times that of the discharge passage through the tube 25, the gas will expand when entering the oil chamber 31, and this will reduce its pressure in the ratio of this expan-

sion. If the expansion takes place from a six inch intake passage to a twenty four inch well chamber, then the ratio will be 16-to-1, both in expansion and in reduction of natural gas pressure. If the natural gas pressure below the intake opening of the well is 3,000 lbs. per square inch, then the effective pressure in the well chamber 31, at the time of this expansion and pressure reduction, will be less than two hundred pounds per square inch. At this reduced pressure the flow of oil and gas can be effectively controlled, and gusher waste prevented.

When the combined locking head and pressure regulator has been placed in position, as shown in Figs. 3 and 4, a closure cap 32 is clamped tightly upon the oil well. The upper end of the discharge pipe or tubing 18 extends above this cap, and is provided with means for sealing the joint between itself and the cap against leakage. This closure cap 32 is equipped with a blow off valve 33.

We now have an oil well which has a completed main chamber, a well casing placed in proper position against the wall of the well, a combined pressure regulator and locking head locked in place to the lowermost steel section of the well casing, a closure cap clamped tightly in position over the expansion chamber of the oil well, and a discharge conduit or pipe extending to the head of the well, above and through this closure cap, from the lower end of the well.

The physical structure of the oil well is now ready for flowage of both oil and gas,—excepting the completion of the intake passage to the natural oil and gas reservoir below the pressure regulator. This is drilled only after the pressure regulator has been securely locked in place to the heavy steel casing section 10. The drilling is accomplished by a long drill rod 34, which slides in the bore of the discharge pipe 18, and through the passage of the discharge pipe 25. This drill rod is formed with longitudinal flutes or grooves 35, which are of less length than the discharge tube 25, and which are gradually reduced in depth near their upper ends, so that the area of the discharge passages thereby provided will be progressively reduced, when the rod is placed so that the upper ends of the grooves or flutes will be near the base of the cone head 26 of said discharge pipe 25.

This rod 34 is reciprocated up and down in the discharge pipe 18, so that the rock cover will be pierced, as shown in Fig. 6, and an intake passage thus formed, which will be of a diameter about that of the drill rod, and considerably smaller than the expansion chamber 31 of the oil well. When the intake passage 36 is thus completed, the compressed natural gas and mineral oil under heavy natural pressure, will rush into the intake passage 36, tending to blow the drill rod and flow controller 34 upwardly. When the communication between the discharge passage of the pipe 25 and the ports 29 and 30 has been established, by the vertical movement of the drill rod 34, against the expulsive force of the discharging oil and gas stream, the gas and oil will flow into the oil well chamber 31, thereby reducing the effective pressure at this point. By forcing the rod 34 downwardly the flow of oil and gas may now be cut-off entirely, and discharge prevented from the oil and gas reservoir.

By regulating the relation of the grooves 35 to the conical head of the discharge pipe 25, the volume of oil and gas allowed to flow through the ports 29 and 30 may be controlled or regulated. By regulating the discharge area of the opening formed by registering the ports 28 and 30 partly or wholly, the volume or mass of oil and gas discharging into the oil well chamber 31 may be regulated at will.

The drill rod and controller 34 is formed with an axial passage 34*a*, shown in Fig. 6, which extends from its lower end, through all of the supporting rods or sections coupled thereto. A pressure gauge 37 is mounted on the intermediate tubing 38, which encloses the upper end of the rod 34, so that the effective gas pressure in the natural reservoir may be indicated. This intermediate tube 38 slides within the discharge tubing or pipe 18.

By regulating the ports 29 and 30, and by varying the controlling position of the grooves 35 of the controller and drill rod 34, the volume of oil and gas released from the natural gas and oil reservoir may be controlled at will, and the pressure at which it enters the oil well chamber will also be held under safe control.

We now have an oil well completed and fully equipped with flow and pressure control, and regulation. Oil can be withdrawn from the supply which enters the chamber 31, by means of the drain pipe 39, connected to the closure cap 32.

While the oil well remains with the natural gas pressure sufficient, controlled discharge of oil may be obtained by using the natural gas pressure. But in this case only sufficient natural gas is used to elevate the oil to the head of the well, the gas supply being controlled against gusher discharge.

In the course of time the natural gas pressure will drop and become insufficient to elevate the oil to the head of the well, but the oil will be elevated within the chamber 31. Production of oil must now be continued with the aid of pumping units installed in the oil well.

In order to insure that oil instead of mainly natural gas being discharged when the intake is opened, the combined drill rod and flow controller may be equipped with a metal sleeve 34*c*, coupled thereto, so as to cover the flow passages of the controller, except near

their upper ends. In this construction the controller rod is lengthened, so that the lower end can be pushed into the natural oil and gas reservoir, and the level of the oil reached, so that oil will be caused to flow, under its own natural pressure, through the flow channels or passages of the controller rod, and the gas, which normally floats over the oil, against the rock covering of the natural reservoir, will not be allowed to enter the flow passages of the controller. In this way discharge of the natural gas will be prevented when the intake is opened, by the drilling action of the controller rod.

By this arrangement fluid can pass through the intake passage of the well, only by first entering the end of the sleeve, which has been forced into the oil zone, and gas will be prevented from entering above the lower end of the sleeve, which covers the flow passages of the controller.

When the sleeve 34*c* is used, the upper ends of the flow passages will be disposed in the same general relation to the pressure regulator, as is now disclosed, so that by raising and lowering the controlling rod the same control of oil discharge is obtained, even though only oil is flowing under high pressure.

Having described my invention I claim:—

1. The method of constructing and operating oil wells consisting in constructing a large diameter oil well, providing a small diameter drill at the base of said oil well, installing a pressure regulator at the base of said oil well through which the drill may operate, operating the drill to penetrate the base of the oil well and form an oil and gas intake passage therefor, operating the pressure regulator to control the pressure in said oil well, and operating the drill to control the flow into said oil well after the intake passage has been formed.

2. The combination with an oil well having an intake passage and a pressure reducer communicating therewith, of a rod having a drill on its end with which material may be displaced by precussive movement of the drill and also having a flow channel in its side which may be closed or opened by raising or lowering the rod in said pressure reducer.

3. The combination with an oil well having an intake passage at the base thereof, a pressure reducer locked to the wall of the well against the expulsive force of the natural gas entering the well, and means insertable through the pressure reducer and the intake passage for varying the flow into the well.

4. The combination with an oil well having an intake passage at the base thereof, of a rod having a series of flow channels extending for a limited distance thereon, and insertable in the intake passage of the well so that flow of gas and oil into the well may occur through said channels, and adapted to be vertically moved in the intake passage so that the upper ends of the flow channels may be wholly or partly closed by the wall of the intake passage.

5. The combination with an oil well having an intake passage, a pressure reducer locked to the base of the well and provided with a passage communicating with the intake passage, said pressure reducer having means for controlling the flow of oil from said intake passage to the chamber of the oil well, and means operating through the passage of the reducer to control the flow of oil through the intake passage into the well.

6. An oil well having an intake passage, a device having a passage connected thereto, a valve for controlling the flow of oil and natural gas from the last passage to the oil well itself, and a controller working through the device and valve for controlling the flow of gas and oil through the intake passage.

7. An oil well flow and pressure controller consisting of a body having a passage therethrough, a valve on said body for controlling the flow of natural gas and oil from the passage, a tubular operating member connected to said valve for closing and opening the same, and a rod extending through said tubular operating member from the head of the well and provided with a flow passage therein through which initial gas and oil may flow into the well, said rod having drilling means on its end.

8. An oil well having an expansion cone in its base locked to the wall of the oil well to resist expulsion by released gas pressure, and a combined drill for forming an intake for the oil well and flow controller working through the expansion cone.

9. An oil well having a pressure regulator at its base, a tube extending from the head of the well and operatively connected with the pressure regulator, a controller rod extending through the pressure regulator below the same and provided with a flow passage in its side, and means connected with said rod and extending through the tube for operating the same to control the relation of the controller rod to the intake of the well.

10. The method of constructing and operating oil wells which comprises drilling the well to cap rock, providing a drill guide at the bottom of the well thus formed, and finally breaking through the cap rock into the oil zone with a fluted drill snugly fitting the guide so that the flutes in the drill may serve as passages for the oil from the oil zone into the well.

11. The method of constructing and operating oil wells which comprises drilling the well to cap rock, providing a drill guide at the bottom of the well thus formed, finally breaking through the cap rock into the oil zone with a fluted drill snugly fitting the guide so that the flutes in the drill may serve as pas-

sages for the oil from the oil zone into the well, and controlling the oil flow by adjusting the drill vertically in the guide to expose the upper ends of the flutes above the upper end of the guide or completely enclose them within the guide.

12. The method of constructing and operating oil wells which comprises drilling the well to cap rock, providing a tubular guide at the bottom of the well thus formed, breaking through the cap rock into the oil zone with a fluted drill snugly fitting the guide and whose flutes are of a progressively reduced depth from the lower end of the drill, and adjusting the position of the drill in the guide to regulate the flow of oil from the oil zone into the well by exposing more or less of the upper ends of the flutes above the upper end of the guide.

13. The method of constructing and operating oil wells which comprises first drilling the well into but not through cap rock, and finally breaking through the cap rock with a sleeve covered fluted tool, so that in the event the cap rock be broken in a gas zone the tool may have its lower end enter the oil zone to expose the flutes to the contents thereof while the sleeve sheathes the flutes in the gas zone.

14. An oil well having a reducing head disposed at the cap rock and provided with a channel therethrough, and a tool disposed in said channel to first puncture the cap rock and thereafter serve as a means for controlling the flow of oil through said channel by adjustment in the latter.

15. An oil well having a reducing head disposed at the cap rock and provided with a channel therethrough, and a tool disposed in said channel to first puncture the cap rock and thereafter serve as a means for controlling the flow of oil through said channel by adjustment axially in the latter.

16. An oil well having a reducing head disposed at the cap rock and provided with a channel therethrough, and a tool disposed in said channel to first puncture the cap rock and thereafter serve as a means for controlling the flow of oil through said channel by adjustment axially in the latter, said tool being formed with flutes extending for a part of the length of the tool.

17. An oil well having a reducing head disposed at the cap rock and provided with a channel therethrough, and a tool disposed in said channel to first puncture the cap rock and thereafter serve as a means for controlling the flow of oil through said channel by adjustment axially in the latter, said tool being formed with axial flutes opening at the bottom but terminating short of the upper end of the tool.

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