In recent years oil wells in Southern California are operated at very great depths; in some fields reaching a depth of over a mile. When such an oil well is brought into production there is at first a very heavy gas pressure and oil flow amounting to thousands of barrels of oil per day; but after an indefinite time the gas pressure and oil flow decreases so that the oil can only be gotten out of the well by means of pumps.

Much difficulty is experienced in pumping the oil from the great depths involved, for various reasons, such as gas pocketing, interference of gas in the pump valves, and accumulations of sand and silt, which prevent the pump from properly operating and require frequent pulling of the pump in order to clear, repair, and adjust the same.

Furthermore as such wells are deepened the casing is necessarily reduced in diameter from time to time so that in wells where the outer casing at the top may be of 15 1/2 inches in diameter, the inner casings will be necessarily reduced until the innermost casing will be a diameter of four inches from top to bottom of the well.

The difficulties of sinking such wells perpendicularly are greatly increased as the depth increases and diameter decreases, so that it frequently occurs that the lower end of the well instead of being vertical is sinusoid, and likelihood of the sucker rod cutting into the well tubing at the lower depths is greatly increased and as a result the tubing at the lower part of the lower depths frequently becomes worn and split by contact of the sucker rod at the bends.

A further difficulty arises from kinking and stretching of the pump rod which buckles or bends on the down stroke so that the slack must be taken up on the up stroke, and therefore the sucker operates only through a slight portion of its intended full stroke.

An object of this invention is to provide a well of small diameter, with means whereby the combined operation of expansive fluid at the lower depths of the well, and mechanical pumping operations at a higher level are made effective to produce a greater amount of oil under the difficult conditions above indicated, than can otherwise be produced by means heretofore known.

In this invention I utilize the casing, with a packing therein to form a sump to contain a pool of oil which is supplied from the oil bearing strata by the lifting force of expansive fluid, as the gas issuing from the oil producing strata with the oil, so that oil may be pumped to the surface from such pool through pump tubing of greater diameter than would be possible to install in such casing of small diameter without my invention.

A feature of this invention is that I minimize the pressure against which the pressure of the expansive fluid at the lower depths has to overcome while it is lifting the oil to the influence of the mechanical pumping means; and I have made provision whereby a minimized horizontal surface of the upwardly moving gas elevated column of oil is subjected to no more down pressure per square inch than that which is applied on the larger surface of the oil pool to cause the oil from such pool to flow upward responsive to the suction of the pumping means depended upon to lift the oil from such pool to the surface.

Compactness and simplicity of construction are objects of the invention.

An object is to make provision whereby a maximum output of oil may be produced from a given well, with less depth of mechanical lift than would be possible without the use of my invention, and whereby the expense of producing the oil is reduced, and the attention required is minimized.

A feature of this invention is that I apply to the surface of oil in the oil pool such gas pressure as may be maintained in the gas delivery pipes, to assist the suction of the pumping means for discharging the oil from the oil pool.

The installation is also more economical since the pump tubing and sucker rod are greatly reduced in length; and furthermore, the power necessary to operate the pump is also greatly reduced.

I have discovered that by allowing the gas to discharge the oil into the casing at that height to which the gas is capable of lifting the oil in a thin stream or column, and then pumping the oil mechanically from that height to the surface of the earth, that the gas, thus being freed from interference of the pumping mechanism, will be able to discharge a greater quantity of oil from the bottom of the well than it can discharge when the flow of oil is impeded by the mech...
anism of the pump; and that, by freeing the pump from the interference of the gas and freeing the operation of the gas from interference with the pump, the production of the well may be greatly increased and in some instances I have been able to increase the production of a well as much as 500 per cent.

Other objects, advantages and features of the invention may appear from the accompanying drawing, the subjoined detailed description and the appended claims.

The discovery and invention may be understood from the following description, reference being had to the accompanying drawing, which illustrates a form of apparatus adapted to carry this discovery and invention into effect.

Figure 1 is a broken axial section of an oil well equipped for oil production in accordance with this invention and discovery, showing only the innermost casing.

Fig. 2 is an enlarged fragmental axial section on the same plane as Fig. 1.

Fig. 3 is a transverse section on line $x^2$, Figs. 1 and 2.

Fig. 4 is a transverse section on line $x^4$, Figs. 1 and 2.

1 indicates the well casing having at the top the usual head 2 with the gas outlet 3, a cap 4 into which is screwed the pump tubing 5 and the nipple 6 that carries the T 7, having the oil outlet 8. 9 is the usual stuffing box and 10 the polishing rod which operates the sucker rod 11 that in turn operates the plunger 12 in the working barrel 13.

Said working barrel is connected by a coupling 14 to the pump tubing extension 15, which is provided with an oil and gas outlet 16 connected by a coupling 17 with the oil and gas tubing 18 extending down through tubing extension 19 connected to the oil intake 20 that is sealed to the casing 1 by a packing 21 and may be of any usual form compressed and secured by the lock nuts 22 screwed onto the threaded section 23 which is internally threaded at its lower end to receive the sub 24 that is provided with a valve seat 25, seating the valve 26 and having the valve stop 26'. The oil and gas tubing 18 is threaded into the upper end of the sub 24, and the oil and gas tubing extension 27 is screwed into the lower end of the sub and extends down to near the top of the oil bearing strata 28, and is provided at its lower end with an oil and gas receiving inverted funnel 28, the upper end of which is provided with a beam 29 to discharge oil and gas in a concentrated stream into the oil and gas tubing extension 27. The inverted funnel or oil and gas receiver 28 is shown provided with guards 30 in the form of arcuate wires, rods or strips to allow the receiver 28 to be easily passed down through the casing, the lower end of which is perforated at 31 to allow oil and gas from the formation to flow into the casing below the receiver 28.

The manner of installing the apparatus in the well will be understood from the foregoing, and in practical operation when the apparatus is installed, the gas pressure carries the oil into the receiver 28 up through the beam 29, the oil and gas tube extension 27 and the oil and gas tube 18 and discharges the oil and gas into the space 32 between the casing and the pump tubing; the oil is then deposited by gravity into the elevated sump 33 formed above the packing 21 between the casing and the perforated pump tubing 20, thus forming a pool from which I pump the oil while the gas is being exhausted from the upper part of the casing.

The mechanical pump is put into operation and the oil is pumped from the sump and discharged from the pump through the oil outlet 8, while the gas goes out through the gas outlet 3, which is preferably subject to sufficient suction by connection with a gas compressor not shown to cause the gas to freely discharge above the oil.

It is noted that in carrying out this invention there are provided three ways through which the fluid contents of the strata are conducted to the surface.

First, there is an oil and gas way comprising an oil and gas collector as the funnel 28 and its tubing 27 and 18; the funnel being open at its lower end, and arranged to receive oil and gas from the casing above the perforations 31, therein, through which the oil and gas flow from the producing strata below the packing 21 and the tubing 18, and opening to the casing at the mouth above the packing 21. The oil and gas flow through 28, 27 and 18 and are discharged at the mouth 16 which is nearly at that elevated level to which the pressure of the expansive fluid underneath the funnel will carry the oil to discharge it through such mouth.

Second, a gas way 32 inside the casing leading from the gas and oil outlet 16 to the gas outlet 3 at the top of the well.

Third, the oil way which includes the sump space 33 lying between the casing 1 and the pump tubing 15 and between the packing 21 and the oil and gas outlet 16 and the pump tubing parts 19, 15, 13 and 5, and discharging oil at 8; this latter way being provided with pump means as the piston 12 and standing valve 13' so that by operating the piston the oil is pumped to the surface free from any interference of gas.

I claim:

1. The combination with an oil well casing adapted at its lower end to receive oil and gas from the producing formation, and a packing near and below the level to which the gas pressure from such formation may lift the oil in a thin column, said casing being provided with a gas outlet at the top;
a tube provided with a collector to concentrate the gas pressure to cause a stream of oil and gas to flow through such tube; pump tubing through which the oil and gas tube extends, said oil and gas tube being adapted and arranged to discharge a stream of oil and gas from the tubing at a height above the packing so that the oil may be made to descend by gravity to a sump formed in the casing above the packing, and form an elevated accumulation of oil around the intake of the pump tubing; and means for pumping oil from the sump through the pump tubing, and discharging such oil at the top of the well.

2. The combination with an oil well casing adapted at its lower end to receive oil and gas from the producing formation, and a packing near and below the level to which the gas pressure from such formation may lift the oil in a thin stream; an oil and gas tube opening into the casing above the packing, and a sump for separated oil above the packing; a collector to concentrate the gas pressure to cause a stream of oil and gas to flow through such tube; a beam through which the collector discharges the oil and gas into the oil and gas tube; means to remove the oil from above the packing, and means to remove the gas from above the separated oil.

3. An apparatus for removing oil from wells comprising tubing extending down into the well to collect the mixed oil and gas issuing from the oil bearing stratum, a packing between the tubing and side of the well located a distance above the oil bearing strata and to which the pressure will raise the mixed oil and gas, said tubing being provided with means extending above said packing to allow the oil to pass out of the tubing into the casing and rest above the packing, and the gas to escape and pumping means in said tubing having its only inlet opening below the gas discharge to draw the oil through the tubing and to force it to the surface.

4. An apparatus for removing oil from wells comprising tubing extending down into the casing to collect the mixed oil and gas issuing from the oil bearing stratum, and a packing between the tubing and casing, said tubing being provided with means extending above said packing to allow the oil to pass out of the tubing into the casing and rest above the packing, and the gas to escape and pumping means in said tubing having its only inlet opening below the gas discharge to draw the oil through the tubing and to force it to the surface.

5. An apparatus for removing oil from wells comprising tubing extending down into the well to collect the mixed oil and gas issuing from the oil bearing stratum, said tubing comprising a section having a flared bottom opening and a contracted throat, the tubing extending above the throat and having a packing between the tubing and side of the well, said tubing being further provided with means extending above said packing to allow the oil to pass out of the tubing and rest above the packing and the gas to escape, and pumping means in the tubing having its only inlet opening below the gas discharge to draw up the oil resting on the packing and force it to the surface.

6. An apparatus for removing oil from wells comprising a casing, tubing extending down thereinto, said tubing comprising an outer and an inner tube, said inner tube in its lower portion communicating with the casing through the walls of the outer tube, a packing between the outer tube and the casing, there being perforations in the outer tube above the packing and below the upper end of the inner tube, and a piston in the outer tube.

7. An apparatus for removing oil from wells comprising tubing extending down in the well to collect the mixed oil and gas issuing from the oil bearing stratum, means interposed between the tubing and the side of the well at a distance above the oil bearing stratum to collect in a pool the oil that is raised through the tubing with provision for allowing the gas to escape to the top of the well, and pumping means connected to the lower portion of the pool to draw the oil from near the bottom of the pool and force it to the surface whereby the pump functions to continue the upward flow of oil alone after the oil is separated from the gas.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 21st day of January, 1926.

WALTER J. BARNHART.
CERTIFICATE OF CORRECTION.

Patent No. 1,674,815. Granted June 26, 1928, to

WALTER J. BARNHART.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, lines 58 and 73, for the word "beam" read "bean"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of August, A. D. 1928.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.