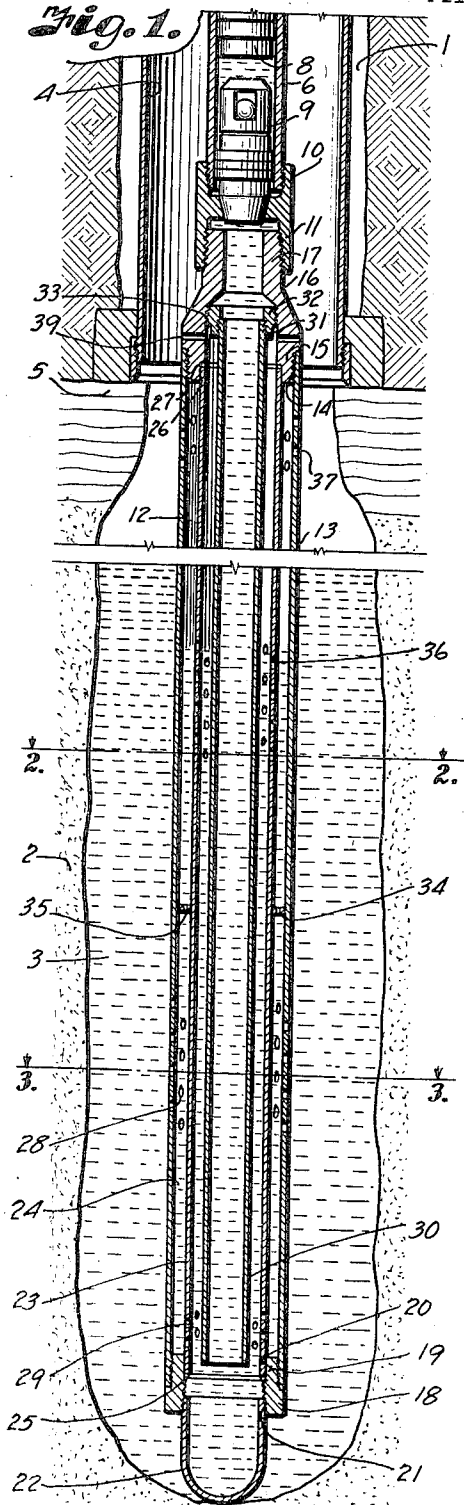
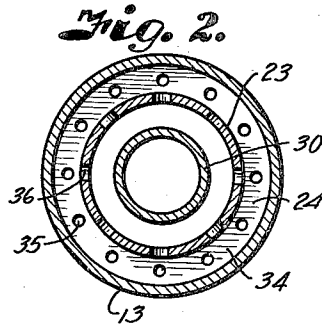
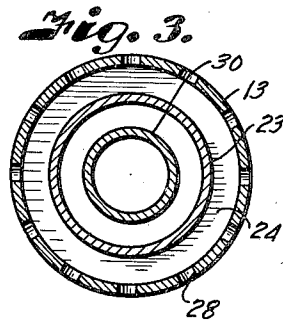
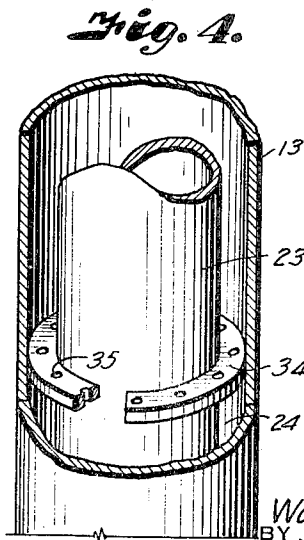
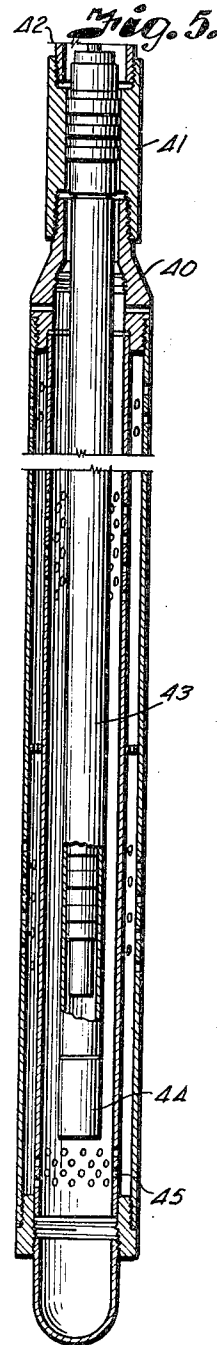


April 11, 1944.

W. A. O'BANNON
SEPARATOR FOR WELL PUMPS

2,346,602

Filed Feb. 17, 1941



INVENTOR
Walter A. O'Bannon
BY
Arthur C. Brown
ATTORNEY

UNITED STATES PATENT OFFICE

2,346,602

SEPARATOR FOR WELL PUMPS

Walter A. O'Bannon, Tulsa, Okla.

Application February 17, 1941, Serial No. 379,265

6 Claims. (Cl. 103—203)

This invention relates to well pumping equipment, and more particularly to a bottom hole separator for use in connection with the intake of a well pump, and has for its principal object to provide a separator of this character which effectively eliminates entrained gas from the well liquid so that only clean, dead liquid is delivered to the pump.

In accomplishing this and other objects of the invention, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawing, wherein:

Fig. 1 is a vertical section through the lower portion of a well equipped with an oil and gas separator embodying the features of the present invention.

Fig. 2 is a cross-section on the line 2—2 of Fig. 1.

Fig. 3 is a similar section on the line 3—3 of Fig. 1.

Fig. 4 is an enlarged fragmentary view of the separator, particularly illustrating the baffle located between the oil inlets at the bottom of the separator and the gas outlets at the upper end of the separator.

Fig. 5 is a vertical section through a modified form of the invention.

Referring more in detail to the drawing:

1 designates the bore-hole of an oil well extending from the surface of the earth to the producing formation 2 from which the well fluids, usually consisting of oil and gas, flow into the pocket or shot-hole 3. The bore-hole 1 is provided with the usual casing 4 that is set on the cap-rock 5 above the formation 2.

Mounted in the well is a pumping unit including a barrel 6 having a piston 8, which is reciprocated by means of sucker rods or the like (not shown). The pump also includes a standing valve 9 which seats in a shoe or collar 10 fixed to the lower end of the working barrel and which has an inwardly threaded skirt portion 11 for connecting the separator 12 which constitutes the present invention.

The well fluid flowing into the pocket 3 often contains large quantities of gas which reduces the amount of fluid displaced by the pump, sometimes makes the pump completely inoperative, and often causes the well to flow by heads. The separator 12 is, therefore, designed for separating the gas from the oil or well liquids before the liquids pass the standing valve and flow into the pump barrel.

The separator 12 includes an outer cylindrical shell 13 having an internally threaded upper end

14 threadedly connected with an externally threaded skirt 15 on a swedge-shaped head 16. The head 16 also includes a reduced externally threaded top 17 engaging the threaded skirt portion 11 of the collar previously described.

The outer shell 13 is of such diameter that it may be lowered freely through the casing 4 and of a length to extend from the location of the pump to the bottom of the well and form an anchor support for the pump. The lower end of the outer shell carries a bushing 18, having an externally threaded portion 19 engaging internal threads on the shell, as clearly shown in Fig. 1. The bushing has an axial bore forming a cylindrical sleeve 20 at its upper end and an internally threaded opening 21 at the lower portion thereof in which is threaded a bull-plug 22.

Located in the outer shell and extending coaxially therewith is an inner shell 23 of smaller diameter than the outer shell to provide an annular passageway 24 therebetween extending from the bottom to the top of the separator. The lower end of the inner shell is sleeved within the sleeve portion 20 of the bushing 18 and engages against an internal shoulder 25. The upper end of the inner shell is received in a counterbore 26 in the skirt portion of the head and seats against a shoulder 27 so that when the outer shell is in position and connected with the head 16 and bushing 18, the inner shell is retained coaxial and from longitudinal movement.

The outer shell is provided, adjacent the lower end, with a plurality of inlet openings 28, which openings are preferably located near the bottom of the pocket so that the liquid will flow thereinto when low levels are carried in the well, but the openings are at sufficient height that the heavier oil, which is substantially free from entrained gas, flows downwardly toward the bottom of the passageway 24 and through inlet openings 29 which are formed in the lower end of the inner shell at a point directly above the bushing 18, which oil, being free of gas, may flow directly to the working barrel, through a pump inlet tube 30 positioned coaxially within the inner shell and having its upper end threadedly connected, as at 31, with a bushing 32 threaded into the head of the separator, as indicated at 33. The lighter liquid, or that containing some gas, will rise upwardly in the passageway 24, but the flow thereof is retarded by a baffle 34. The baffle 34, being of ring shape, closes the passageway above the liquid inlets but is provided with a series of openings 35 to allow passage of the gas to the upper end of the passageway. Retarding flow of the liquid by the

baffle assists in the gas separation so that the separated liquid flows through a series of inlets 36 formed in the inner shell at a point above the baffle but below the upper end thereof. The liberated gas continues to the upper end of the passageway and is discharged through openings 37 that are formed therein directly below the head 16. It is possible that some of the gas may still remain in entrainment with the liquid passing through the inlets 36, however, this gas will rise in the passageway 38 which encircles the tube 30 and is discharged through lateral ports 39 in the head 16. The liquid passing through the inlets 36, being freed of the gas, gravitates downwardly so that it may pass into the lower end of the tube 30 for flow into the pump.

It is thus apparent that the gas is separated in a series of stages, first where it passes through the inlet openings 28, again where it passes through the openings of the baffle, and where the liquid is diverted into the inner shell through the inlets 36. Therefore the liquid is effectively relieved of any entrained gas so that it is delivered in clean, dead state to the pump, thereby assuring a full volume displacement upon each stroke of the pump. Since the gas has been separated from the oil, there is no likelihood of the pump valves becoming gas locked which ordinarily interferes with the effectiveness of the pump and often results in rod breakage and stuffing box trouble at the top of the well.

The form of the invention shown in Fig. 5 is substantially the same as that just described, with the exception that the inlet tubing to the pump is eliminated and the head 40 of the separator is connected with a collar 41 which is fixed to the lower end of the pump tube 42, the collar 41 being provided with a holddown for stationary barrel rod pumps, in which case the working barrel 43 of the pump is suspended coaxially within the inner shell and the lower end provided with a standing valve 44 which is positioned above the liquid inlets 45 in the lower end of the inner shell. Otherwise the shells and openings are arranged in the same manner as that described in the first form of the invention. The operation thereof is the same with the exception that the liquid passes from the inner shell directly to the intake of the pump.

From the foregoing it is obvious that I have provided a separator of simple and inexpensive construction, and which is capable of effectively eliminating entrained gas from being pumped.

What I claim and desire to secure by Letters Patent is:

1. A separator of the character described including, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly within the shell and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway therebetween for a divided upward and downward flow of said fluids and having liquid inlet openings spaced a substantial distance below the inlet openings of the outer shell for inflow of heavy liquid from said passageway and having upper liquid inlet openings located at a point spaced a substantial distance above the inlet openings of the outer shell for providing sufficient travel of the liquids to effect separation of the contained gas, means closing the lower ends of said shells, a head closing the upper ends of the shells, said outer shell having gas outlet openings adjacent said head and

located above said upper liquid inlet openings to provide a gas flow space for discharge of gas separated in said annular passageway, and a baffle located in said annular passageway and spaced above said inlet openings of the outer shell and below said upper liquid inlet openings of the inner shell to retard upward flow of said lighter fluids in the passageway so that gas contained in the lighter fluids separates for discharge through the gas outlet openings of the outer shell and the liquid flows through said upper inlets of the inner shell.

2. A separator of the character described including, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly within the shell and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway therebetween for the upward and downward flow of said fluids and having liquid inlet openings spaced below the inlet openings of the outer shell for inflow of heavy liquid from said passageway and having upper liquid inlet openings located at a point a substantial distance above the inlet openings of the outer shell, means closing the lower ends of said shells, a head closing the upper ends of the shells, said outer shell having gas outlet openings adjacent said head and above the upper liquid inlet openings of the inner shell to provide a gas flow space for discharge of gas separated in said annular passageway, and a baffle located in said annular passageway and spaced above said inlet openings of the outer shell and below said upper liquid inlet openings of the inner shell to retard upward flow of said lighter fluids in the passageway so that gas contained in the lighter fluids separates for discharge through the gas outlet openings of the outer shell and the liquid flows through said upper inlet openings of the inner shell, said baffle comprising a ring encircling the inner shell and provided with openings for the flow of the lighter fluids therethrough.

3. In an apparatus of the character described, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway therebetween for the upward and downward flow of said fluids and having liquid inlet openings spaced a substantial distance below the inlet openings of the outer shell for inflow of heavy liquid from said passageway and having upper liquid inlet openings located at a substantial distance above the inlet openings of the outer shell, means closing the lower ends of said shells, a head closing the upper ends of the shells, said outer shell having outlet openings near said head and spaced above the upper liquid inlet openings of the inner shell to provide a gas flow space therebetween for discharge of gas separated in said annular passageway, means located in said annular passageway and above said inlet openings of the outer shell and below said upper liquid inlet openings of the inner shell to retard upward flow of said lighter fluids in the passageway so that gas contained in the lighter fluids separates for discharge through the gas outlet openings of the outer shell and the liquid flows through said

upper inlet openings of the inner shell, and a pump inlet member in the inner shell and having an inlet located within the inner shell at a point adjacent the lower inlet openings thereof.

4. In an apparatus of the character described, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway therebetween for the upward and downward flow of said fluids and having liquid inlet openings spaced below the inlet openings of the outer shell for inflow of heavy liquid from said passageway and having upper liquid inlet openings located at a point above the inlet openings of the outer shell, means closing the lower ends of said shells, a head closing the upper ends of the shells and having a bore therethrough, said outer shell having outlet openings near said head and spaced a distance above the upper liquid inlet openings to the inner shell to maintain a gas flow space therebetween for discharge of gas separated in said annular passageway, a baffle located in said annular passageway and spaced above said inlet openings of the outer shell and below said upper liquid inlet openings of the inner shell to retard upward flow of said lighter fluids in the passageway so that gas contained in the lighter fluids separates for discharge through the gas outlet openings of the outer shell and the liquid flows through said upper inlet openings of the inner shell, said head having means adapted for supporting a pump, and a suction tube in the inner shell and having an inlet located within the inner shell at a point adjacent the lower inlet openings thereof and having an outlet at the upper end connected with the bore of said head.

5. In an apparatus of the character described, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway for the upward and downward flow of said fluids and having liquid inlet openings spaced downwardly from the inlet openings of the outer shell for inflow of heavy liquid from said passageway and having upper liquid inlet openings located at a point above the inlet openings of the outer shell, 55

means closing the lower ends of said shells, a head closing the upper ends of the shells, said outer shell having outlet openings spaced a distance above the upper liquid inlet openings to the inner shell to maintain a gas flow space therebetween for gas separated in said annular passageway, a baffle located in said annular passageway and spaced above said inlet openings in the outer shell and below said upper liquid inlet openings of the inner shell to retard upward flow in the passageway so that gas contained in the lighter liquid will separate in the passageway for discharge through the gas outlet at the upper end of the outer shell and the liquid will flow through said upper inlet openings of the inner shell, said baffle comprising a ring encircling the inner shell and provided with openings for the retarded flow of the well fluid therethrough, pump supporting means carried by said head and a pump inlet member located within the inner shell at a point adjacent the lower inlet openings thereof.

6. A separator of the character described including, an elongated outer shell having inlet openings spaced upwardly from the lower end thereof for the inflow of well fluids and wherefrom the heavy liquid components of the inflow move downwardly within the shell and the lighter fluids containing gas rise upwardly within said shell, an inner shell cooperating with the outer shell to form an annular passageway for flow of said fluids and having liquid inlet openings spaced downwardly from the inlet openings of the outer shell for inflow of the heavy liquid from said passageway and having upper liquid inlet openings located at a point above the inlet openings of the outer shell, means closing the lower ends of said shells, a head closing the upper ends of the shells, said outer shell having outlet openings adjacent the head and spaced a distance above the upper liquid inlet openings to the inner shell to provide a gas flow space therebetween for gas separated in said annular passageway, and a baffle located in said annular passageway and spaced above said inlet openings in the outer shell and below said upper liquid inlet openings of the inner shell and arranged to retard upward flow in the passageway so that gas contained in the lighter liquid will separate in the passageway for discharge through the gas outlet at the upper end of the outer shell and the liquid will flow through said upper inlets of the inner shell, said head having gas outlet openings connected with the interior of the inner shell above the gas outlet openings of the outer shell.

WALTER A. O'BANNON.