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3,360,903

TREATMENT OF OIL WELL PRODUCTION

Filed July 19, 1965

2 Sheets-Sheet 1

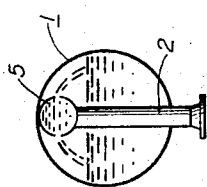


Fig. 1A

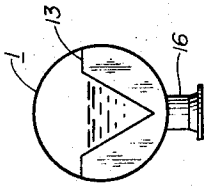


Fig. 1B

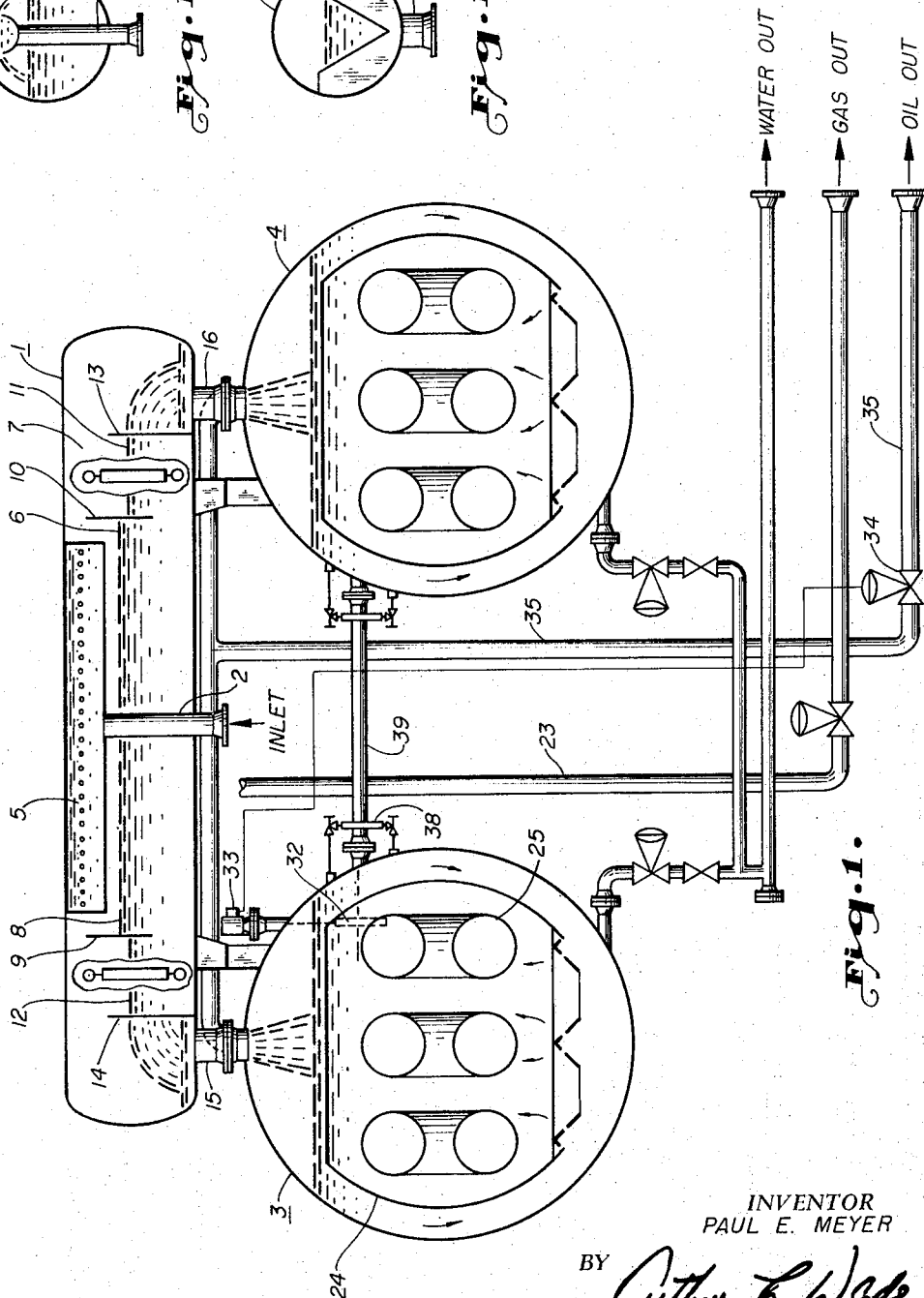


Fig. 1

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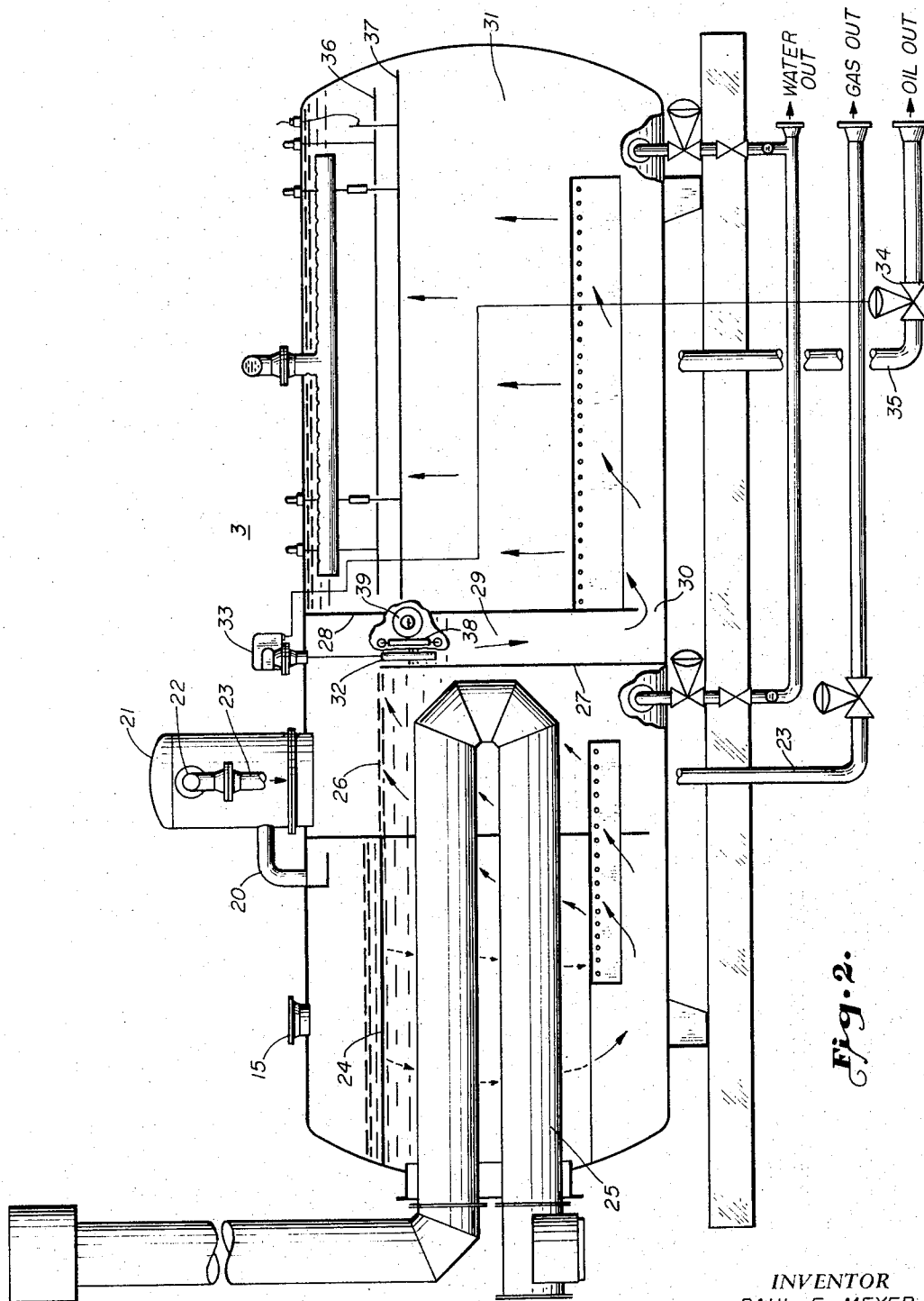


Fig. 2.

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TREATMENT OF OIL WELL PRODUCTION

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1 Claim. (Cl. 55—164)

The present invention relates to the treatment of oil well production in amounts too large to be processed in a single vessel of normal capacity. More particularly, the invention relates to controlling flow through a system utilizing a plurality of treating vessels so as to manifest the distribution of the throughput load among vessels.

In some oil-producing localities of the world, the streams of well production are so large that the initial dehydration, or "treatment" near the well head cannot be carried out in a single vessel of practical size. The treating vessels are basically fabricated far from the localities where these large streams are produced. The fabricating facilities can always be modified to produce larger and larger vessels, but the transportation of these vessels eventually becomes too great a problem. As a practical matter, it has become advisable to treat these large streams in groups of vessels that are each considered to be of presently normal size.

The manifolding of a plurality of treatment vessels offers some formidable problems. The total frictional drop through a treating vessel is of the magnitude of one tenth foot of head of the flowing fluid, excluding the inlet and outlet resistances. Acceptable performance is practically impossible for velocities much above that corresponding to this drop value. Also, the treating process is one requiring relatively steady state conditions. An instantaneous surge can cause an upset condition that may require hours to be corrected. An additional factor of concern is that any extraneous back-pressure imposed on a producing well, at some time in the life of the property, will either restrict its productive potential or require additional lifting horsepower. Furthermore, the multi-phase character of the feed stream provides the possibility of the simultaneous existence of fluid densities varying from essentially 0 to 65 pounds per cubic foot from gas to salt water. Since the process pressure drop is not sufficient to adequately split the stream, this requirement must be provided by some outside mechanism. Installations in which the splitting has been attempted by an absolute similarity in the piping systems have failed because one side would log up with a higher density material and temporarily divert the entire stream through the other ligament. Also, any splitting mechanism which requires an appreciable pressure drop may increase the degree of emulsification and make resolution more difficult.

A free liquid surface must exist in both the vessel used to split the stream and the treater vessel itself. And to provide this free surface for the liquids, there must be a gas associated with the stream or gas must be supplied from an outside source. If both vessels are supplied the free liquid surface, the performance of the treater will be satisfactorily isolated from the performance of the splitter under normal operation.

A principal object of the present invention is to establish a free liquid surface in a liquid-splitting vessel with a common gas pressure and a free liquid surface in each of a plurality of process vessels with the common gas pressure and to control the combined liquid discharge from a plurality of free-surface vessels from the level of the free liquid surface in one of the vessels with an indication of the differences in liquid heads resulting from differences in the restrictions to throughput flow between the vessels.

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The invention contemplates a vessel receiving a total stream of oil well production to be processed. A system of weirs divides the liquids of the production in predetermined quantities and the divided quantities of liquids and gas of the production each flow to a processing vessel. The divided quantities of liquid are heated to establish a treating viscosity and to prepare the water of the liquids for coalescence. A level is established for the heated liquids of each divided quantity prior to the liquids flowing through an electrostatic field which promotes coalescence. The bodies of heated liquid quantities are connected with a passage and a means for visual observation of the respective levels are provided for the difference in heads to flow through the coalescence chambers in which the electrostatic fields are maintained. The total discharge of liquids from all process vessels is controlled by a level control for the level of liquid in one of the heated bodies.

Other objects, advantages and features of this invention will become apparent to one skilled in the art upon consideration of the written specification, appended claim, and attached drawings, wherein;

FIG. 1 is a sectioned elevation of a system including a flow splitting vessel and a plurality of process vessels for a stream of oil well production in which the invention is embodied;

FIG. 1A is a sectioned elevation of the splitter vessel of FIG. 1 disclosing the inlet conduit for the well stream and diverter;

FIG. 1B is a sectioned elevation of the splitter vessel of FIG. 1 disclosing the weir in one end of the vessel and the outlet conduit; and

FIG. 2 is a sectioned side elevation of one of the plurality of process vessels disclosing the flow pattern through the vessel.

FIG. 1 discloses the splitter vessel 1 in sectioned elevation, positioned above two process vessels between which the production is equally divided. The oil well production is formed into a stream in conduit 2 and introduced into the vessel 1 for division into the plurality of portions. Process vessels 3 and 4 represent any plurality of vessels, each connected to receive one of the portions.

The internal structure of vessel 1 functions to provide predetermined division of the well stream introduced into the vessel shell. In the present disclosure, the division is two equal portions. Conduits 15 and 16 deliver the portions down into the lower vessels 3 and 4.

Splitter structure

The shell of splitter 1 is disclosed as an elongated, horizontally arranged, cylinder. The conduit 2 is extended up through the shell at a central location to carry a diverter, distributor 5 near the top of the shell.

Distributor 5 extends along the top of the central portion of the shell and directs the well stream against the upper internal wall of the shell. This arrangement and structure can be further understood with FIG. 1A which is a sectioned side elevation of the shell.

The well stream separates into a gaseous and liquid phase below distributor 5. Between the liquid body 6 and gaseous body 7 an interface 8 is formed. Upright, transverse baffle plates 9 and 10 are mounted to extend a substantial distance above and below the interface 8 so liquid will be forced to flow down and up to form interfaces 11 and 12 for comparatively quiet, even flow of the liquid over weirs 13 and 14.

FIG. 1B, is a sectioned end elevation of the right end of shell 1, taken to clearly show the configuration of the weirs. Weir 13 is a representative of both weirs and can be seen as a simple V-notch type of weir over which the liquids flow in equal portions.

The gaseous body 7 will divide equally between the two ends of the shell and be ejected with the liquid portions

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down conduits 15 and 16. Therefore, the balanced arrangement of structure within the shell, including the weirs functions to receive the well stream and flow it equally down conduits 15 and 16 to process vessels 3 and 4. The quantity of liquid and gas making up the well stream is so large that it cannot be processed in a single vessel of practical size. Process vessels, or treaters, 3 and 4 are sized to receive separate halves of the stream fluids and produce an oil of marketable quality.

Treaters

Treater 3 is disclosed alone in FIG. 2. The sectioned side elevation shows the essential structure of this process vessel whereby the forces of heat and the electrical energy of an electrostatic field are brought to bear on the liquids in order to coalesce the water from the oil and remove these two liquids separately. Manifolds are provided, connected between sections of the two treaters for removal of the two fluids and gas. These connections are disclosed by both FIG. 1 and FIG. 2; both must be taken together to give complete appreciation of the structural arrangement of both the treaters and the connections between the treaters.

FIG. 2 discloses treater 3, but represents treater 4 as well. Therefore, conduit 15 is shown, introducing the half of the well stream fluids flowing to the left end of splitter vessel 1. The free gas of the fluids readily disengages from the liquids and flows out pipe 20 and into dome 21 where it is joined by subsequently evolved gas, all of which then flows out pipe 22 and into common header 23 for sale or use.

The liquids flowing out of conduit 15 drop down on the top of a hood 24 which form two passages with the internal walls of shell 1. These two passages direct the liquids down and around heat source 25 so the liquids will be preheated to start the process of evolving gas.

When the liquids reach the lower end of hood 24 they are released from the passages and flow upward, directly over the heat source. The liquids are thereby raised to a temperature at which a desired amount of gas is evolved and disengaged from the liquids at surface 26. This gas is that subsequently evolved gas previously referred to. This gas flows up into dome 21 to join the previously released gas for flow out pipe 22.

The degassed liquids are now ready for water in them to be coalesced. Heated as these liquids are, they are retained in a body about heater 25 with vertical baffle 27 which is extended transversely across the shell of treater 3 and up to well above the elevation of the heat source 25. Spaced further down the length of the shell is a baffle 28 which extends transversely and depends from the top of the shell to an opening in the lower part of the shell. Spaced from each other, the baffles 27 and 28 form a well 29 into which the heated liquids fall over the upper edge of baffle 27. From well 29, the liquids discharge through opening 30 in baffle 28 and are distributed along the bottom of coalescing compartment 31 for contact with an electrostatic field.

The liquids collected in well 29 are maintained within a predetermined range of levels by controlling the valve-regulated discharge of oil from compartment 31. A float 32 is provided to directly respond to the liquid level in well 29. This float 32 is connected to a relay 33 which in turn positions valve 34 in oil output conduit 35. When the liquid level in well 29 raises, float 32 causes valve 34 to open. A differential exists between the pressure on the surface of well 29 liquids and on the liquids in compartment 31. This differential in pressure forces the liquids to flow down well 29, through opening 30, up through the compartment 31 and to discharge through conduit 35. As the level in well 29 raises or lowers, valve 34 is controlled toward opening or closing to establish the discharge of oil through conduit 35 at a rate which will maintain the well level within a predetermined range of heights.

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The electrodes of the electrical system are indicated at 36 and 37, but no other structural details of this system are necessary to illustrate the invention. The water coalesced and fallen to the lower part of compartment 31 and the water previously collected in the lower part of the heating compartment are joined in a common manifold and are withdrawn from the shell by a separate manifold conduit. The gas is also withdrawn through a separate manifold conduit. The invention resides in connecting the wells of the separate treaters and controlling the total oil discharged through the manifold provided for the purpose. This control is carried out so the difference between liquid levels in the wells within the various treaters can be observed as a guide to the need for clearing obstructions from the coalescing compartments.

Control of the well interconnection

As can be seen from FIG. 1, the treaters are tied together through their manifolds to remove oil. A single level control is provided to regulate the oil manifold valve 34. This control maintains the liquid level in the well of its treater within a predetermined range. This well level can be directly observed by sight glass 38.

With a sight glass provided for each well of the various treaters, the difference between the liquid levels observed becomes very significant. These differences at any one time, and their changes, can be very useful guides in forestalling cumulative obstructions to flow of the liquids through the coalescing compartments of the process vessels.

Any difference in pressure drop in the distribution and collection piping of the treaters, from their respective wells to their common manifold, will result in a difference in well levels. If the conduits to the common manifold are not physically symmetrical, the resulting difference in pressure drops will be evidenced by the difference in well levels. This condition, of course, is a permanent bias that is characteristic of any particular system of non-symmetrical conduits.

Should the flow through the connected treaters become unequal for any reason, including the build-up of solid material in any one of the coalescing compartments, the difference in well levels will become evident. The compartment with the lesser flow will continue to increase its well level, trying to attain a head force sufficient to re-establish the normal flow relations between compartments. The liquid could back up in the treater and eventually reach the weirs 13 and 14. However, the wells are interconnected with a conduit 39 so the compartment of lesser flow can be partially, and perhaps temporarily, by-passed through its companion compartments in the other treaters. A difference in well liquid levels will exist, and be observed, by the sight glasses of the wells, but the liquid throughput load will be proportioned among all the connected treaters. The well levels will stabilize at some difference in their heights which will guide operations to clean the coalescing chambers as necessary.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The present invention having been described, what is claimed is:

1. A treating system for oil well production including, a first vessel in which production is received,

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a plurality of weirs mounted in the first vessel and so positioned to flow liquids of the production into predetermined proportions,
 a series of second vessels, each second vessel connected to the first vessel to receive in a first compartment liquids of the production from one of the weirs, 5
 means mounted in each first compartment for heating the liquids of the production received from one of the weirs,
 means responsive to the level of liquids in one of the first compartments, 10
 a second compartment in each second vessel connected to the first compartment of each second vessel to receive the heated liquids of the first compartment,
 a coalescing structure mounted in each second compartment for coalescing water of the heated liquids, 15
 a first manifold connected to the first compartments so as to remove gas from the first compartment at a common pressure,
 a second manifold connected to the second compartments so as to remove oil from the second compartment,
 a valve in the second manifold conduit which is connected to the means responsive to the level of

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liquids in one of the first compartments to control the oil removed from all the second compartments and maintain the liquid level of the one of the first compartments within a predetermined range,
 a conduit connected to each first compartment for flow of liquid between the first compartments,
 and a means for directly observing the level of liquid in each of the first compartments.

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