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Mecusker

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[54] **CLEANING APPARATUS FOR OIL WELL PRODUCTION**

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[52] **U.S. Cl.** **166/75**, 166/267, 210/73

[51] **Int. Cl.** **E21b 33/03**, E21b 43/00

[58] **Field of Search** 166/75, 267; 210/512, 73

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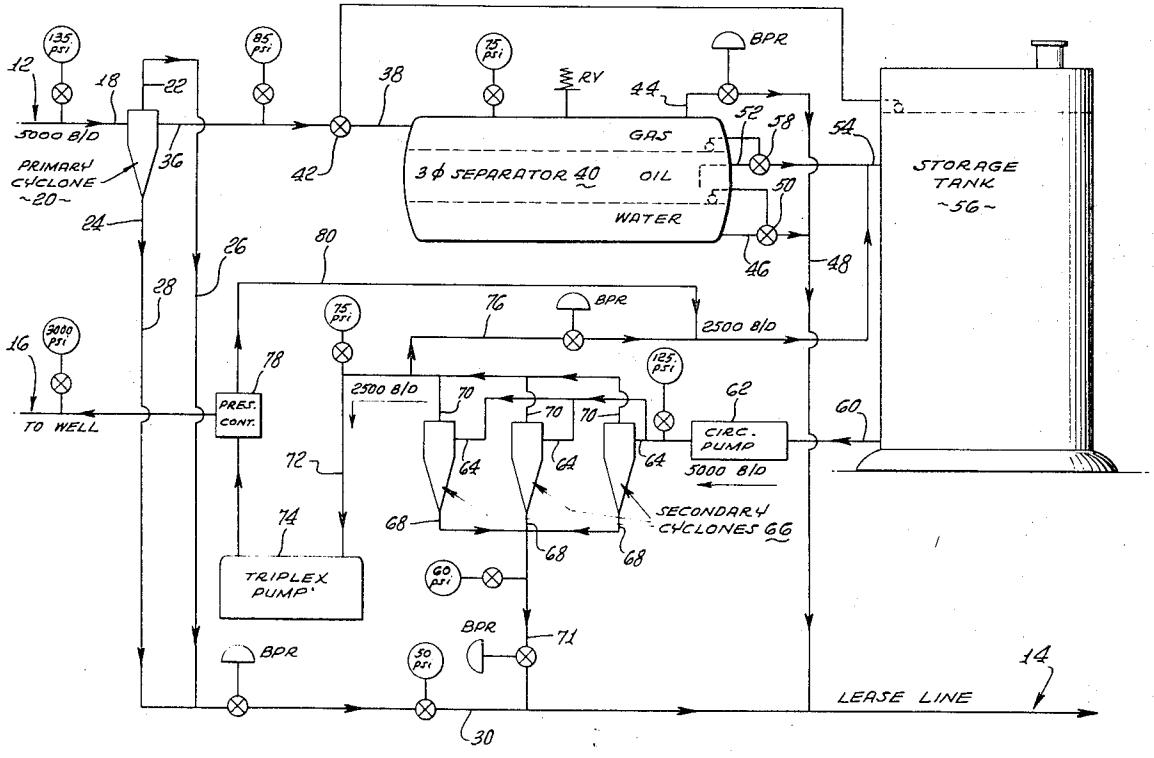
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[57] **ABSTRACT**

An apparatus for processing production fluid from an oil well in the field to obtain clean power oil for a fluid operated pump in the well. The apparatus is intended to service a single well, or at most a few wells, and includes components for removing solids, gas and water from the production fluid to obtain the clean power oil, which is pressurized by a triplex pump and delivered to the fluid operated pump in the well. The apparatus also includes a storage tank containing a sufficient reserve of clean power oil for circulating the fluid operated pump into and out of the well. A circulating pump having a capacity about twice that of the triplex pump continuously circulates the clean oil in the storage tank through parallel cyclones which remove any residual solids.

4 Claims, 4 Drawing Figures



2 Sheets-Sheet 1

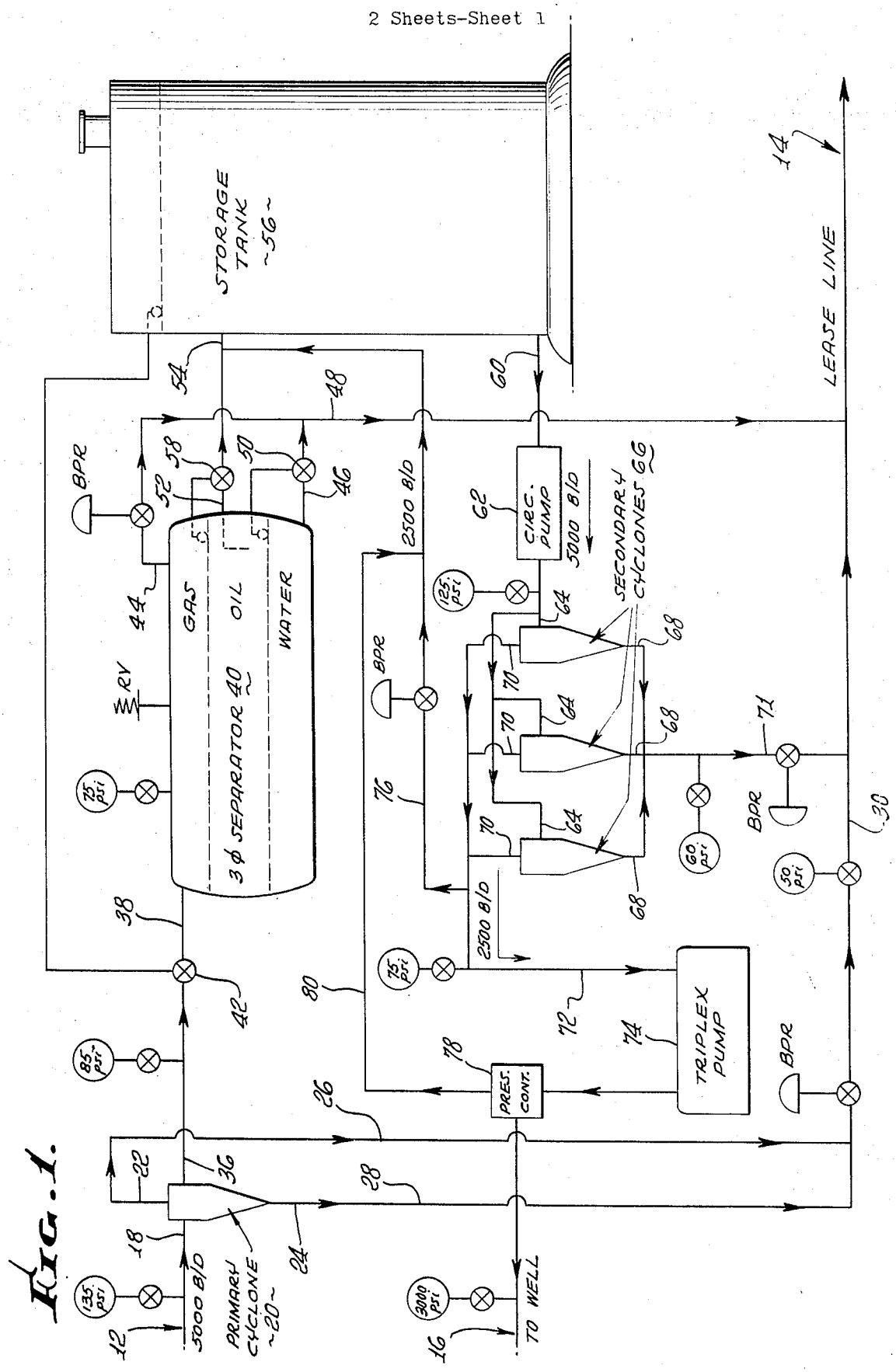


FIG. 1.

FIG. 2.

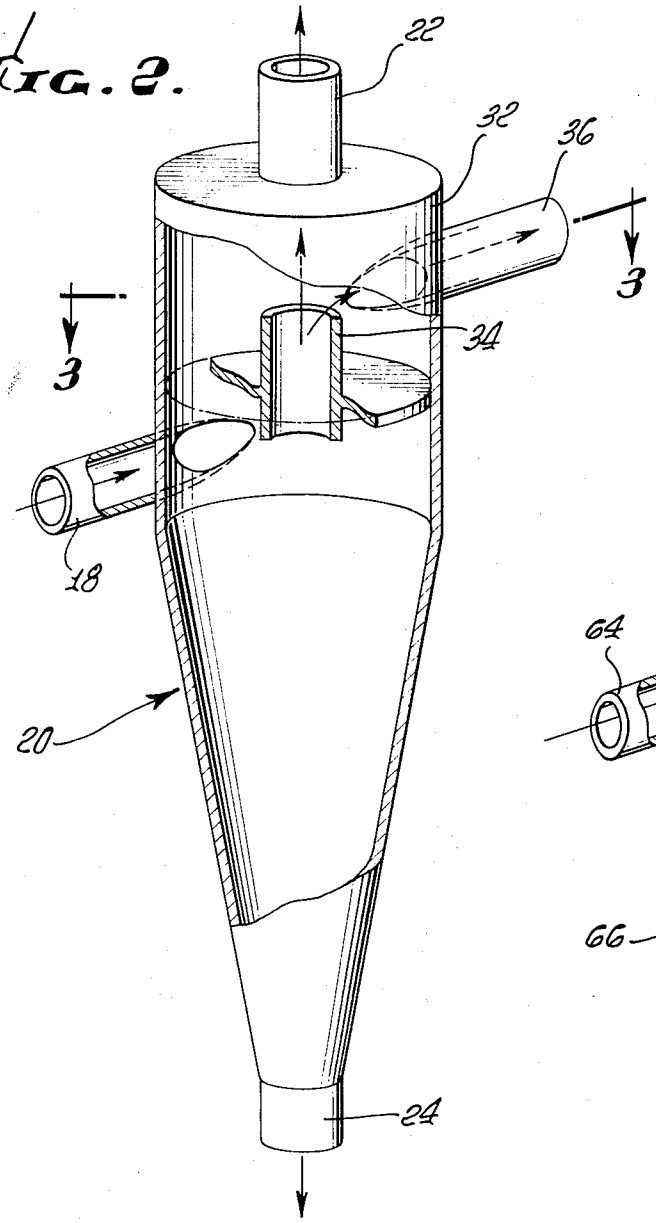


FIG. 4.

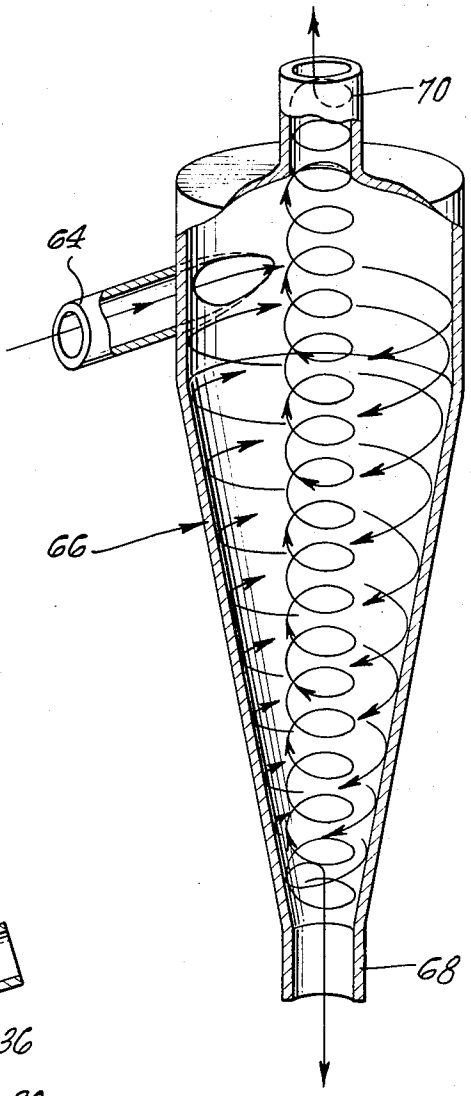
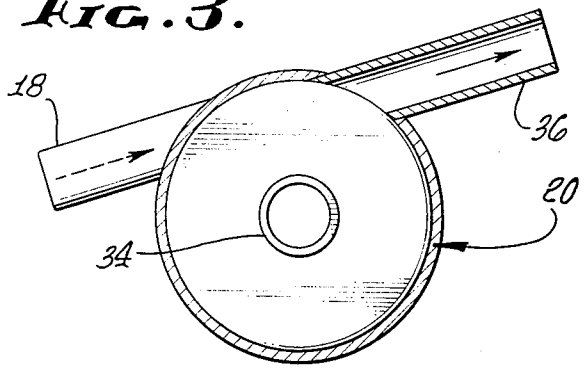


FIG. 3.



CLEANING APPARATUS FOR OIL WELL PRODUCTION

BACKGROUND OF INVENTION

The present invention relates in general to an apparatus for cleaning crude oil and, more particularly, to an apparatus for processing production fluid from an oil well in the field to obtain clean power oil for a fluid operated pump in the well.

SUMMARY AND OBJECTS OF INVENTION

The primary object of the present invention is to provide a self contained apparatus which may be installed at or adjacent the well head to obtain the necessary clean power oil from the production fluid as the latter is produced.

Another object of the invention is to provide an apparatus having components for removing solids, gas and water from the production fluid to obtain clean power oil for the fluid operated pump in the well, the clean power oil being pressurized for delivery to the fluid operated pump by a triplex pump forming part of the unit.

Another object is to provide a storage tank for clean power oil having a capacity sufficient for such related operations as circulating the fluid operated pump into and out of the well.

A further object is to continuously circulate clean power oil from the storage tank through a cyclone or cyclones to remove any residual solids.

The invention may be summarized as including, and an important object is to provide an apparatus which includes: a production fluid inlet for production fluid from the well; a production fluid outlet connectible to a point of production fluid disposal; a power oil outlet connectible to the fluid operated pump in the well; a primary cyclone having an inlet connected to the production fluid inlet, having a gas outlet and a solids outlet connected to the production fluid outlet, and having a clean fluid outlet; a three phase separator connected to the clean fluid outlet of the primary cyclone, the separator having gas and water outlets connected to the production fluid outlet and having a clean oil outlet; a storage tank connected to the clean oil outlet of the separator; a secondary cyclone having an oil inlet, an oil outlet and a solids outlet, the latter being connected to the production fluid outlet; a circulating pump having an inlet connected to the storage tank, and having an outlet connected to the oil inlet of the secondary cyclone; and a triplex pump having an inlet connected to the oil outlet of the secondary cyclone, and having an outlet connected to the power oil outlet.

A further object is to provide an apparatus of the foregoing nature wherein the circulating pump has a capacity considerably in excess of that of the triplex, and wherein there is a bypass from the oil outlet of the secondary cyclone back to the storage tank. With this construction, the clean power oil in the storage tank is continuously circulated through the secondary cyclone for further solids removal.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results which will be evident to those skilled in the crude oil cleaning art in the light of this disclosure, may be achieved with the exemplary embodiment of the invention illustrated in the accompanying drawings and described in detail hereinafter.

DESCRIPTION OF DRAWINGS

In the drawings:

FIG. 1 is a schematic view of a crude oil cleaning apparatus which embodies the invention;

FIG. 2 is a sectional perspective view illustrating a primary cyclone incorporated in the apparatus of FIG. 1;

FIG. 3 is a horizontal sectional view taken as indicated by the arrowed line 3—3 of FIG. 2; and

FIG. 4 is a sectional perspective view of a secondary cyclone incorporated in the apparatus of FIG. 1 of the drawings.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT OF INVENTION

Referring initially to FIG. 1 of the drawings, the oil well production fluid cleaning apparatus of the invention is illustrated therein diagrammatically and is composed of components which, for the most part, are entirely conventional so that detailed descriptions of the components are not necessary, the invention residing in the combination of these components and the relationship between them.

Throughout FIG. 1 there are legends indicating such things as flow rates in barrels per day, pressures in pounds per square inch, and the like. These are illustrative only and serve to indicate flow rates and pressures which will provide an operative system. It will be understood, of course, that other flow rates and pressures may be substituted. Also, throughout FIG. 1 there are various conventional components which are identified by the legends "BPR" (pressure reducing valve) and "RV" (relief valve). It is thought that the functions of these conventional components will be apparent so that descriptions thereof are not necessary.

Considering the cleaning apparatus generally, it includes a production fluid inlet **12** which receives the production fluid pumped from an oil well, not shown, by a conventional fluid operated pump, not shown. The production fluid may include native well fluid and spent power oil discharged by the pump. The cleaning apparatus also includes a production fluid outlet **14** which is shown as comprising a lease line leading to a suitable point of disposal for the production fluid, such as processing equipment, storage tanks, and the like. The apparatus also includes a power oil outlet **16** which is connectible to the fluid operated pump in the well and from which the fluid operated pump is supplied with clean power oil furnished by the apparatus.

As is well known, the production fluid from the well entering the cleaning apparatus at the production fluid inlet **12** may contain oil, water, gas, solids, and the like. The function of the apparatus is to remove substantially all of the gas, water, solids, and other contaminants, from the crude oil so as to provide the desired clean operating fluid for the pump in the well. The contaminants, i.e., the gas, water, solids, and the like, are discharged from the apparatus at the production fluid outlet **14**.

The production fluid flowing into the cleaning apparatus at the inlet **12** enters the inlet **18** of a primary cyclone **20** which is illustrated diagrammatically in FIGS. **2** and **3**. The primary cyclone **20** is provided with a gas outlet **22** and a solids and dirty liquid outlet **24** which

are connected to the production fluid outlet 14 by lines 26 and 28 and a line 30. The primary cyclone 20 differs from the usual cyclone in that it is provided at the top with an extra cylindrical section 32 connected to the lower section by a central duct 34. Liquid is discharged from the cylindrical section 32 tangentially through a clean liquid outlet 36.

With the foregoing construction, major portions of the gas and solids are removed so that the fluid discharged through the outlet 36 of the primary cyclone 20 consists of oil and water which are relatively gas and solids free.

The clean fluid from the outlet 36 enters the inlet 38 of a conventional three phase separator 40. The flow into the separator 40 is controlled by a float actuated valve 42 the float of which is in a storage tank 56 to be described. The separator 40 is provided with gas and water outlets 44 and 46 connected to a line 48 leading to the production fluid outlet 14. The water level in the separator 40 is controlled by a float actuated valve 50 controlling flow through the water outlet 46, the float of the valve 50 being in the separator. The oil phase leaves the separator 40 through a clean oil outlet 52 connected to the inlet 54 of a clean oil storage tank 56, the liquid level in the storage tank being controlled by the float actuated valve 42. The oil level in the separator 40 is controlled by a float actuated valve 58 the float of which is in the separator.

The foregoing combination of the primary cyclone 20 and the three phase separator 40 is one of the important features of the invention. The primary cyclone 20 disposes of most of the dirty liquid and the gas, discharging only relatively clean liquid into the separator 40. Also, the primary cyclone 20 achieves some degree of oil and water separation so that the water content of the oil entering the separator 40 is reduced. This results in a substantial reduction in the load on the separator 40, which means that the separator can operate much more effectively for a given capacity.

The storage tank 56 provides a reserve of clean power oil whenever the separator 40 runs out of oil due to a gas head from the well, or such well servicing operations as pumping the fluid operated pump in or out. The storage tank 56 has a power oil outlet 60 which is connected to the inlet of a circulating pump 62 having an outlet connected to the inlets 64 of three parallel connected, secondary cyclones 66. One of these is shown in some detail in FIG. 4, which also illustrates its characteristic mode of operation. The secondary cyclones 66 are provided at their lower ends with solids outlets 68 connected by a line 71 to the line 30 leading to the production fluid outlet 14.

The secondary cyclones 66 are provided at their upper ends with clean power oil outlets 70 connected to a line 72 leading to the inlet of a conventional triplex pump 74. The clean power oil outlets 70 of the secondary cyclones 66 are also connected to a bypass line 76 leading back to the storage tank inlet 54.

The outlet of the triplex 74 leads to a pressure controller 78 which determines the power oil pressure delivered to the power oil outlet 16 leading to the fluid operated pump in the well. Any excess power oil from the pressure controller 78 is returned to the storage tank 56 by a line 80 connected to the bypass line 76.

The capacity of the circulating pump 62 and the combined capacities of the secondary cyclones 66 are considerably greater than, and preferably about twice, the capacity of the triplex 74. Consequently, assuming, for example, a flow of 5,000 barrels per day through the secondary cyclones 66 and an output of 2,500 barrels per day by the triplex 74, 2,500 barrels of oil are returned to the storage tank 56 daily for further processing in the secondary cyclones. This constant recirculation of part of the clean power oil in the storage tank 56 through the secondary cyclones 66 results in the removal of further foreign matter from the power oil, thereby minimizing any residual foreign matter in the power oil delivered to the triplex 74, and ultimately to the fluid operated pump in the well. Thus, the storage tank 56 serves the additional function of permitting recirculation of the power oil through the secondary cyclones 66 for further cleaning, which is an important feature.

Another feature resides in the use of the parallel connected secondary cyclones 66, instead of a single larger cyclone. The smaller cyclones permit developing higher centrifugal forces, and thus better separation of contaminants.

Although an exemplary embodiment of the invention has been disclosed for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiment without departing from the spirit of the invention as defined by the claims appearing hereinafter.

I claim as my invention:

1. An apparatus for processing production fluid from an oil well in the field to obtain clean power oil for a fluid operated pump in the well, including:
   a. a production fluid inlet for production fluid from the well;
   b. a production fluid outlet connectible to a point of production fluid disposal;
   c. a power oil outlet connectible to the fluid operated pump in the well;
   d. a primary cyclone having an inlet connected to said production fluid inlet, having a gas outlet and a solids outlet connected to said production fluid outlet, and having a clean fluid outlet;
   f. a three phase separator connected to said clean fluid outlet of said primary cyclone, said separator having gas and water outlets connected to said production fluid outlet and having a clean oil outlet;
   g. a storage tank connected to said clean oil outlet of said separator;
   h. a secondary cyclone having an oil inlet, an oil outlet and a solids outlet, the latter being connected to said production fluid outlet;
   i. a circulating pump having an inlet connected to said storage tank, and having an outlet connected to said oil inlet of said secondary cyclone; and
   j. a triplex pump having an inlet connected to said oil outlet of said secondary cyclone, and having an outlet connected to said power oil outlet.

2. An apparatus according to claim 1 wherein said circulating pump has a capacity in excess of that of said triplex pump, and wherein there is a bypass from said oil outlet of said secondary cyclone back to said storage tank.

3. An apparatus according to claim 2 wherein the capacity of said circulating pump is of the order of twice that of said triplex pump.

4. An apparatus according to claim 3 wherein there are two or more of said secondary cyclones connected in parallel.

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