A single well servicing combination unit comprising: a hydraulic manifold removably connectable to the power-take-off of an external power source to drive a plurality of hydraulic pumps and motors that control a plurality of well servicing units mounted on said combination unit, said well servicing units being interconnectable by plumbing.
WELL SERVICING COMBINATION UNIT

FIELD

[0001] This invention rotates, generally, to the treatment of oil and gas wells using fluids to increase the production capability of the wells, and more specifically, to providing for treatment of oil and gas wells with a means and apparatus that combines multiple units—which may include: coiled tubing, nitrogen generation, fluid pumping, blending tanks, wireline inspection, and other units—into a single unit powered by an external source.

BACKGROUND

[0002] It is known in the art to use self-powered units to provide wireline inspection and workover operations using gaseous nitrogen to remove sand and/or water or other impediments to production of oil and gas wells. The prior art has not recognized that a single, relatively small, engineless unit requiring minimal set-up/take-down time can be provided with all of the equipment and accessories for tapping into an onsite power source to run a combined and integrated system that may include one or more of the following: coiled tubing unit, nitrogen generator, fluid pumps, blending tanks, and wireline inspection unit, or other units.

[0003] The prior art equivalent typically brings as many as five transportation units (tractor-trailers, barges, or boats) to the well to be treated, one having a coil tubing unit; one having either a liquid nitrogen tank or a large footprint nitrogen generation unit; one having the nitrogen pumping unit; one high pressure pumping unit for acids and other chemicals; and a separate wireline unit. Alternatively, the prior art may have a very large boat or barge with multiple units, each with its own power source. Separate, dedicated power sources for each unit drastically increases the mass and volume that must be transported. Current power packs are horsepower limited, which limits the equipment that can drive. Conventionally, each of the five units above has its own engine. Even with a hydraulic power manifold to drive multiple units from a single engine, the horsepower limits how many can be integrated. The requirement for multiple (or much larger) transportation units increases the transportation costs, time, and personnel required to bring the units to the well and run these services.

[0004] U.S. Provisional Patent application 60/699,759, by the present inventors, teaches a single, relatively small, self-powered unit with all of the equipment and accessories for running a nitrogen generation system and pressure pumping chemicals to treat wells.

[0005] U.S. Pat. No. 6,230,805 (Vercaemer) teaches a method of hydraulic fracturing in which at least two separate fracturing fluid components are pumped downhole—one of said components being pumped downhole within coiled tubing—but does not teach how to accomplish this with a single compact unit in which all equipment is powered by an onsite engine and that also provides for the coil tubing operation and wireline inspection.

[0006] U.S. Pat. No. 6,273,188 (McCafferty) teaches a trailer mounted coiled tubing rig.

[0007] U.S. Pat. No. 6,702,011, also by the present inventors, teaches a combined nitrogen treatment system and coiled tubing system in one tractor/trailer apparatus. A single tractor-trailer unit is provided, in which the tractor itself drives a plurality of hydraulic motors that control the pumps and motors associated with a nitrogen system that is used for injecting nitrogen into a well. A crane unit and a coiled tubing injection unit are also provided. Unlike the present invention, no disclosure is made for the provision of wireline inspection, well servicing fluid tanks, mixers, and pumps. Unlike the present invention, the preferred type of nitrogen system is tanks of liquid nitrogen, although an alternative mode is disclosed in which the liquid nitrogen system is replaced with one or more nitrogen generators that gather nitrogen from the earth’s atmosphere. However, it was not disclosed, as in the present invention, that the nitrogen could be mixed with well servicing fluids provided by the same unit.

[0008] PCT Application US2004/034521, also by the present inventors, teaches a three-in-one nitrogen treatment system, fluid system, and coiled tubing system in one unit. A single tractor-trailer or marine unit is provided, but unlike the engineless present invention, an onboard engine drives a plurality of hydraulic motors that control the pumps and motors associated with a nitrogen system and a fluid system that is used for injecting nitrogen and fluid into a well. Like the present invention, a coil tubing system is also provided. The only means disclosed for pumping fluid to the well is through the coil tubing system and no disclosure is made for the injection of well servicing fluids directly into the well, and no fluid blending tank is disclosed. Also, no means for wireline inspection is provided.

[0009] The off-shore prior-art that has the same functionality as the present invention is larger, more expensive, and requires either multiple barges or ships—necessitating additional time and expense for set up and take down of ship to ship plumbing—or a larger, more expensive barge or ship that has a deeper draft and can therefore depart from and reach fewer locations.

[0010] The primary object of this present invention is to provide a small engineless unit that can be placed on a single small barge or ship or a single tractor-trailer or marsh buggy and use an onsite power supply to provide wireline inspection, coil tubing operations, and nitrogen generation and pump a combination of high pressure nitrogen and acids or other chemicals into wells. The configuration of the present invention on a marsh buggy could be nearly identical to the configuration on a boat or barge. Combination of multiple units such as a wireline, coil tubing unit, nitrogen generator with fluid pumping and mixing on a single transportation unit and all powered by an external power source through an angle on board custom hydraulic manifold is not known in the prior art to the best of the inventor’s knowledge.

SUMMARY OF THE INVENTION

[0011] A single small engineless well servicing unit comprising:

[0012] a custom hydraulic manifold removably connectable to an onsite power source to drive a plurality of hydraulic motors, which control several of the following as well as other units:

[0013] a wireline inspection unit;
[0014] a coil tubing unit;
[0015] an injector;
[0016] one or more nitrogen generators that gather nitrogen from the earth’s atmosphere;
[0017] an acid pump;
[0018] high pressure pumps;
[0019] acid tanks;
[0020] blending tanks;
a combination nitrogen and fluid pumping unit; and
other pumps and motors associated with oilfield services that require pressure pumping of various chemicals down a well—said pumps, motors, tanks, nitrogen generator(s), and coil tubing being interconnectable by plumbing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view diagram of the lay out of a 105 class jack-up boat with a custom hydraulic manifold, wireline inspection unit, coil tubing equipment, crane, mixing tank, storage tank, fluid pump with power pack, operator console, and nitrogen generation equipment;

FIG. 2 is an elevated, block diagram side view of the deck of the boat from FIG. 1, that shows nitrogen generation equipment that is connected to the discharge line at a tee, and storage, mixing, and pumping equipment for well servicing fluid connected to said discharge line at said tee;

FIG. 3 illustrates, in block diagram, the various systems that are used in accordance with the present invention to treat a well with nitrogen and well servicing fluid;

FIG. 4 is a pictorial view of three nitrogen generators; and

FIG. 5 is a pictorial view of membrane technology used to pull gaseous nitrogen out of the atmosphere.

DETAILED DESCRIPTION OF THE PREFERRED MODE OF THE INVENTION

Referring now to FIG. 1, a top view of a jack-up boat 10 having either a gasoline engine or a diesel engine is illustrated. Mounted on the boat deck 30 is nitrogen generator 31 (also shown in FIG. 4) that extracts nitrogen from the atmosphere to eliminate the need for (and the associated cost of) transporting and filling nitrogen tanks. Mounted to boat deck 30 are chemical storage tanks 42 that supply chemicals to blending tanks 50 where the chemicals are mixed. The mixed chemicals flow to the well servicing fluid pump 48. The mixed chemicals may flow through the coil tubing 82, 50 to the well head. Wireline inspection unit 52 is mounted to deck 30. Also mounted on the deck 30 is control cabin 34 in which the electrical and hydraulic units 36 are controlled by a human operator. Components are described in greater detail in the description of FIG. 2 below.

Referring now to FIG. 2, a diagram of a jack-up boat 10 is illustrated. Mounted on the boat deck 30 is a custom hydraulic manifold 70 that distributes power from an external power source 200 to all engineless units on deck 30—nitrogen air feed system 32, injector 44, crane 46, well servicing pump 48, blending tanks 50, and Wireline 52. Mounted on deck 30 is a feed air system 32 that is connected to nitrogen membranes 33. Together, the feed air system 32 and nitrogen membranes 33 function as a nitrogen generator 31 (also shown in FIG. 4) that extracts nitrogen from the atmosphere to eliminate the need for (and the associated cost of) transporting and filling nitrogen tanks. In the preferred embodiment, nitrogen generator 31 utilizes a membrane 33 (also shown in detail in FIG. 5) that allows nitrogen-rich air from the earth’s atmosphere to be continuously fed into bundle housing. The air reaches the center of the bundle of membrane fibers which, at that point, consists mostly of gaseous nitrogen. The nitrogen collects in the mandrel at the center of the bundle. As the air passes through the bundle of membrane fibers, the oxygen and other fast gases pass through the wall of the membrane fibers as the fast gases go through to be collected at the end. Oxygen, water vapor, and the other fast gases are continuously collected and are moved from the bundle, thus leaving the nitrogen available to be used for injection into the well being treated. This occurs at near ambient pressure and temperature. It is an advantage of this embodiment that large volumes of nitrogen can be provided at the well site to be pumped into the well, without the need to transport that entire volume in either liquid or gaseous form to the well site. The nitrogen generators 31 of the preferred embodiment accomplish this nitrogen generation with a smaller footprint than any prior art the inventor knows. The nitrogen then flows to the nitrogen booster compressor 38 that then compresses the dry nitrogen to the desired pressure. The nitrogen will then be pumped to the tee 39 where it mixes with a fluid or a fluid mix, such as an acid, and then the resulting mixture enters the discharge line 41. The nitrogen in the discharge line may be either liquid or gas. Mounted to boat deck 30 are chemical storage tanks 42 that supply chemicals to blending tanks 50 where the chemicals are mixed. The mixed chemicals flow first to the centrifugal pump 47 and then to the well servicing fluid pump 48. The mixed chemicals flow to the tee 39 where the mixed chemicals mix with nitrogen and the resulting mixture flows into the discharge line 41. From the discharge line 41 the resulting mixture can flow directly to the well head or through the coil tubing 55 to the well head. An injector unit 44, also described in more detail hereinafter, is situated on the boat deck. A hydraulically driven crane 46 is also situated on the boat deck for situating the coil tubing injector 44 immediately above the well being treated. A hose reel 45 and a coil tubing reel 55 are situated on the deck 30. A gooseneck 53 is also situated on the deck 30 adjacent the coil tubing injector system 44 for feeding the coil tubing from the reel into the injector. A stripper 54 is located on the lower end of the coil tubing injector system 44 for enabling the coil tubing 55 to be placed into the well being treated. A blow out preventer unit 56 is also located on the boat deck to be used in shutting in the well to be treated, if needed. Wireline inspection unit 52 is mounted to deck 30. Also mounted on the deck 30 is a control cabin 34 in which the electrical 36 (not shown) and hydraulic units 70 are controlled by a human operator.

Referring now to FIG. 3, there is illustrated in block diagram some of the components that are illustrated in FIGS. 1 and 2.

The nitrogen air feed system 32 has its output connected into the input of a hydraulic pump 90. The custom hydraulic manifold 70, which may be connected to either a gasoline powered or diesel powered external power source 200, has a return line 74. A hydraulic pump 90 is connected into a hydraulic motor 92 that is used to drive the return line 74.

A hydraulic pump 96 is connected into a hydraulic motor 98 that is used to drive the chains of the injector 44 that can either move the coil tubing into the well being treated or pull the coil tubing out of the well being treated, as desired, depending on the direction of the chain rotation.

Another hydraulic pump 100 drives a motor 102 to drive the crane 46 illustrated in FIG. 2.

Another hydraulic pump 110 drives a motor 112 to power the well servicing pump 48, which is illustrated in FIG. 2.

Another hydraulic pump 116 drives a motor 118 to power the blending tanks 50, which are illustrated in FIG. 2.
Another hydraulic pump 122 drives a motor 124 to power the wireline inspection unit 52, which is illustrated in FIG. 2. It should be appreciated that from the power-take-off of an onsite power source 200, a custom hydraulic manifold distributes power to each of the five units. Said external power source with a power-take-off of 200 routed through custom hydraulic manifold 70 drives each of the hydraulic pumps 90, 96, 100, 116 and 122 as shown by the line 106. Coming off of the custom hydraulic manifold 70, the hydraulic pumps 90, 96, 100, 116 and 122 are preferably driven by one or more belts that can be used with clutch pulleys as desired. The compressor unit 108 is also driven by the custom hydraulic manifold 70 via the drive line 106 to bring the nitrogen down to its desired temperature. By using a power-take-off on the vessel (rig, platform, work boat, tug boat, or jack up barge) that is already on site, that power source 200, with over 1000 horsepower available, can drive more machines than a less powerful onboard source could.

The preferred embodiment of the present invention can operate with a separate land or marine external power source. As long as the preferred embodiment of the present invention can avail itself of an adequate external power source it can do all of the following well servicing, including but not limited to:

- Completions
- Workovers
- Underbalanced drilling
- Well servicing
- Enhanced oil recovery
- Industrial plant degassing and purging
- Mining
- Purging pipelines with nitrogen
- Deepwater marine applications
- LNG & LPG tanks and facilities
- Nitrogen lifting, the flooding webs that won’t flow with nitrogen

Nitrified Acid
Nitrogen Displacement
Pipeline testing
Tubing testing
Acidizing
Cleanouts
Fix sanding up
Paraffins
Foam wash
Jet with nitrogen
Nitrify acid
Nitrogen inhibitor
Wireline inspection

One advantage of the present invention is that it makes it possible to do with one unit and an onsite power source what previously required five separate powered units—a wireline inspection unit, a coiled tubing unit, a liquid nitrogen tank transport means, a powered unit with a high pressure pumping system for other chemicals and acids, and a unit with a nitrogen pumping means. Because this embodiment allows one unit to do what once required several powered units connected together with the requisite hoses and plumbing, the time and expense of plumbing rig-up is avoided. Disconnecting and stowing all of the plumbing after completion is also avoided, saving additional time and labor. Where the prior art would have taken several units and several days for set-up, inspection, well treatment, and disassembly, the preferred embodiment of the present invention can do the same job with one unit in one day. The present invention saves the trouble and expense of transporting five separate power sources to the site, each of which takes up over sixty square feet of deck space, allowing tins combined unit to be smaller and cheaper than any prior art equivalent. The smallest existing vessel with a coil tubing unit is a 175 class boat, yet an embodiment of the present invention with an integrated coil tubing unit along with four other integrated units can be placed on a single 105 class boat. The deck load of the prior art equivalent would be about 150,000 pounds, yet an embodiment of the present invention has a deck load of only about 50,000 pounds, allowing operations in shallower water. The danger of transporting liquid nitrogen, which is an explosion hazard, is also avoided. Hazards associated with running plumbing and hoses from boat to boat are also avoided, and fewer personnel are required. As far as the inventor knows, the preferred embodiment of the present invention has a smaller footprint and lighter weight than any functional equivalent.

The preferred embodiment of the present invention is even more advantageous in remote locations where liquid nitrogen is rare and expensive, or extremely difficult to transport to the well head.

The invention is well suited for offshore use. Because of its small footprint, this invention allows replacement of large, expensive vessels with much smaller and cheaper barges or ships that have shallower drafts. An embodiment of the present invention may also be trailer on land, to replace as many as five separate units and realize similar time and cost savings.

Although the present invention has been described by reference to its preferred embodiment as is disclosed in the specification and drawings above, many more embodiments of the present invention are possible without departing from the invention. Thus, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A single, well servicing combination unit comprising: a hydraulic manifold removably connectable to the power-take-off of an external power source to drive a plurality of hydraulic pumps and motors that control a plurality of well servicing units mounted on said combination unit, said well servicing units being interconnectable by plumbing.

2. The combination unit according to claim 1, wherein said well servicing units comprise:
   i. a wireline inspection unit;
   ii. a coiled tubing unit;
   iii. a nitrogen source;
   iv. a unit pump; and
   v. a blending tank;
   said blending tank, unit pump, nitrogen source, coil tubing unit, and wireline inspection unit being interconnectable by plumbing.

3. The combination unit according to claim 1, wherein said well servicing unit comprise: a nitrogen source; and a coil tubing unit; said nitrogen source and coil tubing unit being interconnectable plumbing.

4. The combination unit according to claim 3, further comprising a high pressure pump, said nitrogen source, coil tubing unit, and high pressure pump being interconnectable by plumbing.
5. The combination unit according to claim 3, wherein said nitrogen source comprises a nitrogen generator that gathers nitrogen from the earth’s atmosphere and wherein said combination unit further comprises a compressor connectable by plumbing to said nitrogen generator.

6. The combination unit according to claim 3, wherein said nitrogen source comprises a tank of compressed nitrogen gas.

7. The combination unit according to claim 3, wherein said nitrogen source comprises a tank of liquid nitrogen.

8. The combination unit according to claim 2, wherein said unit pump is a high pressure pump.

9. The combination unit according to claim 2, wherein said unit pump is a well servicing pump.

10. The combination unit according to claim 1, wherein said well servicing units comprise: a wireline inspection unit; and a coiled tubing unit; said wireline inspection unit and said coiled tubing unit being interconnectable by plumbing.

11. The combination unit according to claim 1, wherein said well servicing units comprise: a high pressure pump; and a blending tank; said high pressure pump and blending tank being interconnectable by plumbing.

12. The combination unit according to claim 11, further comprising a crane, said blending tank, high pressure pump and crane being interconnectable by plumbing.

13. The combination unit according to claim 2, further comprising an acid pump and an acid tank that is connectable by plumbing to said blending tank and said coiled tubing unit, wherein said hydraulic manifold is removably connectable to said power-take-off of said external power source to also drive hydraulic pumps and motors that control said acid pump.

14. The combination unit according to claim 1, wherein said well servicing units comprise: a coil tubing unit and at least one other well servicing unit; said coil tubing unit and other well servicing unit being interconnectable by plumbing.

15. The combination unit according to claim 1, wherein said well servicing units comprise: a wireline inspection unit; and at least one other well servicing unit said wireline inspection unit and other well servicing unit being interconnectable by plumbing.

16. The combination unit according to claim 2, further comprising a combination nitrogen and high pressure pump that is connectable by plumbing to said blending tank and said coil tubing unit, wherein said hydraulic manifold is removably connectable to the power-take-off of said external power source to also drive hydraulic pumps and motors that control said combination nitrogen and high pressure pump.

17. The combination unit according to claim 1, wherein said well servicing units comprise: a reel of coiled tubing for introducing well treatment fluid into a well; and an injector that can advance said coiled tubing into a wellbore.

18. The combination unit according to claim 1, wherein said well servicing units comprise a coiled tubing injector and a crane for picking up and lowering said coiled tubing injector.

19. The combination unit according to claim 1, further comprising an operator’s console whereby said motors and pumps may be controlled by an operator.

20. The combination unit according to claim 1, wherein said combination unit comprises a barge or marine vessel.

21. The combination unit according to claim 20, further comprising a marine engine connectable to said power take-off.

22. The combination unit according to claim 21, wherein said marine engine is skid mounted and portable.

23. The combination unit according to claim 1, wherein said combination unit comprises a trailer.

24. The combination unit according to claim 1, wherein said combination unit comprises a skid.

25. The combination unit according to claim 1, wherein said external power source comprises a truck engine.

26. The combination unit according to claim 25, wherein said truck engine is skid mounted and portable.

27. The combination unit according to claim 1, wherein said combination unit is engineless.

28. The combination unit according to claim 1, wherein at least one of said well servicing units is removably connectable to said combination unit.

29. The combination unit according to claim 28, wherein said removably connectable well servicing unit can be replaced with another well servicing unit that is removably connectable to said combination unit.

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