

Installation & Operation Of Submergible Pumps

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DESCRIPTION

General

A Reda pump is essentially a multistage centrifugal pump, the shaft of which is directly connected through a protector section to a submergible electric motor. The entire assembly, as a unit, is of such outside diameter that it can be installed in wells completed with standard size casing. In operating position, the unit is suspended on tubing, submerged in the well fluid, with a cable from the surface supplying electricity to the motor. The installation may be for any depth since the unit is designed to function under any submergence pressures encountered. The installation is illustrated in Fig. 1. The cross section of the assembled unit is illustrated in Fig. 2.

Pump

The Reda multistage centrifugal pump is manufactured in a wide range of capacities to provide the desired head

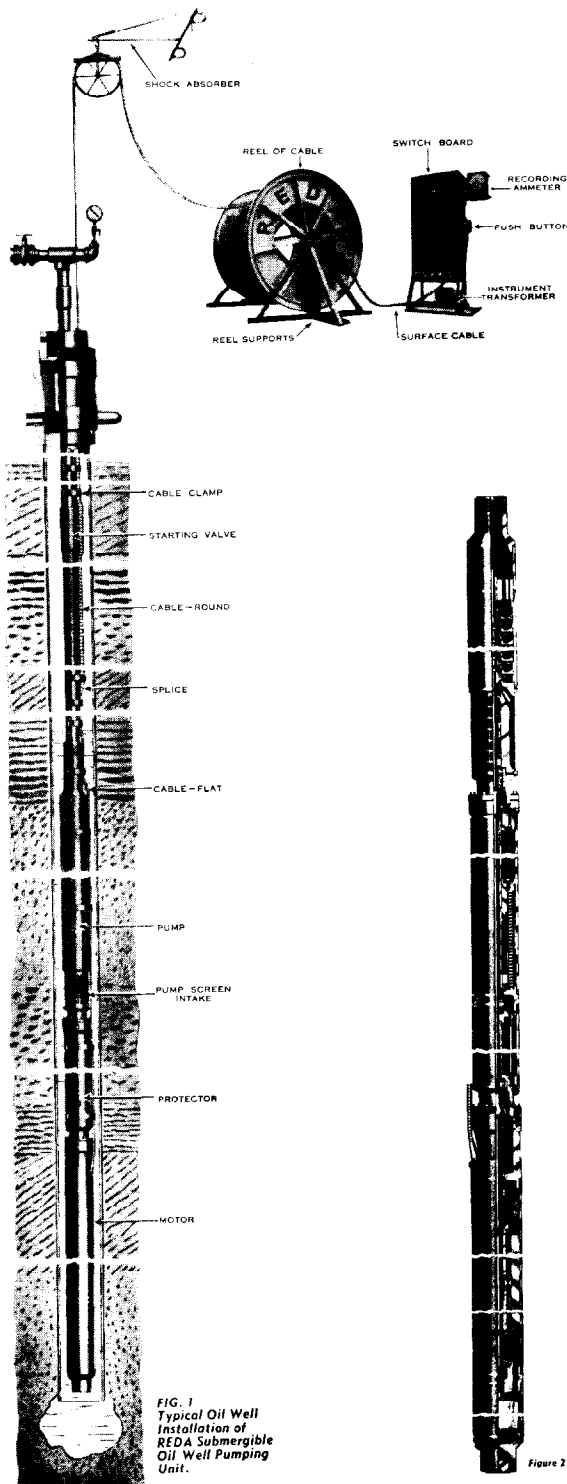
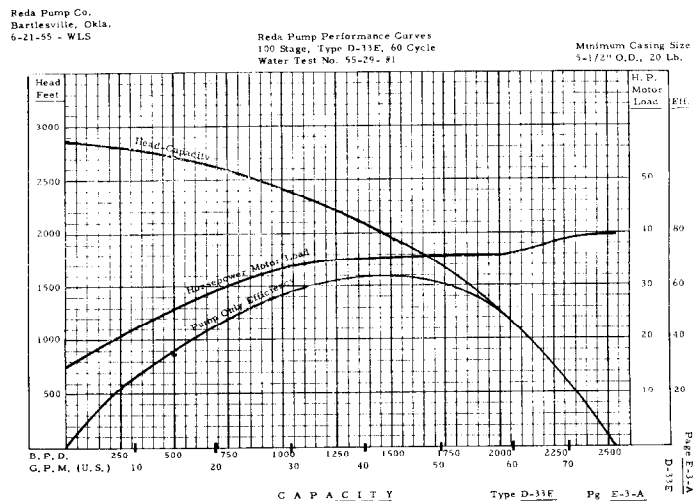
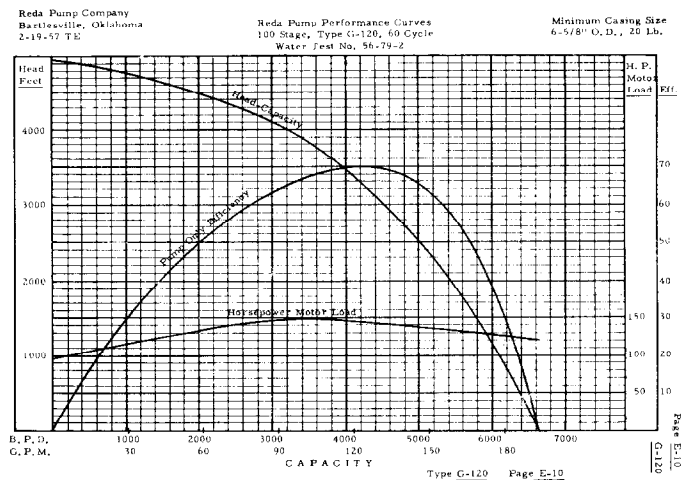


FIG. 1
Typical Oil Well
Installation of
REDA Submergible
Oil Well Pumping
Unit.



Figure 2



capacity in each particular installation. The pump section consists of a series of stages, each composed of an impeller and diffuser, keyed to the pump shaft. This shaft is close-coupled through the protector section to the motor.

The characteristics of a centrifugal pump are quite different from those of a reciprocating or positive displacement pump — its capacity varies inversely with the head (feet of lift or pounds per square inch of pressure). This is shown by the head-capacity curve in Figs. 3 and 4. (100 Stage G-120 and D-33E).

The above curves are for two different capacity pumps. These are but two of the 17 pump designs for capacities from 300 B.P.D. to 20,000 B.P.D. From curves such as these it is possible to calculate the head value of one stage at a given producing rate. When the required head is known, the number of stages can be determined for a pump to meet the head capacity requirements.

Protector

The protector section, located between the pump and the motor, serves to equalize internal pressure in the motor with submergence pressure in the well. A tandem arrangement of two oil chambers, each containing a mechanical seal, serves to exclude well fluid from the motor while permitting expansion and contraction of the motor oil due to the alternate heating and cooling of the motor.

Motor

The submergible motor is of the squirrel cage induction type which was designed and developed by Reda. It is filled with a special dielectric oil to insure lubrication and proper cooling and operates at approximately 3450 revolutions per minute. Reda Pump Co. is the only company that has built submergible electric motors for oil wells for the past 30 years. Even now, Reda is the only company that manufactures electrical motors of higher horsepower for oil wells. Reda electrical motor horsepower ratings are controlled by casing sizes as shown below.

	<u>Single Motors</u>	<u>Tandem Motors</u>
4-1/2" O.D. Casing	21.5 H. P.	64.5 H. P.
5-1/2" O.D. Casing	59.5 H. P.	119 H. P.
7" O.D. Casing	150 H. P.	300 H. P.
8-5/8" O.D. Casing	240 H. P.	480 H. P.

Cable

The electric cable supplying power to the pump motor assembly is manufactured in various sizes. It is oil and water resistant and capable of operating under the most severe well conditions. Mechanical protection is provided by interlocking steel, bronze or monel, as dictated by the corrosive aspects of the well fluid. The cable is clamped to the tubing at approximately 15 foot intervals during the installation and is available for temperatures up to 250 degrees Fahrenheit.

Switchboards and Controls

The controls vary from simple pushbutton magnetic contactors with overload protection to switchboard assemblies with devices such as fused disconnects, recording ammeters, undervoltage and overload protection, signal lights, timers for intermittent pumping and instruments for automatic remote control operation.

The more simple controls are for 440-volt operation and may be equipped for 550 volts. Accessories include

undercurrent relay, automatic restart, float switch operation and recording ammeter. For operating voltages between 762 and 880 volts, a 60-ampere switchboard is available. This has no voltage protection and is equipped with a fused disconnect switch. Recording ammeter and automatic controls can be added if required.

Larger switchboards are available for voltages up to 1000, 1100 and 2300 volts — all with automatic controls, disconnect switch, undercurrent, overcurrent and undervoltage protection, and recording ammeter.

Power Sources

The common source of electric energy is the utility power company, but in remote locations electric power may be generated on location. Engine generators of various capacities are available on a rental basis for testing the productivity of wells or for permanent installations where commercial power is not easily obtained.

Auto transformers, capable of operating with motors as large as 80 H. P., are being used where a power source of 440 to 480 volts is available. Where the primary power is 2400, 4160 or 13,200 volts, large outdoor type transformers are being used.

SERVICE INFORMATION

The majority of Reda installations operate on a constant 24 hour pumping schedule. The routine of this operation takes very little of the pumper's time or attention — changing the ammeter charts once a day is usually all that is required.

Frequently a light is installed at the well to visually inform the operator at a distance that the pump is operating, saving him unnecessary trips for checking the performance.

Should interruptions in operation occur due to power failure or other causes, certain precautions should be observed before restarting the unit.

Check Valve

In nearly all cases a check valve is installed in the tubing string just above the pumping unit to prevent fluid from draining back through the pump. Occasionally a check valve may fail to hold due to the presence of foreign material or where installations have not included a check valve. Then, where switchboards are equipped with automatic controls, the time clock should be set so that sufficient time is allowed for the tubing to drain and for the motor to come to a stop from revolving in reverse direction before restarting.

Use of a Nonautomatic Switchboard

When a hand-operated, nonautomatic switchboard is used, the tubing should be checked before attempting to start the unit after a short time interval. This may be done by opening the tubing bleeder and checking for suction to indicate the tubing is still draining. Generally a down time of two minutes per thousand feet of pump setting should be satisfactory.

Reduction of Capacity

In some applications, as in water supply wells for water-floods, the daily pump capacity may be in excess of the daily requirements. This may be controlled by one of these two methods:

1. Intermittent operation by using a float switch in the storage pond or tank.
2. Time clock control.

As an alternate, a high pressure valve and a gauge may be employed to impose back pressure on the tubing. The flow may be decreased or increased by varying this pressure. This method is less efficient from the view of power consumed for work done than the methods previously cited.

When operating in this manner, the pumping unit should not be restricted to less than about 70 per cent of its nominal rated capacity. Reduction of flow beyond this point may cause increased rate of wear in the pump due to down-thrust. In such a situation, a smaller pump of the desired capacity should be installed.

Gas Conditions

Some wells, either oil or water, may evolve sufficient quantities of gas at the pump screen to interfere with the pump capacity or cause a gas lock. When gas is known to be present, a separator is provided in the base of the pump which effectively separates large amounts of gas from the well fluid, enabling the pump to produce at or near its volumetric rating.

Most switchboards are equipped with an underload shut-down device which will stop the pumping unit when a pump-off occurs. The time clock setting can then provide a sufficient down-time interval to let more fluid accumulate in the well and to permit the gas to escape.

SWITCHBOARD AND CONTROL PANEL OPERATION

Most installations of 70 H. P. or more use the 100 ampere automatic board that is equipped with overload and underload relays, recording ammeter and restart panel.

There are four external switch controls:

1. The lever hand switch on the door face (M-100 type switchboard) opens and closes the main service circuit. It also acts as a safety switch by not permitting the door to be opened while the switch is closed.
2. At the right of the control panel is an off-on switch that energizes the control system.
3. Directly over the above switch is a push-button starter. This is for hand starting and energizes the magnetic relays on the motor starter.
4. The timer restart can be set to restart the unit at any interval from five minutes to five hours after shutdown. An underload cutout relay at the base of the control panel is set to cut out the motor starter when the electric load drops below a certain point. This occurs when a well pumps off or when the pump gas-locks. In either case the re-starter begins to function immediately after the shutdown occurs, restarting the unit on the time interval for which it is set.

If delayed start is not desired, the push-button starter may be used and the timer relay is cut out of the circuit.

Overload Relays

Overload relays are designed to open the motor starter as protection against current overload, some causes of which are listed below.

1. Pump drag due to sanding up
2. Short circuit or burned cable
3. Burned Motor
4. Single phase on power supply due to a single power transformer or fuse burning — a broken power line will have the same result.

Restarting the Control

Once the unit shuts down on overload, it remains shut down until someone checks the unit to determine the cause of stoppage. When a manual switchboard is used, a set of fuses, in addition to the usual overload relays, protects against overload.

In case of trouble with either the automatic or manual control, the operator should not attempt to start the unit by push - button more than once. If it does not start on the first try, a service engineer should be called.

TROUBLE CAUSES

Two sources of trouble, which are quite uncommon, can be recognized with little study. One is a tubing leak, the other is a casing leak from a water zone above the pump. The former results in a decrease in the volume of flow at the surface and, generally, an increase of the amperage on the recording ammeter. The latter will cause an increase in the total volume, the percent of water, and the amperage.

In either of the above situations remedial measures should be taken to correct the trouble, as both contribute to loss of production and high operating costs.

SUMMARY

By being the most powerful pumping equipment for any given size of casing, Reda submergible electrical centrifugal pumps for the oil industry have found worldwide acceptance because from decades of actual experience they have proved to be the best buy, not only in the first cost which is low, but also the best buy in operating cost.