Automatic Custody Transfer Equipment

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INTRODUCTION

Automatic Custody Transfer is the transfer of oil from the producer's lease to the pipeline. The oil is automatically transferred from the producer's lease storage equipment into a unit that will accomplish the following:

1) After any given quantity of oil is produced in the stock tank, the unit automatically starts a transfer pump and moves the oil from the stock tank into the pipeline, then automatically stops the transfer of oil.
2) The unit will automatically take a sample of the oil that has been transferred to the pipeline and store this oil in a tamper-proof container, so at a later date the API gravity and quality of the BS&W content can be assigned to the quantity of oil sold.
3) The unit will measure the quantity of oil transferred from the producer to the pipeline.

A lease that is to be equipped with an automatic custody transfer unit must be studied to determine all of the possible producing conditions, treating, and storage. ACT equipment is being installed on large and small producing leases, and the accessories used in this equipment range from the minimum unit (pump - meter - sampler) to elaborate units that tie into the complete automation of the lease.

POSITIVE DISPLACEMENT METER UNIT

A typical ACT unit known as the "Positive Displacement Meter Unit" is pictured in Figure 1. The components that make up this unit are:

Pump and Motor

When sizing the pump and motor, the quantity of oil to be shipped per day, the allowable time of day available to ship to the pipeline, and the pipeline pressure and power requirements of the motor must be determined.

Strainer

On strainer size selection, manufacturers' rates and mesh size should be taken into consideration.

Deareator

The deareator is optional equipment on some units, but this component may be required by the pipeline. It is used on a unit where there is the possibility of entrained gas which would cause a malfunction of the monitor or meter system.

Sampler & Container

Attachments on the meter will actuate the sampler a given number of times per barrel, and incorporated in the sampler is a volume regulator. Considerable experimenting has been carried on to determine the best placement of the sample probe, the design of the probe, the sample system, and the storage container. The sample probe should be mounted in a vertical run of pipe and extend into the center of flow, cut on a 45° angle to the angle of flow. The sample pump should have a fresh representative sample flowing to it at all times, for the larger volume of sample taken, the closer the gravity will be, to that actually run to the pipeline.

BS&W Monitor & Probe

This electronic device is placed next in line on the unit and automatically gauges the "quality" of the oil being sold to the pipeline. The general monitor is not a recording device, but merely a gauge that "checks" the oil. The principal of operation is that of measuring the capacitance of the fluid passing the probe. The capacitance of oil or water is known. The percentage of either in the mixture will produce a different capacitance. If the percentage of water becomes excessive the monitor will detect this fluid and cause the unit to divert the oil being sold back to the tank battery.

Diverting Valve

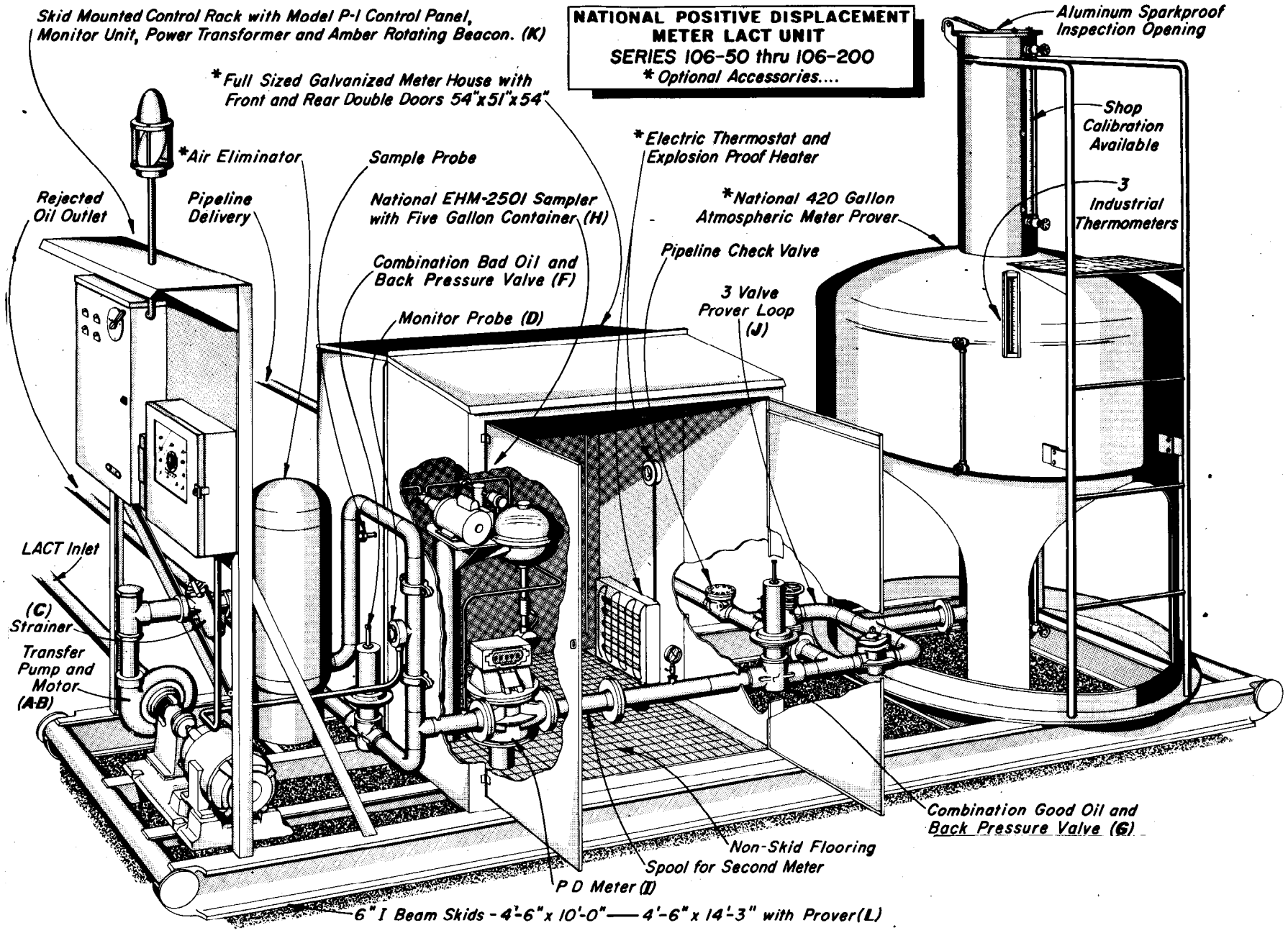
This valve is located downstream from the monitor probe and ahead of the meter; and its purpose is to divert the flow of oil back to the tank battery if the quality of the oil flowing past the probe should be below pipeline specifications. This valve diverts the oil before it passes through the meter; the valve is actuated by any means from a signal from the monitor. A 3-way 2-position valve or a 2-way valve, used with a positive lock-in back pressure valve, is suitable for this service. Valve size and pressure drop should also be considered.

Positive Displacement Meter

The rotary type meter is the component that measures and records the quantity of oil shipped. All the operating conditions -- flow rate, temperature compensation, working pressure and other specifications of the manufacturer -- must be met to get the maximum accuracy and service life from the meter. The meter can be equipped with all iron trim and a coating to retard corrosion and can be equipped with a temperature compensator (so the counter will read net barrels) or a counter with a temperature recorder. The meter must also be equipped with an impulse switch that will signal the sampler to take a sample and that can also be used to signal a "meter monitor" which is a system of components that insures that the meter is working properly. If anything in the meter should fail, the meter monitor will shut the ACT Unit down; thus this monitor is protection both to the operator and the pipeline. The impulse switch is also connected to a counter so that any quantity of oil can be sold; then the unit is automatically shut down. This counter is called the "allowable counter" and is wired in connection with the transfer pump. The meter can be also equipped with a counter and printer that would print a run ticket.

Back Pressure Valve

To insure meter accuracy this valve is used to hold a constant back pressure on the meter. The valve can also be used with a positive lock-out from the monitor to insure that no oil is sold below pipeline quality.


NATIONAL POSITIVE DISPLACEMENT METER LACT UNIT
SERIES 106-50 thru 106-200
* Optional Accessories....
Skid Mounted Control Rack with Model P-1 Control Panel, Monitor Unit, Power Transformer and Amber Rotating Beacon. (K)
* Full Sized Galvanized Meter House with Front and Rear Double Doors 54"x51"x54"
*Air Eliminator
Sample Probe
* Electric Thermostat and Explosion Proof Heater
Aluminum Sparkproof Inspection Opening
Shop Calibration Available
3 Industrial Thermometers
Rejected Oil Outlet
Pipeline Delivery
National EHM-2501 Sampler with Five Gallon Container (H)
*National 420 Gallon Atmospheric Meter Prover
Pipeline Check Valve
Combination Bad Oil and Back Pressure Valve (F)
3 Valve Prover Loop (J)
Monitor Probe (D)
LACT Inlet
(C) Strainer
Transfer Pump and Motor (A-B)
Combination Good Oil and Back Pressure Valve (G)
Non-Skid Flooring
Spool for Second Meter
P D Meter (I)
6" I Beam Skids - 4'-6"x 10'-0" — 4'-6" x 14'-3" with Prover(L)

Prover Connection

Connections and valves are put on the ACT Unit for the convenience of proving the meter. An acceptable method uses a calibrated master meter which has been proved into an API prover tank and a meter factor established for that meter on that type crude. As illustrated in Figure 1, the ACT Unit can be equipped with an API prover tank of 5, 10, 20, etc., bbl capacities. Each ACT meter must be periodically proved by an accepted proving method, and a meter factor for the ACT meter must be established and used to determine the correct amount of oil sold. The components of the ACT Unit are coupled together to make a complete automatic unit and are packaged on a skid for easy economical installation.

Panel

The control system houses all the power, motor starters, relays, monitoring systems that make the unit an automatic package. By a system of lights the panel should tell the operator exactly what the unit is doing. Frequently the unit will shut itself off and without lights the operator not being able to detect the trouble will manually operate the controls, but by a system of indicating lights the operator can determine the operation of the unit. The minimum indicating lights which a system should have should indicate (1) allowable made (2) meter failure (3) bad oil, and (4) high pipeline pressure.

Pre-Installation Study

The foregoing describes what would be considered an ACT PD Unit. However, before installing ACT the following lease producing characteristics must be studied: the allowable of the lease, the storage that must be used for weathering, bad oil storage, a recirculation system, and the use of controls to start and stop the ACT Unit. Sufficient storage must be provided to handle the crude in the event of bad oil, a malfunction of the ACT Unit, or pipeline failure. If storage is not provided then automatic controls must, in connection with the ACT Unit, be used to automatically shut in the lease until such time as the system is again ready to receive oil.

TANK BATTERIES

The two illustrated tank batteries are set up for automatic custody transfer, with the accessory controls and a PVM (positive volume meter units).

ACT TANK BATTERY

The lease is produced to the tank battery which includes the well header, the treating system, the run tank, the ACT unit and the accessories (Fig. 2).

The Treater

The treater must be sized to handle the normal production rate of the daily allowable of the wells. The treater must also have enough treating capacity to handle a given volume of oil that would be circulated back to the treating system; on large leases a separate treater is used to clean up the bad oil.

The Run Tank

As illustrated this run tank serves a multi-purpose. The lower portion of the tank is equipped with a probe that will detect the build up of BS&W in the bottom of the tank and that will automatically start the circulation pump to clean up the tank bottom. Located in the lower portion of the tank is a monitor system, while the inlet of the probe is below the oil outlet to the ACT system. Before bad oil could get as high as the ACT outlet the monitor would cause the ACT system to lock out and start the circulation pump to clean up the tank. If the oil is not of pipeline quality the oil is continuously circulated back through the treating system until the monitor shows good oil. Above the ACT outlet are the start-stop level controls of the ACT Unit; and between these levels sufficient quantity of oil is collected to allow pipeline schedules or sell enough oil to make a run. Normal runs are 50 to 500 bbl.

Between the ACT start level control and the full capacity of the run tank, room is left to allow a time for the lease to continue to produce while the bad oil is being circulated through the treating system. However, after a time of circulation and normal production, if the oil has not cleaned up, the fluid level will reach the high-level lease shut-in control. This high level control will close the lease shut-in valve which the tank battery shuts off because of lack of storage. All these operations are part of the tank battery-ACT Unit. Provisions must be made with pressure shut-off valves to automatically shut-in the flowing wells and with pressure switches down to shut the pump units and there can be installed lease control equipment that will automatically put the lease in operation if the battery conditions right themselves and the ACT Unit starts to transfer oil, making storage room available.

Illustration

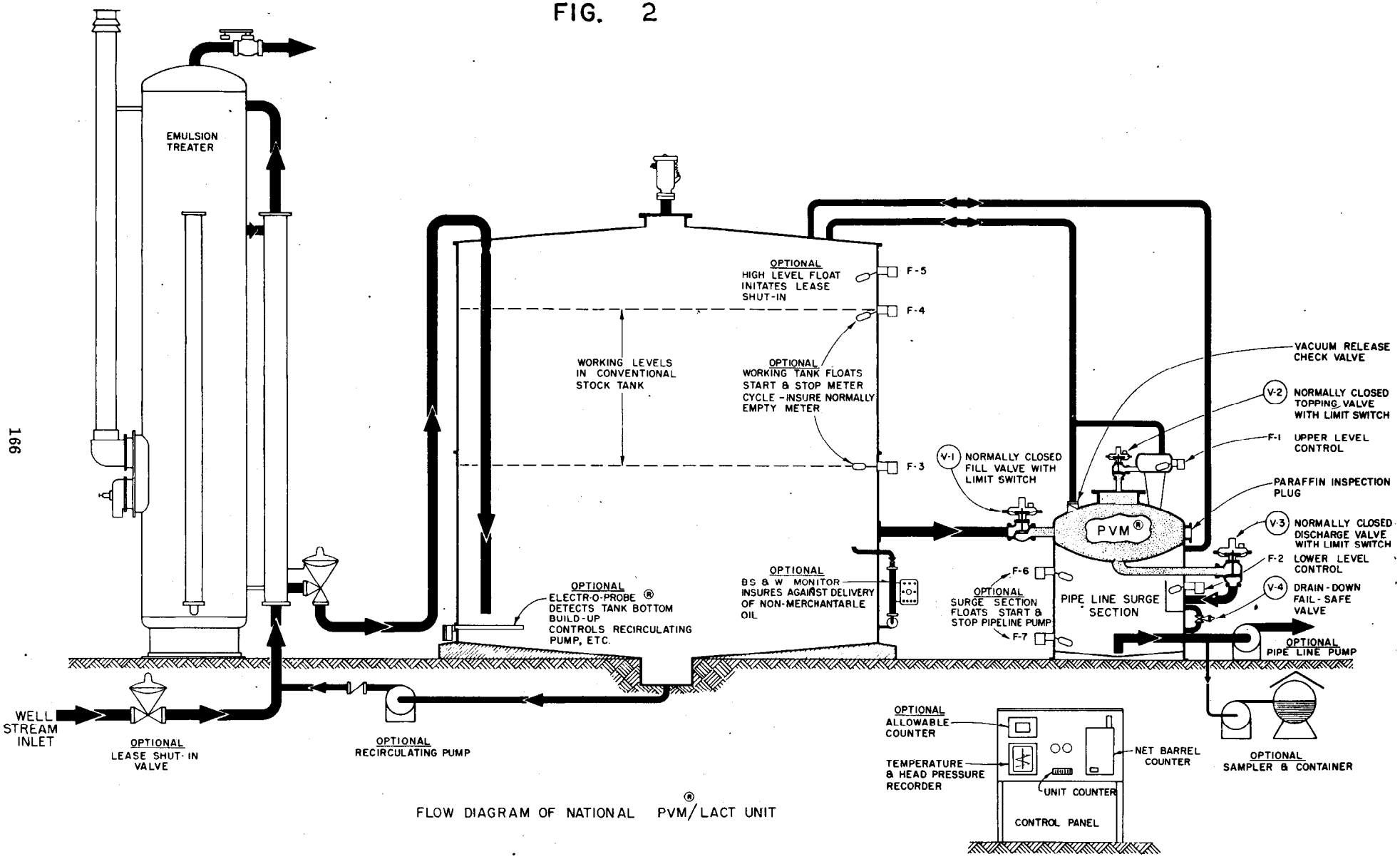
Figure 3 illustrates a tank battery with an ACT unit. The battery operation is essentially the same as discussed with Figure 2, except for the storage tank arrangement. Depending on the size lease, the bad oil storage required could require several tanks where the oil could be stored because of (1) pipeline capacity shipping schedules, (2) weathering time for the crude before custody transfer, and (3) treater failure. The wet oil storage tanks can be automated into the ACT system or the treating system so they will work automatically or transfer back to the working tank.

The positive volume meter is a complete ACT Unit and functions the same as does the PD meter unit; only the method of measurement is different. The PVM-ACT system has many of the components of the PD Unit, including the following:

1) Pump and motor
2) Monitor and probe
3) Sampler
4) Temperature recording system
5) Counters

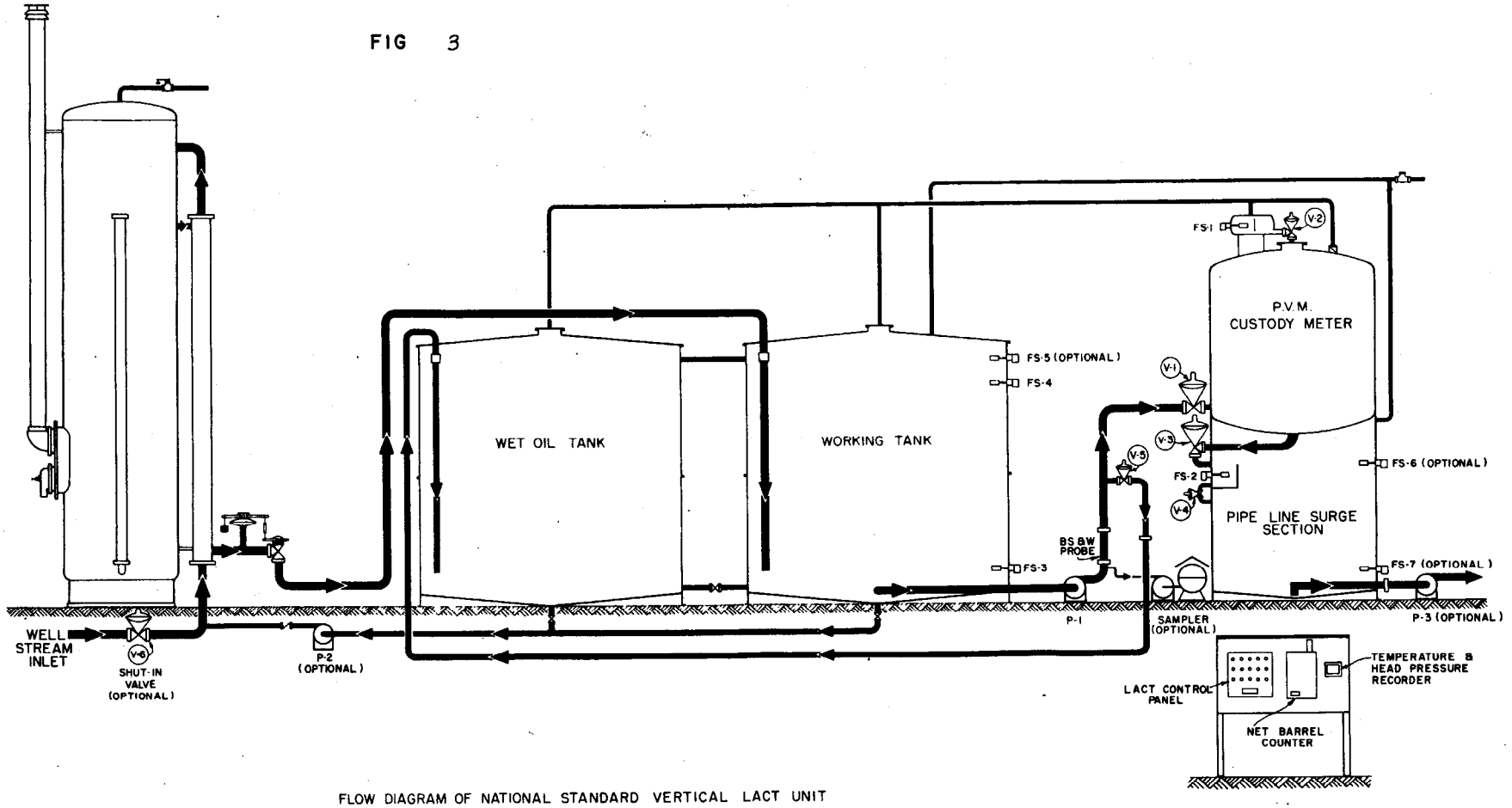
The PVM tank is the meter. The "dump" tank is of a specific calibrated volume and is equipped with valves which are inner locked so they will fill the tank to the specified volume and record the temperature of that quantity of oil. That volume of oil is dumped to the pipeline surge tank and, at the control panel, the transfer is recorded on unit dump counters and net barrel counters. The PVM measures and transfers to the pipeline the exact quantity each time; and the temperature is the only variable that must be corrected. The PVM units are built in sizes of 5, 10, 25, 50, and 100 bbl tanks. The PVM itself is the prover tank and represents the ultimate in accuracy of custody transfer

FIG. 2



FLOW DIAGRAM OF NATIONAL ® PVM/LACT UNIT

FIG 3



FLOW DIAGRAM OF NATIONAL STANDARD VERTICAL LACT UNIT

measurement. The level controls on the pipeline surge tank are the conventional type that starts and stops the pipeline pump to move the oil on to the pipeline.

MULTI LEASE ACT UNIT

Because of the economy of central battery operation several producing zones or royalty accounts can be handled by the "multi lease ACT unit". This operation is the same in principle as the ACT unit connected to one working tank. However, the ACT unit would take suction from one or more working tanks, and each working tank would have a motor control shut-off valve that is programmed by a time clock. Storage must be provided so there is ample room in the working tank or additional storage to hold the production until that working tank is selected to ship oil; but the suction pump is common to all working tanks. Each working tank would be equipped with a sampler and controlled by the program selector to collect and keep separate each sample. The diverting valve coupled with a lease re-route valve and selector will put the bad oil back to the proper lease treating system. The PD meter system will total the oil transferred as well as allocate, to separate lease counters, the oil transferred from each lease.

CONCLUSION

The Use of ACT has effected considerable savings on tank battery construction and maintenance cost. In many cases considerable labor savings and greater pipeline utilization have been effected. The ACT Units have become reliable pieces of production equipment.