

# Surface Producing Equipment For Deep Gas Wells In The Delaware Basin

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The discovery and development of the very deep natural gas reserves of the Delaware Basin of West Texas led to what has been described as the largest concentration of ultra-deep drilling rigs ever assembled in simultaneous operation. Due to the success of these operations, it may now be said that the basin also contains the largest concentration of high-pressure-gas producing, treating, and transmission facilities ever assembled. Figure 1 indicates the location of some of the major gas fields of the Delaware Basin in Ward, Reeves, and Pecos Counties. This paper will attempt to illustrate and describe the producing equipment and various methods of making gas available to purchasers which have been developed by the working interest owners for some of the wells in these fields.

Figure 2 is an example of split-flow of gas downstream from jointly owned producing equipment. The well, which is completed in the Ellenburger at approximately 20,000 ft, was initially tested at 23 MMCF/D at a flowing tubing pressure of 6600 psi. The producing equipment consists of a 48-in. x 18-ft 2,000,000 BTU/hr steam generator and a 30-in. x 10-ft 1440 psi working pressure separator. Gas is delivered into one owner's flow line at 1200 psi where it is transported to a flow control center. Gas is delivered for another owner to an on-the-site purchaser at 1200 psi by means of a control valve on the separator outlet and a differential controller on the on-the-site sale meter.

A diagram of a six-well flow control center which provides central point delivery to two purchasers is shown in Fig. 3. The separators on wells producing into this center are equipped with diaphragm-operated adjustable chokes, and flow control is achieved by regulation of set points on the controllers. The center is equipped with 4-in. control valves, 6-in. meter tubes, differential pressure indicating controllers, orifice meters, temperature recorders, piston-operated check valves, and a 10-in. header. Gas sales to Purchaser "A" are processed through a 10-in.

meter run, 6-in. control valve, a 36-in. x 15-ft 1200 psi scrubber and a dehydration unit. The center delivers about 40 MMCF/D to Purchaser "A" and 70 MMCF/D to Purchaser "B". The center as constructed is shown in Fig. 4.

Figure 5 is an example of full well stream production. Gas from the 22,000-ft Ellenburger well is delivered to the purchaser's centralized gathering system through a 2,000,000 BTU/hr indirect heater at 1000 psi. Initial producing rate on the well was 16 MMCF/D at 5200 psi.



FIGURE 1

Some Major Deep Gas Fields in the Delaware Basin of West Texas.

An example of a 12-well flow control center with centralized water separation facilities is shown in Fig. 6. The center consists of 4-in. valves, 6-in. meter tubes, differential pressure transmitter, recorder-controllers, 4-in. control valves, 4-in. piston checks, and 16-in. manifold. Water is extracted by use of three 36-in. x 15-ft 1440 psi separators and piped to a nearby disposal well. Wells producing into the center are equipped with diaphragm-operated adjustable heater chokes, and flow regulation is achieved remotely by set points on the recorder-controllers. The center is currently furnishing about 170 MMCF/D to the purchaser. Fig. 7 shows the center as installed.

Figure 8 is an example of split flow at the wellhead. The well is a 21,000-ft Ellenburger producer and initially delivered gas at 25 MMCF/D with a tubing pressure of 4800 psi. One owner delivers gas full well stream through an indirect heater to the purchaser's gathering system at 1800 psi. Another owner delivers gas to another purchaser's gathering system at 1000 psi by means of an indirect heater and separator.

An interesting installation for a dually com-

pleted well with split flow is shown in Fig. 9. The Ellenburger zone, which produces approximately 7.5 MMCF/D at 2600 psi is produced into a 20-in. x 10-ft 6000 psi working pressure free-water knockout and then split to two heaters. The Devonian zone, which produces approximately 17 MMCF/D at 3500 psi, is split at the wellhead and produced into the two heaters. Each heater is equipped with two sets of coils and two diaphragm-operated chokes. The two streams from the 6-ft x 12-ft 2,000,000 BTU/hr heater are passed through 1440 psi working pressure separators for one owner, with the condensate being recovered in storage tanks and the gas being delivered to the gathering system of an on-the-site purchaser at 1000 psi.

The two streams from the 5-ft x 12-ft 1,500,000 BTU/hr heater are delivered into another owner's gathering system at 2500 psi and transported to a plant where liquids are extracted and the gas sold to various purchasers. Each of the four meter runs is equipped with a recorder-controller and control valve which positions the diaphragm-operated heater choke.

Dual production equipment for high rate

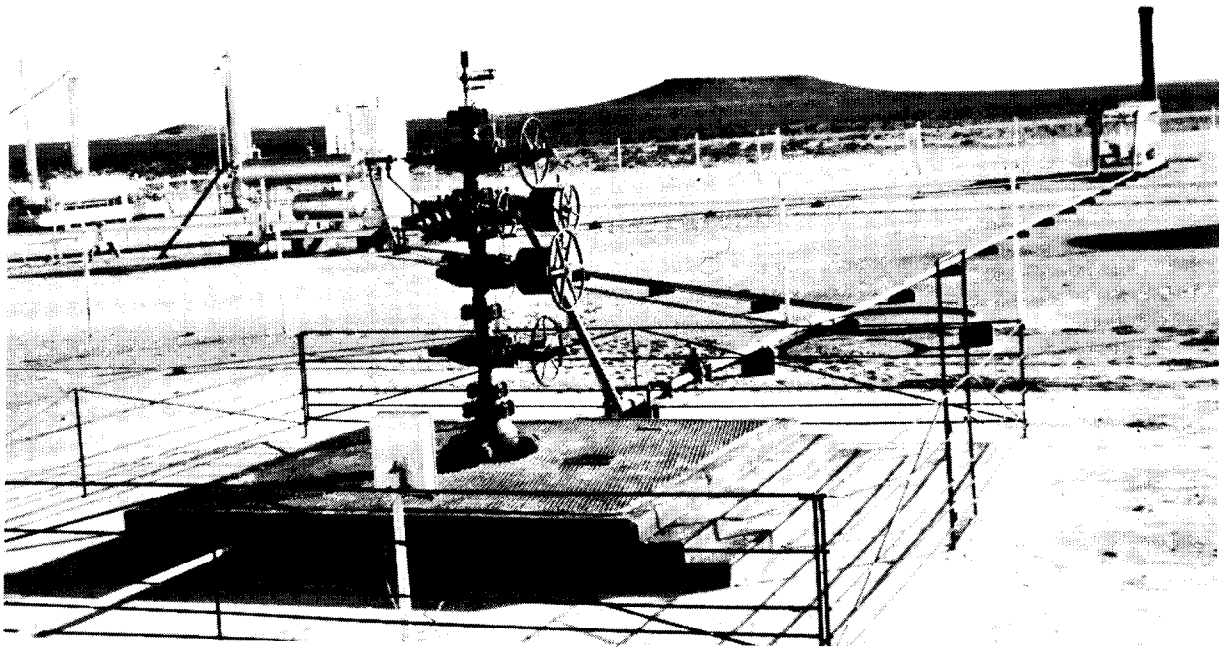


FIGURE 2

Split Gas Delivery Downstream From Producing Equipment.

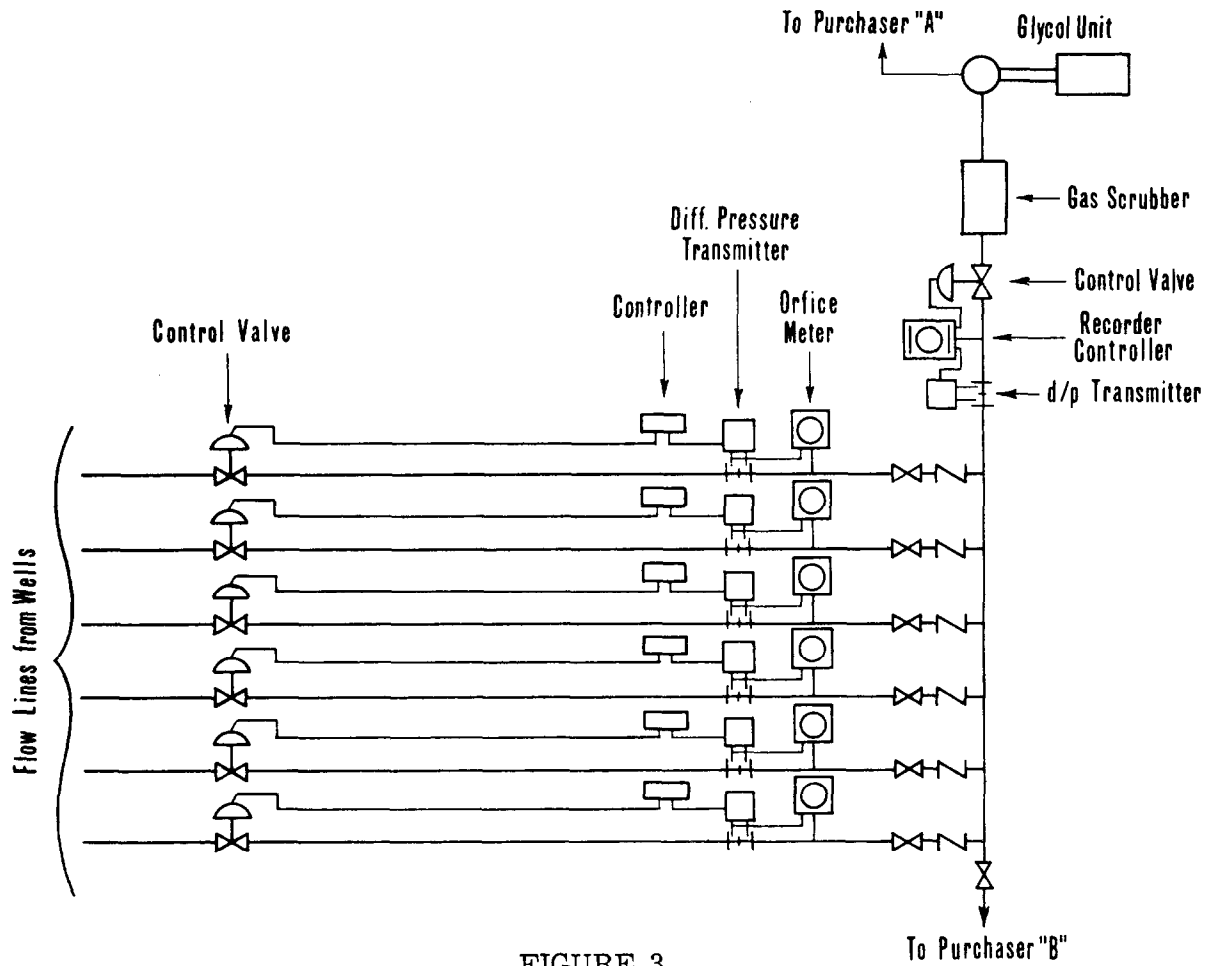


FIGURE 3

Diagram of Flow Control Center "A"—Central Point Gas Delivery to Two Purchasers.

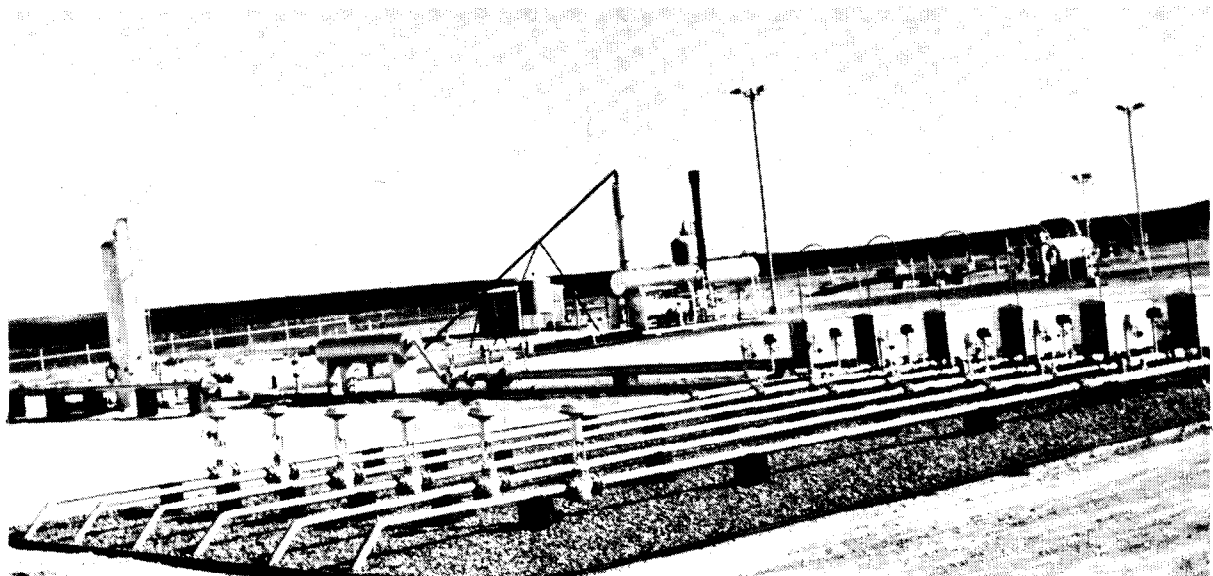


FIGURE 4

Flow Control Center "A" As Installed.

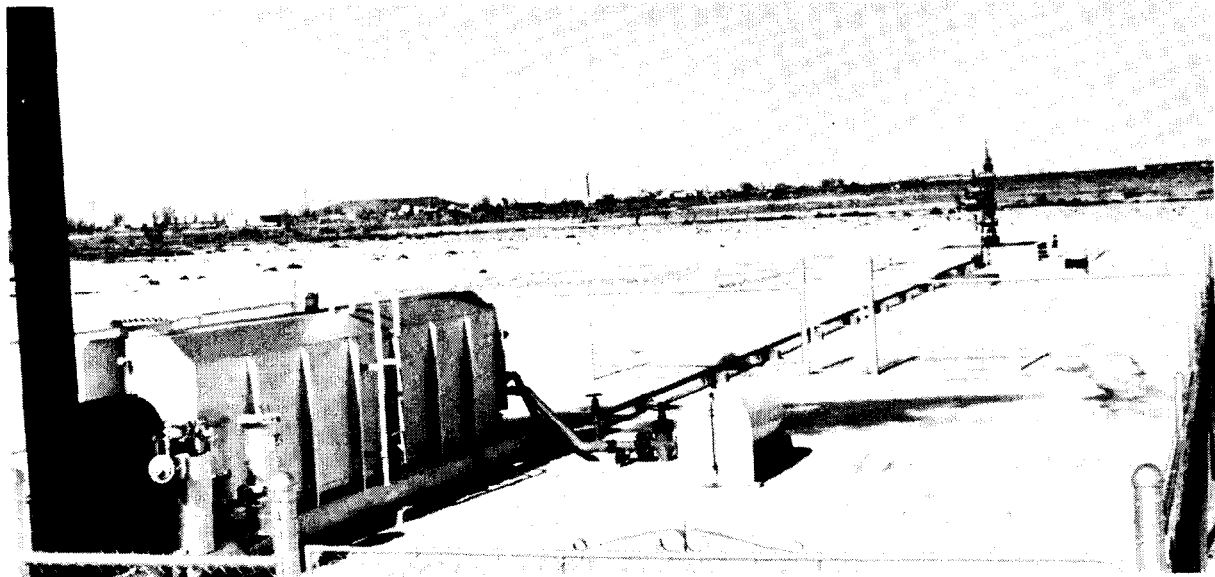


FIGURE 5

Production Equipment for Full Well Stream Delivery for a Gas Well.

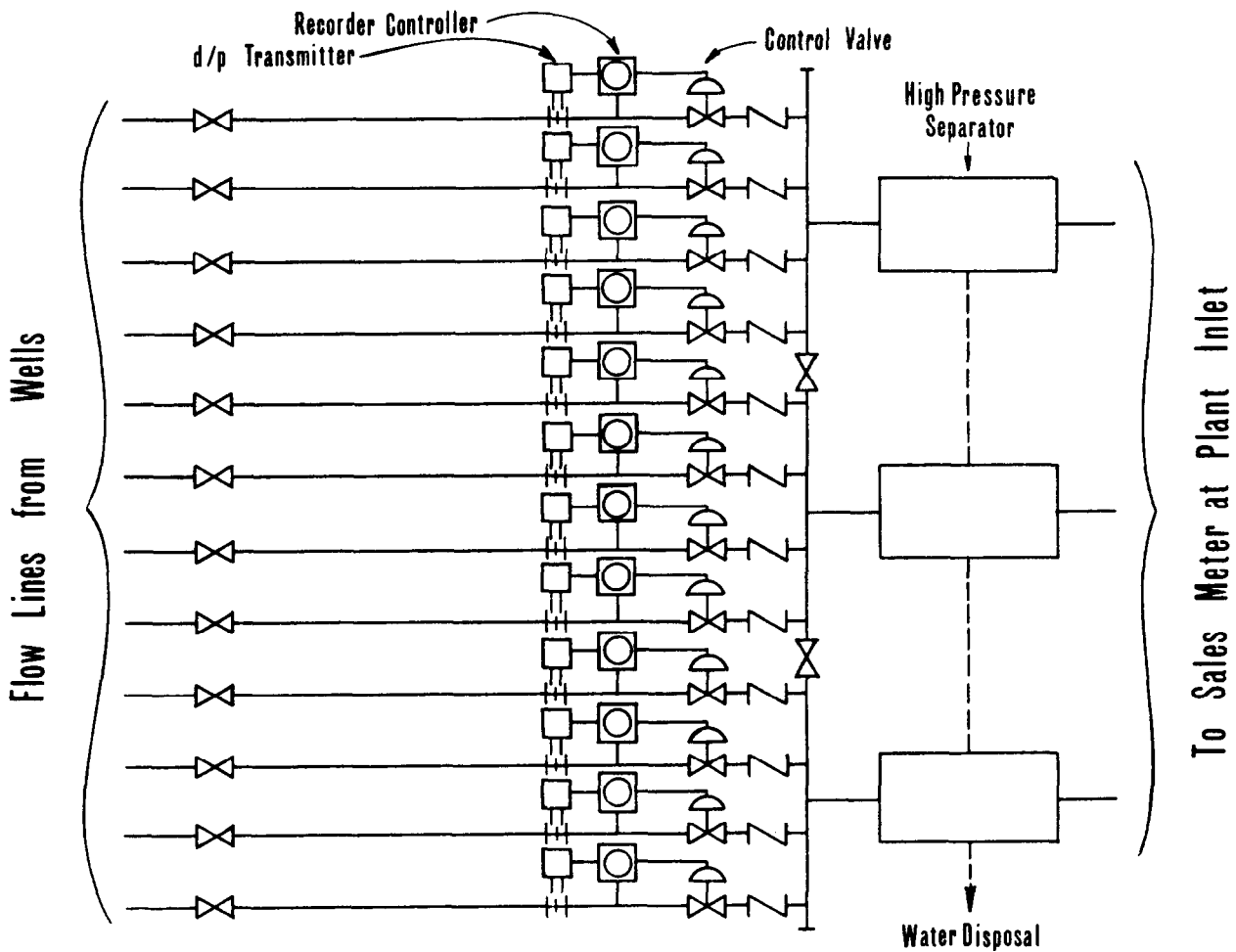


FIGURE 6

Flow Control Center "B"—Central Point Gas Delivery for Full Well Stream Production.



FIGURE 7

Flow Control Center "B" As Installed.

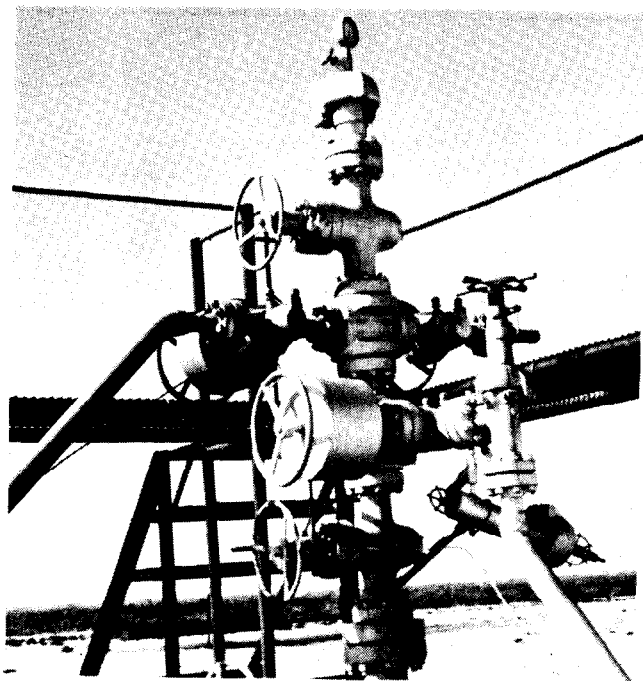


FIGURE 8

Split Flow at the Wellhead of a Gas Well.

production is shown in Fig. 10. The 21,000-ft Ellenburger well has produced over 45 MMCF/D at 1540 psi utilizing two 6-ft x 12-ft 2,000,000 BTU/hr heaters for start-up and a 42-in. by 15-ft 1440 psi separator. Gas is delivered to the purchaser's gathering system at 1000-1200 psi.

A unitized indirect heater and separator are shown in Fig. 11. The well initially tested 18 MMCF/D at 4800 psi, and gas to purchaser's gathering system is delivered at 1000 psi through a 2,000,000 BTU/hr indirect heater and 30-in. x 10-ft 1440 psi horizontal separator.

In reviewing the methods that have been utilized by natural gas producers in getting gas to market in the Delaware Basin of West Texas, the use of centralized gathering systems and flow control centers is an important development. The centers offer the advantages of single-point treating and liquid-extraction facilities, remote control of wells, and flexibility in furnishing gas to one or more purchasers.

To the production engineer, these developments mean that he must work closely with the

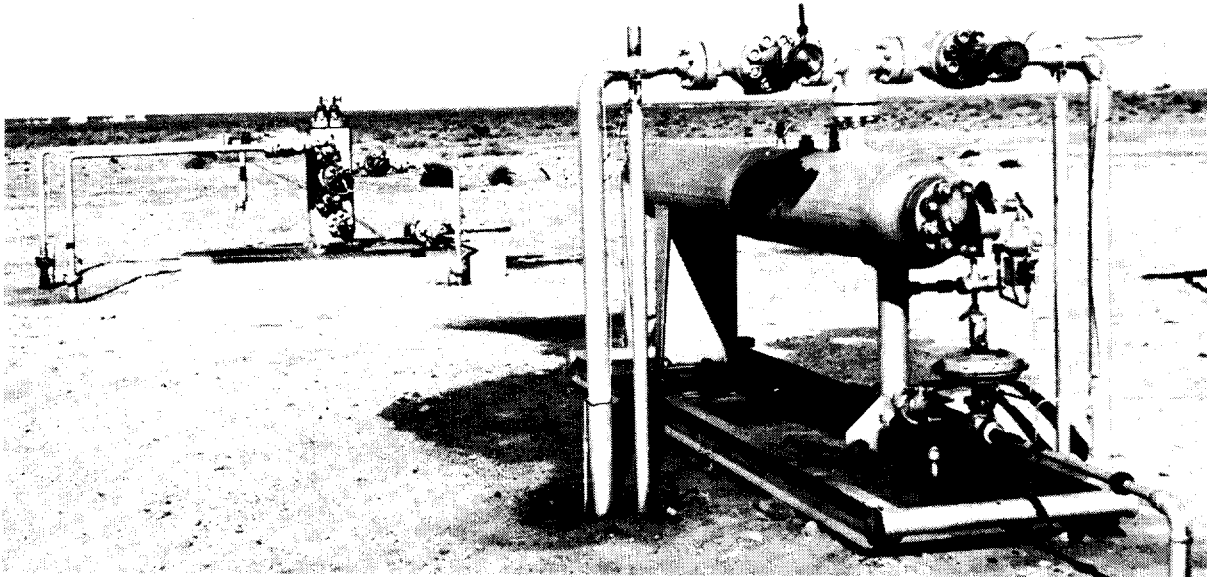


FIGURE 9

Production Equipment for a Dually Completed Gas Well With Split Flow.

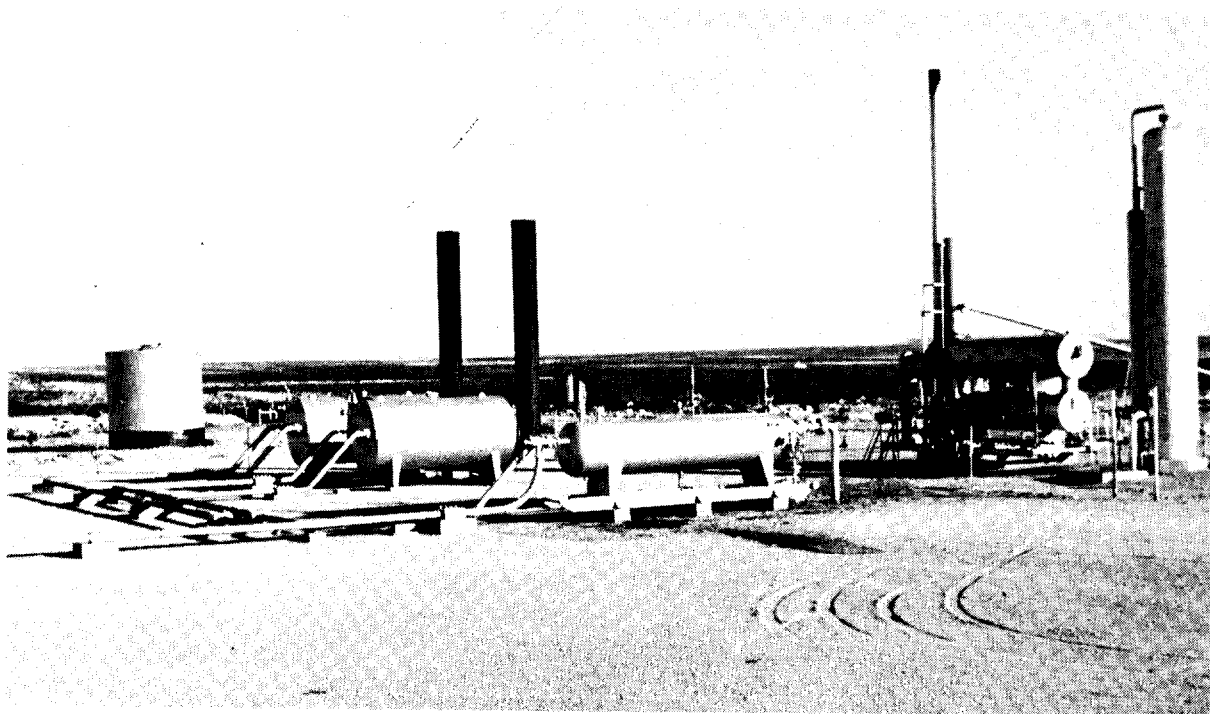


FIGURE 10

Production Equipment for High Flow Rates for a Gas Well.

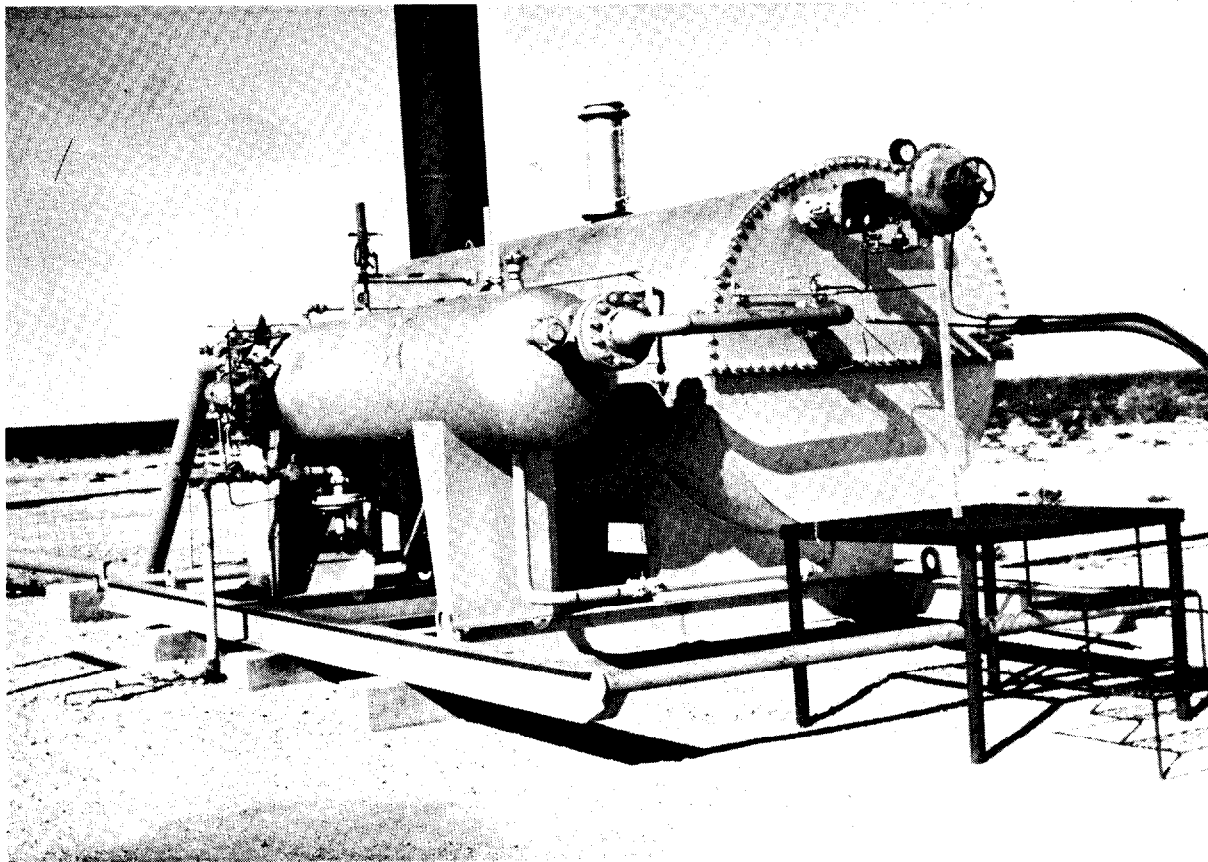


FIGURE 11

Unitized Gas Well Production Equipment.

gas contract people in his company so that the executed contracts will allow maximum return on investment and operating expense. When the method of furnishing gas to a purchaser has been decided, then testing of the wells becomes of primary importance. Sufficient information must be obtained from tests with temporary equipment so that the proper permanent equipment can be sized and installed.

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