New well drilling methods and improvements in pumping plant equipment, as well as lowering of fuel costs and the use of special fuels such as butane and natural gas, have reduced pumping costs and greatly extended the areas in which pumping for irrigation is feasible. Widespread droughts in recent years have increased the interest in pumping from wells for irrigation because the water stored in the ground is, in most cases, the only source that can be tapped to provide additional supplies of water. These factors are the principal causes for the great increase in pumping for irrigation throughout the arid West during the last decade.

A new method of drilling wells that has recently come into use, is an adaptation of the hydraulic rotary method but, instead of forcing water through the drill stem and out through the drilling bit to assist in loosening the material in the hole, water and drillings are drawn through the drill stem by means of a large capacity centrifugal pump. The pump discharges into a pool in which the drillings are deposited and the water runs back into the well by gravity. No casing is used and in order to keep the well from caving it must be kept full of water. Holes up to 50 inches in diameter and more than 200 feet deep have been drilled by this method. Clay is ordinarily not added to the water, and consequently there is less tendency to clog the water-bearing formations than when the rotary method is used.

This new method is most effective in drilling wells in sand and clay formations. It cannot be used in hard rock or boulders. Because of the danger of caving, drilling is usually carried on continuously after once being started. If it is necessary to stop for any reason, the possibility of caving may be largely eliminated by keeping the hole completely filled with water. Drilling progresses at a rapid rate because there are no delays caused by stopping to bail out the drillings or to drive casing.

Casing is set in the well as soon as it is completed, and the space around the casing is back-filled with screened gravel. When the back-filling is completed the well is developed in the usual manner. Where conditions are favorable, very satisfactory wells can be drilled by this method. In water-bearing formations of considerable thickness, wells having capacities from 1000 to 1500 g.p.m. with relatively small drawdowns, are frequently obtained. The reduction in the drawdown decreases the lift and reduces the cost of pumping in almost direct proportion.

Very efficient and dependable pumps are now available for meeting practically any irrigation pumping problem and the care with which the pump companies' engineers are choosing the pump to fit the conditions of each problem, has resulted in a marked increase in overall efficiencies of recent installations. Leading pump manufacturers now have in stock a wide variety of pump impellers from which bowl assemblies can be made which will fit almost any condition of well capacity and lift, with high efficiency. Bowl efficiencies of over 80 per cent are not unusual. A recent development is the low-lift, high-capacity vertical screw pump. These pumps are very efficient and of relatively low cost. They are particularly adapted for pumping from streams and reservoirs, although the smaller sizes may be used in wells where the lift is small.

The use of special steels for pump shafts and special alloys for impellers and bowls, has increased the useful life of pumps. The use of porcelain-coated impellers and porcelain-lined bowls increases the efficiency of the pump several per cent when new but if the pump is discharging much sand with the water, the porcelain lining will ultimately be worn off. Considerable progress has been made in perfecting water-lubricated pumps and in perfecting the bearings of both oil- and water-lubricated pumps. All these improvements which increase the life or the efficiency of the pump, help reduce the cost of pumping.

Where electric power is not available or where the cost of electric power is too high for use in pumping for irrigation, some type of internal-combustion engine must be used to furnish power. The extensive use of internal-combustion engines for driving trucks, tractors and earth-moving machinery of all kinds has made possible the expenditures of large sums of money for experimental work on engines of this type and many improvements have been made which decrease the fuel consumption and increase the life of the engines, as well as make them more dependable and simpler to operate. Modern internal-combustion power units now require only a minimum of attention and are as dependable as an automobile engine and almost as easy to operate.

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Modern high-speed Diesel engines are widely used in pumping water for irrigation. These Diesel engines are more expensive than gasoline engines but they use a cheaper grade of fuel and also less of it because of their higher efficiency. Consequently, they provide one of the most economical sources of power for pumping if the plant is used enough so that the fixed charges due to higher initial cost do not overshadow the effect of lower operating cost. Many of these modern Diesel engines have been in operation for more than five years and wherever they have been used under suitable conditions, they have demonstrated their dependability and economy.

Natural gas and butane are excellent fuels for internal-combustion engines and, since they are available in many parts of the country, they are frequently used to provide power for driving pumps. With minor changes ordinary gasoline power units will operate efficiently on these fuels. Where natural gas or butane are relatively cheap, these fuels are the most economical source of power for pumps, in fact, they may provide cheaper power in many instances than Diesel engines.

Electricity is still the most dependable source of power for pumping and although it may be slightly more expensive than other sources of power, the many advantages of the electric motor-driven plant have made it the most common type where electric power is available at low rates. Electric rates have been lowered from time to time and they are now the lowest they have ever been. Most electric power rates for agricultural service are arranged so that the power in the lowest brackets of the schedule is less than 1 cent per kilowatt-hour. In some electric rates the demand charge is based on the maximum power demand of the motor rather than on the name-plate rating. This results in a considerable saving to the farmer, particularly if his motor is not fully loaded. These facts have, in many places, reduced the cost differential in favor of other sources of power.

State and government agencies in many western states are keeping records on the cost of pumping and are assisting the farmers in obtaining efficient and economical plants by advising them as to the best types of pumps and power units for their particular conditions. Many of the power companies have testing departments which make tests of pumping plants. The condition of the plant is determined by the tests and, if the efficiency is low, the testing engineers may recommend the purchase of a new pump or the repair of the old equipment. The services rendered by these agencies also help in increasing plant efficiency and reducing the cost of pumping.

As a result of all these developments, the cost of pumping has been materially reduced. At the present time under ordinary conditions as to fuel or energy prices, a modern and efficient pumping plant, if operated so as to get the most economical service from the equipment, should pump water at a total cost for fixed charges and operation of 5 cents or 6 cents per acre-foot per foot of lift and possibly as little as 3 cents where fuel costs are exceptionally low and fixed charges small because of maximum hours of operation each year.