An Electric Water System For The Farm

By
E. T. Swink
Assistant Agricultural Engineer
V. P. I. Extension Division

A typical deep well type automatic electric water system on a farm in Roanoke County, Virginia. The pressure tank is located in the basement of the house. The pump is equipped with an anti-freeze set length, access to which is made through the man-hole shown by the concrete well top. A portable cover is provided for the pump to protect it from the weather.
An Electric Water System For The Farm

By

E. T. SWINK

Agricultural Engineering Department

The first and most useful job that can be given to electricity on the farm is that of pumping water. Running water should be placed second only to electric lights in importance, and in many cases it should be given first choice where a choice must be made. There is no reason why the farm family with electric service should not have the labor-saving convenience of running water just as their city cousins do. To have an abundant supply of water at the turn of a spigot is of far greater value to the farmer because there are so many essential uses for water in the operation of a farm.

Health records show that typhoid fever and other diseases induced by poor sanitation are rapidly reduced in communities where definite steps have been made to improve the farm water supply. The use of electric water systems can often facilitate better sanitation.

This shallow well pump was installed with a farm light plant on a Montgomery County, Virginia, stock farm eighteen years ago. Service from the power company was made available ten years later and an alternating current motor was installed in place of the direct current motor. It is still good for many years of dependable service.
The "hired hand" is generally referred to as the person doing most of the water pumping on the farm. This "hired hand," however, is usually the mother or housewife. Few people realize how much time and labor are required to hand-pump and carry water for the household. Actual studies show that the average American farm wife carries 20 tons of water each year and takes over 200,000 steps doing the task. This means an equivalent of 30 eight-hour days spent each year just carrying water. In many cases this same job is being done by an electric pump at less than one cent a day, or about $3.50 a year, for operating costs.

Tests at Iowa State College show that dairy cows with free access to water in drinking cups in the barn produce 6.14 percent more milk and 12.12 percent more butter fat than cows offered water twice a day at drinking troughs. The cup-watered cows drank 18.37 percent more water than the others. Records from dairy farm experiments lead to the same conclusion.

An egg contains 73.2 percent water and it can therefore readily be seen that better egg production results from having a constant supply of drinking water before the hens at all times.

A typical deep well pump installation supplying water from a well 125 feet deep. An abundance of water is always available for the residence, livestock and irrigation of the lawn and garden on this farm.

The following are outstanding advantages of having water available under pressure on the farm:

1. A safer and purer water supply, helping to protect the health of the family.
2. More efficient production of vegetables, of dairy, poultry, and other farm products, with less labor and increased farm income.
3. Facilities for irrigating the farm garden, assuring higher yields and protection against drought.
4. Good protection of farm buildings and property from the ever present danger of fire.
5. Complete modernization of the farm home.

It is surprising to note that less than 30 percent of those farm homes in Virginia which have electric service have been provided with water under pressure when it can be so easily and economically obtained. The cost of this farm improvement is so little that every electrified farm should at least provide running water in the kitchen and a connection for irrigating the garden. The installation of bath room fixtures and the extension of water pipes to other parts of the farmstead can be made as finances permit.

The purpose of this circular is to explain the installation and operation of electric pumps on the farm, hoping that the information will aid many Virginia farmers in obtaining the comforts and satisfaction of running water.

**Types of Electric Pumps for Farm Use**

There are two main types of automatic electric pumps for farm use: the cistern or shallow well pump, and the deep well pump. The shallow well pump is for wells or cisterns where the suction lift (vertical distance from water level to pump cylinder) is not over 20 feet. This type of pump may be installed at any convenient location in the house basement, outbuilding, or pump house. It is designed to maintain automatically a pressure of 20 to 40 pounds per square inch in the service pipes and is obtainable in capacities of 200 to 1,000 gallons per hour, using motors of 1/6 to 1 horsepower.

The deep well pump will pump water satisfactorily from any well. This type is larger and more expensive than the shallow well type and is used where the suction lift is over 20 feet. Deep well pumps are available in capacities of 100 gallons per hour and up, and require motors of 1/3 H.P. and larger, depending on the pump capacity and lift.

In addition to the conventional shallow and deep well pumps, there is also available a type of pump that will operate from shallow wells or from deep wells up to 120 feet deep. It is called the centrifugal jet pump, and consists of a vertically mounted centrifugal pump and motor located above the ground and connected by pipes to an ejector or jet below the water level in the well. The pump is similar in appearance to conventional vertical centrifugal pumps except that it has two discharge connections in the casing instead of one. One of these connections carries water to the pressure or storage tank. The other diverts part of the output of the pump to the jet located down in the well. The pressure in this line forces water through the jet nozzle at a high velocity, creating a vacuum which lifts water through the foot valve into the body of the jet and carries it upward to within suction distance of the centrifugal pump. This cycle is continuous during the operation of the pump.

The centrifugal jet type pump is available in sizes of 1/4 H.P. to 5 H.P. with capacities from 200 gallons per hour to 4,500 gallons per hour. The outstanding advantage of the centrifugal jet type pump is that it will pump from deep wells up to 120 feet without having to be located immediately over the well. This makes it possible to install the pump in the basement of the house or in some outbuilding, and pump from a well in the yard, thereby eliminating the necessity of building a frost proof pump house. When this is done, it is necessary to run two pipes from the pump to the well and these pipes must be increased in size according to the size of the pump and the distance from
the well to the pump. Care should be taken to see that these two pipes slope uniformly upward toward the pump, without dips, so that no air pockets will be formed in the line.

Complete information on the pump selected should be gotten from the manufacturer and the instructions for the installation and operation of the pump should be followed carefully.

A centrifugal jet type automatic electric water system with a 42 gallon pressure tank, installed in the basement of a farm home in Roanoke County, Virginia.

In some installations an electric motor can be applied to operate a pump already in use, in connection with a pressure tank or elevated storage tank, but each installation of this type presents individual problems which are so varied that no further discussion of them will be attempted.

**Location of the Pump**

A shallow well pump may be installed in any convenient location. Care should be taken to see that it is adequately protected from freezing, and this one reason makes the house basement a very desirable location. (See Fig. 1.) The electric wires and switch to the pump should be placed where they will be least liable to damage in case of fire on the premises, because one of the most valuable assets in having a water system is its value in fighting fire. It must be remembered that any machine requires some attention, and therefore the pump should be installed where it will be easily accessible for lubrication and maintenance.

The conventional deep well pump requires a rigid sucker rod from the pump head to the cylinder in the well and, therefore, it is necessary that the pump be located immediately over the well. A shelter or pump house must be provided to protect the pump from the weather and freezing (Fig. 2). This may be either a pump house above ground or a pit in the ground over the well. In either case, the shelter should be large enough to provide room for servicing the pump and the top or roof should be so arranged that the pump stock can be raised through it should it be necessary to remove the stock from the well.
Ventilation provisions should be made to keep down moisture in the room, thereby preventing rusting and deterioration of the pump and motor. Brick, concrete, cinder block or frame construction may be used, just so frost protection for the pump is assured. Provision should also be made for a drain from the pump house floor to prevent water from accumulating from leaks in the system or other sources and possibly draining back into the well. 

The same general rules that apply to the shallow well pump should be observed in locating the centrifugal jet pump. If the centrifugal jet pump is to be located over the well, deep well pump location instructions will apply. For all three types, it is necessary to locate the pump (1) at the proper place for good operation, (2) where it can be serviced easily, and (3) where it will be protected from moisture and freezing. All underground pipes should be placed well below the frost line and exposed pipes should be equipped with shut-off valves and drains for use in freezing temperatures.

Figure 1.—Typical shallow well pump installation. The same general arrangement is applicable to the centrifugal jet pump installation in wells up to 100 feet deep.
Determining the Size of Pump

In buying an electric water pump, the most important item to consider is pumping capacity or size. It should be remembered that in general the operating costs are practically the same whether a 200 gallon per hour or a 300 gallon per hour pump is used to pump the same quantity of water. The larger pump costs more while it is running but does not run as long as the smaller pump. The small difference in price more than justifies the added capacity available for fire fighting purposes, garden irrigation and the assurance of more years of service from the pump. If a pump larger than present requirements demand is installed, future increased requirements are taken care of and the life of the pump will be much longer. At least a 42 gallon pressure tank should be used with the electric farm water system.

Figure 2.—Typical deep well pump installation.
The following table gives the average amount of water used daily in the
average household or on the average farm:

1. Household services —

(A) Per person — with complete bath room — 20 to 40 gallons
(B) Per person — without bath room — 15 to 20 gallons
(C) The following are requirements for various fixtures which are included in
(A) and (B)

(a) Toilet — 3 to 5 gallons each time flushed
(b) Shower bath — 4 to 6 gallons per minute used
(c) Washing machine — 2 to 3 gallons per lb. of dry clothes
(d) Bath tub — 8 to 20 gallons each time used
(e) Kitchen — 8 to 15 gallons per person per day
(f) Lavatory — 1 to 1½ gallons each time used
(g) Hydrant on lawn, ¾ inch hose nozzle, with the pressure tank operat-
ing at 20 to 40 lbs. — about 5 gallons per minute

2. Livestock and garden requirements —

(a) Each cow — 10 to 15 gallons per day
(b) Each horse — 10 to 15 gallons per day
(c) Each hog — 1½ to 2 gallons per day
(d) Each sheep — 1 to 2 gallons per day
(e) Each 100 chickens — 5 gallons per day
(f) Garden irrigation — 3 to 5 gallons per minute

From this table an estimate can be made of approximately how much water
will be used on any farm under normal circumstances. It is wise and good
practice to use the figure thus obtained as gallons per hour capacity rating of
the pump that should be installed. In no case, however, is it advisable to install
a pump smaller than 250 gallons per hour. The chief factor that might limit
the size pump to be installed is the flow of the source of water supply. With
either a well or spring, the normal flow in gallons per minute should always
be checked before purchasing an electric pump. If a well is to provide the
source of water, a pump should never be installed that has a greater pumping
capacity than the flow of the well. For a spring with a small flow it is usually
possible to build just below the spring a concrete storage reservoir where water
can accumulate while the pump is not operating.

The automatic electric farm water system can be used to an economic advan-
tage on many farms for irrigating home gardens and truck patches. Small rotary
nozzles have been developed for operation on pressures of 20 to 40 pounds per
square inch, which is the normal operating pressure of most automatic electric
water systems. These nozzles require from 3 to 5 gallons of water per minute
and will irrigate an area 50 to 70 feet in diameter. The cost of rigging up a
portable irrigation unit using this type nozzle varies from $7.00 to $15.00,
depending on the distance from the water system to the area to be irrigated.

Tests have shown that vegetable yields can be doubled even in wet years by
applying small quantities of water during slack rainfall periods. In dry seasons
this equipment will make a garden flourish where otherwise it would have been
a complete failure. A shallow well system with a capacity of 340 gallons per
hour or a deep well system with a capacity of 220 gallons per hour either to be
equipped with at least a 42 gallon pressure tank, will provide facilities for garden
irrigation in addition to normal water requirements on the average farm.
Cost of the Water Pump

The price of electric water systems, like all other commodities, varies with the size and quality of equipment and with the manufacturers. Reliable shallow well water systems complete with 42 gallon pressure tank, motor and controls, and having a capacity of 300 gallons per hour, are available at $65 and up. Deep well water systems complete with 42 gallon pressure tank, motor and automatic controls and having a capacity of 180 gallons per hour, may be bought at $90 and up. Smaller sizes are cheaper and larger sizes cost more; however, in no case is it recommended to use pumps smaller than these for average farm use. The centrifugal jet water systems are approximately the same in price as conventional deep well systems of similar capacities. It is always advisable to buy equipment that is known to be reliable and for which replacement parts can be easily obtained.

It is impossible to give an estimate on the cost of the electrical installation of the pump because no two installations are alike. The best plan is to call on the agricultural engineer of the local electric service organization or a local electrical or plumbing contractor for information on the particular installation in question. Either of these agencies will gladly furnish the information without obligation.

Cost of Piping

The cost of piping can be closely estimated, after it is known where the water is to be used about the farmstead. Lines between farm buildings, supplying water for normal uses and not over 250 feet in length, can be of 3/4 inch pipe. Short service pipes within the house or other buildings can be of 3/4 inch pipe also. One-inch pipe should be used for main lines of over 250 feet in length or where large quantities of water are to be used as in sprinkling large lawns or irrigating gardens. It is advisable to obtain the free advice of the electric service organization or the Virginia Agricultural Extension Service on the size of pipes necessary for a particular installation.

Operating Costs

Numerous tests have been made on electric water pumps in practical operation in all sections of Virginia. These tests show that a shallow well pump will consume from 1 to 1 1/2 units (kilowatt-hours) of electricity in pumping 1,000 gallons of water. Similar tests on deep well pump installation show that from 1 1/2 to 2 1/2 units of electricity are consumed in pumping 1,000 gallons of water. The variation in the amount of current consumed in different installations is due to differences in well depths, pressures maintained in the storage tanks, and efficiencies of pumps.

From the table on page 8 the amount of water to be used on a particular farm can be estimated, and also the cost of pumping it. The following example illustrates this procedure: Suppose that the well on the farm in question requires a deep well pump using 1 1/2 units of electricity per 1,000 gallons and water is to be pumped for the following:

| 5 people @ 30 gallons each per day | 150 gallons |
| 8 cows @ 12 1/2 gallons each per day | 100 gallons |
| 4 horses @ 12 1/2 gallons each per day | 50 gallons |
| 30 hogs @ 2 gallons each per day | 60 gallons |
| 30 sheep @ 1 gallon each per day | 30 gallons |
| 200 chickens @ 5 gallons per 100 per day | 10 gallons |

Total daily water consumption 400 gallons
For the month’s water consumption:

$$400 \times 30 = 12,000 \text{ gallons per month}$$

Total units of electricity used per month:

$$12 \times 1\frac{1}{2} = 18 \text{ units or kwh}$$

Assume the cost of electricity for the pumping to be 4 cents per unit or kwh (the average cost to Virginia farmers):

$$4 \text{ cents} \times 18 = 72 \text{ cents per month or } 2\frac{1}{2} \text{ cents per day}$$

It would require from one to two hours to pump 400 gallons of water with a good hand pump and much additional time and labor in walking to the pump and carrying the water to the place where it is used. It would be difficult to employ a hired hand to do this job for 2\frac{1}{2} cents a day.

**Care and Maintenance**

It is very important that the electric pump be properly installed, according to manufacturers’ recommendations. Most newer model pumps are designed to operate in an oil bath and require no lubrication except the changing of this oil once or twice each year. Pumps properly installed with ample frost protection require practically no attention other than lubrication and will give continuous service for many years with negligible maintenance cost or attention. When repairs or adjustments are needed, they should be made by the pump dealer or someone familiar with the operation of the equipment.

**Conclusion**

When an electric water system has been installed on the farm, the first and most important step has been taken in modernizing the farm home. Complete bath room outfits are available for as little as $50 and the necessary approved sewage disposal system can be installed cheaply, using a homemade septic tank. Plans for these tanks are available through the county farm and home agents, local health officers, and the V. P. I. Extension Division. These agencies are also glad to give assistance in planning the entire water system and sewage disposal plant. The farm water supply and sewage disposal system should be carefully planned and the proper size and type of equipment and pipes must be used in order to assure satisfactory service for a long period of years. No improvement can be made on the farm that will pay larger dividends in health, happiness and convenience than the installation of an automatic water system.