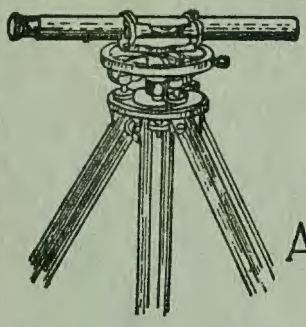

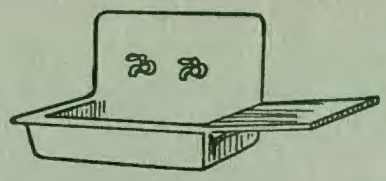

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WINDMILLS

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Windmills in one form or another have been used since the twelfth century. The place of origin is uncertain, but it probably was somewhere in Germany The post mill of that time was, naturally, of rather crude construction and had to be turned by hand to face the wind. The somewhat later mill as made in what is now the Netherlands had a stationary tower with a revolving top. This mill was also without a rudder but later developments added a small secondary wheel which operated a pinion on a rack and automatically kept the big wheel in the wind. These mills were sometimes of tremendous size, 70 or 80 feet in diameter. The sails, usually four or six in number, were merely racks covered with canvas. The only means of governing was to stop the mill and add or take off the canvas. The modern Dutch windmill is built along much the same line. The earliest mills were probably used to turn mill stones or other grinding devices.

MODERN WINDMILLS

The first practical windmill in America was brought out in 1854. This mill was of the direct stroke type and had wooden sails and vane and was mounted on a wooden tower. These early mills and their successors give one power stroke for each revolution of the wheel. The pitch of the blades or sails is so steep that high speeds are not common. Most of these earlier mills were of the sectional type, that is, the wheel was divided into sections which were hinged in such a way that strong winds or sudden gusts tended to fold the sails so they were parallel with, instead of perpendicular to, the wind. The sections were held in normal position by springs and the tension on these springs provided a means of governing the speed. The sails were furled by overcoming this spring tension. Both solid and sectional wooden wheel mills are still made and sold. A relatively recent development is a mill with a sectional wooden wheel which runs behind the tower. This type of a mill does not require a vane or a rudder and while it has some advantages is apt to be less steady in the wind than the rudder type.

The steel windmill in this country dates from about 1883. The curved sail surface made possible by the use of steel is probably the most important single improvement in windmill history. The more efficient use of the wind results in a higher speed mill and one which will run in a lighter breeze. The higher speed of the wheel necessitates some form of reducing motion with the result that steel mills are almost always back geared.

SPEED AND GEAR RATIO

The steel windmill is most efficient at fairly high speeds and practical considerations limit the number of power strokes of a pump to about 40 a minute. As a result most of the steel mills have a gear ratio of from 4 to 1 downward. As a general thing the smaller mills run at a higher speed and have a higher gear ratio. Since the power required to pump water varies directly with the lift most mills have some provision for changing the length of stroke. Customarily the longest stroke in inches is the same as the diameter of the wheel in feet; for instance, a 10-foot mill might have 10-, 8-, and 6-inch strokes. The more or less common use of drop cylinders with windmill pumps means that the shortest stroke has to be used.

Perhaps one of the greatest recent advances in windmill design is in the bearings. Any machine with moving parts needs lubrication and the windmill, owing to its relative inaccessibility, is frequently neglected. The earlier mills had plain cast-iron bearings with small and hard to-get-at oil holes. Later developments saw oil soaked wood, babbit, bronze, roller, and ball bearings succeed each other rather rapidly. The greatest single step forward was the oil chamber and the run-in-oil mill which it made possible. Modern windmills, especially the back geared type, need oiling but once a year. Better lubrication has made for a much more efficient mill and one which will last much longer.

COST

The first cost of a windmill will be determined by such factors as size of wheel, height of tower, kind of workmanship, type of mill, and possibly freight rates. One well known 6-foot wheel and working head may be had at the factory for less than $20. The cost of towers depends largely on the height but will range upward from a dollar a foot. Cut steel gears, roller and ball bearings, accurate machine work, etc., all tend to make a higher first cost. Direct stroke mills are, in general, cheaper than the back geared kind although wooden wheels cost more than steel wheels. There probably is no such thing as an average windmill but there are a good many 8-foot steel mills on 30-foot steel towers that have cost, ready to run, less than $125.

A COMPARISON OF METHODS OF PUMPING

The water on most farms is pumped by windmills, gas engines, or electricity. The first cost of a windmill, a gas engine and pump jack, or an electric deep well pump is about the same. Operating costs strongly favor the windmill. The windmill and the electric pump may be expected to last at least twenty years and the engine and jack about half as long. The electric pump excels so far as convenience is concerned. As to reliability there is some question. There are windless periods during the summer months and there are interruptions in electric service. There are also frozen water jackets and gas engines that refuse to go.

Windmills require some attention, at least to start and stop them, and a relatively large water storage capacity is desirable. Windmills are not automatic and the owner does not have to pay, in first and operating cost, for the automatic feature.

If low first cost is of prime importance, then pump by hand. If convenience is the feature most desired, then the electric pump is indicated. If moderate first cost, low operating cost, freedom from monthly bills, and general all around reliability are desirable, then the windmill will be the choice.

A final suggestion may be in order. The power of windmills varies as the squares of the diameters of the wheels. For instance an 8-foot mill will do almost twice as much as a 6-foot mill. while a 10-foot mill will do about three times as much as a 6-foot mill. Large wheels run in lighter winds.

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