WIND ENERGY FOR EARTHKEEPERS

SAVONIUS WIND MILL

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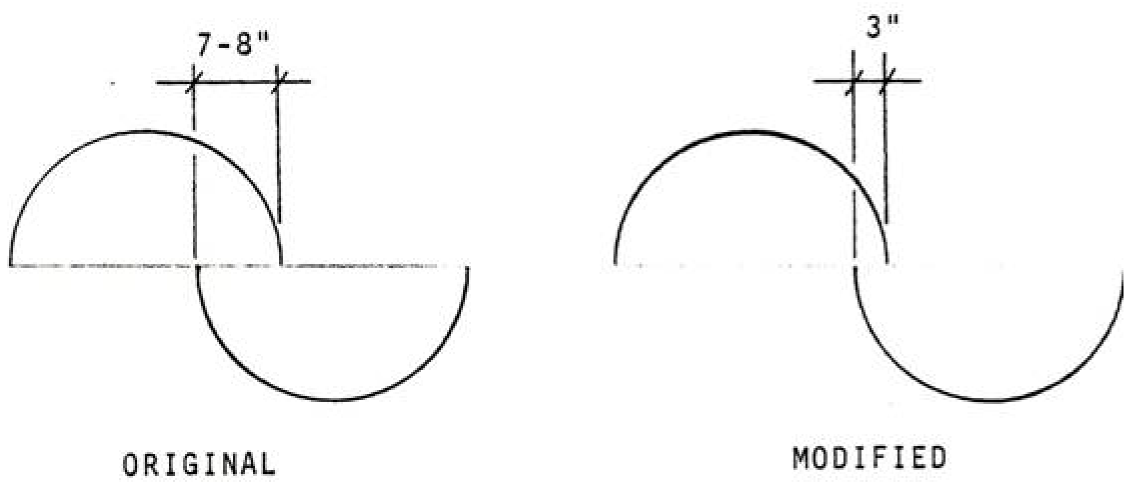
INTRODUCTION

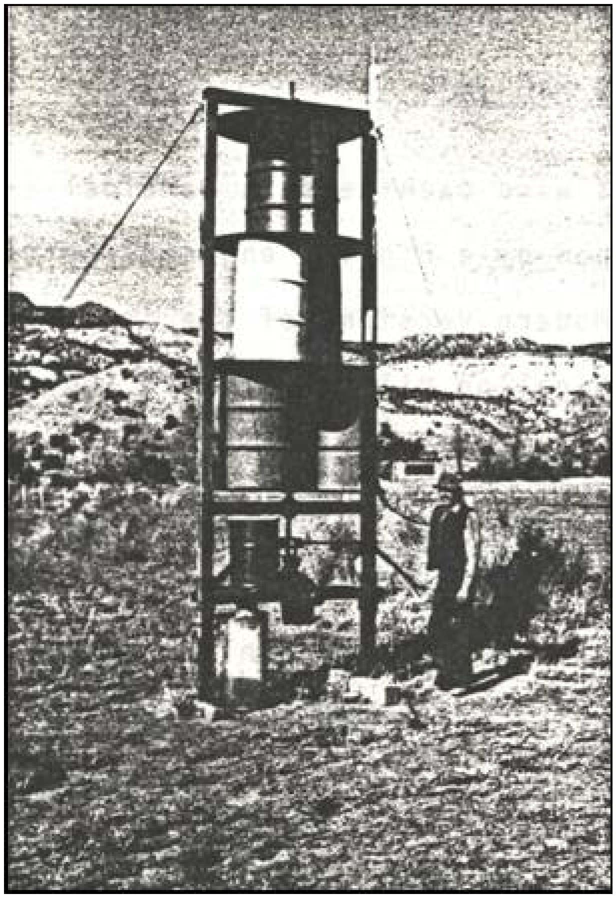
Wind energy has been used by various cultures for several centuries. The residents of Crete Island used a sail wing wind machine for water pumping. The Dutch used huge windmills for both water pumping and grinding grains. In the Western regions of the US, windmills were part of the farms and railroad stops as they pumped water from deep wells. In fact, the Western regions of the US could not have been settled but for the windmills pumping water in arid and semiarid regions.

In recent decades due to the search for renewable energy, many efficient wind generators have been developed and tested. Today, we see enormous wind generators dotting the landscapes of many states. Wind generators, especially the recent ones, are quite sophisticated, costly and needs expertise to maintain and operate.

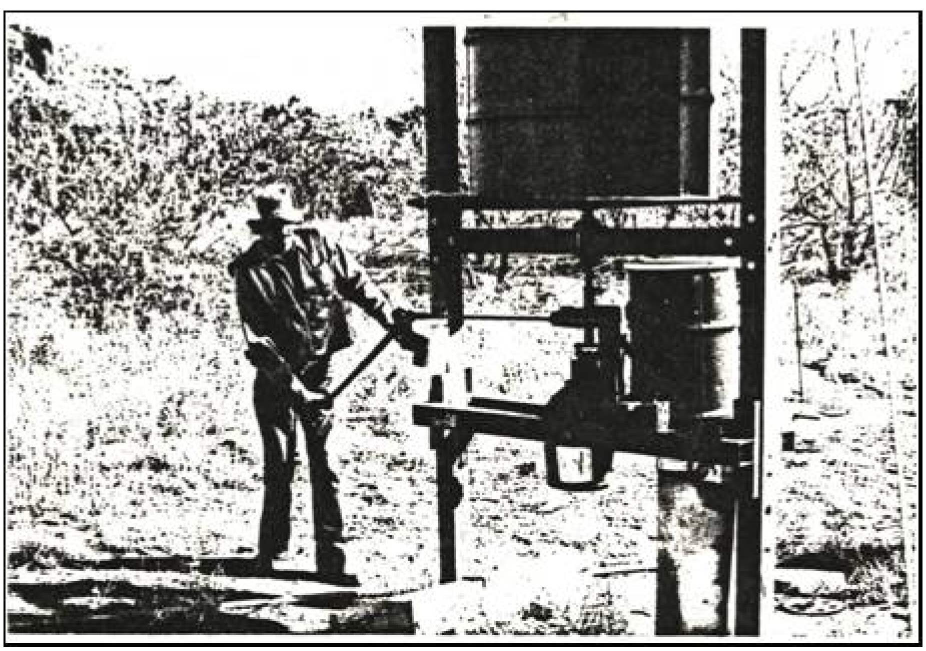
The most appropriate wind machine for use in less income countries was found to be a simple machine invented by a Finnish Engineer, Savonius. The Savonius wind mill is a vertical axis wind machine which was developed by a Finnish engineer by the name of Savonius in the 1920's. Modern versions of the impeller of this machine often utilizes 55 gallon oil drums split lengthwise to form an S shape as shown in the enclosed plan for a Savonius windmill. The Village Technology Program built such a Savonius wind machine for use in water pumping and grain grinding.

Details of the machine's construction are shown in the enclosed photos and diagrams. The basic design was taken from the book "Wind and Windspinners", by Michael Hackleman and David House, published by Earthmind Press, California. There were two modification made from the original design. The first one was based on a study made by the Sandia Laboratories in Albuquerque, which recommended a different spacing between the two buckets than suggested in the original design of Hackleman. The following diagram shows the modified spacing as well as the original spacing.

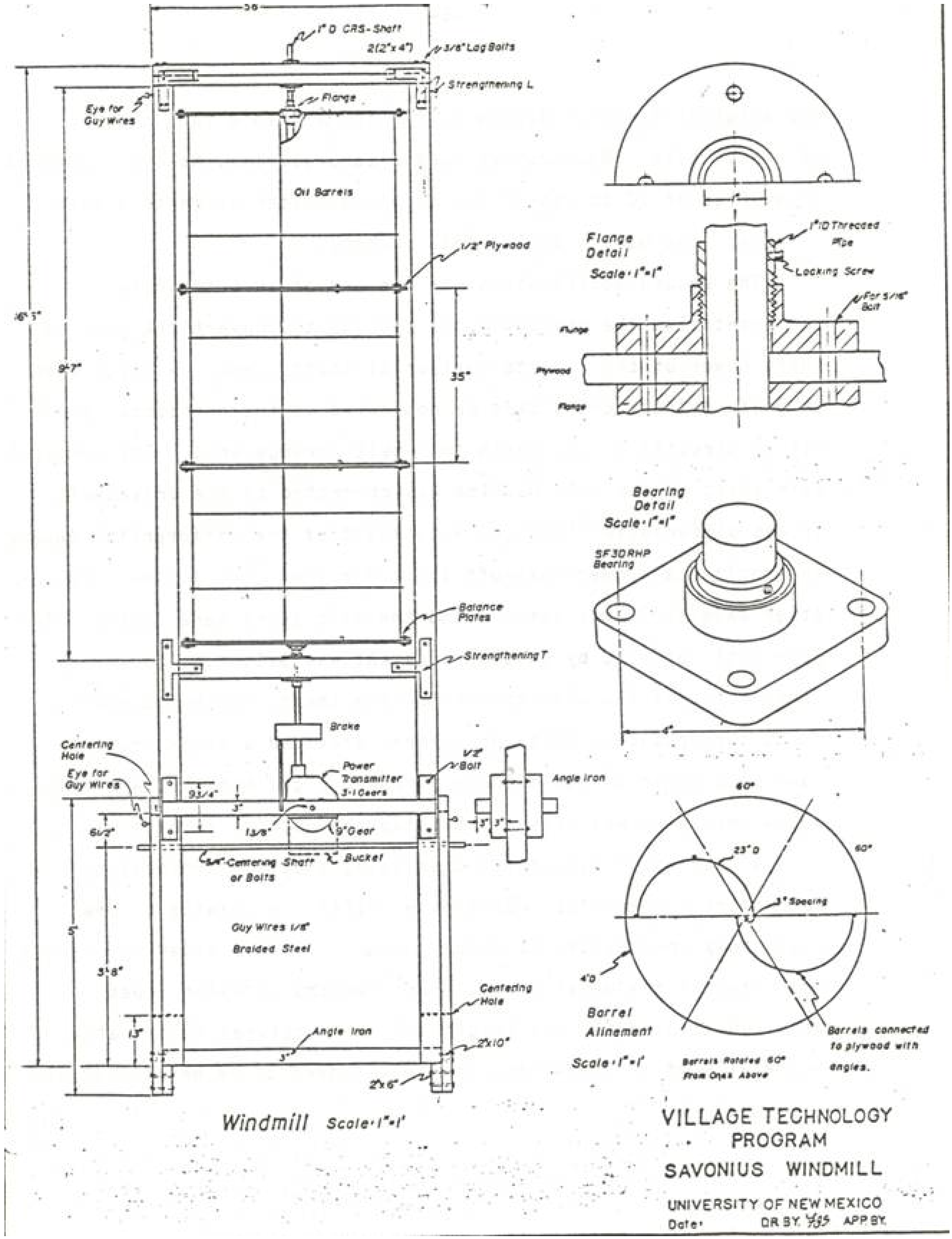




Savonius Wind Machine



Brake Mechanism Of Savonius Wind Machine



The original Savonius design called for a 7 to 8 inch overlap of the buckets. Research at Sandia Laboratories, however, suggested an overlap of 10 to 15% of the bucket diameter or in this case 3 inches (the bucket diameter=23 inches).

The second modification was the use of an automobile differential at the bottom of the machine to convert the vertical shaft power of the rotor to horizontal shaft power. A water pump or grain grinder could then be connected to the horizontal shaft either directly or via chain or V belt arrangements. The vertical main shaft of the wind machine was connected to the driveshaft of the differential., and one axle shaft of the differential became the horizontal power take off shaft for the wind machine. The other axle shaft was removed and the slip gears were locked. The gear ratio offered by this arrangement was 3:1, i.e. for every three turns of the wind machine's main shaft, the horizontal shaft turned once. This arrangement provided a high torque, low speed power to run a chain pump and a grain mill. A simple brake mechanism was provided to stop the machine in high winds.

A chain pump was constructed using a design proposed by Volunteers in Technical Assistance (VITA). A drawing of the chain pump constructed is shown below. In order to prevent corrosion of the metal chain, short lengths of nylon ropes were substituted for the lengths of chain between each leather washer. This substitution;. however, proved to be unsatisfactory

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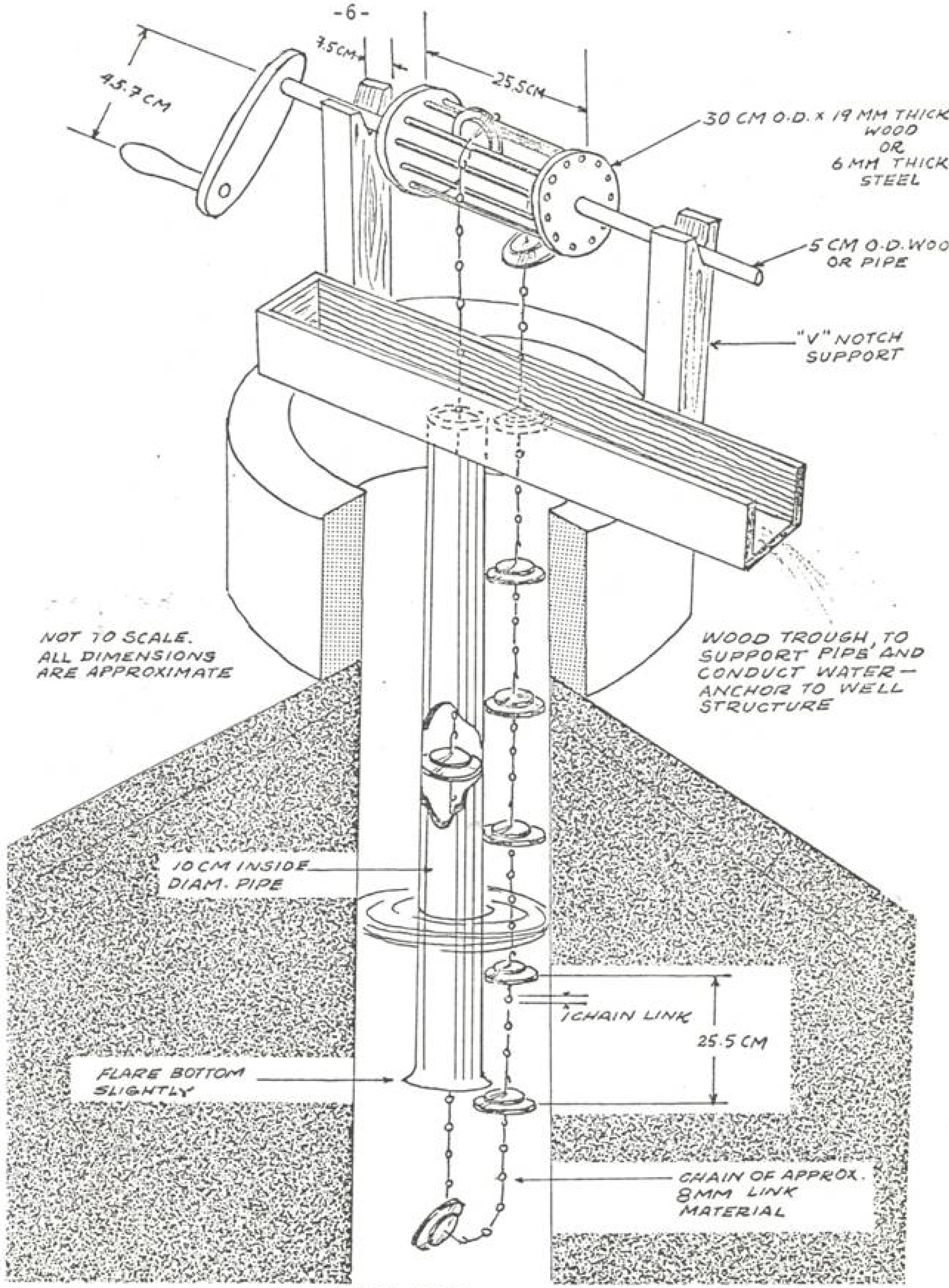

45.7 CM
7.5 CM
25.5 CM
30 CM O.D. x 19 MM THICK WOOD OR 6 MM THICK STEEL
5 CM O.D. WOOD OR PIPE
"V" NOTCH SUPPORT
NOT TO SCALE. ALL DIMENSIONS ARE APPROXIMATE
WOOD TROUGH, TO SUPPORT PIPE AND CONDUCT WATER — ANCHOR TO WELL STRUCTURE
10 CM INSIDE DIAM. PIPE
1 CHAIN LINK
25.5 CM
FLARE BOTTOM SLIGHTLY
CHAIN OF APPROX. 8MM LINK MATERIAL

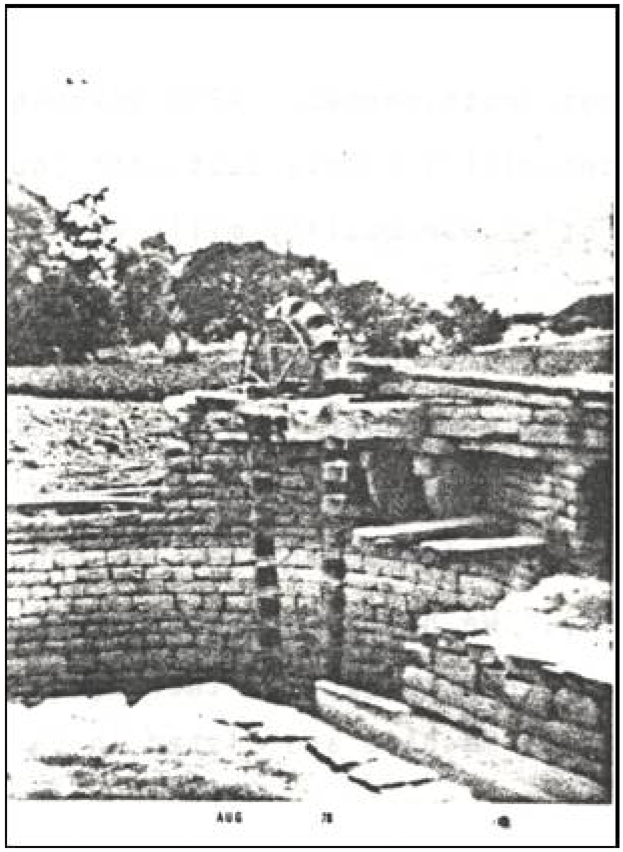
CHAIN PUMP

as there was much binding and misalignment of the washers as they ascended the pipe. It is suggested that the metal links should not be replaced by light weight ropes as the weight of the links keep the washers taught and aligned well. Aside from these alignment problems, the Savonius machine performed well. The Brace Research Institute in Canada has successfully operated a diaphragm pump made of a tire with a Savonius windmill. It is suggested that a diaphragm pump may be better suited for Savonius windmill than a chain pump. Although the Village Technology Program did not construct and test a chain bucket pump (shown below), it is believed that it might perform very well with a Savonius windmill. Conventional piston pumps can also be used with a Savonius windmill.

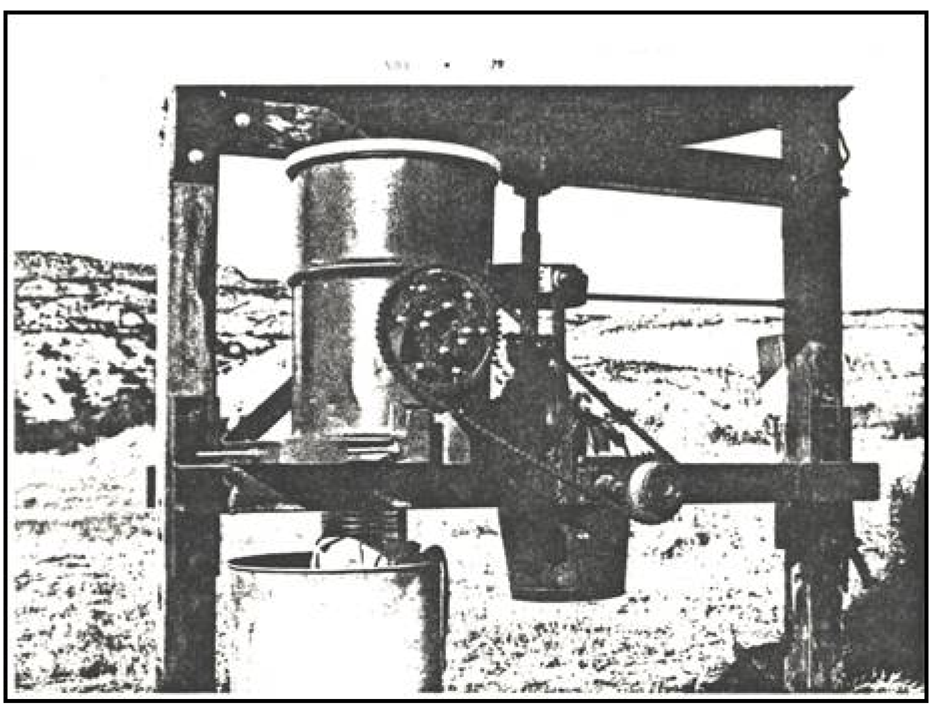
The Savonius windmill was also used to grind grain. A small grain mill known as "Corona Convertible" manufactured in Columbia, South America, was fitted with a hopper and sprocket.

The hopper holds a large amount of grain and can feed the mill automatically. A s shown below, the horizontal shaft of the windmill is connected to the grain mill via a roller chain and sprocket drive. The overall ratio between the wind machine and the grain mill was 5:1. The mill turned once for every five turns of the rotor. This wind machine and mill combination successfully ground grain into fine flour. However, the rate of production and wind speed are not known with any accuracy, as this set up was not instrumented. Also unknown is the eventual durability of the mill's simple cast iron journal bearings. Perhaps the use of higher quality mills with better bearings will be required.

All factors considered, the Savonius design affords a very simple, stable machine requiring little maintenance. The Savonius' power output is relatively low (about 1 2 hp), but so is the initial investment for its construction (about $250 of materials). We highly recommend this machine for use in Third World countries.



Proposed Chain-Bucket Pump For Savonius



Grinder Powered By Savonius