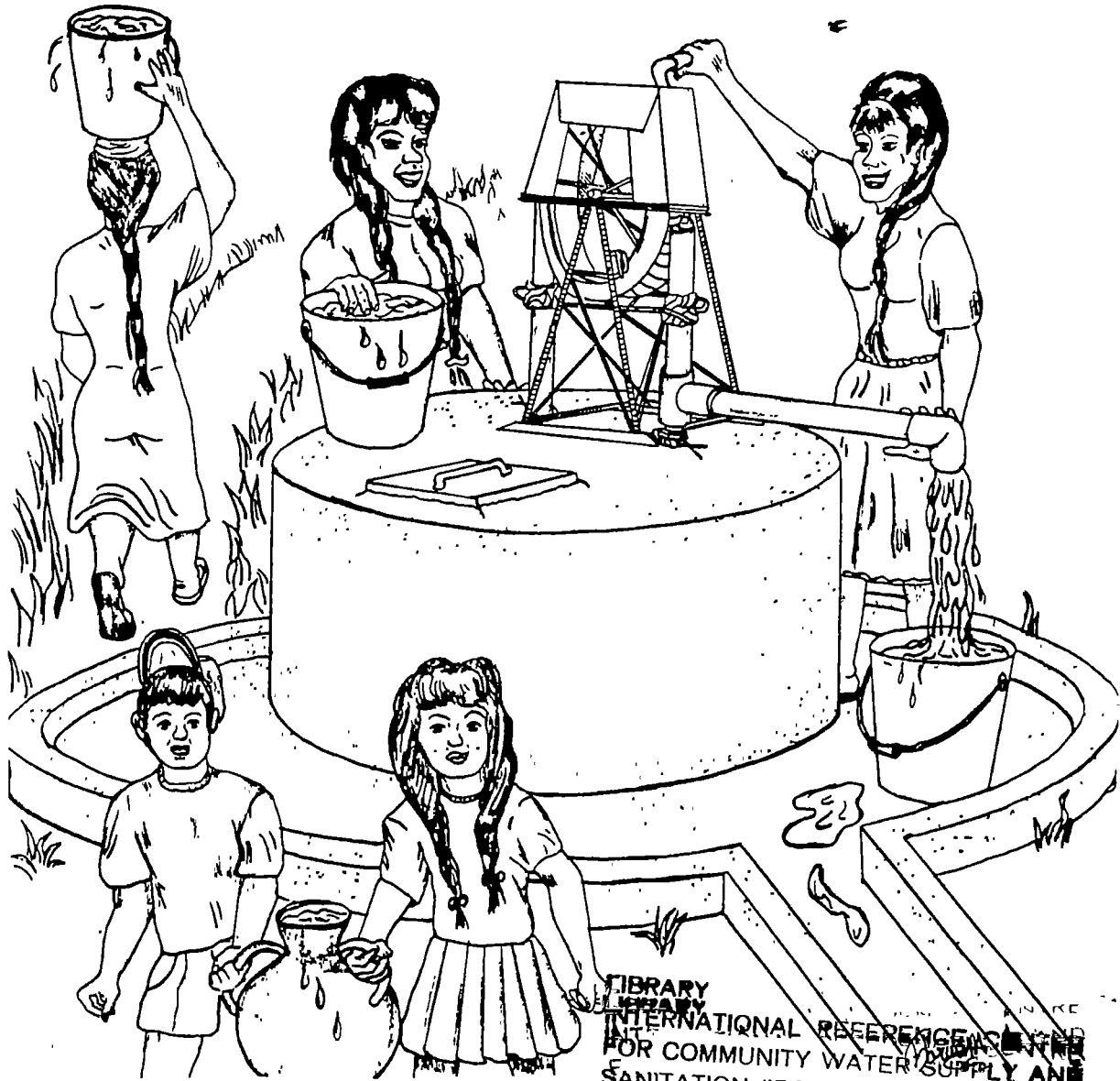


INSTALLATION AND MAINTENANCE MANUAL FOR THE EXTRA STRONG ROPE PUMP FOR COMMUNITY WELLS



LIBRARY
INTERNATIONAL REFERENCE CENTER
FOR COMMUNITY WATER SUPPLY AND
SANITATION (IRC)

Bombas de Mecate S.A.
Km. 29, Carretera vieja a León
P.O.Box 3352
Managua, Nicaragua

INTRODUCTION

The present installation and maintenance manual is directed towards our clients, users, promoters and technicians to support the installation, maintenance and repair of rope pumps for community wells.

In the chapter on technical specifications you will find information on the quantity of water drawn by the pump and an informative table about the diameter of pipes to be used depending on the depth of the well.

The most important chapter is on the installation of the pump. This chapter describes the correct way of installation using a combination of drawings and text. In the last chapter the maintenance and repair procedures are shown. The steps to be followed for repairs to the pump are similar to those used in its installation.

Two manuals have been produced: the present one is on the extra strong rope pump to be used on community wells and in cases when an intensive use of the pump is expected. This manual is directed towards promoters and international aid organisations to assist them with the correct installation, maintenance and repair of the rope pump, but at the same time can be used by the community for maintenance or repairs. The extra strong rope pump is used where more than five families expect to use the rope pump. We also recommend the extra strong rope pump for irrigation and for cattle farmers with more than 50 head of cattle.

The other manual deals with the family rope pump. This is the cheaper version of the rope pump without extras. The family rope pump is the basis of the commercial success of the rope pump. The two manuals are very similar.

To ensure optimal hygienic conditions, the extra strong rope pump or rope pump for community wells should be installed on a concrete slab. For this reason the extra strong rope pump is also produced with a protection cover to ward off dust and sun.

Separate annexes have been made to cover the installation of the extra strong rope pump on drilled wells and for special designs such as post-mounted rope pumps and motor-driven rope pumps.

The production of these manuals and its translation has been made possible thanks to the financial collaboration of the Swiss Development Cooperation (Cooperación Suiza al Desarrollo (COSUDE)). The manual has been elaborated by the firm "Bombas de Mecate S.A." (Rope Pumps Ltd.) and can be reproduced freely.

Los Cedros, Department of Managua, Nicaragua. May 1994.
English version July 1995.

Authors: Henk Alberts and Juan Gago Gonzalez
Drawings: Henri García Montoya.

LIBRARY, INTERNATIONAL REFERENCE
CENTRE FOR COMMUNITY WATER SUPPLY
AND SANITATION (IRC)
P.O. Box 93190, 2509 AD The Hague
Tel. (070) 814911 ext. 141/142
RN: 12848-1
LO: 232.2 95IN

TECHNICAL SPECIFICATIONS

Pumping Capacity according to depth:

Depth (varas)	Adult (Gallons per minute)	Child (Gallons per minute)	Time needed for an adult to fill a barrel (minutes)
5	22	12	2,5
10	11	6	5,0
15	7	4	7,8
20	5	3,1	11
25	4	2,5	14
30	3,5	2,1	16
40	2,7	1,5	21
50	2,2	1,2	25

1 vara = 33 inches = 0.83 meters. The "vara" is used in rural areas of Nicaragua.

The pumping capacity indicated in the table is based on operation under normal conditions. Even for children it is easy to fill a bucket thanks to the high efficiency of the pump. This is an important requirement to obtain the social acceptance of the rope pump.

The diameter of the pipes is determined by the depth from wellhead to water level:

Depth (varas)	Pumping pipes	Discharge pipes
0 - 13 varas	1 " inch	2 " inch
13 - 23 varas	3/4" inch	1 ½" inch
23 - 50 varas	1/2" inch	1 " inch

The pulley wheel is made from the inner sidewalls of 20" inch truck tires, but for wells deeper than 35 varas (about 30 meters) 16 " inch tires or smaller are used. In shallow wells, up to 3 meters and up to 5 meters, pumping pipes of 2" and 1 ½" respectively are used with a discharge pipe of 3" inches.

For extra strong rope pumps, the support structure of the pulley wheel is made of thicker iron and some additional supports and reinforcements compared to the family rope pump. Bolts embedded in concrete are used to fasten the rope pump to the concrete slab. In this way the wheel can be changed

if necessary. Different variations of the extra strong rope pump can be found depending on the type of use that it is to be given. These variations are:

- The use of two pulley wheel handles for relatively deep wells in the range of 30 to 50 meters.
- The use of wooden bearings similar to those used in the engine driven rope pump. These are employed when the rope pump is used during several hours each day. If more than 20 families are using the pump the application of wooden bearings is justified.
- The application of a pulley wheel protector to cover the pulley and protect it from the sun and dust

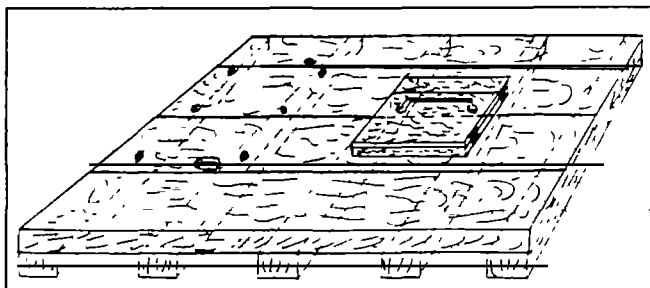
These variations do not influence the installation process.

SPECIFICATIONS OF THE WELL COVERS AND STRUCTURES TO FASTEN THE ROPE PUMP

In the next section a description is given for the construction of a wooden cover and concrete slab, as well as instructions on how to fasten the pump to the cover.

a) Wooden cover

Place two wooden beams at least 2x4" thick across the wellhead. Place the wheel (support structure of the pulley wheel) on the beams accommodating them in such a way that the rope which hangs down loose does not touch the inside wall of the well or the beams. This can be checked with a plummet or by hanging a rope with a small weight down from the pulley wheel. The pumping pipe may be positioned so that it barely touches the wall or wellhead. The pulley wheel handle should extend far enough away from the wellhead to operate the pump. The two beams will be part of the wooden well cover. Reinforce the wooden cover with sufficient wooden beams which should be covered with planks at least 1" thick. In these cases an access hatch is not required because the pipes of the pump can be brought into the well while the cover is partially removed.

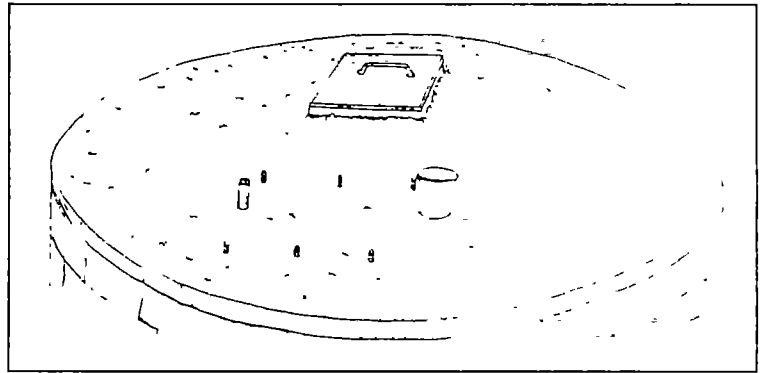


Wooden cover

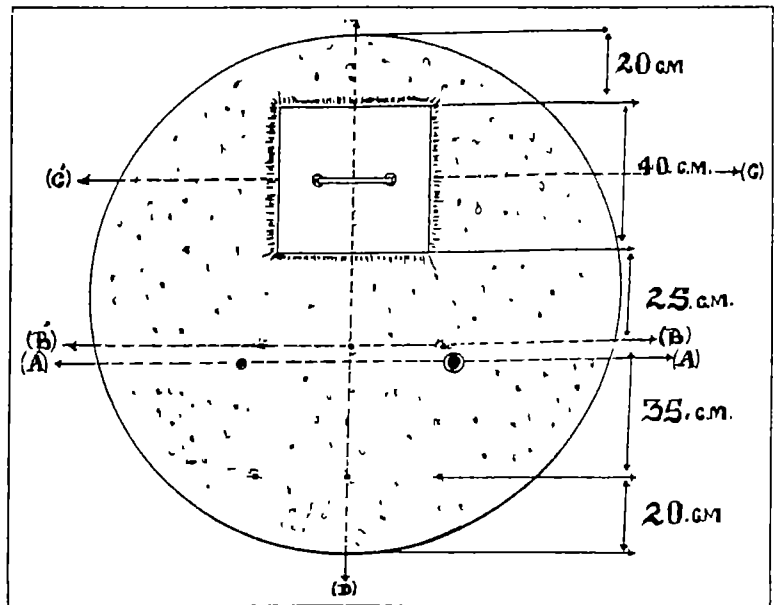
b) The concrete slab

Protecting the water quality in the wells is one of the main reasons for installing hand pumps, because in this way the well can be sealed thereby preventing filtration. Although the rope pump does not seal the well hermetically it does give a high protection against contamination. The use of a rope pump instead of a bucket with rope decreases contamination of the water, and the use of the concrete well cover gives even better results. The construction of the concrete slab requires some experience in masonry. The materials needed depend on the diameter of the well. For a wellhead of 1.4 meter in diameter the following materials are needed.

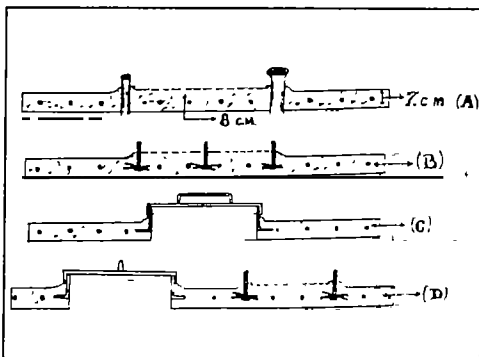
- 3 buckets 1/4" gravel
 - 3 tins of sand
 - 1 1/2 sacks of cement
 - 24 meters 3/8" concrete iron rods
 - 15 meters of fastening wire
 - Strips of plywood measuring meters in length and 7 centimetres in height
 - 3 meters of 1"x 4" planks to make the mould for the access hatch
 - the wheel for the extra strong rope pump
 - protection pipes of which the diameter depends on the pumping pipe to be used
 - 6 rustproof bolts with reinforcements and the cover of the access hatch with its frame, both of which can be purchased with the rope pump if desired
- (The quantities of cement, gravel and sand indicated depend on the locally used containers, but they should be in a proportion of 1:2.5: 5.)



Concrete slab



Dimensions of the slab



Vertical section of the slab

Steps for building the concrete slab.

- Select a clean place for the elaboration of the slab.
- Make a circle from the plywood strips according to the dimensions of the well.
- Determine the position of the pump and the access hatch.
- Position the mould of the access hatch. The outside dimensions of the mould are equal to the inside dimensions of the access hatch frame.
- Cut and fasten the concrete iron rods for reinforcement. The rods should have a distance of about 12 centimetres between each one.
- Position the wheel with its bolts in such a way that the reinforcement rods do not disturb the positioning of the pumping or protection pipes, using the plummet to determine the exact place of these pipes. The angle-irons of the wheel should be placed on supports in order for them to remain about 2 centimetre above the concrete surface of the slab.
- The slab should be at least 7 centimetres thick.
- Prepare the mixture, wet the frame and rods and cast the concrete. Position the protection pipe and

a piece of pumping pipe.

- Place the frame of the access hatch over the mould and lower it about two centimetres into the concrete mix.
- After a few hours the mixture for the plaster can be made.
- Fill the space underneath the angle irons and around the pipes so that any excess water will flow off the slab and not remain around the pipes or beneath the angle irons.
- Give a finishing touch to the slab with plaster.
- Wet the slab completely after three hours. This should be repeated at least three times a day for five days.

c) Structure for installation on drilled wells

A drainage apron is made around the drilled well. The wheel should be positioned against the well where the plummet indicates the correct place. The bolts and their reinforcements are embedded in the concrete of the apron. The apron should be a few centimetres high at the point where the wheel is to be placed.

Details are explained in the annex on installation of the extra strong rope pump on drilled wells.

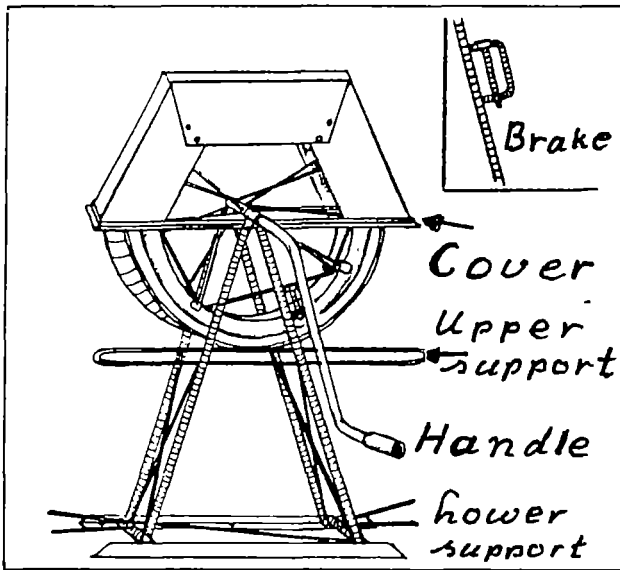
INSTALLATION

The rope pump is of an uncomplicated design, made of just a few components and easy to install. We recommend that technicians who install the pump follow step by step the instructions given in this manual in order to ensure its proper functioning. In a separate annex some aspects of the installation of rope pumps on drilled wells are explained.

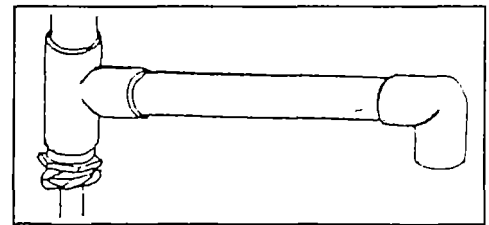
a) LIST OF COMPONENTS, TOOLS AND MATERIALS

COMPONENTS:

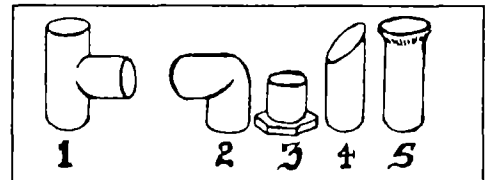
The rope pump consists of the following components:



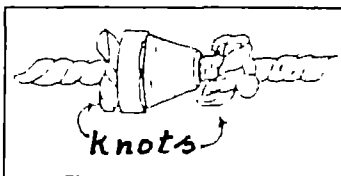
a1. Structure of the wheel.



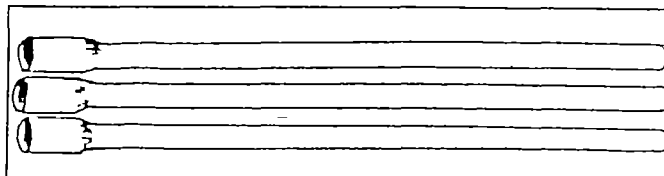
a2. Discharge pipe



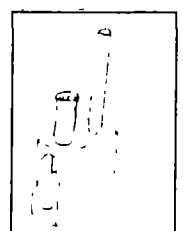
a3. 1 = Tee 2 = Knee
3 = Reduction 4 = Nipple
5 = Protection pipe



a4. Rope with piston



a5. Pumping pipe



a6. Guide

- * The pulley wheel is turned with the handle to move the rope and pump water.
- * The brake prevents the wheel from turning backwards after pumping.
- * The pipes are fixed to the supports.
- * The pistons on the rope are fixed with a knot in front of and behind each piston, one meter apart. The rope is about 6 millimetres or a quarter of an inch in diameter.
- * The guide on the bottom of the well prevents rubbing or wear on the rope and pistons when entering the pumping pipe.

TOOLS AND BASIC MATERIALS:

Pipe-cutting saw, oil-syringe or greaser, 8 meters of galvanised wire to probe the pipes and insert the rope, matches or cigarette-lighter.

For installation on a prepared concrete slab: Key number 14 to fix the nuts.

For installation on a wooden cover: Claw-hammer, saw, chisel, key number 10 and 11 if wood-screws are used.

Installation on a concrete slab which was not specially made for the installation of a rope pump requires the following additional tools: A 4 pound sledge-hammer, 5 and 8 mm augers for concrete, a drill, concrete chisels, and key number 10 or 11 to fix the screws in the plugs.

Useful tools although not indispensable are: Measuring-tape, plummet, gauge, drill and 3/4" augers for wood, file or rasp for wood.

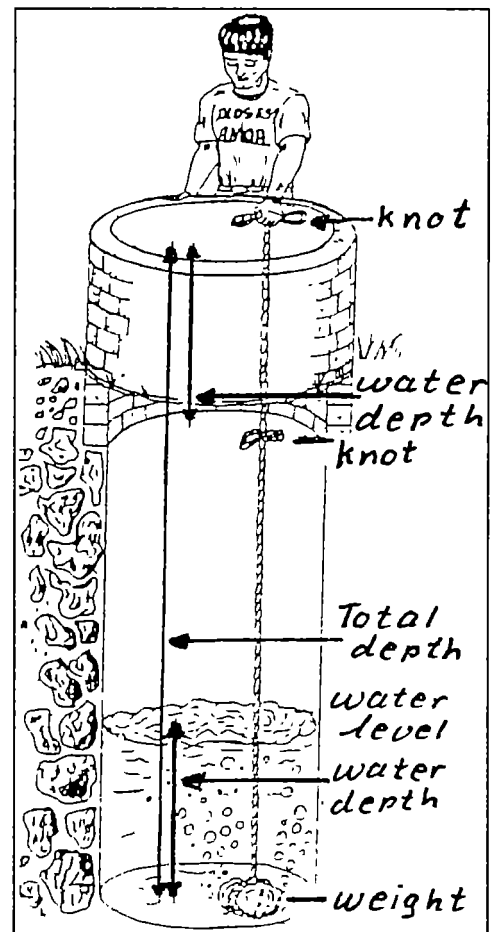
Materials for installing the rope pump are: PVC-glue, rubber strips cut out of an inner-tube, 6 mm or 1/4" screws with hexagonal head, 8 mm concrete plugs, 2" and 4" inch nails.

b) INSPECTING AND MEASURING THE DEPTH OF THE WELL

Make an inspection of the well and ensure that there are no roots or other type of rubbish in the well which could affect the functioning of the pump. It is always best that the well be cleaned before installing the pump.

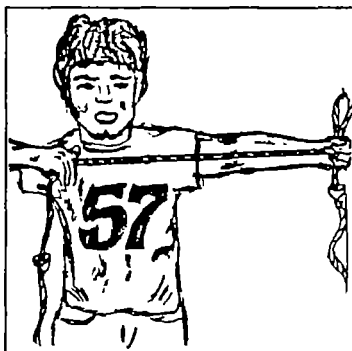
To measure the depth of the well, a rope with a heavy object tied to one end is used. The weight should be lowered carefully from the wellhead until it touches the water level and a knot made; then it is lowered until it touches the bottom of the well and a second knot is made.

The distance between the two knots gives an indication of the quantity of water in the well. Although the rope pump will work with a minimum of 20 centimetres of water in the well, it is recommended that the well has at least 1 meter of water.

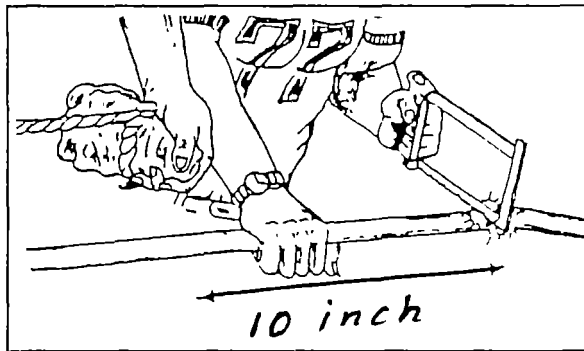


b1. Measuring the well

Once this has been done, the rope is removed from the well and measured in arm-lengths. In this way the depth of the well from wellhead to water level, and the quantity of water in the well can be determined. The same rope is used to measure the length of the pumping pipe which can



b2. Measuring the depth



b3. Cut the pumping pipe, leave 10 inches extra

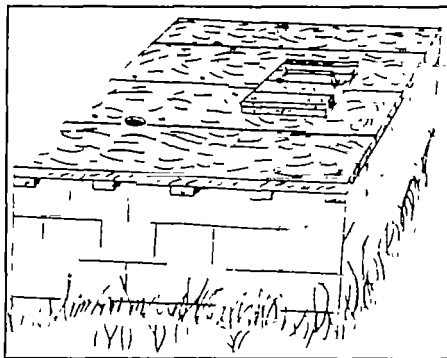
then be cut leaving about 10 extra inches. After inspecting and measuring the well, the diameter of the pumping pipe can be determined. This diameter depends on the depth from wellhead to water level. Refer to the chapter on Technical Specifications.

c) PREPARING THE CONDITIONS FOR INSTALLING THE PUMP ON THE WELL

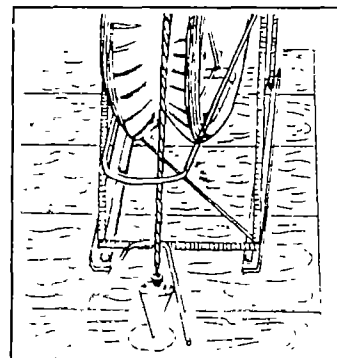
In this paragraph a description is given on how to position the wheel on the well cover. First the conditions are prepared for a wooden cover, a concrete slab or the apron for the drilled wells as indicated in the paragraph on Technical Specifications.

c-1 Wooden Cover:

Place the wheel on the wooden cover in such a way that the rope hanging down loose into the well does not touch the wellhead. The pumping pipe may be positioned against the wall or wellhead. The wheel must be screwed onto the beams used to reinforce the wooden well cover. A hole the size of the diameter of the pumping pipe is made in the cover.

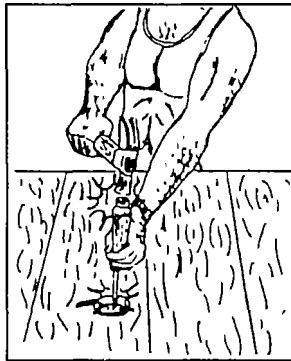


c1.1. Wooden cover

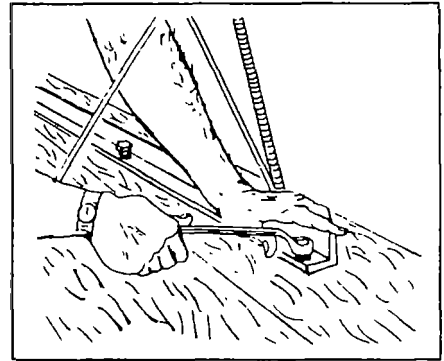


c1.2. Use the plummet

A plummet hanging over the wheel determines the exact place of the hole. In the same way a hole is made in the cover for the rope which hangs down. This hole has to be of a greater diameter in order to prevent the rope and pistons from rubbing against the cover.



c1.3. Make the hole

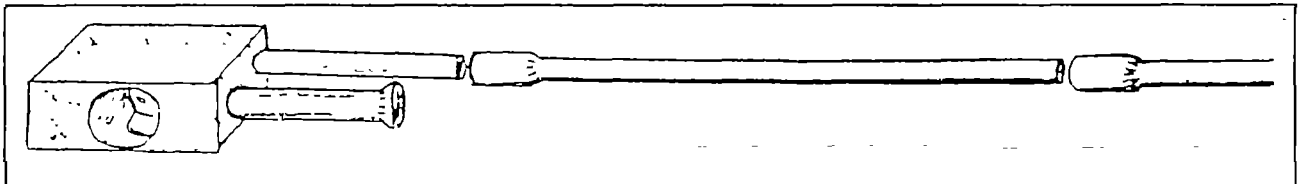


c1.4. Fasten the screws

c-2 Concrete slab:

Fixing the wheel to the previously prepared concrete slab is quite easy. Place the wheel over the bolts and fix it with the nuts.

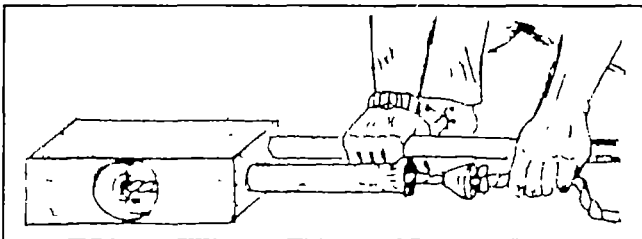
d) POSITIONING THE PIPES OUTSIDE THE WELL AND THE GUIDE



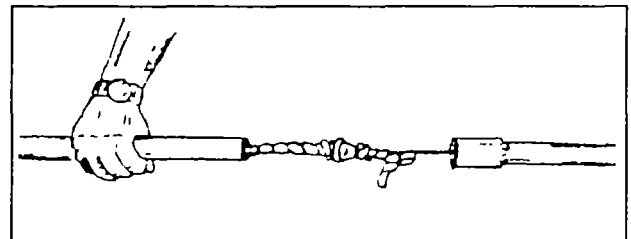
d1 Extension of the guide and the pumping pipes

- 1- Position the guide near the well
- 2- Position the pipes with the jacket towards the guide so that they can be joined

e) HOW TO INSERT THE ROPE INTO THE PIPES



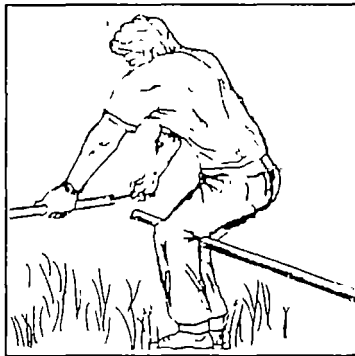
e1 Introduce the rope in the guide



e2. Wire and rope to probe the pipe

Insert the end of the rope through the two pieces of pipe of the guide in such a way that the pistons go into the pipe like arrows and not like cups. In this way the pumping process functions where pistons pass through the pumping pipe like arrows and not like small cups. The rope is fastened to the galvanised wire to probe the pipes. The wire is about 8 meters in length. The wire is inserted into the first pipe starting at the end where the guide is placed.

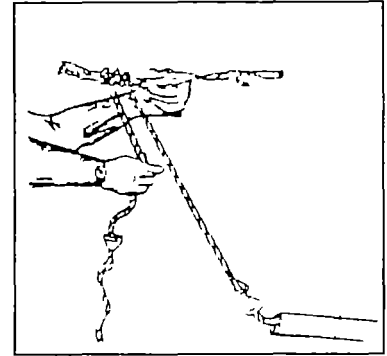
Be careful that the pistons are not introduced backwards. Study the drawings carefully.



e3. Pass the wire



e4. Pass the rope

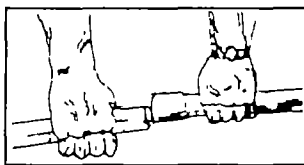


e5. Tie a small object to the rope

As the wire comes out of the first pipe, it should be pulled out and at the same time inserted into the next one and so on until leaving the last pipe. Then some small object must be tied to the rope to prevent it from slipping back into the pipe. During this process the pipes are not yet glued together. Unwind the other half of the rope and tie the two ends together to prevent the rope from falling down into the well during installation.

f) HOW TO PUT THE PVC-GLUE ON THE PIPES

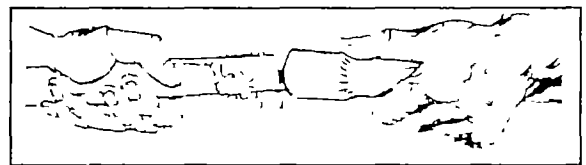
Before assembling the pipes, the jackets should be checked for dirt. Using a small brush or a finger, cover the outside part of the pipe at the side where there is no jacket with PVC-glue. Immediately thereafter insert the pipe into the jacket of the next pipe, giving it half a turn and leave it to dry for a few minutes. Do not put glue inside the jacket.



f1. The Pumping pipes



f2. Put the glue on



f3. Connect the pipes

g) HOW TO INSERT THE PIPES WITH THE ROPE INTO THE WELL

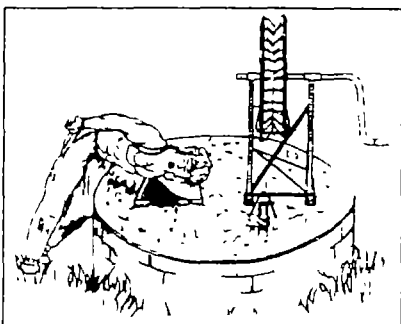
Insert the guide with the pumping pipe into the well through the access hatch. One person lowers the pipe while the other lowers the rope, using a bit of tension while the guide is lowered. (see drawing g1). Prevent the pipe from rotating while it is being lowered into the well as this would cause the rope to wind itself around the pipe. When the guide touches the bottom of the well the two ends of the rope should be untied. The end of the rope which comes out of the pumping pipe should be passed from beneath through the hole in the slab. The pumping pipe should then be put through the same hole. (see drawing h1.) Pass the other end of the rope through the protection pipe and tie both ends to the wheel.



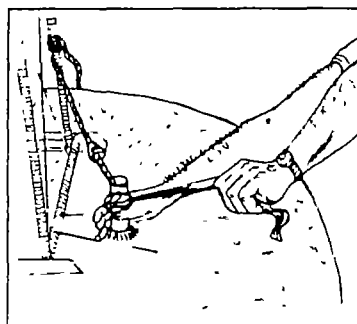
g1. Introduce the pipes

h) HOW TO FASTEN THE PIPES TO THE SUPPORT STRUCTURE AND TO THE SLAB

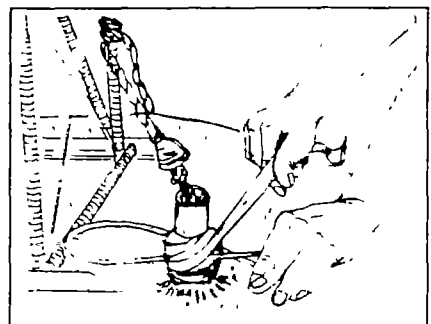
Lift the pumping pipe until the guide no longer touches the bottom of the well. Cut the pipe four inches above the slab. In order to prevent the pipe from slipping back through the hole in the slab a rubber strip of inner-tube must be wound around the pumping pipe. Using another rubber strip, fasten the pipe to the support located at the base of the wheel.



h1. Pass pumping pipe through the slab



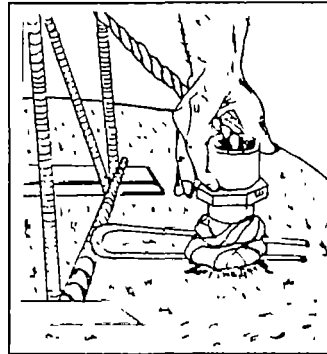
h2. Wind rubber strip around the pipe



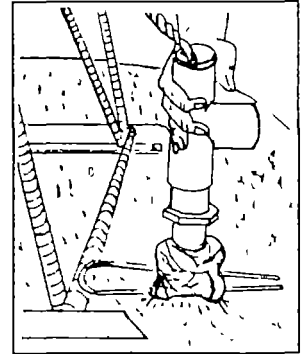
h3. Fasten the pipe in the lower support

i) ASSEMBLY OF THE T-PIECE, NIPPLE AND DISCHARGE PIPE

Cut the pumping pipe to the desired height. Next, place the reducer on the projecting end of the pumping pipe and the T-piece on the reducer. These should not be glued together in order to allow the rotation of the discharge pipe in the direction desired by the user.

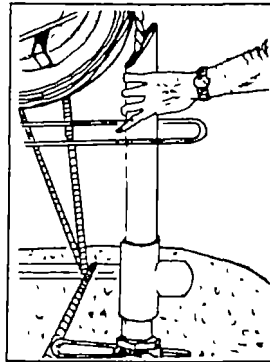


i1. Put the reduction piece

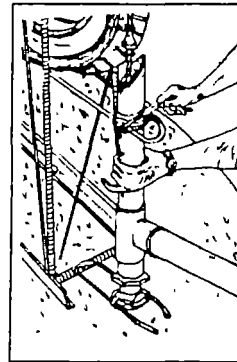


i2. Put the Tee piece

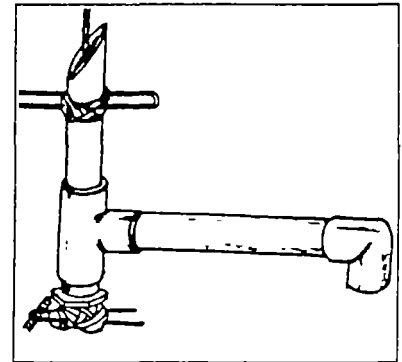
Cut a piece of pipe, to be used as the nipple, of such a length that does not touch the rubber of the pulley wheel. The nipple should be fastened to the upper support with rubber strips of inner-tube. Cut one meter of discharge pipe and place the elbow on one end. Glue is not used in any of the procedures.



i3 Place the nipple



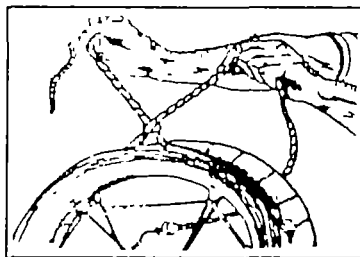
i4. Fasten the nipple



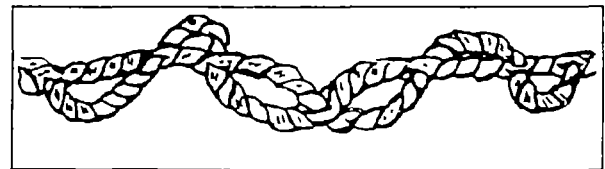
i5. Fastened with rubber strips

j) HOW TO KNOT TOGETHER THE TWO ENDS OF THE ROPE

Place the rope, with the desired tension, over the pulley wheel to indicate where the knot should be made. Remove the rope from the pulley wheel and cut it, leaving about 5 extra inches at each end. Burn the ends with a cigarette lighter or matches and twist them while they are hot.



j1. Tension the rope



j2. Braid ends together

Take the two ends and braid them together as shown in figure j2, then put the rope back on the pulley wheel. The tension is correct when the rope does not slip or slide back over the pulley wheel while pumping water.

MAINTENANCE AND REPAIR

The rope pump has excellent characteristics with regard to its operation and maintenance.

Its operation is very easy and consists solely in turning the handle. The brake can be removed while pumping to prevent continuous noise. Once finished pumping, the brake must be put back on in order to prevent the pulley wheel and handle from turning backwards.

MAINTENANCE

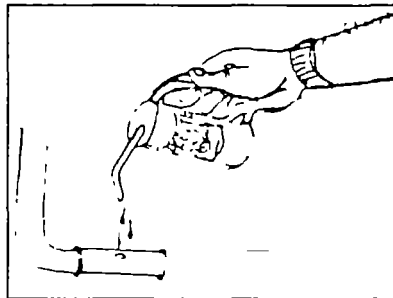
The maintenance can be divided into:

PROPER ROPE TENSION

It might be necessary to correct the tension in the rope during the first weeks the pump is used, as the knots tend to lengthen the rope. Lack of tension in the rope will cause the rope to slip over the pulley wheel. To alter the tension in the rope, remove the rope and untie the knot. Put the rope back on the pulley wheel with the desired tension to measure where the new knot must be made, and repeat the process of braiding.

GREASING

Oil or grease the bushings of the axle and the handle when considered necessary. To do this any type of oil or grease can be used.



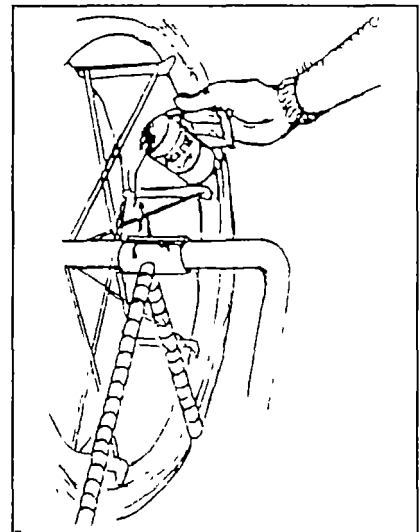
Oil the handle

FASTENING

The fastening of the wheel should be revised periodically, checking the nails or screws.

CLEANING AND PAINTING

To prevent corrosion, clean and paint the wheel every year.



Oil the bushings

REPAIR

With proper maintenance the rope pump should not cause any problem. The most common problems are caused by the rope which is of a thickness (1/4" or 6 millimetres) which would, under normal circumstances, last three years. The most common failures and their solutions are:

WEAR OF THE ROPE

Excessive wear of the rope can occur when the rope is slipping over the pulley wheel while pumping or when the rope is rubbing against the well cover or wall. Replace the rope and prevent rubbing by correcting the tension.

REPLACING THE ROPE

To replace the rope, insert a support rope without pistons into the pipes while removing the worn rope. The same support rope will serve to insert the new rope into the pipes. Be careful of the direction of the pistons.

BROKEN ROPE

Before removing the pipes from the well a support rope without pistons but with a small weight on its end, should be lowered through the pumping pipe. (The weight must fit into the pipes while passing through the guide to the other side.) Next the pumping pipe is removed and the new rope with pistons is inserted with the help of the support rope.

If the pipes are already out of the well, the whole pipe must be probed with a wire the length of the pumping pipe in order to be able to insert the new rope with pistons.

ROPE STUCK IN THE PUMPING PIPE

This kind of failure is normally caused by waste in the well being suctioned into the pipe. Should it not be possible to solve the problem by pulling the rope backwards, the whole pipe must be taken out of the well in order to pull the rope more firmly. If neither of these procedures is successful, the pipe must be cut at the place where the problem is suspected and changed. To join the pipes again a jacket must be made. This kind of work requires some experience.

THE WELL DRIED UP

If the well dries up, it should be deepened by about a meter. Before installing the pump again, an extra piece of pumping pipe is needed. The pumping pipe must be lengthened using an extra piece of pipe with the jacket directed downwards. An extra piece of rope is also needed.

HOW TO MAKE A JACKET ON A PIPE ?

The commercial pipes always have a jacket at one end. But in case it was necessary to cut the pumping pipe or if you only have access to a piece of pipe without a jacket it will be useful to know how to make one.

Heat the end of the pipe (only one inch), take it out of the fire and insert a piece of the same type of pipe into the heated end. Repeat this procedure about three times to obtain a complete jacket. The pipe which was used to make the jacket will reduce its diameter when inserted into the heated pipe end. Cut this pipe when it is reduced too much. (At all times prevent the pipe from burning or scorching. The smoke generated by PVC is known to be very dangerous.)

