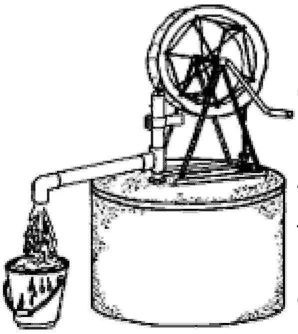


The Rope Pump

The rope pump technology is a solution for water provision used at the family level as well as at the community level, and covering already 25 % of the rural population in Nicaragua. The technology was disseminated in a very short time over the whole country and part of Central America with more than 25.000 pumps installed in hand dug wells and drilled wells. It is the national standard pump for the water & sanitation sector.

Information:
Technology Transfer Division,
Bombas de Mecate S.A.
P.O.Box 3352, Managua, Nicaragua.
Fax 00-505-2784045,
E-mail: ropepump@ibw.com.ni

St Joseph Institute
Lunsar, Sierra Leone
Padre Mario, Padre Gianni
00 232 76 865 956, 076 842 116
E-mail: gzanni06@libero.it
≈ 70 USD equipped with PVC pipes

Sustainability

Favourable Characteristics of The Rope Pump Technology Are:

- High social acceptance.
- High efficiency and durability.
- Easy repair and maintenance by users themselves.
- Local production and thus availability of spare parts.
- Applicable up to a depth of 60 metres.
- Low cost

Interesting studies and evaluations related to sustainability and applicability can be found in: Studies and evaluations.
Costs: The cost of a rope pump is in the range from 70 to 150 US$.
Operation, Maintenance and Repair
Spare Parts

The major conclusion is that the rope pump can potentially form a valuable addition to the range of appropriate groundwater lifting technologies in other countries.

Summary
Anna Cornelia Gorter
Childhood diarrhoea and its prevention in Nicaragua.
Phd. Thesis. University of Maastricht
December 1998

Some of her findings:
"A final practical result from our studies was the development of the rope pump technology. Rope pumps are now widely promoted as a low cost, easily maintained means to improve water availability in many developing countries. The hand-dug well is the traditional type of water source that is mostly used in rural areas. Facilitating the task of drawing water through the installation of a rope pump will reduce the time that is needed to get water. The total amount of used water will increase. Our study looked at the well water quality under a variety of different conditions, comparing bucket and rope wells, with wells with a windlass and rope pump wells. Results indicated a strong reduction of the faecal coliform contamination of the well water due to the installation of a rope pump, compared to bucket and rope wells."

Summary
Rachel Blackman
MSc Poverty Reduction and Development Management 1998-9
International Development Department
School of Public Policy
University of Birmingham

In 1999 Miss Rachel Blackman elaborated an interesting report based on dissertation for MSc Poverty Reduction and Development Management 1998-9, University of Birmingham.
"Financing of rural water supply systems from a rights perspective: A case study of the rope pump in Nicaragua"

One of the conclusions:

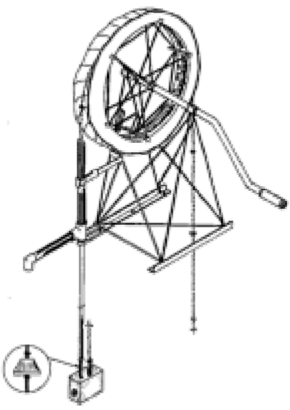
"The common belief that sustainability is dependent on recovery of capital costs is brought into question because rope pump users take responsibility for maintenance and repair regardless of whether they paid the capital cost of the pump, facilitated by fact that this is simple and cheap to do."

Summary
Nynke Post Uiterweer
Community water supply with ropepumps at family level
Wageningen University

In 2000, Miss Nynke Caroline Post Uiterweer, Wageningen University. Presented the evaluation report Community water supply with ropepumps at family level. An evaluation of five development projects in Nicaragua and one in El Salvador.

Some of here findings:

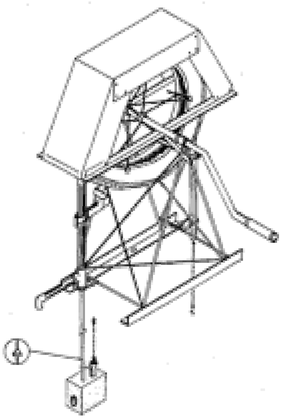
- The majority of the families feels responsible for the maintenance and repair of their rope pump, is able to do it, and really carries it out, independent of if they had to pay the pump or not.
- The Bombas de Mecate S.A. produced and installed rope pump has a low dropout number. Only 6.6% of the inspected pumps were out of order due to technical failures or negligence of the user. The pump proves to be a sustainable solution for water supply in rural Nicaragua.


Family Well rope pump

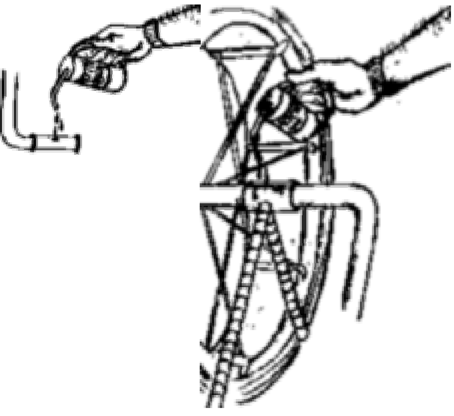
Costs

COST OF A ROPE PUMP

- The cost of a rope pump is in the range from 70 to 150 US$. This always includes the pumping pipes and accessories needed to install the pump.
- The rope pump used at family level has a cost of 70 US$.


Extra Strong rope pump

- The so called Extra Strong Rope Pump has a cost of around 100 US$. The wheel structure of this pump is stronger and it is provided with a cover over the pulley wheel. This is the type generally used at community level.
- The rope pump used on bore holes includes some additional accessories and is therefore a bit more expensive.
- Several other types are available with for example a total galvanized structure or with a cover which encloses the whole pulley wheel.



Operation, Maintenance and Repair

OPERATION

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 the pumping is finished, 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 of use, as the knots tend to lengthen the rope. Lack of tension in the rope can 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. Any type of oil or grease can be used to do this.

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

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

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, under normal circumstances, lasts three years. The most common failures and their solutions are:

WEAR TO THE ROPE
Excessive wear to 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 or slipping 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 and pass through the guide box at 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 of 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 detected 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 one metre. 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. *(Prevent the pipe from burning or scorching at all times. The smoke generated by PVC is known to be very dangerous*

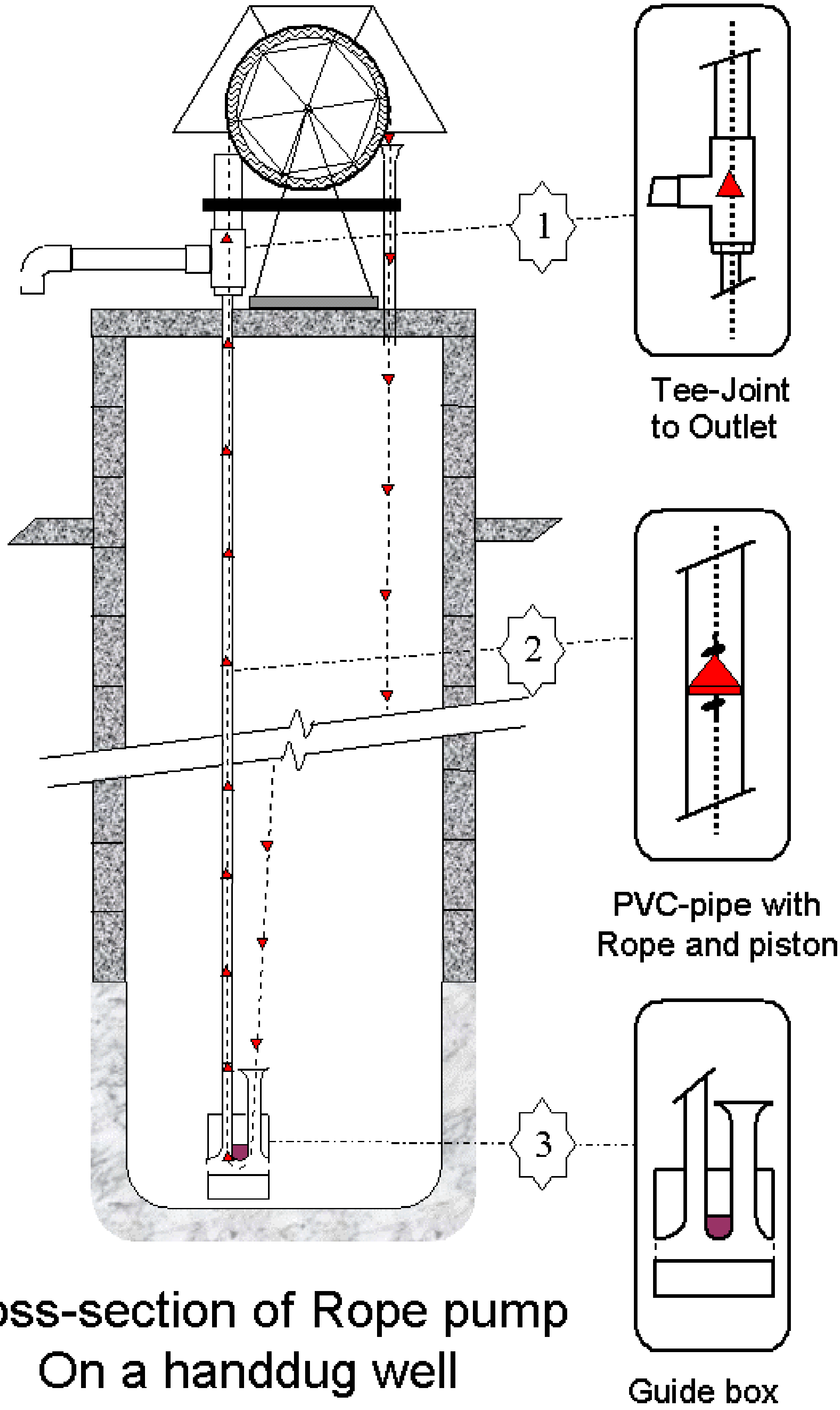
Spare parts

The only spare parts which require the rope pump are the rope and the pistons.
The rope has an approximate live time of 3 years. The rope of the rope pump used at family level has a live time of over 5 years. Family level in Central America means an average of three families per pump. At community level the live time of the rope can go down to one year depending on the number of users.
The pistons have in the same way an approximate live time of 5 years. Pistons of good quality don't break but do have certain wear. The wear and thus decrease of the diameter of the pistons influences negatively in the efficiency of the rope pump. The necessity to change the pistons depends on the application, depth and number of users.

The rope can be found on the local market and can be changed by the users themselves. The pistons have to be acquired at the rope pump producers or at the intermediate piston producers. As the rope pump is (or will be) a national product, the spare parts will be available at the local market as well.
The cost of a new rope prepared with pistons is in the range of US$ 10 to US$ 20, depending on the depth of the well. The pistons will have a cost of around US$ 0.20 each depending on the diameter.
Each metre of rope requires one piston.
The turnover of spare parts at the rope pump producers is very small, less then 3% of the total turns over.

The Technology

The pumping elements of the rope pump are the pistons and the endless rope, which pull the water to the surface through the pumping pipe made of PVC or plastic. The rotation of the wheel, moved by the handle, pulls the rope and the pistons. The pistons, made of polypropylene or polyethylene injected into moulds, are of high precision to prevent hydraulic losses. The structure is basically made out of angle iron, piping and concrete steel. The pulley wheel is made out of the two internal rings cut out of truck tires and joined by staples and spokes, which must be strong for intensive use. A guide box at the bottom of the well leads the rope into the pumping pipe. The guide box is made out of concrete with an internal glazed ceramic piece to prevent any wear. The rope pump can be operated by the whole family and is also used at the community level, for small agriculture production or cattle watering. It is also a high efficiency and low cost technology, but includes some pieces of high precision and high quality.



Cross-section of Rope pump
On a handdug well

Application specification

Rope pumps are installed on hand-dug wells and on drilled wells or boreholes. There is no need for the pumping pipe to be installed vertically which means that rope pumps can be installed as well at riversides for irrigation or at the side of e.g. scope holes.

Maximum depth reached by the rope pump.

- 40 metres standard
- 60 metres with adjustments and double crank
- 80 metres in experimental phase

The water depth required in a well.
The minimum water depth in a well required for a rope pump is only 10 centimetre. The guide box is positioned on the bottom of the well as sand does not affect the functioning of the rope pump as can happen with other brand pumps. In extreme dry seasons when the water table goes down, the rope pump will keep on working until the well really dries up. In this case neither with rope and bucket water can be drawn. This is an important fact related to social acceptance too. When the water table in a well goes down and the traditional pumps can't reach the water any more, than the users blame the pump as they still can fetch water with their rope and bucket. In reality the pumps are OK, but the need to place the foot-valve at certain distance above the bottom of the well to prevent sand coming into the pump, causes this situation.
A hand-dug well should have of course preferably at least one metre of water. In practice the older wells will have a depth of about one metre below the groundwater level of the driest season of the last decennia.

The depths of the hand-dug wells found in Nicaragua can be distributed in:

- 45% in the range 0 - 10 metre
- 30% im the range 10 to 20 metre
- 15% in the range 20 to 30 metre
- 10 % deeper than 30 metre

The maximum depth of hand-dug wells is about 100 metres. These cases are of course quite exceptional.

The depth of the water table in drilled wells depends very much on the local geologic situation.
The four inch casing is the minimum diameter for the drilled wells to install standard rope pumps. The casing can be as small as two inch and still a rope pump with a small diameter guide box can be adapted.

Pumping Capacity of the rope pump according to depth:

Depth(metres)	**Adult(Litres per minute)**	**Child(Litres per minute)**	**Time needed for an adult to fill a barrel (minutes)**
5	70	39	3
10	41	19	5
15	27	13	8
20	20	10	10
25	16	8	13
30	14	6,5	15
35	12	5,5	18
40	10	4,8	20

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.

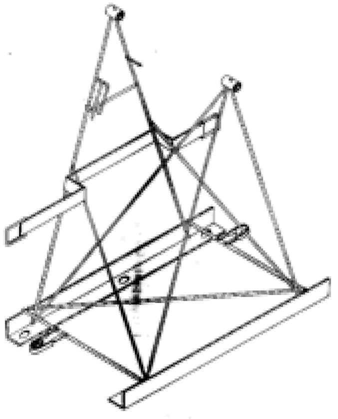
Depth (metres)	Pumping pipes	Discharge pipes
0 - 11 metres	1 " inch	2 " inch
11 - 19 metres	3/4" inch	1½" inch
19 - 50 metres	1/2" inch	1 " inch

The standards used in PVC pipe production differ from one country to the other and will thus influence in the indicated ranges.

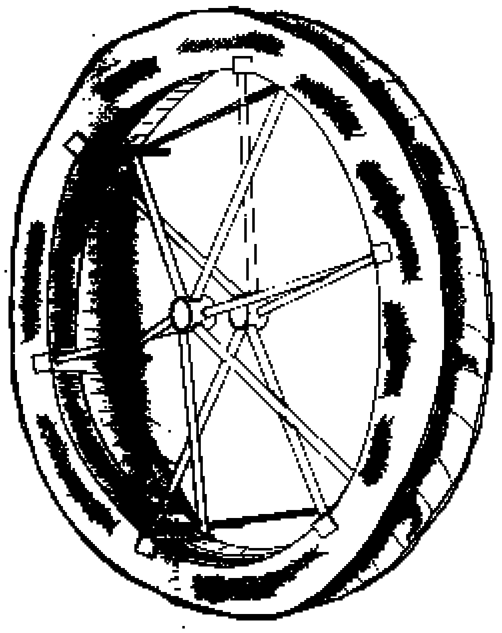
Wheel

The function of the rope pump structure is to support the efforts of the axle, wheel, and crank, as well as fix the pumping pipe, both entry and exit sections. It is the aesthetic part (Visible) of the pump and is installed on the well cover. The types of materials and their diameters depend on the use given to the equipment.
The structure is basically made out of pipes, iron rods, iron strip and angle iron. The pulley wheel is made out of the two internal rings cut out of truck tires and joined by clamps and spokes, which must be strong for intensive use. The 20" inch truck tires are used, but for wells deeper than 29 metres 16 " inch tires are used.

Wheel structure



Pulley wheel



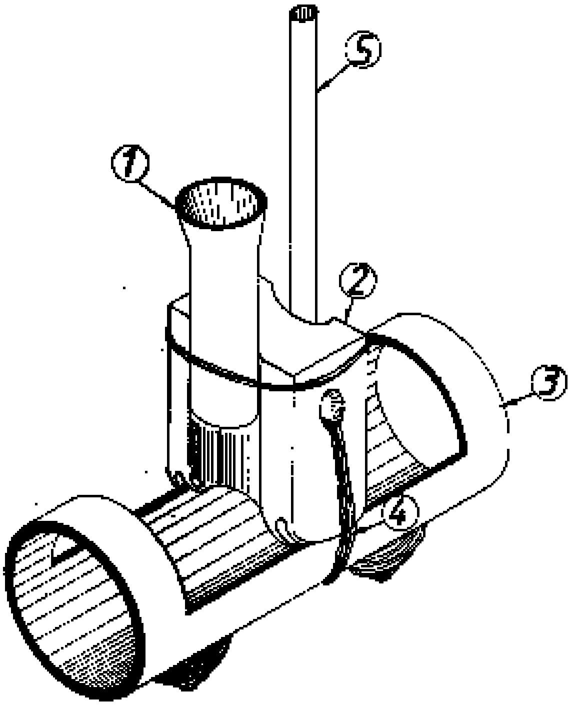
The Guide

The guide is installed at the bottom of the well and is where the pumping process is initiated. Its function consists of guiding the rope with pistons attached so that it enters into the pumping pipe from below, as well as maintaining the pipes taught (plumbed) with the appropriate tension. Therefore, the guide has various functions integrated into one piece. It serves as well as a counterweight to tauten the rope in order to avoid sliding on the wheel.

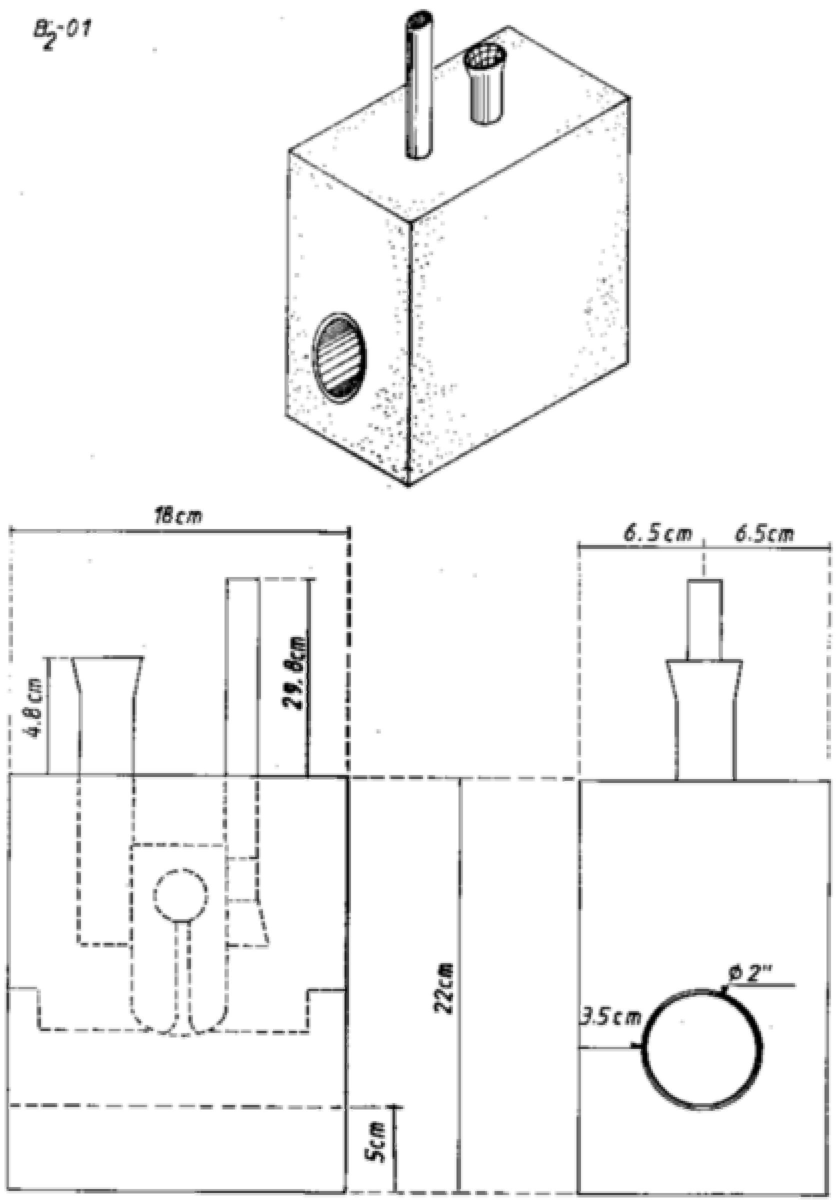
The guide is a concrete box with a base piece, an entry pipe, a pumping pipe and support pipe, and a ceramic piece inside. These parts of the guide must be made in such a way that the rope never touches the concrete, which would cause wear to it as well as to the pistons.
In the production are no iron parts involved and therefore, the rope pump is not susceptible to rust problems and can be used in very corrosive water.
The entry and pumping pipes on the guide have a wide mouth to facilitate the entry of the rope and pistons.
The water enters the guide through the base piece (2" PVC pipe) located at about five centimetres from the bottom of the guide. The guide itself is placed on the bottom of the well. This allows practically all of the water to be drained from the well. This is important when a well has very little water, as water can still be extracted, which would not be the case with a bucket and rope.

The Ceramic piece

The ceramic piece in the center of the guide has a design that was developed based on practical work and corresponds to various needs at the moment of assembly. The ceramic piece is shaped like a horse saddle to stop the rope from leaving the canal formed by the saddle. The ceramic piece is made of refractory clay similar to white porcelain. Its vitrification temperature is between 1250 ^{o}C and 1300 ^{o}C. The ceramic piece has a coat of enamel, which makes it completely smooth there where it touches the rope. This enamel does not wear.



Ensemble of the internal pieces of the guide box



Guide Box

Pipes

The pumping pipes are a fundamental part of the rope pump. The recommended pipe should meet ASTM D-2241 standards. All piping is the pressure type used for potable water. In Nicaragua, measurements are in inches, whereas other countries use millimetre measurements, requiring adaptation. Several countries have changed from PVC to plastic pipes; these equally can be used in rope pump production.
A fundamental difference with the traditional piston pumps is that the weight of the water column is distributed over the pistons and is thus hanging on the rope. The inside pressure on the pipe wall is minimum and as high as the water column between two pistons. The pumping process is a continues process and not an intermittent up and down movement, therefore there is no fatiguing breakage. Only the pumping pipes plus the guide box are hanging on the upper pumping pipe.

Pumping pipes vary according to the depth of the well. The deeper the well, the smaller the diameter of the pipe. The maximum weight of the water in the pipes is 10 kilograms and should not be exceeded. Therefore, if pipes with different measurements are used, the maximum depth should be adapted to the maximum weight of 10 kilograms.

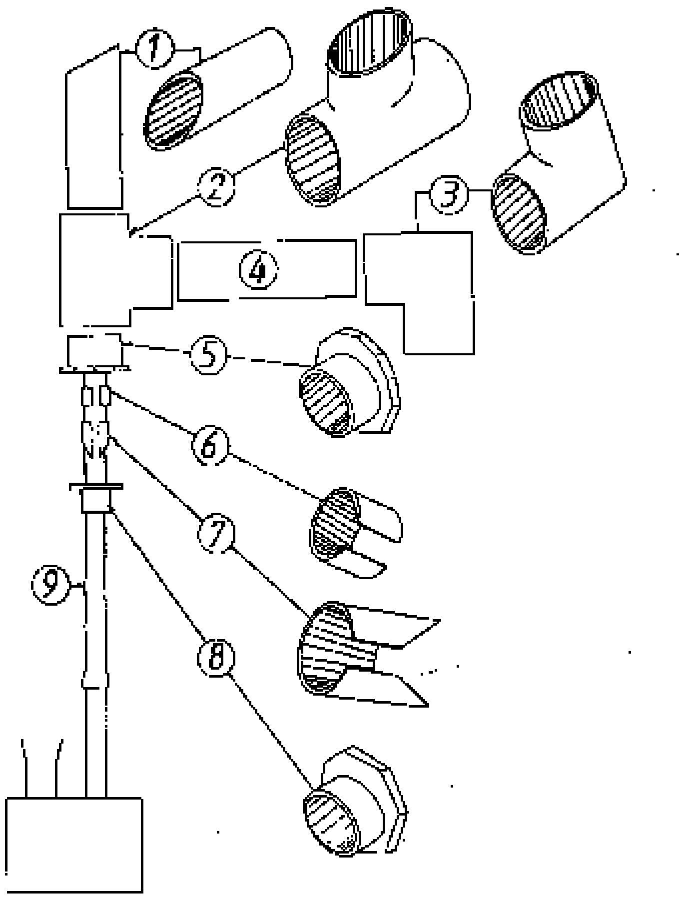
The diameter of the pipes is determined by the depth from wellhead to water level.

Depth (metres)	Pumping pipes	Discharge pipes
0 - 11 metres	1 " inch	2 " inch
11 - 19 metres	3/4" inch	1½" inch
19 - 50 metres	1/2" inch	1 " inch

Deficiencies have been encountered in the pipes depending on their origin of production. Examples of these, which can affect the pumping pipes, are:

- The inside diameter does not meet standards. This causes a problem when the diameter is smaller than what has been established because the piston will not fit or will fit but cause friction.
- The inside walls of the pipes are rippled, which can cause unforeseen friction.
- The jacket is not made correctly. Some jackets are found to have a narrowing, right before the widening, where the pistons stick.

Example of the installation accessories used for the rope pump installation.



Pistons

The pistons are one of the most sensitive parts of the pump. Together with the rope they form an endless chain. When the rope rotates it leads the piston through the pumping pipe, pushing the water inside upwards.
The piston is a cone shaped part with a hole on its top and must meet the following norms:

- Exact dimensions.
- Cone shape to reduce friction.

- Strong and water-resistant material.

The piston diameters vary with depth as do the pumping pipe.

- Piston diameter is determined by the type of pipe to be used and the well's depth. Pistons should be made of injected polypropylene or polyethylene. Neither rubber nor wood are recommended.

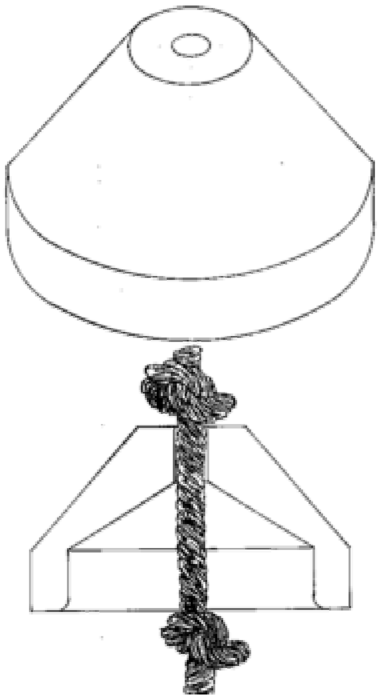
- The rope's length, diameter and amount of pistons are determined by the well's depth.

- Two-inch (0 - 3.5 metres depth) and 1 ½" inch (3.5 - 5 metres depth) pistons are used in wells which are not too deep or when motor driven rope pumps are used.

- A perfect fit is required between the pistons and the pumping pipe. The space between piston and inner wall of the pipe is only 0.15 mm for the 1/2 inch pipe and up to 0.40 mm for the 1 inch pipe. The production of the moulds thus requires high precision.

Piston production requires a small plastic injection machine, and different-size moulds. The pistons are made of high-density polypropylene or polyethylene. Polyethylene is poured in the injection machine hopper. As the plastic passes through the heated hopper bottom, it becomes fluid and is injected into the mould. As it cools, the plastic adopts the mould's form.

PISTON



Rope

In Nicaragua an approximately 5 millimetres diameter polypropylene fibre rope is used.
The rope, together with the pistons, functions as an endless band transporting water. The pistons are located the entire length of the rope and are attached with two knots, one in front of the piston and one directly behind it.
When installing, the ends are attached by braiding. Knots are not used as they are difficult to untie when tautening the rope or for repairs.

The rope must have the following characteristics:

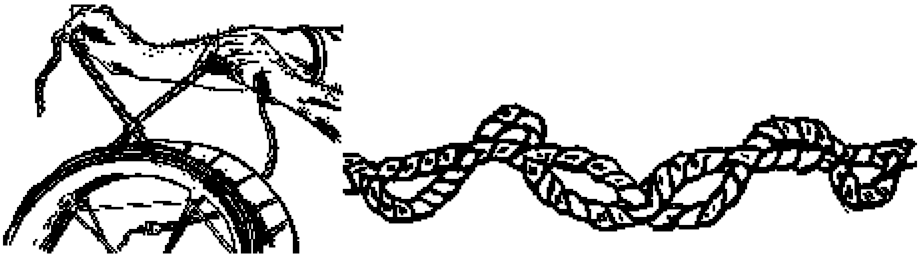
- Be sufficiently strong and durable.

- Must not be stretched during use. Rope that is stretched over time will cause a lack of tension on the wheel resulting in the pump beginning to slide.

- Must not be too smooth to avoid sliding on the wheel.

- Must be water resistant.

Installing 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. Take the two ends and braid them together as shown in figure k2, 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.

Efficiency

There are several facts around the efficiency of the rope pump.

The social acceptance of the rope pump comes forth out of its efficiency. The first application of the rope pump was on open family wells where it had to compete with the bucket with rope or the bucket with rope and wind-lass. Fetching water with a rope and bucket is an almost 100% efficient process, it just takes some additional time to lower the bucket when no energy input takes place neither.

In comparison to the traditional piston pumps the pumping process of the rope pump is quite different. It is a continuous circular movement with a constant energy input and constant force.
The force required during the pumping stroke of a traditional pump has to be the double to reach a similar energy input as it is an up and down wards movement with energy input mainly during the pumping stroke. This is an important fact especially when children are involved.

The pumping capacity of the rope pump.

The pumping capacity of the rope pump depends firstly on the pumping power of the user, which can be between 30 and 100 watts. However, the diameters of the piston and its distance, the depth of the well and the diameters of the pipes and mechanical loss in the guide box and in the bushings could also be determining factors.

The pumping process.

When the crank is turned and the pumping pipe is completely filled with water, the pumping process has begun. Air never enters the pipes. The total weight of the water column is distributed equally over each of the pistons, as long as they have the same diameter, creating a downward pressure. Each piston pushes the water upward.

Efficiency Losses.

Losses take place at:

1. Friction in the bushings of the axle
2. Friction of the rope passing through the guide box
3. Friction of the pistons against the inner wall of the pumping pipe
4. Water leaking down around the pistons
5. Kinetic energy losses
6. Friction in the bushings of the axle.
   The energy input of the user is around 75 Watt. Friction losses show themselves through

noise and warming up of these bushings. Simple calculations and experiments showed that these losses can't exceed 3% of the energy input with normal greased bushings.

7. Friction of the rope passing through the guide box.
   This friction is minimal and must be minimal as it shows itself in wear of the rope and thus can be neglected.

8. Friction of the pistons against the inner wall of the pumping pipe.
   These energy losses never should take place. In recent installed rope pumps this however can happen because of e.g. a seam around the pistons or dust in the pipes. Over time (days) these losses will disappear as the seams on the pistons wear.

9. Water leaking down around the pistons
   The pumping process can be described as a column of water on each piston with the length of the distance between the pistons. This column filters downward around each piston at a certain speed.
   The speed at which the water filters downwards is approximately proportional to that of the distance between the pistons to the power of 0.65 and is directly proportional to the surface of the opening between the piston and the pipe.
   It is easy to obtain a first estimate of volumetric losses and efficiency, considering that the filtration is constant and (almost) does not depend on the pumping speed. By pumping water and decreasing the speed of rotation, a speed is reached wherein water filters downward at the same speed as upward pumping, and at that very moment no water is pumped out. The water column remains semi stable up to the height of the reducer and the volumetric efficiency is zero. Taking the example that to achieve this, nine turns per minute are required, whereas normal operating conditions require 45 revolution per minute, this results in a loss of 9 in every 45 and therefore in a volumetric efficiency rate of 80 %. A volumetric loss of 20 % is considered acceptable while a new pump should have a loss in the order of 10 %.

10. The Kinetic energy of the water column in the pipe, which is proportionate to the speed squared, and with which the water reaches the surface, is also a loss of energy. However, kinetic losses are, under normal operating conditions, less than 1 % of the applied power.

Therefore, the overall efficiency of a (good quality) rope pump is in the order of 80 to 85 %.

The Production Process

The Rope Pump is simply-designed manually-operated mechanical equipment intended for use in rural areas.

The rope pump components include a pulley wheel, pistons, rope, a guide box, PVC piping, and a variety of accessories. The production process for each piece follows specific steps.

A plastic injection machine is used in the piston production process. High-density polyethylene is used as raw material. The various piston melds differ in diameter. Raw material is transformed into high-resistance conical plastic pieces known as pistons. Different size pistons are used in accordance with well depth.

Another pump component is the rope, from which it derives its name. The rope should preferably be made of polypropylene or an adequate substitute material. It serves to tightly fit the pistons and pull them through the suction and entrance pipes.

The guide box is the rope pump's main piece. Its components include an entrance pipe, a pumping pipe, a ceramic piece, a base, and concrete casing. The function of the guide box is to guide the rope and pistons under and into the pumping pipe, keep the pipe in place (plumbed) and ensure adequate rope tension.

A two-step process is involved in the production of the ceramic piece. First, the piece is made by hand. Once this step has been completed, the piece is fired in an electric or gas kiln. Natural clay is transformed into a glazed ceramic piece. The process includes the hand-making of the piece, dehydration in a kiln, and glazing procedure. By guiding the rope into the pumping pipe, the glazed ceramic part prevents it from rubbing and wearing.

Regarding the pulley wheel, this is manually produced through a mechanical process in which a variety of tools to measure, bend, cut, assemble, and solder are used. Its function is to rotate the pistoned rope. Through this process, rods and angle irons, as well as transversely cut tires are transformed into parts of the wheel, such as the wheel structure and brake.

In terms of wheel structure, it is classified according to use. It can be a family-well rope pump, an extra-strong rope pump, or a community well rope pump. Each of these structures has specific features.

As to the process of pump production, it includes a variety of steps, such as plastic injection; hand-making, dehydration and glazing of ceramic piece; metal work to make the wheel structure and pulley wheel; and other manual mechanical work.

A rope pump is a unique product which requires a specialized production process that involves a wide range of steps.

WARNING

The rope pump is in its installation, use and maintenance, an appropriate technology, which does not require any special tools. However, its production includes high quality parts.

THE ROPE PUMP at its current technological level:

- o Does not have a rope with pieces of rubber acting as pistons!
- o Does not have a crank with screwed in pipes and elbows!
- o Does not have a siphon in the bottom of the well acting as a guide!
- o Does not have a wheel made from wood or a bicycle wheel

Rope Pump Models

The rope pump is a simple technology that has been widely applied in the Nicaraguan rural area, especially in water and sanitation projects. But it has also become an alternative to support small farm production through other models that constitute the diversification illustrated for future producers or persons interested in this technology.

The following models exist:

- Pumps for drilled wells
- Double-crank pumps
- Arial pumps (to fill tanks)
- Bici-bombas (bicycle type pumps)
- Air pumps (activated by the wind)
- Animal traction pumps (activated by a horse or ox)
- Motor pumps (activated by a gasoline motor)
- Tractor-adapted pumps (Activated by the power of a tractor)

THE DOUBLE-CRANK PUMP

The double-crank pump is similar to the extra-strong pump, with certain adaptations in order to be able to extract water from relatively deep (37 to 50 meters), dug or drilled wells. When two people work to turn the wheel, the power applied is duplicated (75 watts x 2) and therefore, there is a capacity to raise the water column from this depth. This is the reason for the double crank on this type of pump.

The structure of this pump is the same as the extra-strong pump. The pieces of tire that are used to make the wheel are from a # 16" hubcap, which are more flexible. This is why they have 12 clambs made of iron strips of 1/8" x 1" with their respective spokes and supports. It is important to mention that even though this pump is being installed on a dug well, it should be installed as if it were a drilled well in order to increase contact between the wheel and rope and avoid sliding.

The two handles are attached together by soldering down the centre of the two bushings of the wheel, so that it does not suffer added weight since tension is placed on the bushings. The bearings are wooden blocks with an inside nominal diameter of 3/4", and therefore the handles and wheel are removable. The piston and pumping pipes have nominal measurements of 1/2", and the discharge pipe is 1". The rope to be used is a relatively thick nominal measurement of 1/4", so as to ensure that it has sufficient strength to support the weight of the water column. Furthermore, when the rope takes up more of the space in the pipe, the volume of water to be extracted is less, thus making the crank easier to turn and the human energy expended less. On the other hand, at this depth knots are not used to fasten the pistons. Instead braids or injected polyethylene knots are used.

In these pumps which are installed for depths of less than 37 meters, pipes with larger diameters and 20" hubcaps can be used, resulting in greater amounts of water for special applications such as draining wells.

THE PUMP FOR DRILLED WELLS

The double-crank pump, which has a proven limit of 50 meters in depth, is recommended for drilled wells, as they are usually deep. Drilled wells originated in water and sewage projects in rural areas, and their diameter is in the range of 4" to 12". When the well is drilled, a PVC pipe is inserted becoming the walls of the well. A PVC plug is placed on the terminal of the pipe. Installing a rope pump on a drilled well is simple, but certain technical parameters must be considered. A 32" (long) x 23.5" (wide) x 14" (high) pedestal must be built so that the exit pipe is located at the height of a bucket.

An enamel ceramic piece with fastening support is installed in the pump structure, which must be aligned with the return pipe so as to ensure that the rope enters vertically without touching the pipe. Another method for inserting the rope into the pipe is by using a curved pipe which starts in a horizontal direction below the wheel and almost makes a 90o turn to enter the return pipe which projects from the plug of the casing. This curved pipe can be made of PVC, filled with sand and heated slowly. However, the rope tends to wear a groove in the curved pipe made of PVC. A good alternative to replace the PVC curved pipe is bent thin-walled galvanized pipe.

Since these wells are deep and of a small diameter, on installation the guide tends to twist and get tangles up with the rope. This is the reason for double pipes, the pumping pipe and the return pipe, which lead to the sealed plug which has two holes, and which should be aligned with the ceramic piece. The installation accessories should be placed past the sealed PVC plug and should remain firm so as to ensure that the pipes do not sink to the bottom.
The guides used are cylinder-shaped and must measure 1" less than the diameter of the well. The ceramic piece for 4" wells is smaller than that normally used on drilled wells.

OTHER TYPES OF PUMPS

The other types of pumps previously mentioned, such as the aerial pump (to fill tanks), the Bici-bomba (bicycle type pump), the Air-pump (activated by the wind), the animal traction pump (activated by a horse or ox), the motor pump (activated by a gasoline motor) and the Tractor adapted pump (Activated by the force of a tractor), are not discussed in this document.

ROPE PUMP PRODUCTION

PHOTOMANUAL

PRESENTATION

This document includes step-by-step photos of the rope pump production process. A detailed description of the various steps in the pump production process and the corresponding diagrams precede each photographic sequence. Thus, the document offers a graphic explanation of the technique used in the rope pump production process.

In March 1996, the Governments of Nicaragua and Switzerland - through COSUDE - signed a new three-year bilateral cooperation agreement through which INAA-COSUDE programme activities are to continue for the period 1996-1998. Within the framework of this agreement, the transference of rope pump technology seeks to promote rope pump production at the regional and international levels. The Technology Transfer Division of the Rope Pump Company will be in charge of carrying out the aforementioned production activities. The Division receives technical consultancy services from the Dutch Ecumenic Development Cooperation Organization known as "Servicio Ultramar" ("Overseas Services") or DOG (for "Dienst Over de Grenzen").

This is an easy-to-understand document and is aimed at future producers, cooperation organizations working in the field of water and sanitation, and other persons interested in the rope pump technology.

It complements other documents produced or in production, which provide the basis for the transference of technology at the international level.

The Manual reflects the experience accumulated by the Rope Pump Company over the years, as well as its technical development.

The production process is presented in photographic sequence and includes the following steps:

A. Piston production by plastic injection and rope pistoning

B. Glazed ceramic and guide box production processes

C. Metal-mechanic production of pulley wheel and wheel structure, as well as production of a variety of rope pump protection and security accessories

This Manual has been prepared by the Technology Transfer Division of the Rope Pump Company. It can be freely reproduced.
Los Cedros, Province of Managua, Nicaragua. 12 March 1997.

OBJECTIVES

1. To transfer in a simple, clear and precise manner the rope pump technology

2. To present a detailed photographic sequence of each step in the rope pump production process

3. To complement the knowledge and experience reflected in other technological documents (technical drawings, production as well as installation techniques)

4. To serve as didactic material for the various training courses provided by the Technology Transfer Division of the Rope Pump Company

5. To facilitate information to clients and friends of the Rope Pump Company who wish to acquire a more in-depth knowledge of the rope pump production process

   In this WEB-site only some of the 55 photo pages are included

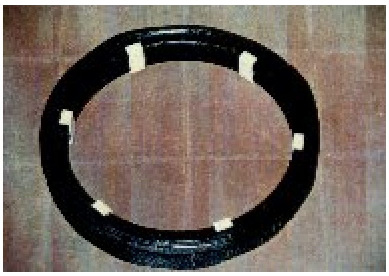
---

Making Pulley Wheel Hub

Place two used tire cuttings (#20) on device.

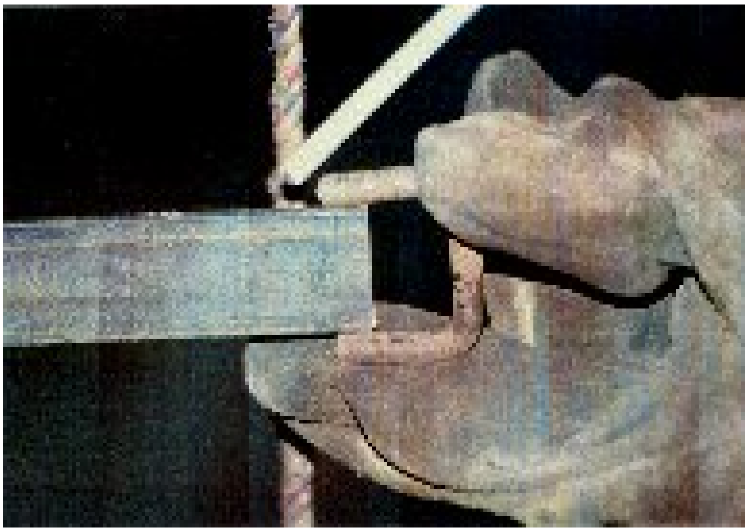
Staple tire cuttings together.

Tire cuttings already stapled.



Upper Support and Finished Wheel

Solder upper support of discharge nipple.



Clamp upper support buckle.

Finished wheel.