ROPE PUMP PRODUCTION

PHOTOMANUAL

Photographic Presentation of the Rope Pump
Production Process

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Produced in cooperation with the National Institute for Aqueducts and Sewage Systems (INAA) and the Swiss Development Cooperation Agency (COSUDE).

March 1997

CONTENTS:

I

PRESENTATION

I - 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.

II

OBJECTIVES

II - 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.

III

DESCRIPTION OF THE ROPE PUMP PRODUCTION PROCESS

III - DESCRIPTION OF THE ROPE PUMP PRODUCTION PROCESS

The Rope Pump is a 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 moulds 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 handmaking 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.

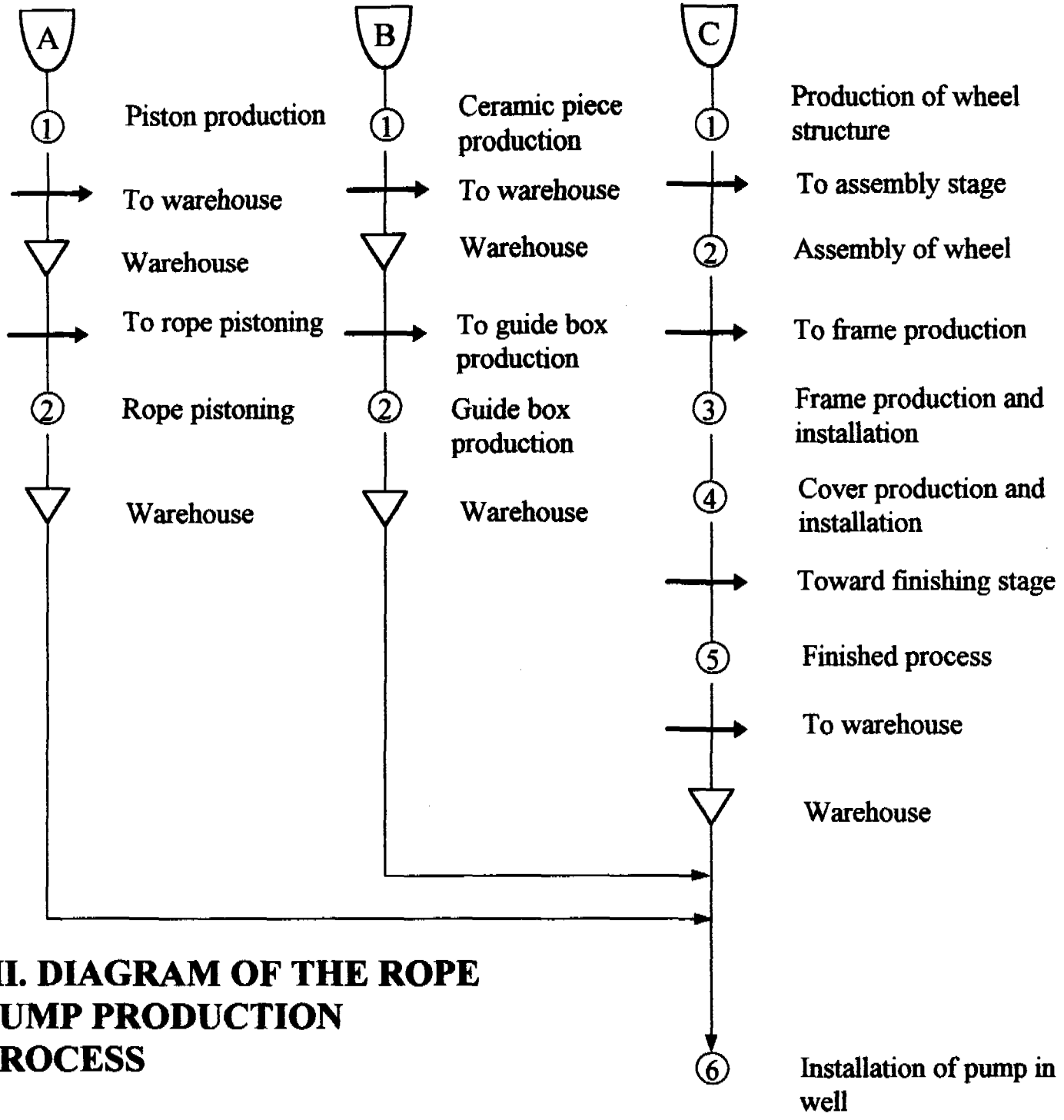
Through this process, rods and angle irons, as well as transversely cut tires are transformed into parts of the wheel, such as the wheel structure and brake.

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; handmaking, dehydration and glazing of ceramic piece; metal work to make the wheel structure and pulley wheel; and other manual mechanical work.

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

PUMP PRODUCTION PROCESS DIAGRAM



III. DIAGRAM OF THE ROPE PUMP PRODUCTION PROCESS

Operation	Symbol	Amount
Operation	○	8
Transportation	→	8
Op-Inspection	◎	2
Delay	D	-
Inspection	▭	-
Warehouse	▽	5

A.1.

PISTON PRODUCTION

A.1. PISTON PRODUCTION PROCESS

Process Description

Piston production requires a small injection machine, and different-size moulds, such as ½", 3/4", 1", 1½", and 2". These are to be used in a variety of pipes, in accordance with well depth.

Pistons are made of high-density polypropylene or polyethylene. Given their characteristics, plastic wastes can be recycled and used again to be injected.

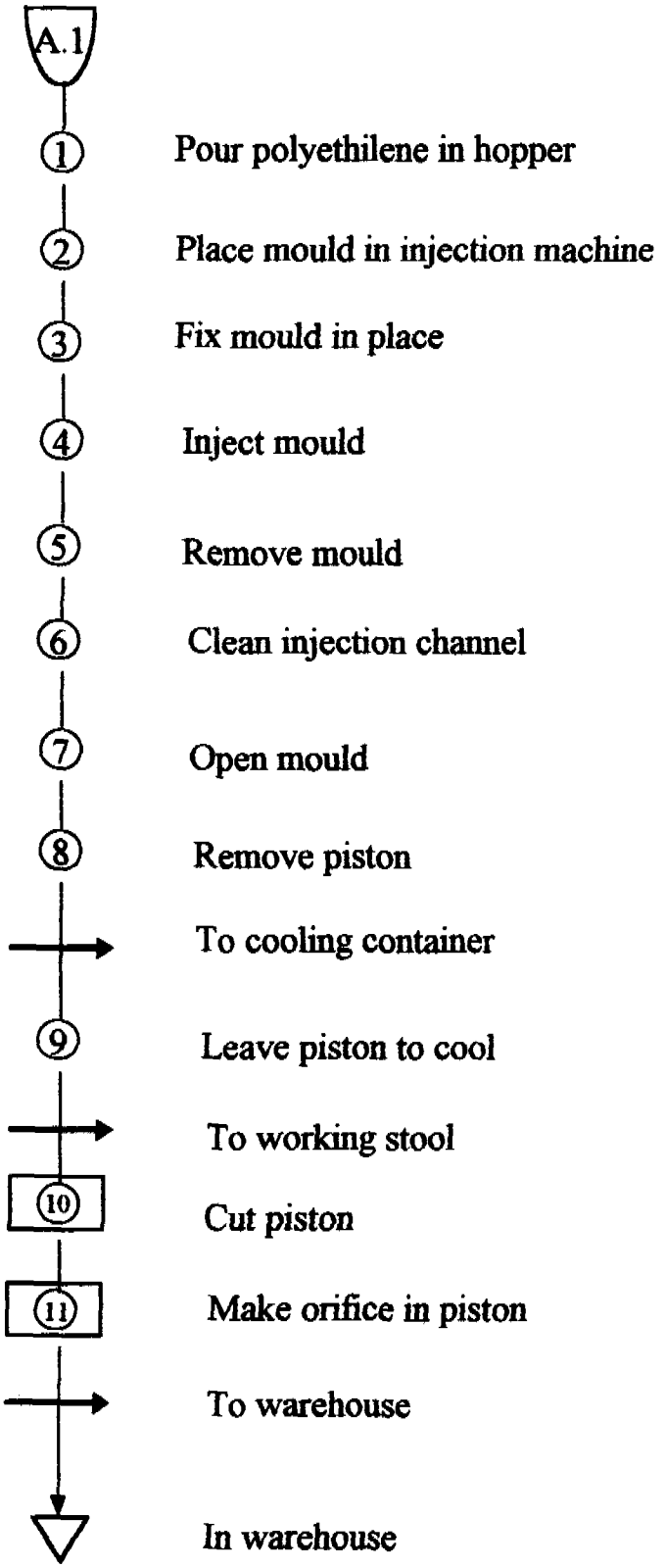
Polyethylene is poured in the injection machine hopper. As the plastic passes through the heated hopper bottom, it becomes fluid and is injected into the mould. As it cools, the plastic adopts the mould's form.

The piston injection process includes the following steps:

1 Pour polyethylene in the injection machine hopper.
2 Set mould in place
3 Fix mould with clamp.
4 Inject mould.
5 Remove mould from injection machine.
6 Clean injection channel.
7 Open mould and remove piston.
8 Leave piston to cool.
9 Open orifice in the piston to let rope through.

A diagram of the piston production process is presented below, as is the photographic sequence of the process.

A.1. PISTON PRODUCTION PROCESS

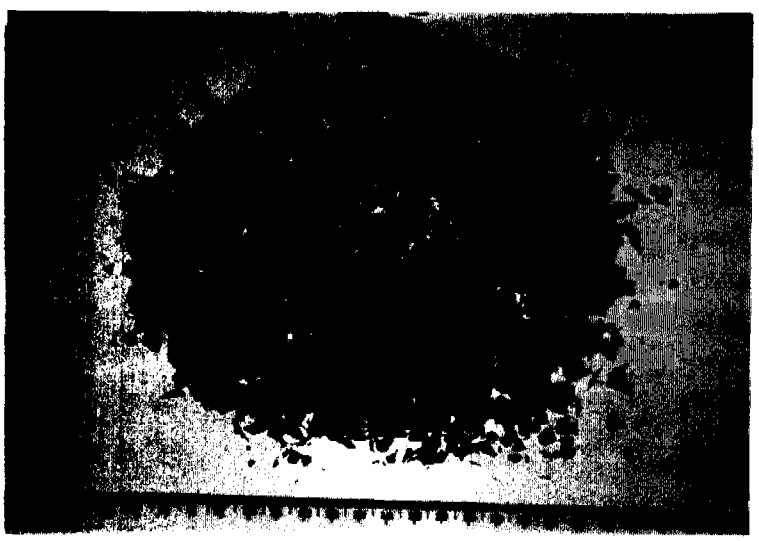


Operation	Symbol	Amount
Operation	○	9
Transportation	→	3
Op-Inspection	⊡	2
Delay	D	-
Inspection	▭	-
Warehouse	▽	1

High-density polyethylene base for piston production.

Polyethylene wastes waiting to be recycled.

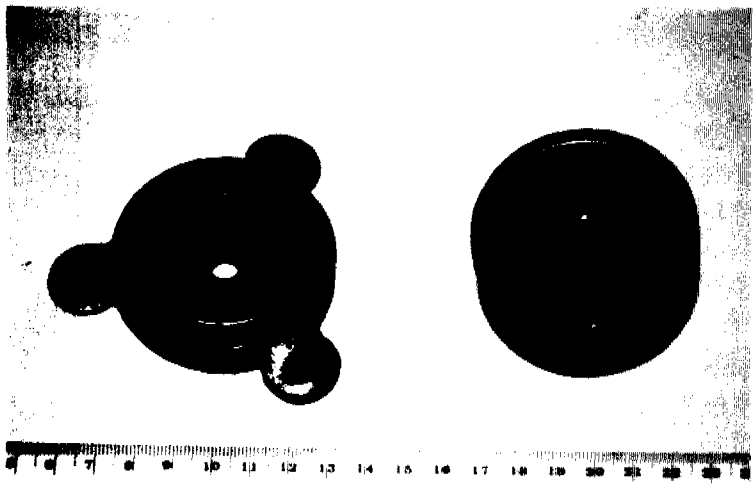
Recycled wastes ready to be used anew in the production of pistons.



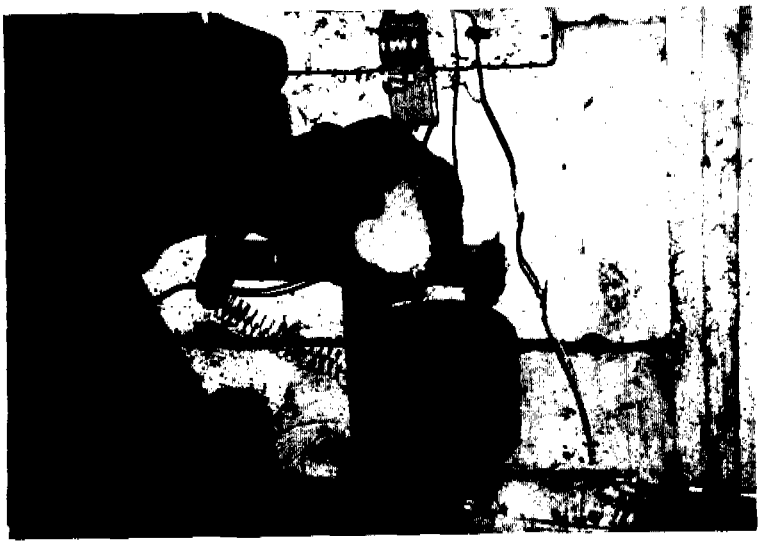
Machine to inject polyethylene.

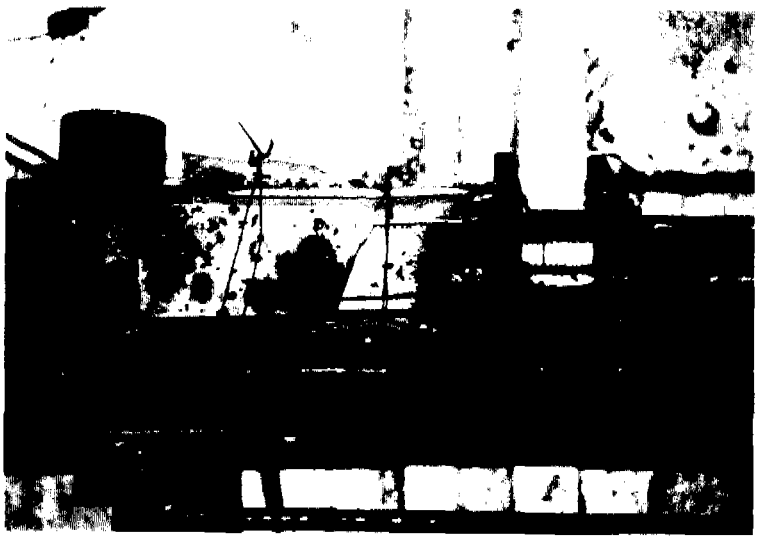
Different-size moulds to inject pistons: 1/2", 3/4", 1 ½" y 2" inches.

Piston mould components.



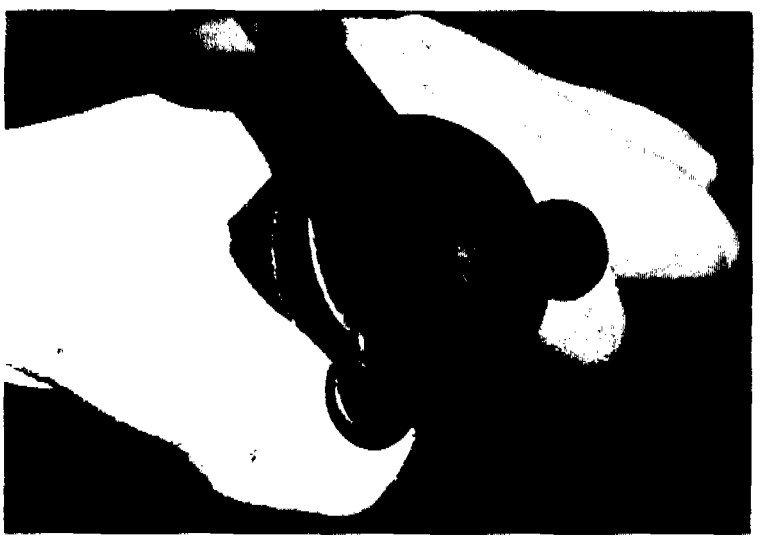
Heat injection machine and pour polyethylene in hopper.





Place mould in injection machine and fix it with clamp. Inject fluid polyethylene at a temperature higher than 134° degrees centigrade.

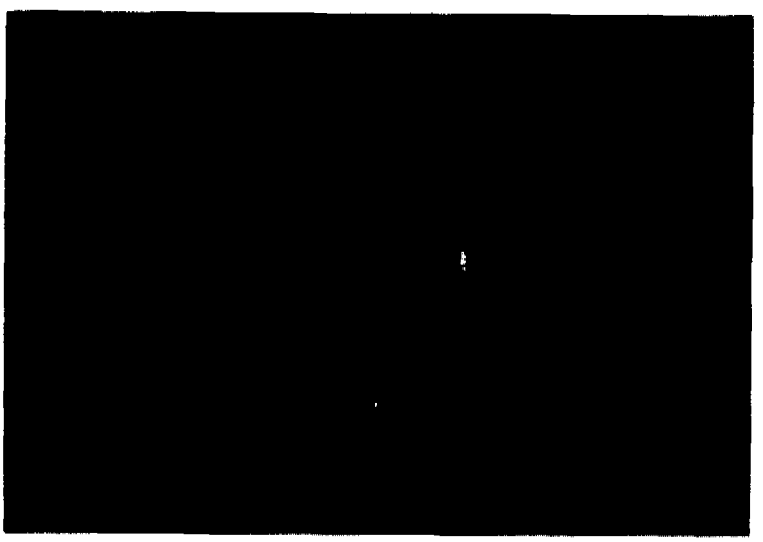
Once the mould has been injected, use gloves to remove it from injection machine and clean injection channel.



Open mould and use pliers to remove piston.

Cut tip of piston so as to leave an orifice through which to insert the rope.

2", 1½", 1", ¾" and ½" finished pistons.



A.2.

ROPE PISTONING

A.2. ROPE PISTONING

Process Description

The rope pistoning process consists of forming a string of rope and pistons, whose length is determined in accordance with well depth (two times plus two meters its depth). Pistons are fixed in place by making knots at both sides of each piston. The string serves to guide the pistons through the entrance pipe and into the pumping pipe of the guide box. It is pulled upward by the pulley wheel.

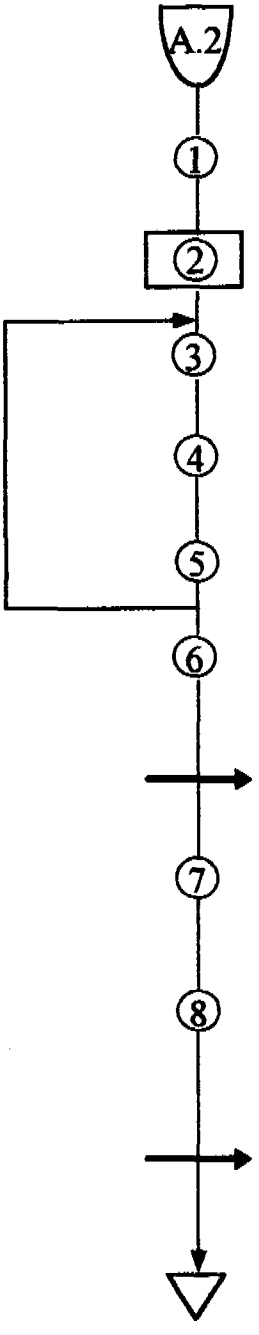
This process requires nothing more than rope and pistons.

The rope pistoning process includes the following steps:

1 Burn one end of rope.
2 Insert rope through pistons.
3 Measure distance between pistons.
4 Hold last piston in place by tying a knot in its lower end (bell end).
5 Tie second knot in the piston's upper end.
6 Repeat steps 3 - 4 - 5 as needed
7 Cut rope and burn this end as in step 1.
8 Stretch the pistoned rope.
9 Carefully wind the rope.

A diagram of the rope pistoning process is presented below, as is the photographic sequence of the process.

A.2. ROPE PISTONING



1. Burn one end of rope.
2. Insert all pistons.
3. Measure first piston
4. Tie first knot at bell side of piston
5. Tie second knot at upper side of piston
6. Burn other end of rope

To stretching stage

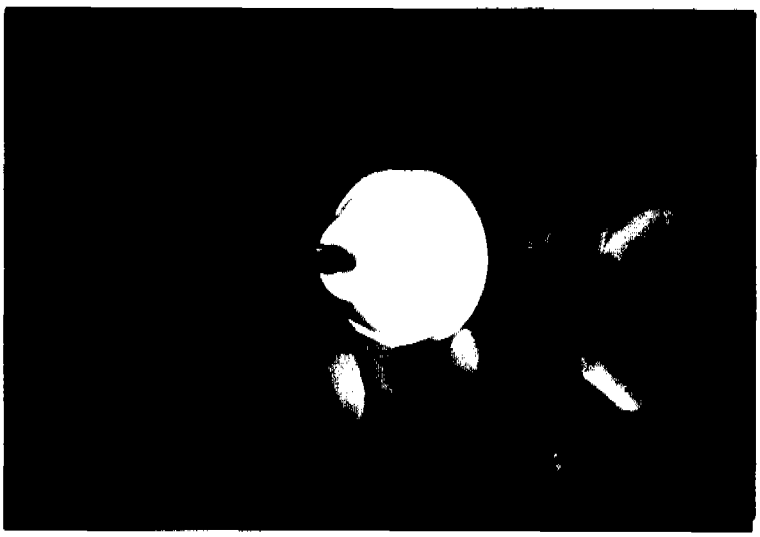
7. Stretch pistoned rope
8. Wind rope with pistons in right place.

To warehouse

Warehouse

Operation	Symbol	Amountad
Operation	○	8
Transportation	→	2
Op-Inspection	▣	1
Delay	D	-
Inspection	▭	-
Warehouse	▽	1

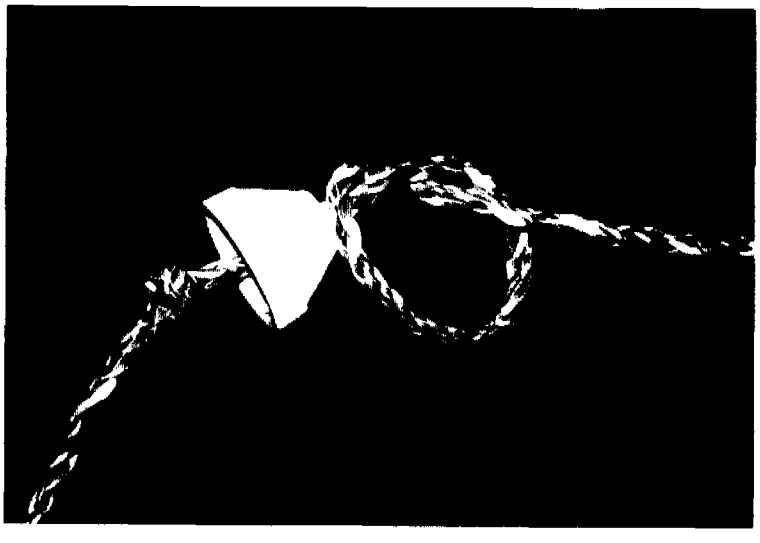
Burn one end of rope to prevent fraying.



Insert all pistons in the rope.

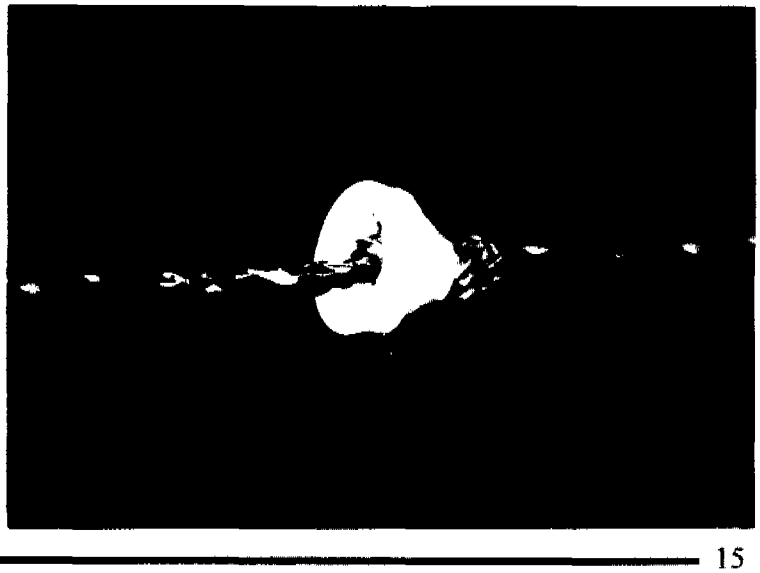
Rope with pistons ready to be fastened with knots.

Tie first knot at the lower end of piston.

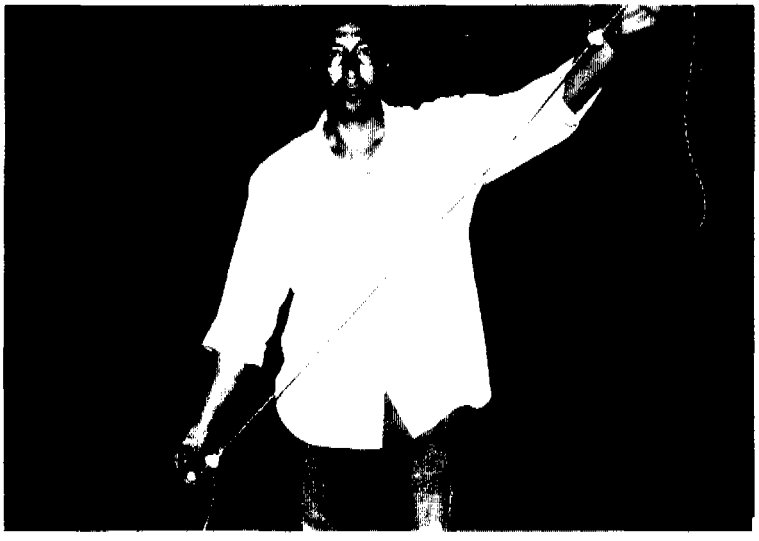


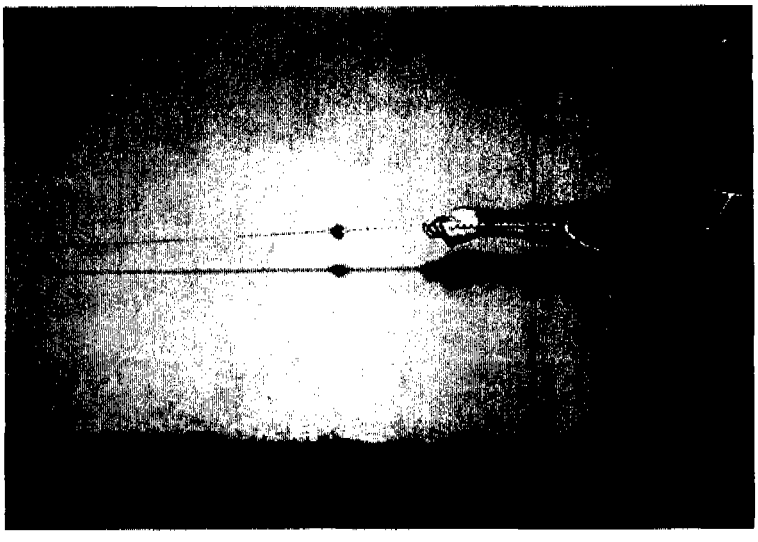
Tie another knot at the upper end of piston so as to prevent it from sliding.

Position of knots at both ends of piston.



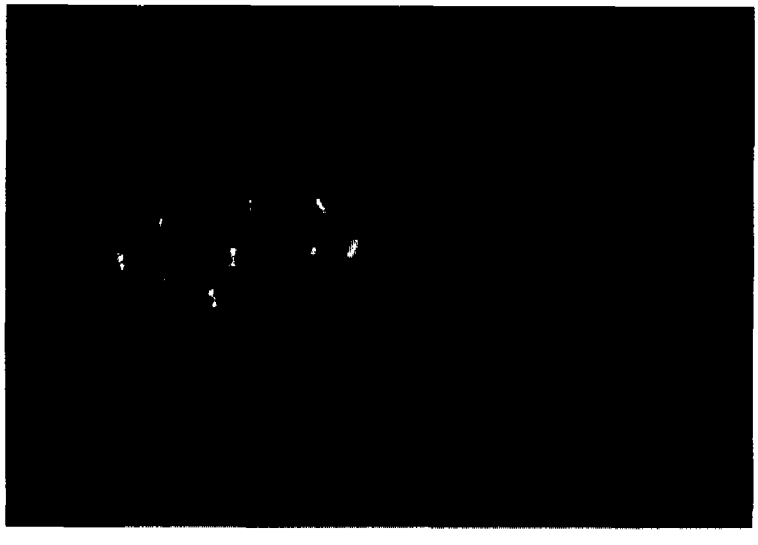
Distance between pistons in the rope (1 meter).





Once the rope has been pistoned, firmly tighten it to prevent any stretching when installed.

Carefully wind the rope.



B.1.

CERAMIC PIECE PRODUCTION PROCESS

B.1. CERAMIC PIECE PRODUCTION PROCESS

Process Description

The ceramic piece is part of the guide box. Its function is to prevent the rope from rubbing, so that it will not wear when sliding over the ceramic piece as it moves in an upward-downward motion.

By protecting the rope, its working life is extended to the maximum. Raw materials used in this process are natural clay and glazing. A beater and an electric kiln with a maximum heating capacity of 1,300° C are the required equipment.

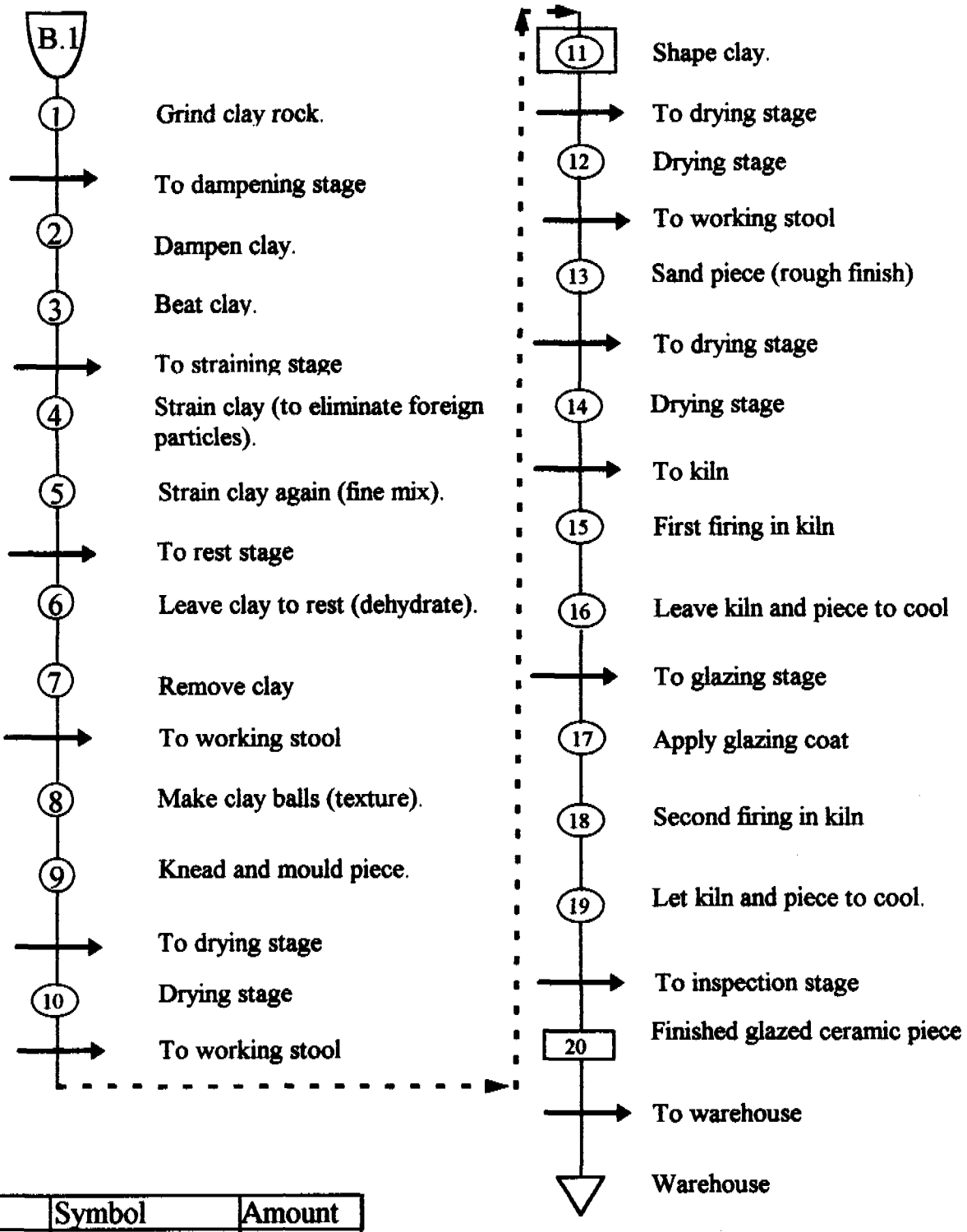
In this process, natural clay is turned into a resistant glazed ceramic piece by firing a glassy compound on it.

This is achieved by preparing the clay and moulding the piece. It is subsequently fired and becomes an opaque and porous ceramic piece. By coating it with the glazing and firing it again at high temperatures, the piece becomes a smooth and bright glazed ceramic piece.

The ceramic piece production process includes the following steps:

1 Grind clay rock.
2 Dampen clay.
3 Strain clay (twice).
4 Leave clay to dehydrate (the clay is left to rest and eliminate excess moisture).
5 Knead clay.
6 Shape clay.
7 Leave clay piece to dry.
8 Give clay piece its final shape.
9 Leave clay piece to dry again.
10 Sand non-fired piece.
11 Leave non-fired piece to dry.
12 Fire clay piece (to become a ceramic piece).
13 Leave kiln and ceramic piece to cool.
14 Glaze ceramic piece.
15 Fire again ceramic piece (glazing).
16 Leave kiln to cool.
17 The ceramic piece is ready to be used.

A diagram of the ceramic piece production process is presented below, as is the photographic sequence of the process.



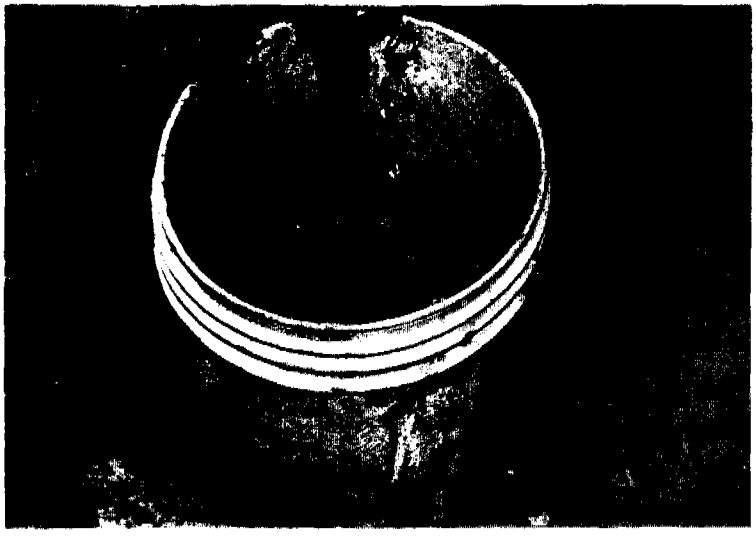
Operation	Symbol	Amount
Operation	○	19
Transportation	→	14
Op-Inspection	◎	1
Delay	D	-
Inspection	▭	1
Warehouse	▽	1

B.1. CERAMIC PIECE PRODUCTION DIAGRAM

Clay rock.

Grind clay rock with mallet.

Place ground clay in container and add water to beat it.



Beat clay with an electric drill and beater.

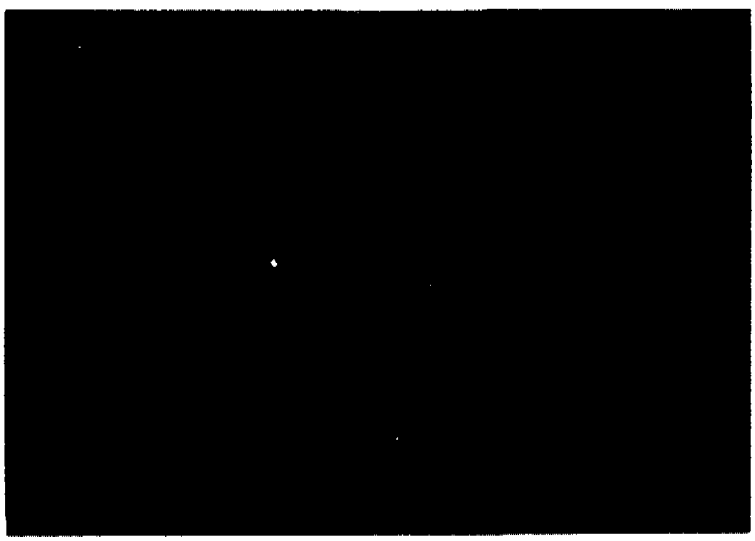
Strain clay to eliminate any foreign particles.

Strain clay again to obtain a finer mixture.

Once strained, place clay mixture on cloth to eliminate excess water. Let it dry for four days.

Remove clay mixture from cloth.

Make 1 pound clay balls with mixture and let them dry for a few hours.

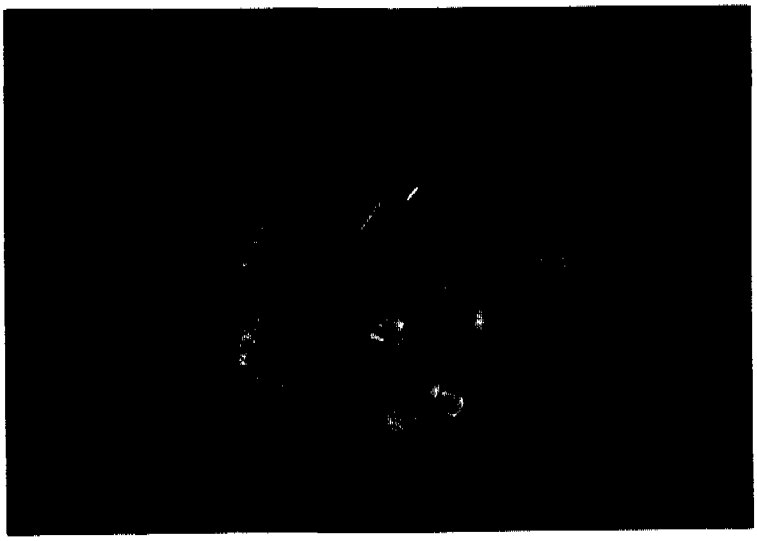


Knead ball to eliminate air bubbles from clay mixture. Mould it and let dry for several hours.

Make a saddle-like channel in upper part of moulded piece where rope will slide. Leave piece to dry for an hour.

Make two grooves on each side of the upper part of moulded piece.

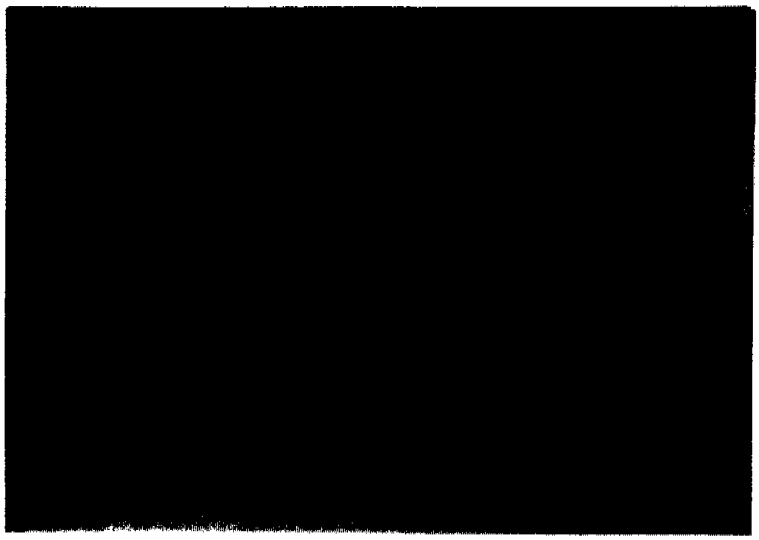
Hold moulded piece. With a knife pare it on both sides, so as to leave a channel on each side where pipes will be embedded.

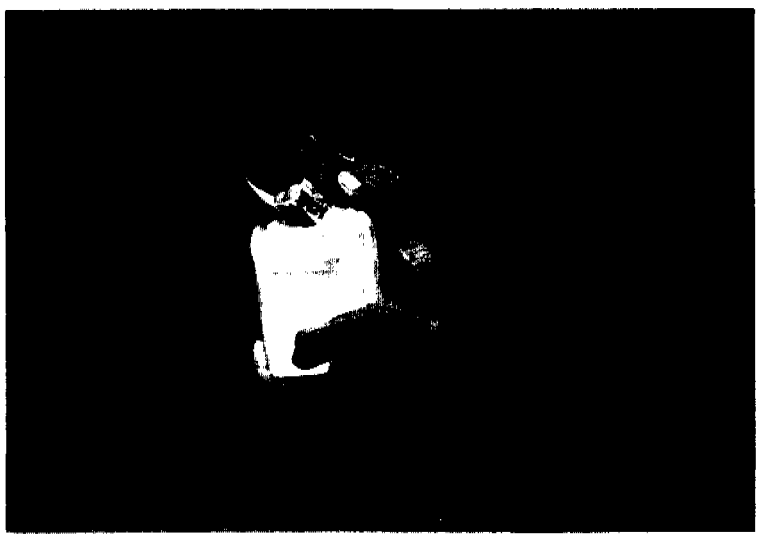


Subsequently, make lateral grooves to hold fastening wire in place.

Make an orifice to let fastening wire through. The wire will be used to fasten the ceramic piece to the base.

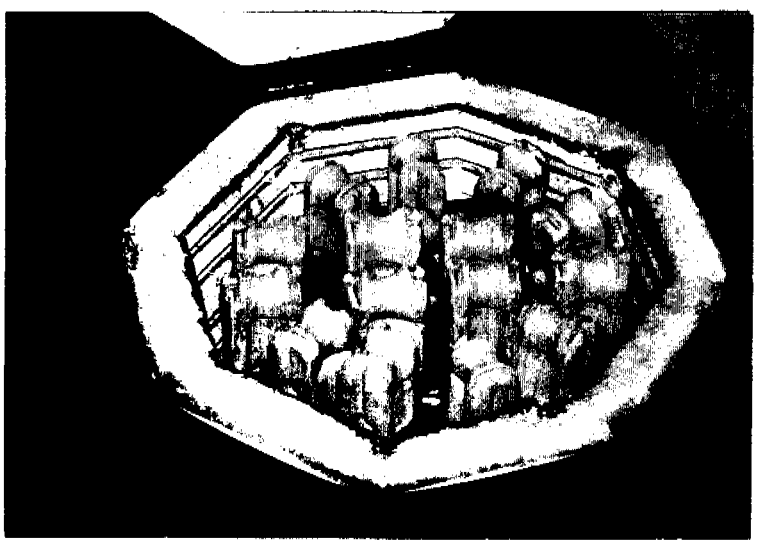
Once the ceramic piece is finished, let it dry for three days.



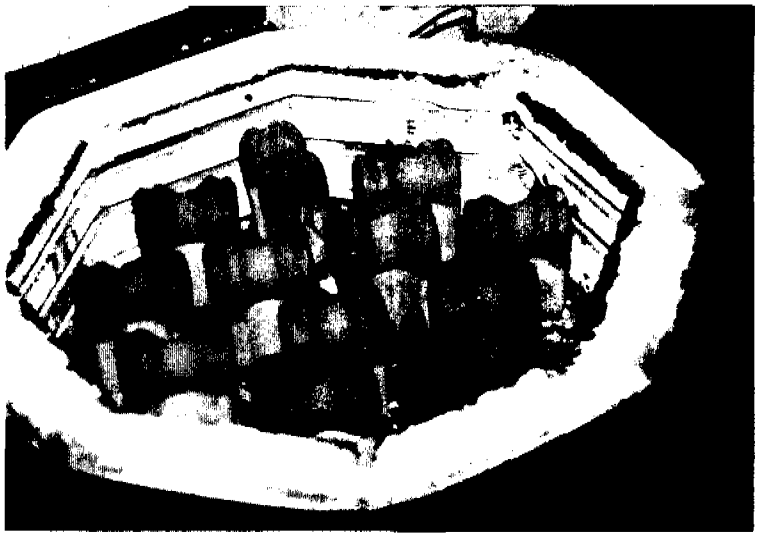


For a fine finish, sand the piece. Then let it dry for a day.

Place pieces on kiln rack to be fired at 790°C. Then leave pieces and kiln to cool.

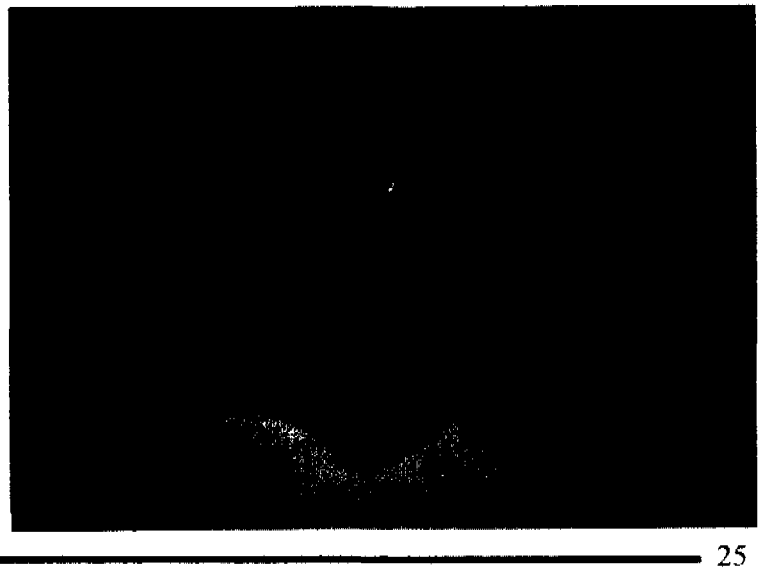


Submerge the upper part of the piece in the glazing.



Place glazed pieces on kiln rack to be fired again at 1,236 °C. Leave kiln and pieces to cool down.

Finished piece after second firing.



B.2.

GUIDE BOX PRODUCTION

B.2. GUIDE BOX PRODUCTION

Process Description

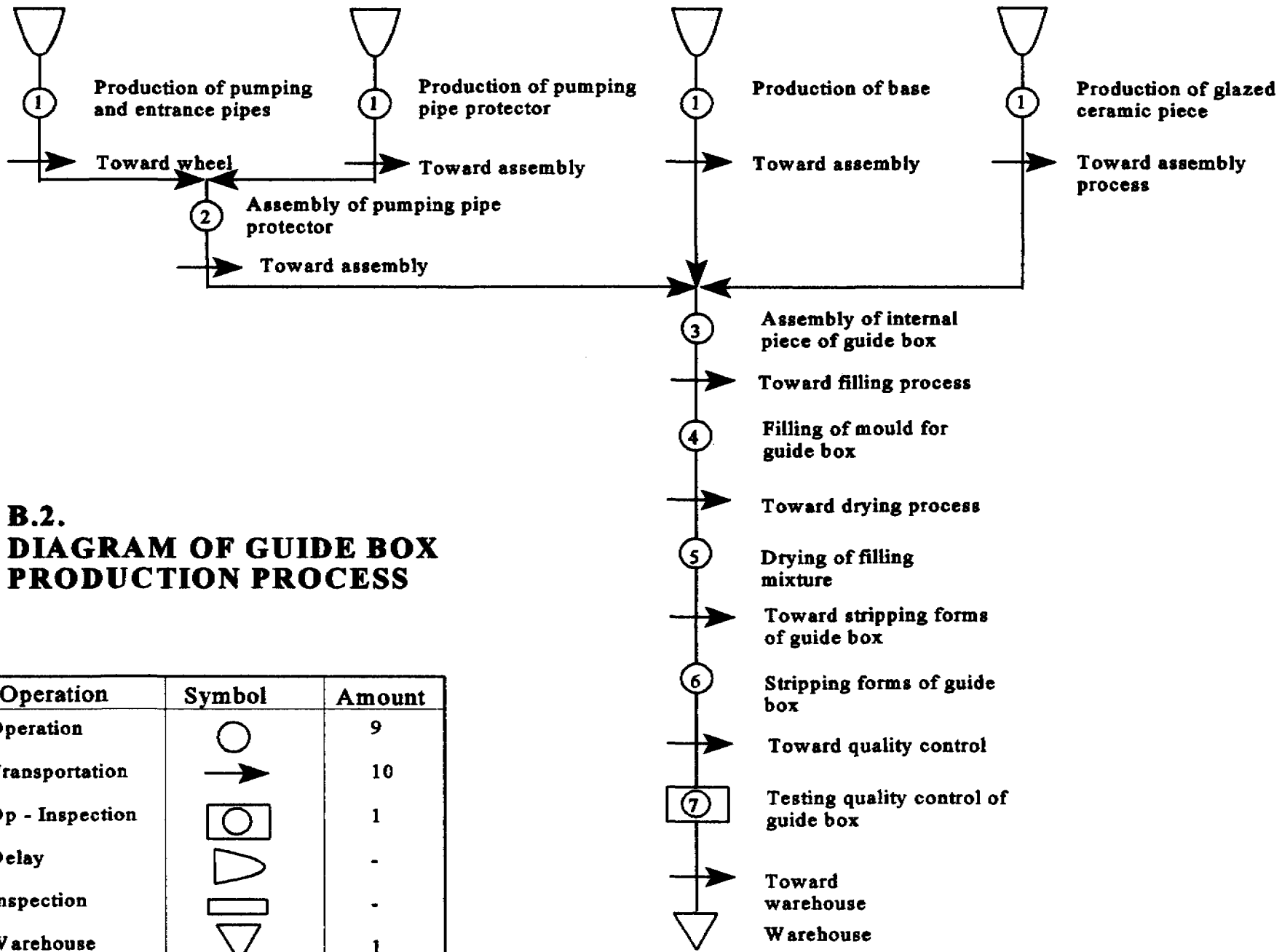
The guide box is installed at the bottom of the well where the process of water pumping begins. Its function is to guide the rope and pistons under and into the pumping pipe, while keeping it in place (vertical), and maintaining the rope properly tightened.

The glazed ceramic piece, entrance pipe to guide box, pumping pipe and pipe protector, as well as the base, and concrete casing are required components in the production of the guide box. A variety of devices such as hacksaw, metal mould, galvanized wire, and a meter are used in the production, preparation, and assembly of all these parts.

The guide box production process includes the following steps:

1 Make ceramic piece.
2 Prepare pumping and entrance pipes.
3 Cut pumping pipe protector piece.
4 Assemble pumping pipe and protector.
5 Make base.
6 Prepare internal guide box piece.
7 Fill mould for guide box.
8 Test quality of assembled pieces.

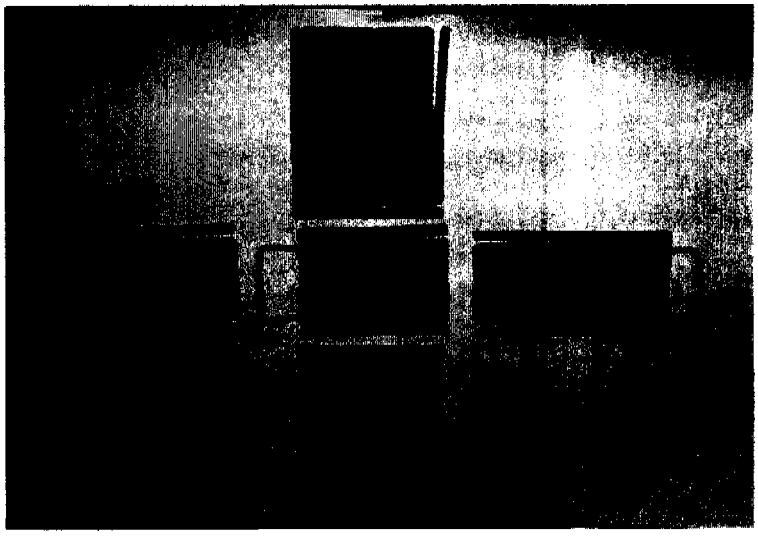
A diagram of the guide box production process is presented below, as is the photographic sequence of the process.



B.2.
DIAGRAM OF GUIDE BOX PRODUCTION PROCESS

Operation	Symbol	Amount
Operation	○	9
Transportation	→	10
Op - Inspection	▭ ○	1
Delay	D	-
Inspection	▭	-
Warehouse	▽	1

Guide box pieces: pumping pipe and protector; entrance pipe; ceramic piece; base.



Open metal forms for moulding the concrete casing for the guide box.

Pipe cutting device.

B.2.1.

PRODUCTION AND ASSEMBLY OF PUMPING AND ENTRANCE PIPES

B.2.1. PRODUCTION AND ASSEMBLY OF PUMPING AND ENTRANCE PIPES

Process Description

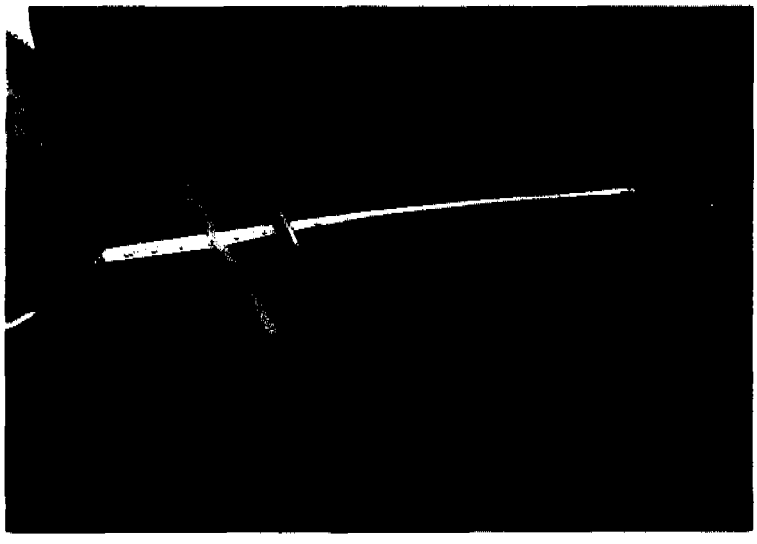
The pumping and entrance pipes are internal pieces of the guide box. These serve to guide the pistoned rope in and out of the guide box. The pipes in the guide box are different in diameter, they vary according to use. The largest one is the entrance pipe. The pumping pipe protector prevents deformation of the pipe while being fixed to the ceramic piece.

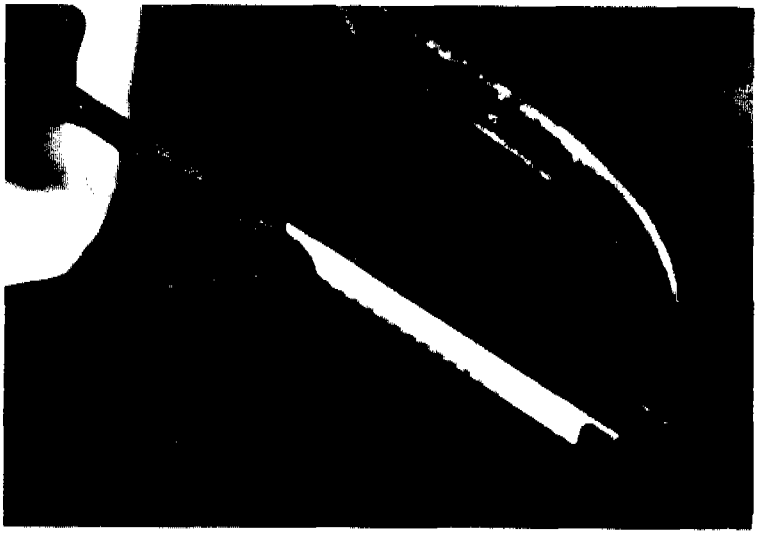
The pipe and protector production process, as well as the process of assembly include the following steps:

1 Measure pipes
2 Cut pipes
3 Sand pipe mouths
4 Heat pipes and make bellmouths
5 Make pumping pipe protector
6 Assemble protector and pumping pipe
7 Test quality.

A photographic sequence of these steps is presented below:

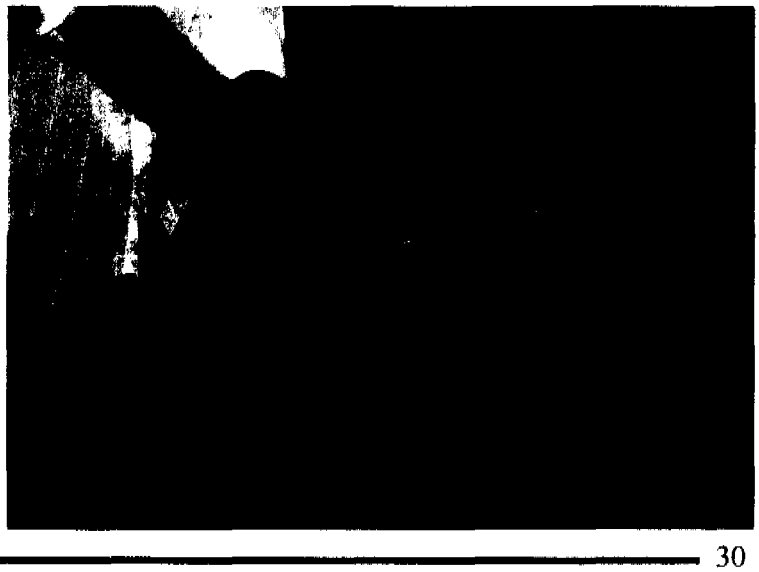
Clamp PVC pipe and make a mark to indicate the cutting point.



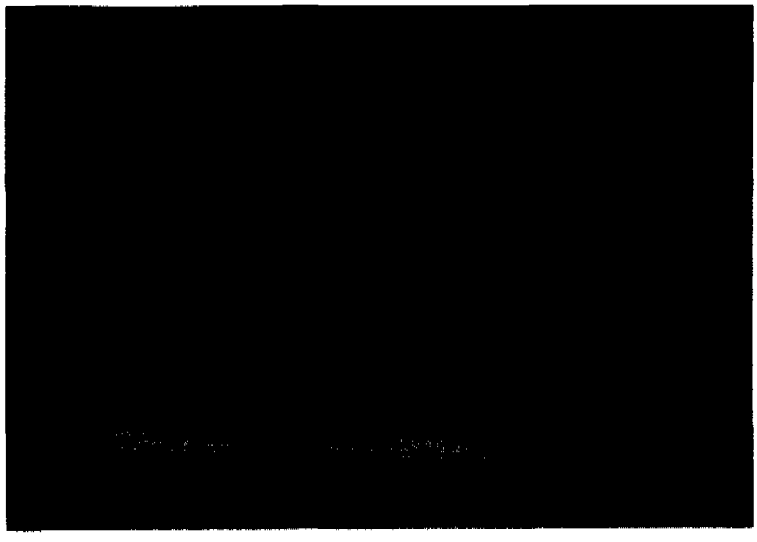


Cut piece to be used as pumping pipe.

Once the pumping pipe has been cut, follow the same steps to cut the entrance pipe to the guide box.

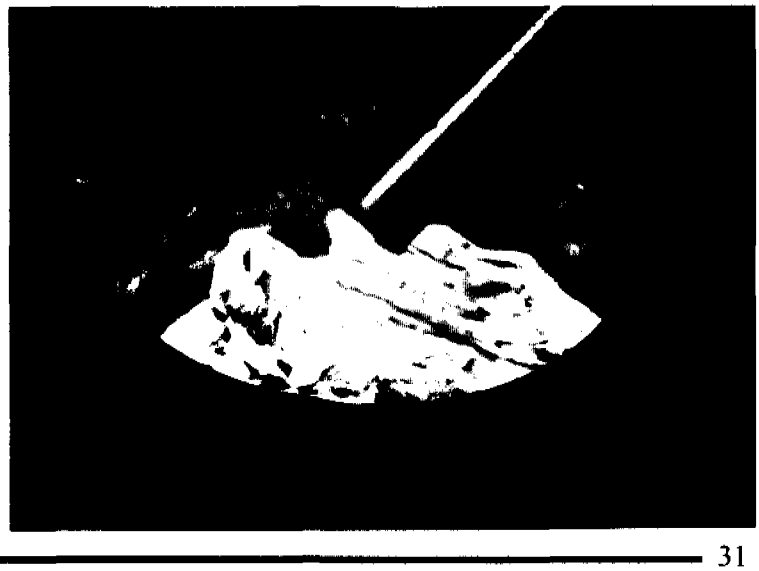


Pumping pipe (30 cm), entrance pipe (15 cm), already cut.



Sand mouth of pumping pipe. Repeat operation with entrance pipe.

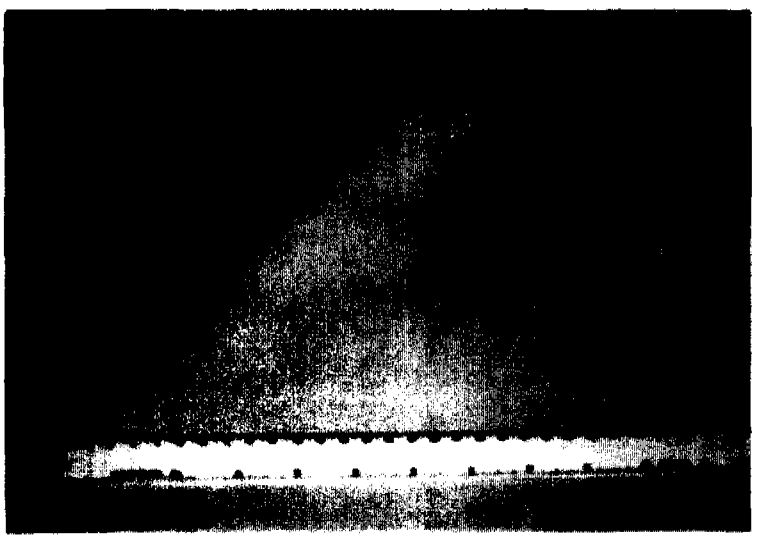
Heat one end of pipe.



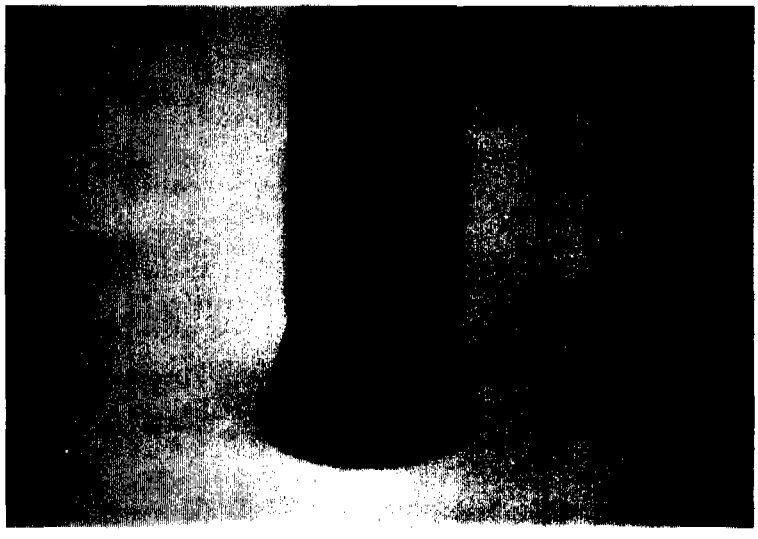
Insert the neck of a bottle into the preheated pipe to widen the mouth.

Carry out the same operation for both the entrance and pumping pipes. Use different-size bottles.

Bellmouthed entrance and pumping pipes. Wide mouth pipes facilitate the pistoned rope's movement into and through the guide box.

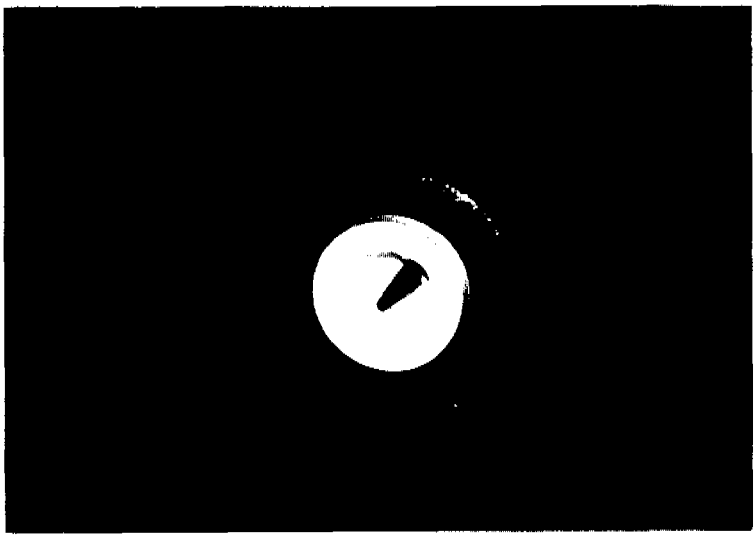


Cut pumping pipe protector (5 cm).



Assemble pumping pipe protector.

To test quality of pumping pipe, insert rod with piston.



B.2.2.

BASE
PRODUCTION PROCESS

B.2.2. BASE PRODUCTION PROCESS

Process Description

The base is a pvc pipe cut in half. It is used to keep the ceramic piece in place and prevent the pistoned rope from rubbing against the concrete casing.

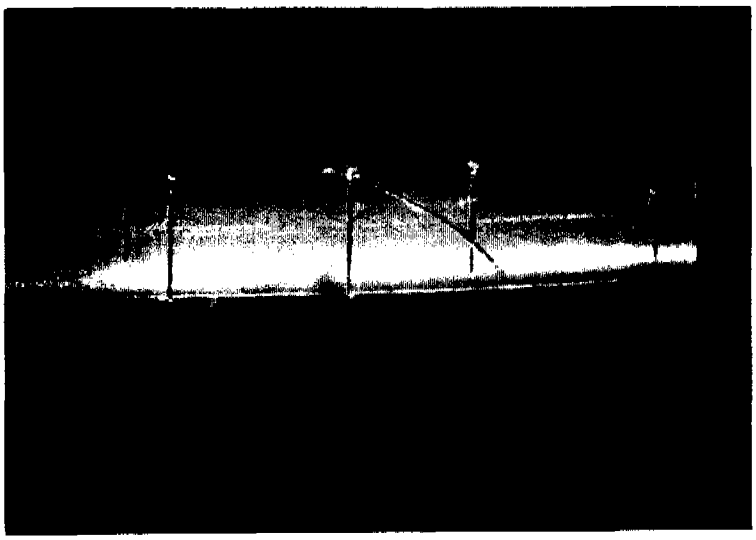
Production materials include a pvc pipe, a cutting device and hacksaw.

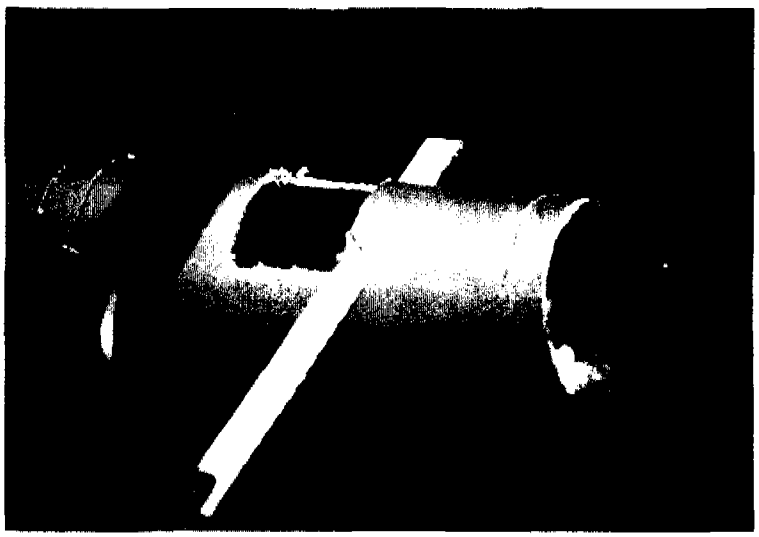
The base production process includes the following steps :

1 Measure and mark the right length of pipe.
2 Mark with "N" shape cuts.
3 Make a horizontal cut (at equal distance from pipe ends).
4 Cut pipe in the form of a half cylinder.
5 Cut pipe to length

A photographic sequence of these steps is presented below.

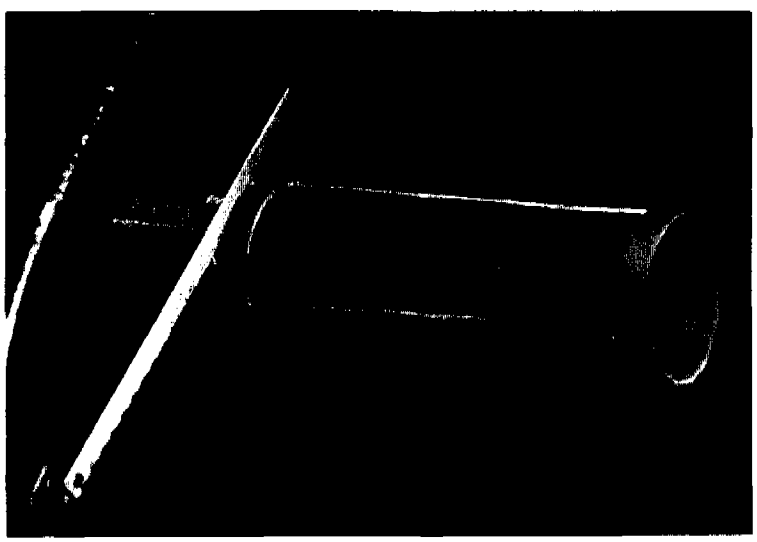
Make "N" shape cuts at centre of pipe.





Cut pipe horizontally, moving from the center to the right end.

Cut pipe in the form of a half cylinder. Pipe should be 17.5 cm long and 5 cm. in diameter.



B.2.3.

ASSEMBLY OF THE INTERNAL PIECE OF GUIDE BOX

B.2.3. ASSEMBLY OF THE INTERNAL PIECE OF GUIDE BOX

Process Description

The entrance and pumping pipes, the ceramic piece, and base are assembled together. These four pieces must be firmly fastened together so as to prevent the rope and pistons from rubbing while rolling.

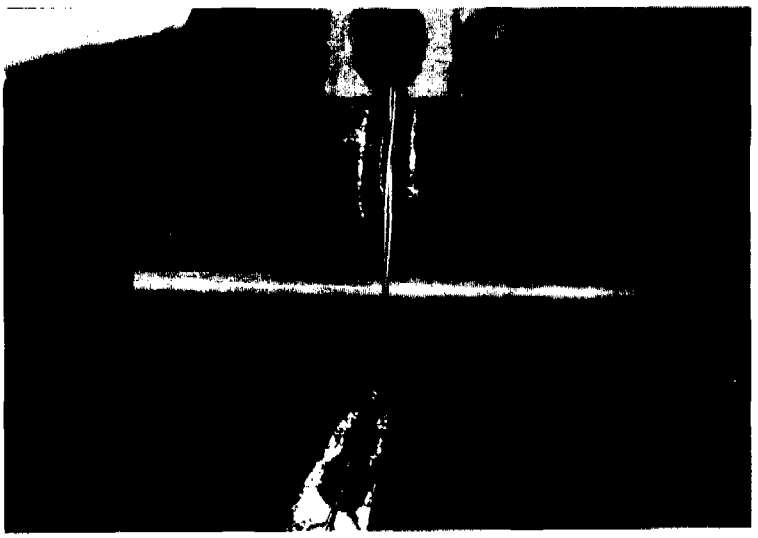
Once assembled, the internal piece must allow water to freely flow in. To assemble the piece it must be wired with the help of pliers.

This process includes the following steps :

1 Fasten ceramic piece to base.
2 Make springs with wire
3 Firmly fasten pumping and entrance pipes to ceramic piece.
4 Introduce wet paper in the pipes and base.

The photographic sequence of the process is presented below.

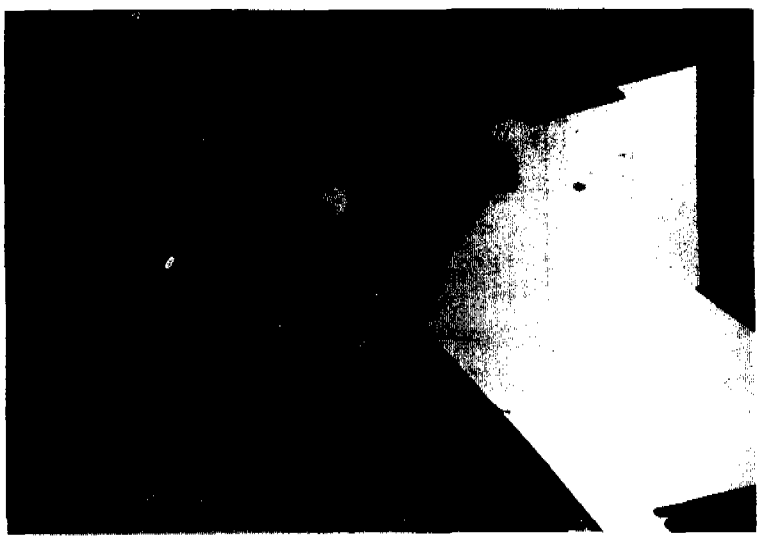
Place ceramic piece on the base. Firmly fasten both pieces together with wire.



Spring wire on the bottom part of base. The spring serves to keep the base off the bottom of the concrete casing.

Ceramic piece fastened to the base.

Fasten entrance and pumping pipes to the ceramic piece.



Insert wet paper into the pipes and the base.

Position of the piece filled with paper in a semi-open mould.

B.2.4.

CONCRETE CASING PRODUCTION PROCESS

B.2.4. CONCRETE CASING PRODUCTION PROCESS

Process Description

The concrete casing serves to embed the internal ceramic piece and plumb it (hold it vertically). The pumping mechanism is thus secured inside the well.

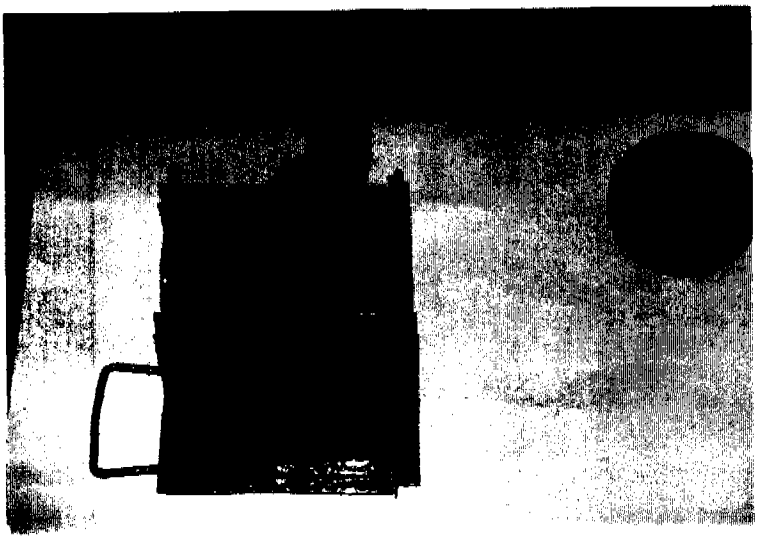
Cement mortar, lube oil and a metal mould are needed to carry out this process.

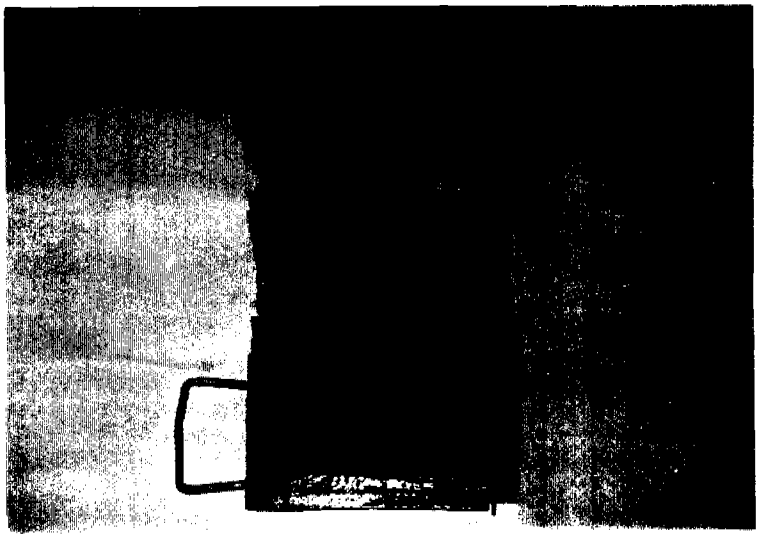
The concrete casing production process includes the following steps:

1 Assemble concrete casing mould.
2 Lubricate mould.
3 Make cement mortar.
4 Initiate filling of mould.
5 Place internal piece of guide box within mould.
6 Finish filling of mould.
7 Compress filling mixture.
8 Let filling mixture to dry up.

A photographic sequence of these steps is presented below.

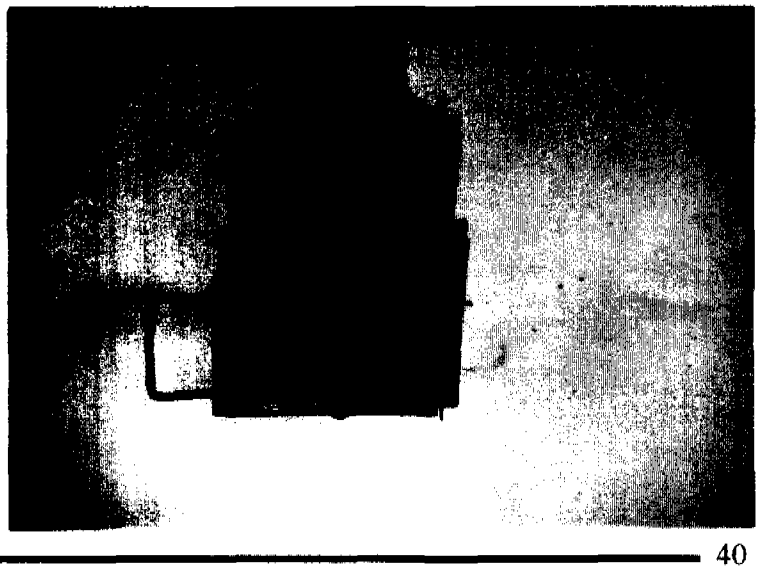
Lubricate the metal mould.





Initiate filling of mould with mortar (4 cm).

Introduce the internal piece of the guide box in the mould.



Fill up the mould.

Compress the filling mixture in the mould.

Leave filling mixture to dry.

B.2.5.

STRIPPING FORMS OF GUIDE BOX

B.2.5. STRIPPING FORMS OF GUIDE BOX

Process Description

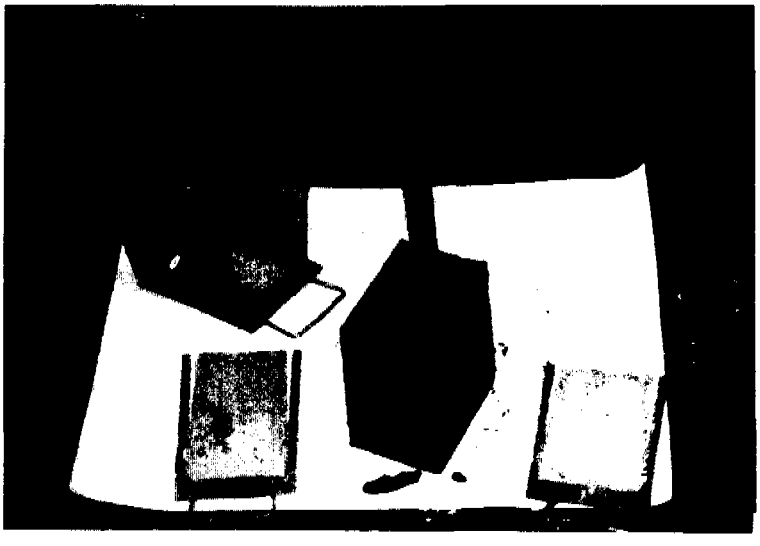
Once the guide box has been stripped of forms, the internal piece should be cleaned. A quality control test is subsequently carried out. The guide box is ready!

This process includes the following steps :

1 Open forms.
2 Strip forms of guide box.
3 Clean guide box gates
4 Take paper out.
5 Clean internal guide box piece.
6 Test quality.

A photographic sequence of these steps is presented below.

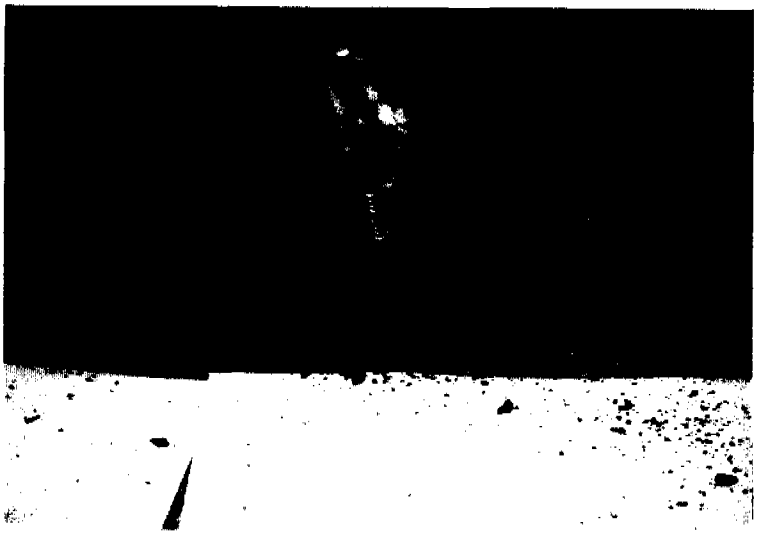
Strip forms and remove the guide box.



The guide box has been removed from metal mould.

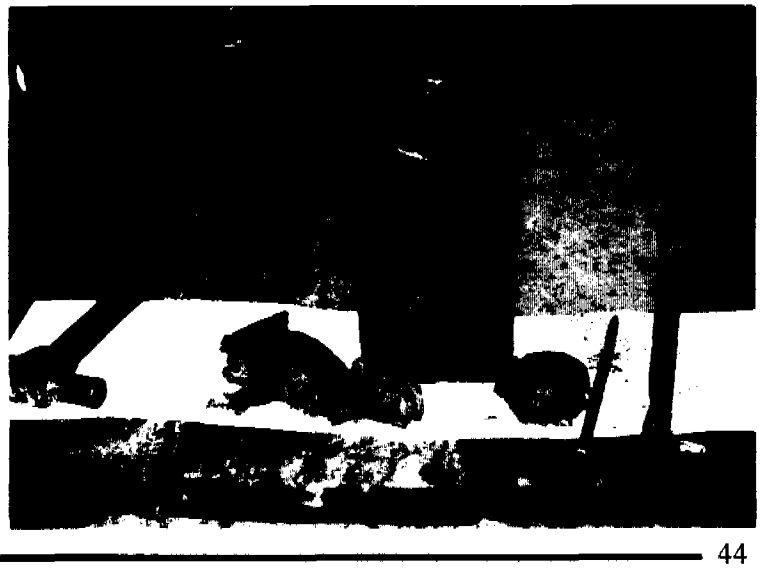
Place the guide box on stool. Clean concrete residue in orifices of guide box.

Turn the guide box downward and clean the outside.

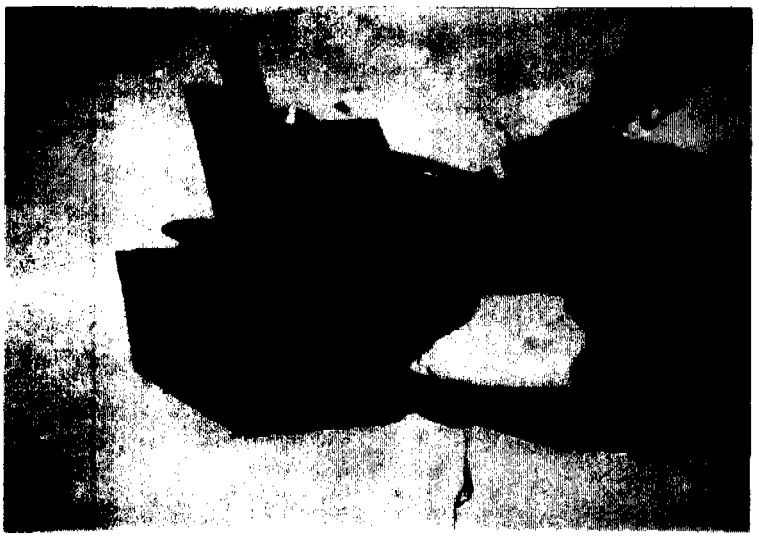


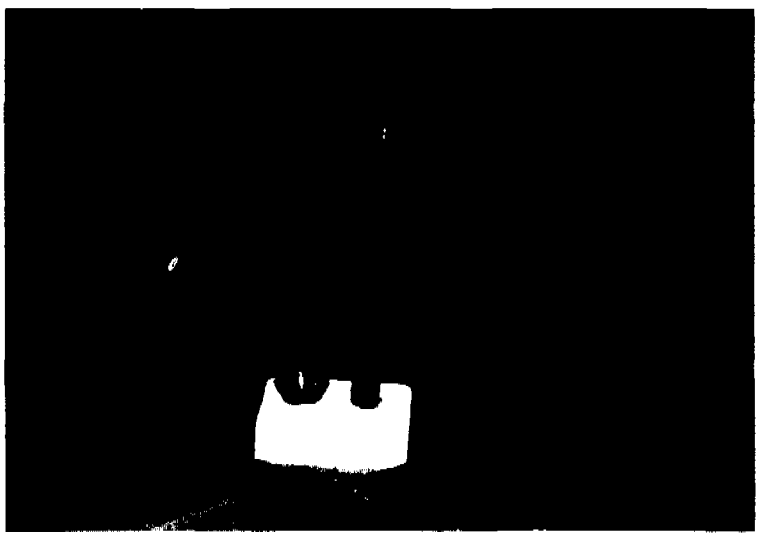
Take paper out of the guide box.

Paper has been taken out of the guide box.



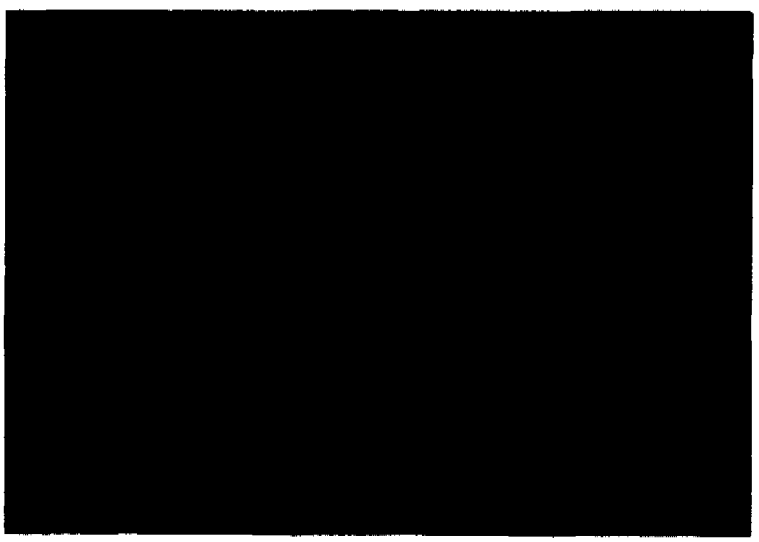
Thoroughly clean the internal part of the guide box.





Test the quality of the guide box with the help of a water container, a rod and piston.

The guide box is ready to be installed.



C.1.

PRODUCTION OF WHEEL STRUCTURE

C.1. PRODUCTION OF WHEEL STRUCTURE

Process Description

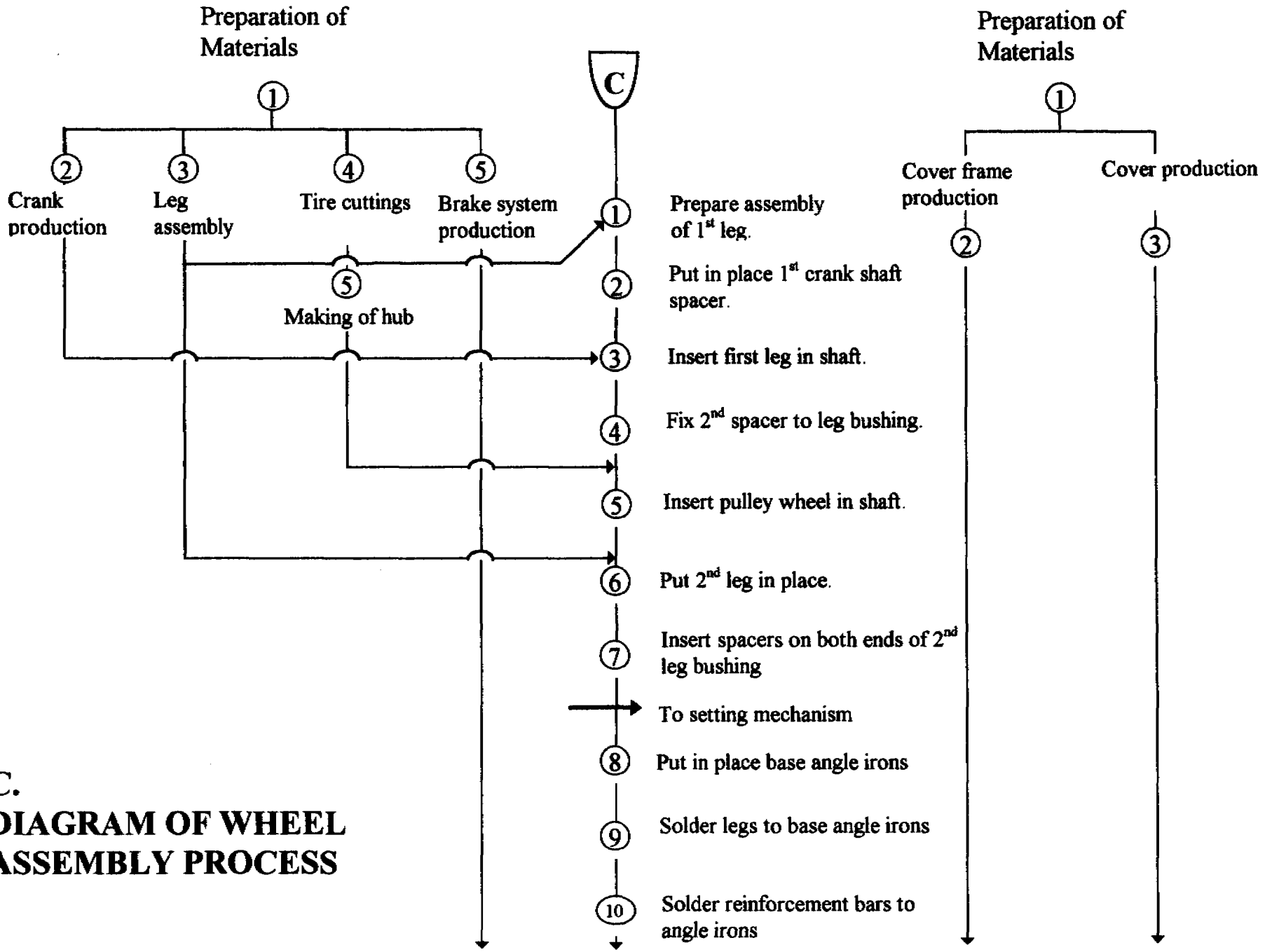
The wheel structure includes a crank, supporting legs, pulley wheel and spokes, as well as brake system. These are assembled according to the various rope pump models.

The type of rope pump to be used is determined by its function. Family-well rope pumps, extra-strong structure pumps and Community-Well Pumps are some of the main types available.

Differences stem from the type of materials used when producing the pumps and their degree of resistance to the particular environment.

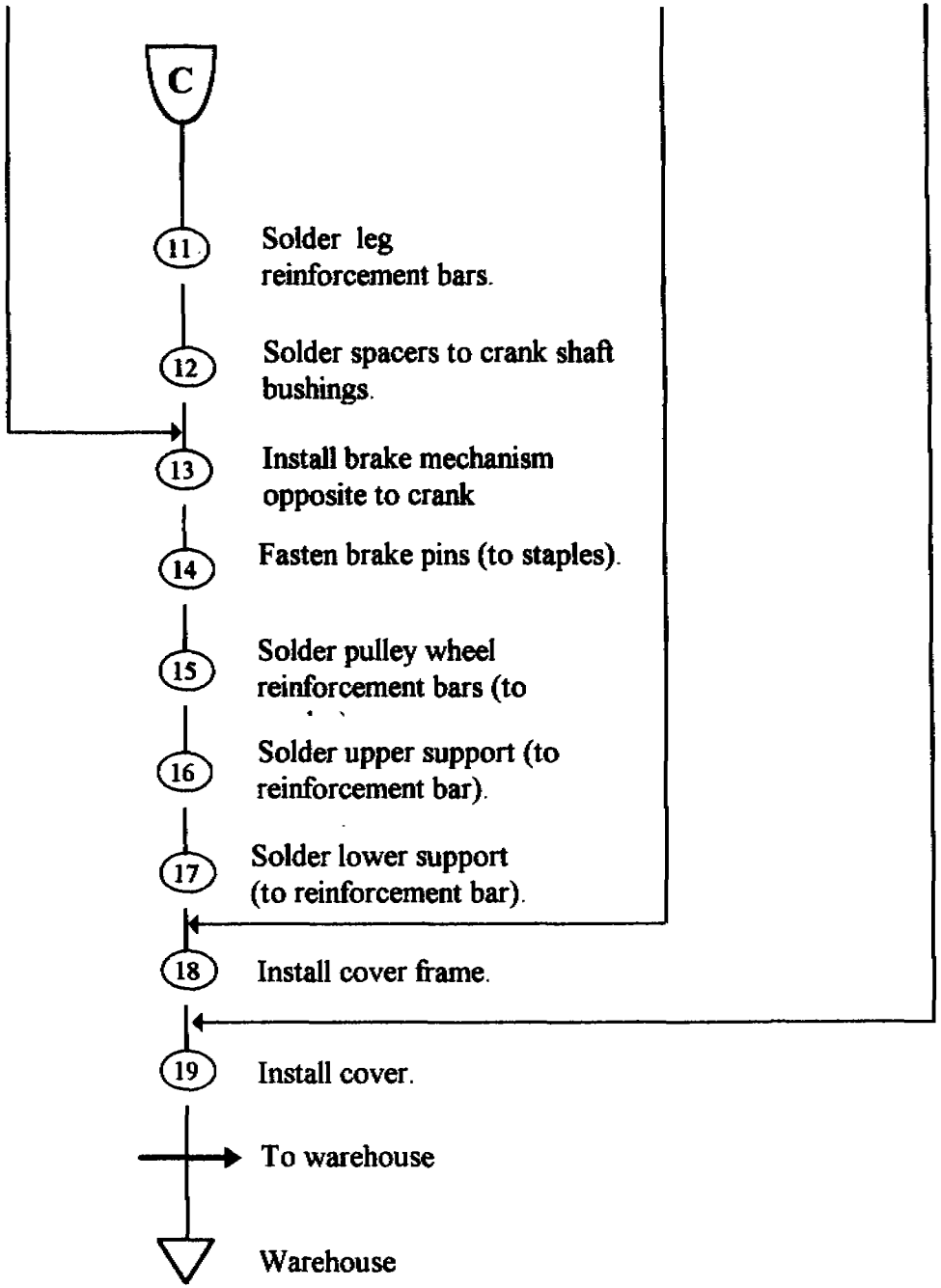
Family-well pumps: For domestic use at minimum cost.
Extra-strong structure pumps: For intensive use by more than three families.
Community Pumps: For use at the community level. For instance in water and sanitation projects. Special attention is given to protecting these pumps from corrosion. A lid is attached to protect the rope from dirt.

A diagram of the wheel structure assembly process and a list of materials to be used in each of the three types of pumps are presented below.



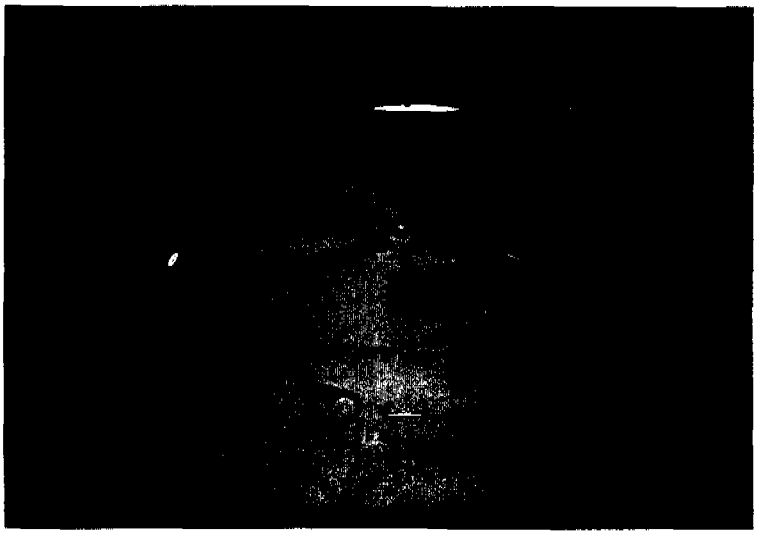
C.
DIAGRAM OF WHEEL ASSEMBLY PROCESS

C.
DIAGRAM OF WHEEL ASSEMBLY PROCESS



Operation	Symbol	Amount
Operation	○	19
Transportation	→	2
Op-Inspection	◎	-
Delay	D	-
Inspection	▭	-
Warehouse	▽	1

Materials for the family-well pump.



Materials for the extra-strong pump.

Materials for the community-well pump.

THE FAMILY-WELL ROPE PUMP

MATERIALS NEEDED TO PRODUCE THE WHEEL STRUCTURE FOR THE FAMILY-WELL ROPE PUMP

Description of Materials

Prior to initiating the wheel structure production process, the following materials must be prepared:

a) Crank Production

1	3/4" x 1 meter long tube for shaft
1	1" x 15 cm. long tube for roller
2	1"x 1 cm. tube spacers

b) Leg Assembly

4	3/8" x 66 cm. rods for legs
1	3/8" x 10 cm. rod for cross (horizontal).
2	1" x 4.3 cm. tube for bushing
4	1" x 1 cm. tube spacers
2	1/8" x 1" x 41 cm. angle irons (for base).

c) Reinforcing Bars for Legs

2	1/4" x 50 cm. rods
1	1/4" x 73 cm. rod
1	3/8" x 73 cm. rod

d) Reinforcing Bars for Angle Iron

1	3/8" x 34 cm. rod
1	1/4" x 46 cm. rod

e) Making the Pulley Wheel Hub

12	1/4" x 25 cm. rods for spokes
6	1/4" x 25 cm. rods for reinforcing bars
6	1/8" x 1"x 10 cm. steel strips for staples
2	1" x 2.5 cm. tubes for bushings
2	Cuttings of tires Rim 20".

f) Brake Production

6	3/8" x 10 cm. rods for pins
1	3/8" x 15 cm. rod for the brake
1	3/8" x 10 cm. rod
1	½" x 2 cm. tube for bushing
1	1/4" x 4 cm. rod for brake lever stop

g) Supports

1	1/8" x 1" x 26 cm. steel strip for upper support
1	1/4" x 10 cm. rod for upper support buckle
1	1/8" x 3/4" x 25 cm. steel strip for clamps of various sizes
1	1/8" x 3/4" x 6 cm. steel strip for clamp holder
1	1/8" x 1" x 30 cm. steel strip for lower support
1	1 ¼" x 2.5 cm. tube

THE EXTRA-STRONG ROPE PUMP

MATERIALS TO PRODUCE THE WHEEL STRUCTURE FOR THE EXTRA-STRONG ROPE PUMP

Description of Materials

Prior to initiating the wheel structure production process, the following materials must be prepared:

a) Crank Production

1	3/4" x 1 meter long tube for shaft
1	1" x 15 cm. long tube for roller
2	1"x1cm. tube spacers

b) Leg Assembly

4	½" x 70 cm. rods for legs
1	3/8" x 13 cm. rod for cross bar (horizontal)
2	1" x 4.3 cm. tubes for bushing
4	1" x 1 cm. tube spacers
2	1/8" x 1 ½" x 60 cm. angle irons

c) Reinforcing Bars for Legs

1	1/4" x 77 cm. rod
1	3/8" x 77 cm. rod
2	1/4" x 53 cm. rods

d) Reinforcing Bars for Angle Irons

1	1/4" x 54 cm. rod
2	3/8" x 34 cm. rods

e) Making the Pulley Wheel Hub

12	1/4" x 25 cm. rods for spokes
6	1/4 x 25 cm. rods for reinforcing bars
6	1/8" x 1" x 10 cm. steel strips for staples
2	1" x 2.5 cm. tubes for bushings
2	Cuttings of tires Rim 20"

f) Brake Production

6	3/8" x 10 cm. rods for pins
1	3/8" x 15 cm. rod for brake
1	3/8" x 10 cm. rod
1	½" x 2 cm. tube for bushing
1	1/4" x 4 cm. rod for brake lever stop

g) Supports

1	1/8" x 1" x 70 cm. steel strip for upper supports
2	1/4" x 10 cm. rods for upper support buckles
2	1/8" x 1"x 10 cm. steel strips for clamps of various sizes
2	1/8" x 3/4" x 6 cm. steel strips for clamp holders
2	1/8" x 1" x 30 cm. steel strips for lower supports (optional)
1	1¼" x 2.5 cm. tube (for pumping pipe)
1	1½" x 2.5 cm. tube (for return pipe)

h) Cover Frame

2	1/8" x 1"x 80 cm. angle irons
2	1/8 x 1"x 20 cm. angle irons

i) Cover

1	40 cm. x 125 cm. zinc sheet, caliber 24

THE COMMUNITY-WELL PUMP

MATERIALS TO PRODUCE THE WHEEL STRUCTURE FOR THE COMMUNITY-WELL PUMP

Description of Materials:

a) Crank Production

1	3/4" x 110 cm. galvanized tube for shaft
1	1" x 15 cm. galvanized tube for roller
6	1" x 1 cm. galvanized tubes for spacers
2	1" x 4 cm. galvanized tubes for bushings

b) Leg Assembly

2	3/4" x 127.5 cm. galvanized tubes for legs
2	1 ½" x 70 cm. angle irons for base (preferably galvanized)

c) Reinforcement Bars for Legs

1	3/4" x 29 cm. tube for upper reinforcement bar

d) Reinforcement Bars for Angle Irons

2	3/8" x 34 cm. rods

e) Making the Pulley Wheel Hub

12	3/8" x 23 cm. smooth rods for spokes
1	1" x 10 cm. tube
8	3/8" x 18 cm. smooth rods for reinforcement bars
8	1/8" x 1 ½" x 10 cm. steel strips for staples
2	Cuttings of tires Rim 20".

f) Brake Production

1	½" x 10 cm. rod for brake lever
1	1/4" x 17 cm. rod for lever stop
2	½" x 2 cm. tube for bushing
1	3/8" x 10 cm. smooth rod for brake frame
1	3/8" x 18 cm. smooth rod for brake frame

g) Tube Supports

1	1/8" x 1" x 69 cm. steel strip for upper supports
2	1/4" x 10 cm. rods for upper support buckles
2	1/8" x 1"x 10 cm. steel strips for clamps of various sizes
2	1/8" x 3/4" x 6 cm. steel strips for clamp holders
2	1/8" x 1" x 20 cm. steel strips for lower supports
1	1¼" x 2.5 cm. tube (for pumping pipe)
1	1½" x 2.5 cm. tube (for return pipe)

h) Cover Frame

2	1" x 66 cm. angle irons for sides
2	1" x 16 cm. angle irons for sides
1	3/8" x 42 cm. rod for frame support

i) Pulley wheel cover

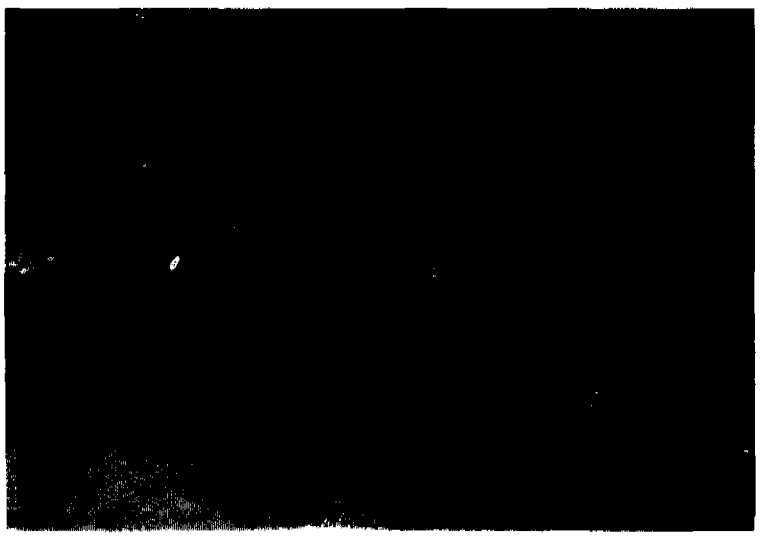
1	89 cm. x 158 cm. smooth zinc sheet caliber 24

Pipe bender to make the crank.

Device to solder wheel legs to bushing.

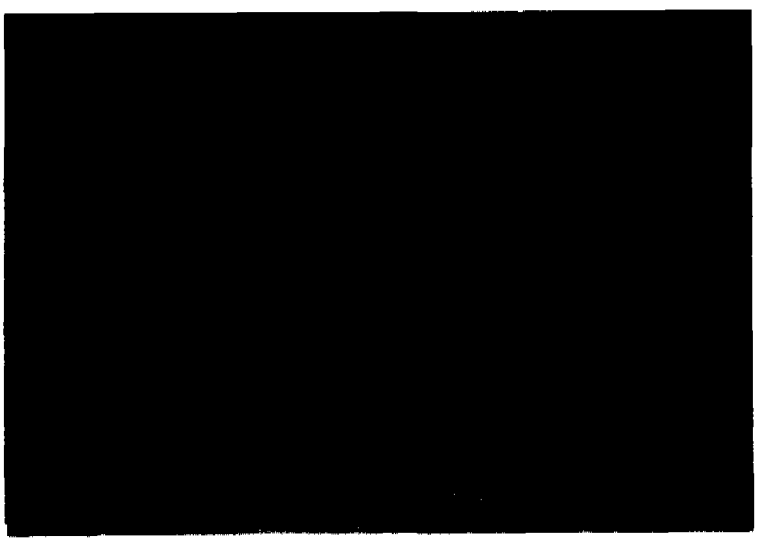
Device to solder spokes to pulley wheel #16 (for wells over 30 meters deep).

Device to solder spokes to pulley wheel #20 (for wells less than 30 meters deep).

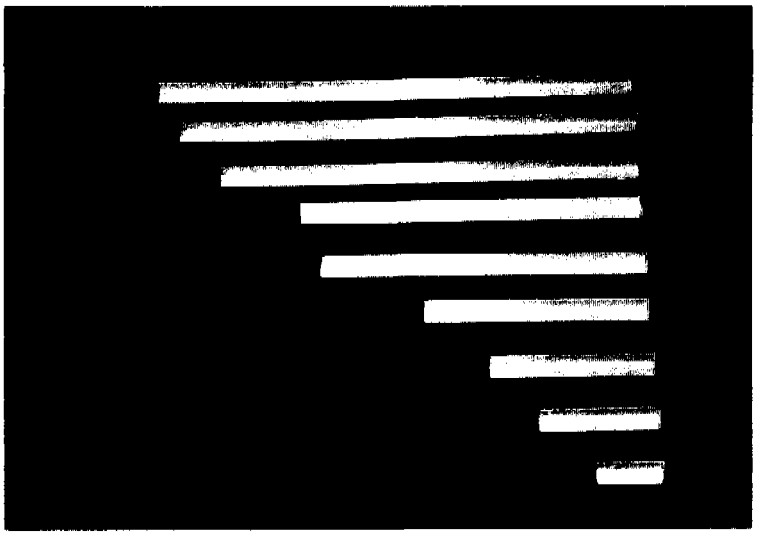


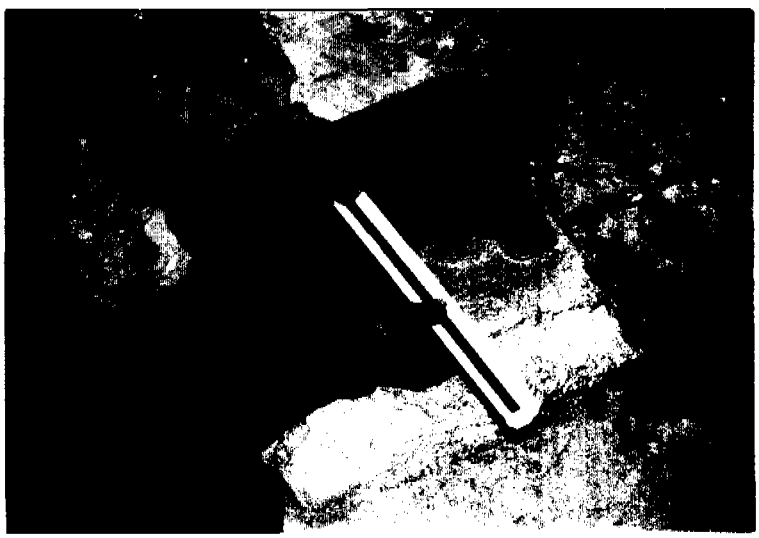
Device to assemble wheel.

Device to assemble cover of extra-strong pump.



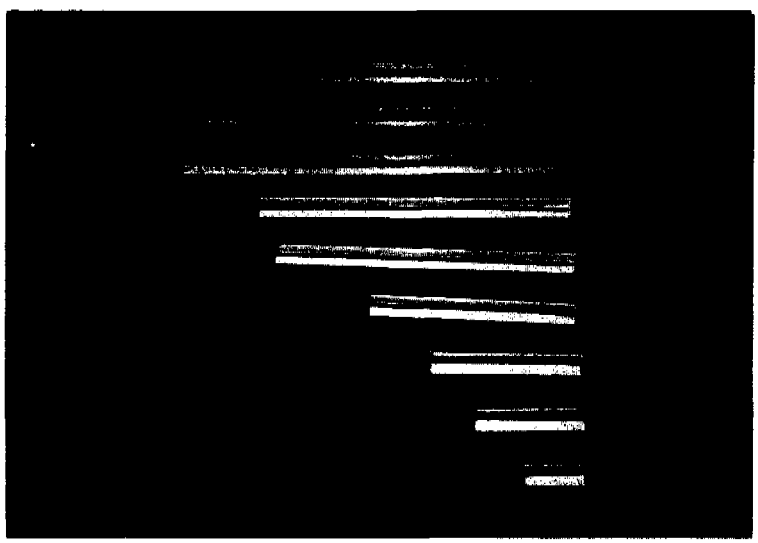
Device to cut rods of various sizes.





Place rod in cutting device.

Rods of various sizes already cut.



C.1.1.

CRANK PRODUCTION

C.1.1. CRANK PRODUCTION

Process Description

The crank serves as a wheel shaft. Further, it provides support when rotating the wheel. A tube bender is used to give it its "Z" shape.

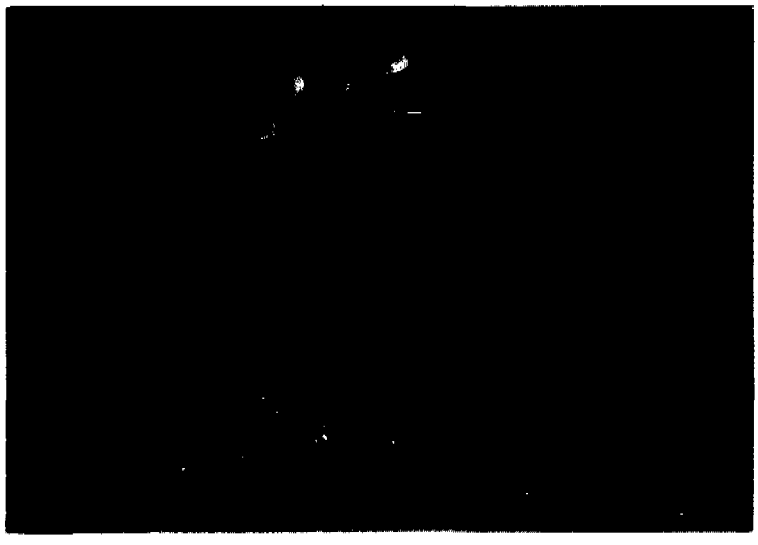
The tube is first bent to make the handle (or support).
It is bent again to make the shaft.
A roller and spacers are subsequently put in place and soldered.

Crank production includes the following steps:

1 Place tube on pipe bender (measure and mark).
2 Bend tube to make the handle (or support).
3 Measure and mark tube prior to bending for the second time (to make the shaft).
4 Bend again.
5 Put first roller spacer in place.
6 Insert roller in handle.
7 Put second roller in place.
8 Solder spacer to handle shaft.
9 The crank is ready to be used.

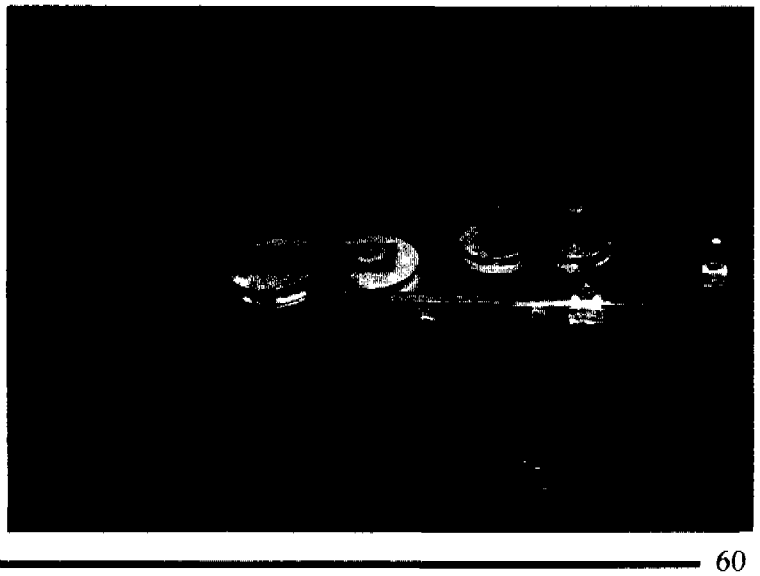
A photographic sequence of these steps is presented below.

Place pipe in bender and measure left end (30cm).



Make a 90° degree bend for the pulley wheel crank.

Measure opposite end (45 cm) and make a 90° degree bend for the pulley wheel shaft.



C.1.2.

ASSEMBLY OF WHEEL LEGS

C.1.2. ASSEMBLY OF WHEEL LEGS

Process Description

The wheel legs serve to support the whole wheel structure. They are attached to a central bushing in an open angle, forming an "A".

An open angle device is needed to assemble the wheel legs, as it provides stability to the whole structure.

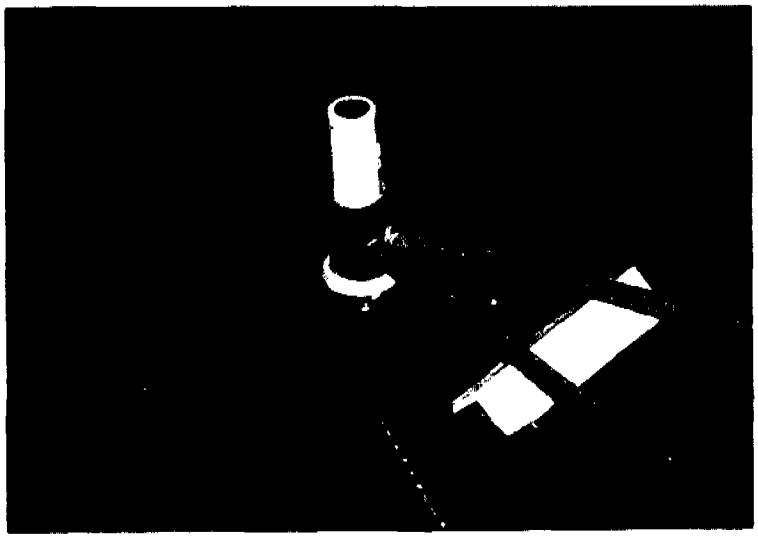
Some rods and a bushing are the necessary materials.

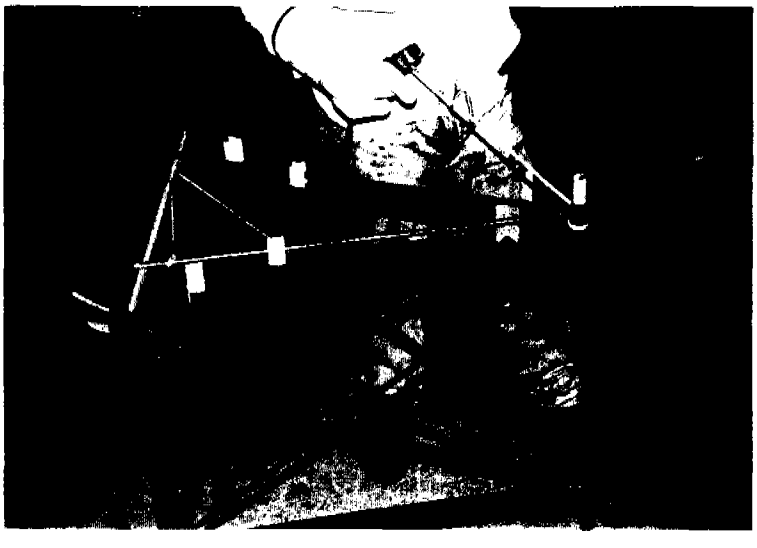
The process includes the following steps:

1 Prepare required materials (cut rods and bushing).
2 Place bushing at the vertex of the device.
3 Place rods at the vertex forming an open angle.
4 Solder rods to the bushing.

A photographic sequence of these steps is presented below.

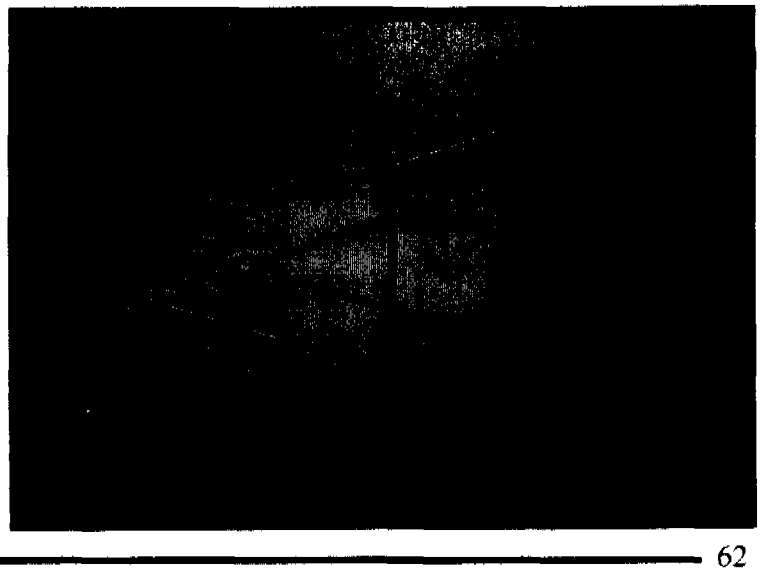
Place bushing on tip of device. Place two rods in the right position.





Solder rods to bushing.

Legs already assembled.



C.1.3.

MAKING THE PULLEY WHEEL HUB

C.1.3. MAKING THE PULLEY WHEEL HUB

Process Description

Several pieces are used in the pulley wheel production process. Reversed tire cuttings are stapled together using six staples. The spokes are soldered to the staples and central bushings, forming an "X".

Tire cuttings, rods, bushings, a device for making the pulley wheel spokes, staples, and a soldering iron are required in the process of making the hub.

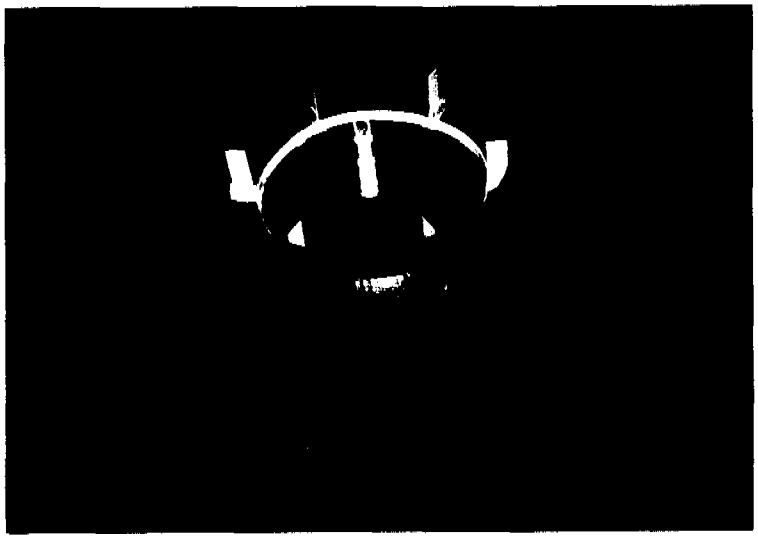
The function of the spokes is to provide stability to the pulley wheel.

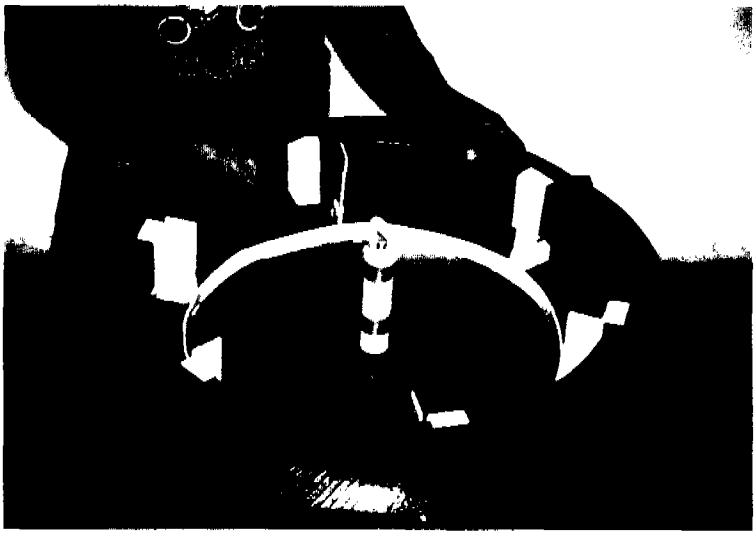
This process includes the following steps:

1 Prepare required materials (measure and cut).
2 Place two reversed tire cuttings on device for making the pulley wheel hub.
3 Staple cuttings together.
4 Place first bushing at the centre of the device.
5 Put spacer in place.
6 Put second bushing in place.
7 Solder spokes from the bushings to the staples, forming an "X" (crosswise).
8 The pulley wheel hub is ready.

A photographic sequence of these steps is presented below.

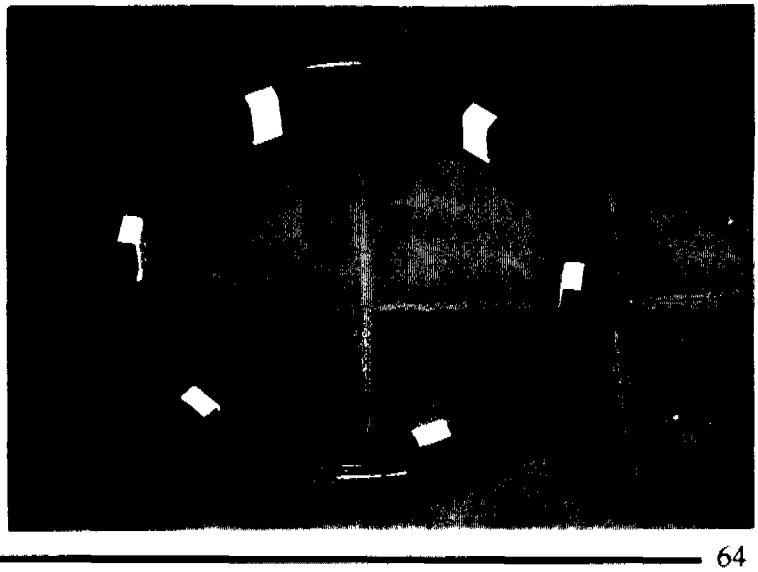
Place two used tire cuttings (#20) on device.



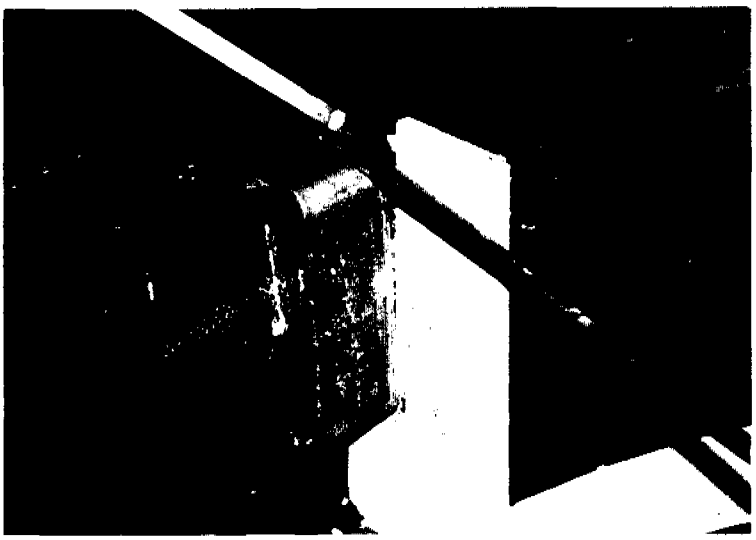


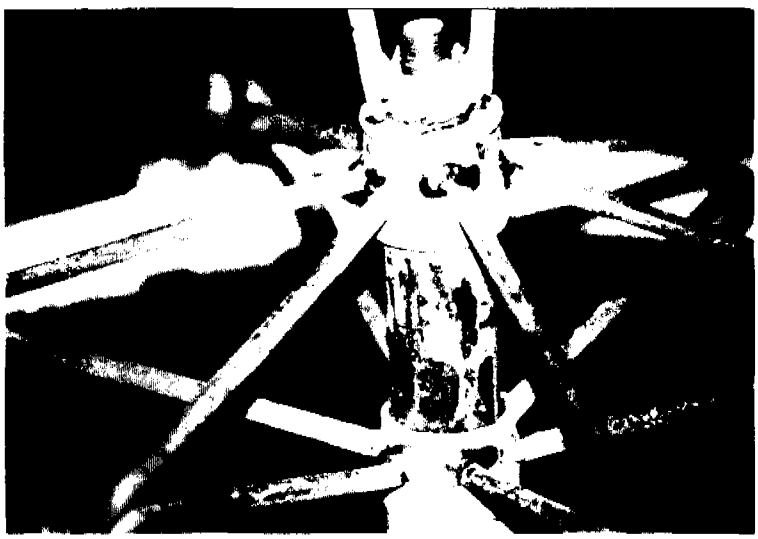
Staple tire cuttings together.

Tire cuttings already stapled.



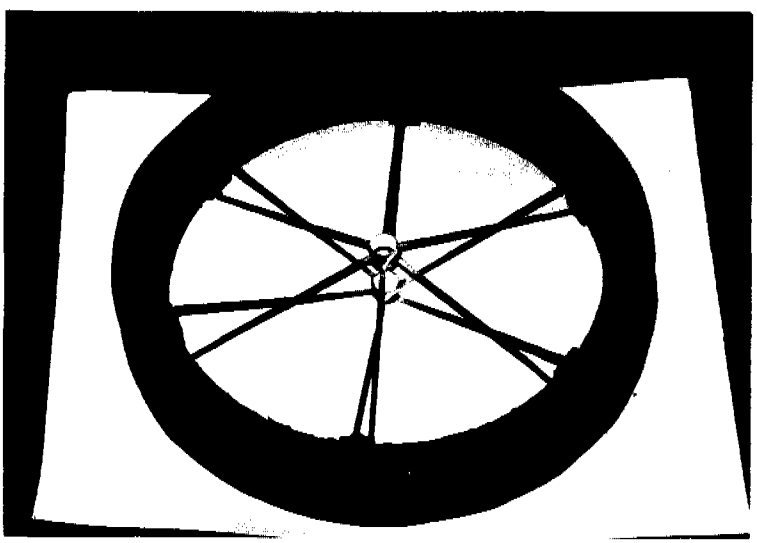
Place two bushings in the centre of the device. Solder spokes to staples and central bushings, forming an "X".





Spokes already soldered to pulley wheel bushings.

Pully wheel hub.



C.2.

ASSEMBLY OF WHEEL

C.2. ASSEMBLY OF WHEEL

Process Description

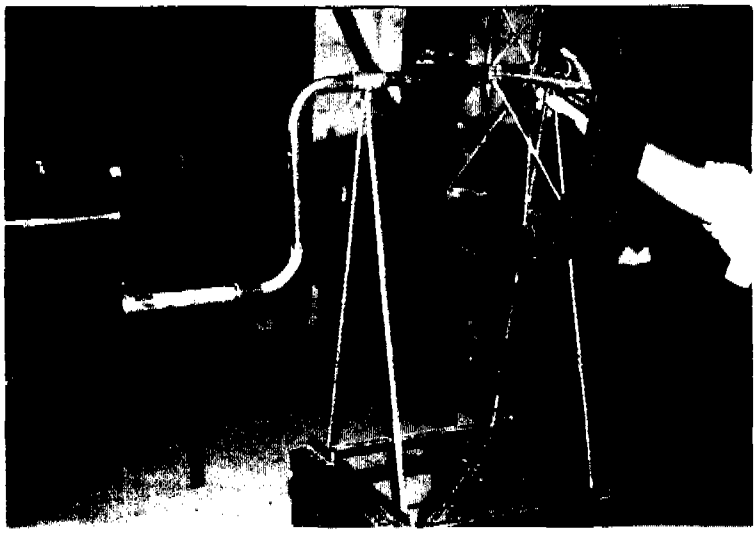
Here, all pieces and the mechanism of the Rope Pump are fitted together.
A device to assemble the wheel, already assembled legs, the crank, pulley wheel hub, spacers, and angle irons, as well as a soldering iron are required to complete this process.

The process includes the following steps:

1 Assemble first leg.
2 Position first spacer in crank shaft.
3 Insert first leg in shaft.
4 Position second spacer next to leg bushing.
5 Insert wheel in shaft.
6 Position first spacer of second leg in shaft.
7 Insert second leg and spacer in shaft.
8 Place angle irons of base on the device.
9 Place legs on angle irons and solder legs to these.
10 Solder reinforcement bars to angle irons of base.
11 Solder reinforcement bars to leg rods.
12 Solder spacers to shaft.
13 Put brake mechanism in place (opposite to the crank).
14 Put brake pins in place (on staples).
15 Solder wheel reinforcement bars to staples.
16 Solder upper support of tubes to the reinforcement bars.
17 Solder lower support of tubes to the reinforcement bars.
18 The assembled wheel is ready to be used.

The photographic sequence of the steps involved are presented below.

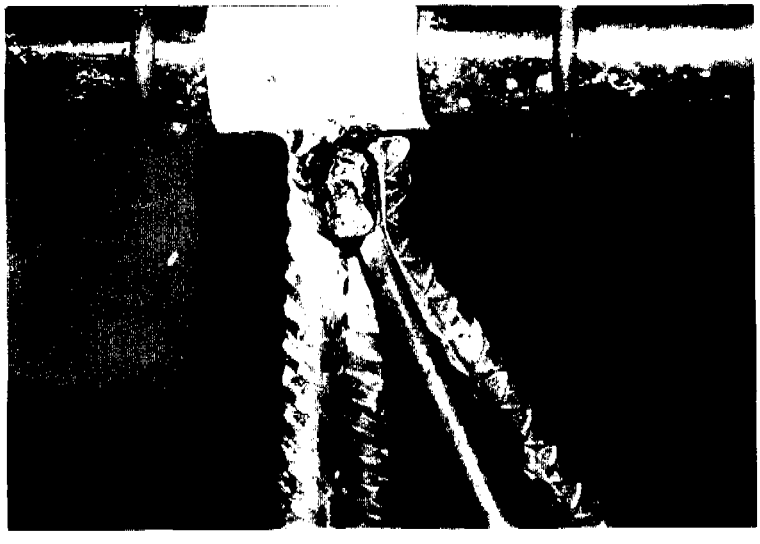
Insert the two legs with spacers and the pully wheel in crank shaft.



Place structure on angle irons for base.

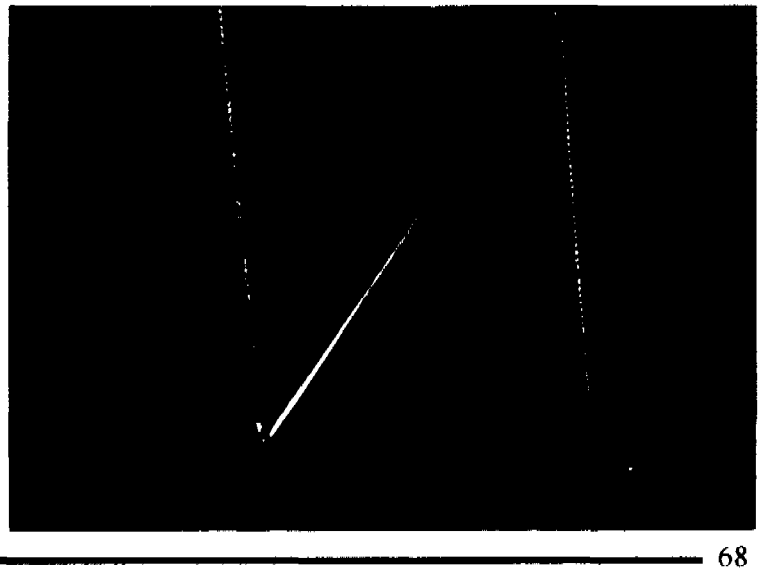
Solder legs to angle irons for base.

Solder reinforcement bars to angle irons.

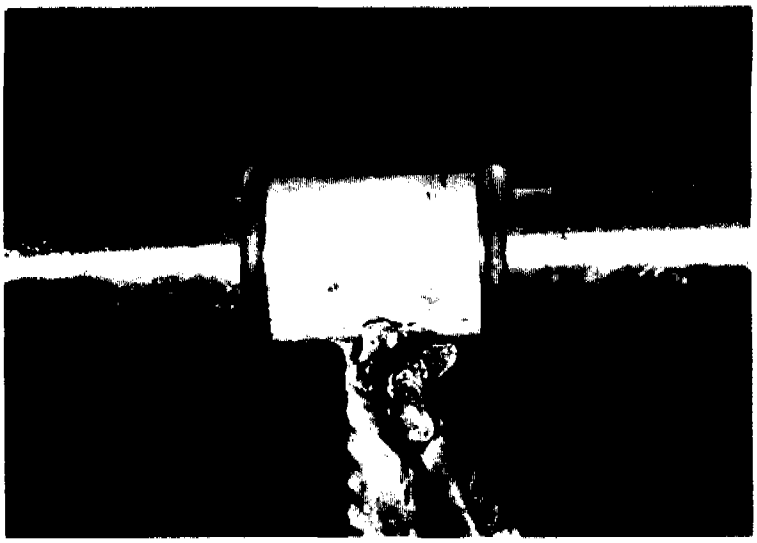


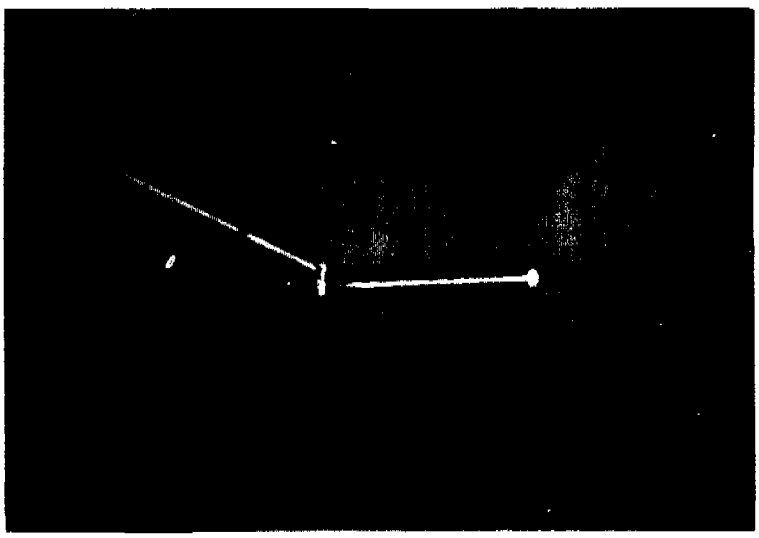
Solder reinforcement bars to legs.

The whole structure with soldered reinforcement bars.



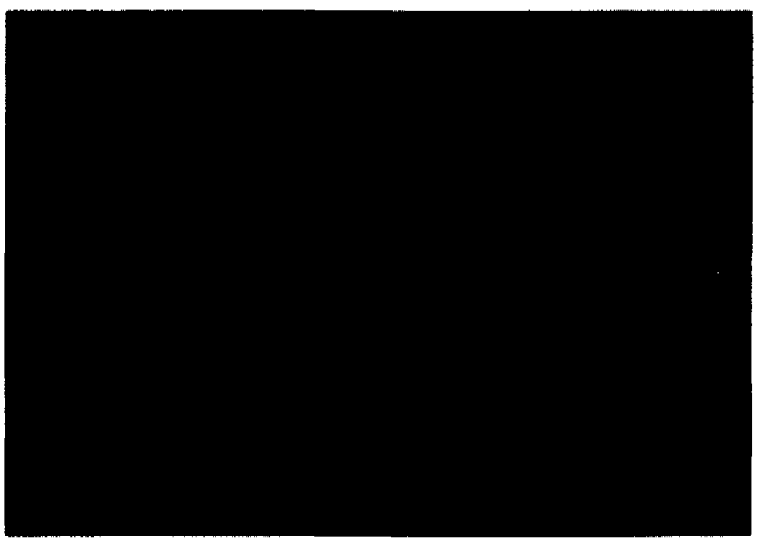
Solder spacers to crank shaft.





Solder roller spacers to crank shaft.

Brake mechanism.



C.2.1.

INSTALLATION OF BRAKE SYSTEM

C.2.1. INSTALLATION OF BRAKE SYSTEM

Process Description

The brake system prevents the wheel from rolling back at great speed after pumping. When the water is pumped, it becomes a heavy column and pushes the wheel back.

The process to produce and assemble the brake system includes the following steps:

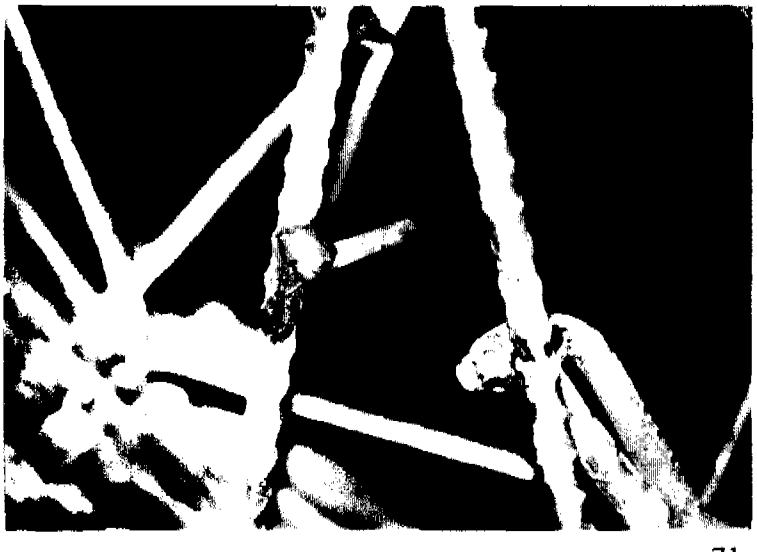
1 Bend one of the rods, forming a "C".
2 Solder one of the rods to a bushing
3 Solder a pin to each staple.
4 Put brake system in place (opposite to the crank).
5 A pin is positioned so as to serve as a stop mechanism for the brake.
6 The wheel now has a brake system.

A photographic sequence of these steps is presented below.

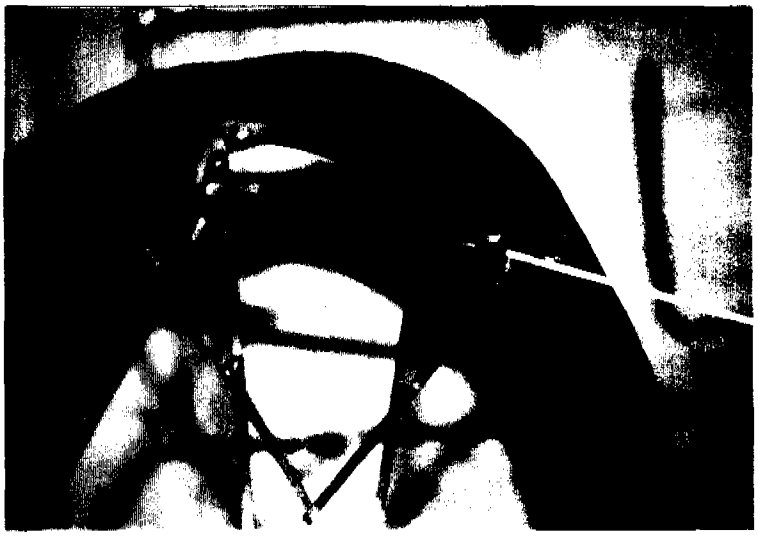
Solder a pin to each staple.

Fasten brake mechanism to leg opposite to crank. Place it 14 cm awy from bushing.

Fasten pin to stop brake lever to the other leg.



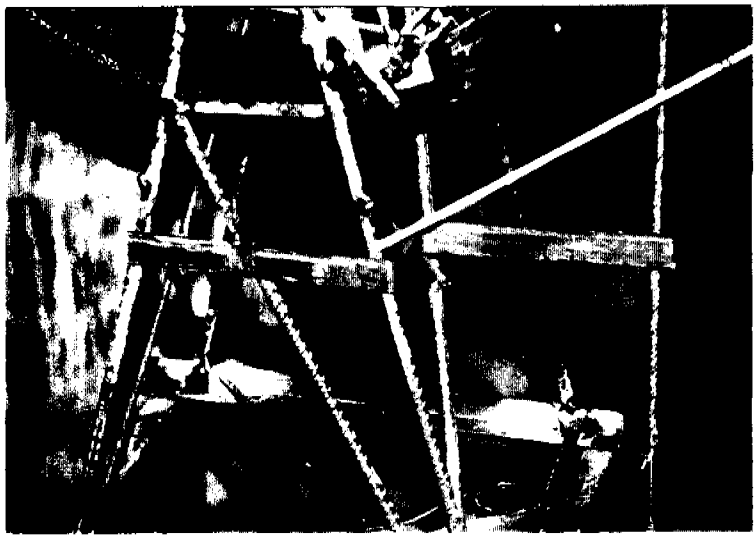
Pulley wheel with brake system in place.

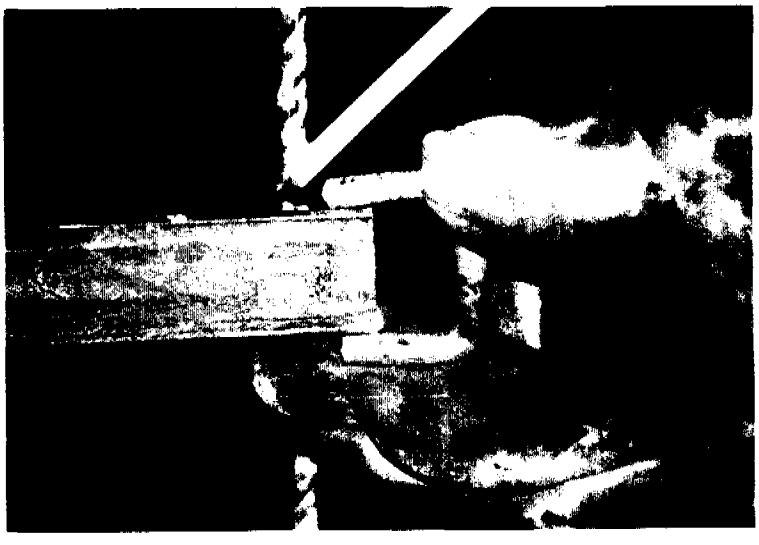


Solder reinforcement bars to pulley wheel.

Solder lower support of pumping pipe.

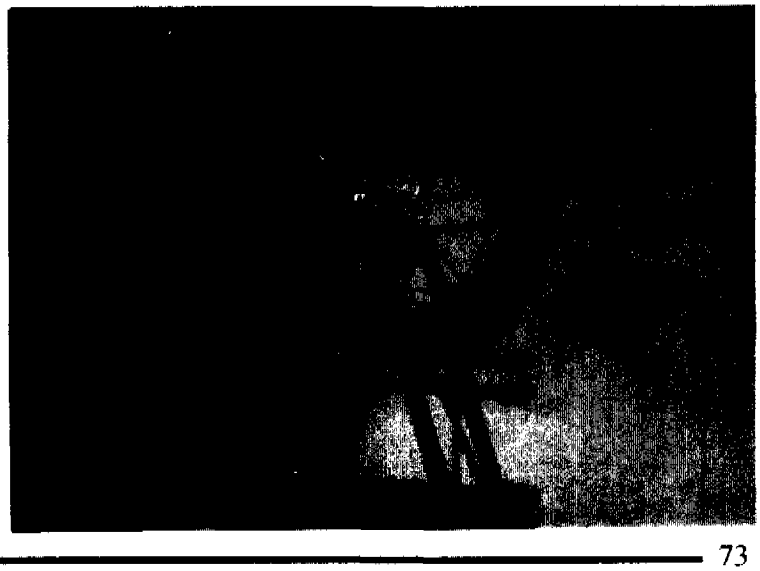
Solder upper support of discharge nipple.





Clamp upper support buckle.

Finished wheel.



C.3.

PRODUCTION AND INSTALLATION OF THE COVER FRAME

C.3. PRODUCTION AND INSTALLATION OF THE COVER FRAME

Process Description

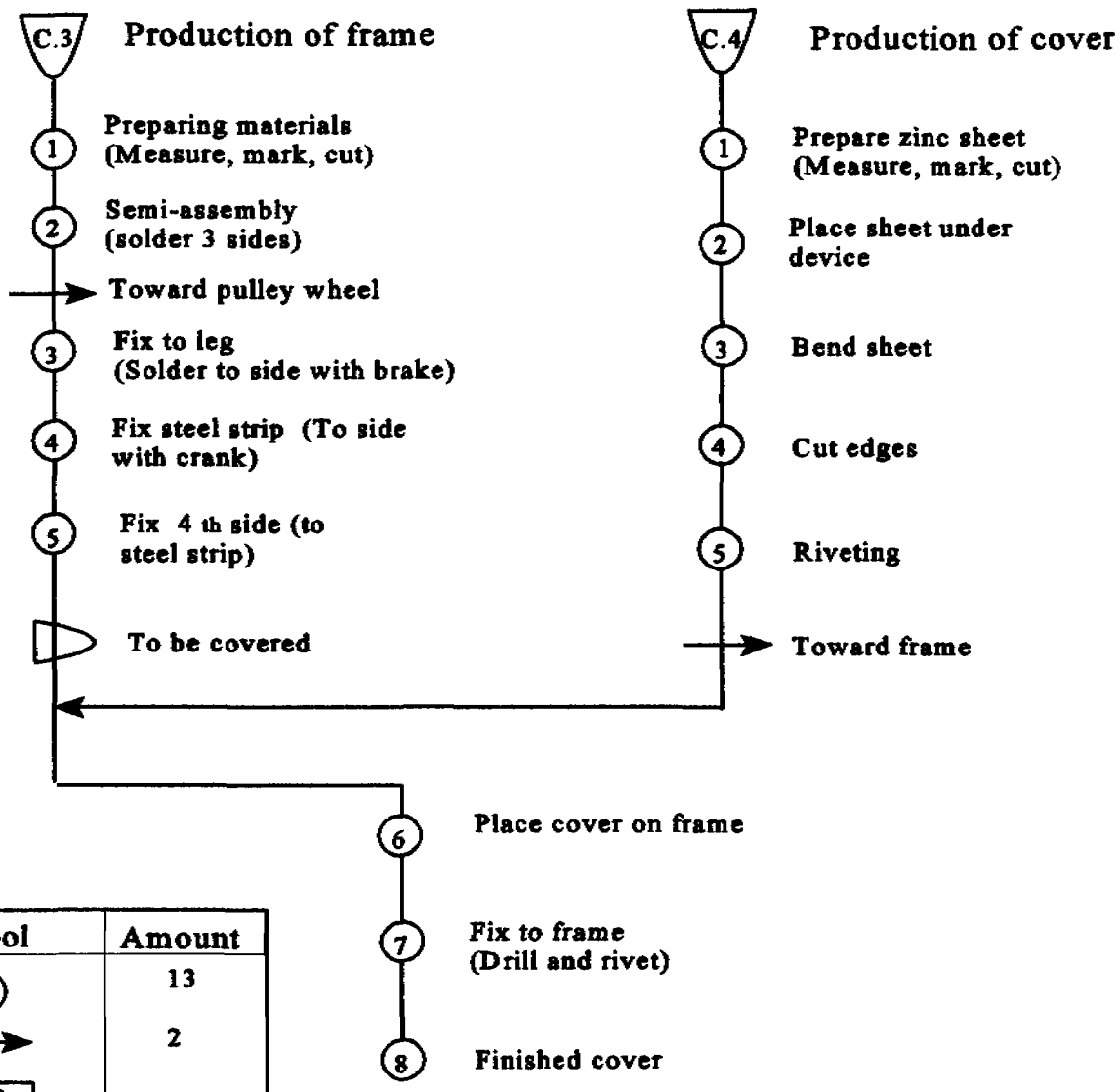
The cover frame is a an additional piece to the pulley wheel. Angle irons, steel strips, an iron solder and a device to assemble the cover frame are required to produce and install the piece.

Its function is to serve as support for the pulley wheel cover.

The process of frame production and installation includes the following steps:

1 Prepare required materials (measure, mark, cut).
2 Solder two 80 cm angle irons to a 20 cm angle iron (forming a "U").
3 Fix semi-assembled frame to leg with brake system attached.
4 Add a steel strip to frame on the crank side.
5 Fix a steel strip to leg rod on same side.
6 Fix fourth angle iron of frame.

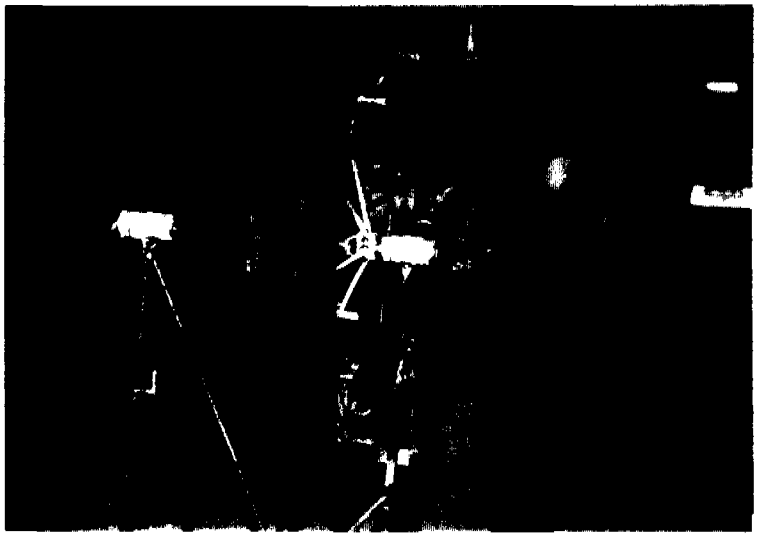
A diagram of the process and photographic sequence of all steps involved are presented below.

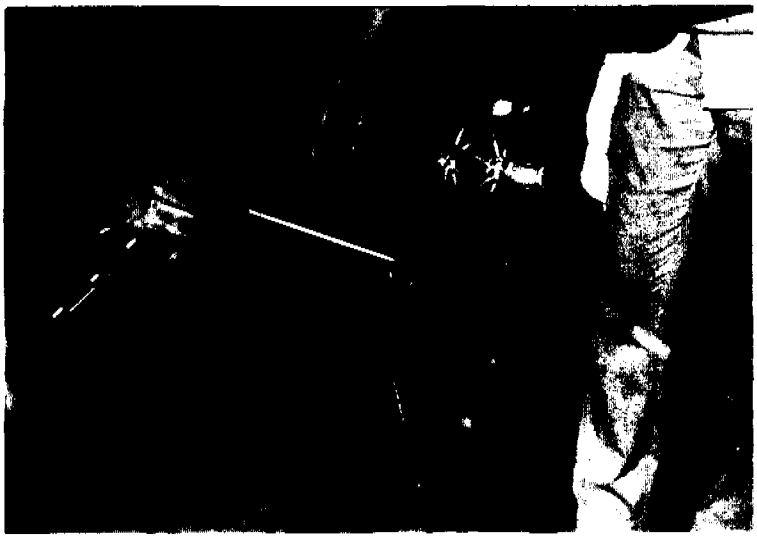


Operation	Symbol	Amount
Operation	○	13
Transportation	→	2
Op - Inspection	◎	-
Delay	D	1
Inspection	▭	-
Warehouse	▽	-

C.3/4
DIAGRAM OF COVER ASSEMBLY PROCESS

Place cover frame (80 x 20 cm) in pulley wheel and fasten it to the side leg with brake system.





Close frame by soldering a 1 x 20 cm angle iron.

Fix steel strip to side leg of wheel.

C.4.

PRODUCTION AND INSTALLATION OF COVER

C.4. PRODUCTION AND INSTALLATION OF COVER

Process Description

The cover is an additional piece to the pulley wheel. Zinc sheet , a device to assemble the cover, a mallet, scissors, a drill, and a riveter are required materials in this process.

The cover function is to protect the pistoned rope. Further, it adds to its durability.

The process to produce and install the cover includes the following steps:

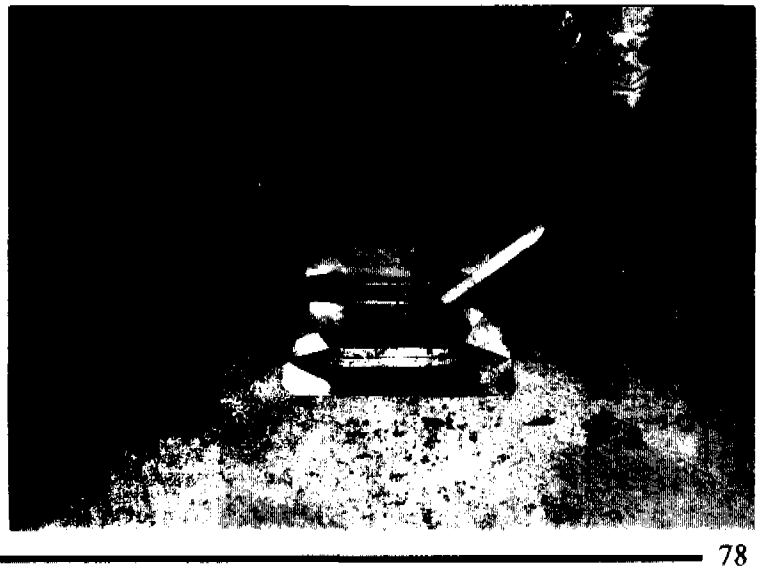
1 Prepare the zinc sheet (measure, mark and cut)
2 Place sheet under device.
3 Fold sheet.
4 Cut edges.
5 Cover device with sheet.
6 Rivet the upper sides of cover.
7 Place assembled cover on wheel frame.
8 Drill cover and frame.
9 Fix cover to frame.
10 Pulley wheel cover is ready to be used.

A photographic sequence of all steps involved is presented below.

Cut a 125 x 40 cm zinc sheet caliber 24 and place it under device.

Bend and cut edges of sheet.

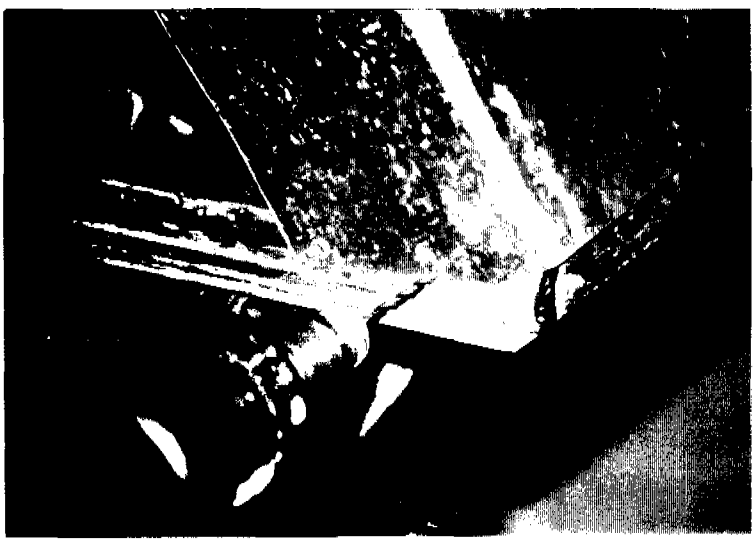
Cover device with sheet pressed against it.



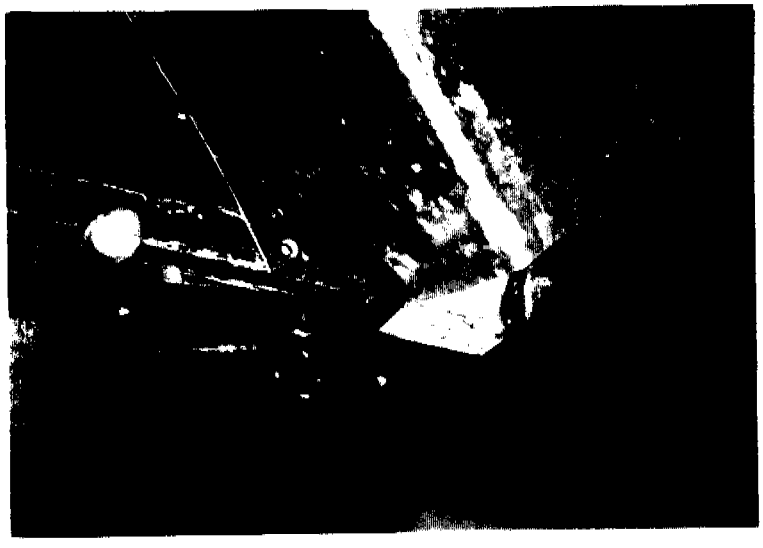
Rivet upper edges of cover.

Finished cover.

Place cover on frame and drill both.



Fix cover to frame with rivets.



Pulley wheel with protection cover.

C.5.

WHEEL FINISHING PROCESS

C.5. WHEEL FINISHING PROCESS

Process Description

A wire brush to remove rust, a hammer, anti-corrosive paint, and oil paint are required to finish the wheel.

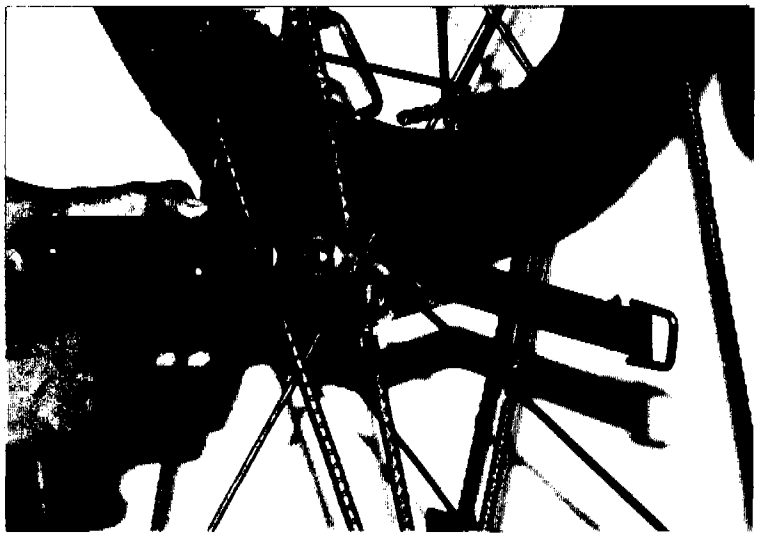
The finishing process is aimed at preventing the wheel from rusting.

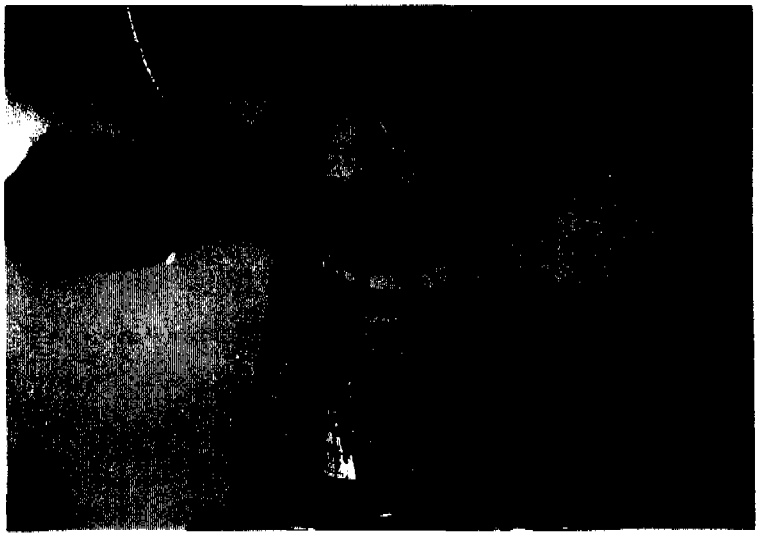
The wheel finishing process includes the following steps:

1 Remove rust and dirt from wheel.
2 Apply coat of anti-corrosive paint to wheel.
3 Apply coat of oil paint to wheel.
4 The wheel is ready to be used.

A photographic sequence of all steps involved is presented below.

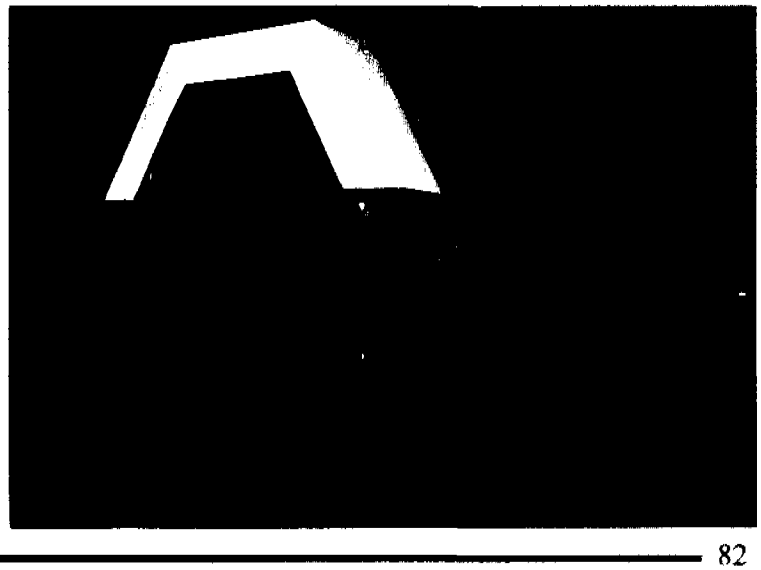
Remove all residue and dirt from wheel.





Apply anti-corrosive paint to wheel, as well as a coat of oil paint.

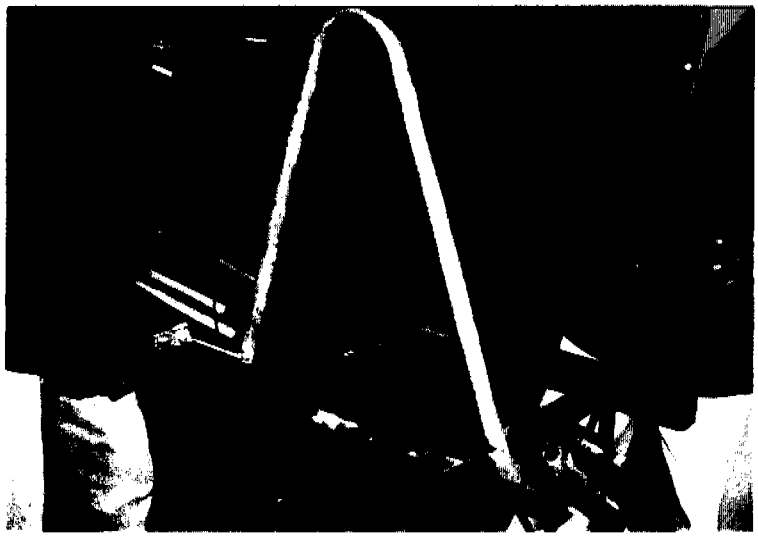
Extra-strong wheel with cover ready to be used.



APPENDIX

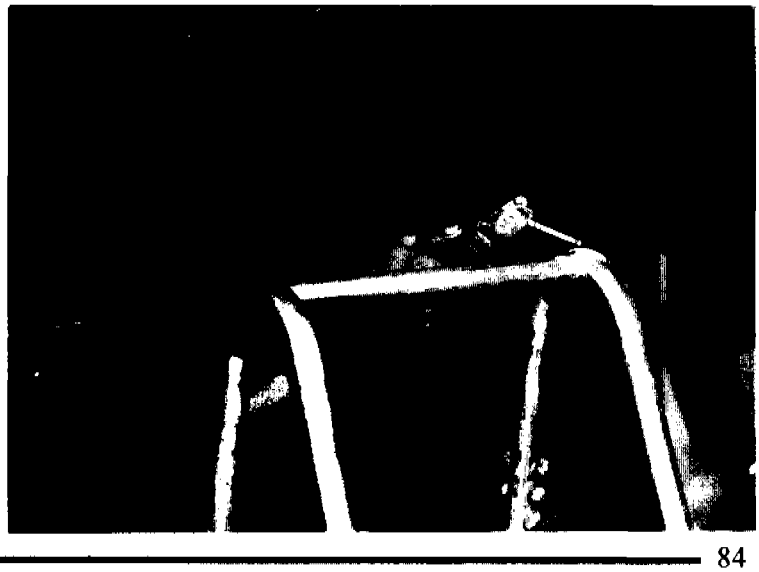
Assembly of Community-Well Pump

Solder one leg to angle irons of base.

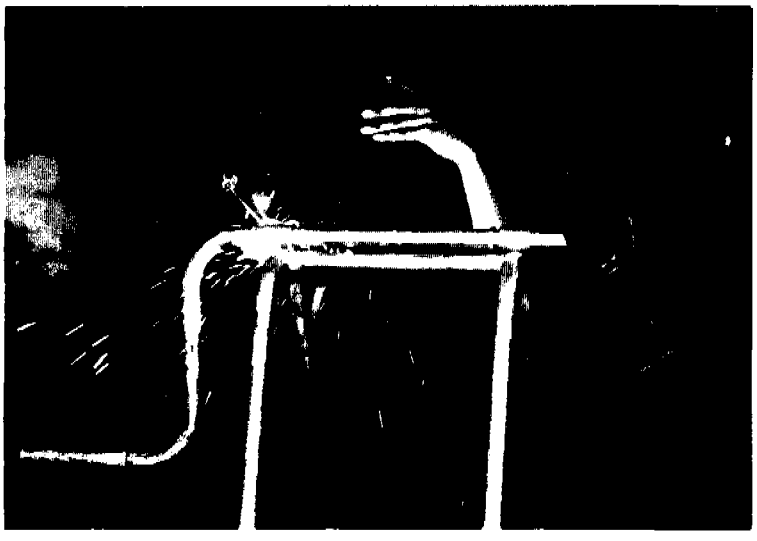


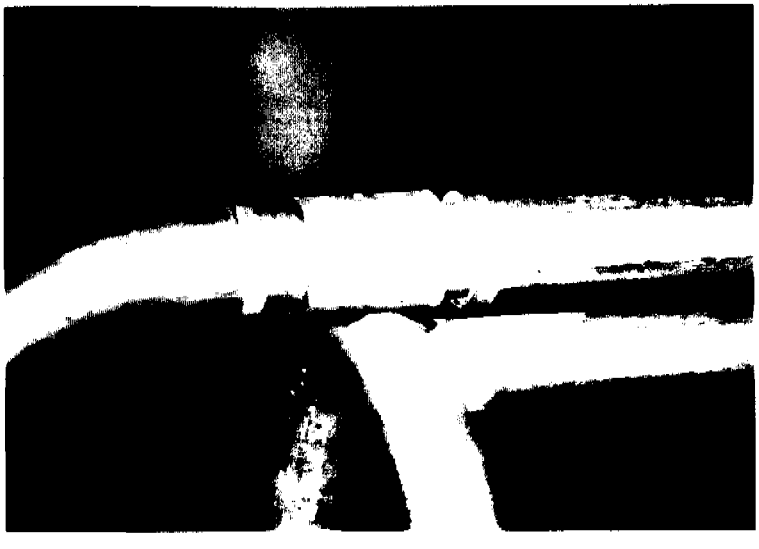
Solder second leg to angle irons of base.

Solder reinforcement bar to upper side of legs.



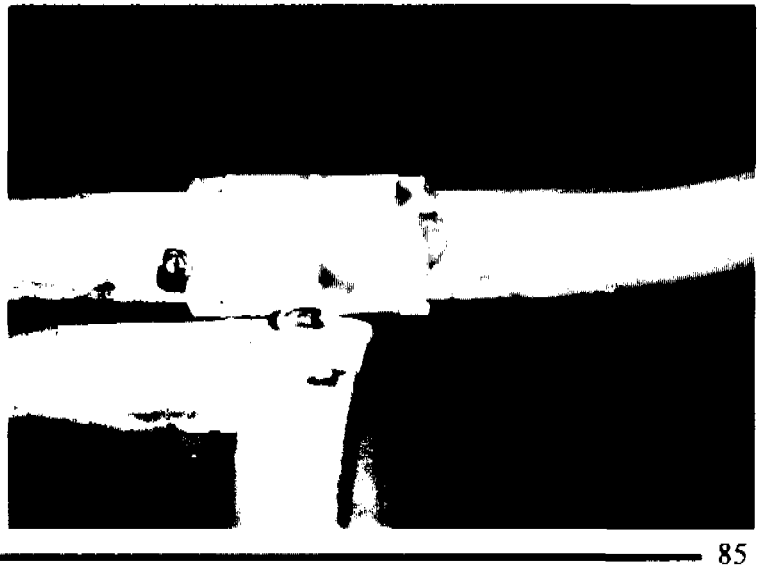
Solder crank to upper part of legs.



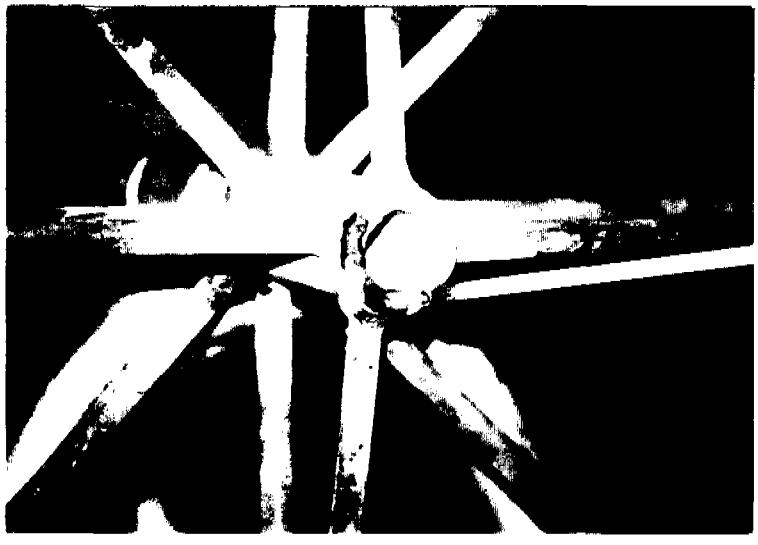


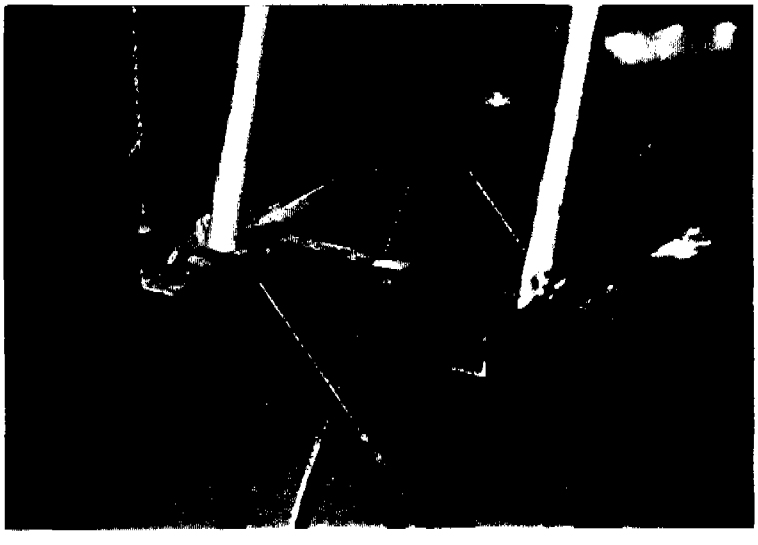
Crank bushing and spacers.

Solder spacers to crank shaft.



Insert pulley wheel in right side of shaft. (Outside the leg structure).





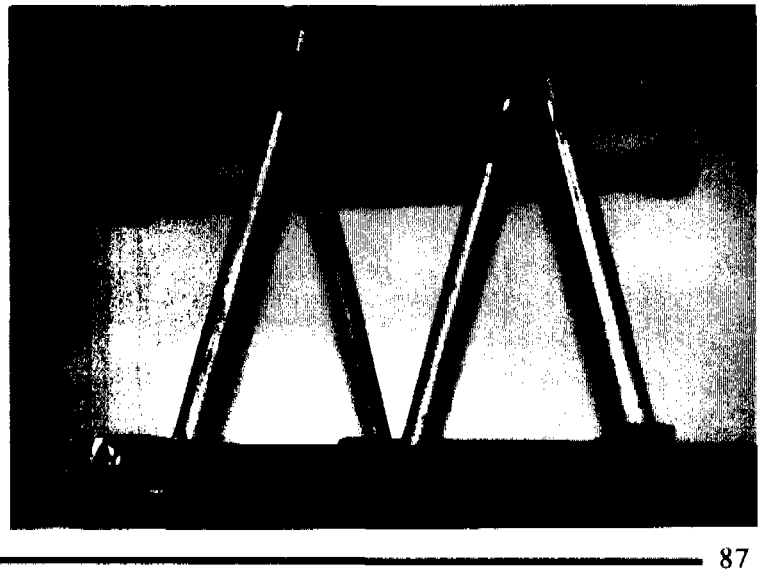
Put in place internal reinforcement bar of legs.

Solder pulley wheel reinforcement bars to staples.

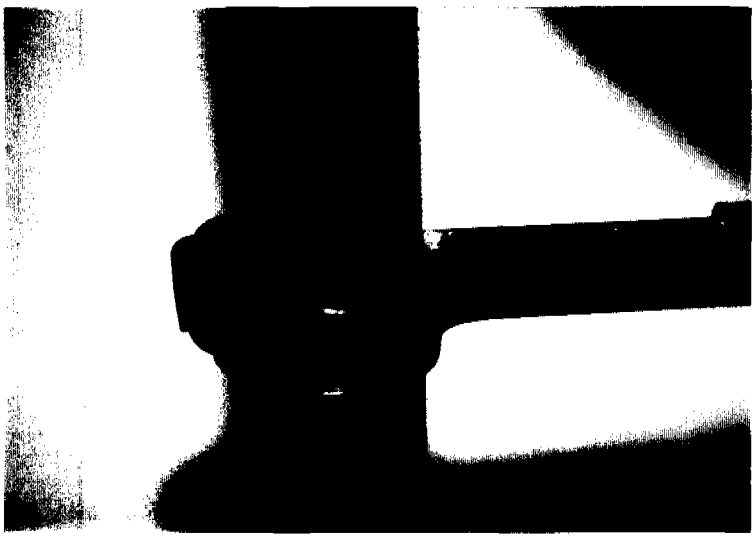
Place lower support on angle irons of base for discharge pipe.

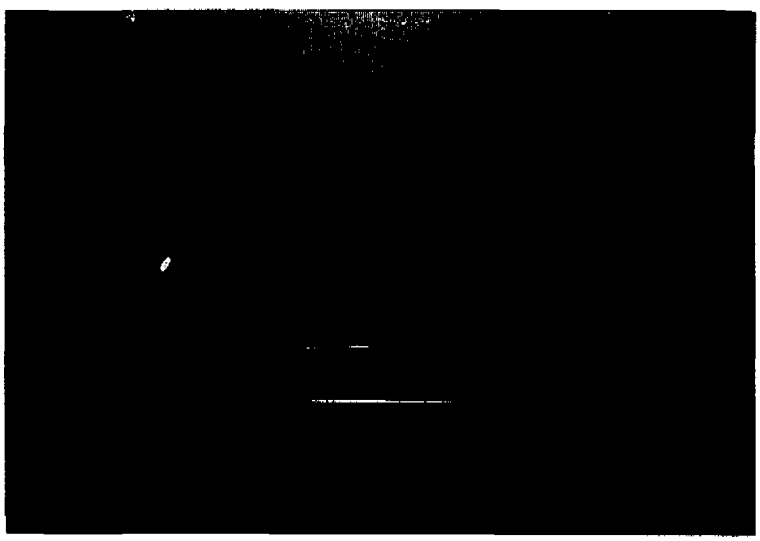
Place in right position lower support of pumping pipe.

Fix in place upper support for discharge and pumping pipes.



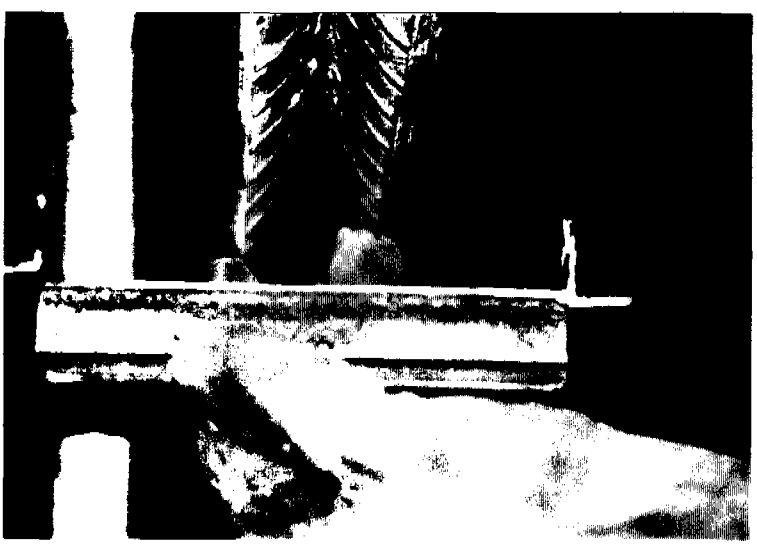
Upper support fixed to nipple.





Cover frame components.

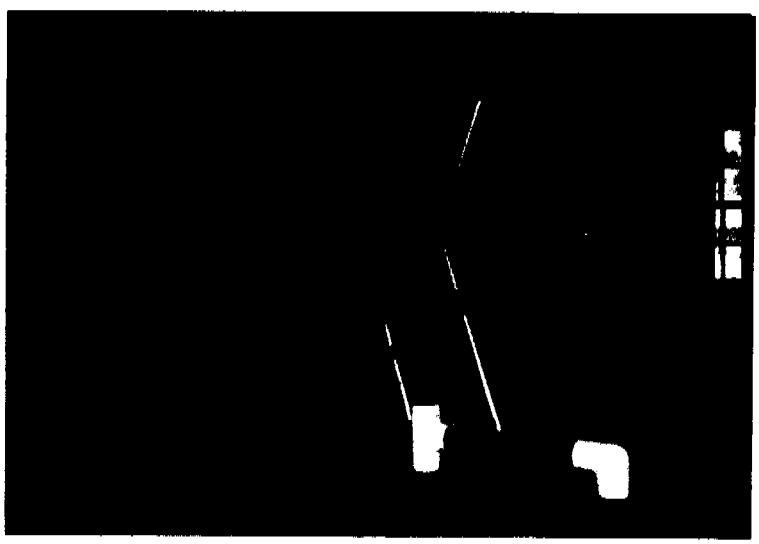
Fix in place semi-assembled frame. Close frame with fourth side.



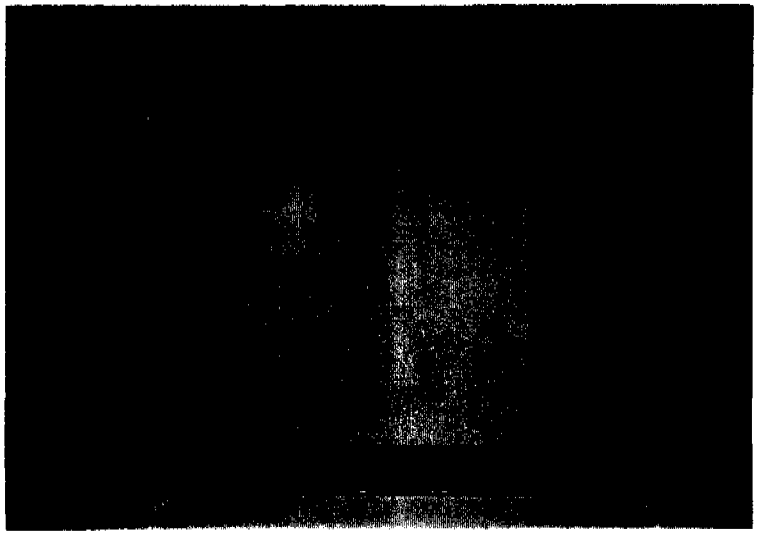
Cover frame and supports already in place.

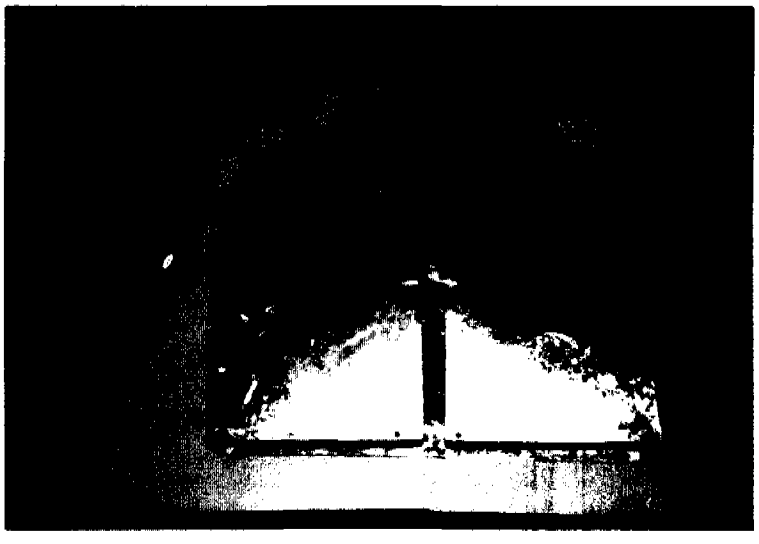
Fix brake mechanism to leg and cover frame.

Assembled community-pump wheel.



Device to assemble cover.





Community-well pulley wheel cover.

Finished community-well wheel.