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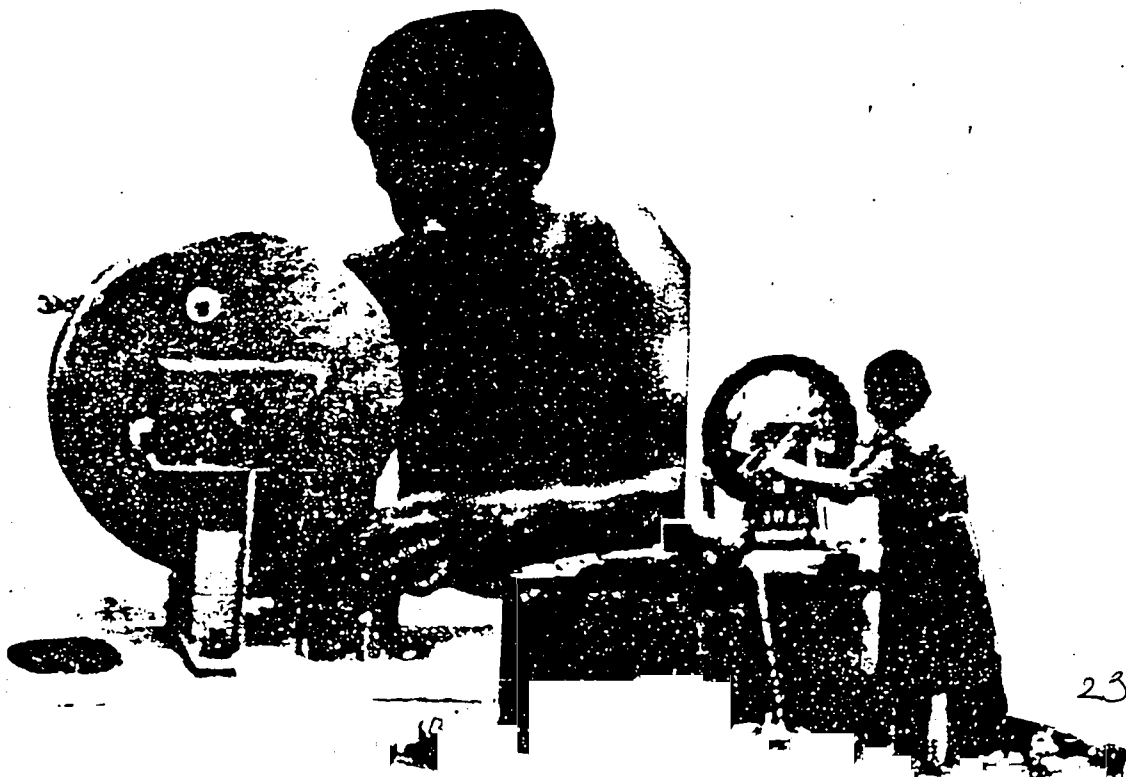
98, Rawatawatta Road,
Moratuwa, Sri Lanka. tel: 505255.

VILLAGE TECHNOLOGY RESEARCH SARVODAYA SHRAMADANA MOVEMENT

ROPE PUMP RESEARCH PROJECT

2nd PROGRESS REPORT

010388 - 310788



232.2-88R0-0961

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This is the second progress report on the Rope Pump Research Project.

1. Objectives

1. The short term aim of the research project is to gain practical experience in the construction and introduction of a simple water-lifting device (the rope pump) for the extraction of water from shallow wells, both for the purpose of drinking as for small-scale home garden irrigation:
A water-lifting device of sufficient capacity, which is cheap, durable, comprehensible, convenient to operate, easy to maintain and locally manufacturable.
2. In the longer term it is expected that this research experience can be shared with other rural development organisations in developing countries, and be utilized by them to facilitate the satisfaction of an important need of many rural families; that is, improved access to well water.

2. Project Implementation Time

The plan is to implement the research project within a period of one year, from 1st January to 31st December 1988.

The implementation period is divided into four phases:

- a 2-months preparatory phase
- a 3-months construction & testing phase
- a 3-months field introduction phase
- a 4-months usage/monitoring phase

3. Location of the Project

The research activities (construction & testing) are undertaken at the Sarvodaya Regional Development Education Centre in the Gampaha District in Sri Lanka.

In the premises of this Centre a workshop has been established.

The project field activities to introduce the rope pump take place in the Gampaha District (for drinking water) and are planned in the Puttalam District (for irrigation water).

4. Project Research Team

The research team consists of 3 workers:

- Mr. Hoali Wickremasinghe (technician)
- Ms. Chitra Rodrigo (draughtsman)
- Ir. Thomas H.J. Pieters (coordinator/initiator)

5. Project Associate Partners

- Sarvodaya Rural Technical Services (SRTS), Sri Lanka
Ir. Han Heynen & Mr. Gunapala Gannegama.

Sarvodaya RTS granted a fund of Rs. 99,940/- for the implementation of the project.

- Delft University of Technology (DUT), The Netherlands
Ir. Willem Dijk & Ir. Willem Riedijk.

Two students of the DUT, Ms. Mariet Lohman and Ms. Annemarijke Mooijman, have come to Sri Lanka to participate in the research during the 2nd phase.

- Village Technology Research (VTR), Sarvodaya/DUT cooperation, Sri Lanka. -

Ir. Thomas H.J. Pieters.

- Dian Desa, Indonesia - Ms. Christina Aristanti
- Intermediate Technology Development Group (ITDG), England - Mr. Frank Almond

- Demo Tech, The Netherlands - Mr. Riindert van Tijen.
- International Development Research Centre (IDRC),
Canada, Dr. Donald Sharp.

6. Summary of previous progress up to 290288

During the preparatory phase, covered in the first progress report, arrangements were made to start and organise the research project:

The budget was approved and financial administrative procedures were agreed upon. The research team was formed. A workshop was established at the Sarvodaya Regional Development Education Centre, where the research activities were to be undertaken and directed.

Other groups and institutions involved in rope pump construction activities were contacted to send information in order to learn from their experiences. The information received was however very brief. Some devices designed by others were either very simple, not very durable, requiring a lot of maintenance, or were technologically too advanced and costly.

Though useful for reflection, the research team as a result had to do a lot of discovery work on its own to develop a functional device that would be cheap, durable, comprehensible and easy to maintain.

Some possible construction designs and their estimated construction costs were presented in the first progress report.

7.0. Progress from 010388 to 310588

Under review are the achievements made during the construction & testing phase covering a period of 3 months.

7.1. Findings and results of construction & testing

The proposed construction designs, which were presented in the first progress report, have been further adjusted and refined while construction work progressed.

We have looked into the appropriateness of different designs for the construction parts that make up the rope pump device, using different materials:

- the near drive wheel

Wheels were made out of wood and iron, with sizes ranging from 1 foot to 2 feet diameter.

Small wheels up to 1 foot can be made out of hard wood (boiled in oil). Bigger wheels can be better made of iron, since wood of that size can easily warp.

For a sufficient extraction of water a certain speed of the rope is required (riser pipe diameter, rope knot diameter and depth of ground water table are also important parameters in this respect).

Smaller wheels have smaller circular rotation speeds at their circumferences than bigger wheels, but the acceptable speed for humans to turn a wheel lies between 60-90 rounds per minute.

Smaller wheels have bigger curves allowing the enveloped rope to have a better grip on the wheel tread.

Slipping of the rope is more likely to occur on bigger wheels, which have smaller curves.

Greater tractive power on the rope will facilitate slipping.

To use old rubber tyres (without profile) as a tread for the rope proves to be very good. The tread should have a V-shape in order to line the rope.

The V-shape should not be too deep, otherwise the rope will get stuck and the wheel blocked.

- bearings

For a centered fixation of the drive wheel, ball bearings \varnothing 35 mm were used and for an off-centered suspension of the wheel ball bearings \varnothing 50 mm.

- bearing house

Hard wood (oalu), boiled in oil, is used as material to lock up and fix the ball bearing.

Because of greater durability, it is more suitable to make the bearing house out of one piece, than to make the house out of two connected equal parts.

- radius of the wheel handle

The lifting of water causes a tractive force on to the rope. This force touches upon the drive wheel on its circumference and works upon the wheel as a Moment Force. It is this Moment which has to be surmounted continuously by human effort.

For a wheel of 1 foot, a handle radius of 15 cm is found suitable. For a wheel of 1,5 to 2 feet, the handle radius can be 20 cm.

- fixation of device superstructure

The lining up and fixation of the bearing house-drive wheel composition has been designed in two ways:

- * by building up an iron frame, which can be attached to a concrete substructure (which partly covers a well head). The iron frame should have sufficient base and be strong in two directions, or
- * by building up a concrete substructure to which the bearing houses can be fixed directly.

- rope and riser pipe

It proves to be suitable to use nylon rope and PVC for the riser pipe. The application of electricity-wire conduit pipes, which are very cheap, is currently being tested.

The rope and pipe diameters used are as follows:

rope diameter	7mm	5mm	4.5mm
knot diameter	26mm	19mm	16 mm
inner pipe diameter	28mm	22mm	17.5mm

- Water outlet

The top of the riser pipe is fitted in a small storage tank. The water lifted by the rope will flow into the tank, to which an outlet pipe is fitted from which the water can be collected.

- Bottom entrance of riser pipe

Attached to the storage tank, the riser hangs freely down in the well shaft.

At the bottom of the riser pipe a shaped hard wood block is fitted to allow a smooth entering of the rope.

The block, which is under water, should be heavy enough to keep the pipe straight against the upward pressure caused by the water.

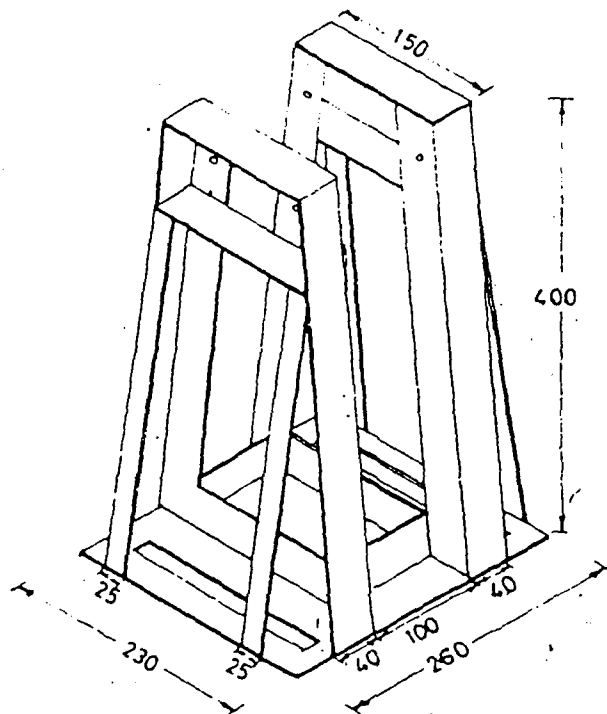
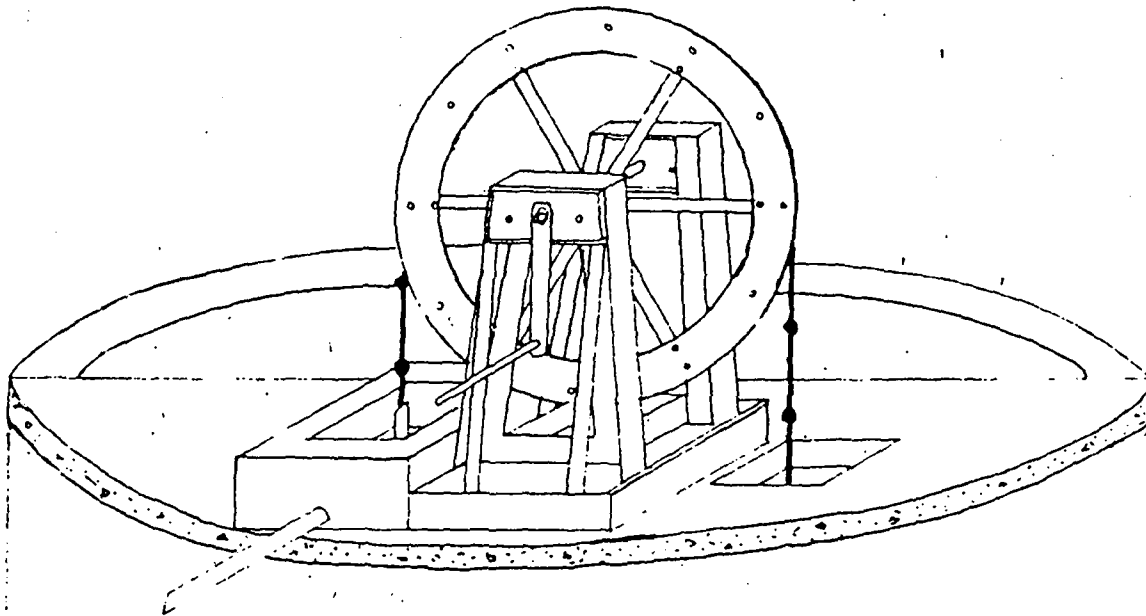
- Maintenance

Through its simplicity it is expected that a rope pump device under use can function problem free for a long time, probably well over 5 years.

To test the durability an electrical powered motor has been connected which drives the pump nine hours per day. The results of this testing will be presented in the next progress report.

Maintenance is required, but is confined to regular greasing of the ball bearings and grip of the handle, checking of a few bolts and connection of the rope ends and repainting of the iron.

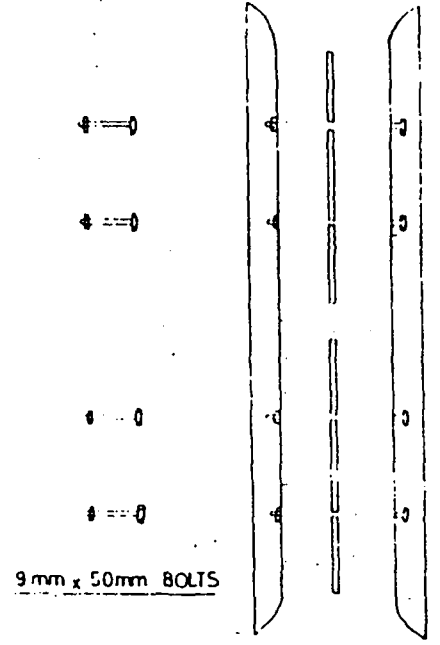
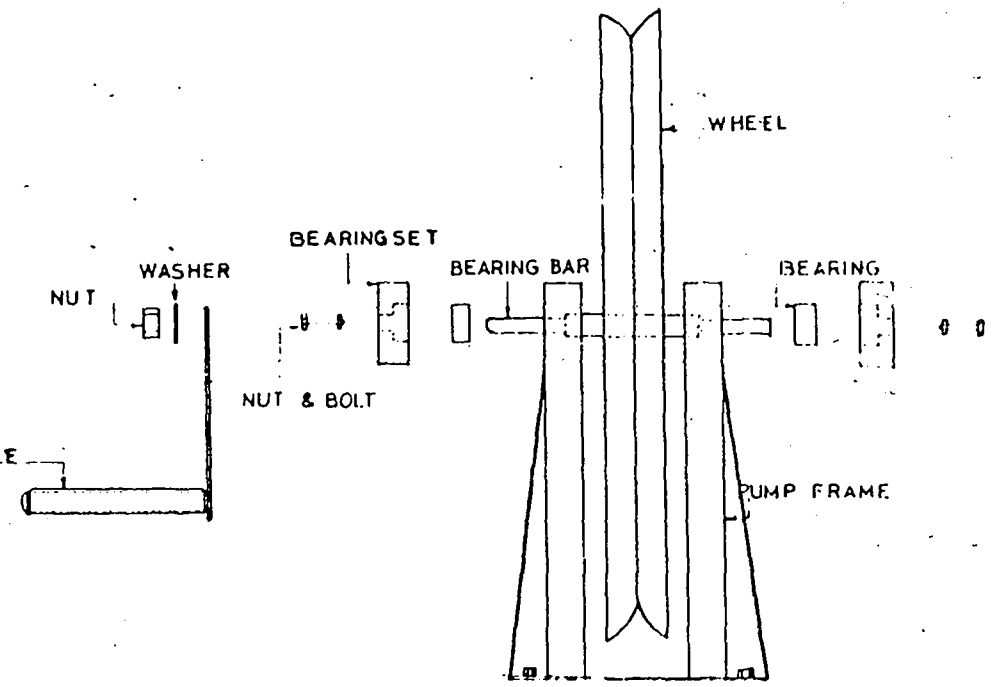
MODEL 1 : iron frame on well head cover.
(centered drive wheel)



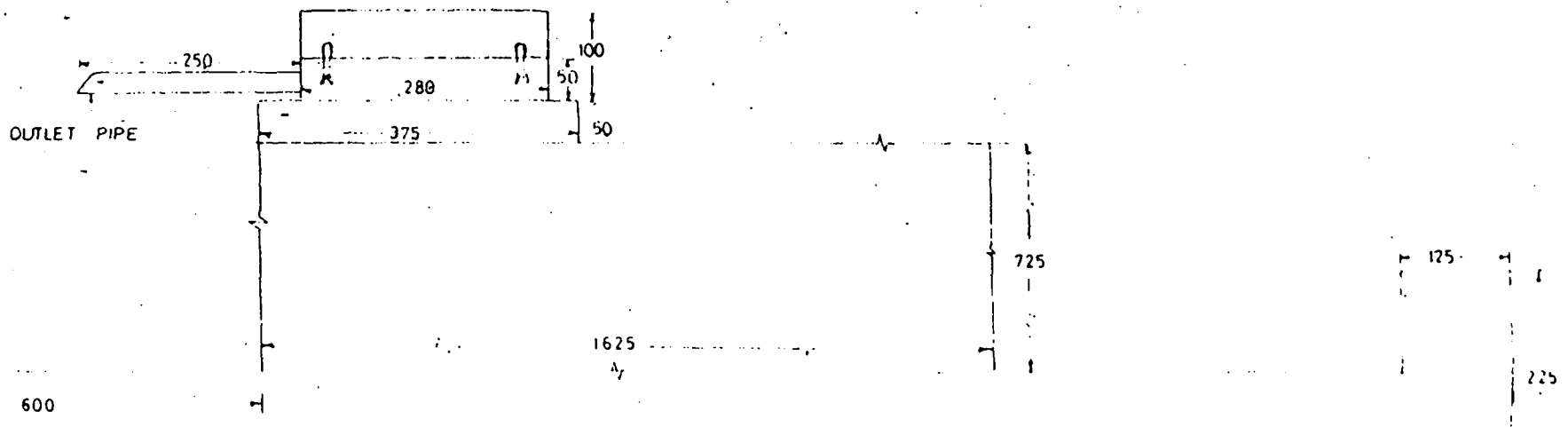
PUMP FRAME

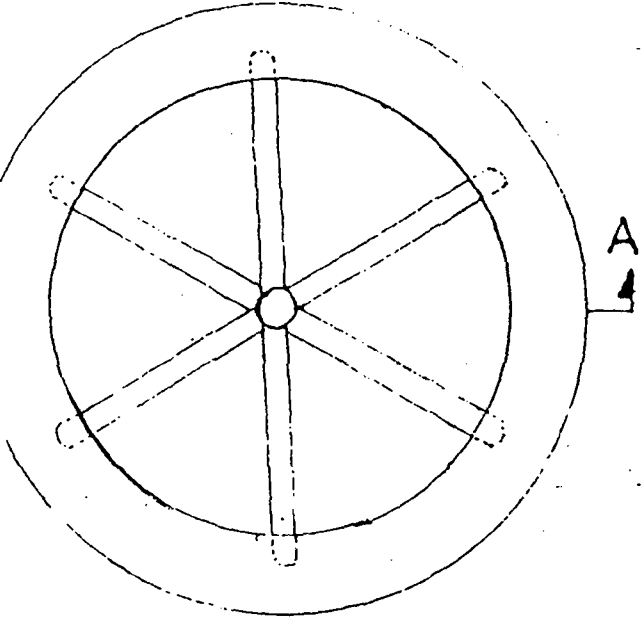
MATERIAL : IRON FLAT IRON

MATERIAL : TYER, BOLTS & NUTS

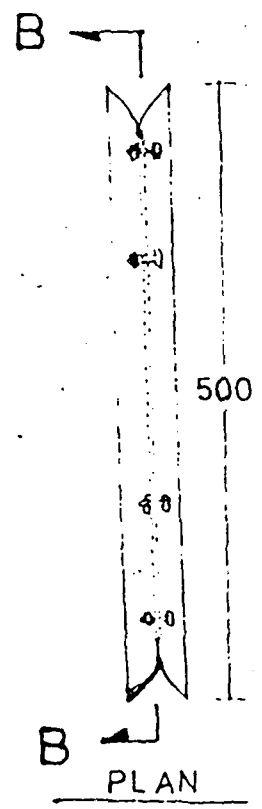


SIDE ELEVATION OF WHEEL

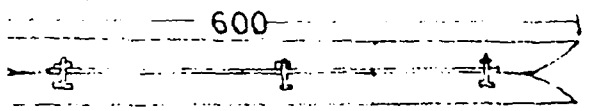
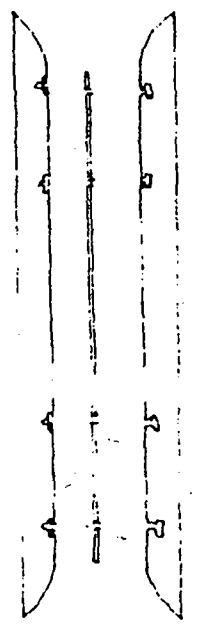




SIDE ELEVATION

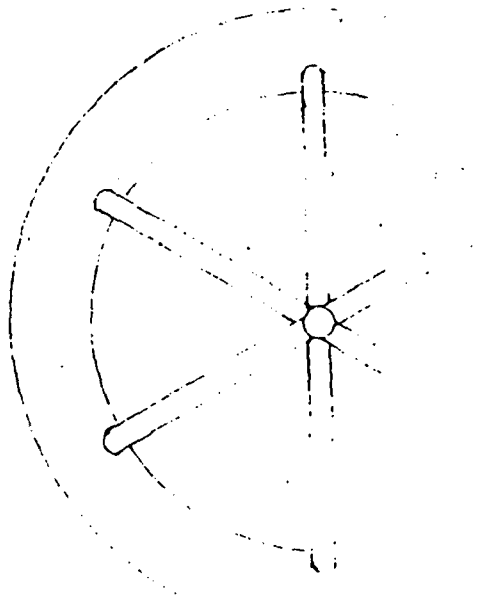


PLAN

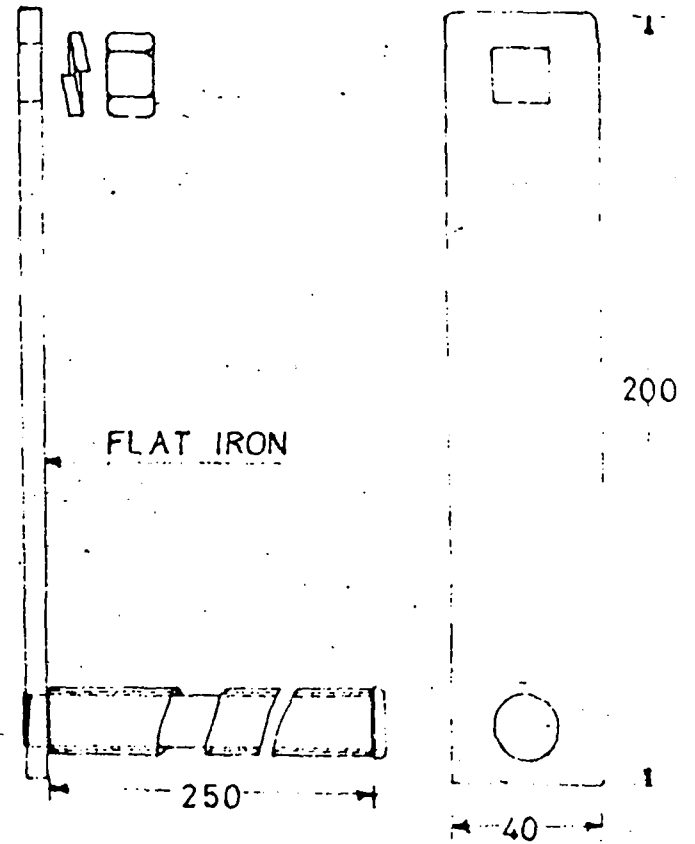
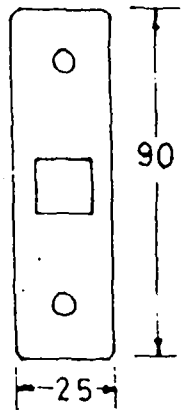
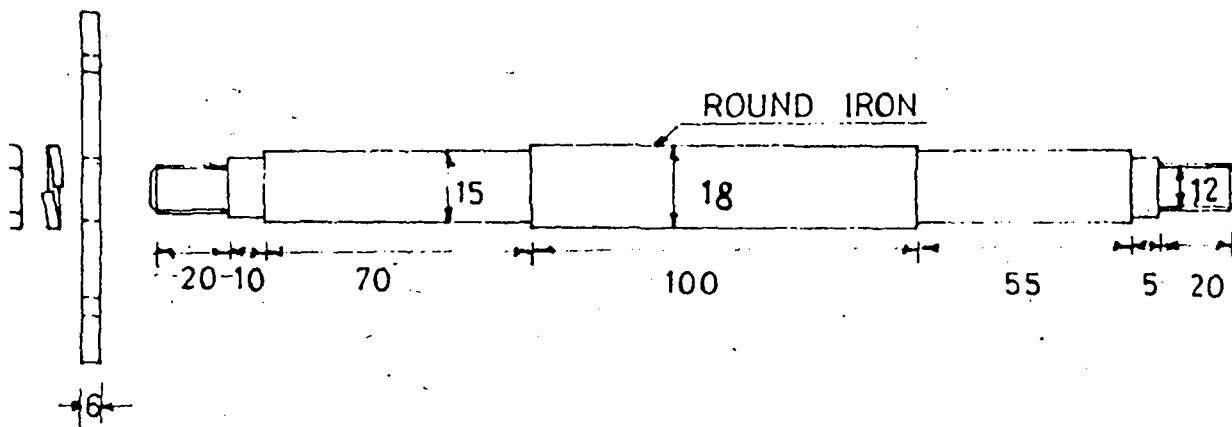


SECTION A-A

HED DRIVE WHEEL
Material: tyer. bolt , flat iron, and nuts
ROPE PUMP PROJECT
Scale : 1:75
All dimensions mm

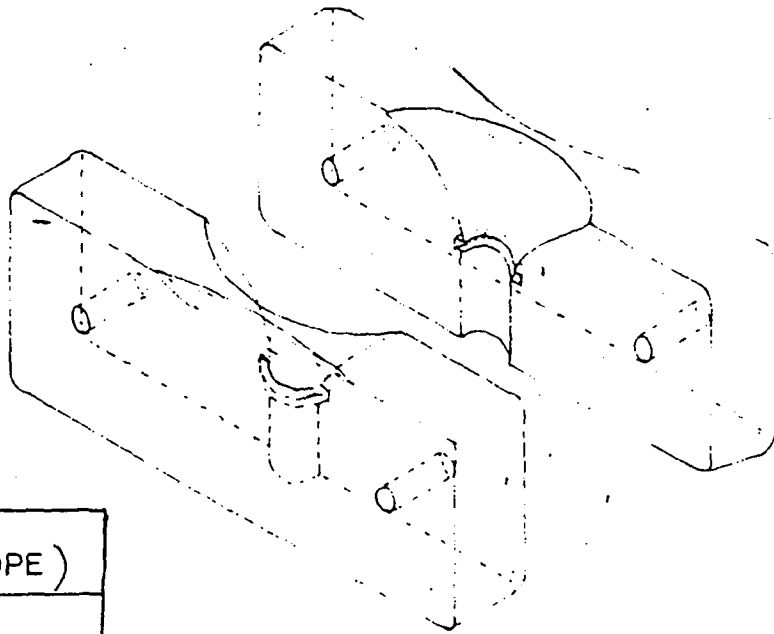
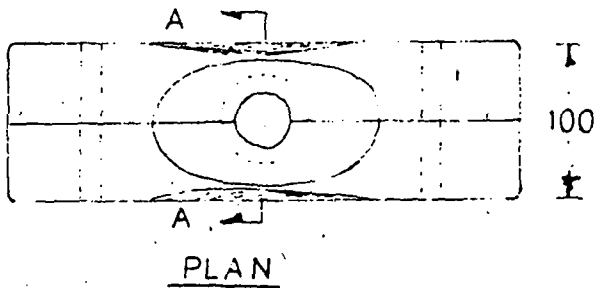
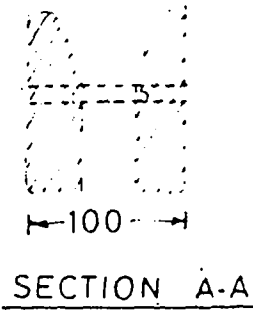
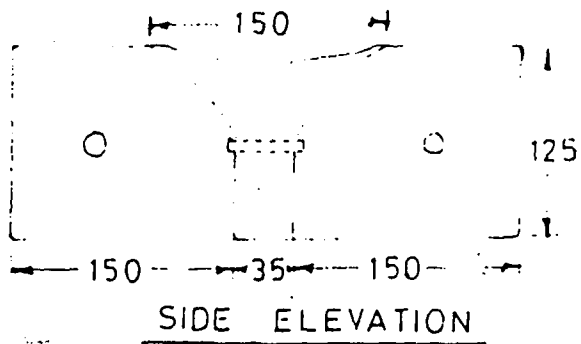


SECTION B-B



BEARING BAR & HANDLE	MODEL 1,2,3
Material : round steel, flat iron, GI pipe , washer & nut	
ROPE PUMP PROJECT	
Scale : 1:20	
All dimensions mm	

FIGURE 02-03



BLOCK (ENTRANS THE ROPE)

Material : wood

ROPE PUMP PROJECT

Scale : 1:50

All dimensions mm

FIGURE 10

CONSTRUCTION COSTS

1. <u>Fumo frame</u>			
L iron	1½" x 1½" x ½"	9' x Rs. 12/- =	Rs. 162.00
flat iron	1" x ½"	7' x Rs. 10/- =	70.00
boring costs		=	20.00
welding costs		=	60.00
			<hr/> 312.00
2. <u>Head Drive Wheel</u>			
flat iron	1" x ½"	6' x Rs. 10/- =	Rs. 60.00
tyer			50.00
nuts & bolts	½" x 2"	18 x Rs. 2/- =	36.00
nuts & bolts	½" x 1"	2 x Rs. 1/- =	2.00
boring costs		=	35.00
welding costs		=	15.00
			<hr/> 198.00
3. <u>Bearings, Bearing House & Bar</u>			
wood		1' x Rs. 25/- =	Rs. 25.00
ball bearings	(no. 5202)	2 x Rs. 57.50 =	115.00
round bar	∅ 22 mm x 280 mm	=	100.00
boring & welding costs		=	40.00
			<hr/> 280.00
4. <u>Handle</u>			
flat iron	1½" x ½" x 8"	=	Rs. 10.00
G.I. pipe	½" x 8"	=	8.00
round bar	½" x 6"	=	6.00
boring & welding costs		=	20.00
			<hr/> 44.00
5. <u>Riser Pipe</u>			
p.v.c. pipe	¾" x 32' (well depth 35')	32x6/- =	Rs. 192.00
p.v.c. cement liquid		=	20.00
			<hr/> 212.00
6. <u>Rope</u>			
nylon rope	∅ 5mm x 50mtrs	50 x Rs. 2/- =	Rs. 100.00
7. <u>Outlet Pipe</u>			
p.v.c. pipe	∅ 2"	1½" x Rs. 12/- =	Rs. 18.00

3. Block (rope entrance)		
wood 3" x 4" x 1 1/2"	=	Rs. 37.50
labor costs (shaping)	=	20.00
nuts & bolts 2" x 6"	2 x Rs. 6/-	12.00
		<u>Rs. 69.50</u>

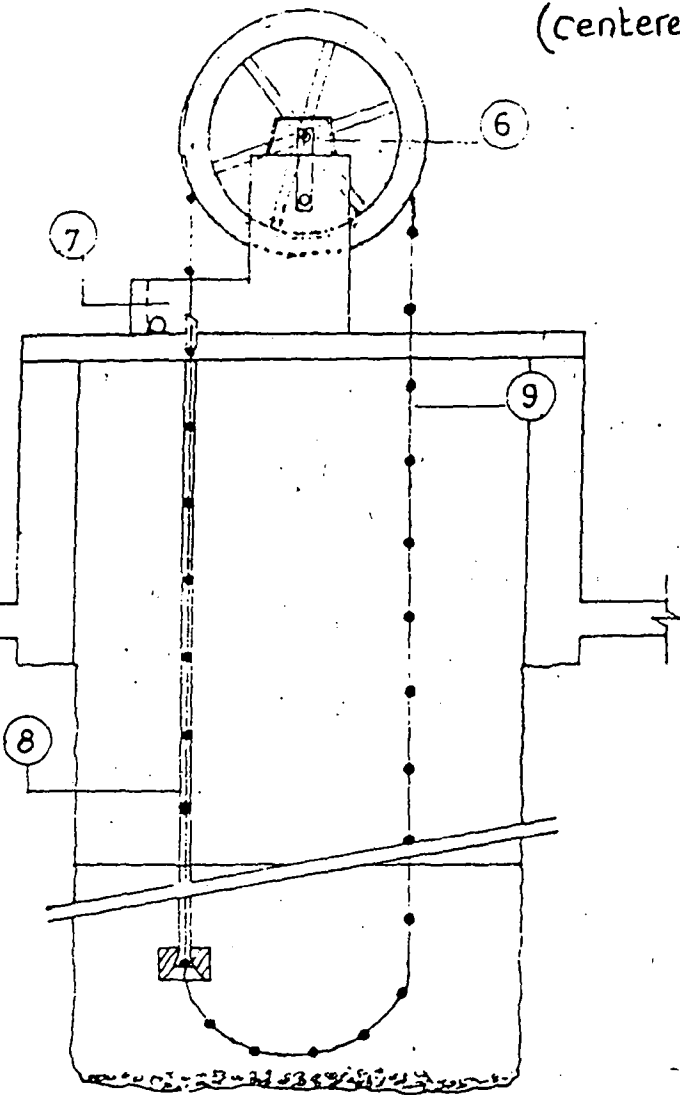
total construction costs of pump device (material cost)

1. pump frame	Rs. 312.00
2. head drive wheel	198.00
3. Bearings, bearing house & bar	280.00
4. handle	44.00
5. riser pipe	212.00
6. rope	100.00
7. outlet pipe	18.00
8. block (rope entrance)	69.50
	<u>Rs. 1,233.50 (US \$ 42)</u>

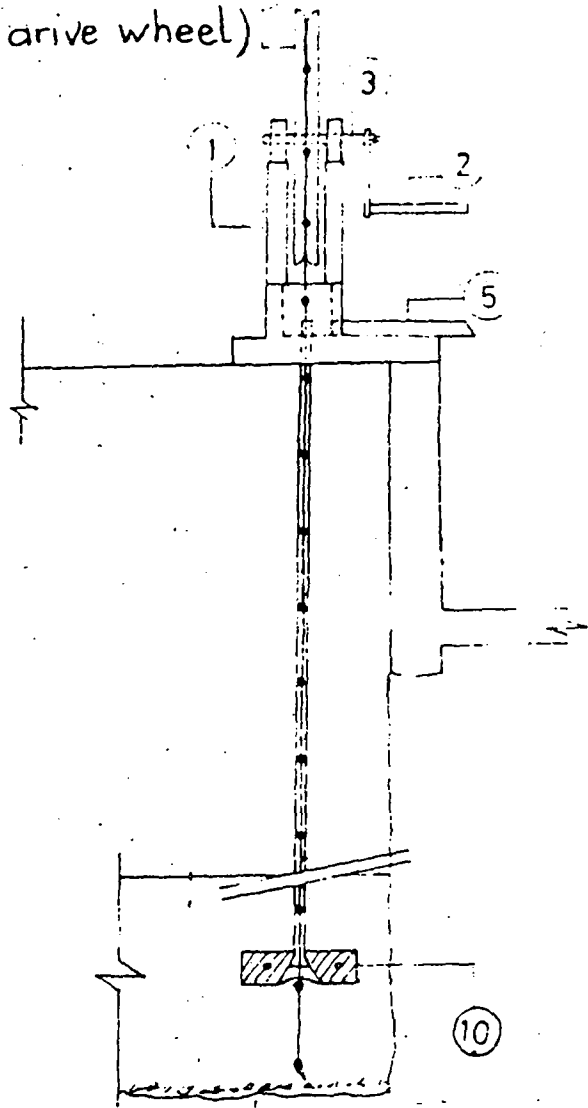
construction costs of a simple well head, drainage apron, and foundation plate for iron frame

cement	10 bags	Rs. 1,150.00
fired bricks	1000	650.00
sand	3/4 cube	220.00
metal stone	3/4" 10 pans	40.00
round bar	Ø 10 mm x 12'	43.00
mason labor	4 1/2 days	400.00
transport		215.00
		<u>Rs. 2,718.00</u>

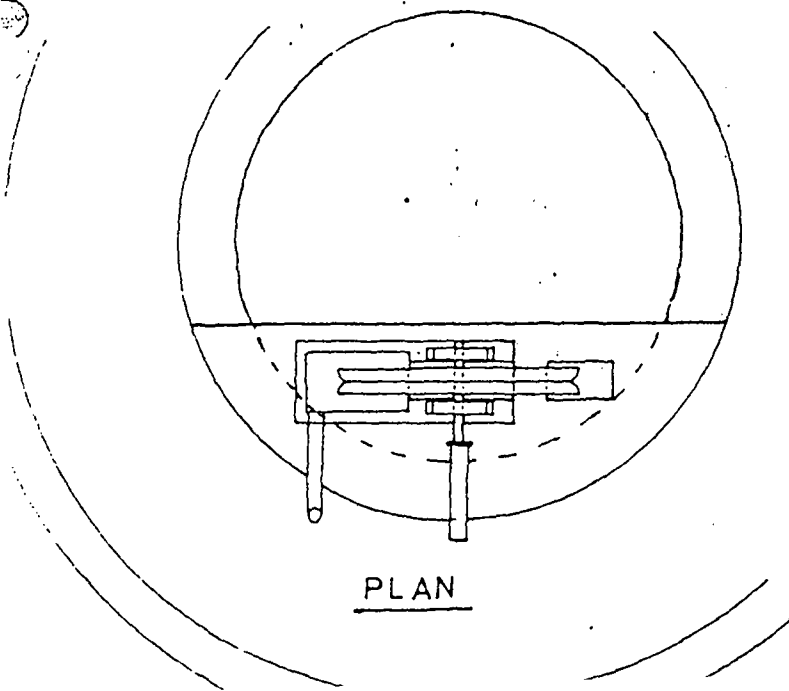
MODEL 2: concrete stand on well - head cover (centered drive wheel)



FRONT ELEVATION



SIDE ELEVATION



PLAN

ROPE PUMP

- | | |
|----|------------------|
| 1 | PUMP STAND |
| 2 | HANDLE |
| 3 | BEARING BAR |
| 4 | HEAD DRIVE WHEEL |
| 5 | OUTLET PIPE |
| 6 | BEARING SET |
| 7 | WATER STOCK TANK |
| 8 | RAZER PIPE 3/4" |
| 9 | ROPE |
| 10 | BLOCK (CENTRAL) |

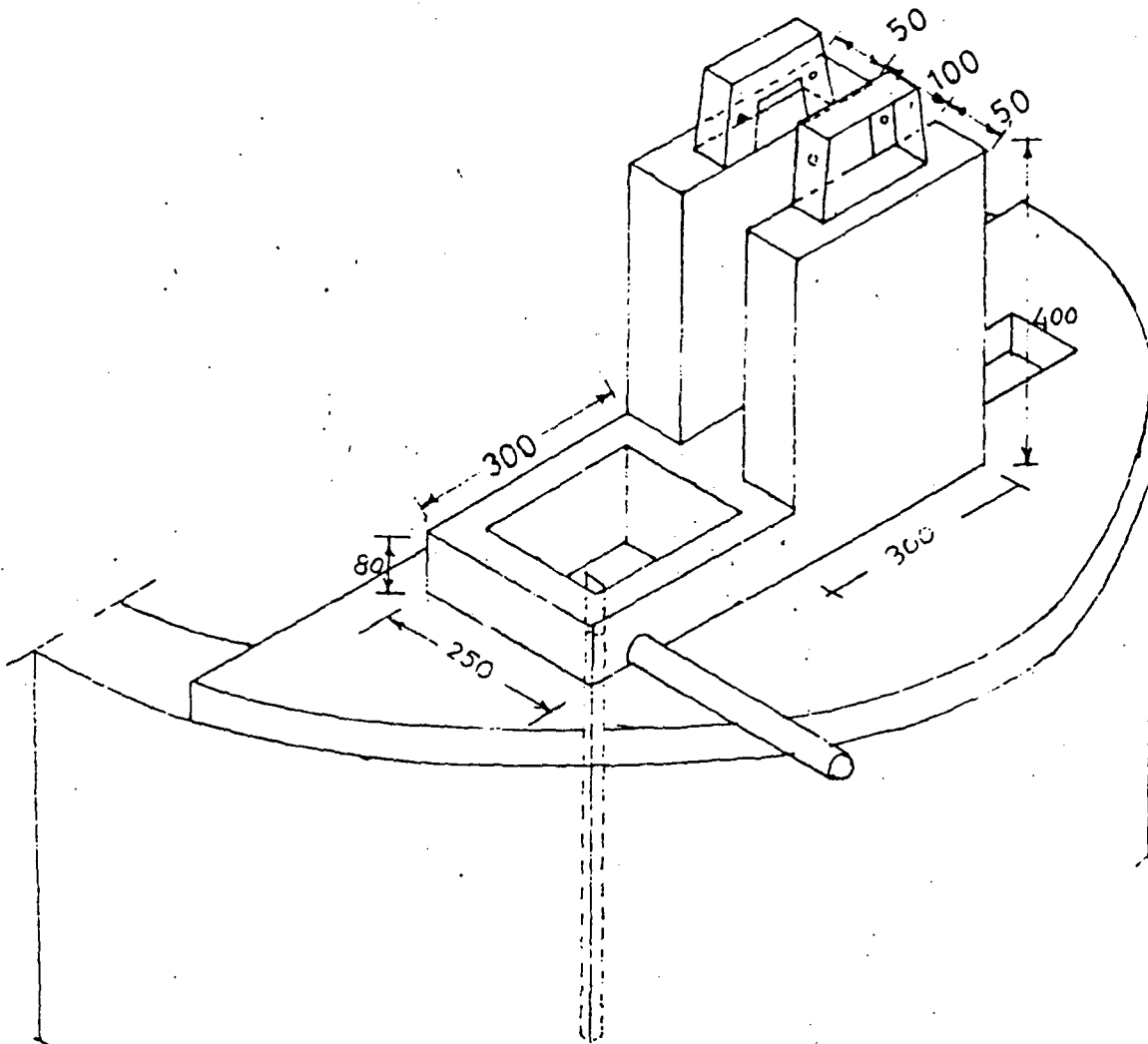
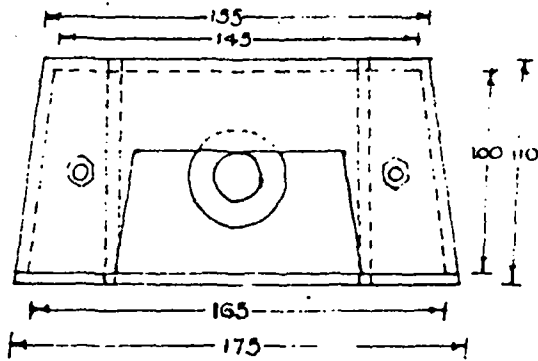
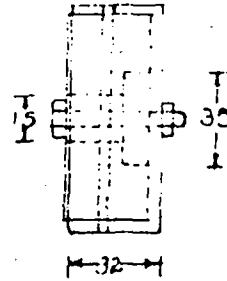


FIGURE 01

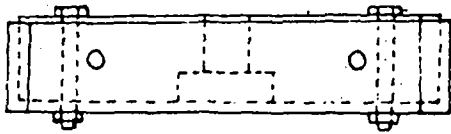
PUMP STAND (CONCRETE SLAB)	
Material : L' iron , PVC PIPE cement , sand , metal , rebar	
ROPE	PUMP PROJECT
Scale	1:10



FRONT ELEVATION

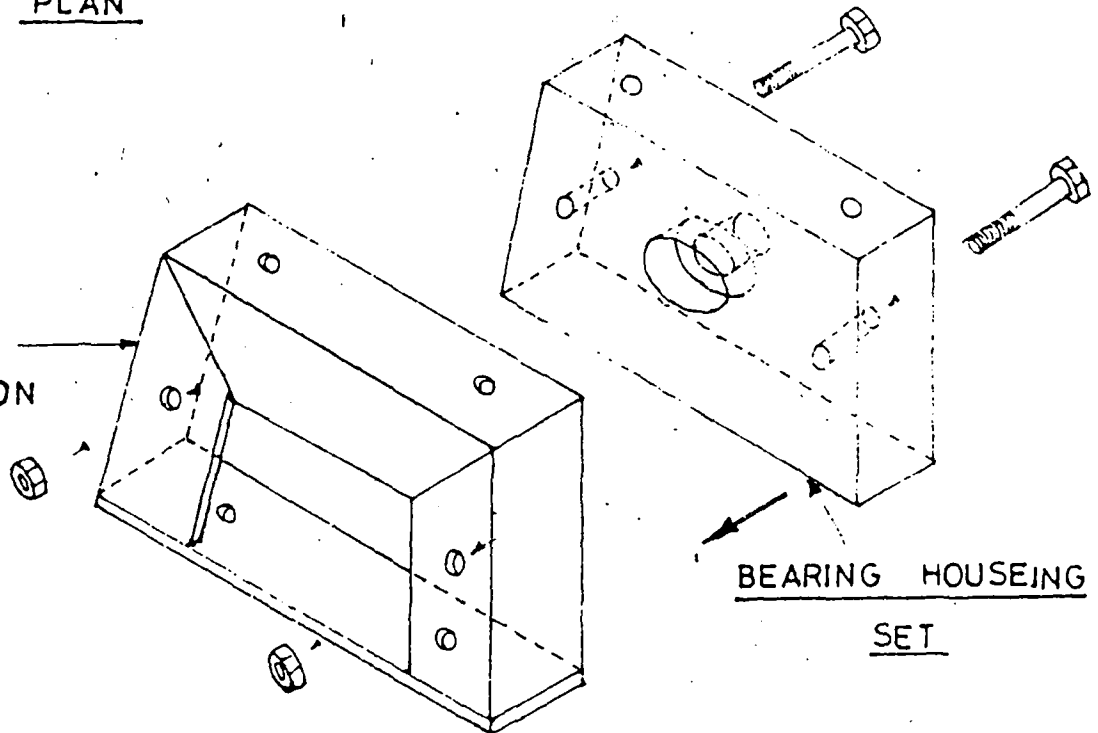


SIDE ELEVATION



PLAN

BEARING COVER
40x40x6 mm L IRON



BEARING HOUSING SET

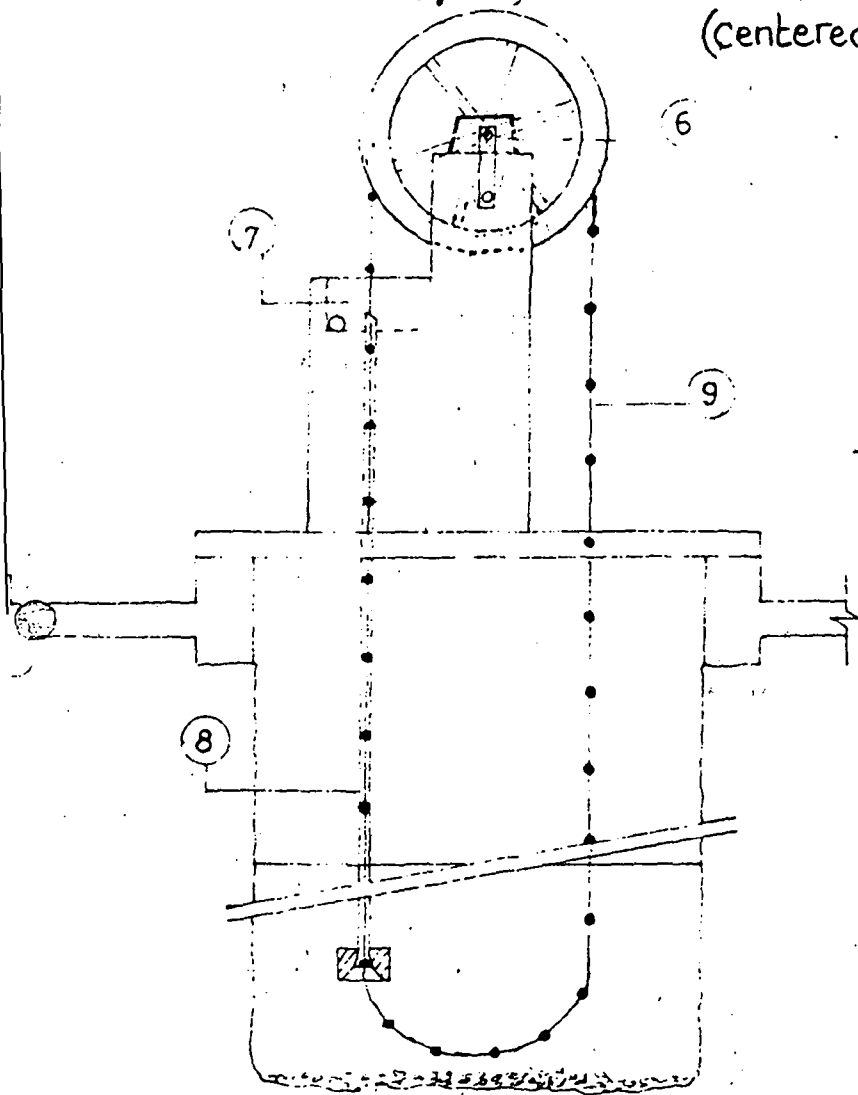
FIGUER 06

BEARING SET WITH COVER

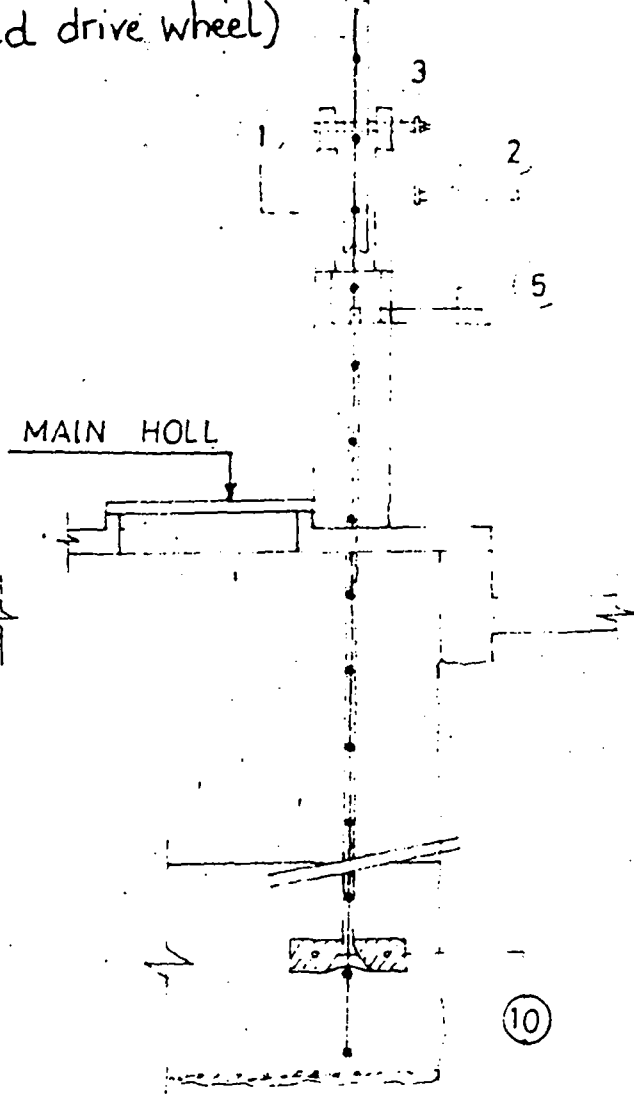
Material 'L'iron, wood
nut & bolt

ROBE PUMP PROJECT

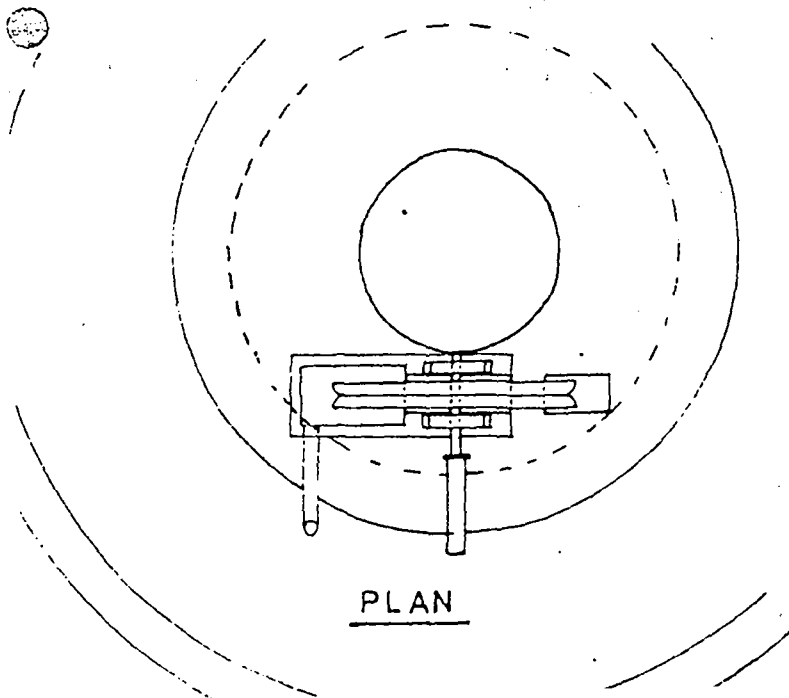
MODEL 3 : concrete stand on pit & slab (centered drive wheel)



FRONT ELEVATION



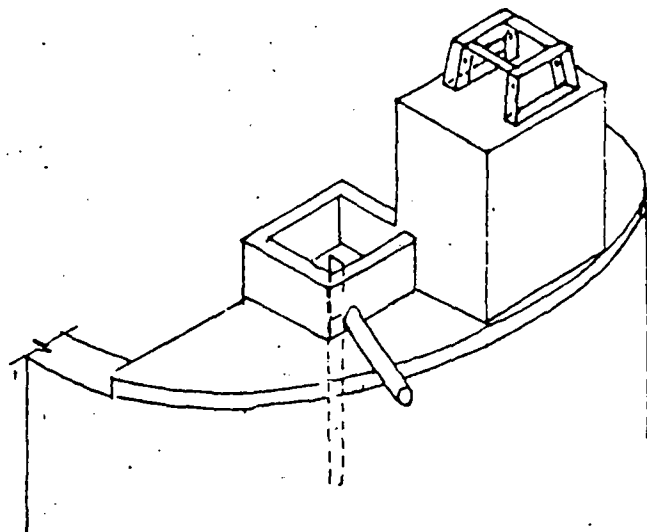
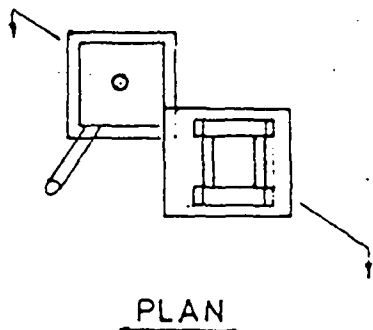
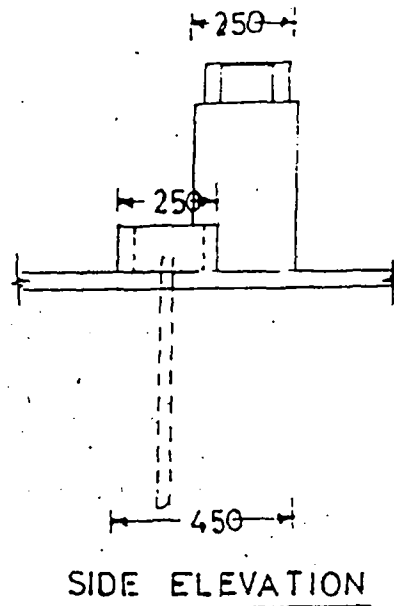
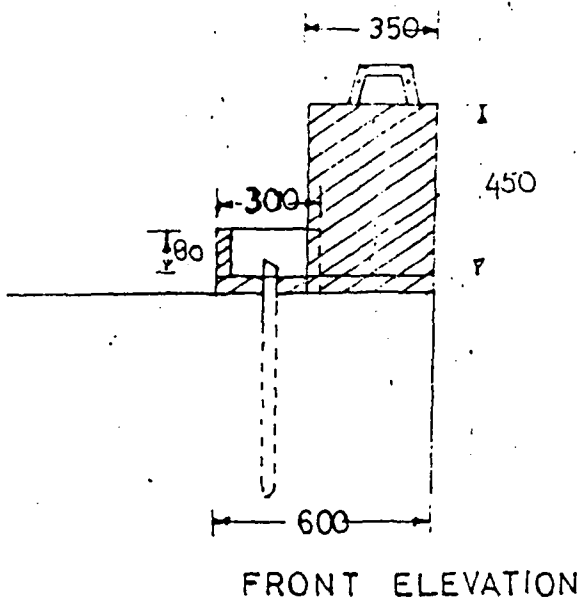
SIDE ELEVATION



PLAN

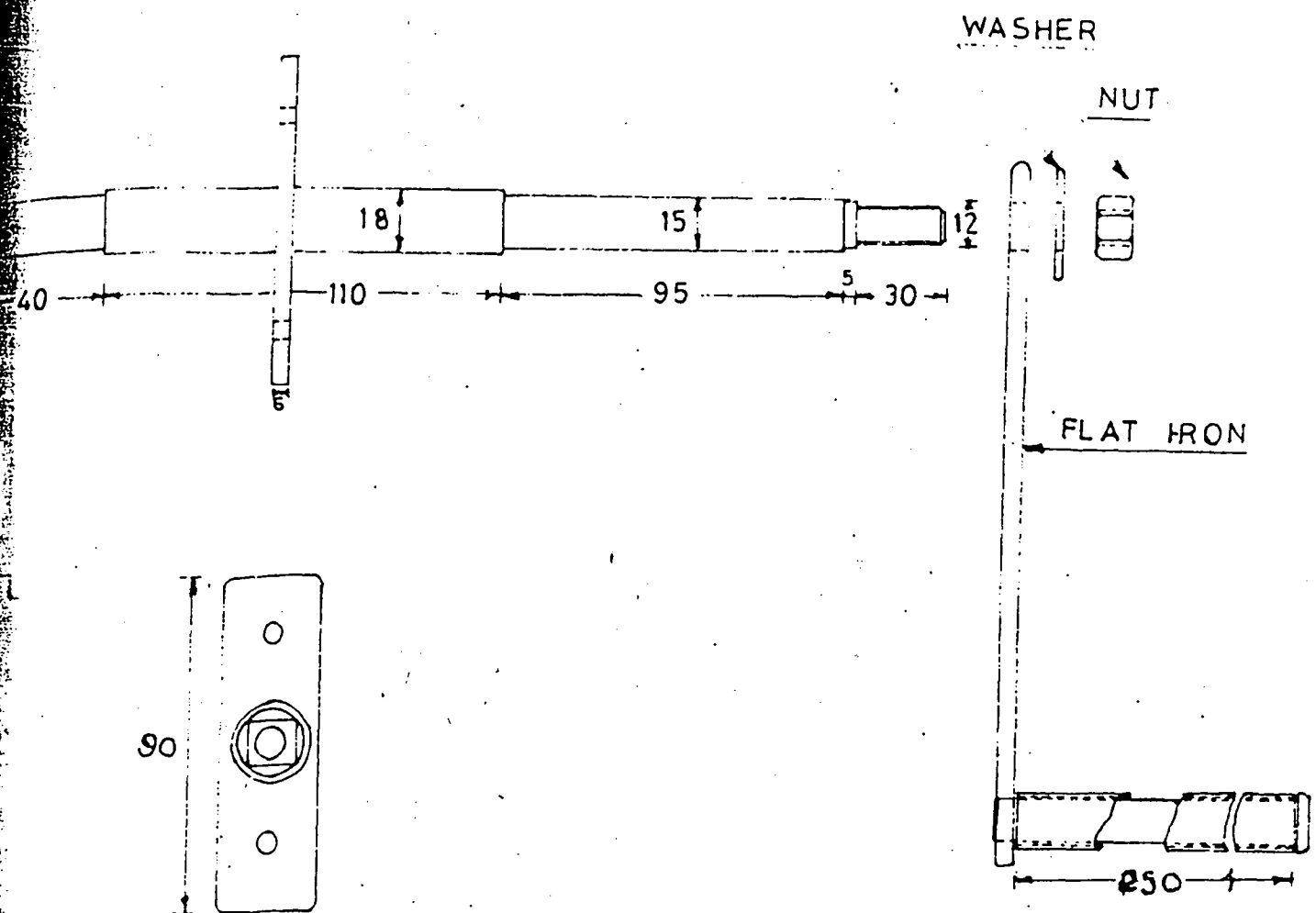
ROPE PUMP

- | | |
|----|------------------|
| 1 | PUMP STAND |
| 2 | HANDLE |
| 3 | BEARING BAR |
| 4 | HEAD DRIVE WHEEL |
| 5 | OUTLET PIPE |
| 6 | BEARING SET |
| 7 | WATER STOCK TANK |
| 8 | RAZER PIPE 3/4" |
| 9 | ROPE |
| 10 | BLOCK (15x15) |



PUMP STANDE (CONCRETE SLAB)
Material : L iron , PVC pipe , cement , sand , metal , rebar
ROPE PUMP PROJECT
Scale : 1:20

FIGURE 01



BEARING BAR & HANDLE	MODEL 4,5
Material : round steel , flat iron GI pipe	
ROPE PUMP PROJECT	
Scale : 1 : 20	
All dimensions mm	

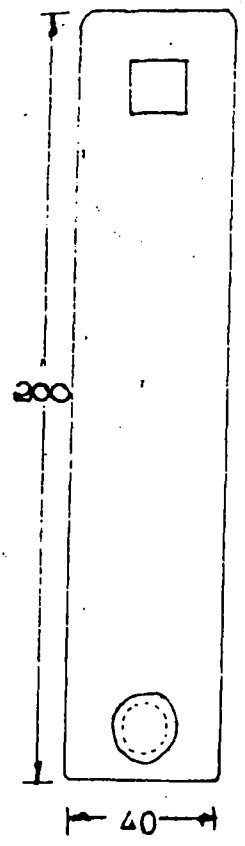
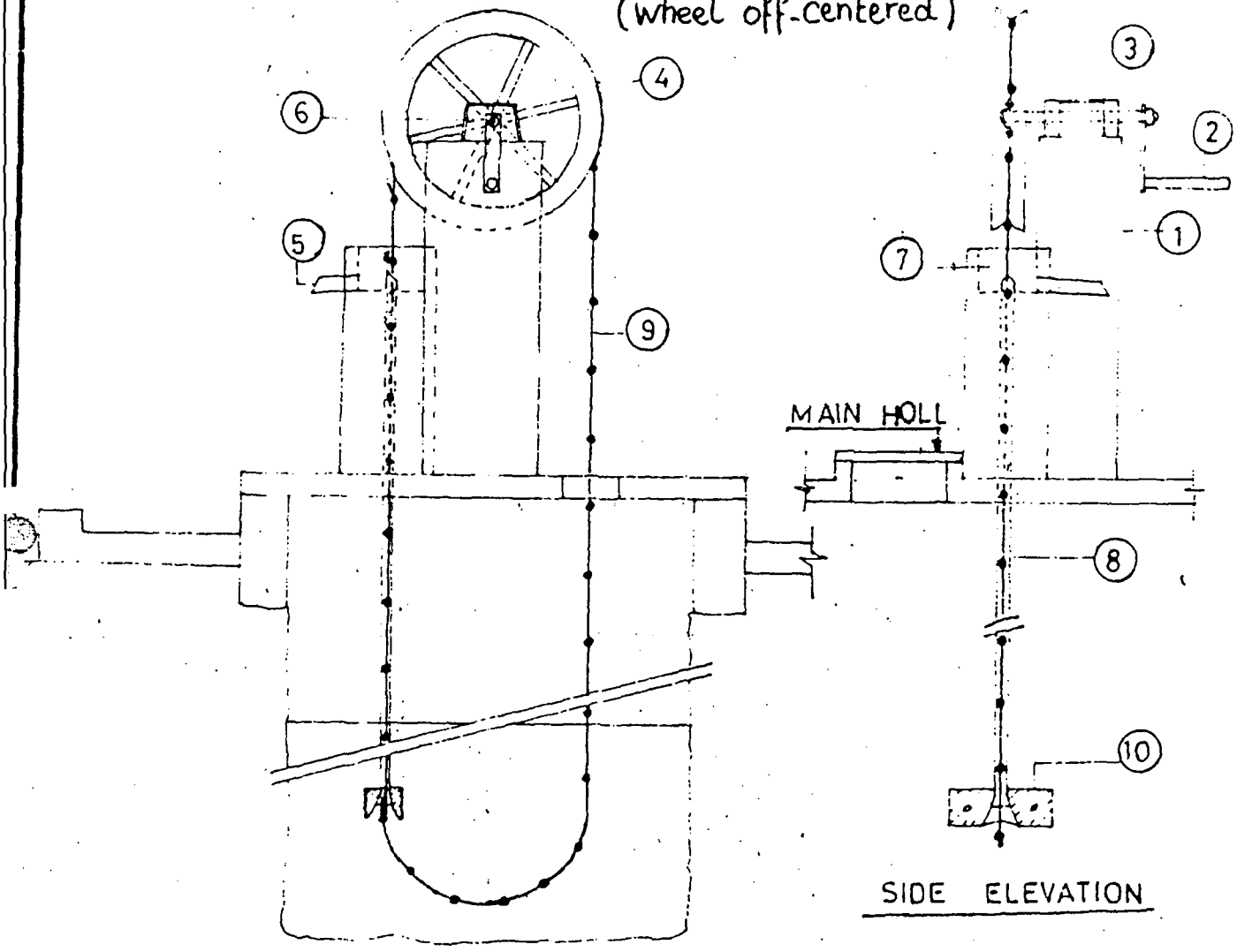


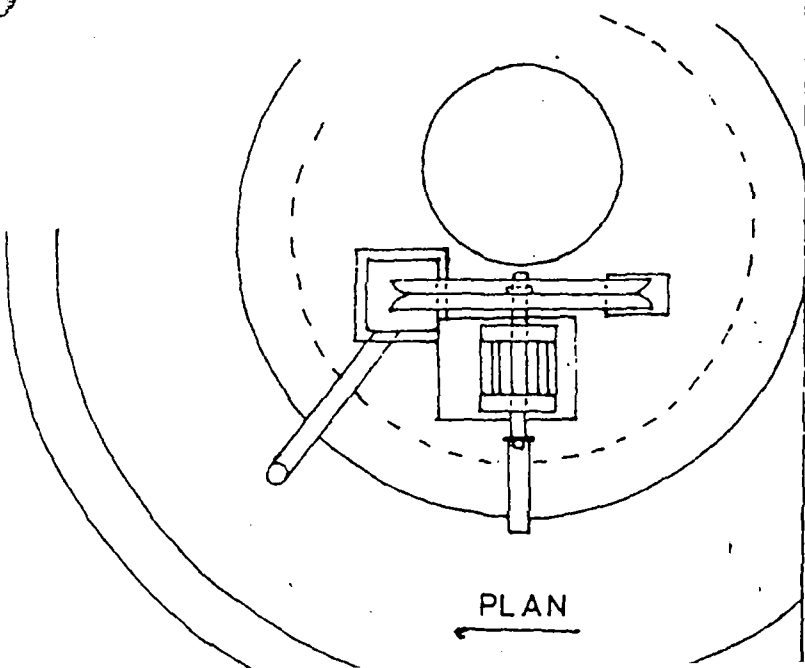
FIGURE 02-03

MODEL 5 : concrete stand on pit slab (wheel off-centered)



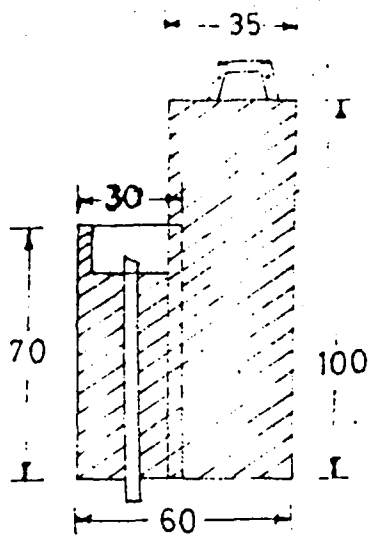
FRONT ELEVATION

SIDE ELEVATION

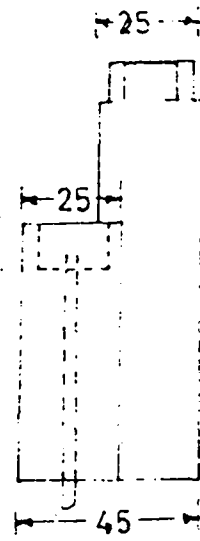


PLAN

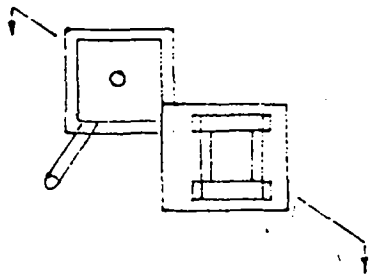
ROPE PUMP	
1	PUMP FRAME
2	HANDLE
3	BEARING BAR
4	HED DRIVE WEEL
5	OUTLET PIPE
6	BEARING SET
7	WATER STOCK TANK
8	RAZER PIPE
9	ROPE
10	BLOCK ENTRANS THF



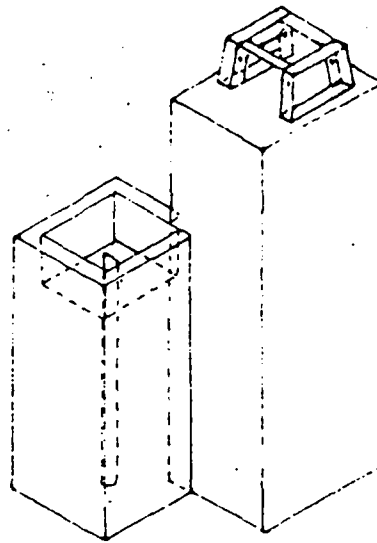
FRONT ELEVATION



SIDE ELEVATION



PLAN



PUMP STANDE (CONCRETE SLAB)
Material : L iron , PVC pipe , cement , sand , metal , rebar
ROPE PUMP PROJECT
Scale : 1:20

FIGURE 01

CONSTRUCTION COSTS

1. <u>Head Drive Wheel</u>	(not altered)	Rs.	198.00
2. <u>Bearings, Bearing House & Bar</u>			
L iron	1½" x 1½" x ½"	1½' x Rs. 18/-	= Rs. 27.00
flat iron	1½" x ½"	½' x Rs. 16/-	= 8.00
wood bearing house		1' x Rs. 25/-	= 25.00
ball bearings		2 x Rs. 57.50	= 115.00
round bar (with lathe costs)	∅ 22mm x 280mm		= 100.00
nuts & bolts	½" x 4"	2 x Rs. 2.50	= 5.00
nuts & bolts	3/8" x 6"	4 x Rs. 6/-	= 24.00
boring & welding costs		Rs. 20/-	= 20.00
			<hr/>
			324.00
3. <u>Handle</u>	(not altered)	Rs.	44.00
4. <u>Raiser Pipe</u>	(not altered)	Rs.	212.00
5. <u>Rope</u>	(not altered)	Rs.	100.00
6. <u>Outlet Pipe</u>	(not altered)	Rs.	18.00
7. <u>Block (rope entrance)</u>	(not altered)	Rs.	69.50
			<hr/>
total construction costs of pump device	(material cost)	Rs.	<u><u>965.50</u></u>

construction costs for a simple well head, drainage apron,
and foundation plate with small pump stand

Rs. 2,718.00

or

construction costs for drainage apron, pit slab and tower
pump stand

cement	7 bags	Rs.	850.00
fired bricks	750		490.00
sand	3/4 cube		220.00
metal stone	3/4" 30 pans		120.00
round bar	3/8 10' (binding wire 15/-)		815.00
mason labor	6 days		600.00
transport			<hr/>
			200.00