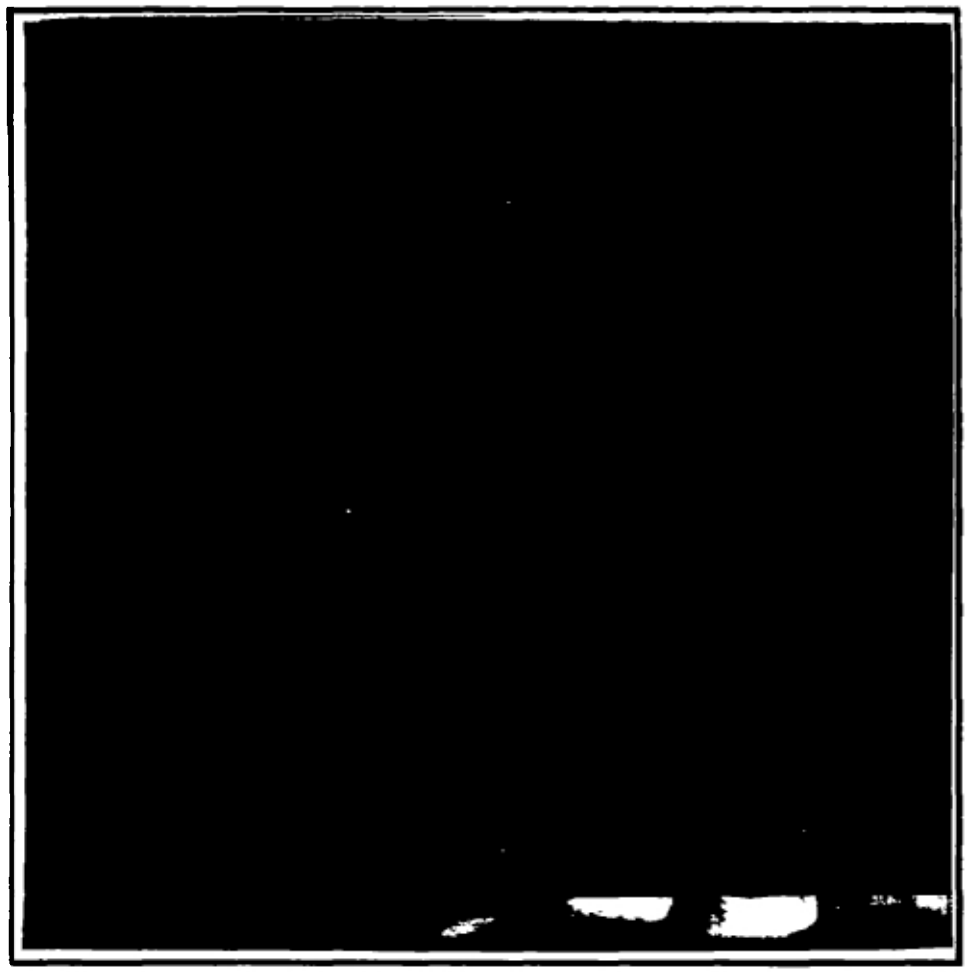
INDIA MARK II HANDPUMP



INSTALLATION AND MAINTENANCE MANUAL

INDIA MARK II HANDPUMP
INSTALLATION AND MAINTENANCE MANUAL

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ABOUT THIS MANUAL

This manual has been developed for use during training programmes on installation and maintenance of the India Mark II handpump for engineers and staff of the maintenance team of the Public health and engineering departments, mechanics and other personnel involved in the installation and maintenance of India mark II handpump.

The India Mark II handpump is different from other handpumps and has to be installed in a slightly different way. This manual explains in detail the basic features of the India Mark II handpump, elaborating on the procedures for installation and maintenance. Checklists on the tools needed for installation and maintenance as well as the spares requirement for normal two year maintenance are given. The manual establishes the need for community based maintenance and specifies the role of the village handpump caretaker in preventive maintenance of the India Mark II handpumps installed.

The manual has been developed specifically as a reference tool to be used during installation and servicing/maintenance of the India Mark II handpump.

INTRODUCTION

IMPORTANCE OF SAFE WATER

All forms of life are dependent on water in one way or another for survival. It is important to use a source of safe water supply for health benefits in terms of reduced morbidity and mortality due to diseases. Water from surface sources like rivers, lakes, ponds etc. is prone to contamination by animals and man. This contaminated water may be the cause of many water borne diseases. It has been revealed through many studies that improvement in water availability and quality have resulted in a substantial impact on the reduction of diarrhoeal morbidity.

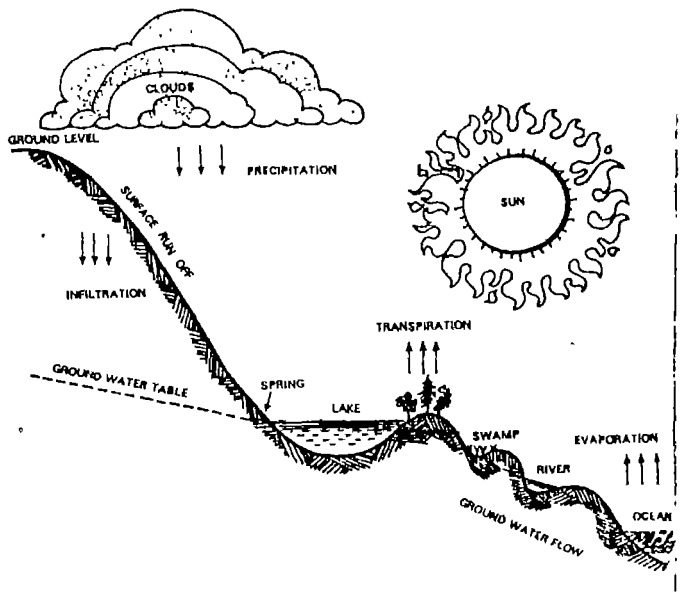
Improvement in	Percentage reduction in diarrhoeal morbidity
Water Quality	16%
Water Availability	25%
Water Quality & availability	37%
Excreta disposal	22%

(Ref : Interventions for CDD among young children, improving water supplies & excreta disposal facilities, Ersay, Feacham & Hughes - WHO Bulletin)

Hence, it is very important that the drinking water is safe and potable. The ground water from deeper strata is safe and dependable if the chemical compositions are within the limits. This is located and tapped by drilling bore/tube wells to a depth of about 100 metres.

WATER RESOURCES

Water circulates between the surface of the earth and the atmosphere and back to the earth's surface in what is called the hydrological cycle. Water evaporates from the ground, oceans, lakes and streams, and transpires from plants into the atmosphere. There it is transported as clouds or humidity and precipitated again in the form of rain, snow hail or dew. This hydrological cycle is illustrated in figure 1.



Whenever it falls on land, a certain proportion filters into the ground and percolates through the porosities and fractures in the subsoil and rocks to lower-lying parts of these formations. The volume open to hold and transmit such "groundwater" varies from fractions of one per cent upto 30 percent of the total soil and rock volume. Such groundwater can be accessed by digging (where the "Water table is shallow) or drilling vertically where the water table is deep and installing a bore/tube well.

The appropriately installed handpump with good concrete platform should be operated properly and maintained periodically by the users.

Therefore, for longer life of the pump:

* The pump handle should be operated fully to the top and bottom for full flow of water.
* The handle chain should be lubricated with grease.
* All the bolts and nuts of the pump should always be kept tight.
* The excess water from the pump should be disposed off to a garden or a soak pit.
* The pump surroundings should be kept clean.
* The community should safeguard the hand pump as their own property.

HANDPUMP : A SOURCE OF SAFE WATER

Why is water from a handpump better than water from other sources?

Water from streams, ponds, stepwells and open wells usually carry disease causing germs. In case of India Mark II deepwell handpump, the tube well is sealed so that harmful germs cannot enter. The water is drawn from deeper strata and hence the deepwell handpump is one of the safest sources of clean, potable water.

The handpump brings safe drinking water to the villagers. So it is important that the handpump does not fail. The handpump must work well and for a long time.

Why was the India Mark IIhandpump developed?

In Indian villages, handpumps are used by many people. Sometimes they are used continuously for upto 18 hours a day. The India Mark II handpump is made of very strong materials. All the parts are checked and quality tested so that they fit together perfectly. Therefore this handpump seldom breaks down.

Why is proper installation of the handpump so important?

The handpump should always bring good, potable water to the villagers. If the handpump is installed correctly, then it will work properly and will need very little maintenance. Proper installation will lead to fewer breakdowns and hence the handpump users will be provided with a source of safe drinking water.

Do you drink only safe water? Do you set an example to the villagers?

Only water from a deep well handpump or water which is known to be safe should be used for drinking purposes. This is important for your own benefit and for that of your family members particularly children. When you work to install a handpump in the village, the villagers will often offer you drinking water. Before drinking the water they offer you must inquire about its source. If it is from an open well, pond or a stream, don't drink it. Tell the villagers that you drink only handpump water, because it is safe. Advise them to do the same. In this way, you will set an example to the villagers. The villagers can see that you are healthy. They can see that you only drink protected water. You do what you say. Your example will show the villagers that safe water is linked with good health.

In this way you can teach the villagers some very important things. You can teach them to value their hand pumps more and to look after their handpumps better.

Then the handpumps which you install will work better and last longer. And so your work will become easier and the villagers will stay healthy.

Many children will grow up healthier because you provided them with safe drinking water. You can be proud of your work.

What should you tell the villagers when you install or repair a handpump?

Here are four important things about handpumps. You should help the villagers to understand these things.

One:

Water from a handpump is safer than water from other sources. Water from rivers and ponds can contain disease carrying germs. If we drink this water, we can get ill. The water from a handpump is protected from disease causing germs as it comes from deeper strata and is not prone to surface contamination. So, if we drink water from a handpump, we will stay healthy.

Two:

People must use their handpumps properly. You should show the villagers how to use the handpump correctly.

Three:

People must maintain the handpumps installed in their villages themselves so that the handpump does not breakdown frequently. The caretaker can carry out preventive maintenance of the above ground components of the India Mark II handpumps.

Four:

The villagers must contact the area mechanic or the block level maintenance team if their hand pump breaks down.

WATER QUALITY PARAMETERS

These are the water quality standards summarised from WHO International Standards for Drinking water. Only the most important parameters are presented.

Parameters (1)	Undesirable effect that may be produced (2)	Highest desirable level (3)	Minimum Permissible level (4)
A. PHYSICAL :			
Colour (Units)	Discolouration	5	50
Odour	Odours	Unobjectionable	Unobjectionable
Taste	Taste	Unobjectionable	Unobjectionable
Total Solids (mg/1)	Taste Gastrointestinal irritations	500	1500
Suspended Matter (Units)	Turbidity Gastrointestinal irritations	5	25
B. CHEMICALS			
pH (Units)	Taste	7.0 to 8.5	6.5 to 9.2
Calcium (mg/l)	Excessive Scale formation	75	200
Chloride (mg/l)	Taste Corrosion in hot water systems	200	600
Flouride (mg/l)	Mottling of teeth Disfiguring of skeletons	1.0	1.5
Total hardness as mg/l of CaCO3	Excessive scale formation	100	500
Mineral Oil(mg/l)	Taste Odour	0.01	0.30
Phenolic subs.(mg/l)	Taste	0.001	0.002

C.TRACE ELEMENTS			
Arsenic (mg/l)	Toxic	—	0.05
Copper (mg/l)	Astringent taste Discolouration Corrosion of pipes; fittings and utensils	0.05	1.5
Cyanide (mg/l)	Toxic	—	0.05
Iron (mg/l)	Taste Discolouration Constipation Turbidity Growth of iron Bacteria	0.1	—
Lead (mg/l)	Toxic	—	0.1
Manganese (mg/l)	Taste Discolouration Turbidity Deposits in pipes	0.05	0.05
Zinc	Astringent taste	5.0	15.0
D.PESTICIDES			
DDT (mg/l)	Toxic	—	0.05
PCB	Toxic	—	Nil

The test characteristics of drinking water have been given in the annexure.

INDIA MARK II HANDPUMP

B. DEEPWELL HANDPUMP

1) INDIA MARK II HANDPUMP

These pumps are manufactured as per IS 9301-1990, covering handpumps for lifting water from wells of depth 20 to 50 m. Above 50 m the efforts put in for pumping may not give adequate results in terms of discharge of water. The specifications for deepwell handpumps first published as IS 9301-82, has undergone many changes, on individual components for better performance of the pump. The specification has been revised in the years 1984 and 1988. The latest Indian standard for deepwell handpumps – specification (third revision) brought out by BIS,IS 9301-1990 covers all latest amendments for different parts. The main sub-assemblies for the India Mark II handpumps are as follows

(i) Pump Head Assembly

The main parts of the pump head assembly are –

1.	Pump head flange	6mm H.R. sheet
2.	Side plate	4mm H.R. sheet
3	Back plate	4mm H.R. sheet
4.	Axle bush (right)	Machined out of 45 mm round M.S. bar
5.	Axle bush (left)	Machined out of 45 mm round M.S.bar
6.	Bracket	4mm H.R. sheet
7.	Gusset	Machined from solid triangular bars
8.	Front bottom end plate	4 mm H.R. sheet
9.	Front top end plate	4 mm H.R. Sheet
10.	Front cover	2 mm C.R. sheet
11.	Hexagonal bolt	M12 x 20
12.	Hexagonal nut	M12
13.	Washer	To suit M12 bolt
14.	Third plate with guide bush welded	6 mm H.R. sheet/guide bush machined out of 35 mm solid bars.

(ii) Handle Assembly:

The main parts of handle assembly are –

1.	Handle bar	Machined from 32 mm sq. bar
2.	Bearing housing	Machined out of 76/80 mm round M.S. bar
3.	Roller chain guide (or Handle Sector)	Manufactured out of 12 mm sq. M.S. bar
4.	Chain	25.4mm pitch roller chain with 7 links
5.	Chain coupler	Forged or machined out of 60 mm M.S. round bar
6.	Handle axle	Machined out of 26mm stainless steel round bar
7.	Spacer	Machined out of 26 mm Solid M.S. bar
8.	Washer	4 mm thick
9.	Nuts	M12
10.	Two bearings–single side shielded	SKF 6204 Z or equivalent
11.	High tensile hexagonal bolt	M10 x 40 mm
12.	Nyloc nut	M10
13.	Grease for chain	Graphite grease
14.	Grease for bearing	Lithon 3 (Lithium Base)

(iii) Water Tank Assembly:

The main parts of water tank assembly are –

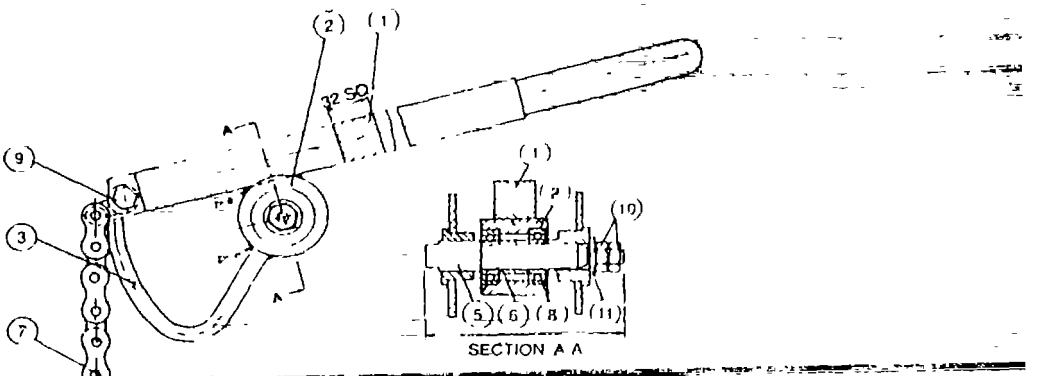
1.	Tank pipe	150 mm N.B. ERW medium grade black pipe
2.	Tank bottom flange	6 mm plate
3.	Tank top flange	6 mm plate
4.	Riser pipe holder	Machined out of 55 mm solid rounds
5.	Spout	40 mm N.B. ERW medium grade black pipe
6.	Gusset	Sheared out of 6 mm plate

(iv) Pump Stand Assembly:

The main parts of pump stand assembly are as follows :

1.	Stand pipe	Made out of 150 mm N.B./175 mm N.B. (for telescopic stand) ERW M.S. Black pipe, medium grade
2.	Stand flange	Made out of 6 mm plate
3.	Legs	Made out of 40 x 40 x 6 mm angle
4.	Gussets	Sheared out of 6 mm plates
5.	Spikes	Made out of 12 mm diameter rod of length 150 mm.

HANDLE ASSEMBLY FOR INDIA MARK II HANDPUMP



11	WASHER (4 MM THICK) TO SUIT M 12
10	HEX. NUT M 12
9	HEX. BOLT M 10 x 1.5 x 40 - WITH NYLOC NUT
8	SINGLE SIDE SHIELDED BEARING
7	ROLLER CHAIN (25.4 MM PITCH)
6	SPACER
5	HANDLE AXLE
4	CHAIN COUPLING
3	ROLLER CHAIN GUIDE
2	BEARING HOUSING
1	HANDLE BAR

(v) Cylinder Assembly

The main parts of the cylinder assembly are –

1.	Plunger rod	Machined from stainless steel round bars
2.	Reducer cap	Cast iron
3.	Sealing ring	Chrome tanned leather / nitrite
4.	Plunger yoke body	Made from gun metal or naval brass
5.	Hexagonal coupler M12 x 1.75	Machined from stainless steel round bars
6.	Rubber seating for (Upper valve)	Nitrile rubber
7.	Upper valve	Made from gun metal or naval brass
8.	Pump bucket	Vegetable tanned leather or nitrile rubber
9.	Spacer	Made from gun metal or naval brass
10.	Follower	Made from gun metal or naval brass
11.	Cylinder body	Cast iron
12.	Brass liner	Brass tube
13.	Rubber seat retainer	Made from gun metal or naval brass
14.	Rubber seating for (Lower valve)	Nitrile rubber
15.	Check valve	Made from gun metal or naval brass
16.	Check valve seat	Made from gun metal or naval brass

The cylinder assembly consists of a cast iron cylinder body with two caps, and the operating mechanism like plunger yoke body with follower, spacer, upper valve assembly along with the check valve assembly. The upper valve assembly or plunger assembly moves up inside the cylinder. At this point, the lower valve which is the check valve will start opening and the upper valve will close, thus allowing the water from the well to flow inside the cylinder. On the return stroke when the handle is moved up, the plunger assembly starts coming down inside the cylinder. The check valve at the bottom will close thereby forcing the water through the follower upwards opening the upper valve. Thus when the plunger moves up and down in the cylinder, the water is displaced and finds its way to the water tank.

(vi) Connecting Rod Assembly

Connecting rods are three metres in length. The rods are manufactured from bright bars, which are rerolled from the nearest round section. The couplers M12 x 50 and M12 x 20 are welded to the rods and then electro-galvanised. The connecting rod is the main link between pump head and cylinder.

The main components of India Mark - II Hand Pump such as head, handle, water tank, and stand assemblies are hot dip galvanised after fabrication are over.

Platform

Each tubewell must be provided with a goc platform around the pump for the followin reasons.

i) It provides a strong foundation around th pump pedestal.

ii) It prevents used water from entering the tubewell and, saves the water from contamination.

iii) It provides a good sanitary seal for the tubewell

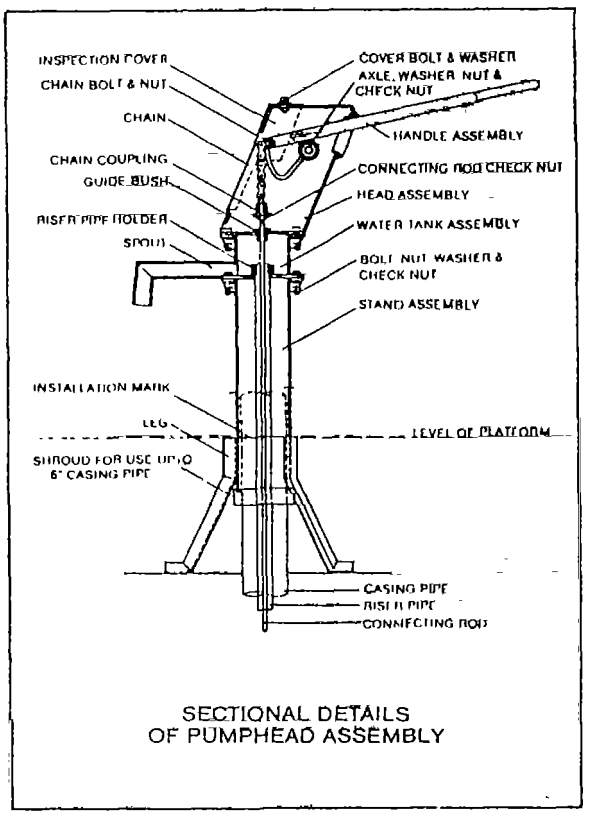
iv) It provides firm, dry good operational area.

The platform is to be constructed to the required size and dimension. The operating floor and the waste water drain are inescapable parts of the tubewell platform.

The tubewell platform is circular in shape with an outer diameter of 1850 mm and 280 mm thick concrete raised to a level of 80 mm above the ground level on the periphery. The platform is constructed so that the water tank spout pipe centre is the centre of the platform. The operating floor or the foot stand from which the user operates the pump handle lies at 200 mm above the ground level measuring 1000 mm x 1000 mm. The cement concrete is made with the use of 20 mm gravel metal, coarse sand and cement at the ratio 1:2:4. The approximate material used for the construction of good platform is cement 6 bags – 50 kgs each, sand – 0.4 cubic meter and metal 0.8 cubic meter.

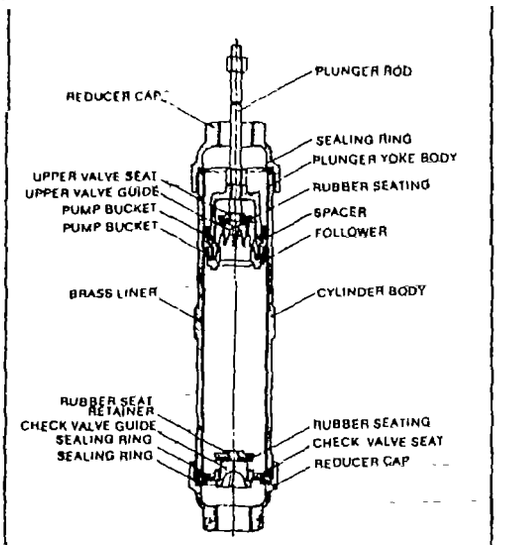
The pump stand is grouted above the borewell in a pit having dimensions, 760 mm x 760 mm x 400 mm. The cement concrete on the platform is to be given 7 days minimum for setting to have a uniform strength and in case setting of concrete is urgently required quick setting compound can be mixed with the concrete.

To drain out the spent water easily a 3 metre long drain having slope of 50 : 1 towards the drain side is constructed.



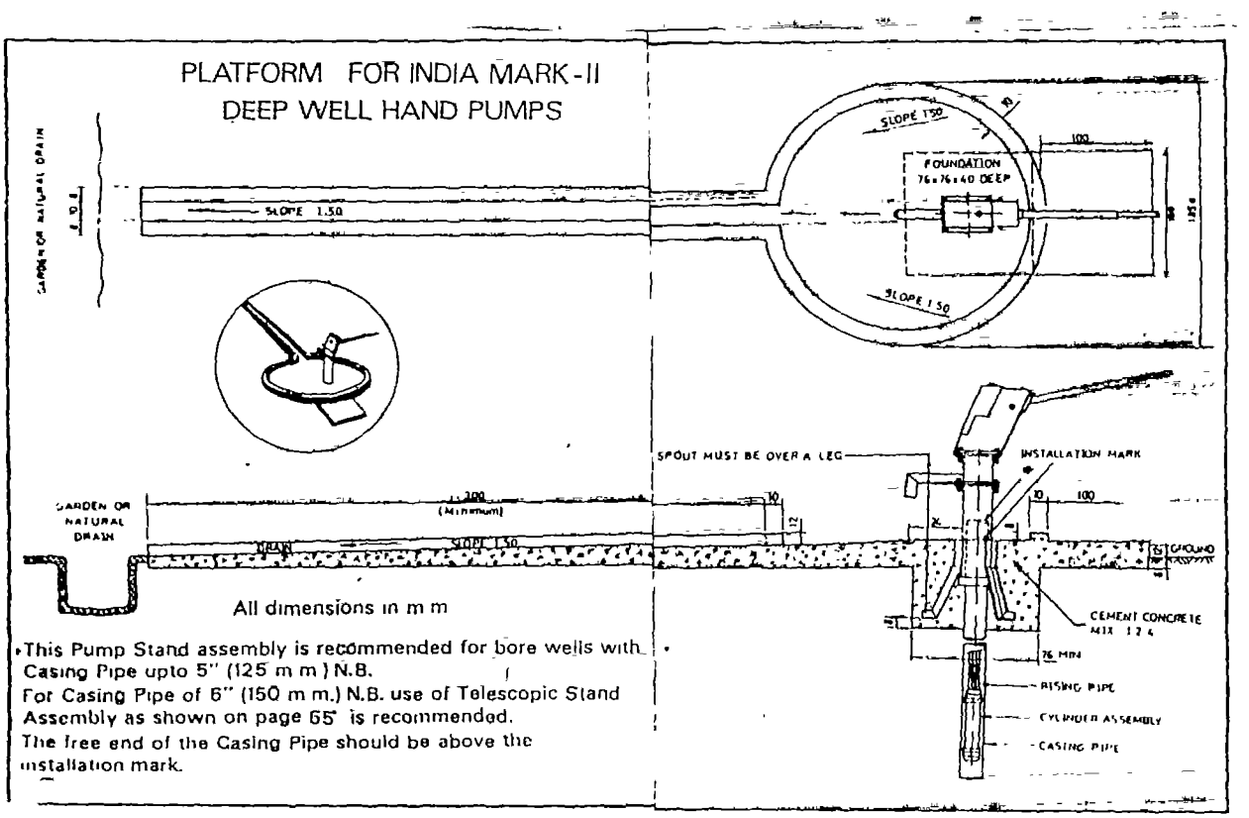
SECTIONAL DETAILS
OF PUMPHEAD ASSEMBLY

SECTIONAL DETAILS OF CYLINDER ASSEMBLY



SECTIONAL DETAILS
OF
CYLINDER ASSEMBLY

DETAILS OF HANDPUMP PLATFORM AND SOAKAGE PIT



All dimensions in m m

- This Pump Stand assembly is recommended for bore wells with Casing Pipe upto 5" (125 m m) N.B.
For Casing Pipe of 6" (150 m m.) N.B. use of Telescopic Stand Assembly as shown on page 65 is recommended.
The free end of the Casing Pipe should be above the installation mark.

SPECIFICATION FOR INDIA MARK II DEEPWELL HAND PUMP

A. SCOPE

This specification covers handpumps for lifting water from bore wells fitted with casing pipes of nominal diameter 100 mm to 150 mm and static water level from 45 m to 90 m.

B. GENERAL REQUIREMENTS

1. The material, tolerance, etc.shall be as given in respective figures.

2. The bolts and nuts used for handpump assembly shall conform to IS 1367 (Part 14) 1984.

3. The riser pipe holder welded in the water tank shall be machined from solid bar.

4. The riser pipe shall be 32 mm nominal bore, hot dipped galvanized, screwed and socketed, pipe in 3 mtr length with a tolerance of -25mm conforming to IS 1239 (Part 1) 1979 medium class. The socket shall be manufactured from seamless pipe or machined from solid bar conforming to grade Fe 410-S of IS 226:1975 with the dimensions (length and diameter) specified in IS 1239 (Part 2) 1982 and shall be hot dipped galvanized. One end of the riser pipe shall be fitted with hot dipped galvanized coupler and the other with a thread protector.

5. The welding shall be done in accordance with IS 9595:1980 welding for stainless steel components shall conform to IS 2811:1987.

6. The castings shall conform to Grade FG 200 or higher of IS 210:1978.

7. The bronze castings shall conform to Grade LTB 2 of IS 318:1981.

8. The connecting rod shall be of 12 mm diameter conforming to bright bar of type 4 and Grade 2 or 3 of steel other than free cutting steel conforming to IS 9550:1980. The electro-galvanizing shall conform to service condition No.4 of IS 1573:1986. Alternatively, the connecting rod may be manufactured from stainless steel grade 04, Cr18, Ni10 conforming to IS 6603:1972.

9. Weights.: For static water level upto 60 mtrs depths no weights shall be added at different intervals.
between 60 m to 70 m : 1 weight
between 70 m to 80 m : 2 weights.

between 80 m to 90 m : 3 weights.

10. The steel plates/sheets, angle, iron and square bars for fabrication of pumps shall conform to grade Fe 410 S of IS 226:1975.

11. The locking of check valve guide with rubber seat retainer shall be done by means of punch locking.

12. Plunger rod 12 mm diameter shall conform to Grade 04 Cr18 Ni10 of IS 6603:1972.

13. Each connecting rod and plunger rod shall be fitted with HDPE thread protector before despatch.

14. Polytetrafluorethylen (PTFE) tape or equivalent shall be used on the riser pipe before installation.

C. ANTI-CORROSIVE TREATMENT

1. The following shall be electrogalvanized and passivated according to the service condition No.4 of IS 1573:1986.

   a. Connecting rod
   b. Bearing spacer.

   All bolts, nuts and washers in the assembly excepting high tensile bolt shall be electrogalvanized and passivated according to the service condition No.3 of IS 1573:1986.

2. Galvanizing:

   The following assemblies shall be hot dip galvanized according to IS 4759 - 1984.

   a. Stand Assembly.
   b. Water tank assembly.
   c. Head assembly and
   d. Handle assembly except the inside portion of bearing housing. The galvanized assemblies shall be given chromate conversion coating type C according to IS 9839:1981.

3. Painting

The exterior surfaces of cast iron components shall be given the following treatment.

a. One coat of red oxide primer, conforming to IS 2074:1979.b. Two coats of synthetic enamel paint conforming to IS 2932:1974.

D. TESTING

1. Sampling

Unless otherwise specified in the contract or order, the procedure in IS 2500 (Part 1) : 1973 shall be followed for sampling inspection. For the characteristics given under D-2 the single sampling plan with inspection level III and AQL of one per cent as given in Tables 1 and 2 of IS 2500 (Part 1) 1973 shall be followed.

2. Visual and Dimensional Tests

a. All the pumps shall be examined for finish and visual defects.

b. All critical dimensions of the assemblies shall be checked for conformance with the drawings.

c. The handle shall have reasonably good surface contact with the top and bottom portions of the bracket.

d. Riser pipe holder welding shall be checked for verticality. Plain round mandrel of 300 mm length shall be screwed to the water tank coupling and the verticality shall be checked with the help of try square. For the entire length of the mandrel a maximum of 1 mm tilt may be allowed.

e. The flanges shall be reasonably flat to provide proper matching of holes to ensure unrestricted insertion of the bolts.

f. After putting the pump on levelled platform, alignment of the rod with respect to the guide bush shall be checked as given below.

g. A rod of length 100 mm and diameter 12 mm shall be fitted to the chain coupling. The handle shall be raised and lowered gently. The rod shall pass through the guide bush freely.

h. The handle shall be checked for lateral play at the end of the handle which shall not exceed 2 mm on either side. The clearance between the handle bracket side shall not be less than 1.5 mm.

I. The stroke of the pump shall be 100 +/- 3 mm.

j. The connecting rod and plunger rod shall be examined for straightness and the formation of the threads. The hexagonal coupler shall also be subjected to similar checks. The hexagonal coupler shall be stress relieved before welding to avoid cracks since these are manufactured from cold drawn bars.

k. When pump head assembled in the handle assembly, it shall be possible to insert handle axle by using soft hammer. The fitment of the bearing and the inner race of the bearing shall rotate freely.

l. The cylinder assembly shall be checked for leakage of water under normal atmospheric pressure and there shall be no leakage.

m. The check valve and plunger valve shall move freely after assembly.

3. Routine Tests

Two complete pumps including cylinders out of the batch selected shall be subjected to the following tests in addition to the tests given in D-2 above.

a. The pump assembly and cylinder assembly shall be dismantled and all the components shall be checked for critical dimensions conforming to the drawings. The connecting rods shall also be checked for dimensions.

b. The cylinder assembly (other than those selected for dimensional checks) of the pumps shall be placed fully submerged in a barrel of 200 litres after getting continuous flow of water through the spout. The water shall then be collected in a container for forty continuous strokes to be completed in one minute and the discharge thus measured shall not be less than 12 litres.

4. Criteria For Conformity

The lot shall be considered as conforming to the requirements of this standard, if the pumps selected according to D1 and D2 satisfy the following requirements.

a. The number of pumps not meeting the requirements of a characteristics

inspected under D2 does not exceed the corresponding acceptance number and

b. The pumps selected according to D3 should meet the requirements given in 3(a) and 3(b).

5. GUARANTEE

The pump and accessories shall be guaranteed for 12 months from the date of installation or 18 months from the date of supply whichever is earlier against bad workmanship/bad material. The life of leather/rubber components shall, however, be guaranteed for only 6 months from the date of supply.

6. MARKING

a. The pump head, cylinder and connecting rods shall be marked as under.

b. The pump head stall have a name plate with the name of the manufacturer and serial number of the pump head assembly. In addition, the head flange, the water tank assembly, top flange and the stand assembly flange shall have steel punch impression of manufacturer's identification mark before galvanizing. The impression shall be deep enough so that they shall not covered under galvanizing.

c. The cylinder body shall have manufacturer's identification mark, marked in raised letters. The serial number shall be marked on the cylinder by steel punch.

d. Each connecting rod shall have steel punch impressions indicating manufacturer's identification mark, month and year of manufacture on the 50 mm long hexagonal coupler.

SITE SELECTION CRITERIA

SITE SELECTION CRITERIA

Proper site selection is essential to ensure optimal utilization of the handpumps for drinking and cooking water. Proper selection based on community involvement constitutes the basis for their participation in the process of installation, use and maintenance of handpumps.

The total population in a village (habitation/hamlet) is taken as the basic unit of reference to decide, on a flat rate basis, the target population in the rural drinking water supply programme. For this purpose a village-wise list of habitations/hamlets and their respective populations is prepared. Thereafter, the handpump site selection for the different habitations/hamlets is carried out with involvement of the people. The criteria for site selection are enumerated below.

However, as socio-economic conditions and patterns of habitations vary from village to village, no uniform site selection criteria can be applied in all cases.

* The number of handpumps should be worked out on the basis one for an average population of 150 people with a provision that the minimum distance of the handpump will not be more than 0.5 km.

* In case of hamlets, if the population of the individual hamlet is less than 50, one handpump should be provided.

  If there are a number of hamlets with populations less than 50 in each, the handpump(s) should be installed at site(s) which is/are equidistant from the hamlets . However, the distance should not be more than 0.5 km from each habitation.

* The handpump site should always be accessible socially. For public gathering places like markets, panchayat offices, bus stands, etc. additional handpumps may be provided.

* Wherever possible, the site selected should be on the way to traditional water sources, where womenfolk go for bathing and washing. This will facilitate collection of drinking/cooking water from the handpump while returning to their homes.

* The handpump site should be on Government land. Where it becomes absolutely necessary to locate a handpump on private land, prior written consent of the private land-owner, in the proper form, should be obtained beforehand. Sample of Land Agreement Form is attached in **Annexure I.**

* The handpump site, if located on private land donated by the land-owner, should be clearly demarcated so as to facilitate access by the users.

* Site should be selected in areas with enough land to construct the standard platform and drain. Activities that are normally carried out near a drinking water source should not be hampered due to less space.

* The handpump site should be so located that it facilitates the drilling work for installation of tubewell/handpump. It should be away from overhead electrical lines, telephone lines and trees as far as possible.

* The handpump site should have scope for satisfactory drainage to a nullah, river, tank, kitchen garden, etc. In case of disposal of drainage water to a kitchen garden, owner's consent should be obtained beforehand.

* The trend of the future growth of the village should be given due consideration in selecting the site so as to give the maximum possible benefit to the future beneficiaries.

* A village plan showing the location of the existing safe sources should be prepared. The proposed locations for the handpumps should be marked on the plan after considering the various criteria. This will help to distribute the handpumps rationally, increase accesibility and reduce distance to source.

PEOPLE'S PARTICIPATION

Proper selection with community involvement is important for their participation in the process of installation, use and maintenance of the handpumps.
People's participation in site selection may be ensured in the following manner.

* Constant interaction with villagers to enquire about some possible sites.

* Interaction with women and local leaders to identify the most suitable site.

* Involvement of people from the potential beneficiary zone during the conversations and discussions.

* Special attention to women's perspective with matters of their concern like distances and surroundings of the proposed handpump sites (Will they feel free to go there?).

* Creation of opportunities for the community members to freely and openly express their views on community problems.

* Obtaining consensus among the beneficiaries through group discussions. The WATSAN committee should be involved in this process.

PRE-CONDITIONS FOR INSTALLATION OF INDIA MARK II & MARK III HANDPUMPS

A handpump is a pumping device.

The borewell yields water to the hand pump. The well also serves as housing for the handpump. The borewells on which a handpump is to be installed must yield sufficient water to the pump, and should have large enough diameter to facilitate free installation and removal of the pump assembly,

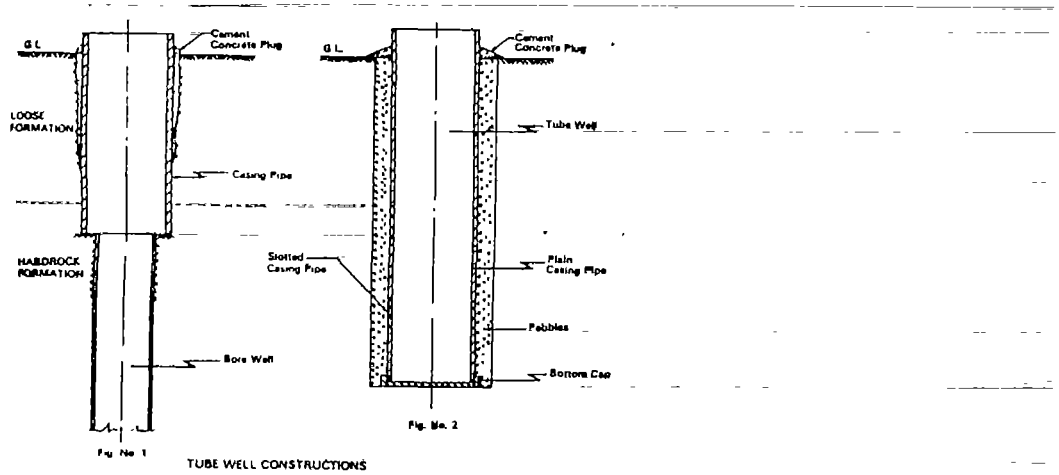
Now a days, India Mark II and India Mark III handpumps are well provided on the drilled for the village water supply.

For installation of the India Mark II handpumps the well should be minimum 45-50 m deep and should have minimum diameter of 100 m through the depth, and should yield minimum 1000 lph discharge. To facilitate proper installation the casing pipe should extend atleast 20 cms. about ground level.

For installation for India Mark III handump all above norms must be fulfilled. However, since the 65 mm in case of Mark II handump - the well should have minimum 115 mm diameter, and should have been provided with 125 mm casing pipes.

Sanitary protection of well is equally important. And hence before installation of the hand pump - the annular space around the casing pipe be grouted using cement.

A cattle trough may also be constructed along with the handpump in desert areas. In such a case, the platform design may be altered accordingly. However, waste water should not be used as drinking water for the cattle.



TUBE WELL CONSTRUCTIONS

TOOLS AND ACCESSORIES

INSTALLATION TOOLS AND ACCESSORIES

Special tool kit

The special tool kit for installation of India Mark II handpumps comprises of the following:

1.	Self-locking clamp	-	1 no.
2.	Tank pipe lifter	-	1 no.
3.	Coupling spanner	-	1 no.
4.	Connecting rod coupling spanner	-	1 no.
5.	Handle axle punch	-	1 no.
6.	Connecting rod lifter 'T' type	-	1 no.
7.	Crank spanner	-	2 nos.
8.	Pipe lifters	-	3 nos.
9.	Connecting rod vice	-	1 no.
10.	Chain coupler supporting tool	-	1 no.
11.	Bearing mounting tool	-	1 no.
12.	Tool box [to accommodate all the above items except item nos. 1,2 and 8]	-	1 no.

TOOL NO.1 - SELF LOCKING CLAMP:

This tool should be used for holding the riser pipe while lifting or lowering. While lifting the pipes, the handle of self-locking clamp need not be opened. It is fully automatic and the jaws open and close automatically.

TOOL NO.2 - TANK PIPE LIFTER:

This tool to should be used lower or lift the water tank with the riser pipe
To use this tool -

i. Screw it on to water tank coupling.
ii. Use 2 or 3 lifting spanners equally spaced on the tank pipe lifter to raise or lower water tank assembly.

TOOL NO.3 - CONNECTING ROD COUPLING SPANNER

This tool should be used for tightening and unscrewing the connecting rod coupler, faster and with ease . It reduces the effort required for the operation.

TOOL NO.4 - HANDLE AXLE PUNCH:

This tool is used for fixing and driving out the handle axle without damage to axle threads.

A. For fixing the handle axle the operation sequence is -
   i. Hold the handle parallel to the ground.
   ii. Insert the handle axle punch through axle left bush and bearings.
   iii. Insert the handle axle through right axle bush so that threaded portion goes into the handle axle punch.
   iv. Hold the handle axle punch by one hand and hammer the handle axle.
   v. Hammer the handle axle till threaded portion comes out through left bush. The handle axle punch would have come out by then.

B. For driving out the handle axle the operation sequence is:
   i. Remove axle nuts and washers.
   ii. Insert handle axle punch on taper portion of axle.
   iii. One person should hold the handle parallel to the ground.
   iv. Hammer gently handle axle punch until you are able to pull out axle by hand.

TOOL NO.6 - CONNECTING ROD LIFTER 'T' TYPE:

This tool should be used for raising or lowering the last [top] connecting rod

   i. Cut threads on the top of the connecting rod, if no threads are on it.
   ii. Screw the tool to the connecting rod threads with check nut.
   iii. Lift or lower the connecting rods as required.

TOOL NO.7 - CRANK SPANNER:

The crank spanners are used for tightening or loosening flange bolts, check nuts, chain nyloc nut and anchor bolts, cover bolt, axle nuts, etc.

TOOL NO.8 - PIPE LIFTER:

This tool is used to raise or lower riser pipes.

   i. Pipe lifters should be spaced equally around the rising main.
   ii. Use two lifters to lower or lift upto 30 meters of rising main.
   iii. Use three lifters if the riser pipes are more than 30 meters. Do not use pipe wrenches for lifting or lowering the riser pipes.
   iv. You can also use one lifter to lock the pipe with the help of a pipe wrench.

TOOL NO.9 - CONNECTING ROD VICE:

This tool is used for lowering or lifting the connecting rod and for holding the same while connecting rod is cut and threaded. Used to hold connecting rod while unscrewing and screwing the same.

TOOL NO.10 - CHAIN COUPLER SUPPORTING TOOL:

This tool should be placed between the chain coupler and the bottom flange of head assembly to facilitate easy fixing of chain on to the handle assembly. The entire weight of the handpump is supported by this tool.

TOOL NO.11 - BEARING MOUNTING TOOL:

With the help of this tool bearings can be fitted very easily in the bearing housing of handle assembly.

TOOL NO.12 - CONNECTING ROD LIFTING ADAPTER:

This tool should be screwed on to the top connecting rod and bolted on to the handle then the handle is pulled downward suddenly. It will help in releasing check valve assembly together with the plunger assembly in case of 'O' ring in the check valve assembly is tight 9 jammed) against cylinder bottom cap which in turn releases the water column in the rising main to facilitate the removal of piston and check valve assembly.

BEARING MOUNTING TOOL OPERATION PROCEDURE

Standard tools and consumables

A tool kit comprising the following standard tools is recommended for the installation team.

1.	M12 x 1.75 pitch button die with die holder	-	1 set
2.	Die set for 32 mm GI pipe with holder	-	1 set
3.	600 mm pipe wrench (stilton type)	-	1 No.
4.	450 mm pipe wrench (stilton type)	-	1 No.
5.	300 mm pipe wrench (stilton type)	-	1 Nos.
6.	M17 x M19 double ended spanners (10mm x 12mm)	-	2 No.
7.	Screw driver 300 mm long	-	1 No.
8.	Screw driver 150 mm long	-	1 No.
9.	300 mm adjustable spanner	-	1 No.
10.	2 Kg (approx) ball pein hammer with handle	-	1 No.
11.	300 mm hacksaw frame with spare blades	-	1 Set
12.	Pressure type oil can with (1/2 pint oil)	-	1 No.
13.	Wire brush	-	1 No.
14.	250 mm half round file with handle	-	1 No.
15.	250 mm flat file with handle	-	1 No.
16.	Graphite grease or multipurpose grease	-	1 Kg.
17.	Nylon rope (3 mm thick)	-	75mtrs.

NOTE: In addition to the above, a pair of pipe stands are also recommended to be kept with the mobile team.

Shuttering India Mark II platform shuttering unit - 1 No.

Masonary tools and consumables

The following masonry tools are recommended to be kept with every installation team:

1.	Metal scoop (Big and Small)	-	2 sets
2.	Metal pan	-	4 Nos.
3.	Spade	-	3 Nos.
4.	Crow bar	-	2 Nos.
5.	Metal spirit level 250 mm	-	1 No.
6.	Wooden levelling plank (small and large)	-	2 sets
7.	20 litre bucket	-	1 Nos.
8.	2 litre mug	-	1 Nos.
9.	3 mtr. metal measuring tape	-	1 No.
10.	Quick setting compound	-	5 Kg. or 5 litres
11.	Pedestal cover plate	-	1 Nos.
12.	Bleaching powder	-	1 Kg.

MAINTENANCE TOOLS AND ACCESSORIES

A tool kit comprising the following special and standard tools is recommended for the maintenance team.

Special tools

1.	Self-locking clamp	-	1 no.
2.	Tank pipe lifter	-	1 no.
3.	Coupling spanner	-	1 no.
4.	Connecting rod coupling spanner	-	1 no.
5.	Handle axle punch	-	1 no.
6.	Connecting rod lifter 'T' type	-	1 no.
7.	Crank spanner	-	2 nos.
8.	Pipe lifters	-	3 nos.
9.	Connecting rod vice	-	1 no.
10.	Chain coupler supporting tool	-	1 no.
11.	Bearing mounting tool	-	1 no.
12.	Tool box [to accommodate all the above items except item nos. 1,2 and 8]	-	1 no.

Standard tools and consumables

1.	M12 x 1.75 pitch button die with die holder	-	1 set
2.	Die set for 32 mm GI pipe with holder	-	1 set
3.	600 mm pipe wrench (stilton type)	-	1 No.
4.	450 mm pipe wrench (stilton type)	-	1 No.
5.	300 mm pipe wrench (stilton type)	-	1 Nos.
6.	M17 x M19 double ended spanners (10mm x 12mm)	-	2 No.
7.	Screw driver 300 mm long	-	1 No.
8.	Screw driver 150 mm long	-	1 No.
9.	300 mm adjustable spanner	-	1 No.
10.	2 Kg (approx) ball pein hammer with handle	-	1 No.
11.	300 mm hacksaw frame with spare blades	-	1 Set
12.	Pressure type oil can with (1/2 pint oil)	-	1 No.
13.	Wire brush	-	1 No.
14.	250 mm half round file with handle	-	1 No.
15.	250 mm flat file with handle	-	1 No.
16.	Graphite grease or multipurpose grease	-	1 Kg.
17.	Nylon rope (3 mm thick)	-	75mtrs.

NOTE: In addition to the above, a pair of pipe stands are also recommended to be kept with the mobile team.

Fishing tools

Fishing is removing fallen pump components from the bore/tube wells.

The fallen components can be referred to as the "FISH". In order to take out or "FISH OUT THE FISH", suitable 'nets' or fishing tools are required. To select a suitable "Fishing Tool", the following points have to be considered:

* Diameter of bore/tube well
* Depth of bore/tube well
* Depth at which the top of the component is lying inside the bore/tube well
* Type of component on top of the fallen assembly
* Size and diameter of component on top of the fallen assembly.

The 'fish' or the fallen components are of three types in general:

* G.I. pipes with couplings
** G.I. pipes without couplings or threads
*** Connecting rods

The fishing tools are designed and manufactured to fish out the components listed above.

TOOL NO.1 - ROD HOOK:

This tool is used to extract fallen connecting rods from a bore/tube well. To extract fallen connecting rods, lower this tool into the borewell by joining the tool to external connecting rods till the time the tool touches the connecting rod in the bore/tube well. Rotate the tool till the time the rod coupler in the fallen rod gets caught in the hook. Now lift the tool slowly without jerks.

TOOL NO.2 - PIPE LIFTING TOOL 'A':

This tool is used to extract a single pipe or a column of riser pipes fallen into a bore/tube well and the top pipe is with a coupler.

To extract a single or a column of fallen riser pipes from the bore/tube well, lower this tool by screwing external 32 mm N.B.
G.I. pipes to one end of the tool where 32 mm coupler is provided. Go on adding extra pipes and lower the tool till it touches the coupler of the fallen pipe column. Now the fallen pipe will get inside the tool and the trap arrangement in the tool will hold the fallen with coupling firmly. Lift the tool and extract the fallen pipe(s).

TOOL NO.3 - PIPE LIFTING TOOL 'B':

This tool is used to extract a single pipe or a column of riser pipes fallen into a bore/tube well and the top pipe is neither having a coupler nor threads or having damaged threads.

To extricate a single or a column of fallen riser pipe from the bore/tube well, lower this tool by screwing external 32 mm N.B. G.I. pipes to one end of the tool where 32 mm female threads are provided. Go on adding extra pipes and lower the tool till it touches the fallen pipe. Engage and align the tool with the fallen pipe. Gently hammer the tool and make sure the fallen pipe is caught within the tool. The pipe will be caught inside the tool because of the upward movement of the flexible tapered bush inside the tool. Hammer further for the firm grip. Lift the pipes from the top, the fallen column will come out.

There are at times, it becomes necessary to fish out some other components other than pipes and rods. For example, if a cylinder has fallen inside a bore/tube well, we need a special fishing tool to remove the same. In these cases special fishing tools are designed and manufactured in materials which will not damage the fallen article.

In case the fallen article is covered by some foreign materials, first these are should be flushed out by injecting compressed air through a compressor or a rig. Water should be poured or injected to loosen the earth around the fallen article. Then, with an appropriate fishing tool, the fallen article can be fished out.

Attention should also be paid to the following before starting any fishing operation.

* Sufficient man power is available.
* Required pipes, rods, wooden blocks, sledge hammers, chain pulley block, tripod, etc are available.
* Water and food are provided for the men engaged in the work.
* Transport arrangements are made for the men and material.

However, the basic things required to fish out any type of hand pump component from a bore/tube well, are common sense, proper tools, sufficient time, manpower and patience.

INSTALLATION PROCEDURE

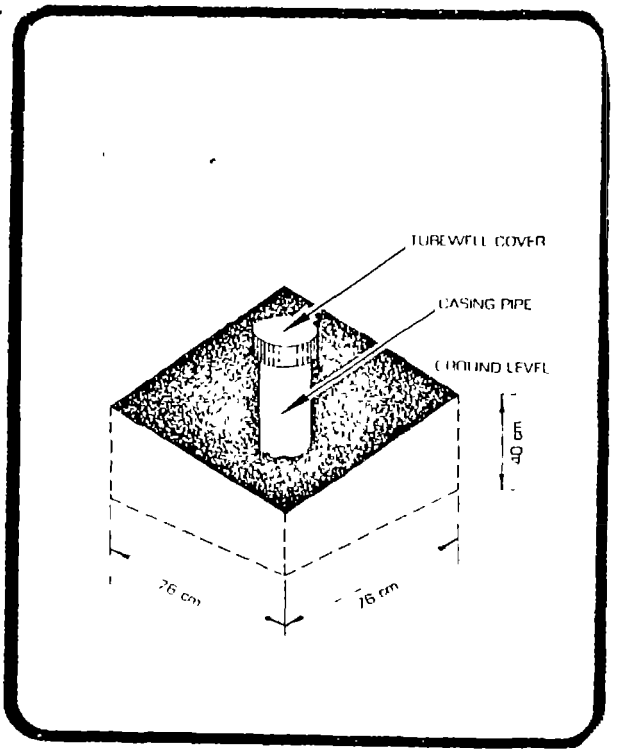
PLATFORM CONSTRUCTION

STEP 1 DIG A PIT FOR THE PUMP PEDESTAL

REMOVE THE BORE/TUBE WELL CASING PIPE COVER.

MEASURE DEPTH OF TUBE WELL & STATIC WATER LEVEL AND ENSURE THAT THE BORE/TUBE WELL AREA IS FREE FROM OBSTRUCTIONS.

COVER THE CASING PIPE.



NOTE : THE CASING PIPE SHOULD BE CUT 30 CMS ABOVE THE GROUND LEVEL.

DIG A SQUARE PIT (76 cms x 76 cms) and 40 cms DEEP AROUND THE CASING PIPE.

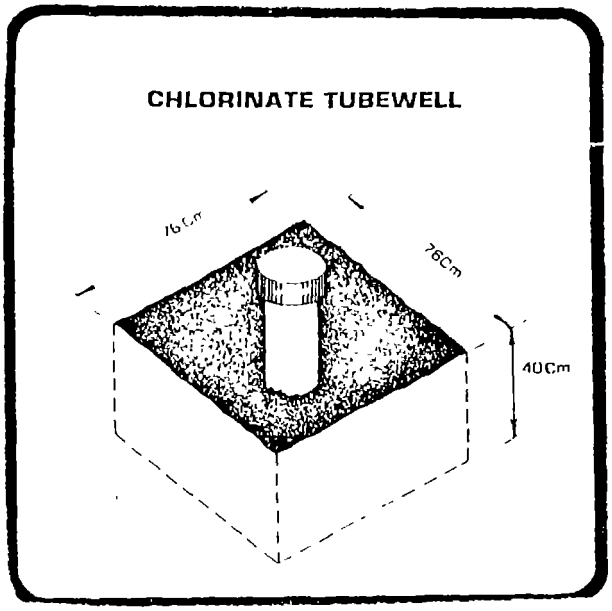
(Size of the foundation of the platform should be decided according to the soil condition of the site).

STEP 2 CHLORINATION OF BORE/TUBE WELL

DURING NEW HANDPUMP INSTALLATION

MIX 300 GMS OF FRESH BLEACHING POWDER IN 15 LITRES OF WATER IN A BUCKET, STIR WELL AND POUR INTO THE BORE/TUBE WELL FOR CHLORINATION.

COVER THE CASING PIPE.



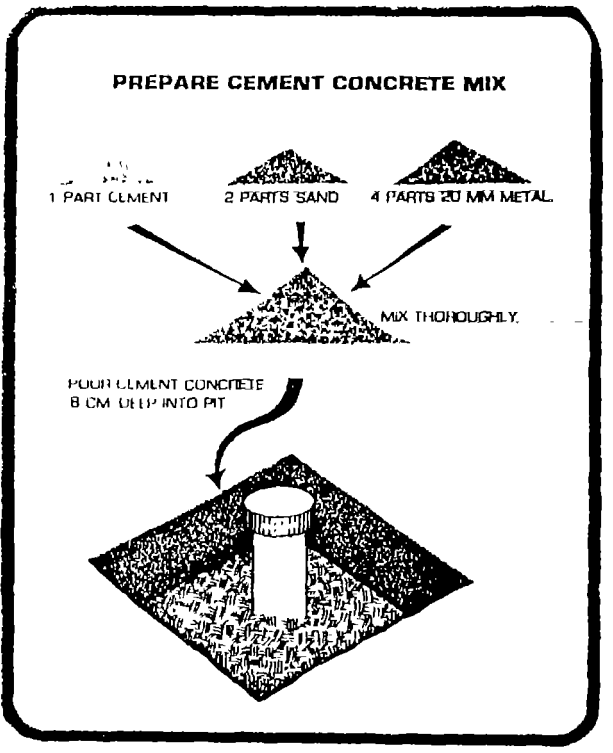
DURING REGULAR MAINTENANCE

CHLORINATION SHOULD BE DONE INITIALLY DURING THE INSTALLATION OF A HANDPUMP AND REGULARLY HENCEFORTH AS A PART OF THE MAINTENANCE SCHEDULE (EVERY 90 - 120 DAYS).
MIX 300 GRAMS OF BLEACHING POWDER IN 15 LITRES OF WATER IN A BUCKET THOROUGHLY.

REMOVE THE FOUR BOLTS CONNECTING THE WATER TANK WITH PEDESTAL.
MOVE WATER TANK WITH RISER PIPE ASSEMBLY TO THE SIDE.

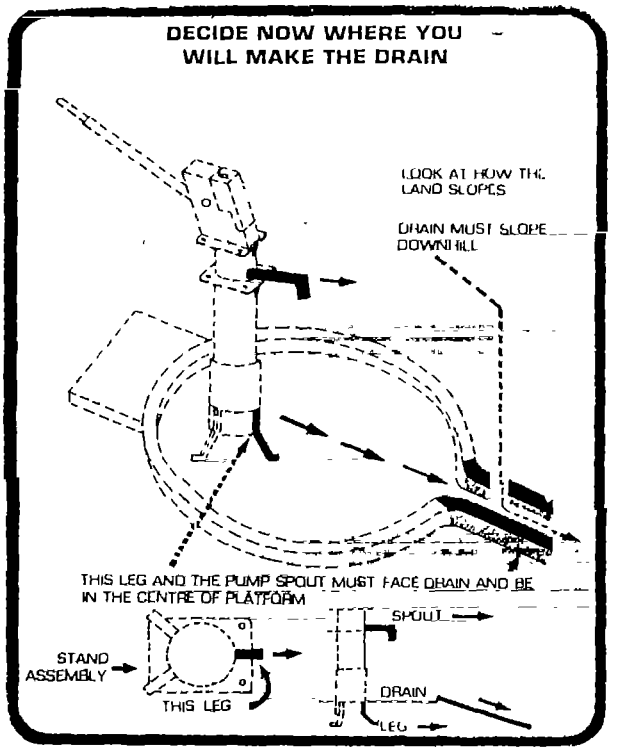
POUR CHLORINE SOLUTION INTO OPEN END OF PEDESTAL.
SLIDE WATER TANK AND BOLT IT BACK TO PEDESTAL.
TIGHTEN THE FOUR BOLTS AND NUTS FULLY.
THE HANDPUMP MUST NOT BE USED FOR ATLEAST HALF AND HOUR AFTER CHLORINATION.
OPERATE THE HANDLE TO PUMP OUT EXCESS CHLORINE IN THE BORE/TUBE WELL WATER COLUMN.

STEP 3 PREPARE CEMENT CONCRETE MIX



1 PART CEMENT, 2 PARTS SAND, 4 PARTS 20 MM METAL MIX THOROUGHLY & POUR CEMENT CONCRETE UPTO 8 CM INTO THE PIT.

STEP 4 DECIDE THE DIRECTION OF THE DRAIN

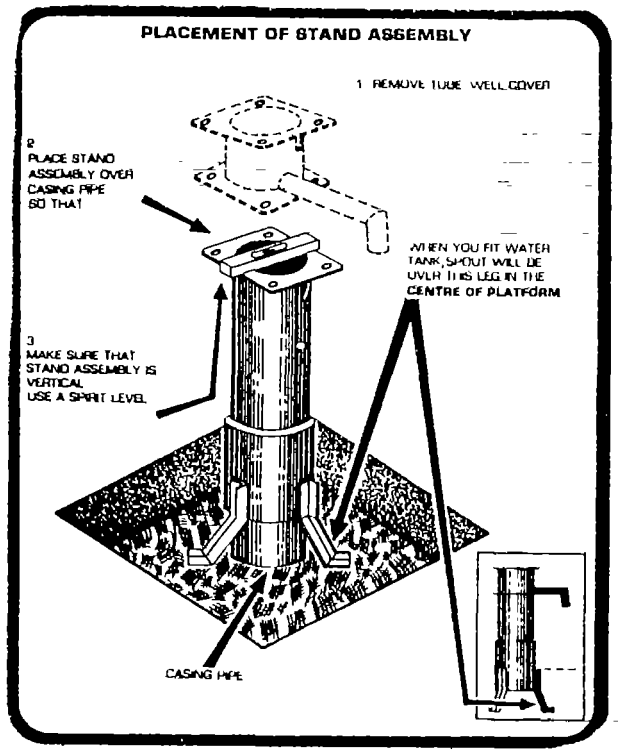


STEP 5 PLACEMENT OF STAND ASSEMBLY

1. REMOVE BORE/TUBE WELL COVER

2. PLACE STAND ASSEMBLY OVER CASING PIPE SO THAT....
... WHEN YOU FIT WATER TANK, SPOUT WILL BE OVER THIS LEG IN THE CENTRE OF PLATFORM

3. USE A SPIRIT LEVEL TO MAKE SURE THAT STAND ASSEMBLY IS VERTICAL

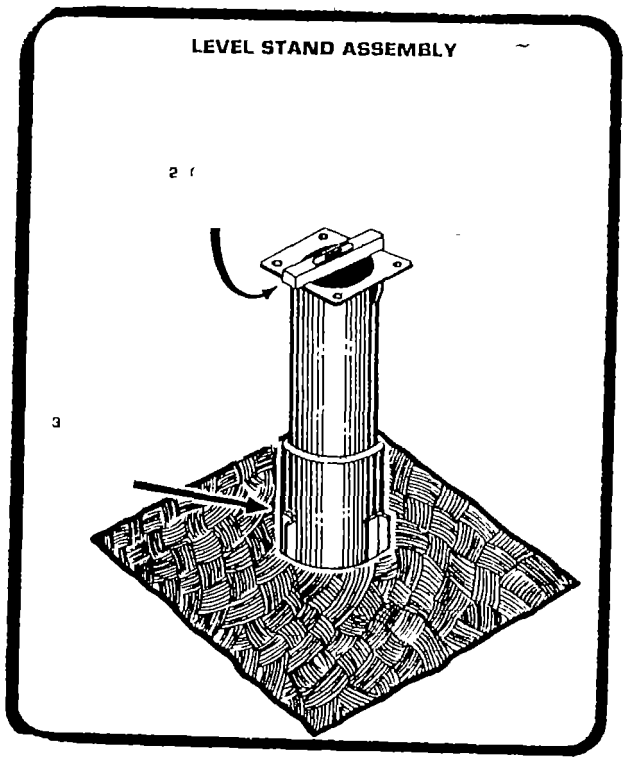


STEP 6 LEVEL STAND ASSEMBLY

1. FILL THE PIT WITH CONCRETE. RAM THE CONCRETE TO CONSOLIDATE IT.

2. USE A SPIRIT LEVEL TO CHECK THAT THE TOP FLANGE IS LEVEL.

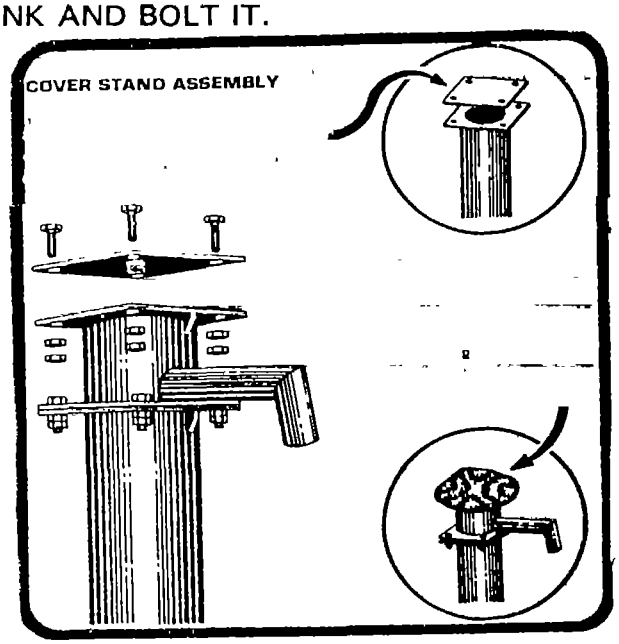
3. CONSTRUCT THE PLATFORM TO THE TOP OF THE LEGS WHILE CONCRETE IS STILL WET.



STEP 7 COVER STAND ASSEMBLY

1. COVER STAND ASSEMBLY SO THAT CHILDREN DO NOT PUT STONES IN THE TUBE WELL - IF YOU HAVE A COVER PLATE, USE IT.

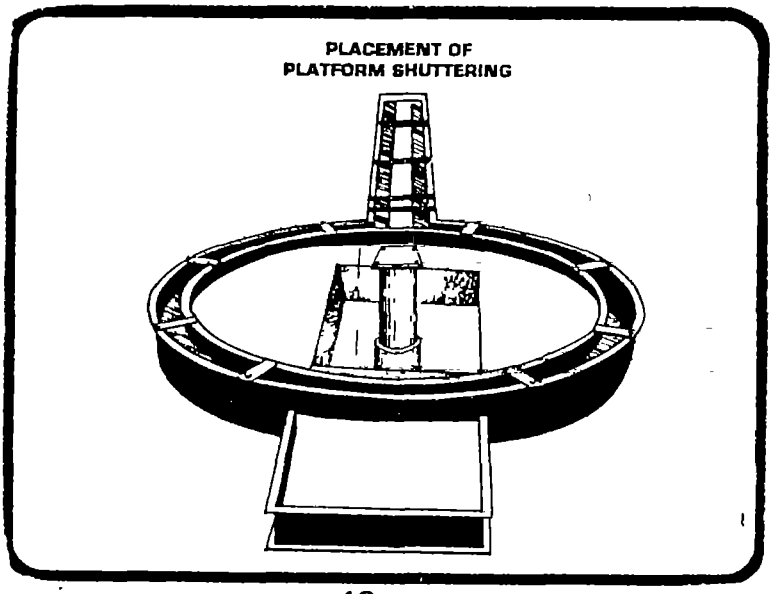
   - IF YOU DON'T HAVE A COVER PLATE.....
   PLACE MIDDLE FLANGE OVER WATER TANK AND BOLT IT.



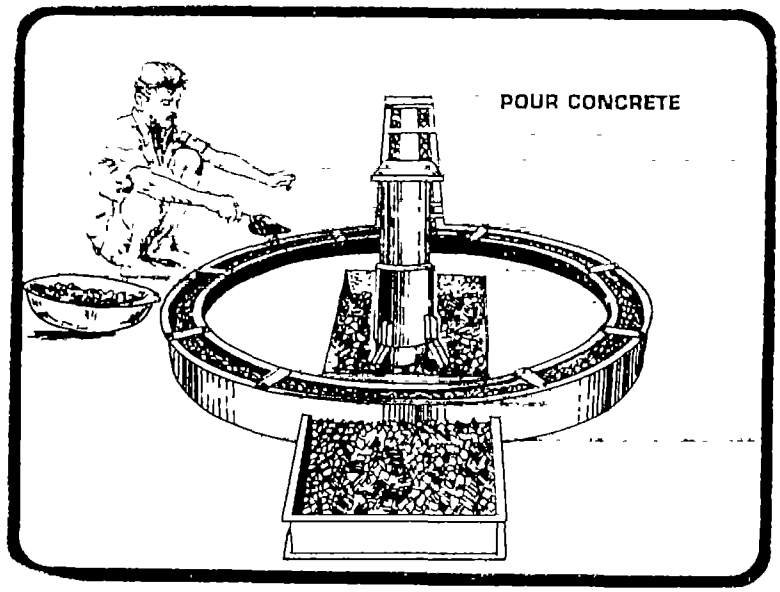
   OR WRAP A CLOTH AROUND AS SHOWN

STEP 8 PLACEMENT OF PLATFORM SHUTTERING

1. LAY THE MILD STEEL PLATFORM SHUTTERING OVER THE LEVELLED GROUND AROUND THE PUMP PEDESTAL AND PREPARE THE GROUND FOR CONSTRUCTNG THE PLATFORM AS PER DESIGN.



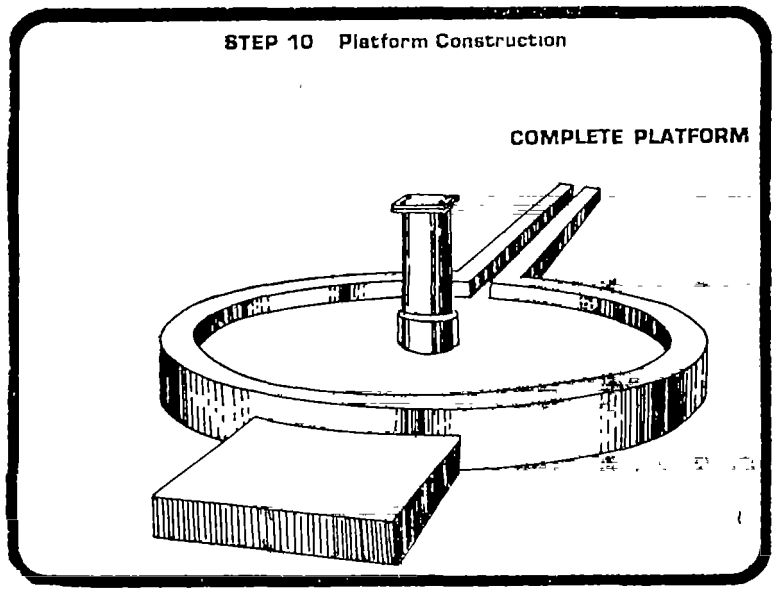
STEP 9 POUR CONCRETE



STEP 10 COMPLETE PLATFORM

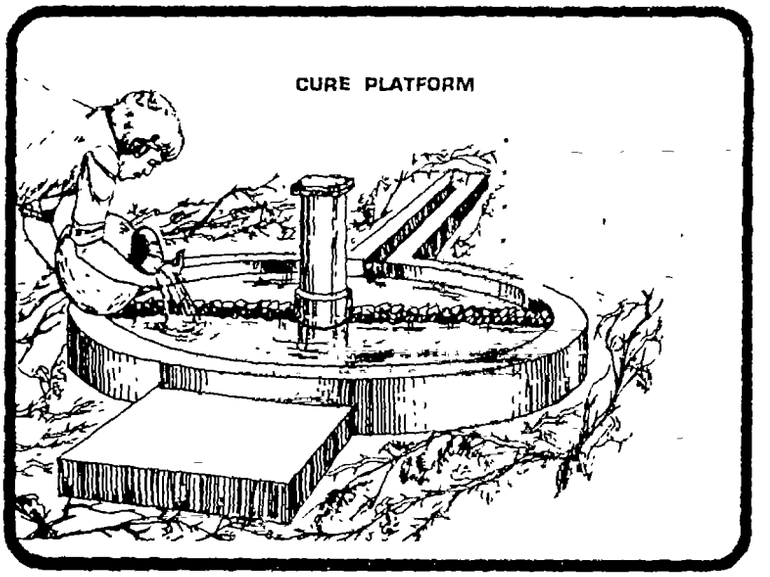
APPROXIMATE MATERIAL REQUIREMENT FOR CONSTRUCTION OF ONE PLATFORM

a) CEMENT ....6 BAGS.
b) SAND.....0.40 M^3
c) METAL (20 MM SIZE)....0.80 M^3



STEP 11 CURE PLATFORM

* TO CURE CONCRETE, BLOCK DRAIN MAKE BUNDS AND FILL THE PLATFORM WITH WATER.
* ASK VILLAGERS TO KEEP AWAY FROM PLATFORM.
* ALLOW CONCRETE TO SET FOR **SEVEN DAYS.**
* SPREAD THORNY BUSHES AND COVER THE PLATFORM TO AVOID PEOPLE OR ANIMALS STEPPING OVER IT.

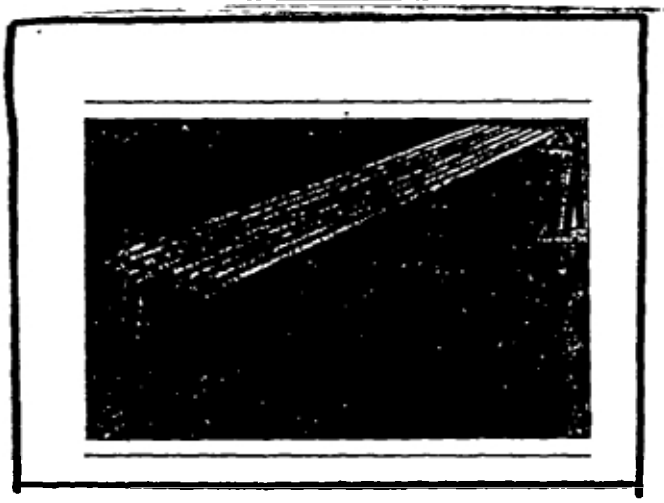


INSTALLATION OF CYLINDER ASSEMBLY AND RISER PIPES

STEP 1

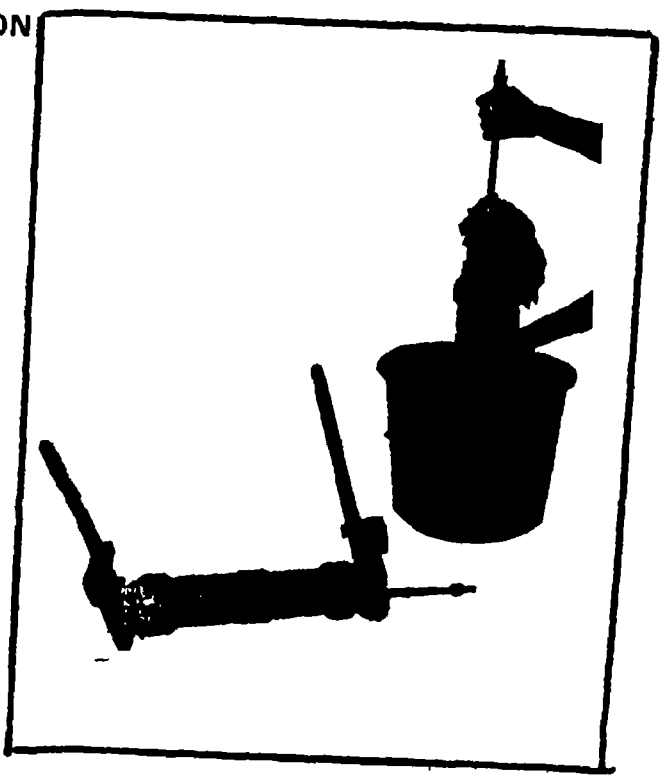
SEVEN DAYS LATER

USE PIPE STAND TO LAY OUT PIPES AND CONNECTING RODS AS SHOWN:
CHECK THAT PIPES AND CONNECTING RODS ARE THREADED ON BOTH SIDES.
CHECK THAT ALL THREADS ARE IN GOOD CONDITION AND CLEAN.
ONE END OF THE PIPES SHOULD BE SOCKETED.
RUN A COUPLER/SOCKET TO ENSURE THE THREADS ARE SMOOTH.



STEP 2 **CHECK CYLINDER OPERATION**

1. OPEN THE CYLINDER TO CHECK THE PISTON AND CHECK VALVE ASSEMBLY.
2. REASSEMBLE THE CYLINDER.
3. TEST THE CYLINDER IN A BUCKET OF WATER TO ENSURE THERE IS NO LEAKAGE. IF LEAKAGE PERSISTS, REPLACE DEFECTIVE COMPONENT.



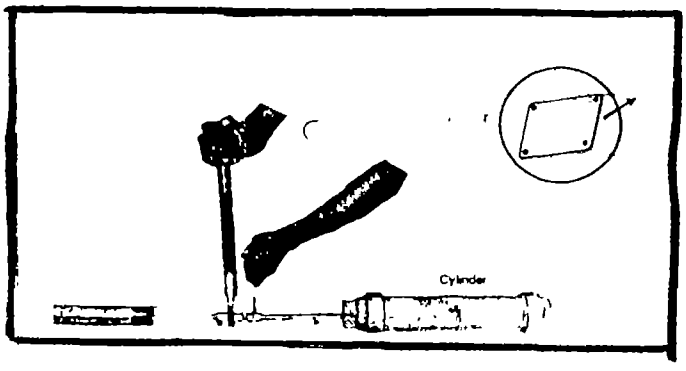
STEP 3 FIX CYLINDER TO FIRST PUMP ROD AND PIPE

1. REMOVE COVER OF THE STAND ASSEMBLY.

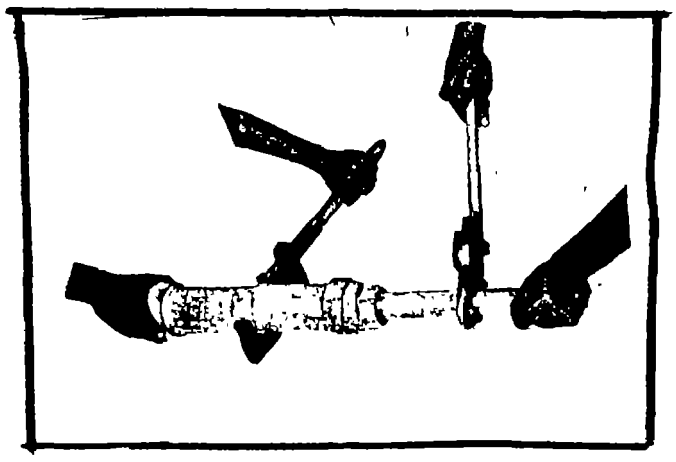
2. JOIN FIRST CONNECTING ROD TO THE PLUNGER ROD.

3. SCREW FIRST PIPE ONTO CYLINDER TOP CAP USING JOINTING COMPOUND TIGHTEN FULLY.

4. WIPE OFF EXCESS JOINTING COMPOUND.



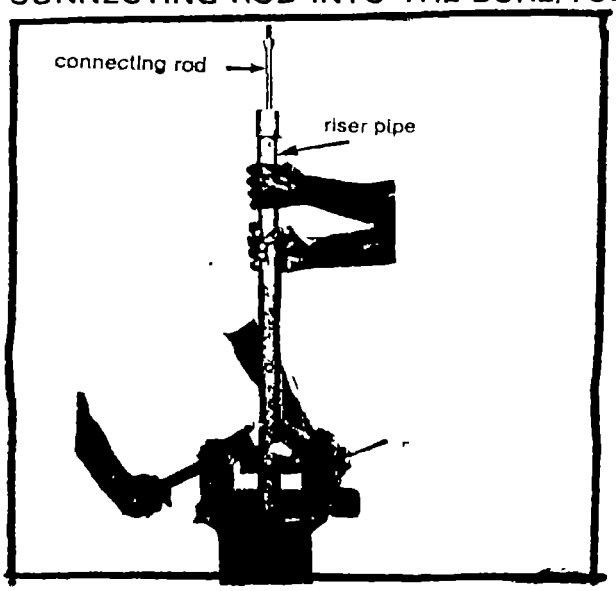
THE CYLINDER SHOULD BE INSTALLED AT A MINIMUM DEPTH OF 24 METERS.



STEP 4 INSTALLATION OF CYLINDER PIPE

> USE OF TRIPOD AND CHAIN PULLEY BLOCK IS RECOMMENDED BEYOND 40 M OF RISER PIPES.

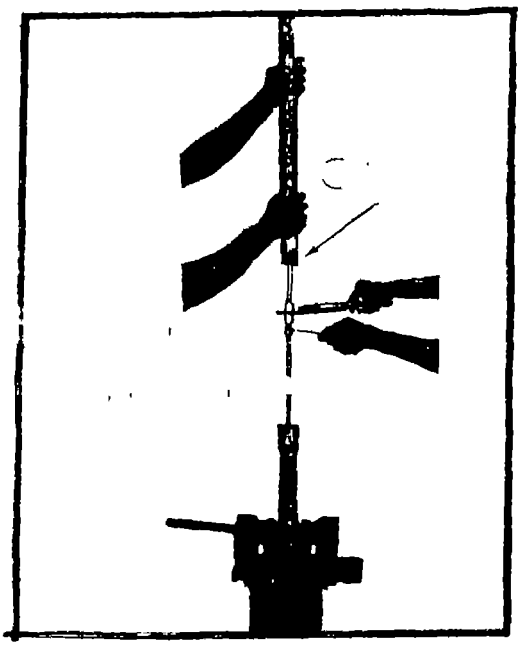
1. LOWER THE CYLINDER, FIRST PIPE AND CONNECTING ROD INTO THE BORE/TUBE WELL.



2. INSERT SELF LOCKING CLAMP TO THE RISER PIPES AS SHOWN.

> NEVER INSTALL A CYLINDER LESS THAN 6 METRES (20 FT.) FROM THE BOTTOM OF THE BORE/TUBE WELL.

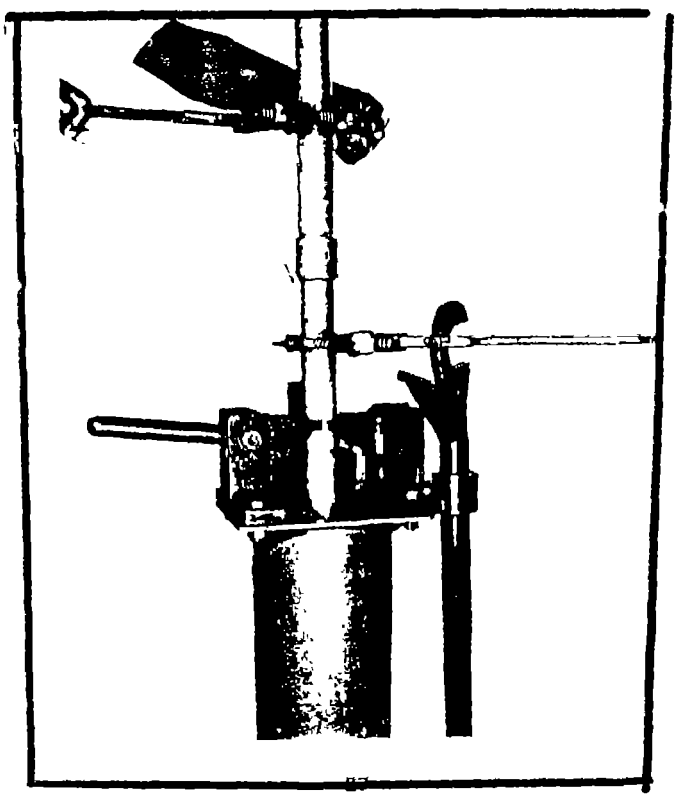
STEP 5 FIX SUCCESSIVE PIPE AND RODS



1. TIGHTEN SELF LOCKING CLAMP WITH FOUR BOLTS & NUTS.
1. JOIN SECOND CONNECTING ROD TO THE FIRST CONNECTING ROD, TIGHTEN FULLY USING A COUPLING SPANNER.
2. APPLY JOINTING COMPOUND ON THE PIPE THREADS.
3. INSERT PIPE LIFTING SPANNER INTO THE BUSH OF SELF LOCKING CLAMP AND LOCK BOTTOM PIPE WITH WRENCH AS SHOWN.
4. TIGHTEN THE PIPES AS SHOWN.

WHILE LOWERING PRESS HANDLE OF SELF LOCKING CLAMP DOWN.

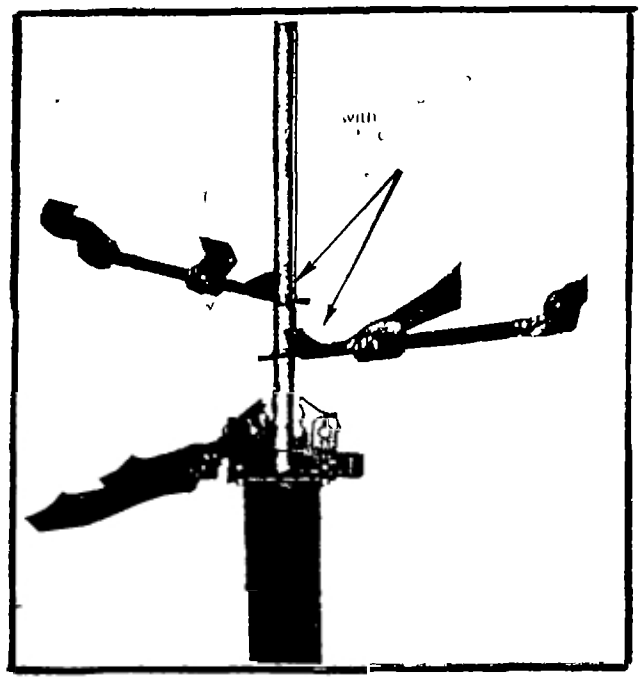
USE JOINTING COMPOUND. WIPE OF EXCESS JOINTING COMPOUND.



STEP 5 FIX SUCCESSIVE PIPE AND RODS

5. LOWER DOWN RISER PIPES GENTLY WITH THE HELP OF PIPE LIFTERS.

6. PRESS SELF LOCKING CLAMP JAWS ONLY WHILE LOWERING DOWN RISER PIPES.



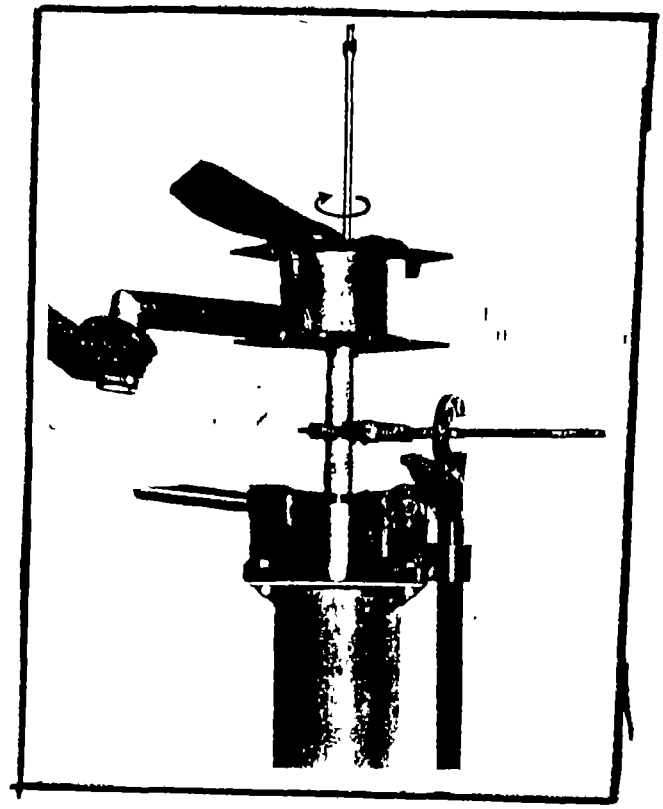
KEEP ON LOWERING THE PIPE AND CONNECTING ROD INTO THE BORE/TUBE WELL TILL THE LAST PIPE.

STEP 6 FIX WATER TANK TO LAST PIPE

1. APPLY GREASE TO WATER TANK COUPLER THREADS.

2. LOCK RISER PIPE WITH HELP OF PIPE LIFTERS AND PIPE WRENCH AS SHOWN.

3. SCREW WATER TANK WITH THE LAST PIPE THREADS. TIGHTEN FULLY.

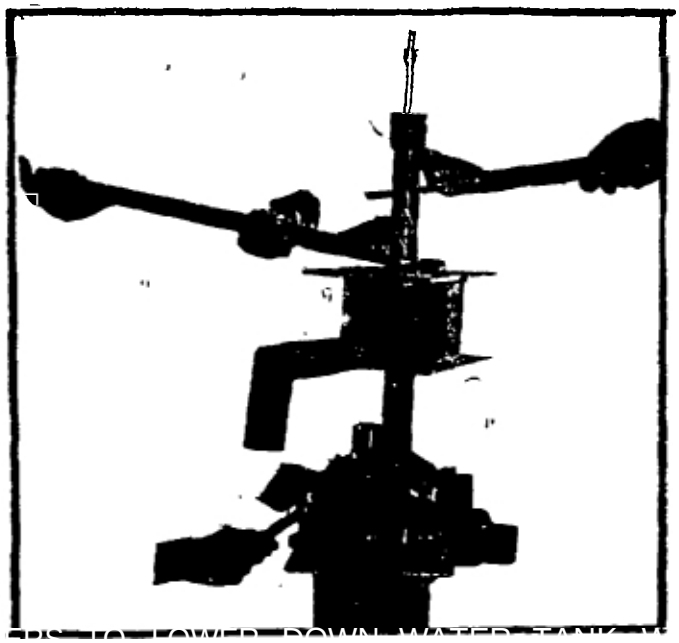


STEP 6 FIX WATER TANK TO LAST PIPE

4. SCREW TANK PIPE LIFTER ON TO WATER TANK COUPLER AND HOLD IT WITH PIPE LIFTERS.

5. REMOVE FOUR BOLTS AND NUTS HOLDING THE CLAMP.

6. WITHDRAW THE SELF LOCKING CLAMP.



7. USE PIPE LIFTERS TO LOWER DOWN WATER TANK WITH RISER PIPES GENTLY AND PLACE ON STAND FLANGE.

8. FIX BOLTS, NUTS AND WASHERS.

INSTALLATION OF PUMP HEAD

STEP 1

1. PUSH THE CONNECTING ROD ASSEMBLY TO BOTTOM MOST POSITION.

2. MARK ROD IN LEVEL WITH TOP OF WATER TANK.

STEP 2

1. BY HOLDING THE ROD LIFTER, LIFT THE ROD ASSEMBLY.

2. INSERT CONNECTING ROD VICE.

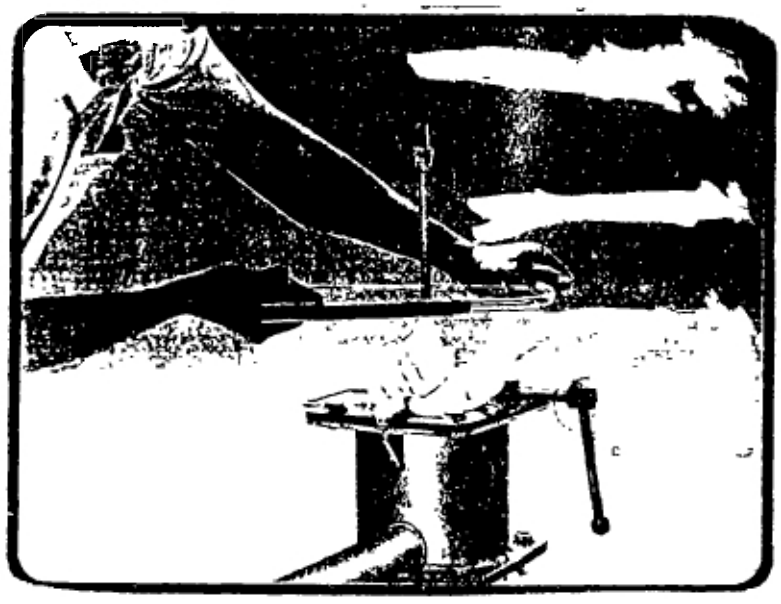
STEP 3

1. TIGHTEN THE CONNECTING ROD VICE.

2. UNSCREW THE CONNECTING ROD LIFTER.

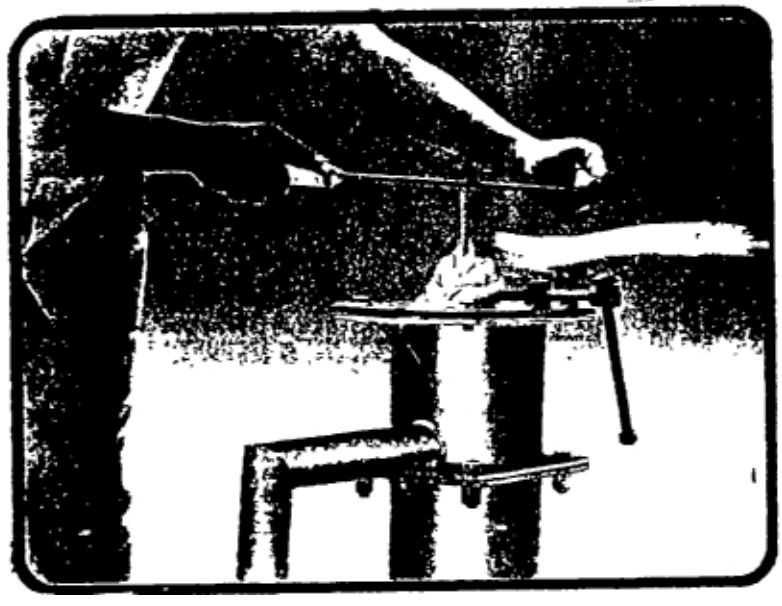
3. WRAP CLOTH AROUND TOP OF CONNECTING ROD VICE SO THAT METAL CUTTINGS DO NOT FALL INSIDE THE RISER PIPES.

4. CUT THE CONNECTING ROD AT THE MARK MADE EARLIER.



STEP 4

FILE THE TOP AS WELL AS THE EDGES OF THE CONNECTING ROD SMOOTHLY.



STEP 5

CHECK THREADS WITH CHECK NUT. YOU MUST BE ABLE TO SCREW THE NUT ALL THE WAY DOWN BY HAND

1. THREAD TOP OF CONNECTING ROD UPTO 45 MM LENGTH WITH M 12 ROD DIE SET. MAKE SURE THE THREADS ARE CLEAN AND TRUE.

2. LUBRICATE THE ROD WITH OIL WHILE CUTTING THREADS.

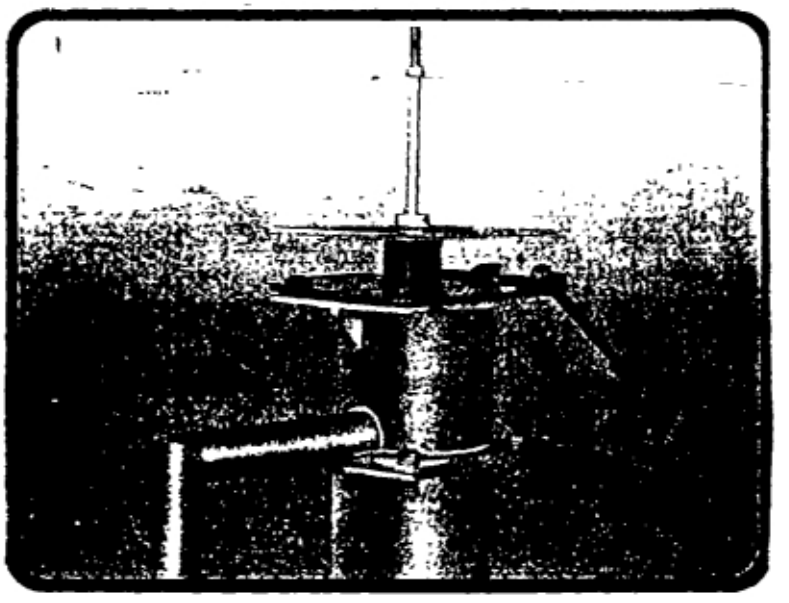
STEP 6

REMOVE THE METAL CUTTINGS AND CLOTH.

INSERT THE MIDDLE FLANGE INTO THE CONNECTING ROD.

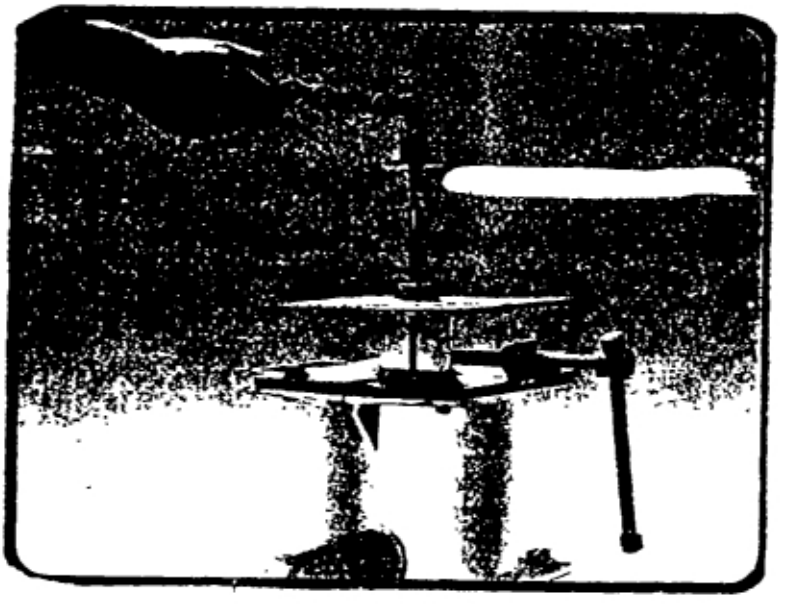
STEP 7

1. ALLOW MIDDLE FLANGE TO REST ON TOP OF CONNECTING ROD VICE.
2. FIX THE CHECK NUT ON THE CONNECTING ROD AS SHOWN.



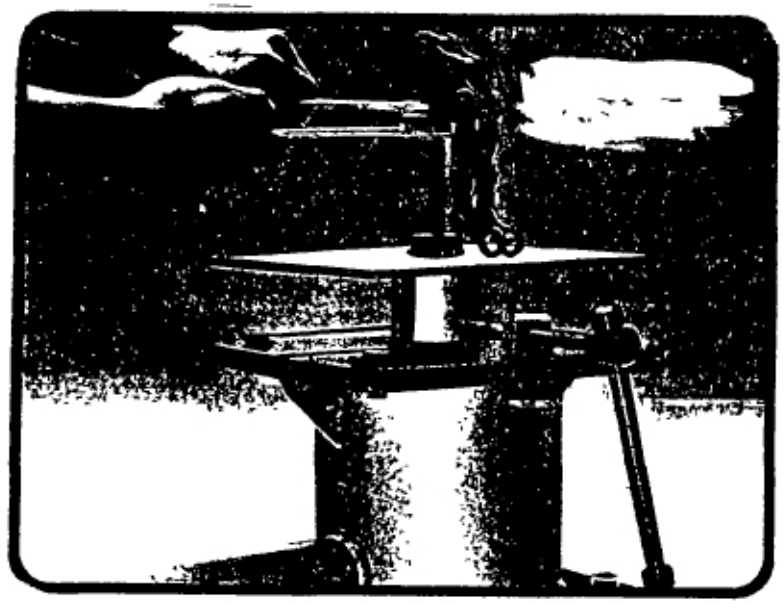
STEP 8

SCREW CHAIN COUPLER ON TO THE CONNECTING ROD THREADS BY HAND.



STEP 9

TIGHTEN CHECK NUT IN THE CONNECTING ROD WITH THE CHAIN COUPLING USING M 17 X M 19 DOUBLE ENDED SPANNERS.

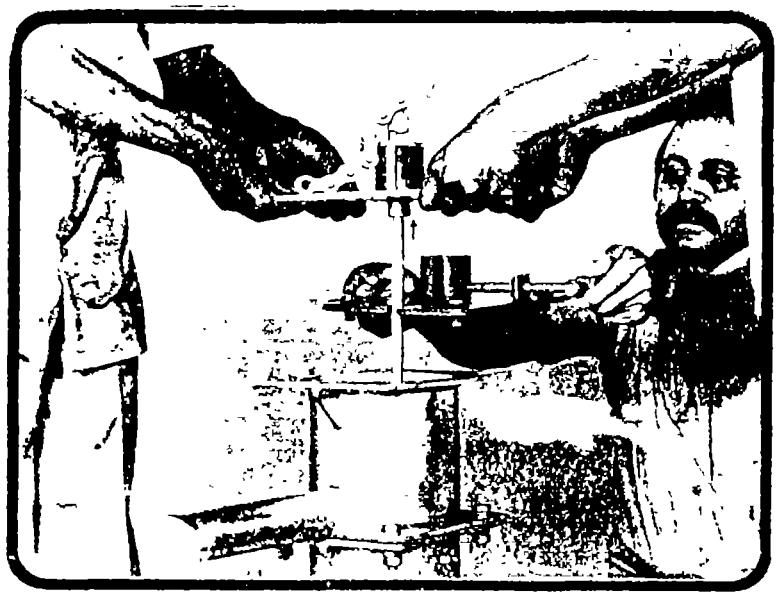


STEP 10

1. INSERT CHAIN COUPLER SUPPORTING TOOL BELOW THE CHAIN COUPLER AS SHOWN.

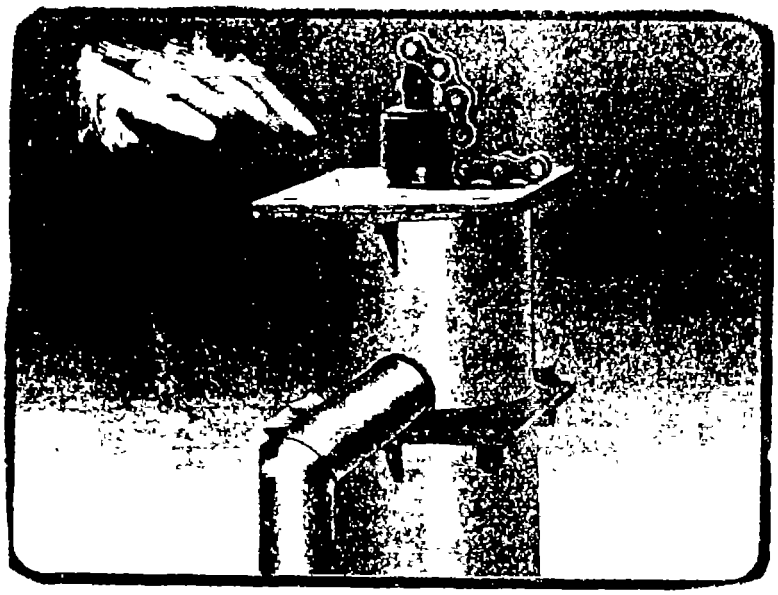
2. LIFT THE MIDDLE FLANGE AS SHOWN.

3. LOOSEN AND REMOVE CONNECTING ROD VICE.



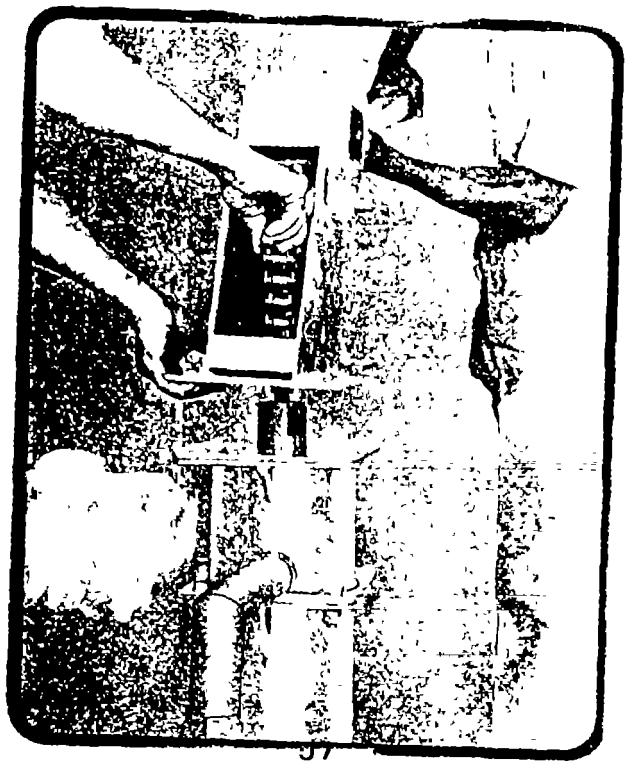
STEP 11

NOW SLOWLY LOWER THE MIDDLE FLANGE ON TOP OF WATER TANK AND ENSURE THAT ALL FOUR CORNERS COINCIDE.



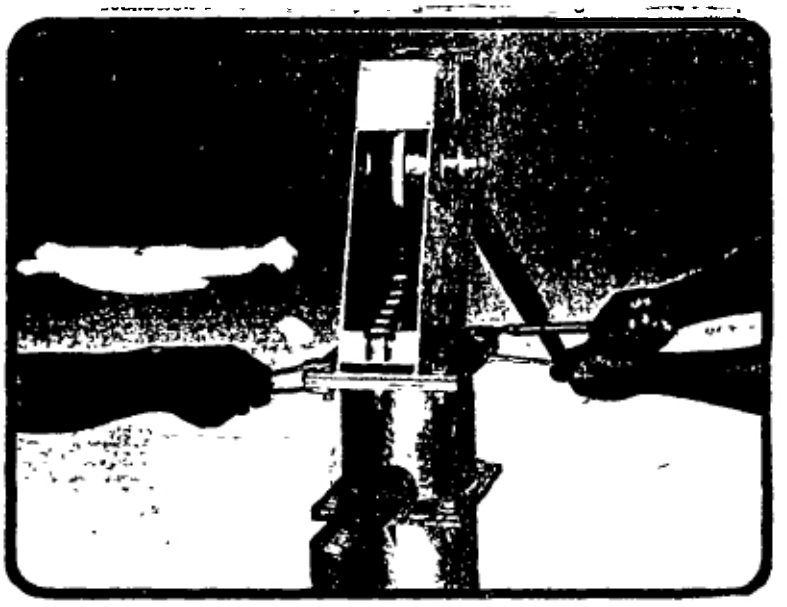
STEP 12

HOLD HEAD ASSEMBLY AS SHOWN. INSERT CHAIN INTO HEAD THROUGH 75 MM DIA HOLE IN THE BOTTOM FLANGE, LOWER HEAD ON TOP OF MIDDLE FLANGE. ENSURE ALL FOUR CORNERS COINCIDE.



STEP 13

TIGHTEN HEAD, MIDDLE FLANGE AND WATER TANK WITH BOLTS AND NUTS.

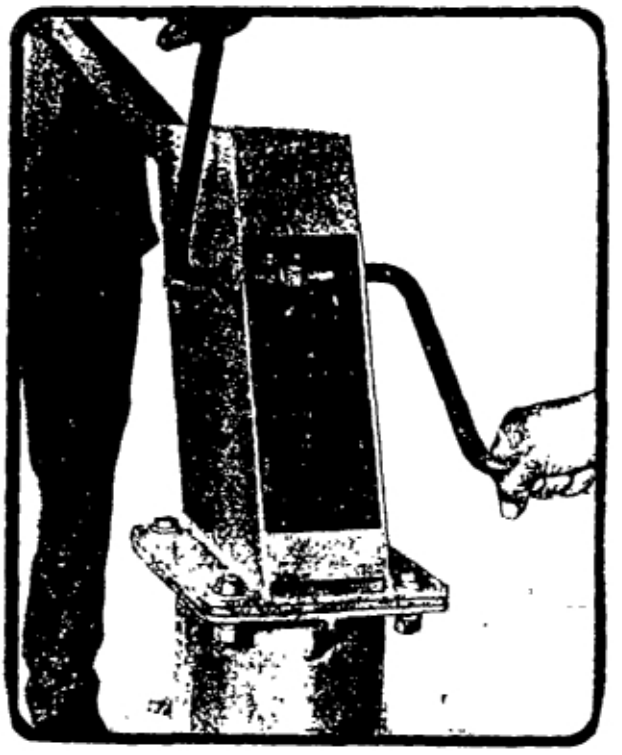


STEP 14

1. LIFT THE HANDLE UP AS SHOWN.
2. FIX FREE END OF CHAIN WITH HANDLE.

STEP 15

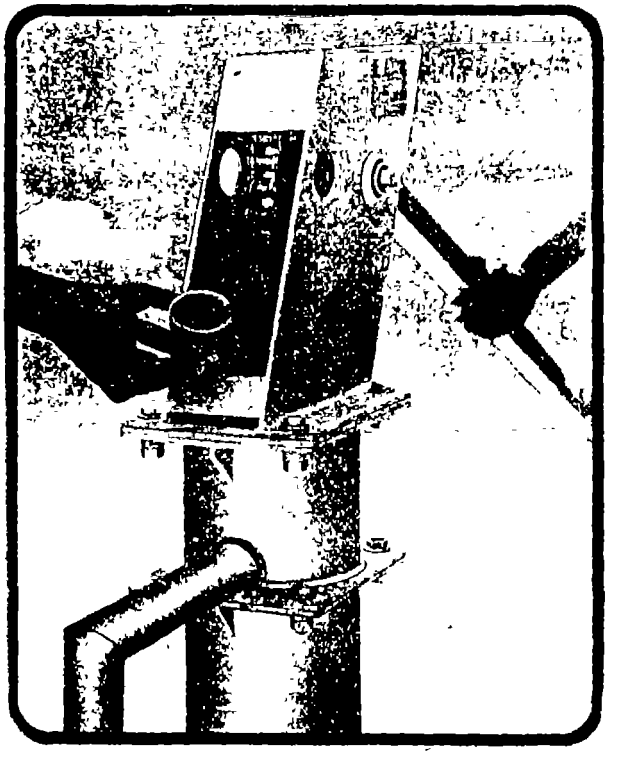
TIGHTEN NYLOC NUT WITH CRANK SPANNERS.



STEP 16

1. LOWER DOWN HANDLE.

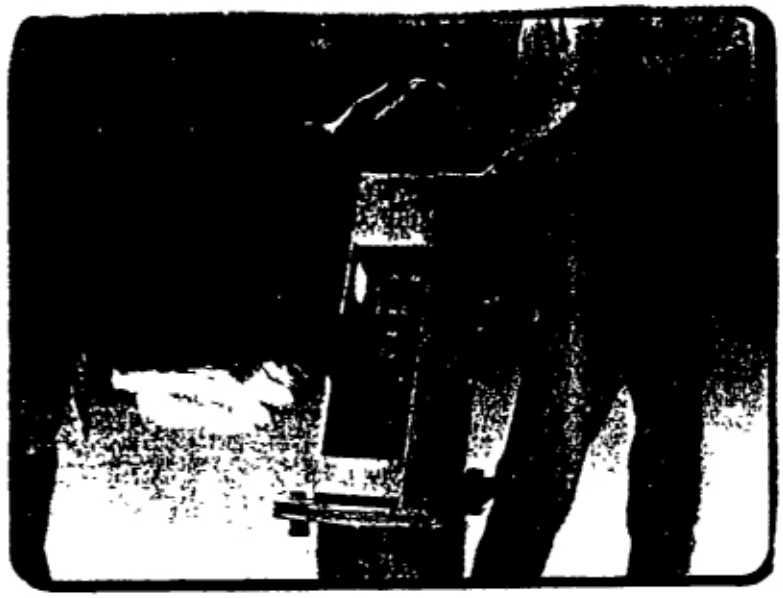
2. REMOVE CHAIN COUPLER SUPPORTING TOOL.



STEP 17

1. LIFT HANDLE UP.

2. APPLY GRAPHITE OR MULTI PURPOSE GREASE ON CHAIN.



STEP 18

1. FIX INSPECTION COVER.

2. TIGHTEN COVER BOLT FULLY BY CRANK SPANNER.

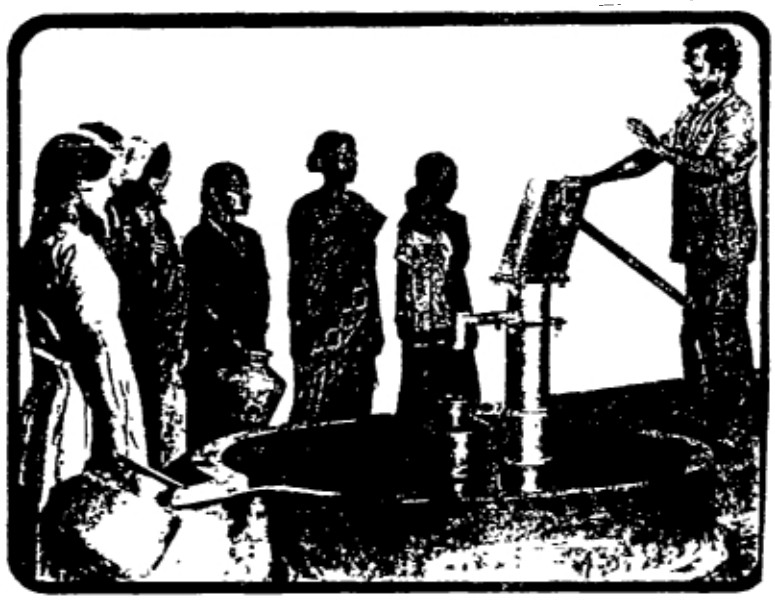
STEP 19

EXPLAIN OPERATION OF THE HANDPUMP TO VILLAGERS.

* *Use the handpump gently.*
* *Operate the handle with long slow strokes without touching the top and bottom of the bracket.*
* *Operate the handle by holding it at the end.*
* *Keep the surroundings of the platform clean and dry.*
* *Any washing should be done at least 5 meters away from the handpump.*
* *Use waste water for irrigation.*
* *Clean the platform regularly.*
* *Donot misuse the handpump in any manner. The handpump belongs to the community, they must look after it.*

MAKE SURE THAT.....

- *When you pump, handle touches top and bottom stops of bracket. If it does not, remove head and check setting of connecting rod stroke length. [Refer step (8)]*
- *Connecting rod moves up and down freely in guide bush. If it does not, the rod must have got bent while threading. Check the rod.*
- *You have threaded chain coupler fully on the connecting rod and have tightened the lock nut.*
- *You have tightened handle axle nut and lock nut completely and handle axle is firmly retained.*
- *You have tightened chain anchor bolt and nyloc nut fully.*
- *All the eight flange bolts and nuts are tight and you have also tightened the lock nuts.*
- *You have left nothing inside the head.*



FINAL CHECK LIST

Before you leave, have you.....

* Explained to villagers about the importance of handpump for their health?

* Purged the tubewell surroundings?

* Checked quality and taste of water?
The water of the well should be tested for bacteriological and chemical contents before installation/commissioning the handpump. Flouride enriched water source may be carefully evaluated prior to commissioning and after ascertaining the flouride content to be within the permissible limit of < 1.5 ppm. Alternatively, flouride treatment units may be installed alongwith the handpump.

* Explained to villagers that water from handpump may taste different or strange? You must explain that they should still drink it, because this water is safe. They will get accustomed to the new taste soon.

* Given the village handpump caretaker and WATSAN committee members the address of your office, so that they can inform you of pump breaks down?

* Made a note of any problem with tube/borewell or hand pump, so that you can report the same to the higher officials and take necessary action?

* Explained to the WATSAN committee/villagers that the water of the handpump should be tested at least twice a year, preferably soon after the rains and whenever any pollution is suspected?

MAINTENANCE & OVERHAUL

INTRODUCTION

The rural water supply programme has achieved significant progress in terms of coverage through the installation of India Mark II handpumps. Although sturdy, this handpump needs preventive and curative maintenance.

India Mark II deepwell hand pumps should be properly and regularly maintained to ensure continuous supply of safe drinking water. This will prevent breakdowns and ensure continuous working of the hand pumps.

India Mark II handpump is like any other machinery. Any machine is to be kept clean, if for no other reason than that, in cleaning, all parts are inspected for formation of rust, insufficient lubrication, loose bolts, nuts, etc. and also for missing parts in time to prevent major failures.

PREVELANT HANDPUMP MAINTENANCE SYSTEMS

Handpumps are the most widely accepted technological option for community water supply. While the India Mark II handpumps are reliable, robust and efficient pumps, like any other machine, they require a certain level of maintenance to function without breakdown. The different handpump maintenance systems prevailing in India are :-

1. Three Tier Maintenance System :

   The organisation of this maintenance system with 3 levels or tiers of functionaries gives the system its name. It was the first institutionalised attempt at involving the users in the maintenance of hand pumps. Essentially, the system proposes the following three tiers :

   i. A village level voluntary Caretaker identified by the implementing agency from among the nearby users of the pump. This caretaker is trained for conducting preventive maintenance, keeping the handpump surroundings clean and motivating the users to handle the pump properly. She/he also reports any event of breakdown to the higher level of the system through a pre-printed post card.

   ii. At the second tier is the Block Mechanic who looks after all the pumps in the block. His duty is to visit all pumps regularly and to undertake minor repairs of the above ground components. In case a major repair

of the below-ground assembly becomes necessary, he too reports such repair needs to the next higher level.

iii. At the district level, the Mobile Maintenance Team constitutes the third tier and is expected to look after all the handpumps in the district. Being equipped with a vehicle and 5 workers, the mobile maintenance team undertakes all major repairs as and when necessary.

The operation of this system hinged on a crucial functionary, the village level handpump caretaker. It has been assumed, wrongly in most cases, that the voluntary Caretakers could be easily recruited and motivated to carry out simple preventive maintenance and communicate the need for repairs.

Independent evaluations of the functioning of the 3-tier system have invariably identified absence and shortage of Caretakers as one of the main reasons why the Three Tier System has not functioned effectively. Unrealistically high workload on Block Mechanics and the Mobile Team and improper work programming have often resulted in unusually high down-time, once a pump had broken down.

2. One Tier Maintenance System :

The search for an alternative system had begun soon after the introduction of the Three Tier System based upon its visible drawbacks and because of a growing belief that rural people could be empowered and enabled to maintain their own handpumps. The first such attempt was made by the Social Work and Research Centre (SWRC), a voluntary organisation based at Tilonia, Rajasthan. It was based upon a conviction that people who were users of handpumps, were capable of maintaining them.

If illiterate villagers could repair electric and diesel pumps, tractors and other agricultural implements which were much more sophisticated machinery than a hand pump, the actual repair task could be demystified and no skills needed to be imported from the district level to keep the pumps going. A village based Handpump Mistry - HPM could replace all the 3 tiers. The idea of a Handpump Mistry was based on the premise that unemployed rural youth from economically poor families could be identified based on their mechanical aptitude and their skills upgraded by training so that they would undertake most common repairs necessary for a handpump.

This system had many advantages in terms of the ready availability of the HPM to the community and use of local skills in maintenance & repair. However, in the process of large scale implementation, it had its own problems including the identification of the right person as the handpump mistry; and bottlenecks in

the provision of spare & tools to the handpump mistry.

3. Two Tier Maintenance System

In many States, this maintenance system went under the name of the Two Tier System and took different forms in different places. Most Two Tier Systems attempted to eliminate the need for Caretaker by increasing the numbers of Mechanics and Mobile Maintenance teams and decentralising them. These actions eliminated the need for the facing the difficult, unfamiliar (and more importantly, non-technical and non-engineering) task of recruiting and motivating Caretakers. Many a time, these modified versions of the Three Tier system completely did away with any semblance of community involvement sometimes.

The village based artisans such as blacksmiths, carpenters and cycle mechanics etc., after receiving training, necessary tools and spare parts, could take care of essential preventive maintenance and regular repair needs of about 20 to 25 pumps. They would need to be backed up and monitored by a second tier consisting of a Junior Engineer and his maintenance crew at the block level.

COMMUNITY BASED HANDPUMP MAINTENANCE

The Community Based Handpump Maintenance System, is a strategy for ensuring sustenance of the water supply through the handpump at the village level. It is a mechanism for planning, operating and maintaining the installed handpumps within the village itself. In a community based maintenance system -

the accountability for operation and maintenance of the handpumps shifts from the government implementing department to the community and its representatives;

the skills necessary for the maintenance are transferred to the representatives of the community through training;

Self sustainability for the water system in terms of the spare part procurement and servicing cost is ensured through contributions from the user groups.

Under this system of maintenance, the user groups select representatives to form a WATSAN committee. The WATSAN committee undertakes the responsibility of management, preventive maintenance as well as repair of the handpumps installed. It collects contributions from the users and uses the money to buy spares required for repair & maintenance.

The accountability for operation and maintenance lies with the WATSAN committee. Self-sustainability in terms of procurement of spares and servicing cost is ensured through contributions from user groups. It is the responsibility of the WATSAN committee to contact the mobile maintenance team incase of handpump breakdown.

User representatives are selected by the WATSAN committee to undertake preventive maintenance of the handpumps. The handpump caretakers are trained within the village to undertake repair of the above ground components of the installed IM II handpumps. The caretakers work under the overall responsibility of the WATSAN committee. The skills necessary for maintenance & repair are transferred to the community representatives (caretakers) through training.

The process of sensitizing the people in the community and mobilizing them for community based maintenance is achieved through a motivational campaign or a Village contact drive. The village contact drive is conducted to initiate the formation of the WATSAN committee.

A village contact drive comprises of planned series of activities at the village level directed towards creating awareness, stimulating enquiry and initiating action from within the communities. During the contact drive people are motivated to come together, take collective action and secure decisions in their own favor.

During village contact drives the following activities are undertaken as part of social mobilization. These activities are directed to culminate in the formation of a village WATSAN committee for community based maintenance.

* Collection of baseline information about the village by contacting people's representatives and governmental functionaries including school teachers and anganwadi workers.

* Awareness creation through - organization of rallies around the village with participation of children, shouting slogans related to messages on safe water and hygiene practices, writing slogans and wall paintings in the whole village, pasting educational posters at vantage points, organization of drama, puppetry shows, bhajan mandalis and other communication activities in the evening with the involvement of local people.

* Participatory needs assessment through organization of village corner/mohalla meetings, village mapping etc. to initiate discussions among the people for formation of WATSAN committee.

Role of women

Studies conducted all over the world have shown that women are the water carriers and handlers in most societies and by virtue of their domestic functions are the managers of water at the household level. They are also the principle influencer of the family's sanitary habits. A women's perspective can, therefore, contribute a great deal to the better planning, functioning and utilization of the improved facilities, especially when they are made aware of the linkages existing between safe water and health and are provided with appropriate training and support.

Women are more than target groups. They are active agents who can contribute to decision making, generation of ideas, mobilizing labor, providing resources, and disseminating and implementing innovations. By involving women in the planning, operation and maintenance stages, the community water supply projects can be expected to be more effective in achieving their objective of sustaining availability of safe water for better health. Moreover, the active participation of women leads to improvement in their status in society as also generates appreciation for their role in development.

Women can participate in the implementation of community water supply projects and contribute to decision-making by providing information on :

- locations for facilities that are convenient for women;
- schedules for using facilities that fit women's work patterns or time use;
- design of technologies that suit women and are easy for women to use.

In addition, women have the potential to provide preventive maintenance and to repair any malfunctioning in the water supply facility, thus ensuring sustained water supply to the community.

STRUCTURE

PANCHAYAT LEVEL

WATSAN Committee

One committee per panchayat.
7-8 members including 3-4 women members.

Selection criteria

Is a resident of the community.
Preferably a woman from the user community.
Has leadership qualities.
Is willing to undergo training.
Is able to read and write.
Is inclined to serve the community voluntarily.
Willing to make themselves free and work without financial compensation.

Handpump Caretakers

Woman user representative per handpump.
Member of WATSAN committee.

Selection criteria

Preferably a woman from the user community.
Is a permanent resident of the village.
Preferably is literate and motivated to undertake the activity.

BLOCK OR DISTRICT LEVEL-

Back-up Maintenance and Monitoring Team

A master mechanic and two helpers.
Tools to carry out major replacements/repairs

RESPONSIBILITIES

The roles and responsibilities of different components of the community based handpump maintenance system are :

WATSAN committee members

* Select the user representatives/village handpump caretakers for the handpumps installed and coordinate their training with the implementing department.

* Open an account in the bank or post office to deposit contributions from users of the handpump.

* Collect contribution for maintenance of handpumps from the users through the panchayat and keep record of income and expenditure on maintenance.

* Procure spares and tools needed for the maintenance and repair of the handpumps from the implementing department or the local market, pay for them through the contributions collected and keep record of their use.

* Promote health and environmental sanitation activities in the village through village meetings, organizing clean village drives and other motivational programmes in liaison with the government departments.

* Take responsibility for village sanitation and undertake activities to maintain a clean environment around the handpump and in the village.

* Inform the backup maintenance team if the handpump breakdown is beyond the capability of the village handpump mechanic.

Village handpump caretaker

* Undertake preventive maintenance of the handpump.

* Ensure the surroundings of the handpump and platform are clean.

* Act as a motivator to promote health and hygiene practices, proper use of the handpump and sanitation in the village.

* Inform the WATSAN committee regarding the repair needs of the handpump.

GUIDE LINES FOR MAINTAINING HAND PUMPS

* Clean the platform regularly.
* Keep the surroundings of the platform clean and dry.
* Ensure that no rubbish is thrown near the pump.
* Keep the drain always clean.
* Make the soak pit away from the pump.
* Keep animals away from the pump and make compost far away from the pump.
* Grease the chain regularly.
* Check the chain bolt and nut very often to ensure that they are in tact and not in loose condition.
* Check all the M12 bolts and nuts regularly to ensure that they are always tight.
* Check for any cracks around the pedestal in the platform and rectify immediately.

Backup maintenance and monitoring team

* Provide backup support to the WATSAN committee for carrying out the major repairs/replacements for all handpumps in the block.

* Maintain a supply of quality spare parts and tools to the committees, on payment, for handpump maintenance.

* Carry out water quality tests/analysis on all samples of handpump water in the block periodically.

* Monitor the activities of the WATSAN committee. Incase the committee of a particular village is inactive, mobilize the people for selection of a new set of members for the committee.

* Monitor the working of the caretakers and mechanics. Incase they are not performing their duties adequately, initiate the selection and training of another caretaker/mechanic within the village.

The following schedule of maintenance is recommended for mobile maintenance teams to carry out once a year:

[A] Examine the pump carefully and check whether:

* Water discharge is satisfactory.
* Handle is shaky.
* Guide bush has excessively worn out.
* All bolts, nuts and washers are in position.
* Chain has worn out.
* Chain guide is excessively worn out.

[B] Pull out the pump and follow the instructions given below:

* If chain, bearings and spacer are damaged, replace them.
* If handle guide is badly worn out, replace handle assembly.
* If any pipes are damaged replace them.
* Replace Cup washers, 'O' ring, sealing rings or any other part found defective in cylinder.
* Check the condition of water tank riser pipe holder. If threads are worn out replace water tank.
* Check all sub assemblies for crack in weld and other visual defects. If defects are serious replace sub-assemblies.
* Reinstall the pump as per instructions given in this manual.
* If the pump is painted, then paint the pump head inside/outside with the recommended colour after cleaning/sending the surfaces.
* If the pump is fully galvanised, wash the surface with clean water.
* Never apply emery paper to clean galvanized surfaces.

PREVENTIVE MAINTENANCE

However, regular maintenance procedures are equally necessary for a long life of the handpump. The care taker should check on a routine basis the following -

* the pump pedestal is firm on its base. If it is loose arrange for fresh foundatlon by reporting to the appropriate higher authority, before the pump and foundation are damaged.

* water discharge is satisfactory [i.e.] whether it is as usual, little or delayed.

* the handle is easy or difficult to operate.

* all the eight flange bolts and nuts are tight.

* handle axle nuts are tight.

* handle chain nyloc nut is tight.

* the chain is lubricated. If not, apply graphite or multipurpose grease.

* the inside of the pump is free from trash or dirt.

CURATIVE MAINTENANCE

Curative maintenance of the below ground assembly is carried out by the maintenance team. The procedure for dismantling of the handpump includes -

1. Loosen pump head cover bolt and remove inspection cover.
2. Lower the handle and insert chain coupler supporting tool.
3. Lift handle to top position to loosen nyloc nut and remove nyloc nut, washer and anchor bolt.
4. Pull out chain from the handle.
5. Loosen flange bolts and nuts of the pump head and water tank. Remove them.
6. Remove chain coupler supporting tool.
7. Lift and remove head assembly leaving chain behind through 75 mm dia hole in bottom flange.
8. Lift connecting rod by holding middle flange. Insert connecting rod vice on water tank top flange and tighten the same.
9. Gently place middle flange on the vice.
10. Loosen and remove chain assembly from connecting rod. Remove check nut and remove middle flange.
11. Screw tank pipe lifter on to water tank coupler and hold it with pipe lifters.
12. Use the pipe lifters to raise the water tank and insert the self locking clamp to hold the riser pipe.
13. Tighten four bolts and nuts holding the clamp.
14. Unscrew the water tank by rotating it anticlockwise.
15. Remove the water tank.
16. Tighten rod lifter to the connecting rod.
17. Press self locking clamp jaws to raise up the riser pipe. Lift the pipes and connecting rod upto the coupler.
18. Lock riser pipe and connecting rod by releasing the self locking clamp.
19. Insert one pipe lifter into the bush of self locking clamp and lock lower pipe with wrench as shown.
20. Unscrew the pipes using another pipe wrench. Raise pipe and unscrew the connecting rod with connecting rod spanners. (Donot use pipe wrench).
21. Repeat the process of raising the pipes and connecting rods and unscrewing them till the last pipe with the cylinder assembly.
22. Hold the last pipe firmly and remove the self locking clamp.
23. Raise the cylinder, last pipe and connecting rod from the bore/tube well.
24. Unscrew pipe and connecting rod from the cylinder assembly.
25. Dismantle the cylinder using pipe wrenches.
26. Dismantle the components of the check valve and plunger assemblies. Replace the damaged components.
27. Reassemble the cylinder and check that the piston assembly and check valve assembly are tight and properly assembled.

28. Join connecting rod to the plunger rod.

29. Screw last pipe to cylinder top cap using jointing compound and tighten fully. Wipe off excess jointing compound.
30. Lower the cylinder, last pipe and connecting rod into the bore/tube well.
31. Insert self locking clamp to hold the riser pipe.
32. Tighten self locking clamp with four bolts and nuts.
33. Join second connecting rod to the first connecting rod, tighten fully using connecting rod spanners. Apply jointing compound on the pipe threads.
34. Insert pipe lifting spanner into the bush of self locking clamp and lock bottom pipe with pipe wrench as shown.
35. Tighten the pipe.
36. Hold riser pipe with pipe lifters firmly. While lowering press handle of self locking clamp. Screw the next riser pipe with the first one. Use jointing compound at the joints and wipe of the excess jointing compound.
37. Lower down riser pipes gently with the help of pipe lifting spanners.
38. Continue lowering the pipe and connecting rod into the bore/tube well till the first pipe. (A standard installation has 8 pipes of 3 m length).
39. Fix the water tank to the top pipe, lock the pipe with a pipe wrench as shown and tighten the water tank to the top pipe.
40. Remove the bolts and nuts holding the clamp.
41. Withdraw the self locking clamp.
42. Hold the connecting rod down and check whether it is level with water tank top flange.
43. Lift the connecting rod by tightening the connecting rod lifter.
44. Insert and tighten the connecting rod vice.
45. Disconnect the rod lifter.
46. Attach the middle flange plate. Attach the checknut and tighten chain.
47. Place the chain coupler supporting tool.
48. Lift the middle flange and remove the rod vice.
49. Carefully place the middle flange on the water tank as shown.
50. Place the head assembly and tighten the flange nuts and bolts.
51. Lift handle to top position and tighten chain nyloc nut, washer and anchor bolt. Lower the handle and remove chain coupler supporting tool.
52. Fix the inspection cover and tighten the pump head cover bolt.
53. Take 50 or more strokes to fill up the raising main and to check whether the pump is working well in all aspects.

TROUBLE SHOOTING CAUSES - REMEDIES

	TROUBLE		CAUSE		REMEDY
1.	Pump handle works easily but no flow of water.	*	Worn out cylinder rubber cup washers.	*	Replace rubber cup washers.
		*	Valve seats worn out.	*	Replace valve seats.
		*	Connecting rod joint disconnected.	*	Pull out connecting rods and joln connecting rods wherever necessary.
		*	Water level gone down below cylinder assembly.	*	Add more pipes and rods.
2.	Delayed flow or little flow of water	*	Leakage in cylinder, check valve or upper valve.	*	Pull out plunger and check valve assemblies replace rubber seats.
		*	Worn out O ring.	*	Replace O ring.
		*	Rubber cup washers worn out.	*	Replace rubber cup washers.
		*	Damaged rising main.	*	Replace damaged pipe.
3.	Folding of chain during return stroke.	*	Rubber cup washers got jammed inside the cylinder.	*	Replace rubber cup washers.

4.	Noise during operation	*	Bent connecting rod.	*	Change defective rod.
		*	Shaky foundation	*	Check foundation and redo the same, if necessary.
5.	Shaky Handle	*	Loose handle axle nuts.	*	Tighten handle axle nuts.
		*	Worn out ball bearings	*	Replace ball bearings.
		*	Spacer worn out or damaged.	*	Replace spacer.
		*	Worn out/ damaged axle.	*	Replace axle.
		*	Bearings loose in bearing housing.	*	Replace handle assembly.

SPARE REQUIREMENTS

RECOMMENDED SPARES FOR TWO YEARS NORMAL MAINTENANCE
(Per Handpump)

The following spares are recommended for each India Mark II hand pump installed for two years normal maintenance.

SPARES FOR PUMP HEAD:

		QTY.
1.	Hexagonal bolts M12 x 1.75 x 40 mm long	8 Nos. x100
2.	Hexagonal nuts M12 x 1.75	18 Nos.
3.	Washers M12	10 Nos.
4.	High Tensile Bolt M10 x 1.5 x 40 mm long	1 No.
5.	Nyloc Nut M10 x 1.5	2 Nos.
6.	Handle axle [stainless steel]	1 No.
7.	Washer [4 mm thick] for handle axle	1 No.
8.	Bearing [6204 Z]	2 Nos.
9.	Spacer	1 No.
10.	Chain with coupling	1 No.
11.	Bolt for front cover M12 x 1.75 x 20 mm long	2 Nos

SPARES FOR CYLINDER:

1.	Nitrile rubber cup washers	4 nos.
2.	Upper valve rubber seating	2 nos
3.	Check valve rubber seating	2 nos.
4.	Rubber 'O' rings	4 nos.
5.	Rubber sealing rings	4 nos.

SPARES FOR CONNECTING RODS AND G.I. RISER PIPES:

1.	Hexagonal rod coupling M12 x 1.75 x 50 mm long	2 nos.
2.	Pipe sockets (32 mm N.B. Medium grade hot dip galvanised)	4 nos.

NOTE: In addition to the above spares we also recommend the stocking of complete pumps to take care of sub-assembly replacement to the tune of 3% of the total number of pumps installed in the field.

NUMBERING OF HANDPUMPS

In order to identify the installations and keep record of the handpump maintenance, the Kardex system may be used.
The formats of the handpump installation card and the handpump maintenance card are given below.

ANNEXURES

TEST CHARACTERISTICS FOR DRINKING WATER

The table below indicates that potable water should meet various physico-chemical standards. The undesirable effect due to the presence of excessive concentration of various constituents is also summarized in the table. It can be seen the while excessive solids cause gastrointestinal irritations, the pH, chloride, mineral oil, phenol, etc. change the taste of water. The presence of even a trace quantity of heavy metal ions imparts toxicity to water. fluoride in excess concentration causes mottling of teeth and also disfigures the skeletons leading to "skeletal fluorosis". The presence of iron in the water which is normally observed in ground water besides imparting a brown colour to water also produces turbidity and enhances the growth or iron bacteria.

Besides, the physico-chemical standards the drinking water should also meet the bacteriological standard which is measured in terms of 'Coliform Court'. The bacteriologically safe water should be free from any pathogenic organism.

TEST CHARACTERISTICS FOR DRINKING WATER

Sr. No.	Substance or Characteristic	Requirement (Desirable limit)	Undesirable effect out-side the desirable limit	Permissible limit in the absence of alternate source	Remarks
A.	Essential Character-istics				
1.	Colour, Hazen Units, Maximum	5	Above 5, consumer acceptance decreases.	25	Extended to 25 only if toxic substances are not suspected, in absence of alternate sources.
2.	Odour	Unobject-ionable	-	-	a) Test cold and when heated. b) Test at several dilutions.

3.	Taste	Agreeable	Test to be conducted only after safety has been established	-	
4.	Turbidity	5	Above 5, consumer acceptance decreases	10	-
5.	pH value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and/or water supply system.	No relaxation	-

Sr No	Substance or Charact-eristic	Requirement (Desirable limit)	Undesirable effect out-side the dsirable limit	Permissible limit in the absence of alternate source	Remarks
6.	Total hardness (as $CaCO_3$ mg/1, Maximum	300	Encrustra-tion in water supply structure and adverse effects on domestic use..	600	-
7.	Iron (as Fe) mg/1, maximum	0.3	Beyond this limit taste and appearance are affected, has adverse effect on domestic uses and water supply structures and promotes iron bacteria	0.1	-
8.	Chlorides (as ClO) mg/1, Maximum	250	Beyond this limit, tast, corrosion and palatibility are affected.	100	-

9.	Residual, free chlorine, mg/1, Maximum	0.2	-	-	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required should be min. 0.5

TEST CHARACTERISTICS FOR DRINKING WATER

Sr No	Substance or Characteristic	Requirement (Desirable limit)	Undesirable Effect out-side the desirable limit	Permissible limit in the absence of alternate source	Remarks
B.	**Desirable Characteristics**				
1.	Dissolved solids mg/1, Maximum	500	Beyond this palatability decreases and may cause gastro intestinal irritation	2000	-
2.	Calcium (as Ca) mg/1, Maximum	75	Encrusta-tion in water supply structure and adverse effects on domestic use.	200	-
3.	Copper (as Cu) mg/1, Maximum	0.05	Astringent taste, discoloura-tion and corrosion of pipes, fittings and utensils will be caused beyond this.	1.5	-

4.	Manganese (as Mn) mg/1, Maximum	0.1	Beyond this limit taste and appearance are affected, has adverse effect on domestic uses and water supply structures	0.3	-

Sl. No.	Substance or characteristic	Requirement (Desirable limit)	Undesirable effect out-side the desirable limit	Permissible limit in the absence of alternate source	Remarks
5.	Sulphate (as SO4) mg/1, Maximum	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400	May be extended upto 400 provided (as Mg) does not exceed 30.
6.	Nitrate (as NO3) mg/1, Maximum	45	Beyond this metha emolobinemia takes place	100	-
7.	Fluoride (as F) mg/1, Maximum	1.0	Fluoride may be kept as low as possible. High Fluoride may cause fluorosis	0.002	-
8.	Phenolic compounds (as C6H5OH) mg/1, Maximum.	0.001	Beyond this, it may cause objection-able taste and odour	0.002	-
9.	Mercury (as Hg) mg/1, Maximum	0.01	Beyond this, the water becomes toxic	No relaxation	To be tested when pollution is suspected.
10.	Cadium (as Cd),mg/1, Maximum	0.01	Beyond this, the water becomes toxic	No relaxation	To be tested when pollution is suspected.
11.	Selenium (as Se), mg/1, Maximum	0.01	Beyond this, the water beomes toxic	No relaxation	To be tested when pollution is suspected.

TEST CHARACTERISTICS FOR DRINKING WATER

Sr. No.	Substance or Characteristic	Requirement (Desirable limit)	Undesirable effect outside the desirable limit	Permissible limit in the absence of alternate source	Remarks
12.	Arsenic (as AS), mg/1, Maximum	0.05	Beyond this, the water becomes toxic	No relaxation	To be tested when polluted.
13.	Cyanide (as CN), mg/1, Maximum	0.05	Beyond this limit, the water becomes toxic	No relaxation	To be tested when polluted.
14.	Lead (as pb), mg/1, Maximum	0.05	Beyond this limit, the water becomes toxic.	No relaxation.	To be tested when pollution.plumbosolvency is suspected.
15.	Zinc (as Zn) mg/1 Maximum.	5	Beyond this limit it can cause astgringent taste and an opalescence in water.	15	To be tested when pollution is suspected.
16.	Anionic detergents (as MBAS) mg/1, Maximum.	0.2	Beyond this limit it can cause a light froth in water.	1.0	To be tested when pollution is suspected.
17.	Chromium (as Cr6+) mg/1, Maximum.	0.05	May be carcinog-enic above this limit	No relaxation	To be tested when pollution is suspected.
18.	Polynuclear aromatic hydro-carbons (as pAH) mg/1, Maximum	-	May be carcinog-enic.	-	-

Sr. No.	Substance or Characteristic	Requirement (Desirable limit)	Undesirable effect out-side the desirable limit	Permissible limit in the absence of alternate source	Remark

19.	Mineral oil mg/1, Maximum	0.01	Beyond this limit undesirable taste and odour after chlorination takes place	0.03	To be tested when pollut-ion is suspec-ted
20.	Pesticides mg/1, Maximum.	Absent	Toxic	0.001	-
21.	Radioactive materials: a) Alpha emiters Bq/1 Max. b) Beta emiters pci/1, Maximum.	-	-		
22.	Alkalinity mg/1, Maximum	200	Beyond this limit taste becomes unpleasant	600	-
23.	Aluminium (as Al) mg/1, Maximum.	0.03	Cumulative effect is reported to cause dementia	0.2	-
24.	Boron, mg/1, Maximum	1	-	5	-
Refer IS : 10500/1991 for Drinking Water Specification					