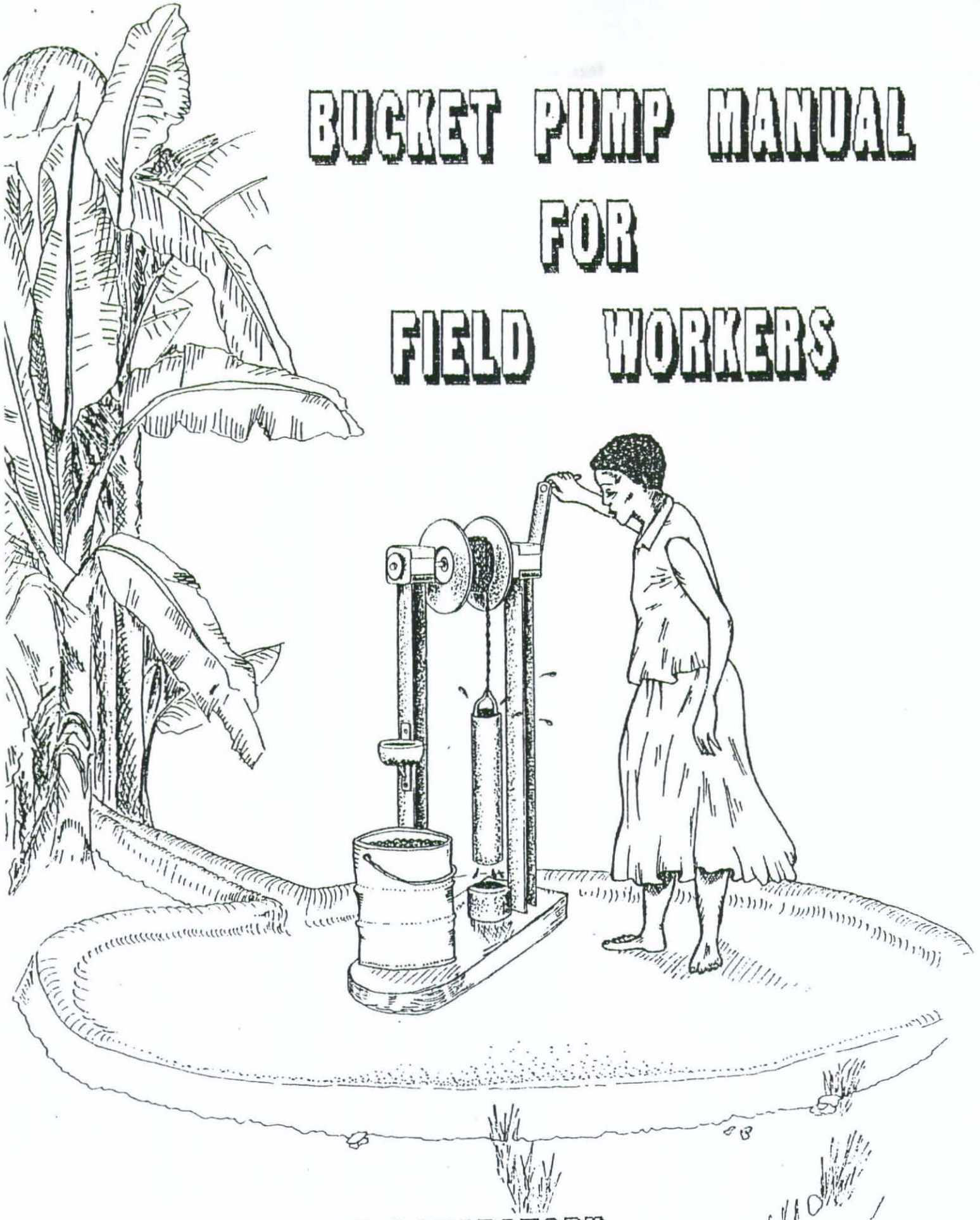
BUCKET PUMP MANUAL FOR FIELD WORKERS



BLAIR RESEARCH LABORATORY
MINISTRY OF HEALTH

BUCKET PUMP
AS MANUFACTURED BY
V. & W. Engineering (Pvt.) Ltd.

ACKNOWLEDGEMENTS

MANY PEOPLE HAVE BEEN INVOLVED WITH THE DEVELOPMENT AND TESTING OF THE BUCKET PUMP IN ZIMBABWE.

THE SUCCESSFUL CONVERSION OF THE ORIGINAL HAND MADE MODEL DESIGNED AT THE BLAIR RESEARCH LABORATORY INTO A DURABLE MASS PRODUCED MODEL IS THE RESULT OF THE COLLABORATION BETWEEN LABORATORY STAFF AND MR. ERWIN VON ELLING OF V & W ENGINEERING IN HARARE, WHOSE GREAT SKILL AND KNOWLEDGE ARE CLEARLY VISIBLE IN THE FINAL PRODUCT. I GREATLY ACKNOWLEDGE HIS EXCELLENT WORK.

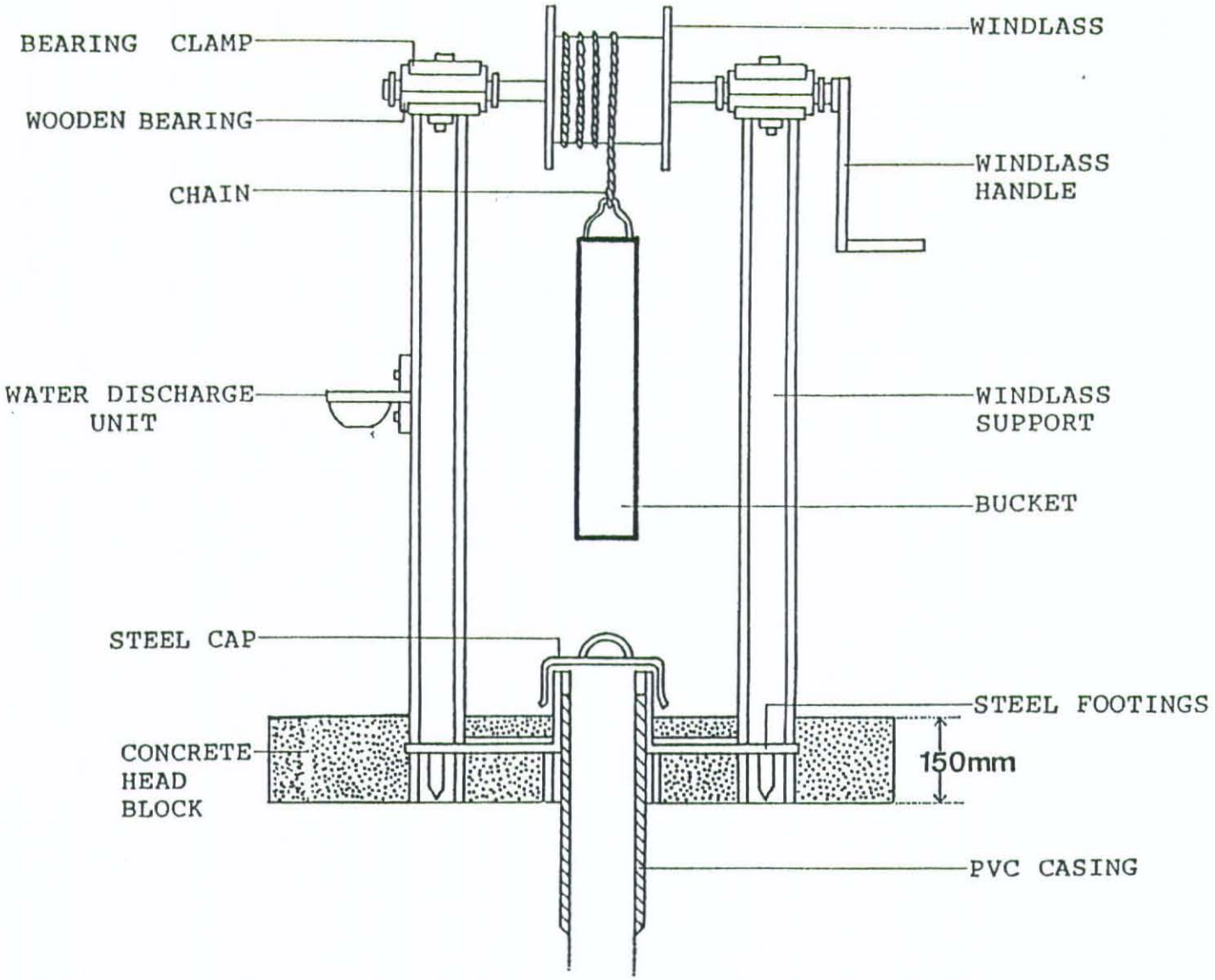
I ALSO WISH TO ACKNOWLEDGE THE STIRLING WORK CARRIED OUT BY THE PUBLIC HEALTH INSPECTORATE IN ALL PROVINCES WHO HAVE GREATLY ASSISTED IN TESTING AND EVALUATING THE BUCKET PUMP. IN PARTICULAR MUCH CREDIT IS DUE TO MR. DAVID PROUDFOOT AND HIS TEAM IN THE MASVINGO PROVINCE SUPPORTED BY GTZ, WHO UNDERTOOK PIONEERING INSTALLATIONS OF THE BUCKET PUMP IN THE RURAL SETTING AND PROVIDED THE VITAL EVIDENCE FOR SPONTANEOUS VILLAGE LEVEL MAINTENANCE OF THE PUMP.

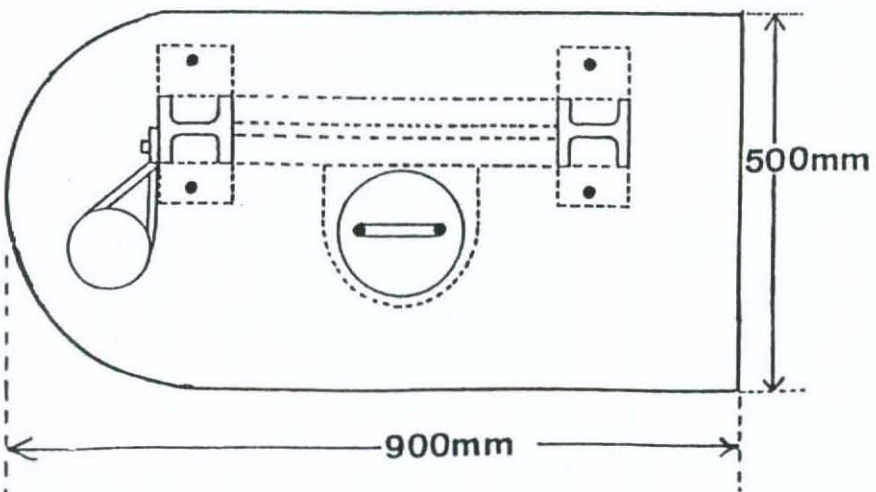
MOST OF THE ILLUSTRATIONS IN THIS MANUAL ARE THE WORK OF TALI BRADLEY WHO HAS PORTRAYED THE DESIGN AND INSTALLATION SO WELL. A FEW FIGURES ARE ALSO THE WORK OF KORS DE WAARD, WHOSE EXCELLENT ARTWORK HAS ILLUSTRATED A NUMBER OF MANUALS DEVELOPED BY MRS SUE LAVER. I GREATLY ACKNOWLEDGE THE CONTRIBUTION MADE BY ALL THESE PEOPLE IN THE PROMOTION OF EDUCATIONAL MATERIAL.

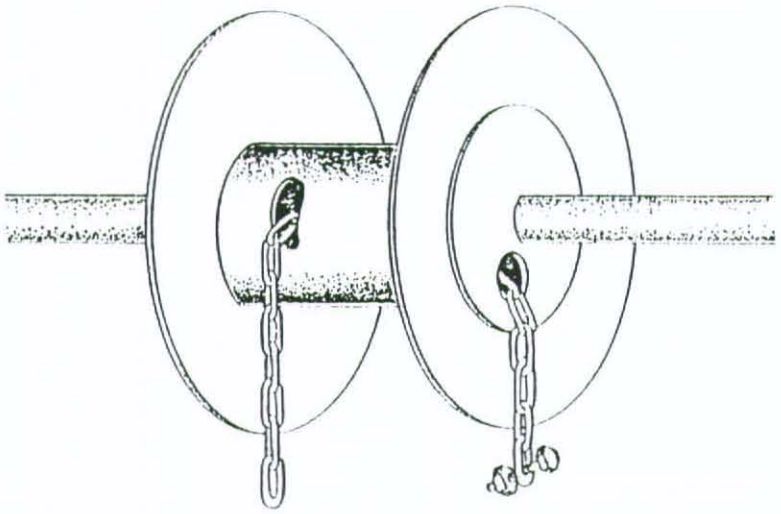
THE EARLY PIONEERING WORK AND BACTERIOLOGICAL TESTING OF THIS PUMP WAS CARRIED OUT BY DEDICATED STAFF OF THE BLAIR RESEARCH LABORATORY, WHOSE CONTRIBUTION IS GREATLY APPRECIATED.

PETER MORGAN
BLAIR RESEARCH LABORATORY
SEPTEMBER 1990.

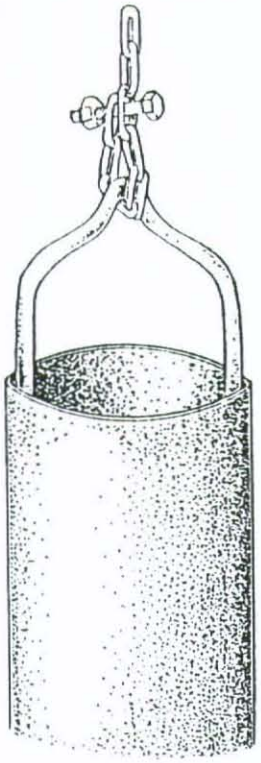
THE BUCKET PUMP





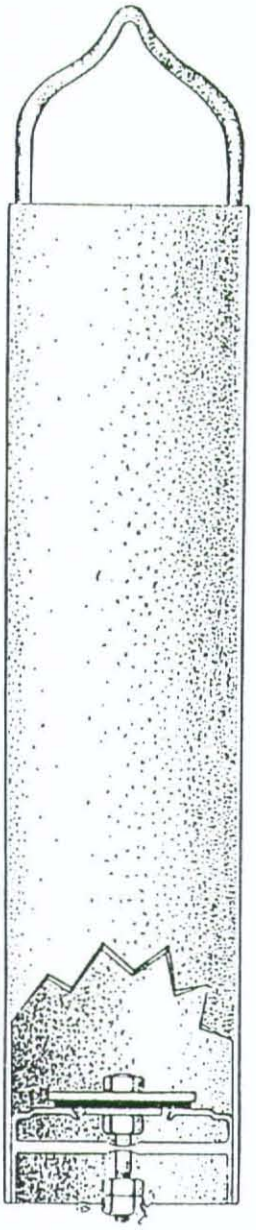


THE WINDLASS AND CHAIN

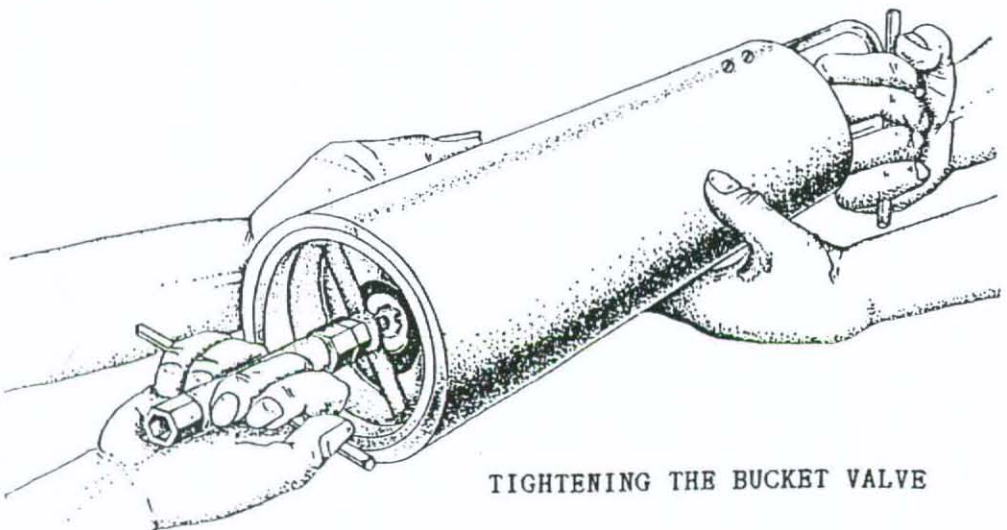


THE UPPER END OF
THE BUCKET

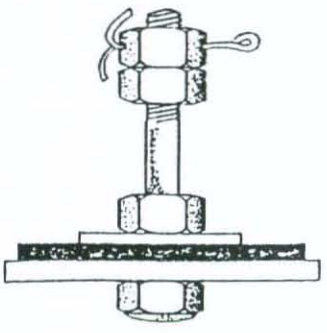
PARTS OF THE BUCKET PUMP



THE BUCKET WITH
CROSS SECTION VALVE



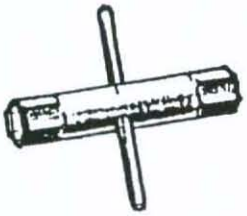
TIGHTENING THE BUCKET VALVE



THE BUCKET VALVE

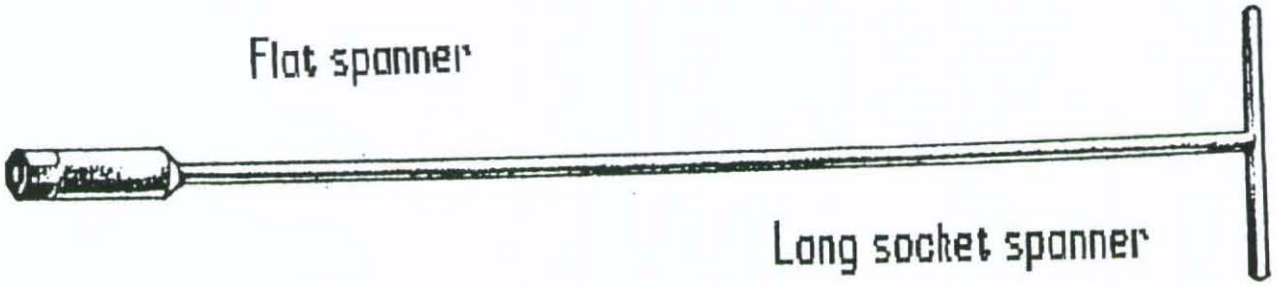
TOOLS AND MATERIALS

These tools are provided with the Bucket Pump.



Short socket spanner

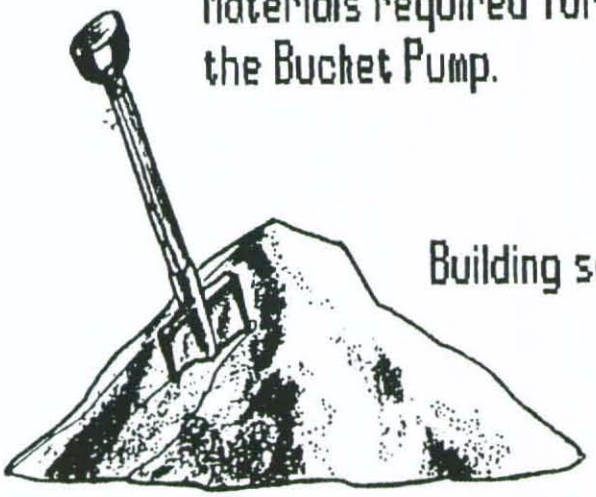
Flat spanner



Long socket spanner

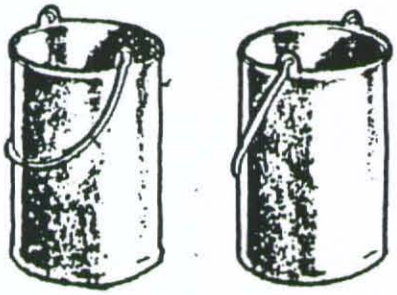
Materials required for fitting the Bucket Pump.

Cement (approx. 4 packets)

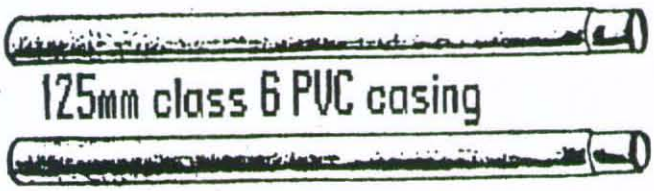


Building sand

Rocks and bricks for building apron, water run-off and drainage area.

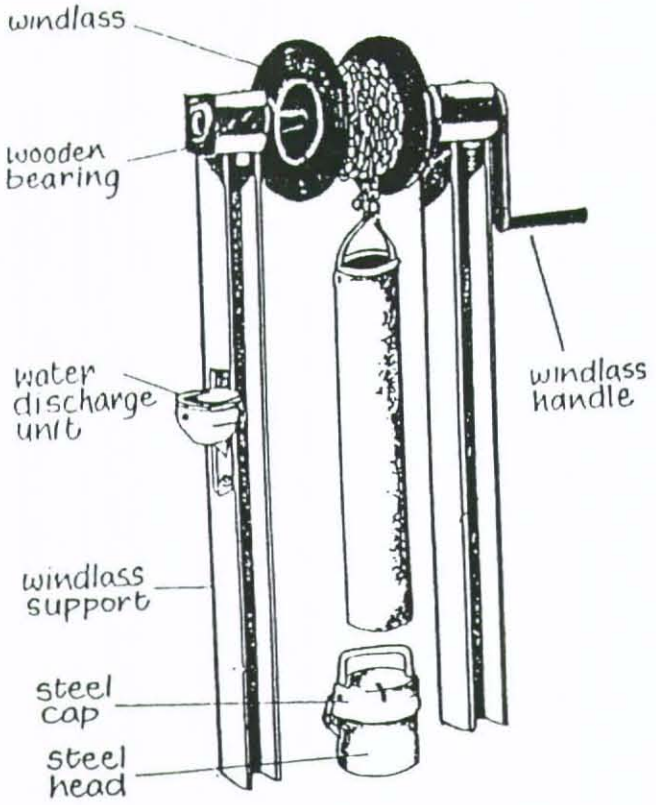


12 X 10 litre buckets full of small granite chips or gravel for gravel packing around casing



125mm class 6 PVC casing

INSTALLING A BUCKET PUMP ON A TUBEWELL



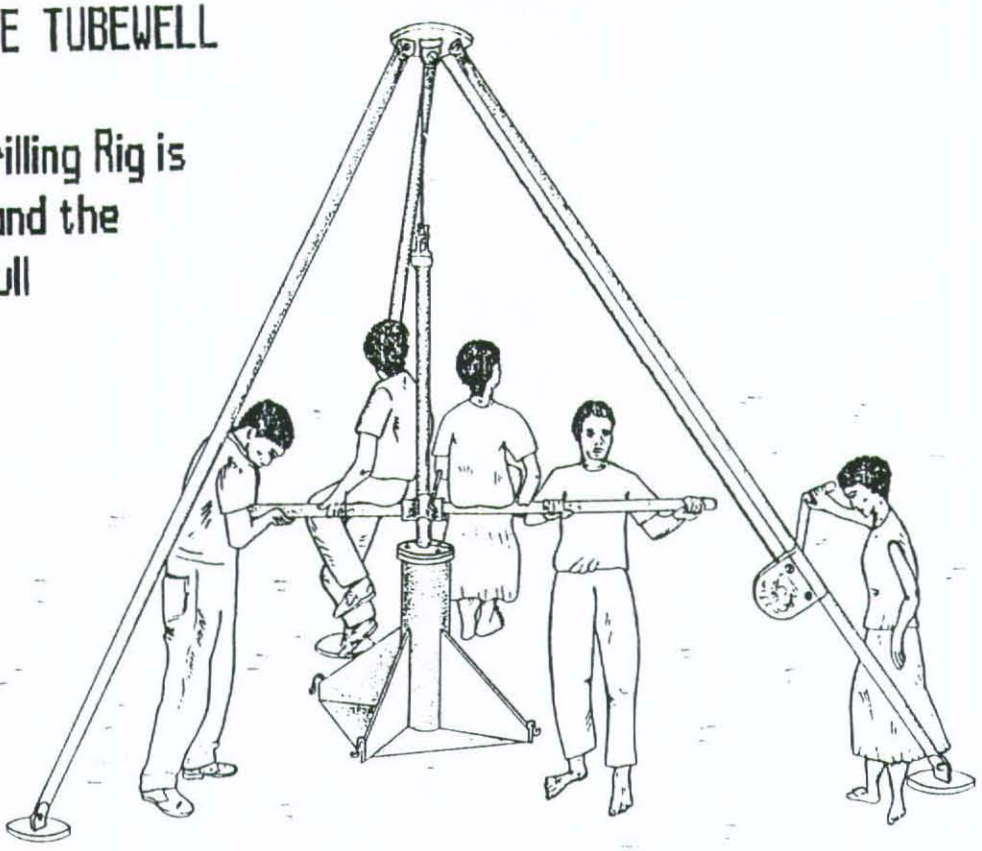
A Bucket Pump is used to raise clean water from the ground. A Tubewell is drilled by the community using a hand operated drilling rig. The tubewell is lined with PVC casing to prevent collapse. The pump is then fitted to the top of the casing. A drainage area and water run-off channel is then built around the pump. The community also assists by bringing sand, stone and gravel.

STAGE 1. SITING THE TUBEWELL

This should be sited in a raised position at least 30 metres from a latrine or cattle kraal. It is best placed close to where people live. Health Assistants and water diviners should assist in siting.

STAGE 2. DRILLING THE TUBEWELL

The hand operated drilling Rig is erected on the site, and the tubewell drilled with full participation by the community. Drilling should continue until at least 3 metres of water is found at the bottom of the hole.

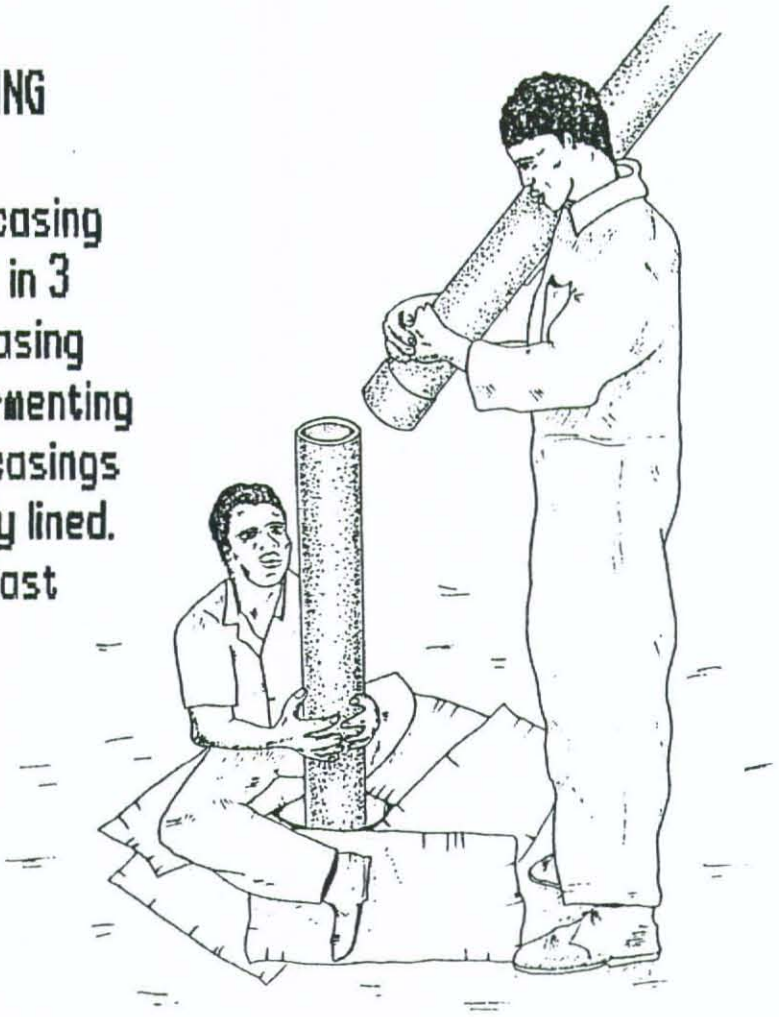


STAGE 3. ADDING GRAVEL

Once the hole has been drilled add auger full of fine gravel or 6mm granite chips carefully into the tubewell. The casing will bed down on this and allow water to pass from the ground into the casing.

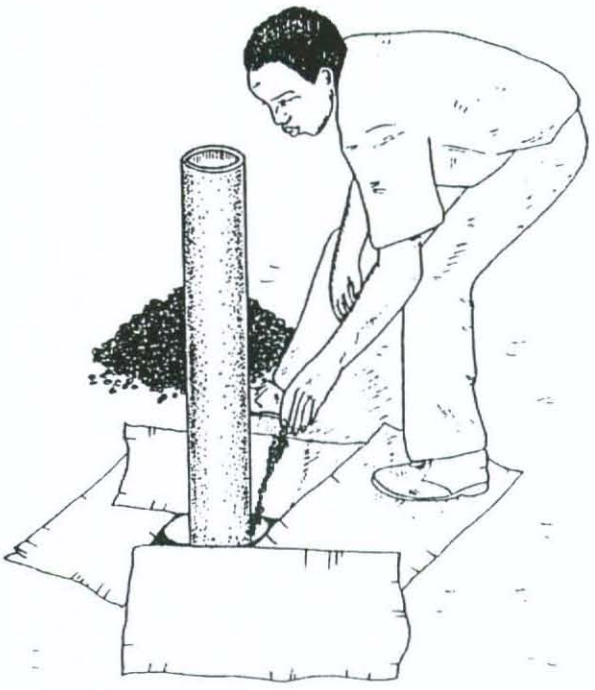
STAGE 4. ADDING THE PVC CASING

Unslotted 125mm class 6 PVC casing is used. These normally come in 3 metre lengths. Lower each casing centrally into the tubewell, cementing one casing to the next. Add casings until the tubewell is completely lined. Leave at least 250mm of the last casing above ground level.



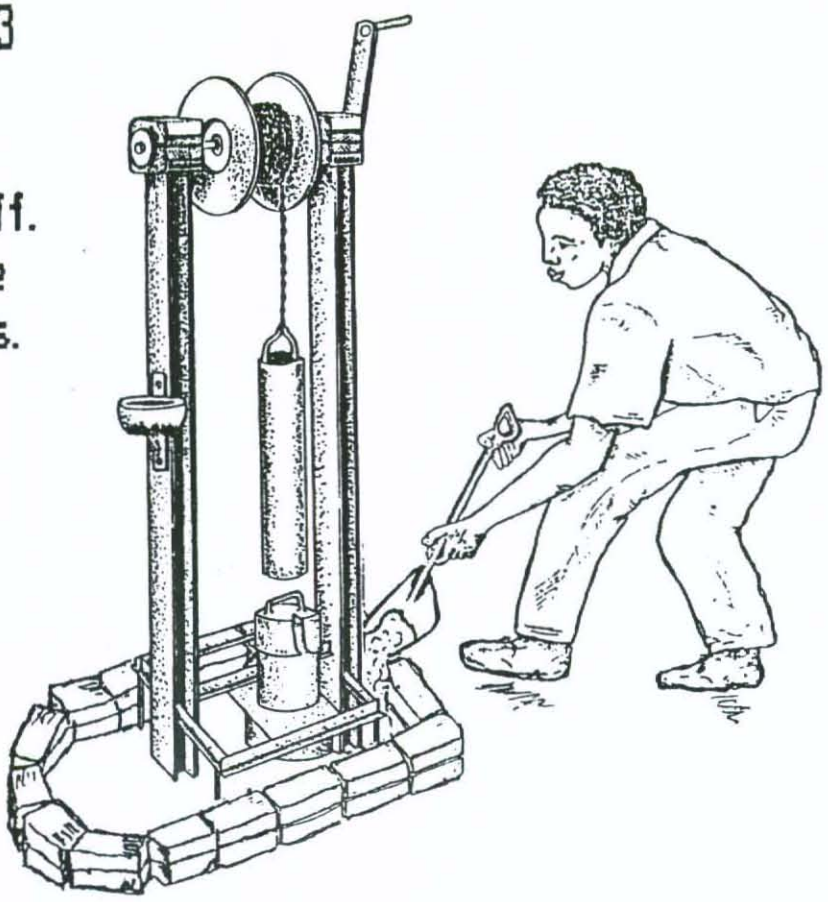
STAGE 5. ADDING THE GRAVEL PACK

Use well washed gravel chips to fill the space between the tubewell and the casing. These should be between 3mm and 6mm diameter. Add the gravel carefully until one metre below the ground level. Fill the last metre with a strong mixture of concrete and level off with the ground.

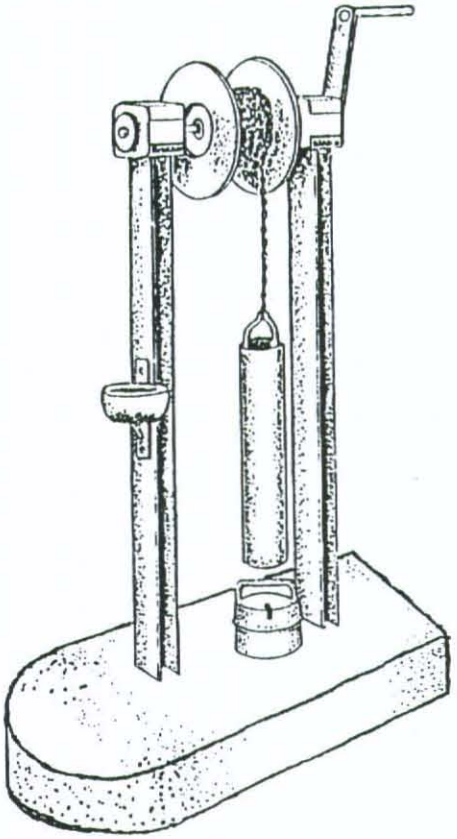


STAGE 6. MOUNTING THE BUCKET PUMP

Cut off the PVC casing straight 230mm above ground level. Mount pump over casing and ensure it is level. Take a number of bricks and arrange around the pump base to form a mould, so that a concrete base 750mm long, 500mm wide and 150mm deep is formed. Make a strong concrete mixture with 3 parts stone, 2 parts washed river sand and 1 part cement. Add into the mould and level off. This should be allowed to cure and kept wet for several days.

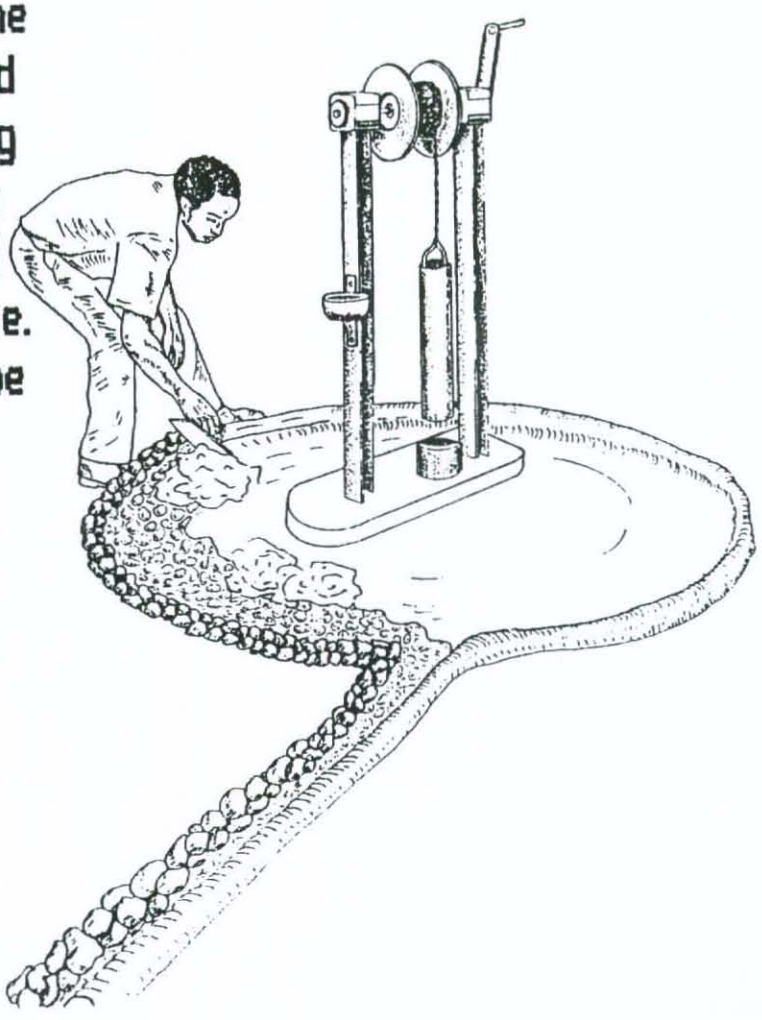


STAGE 7. MAKING APRON & WATER RUN-OFF



Whilst the pump base is curing, the apron and water run-off channel can be made. Arrange a series of bricks or stones in a circle to form the rim of the apron. These should be at least 2 metres and preferably 3 metres in diameter. Extend the apron to form a run-off channel which drains downhill. This should be at least 6 metres and preferably 10 metres long. The bricks or stones should be set in concrete.

Remove the brick mould, and fill the space between the pump base and the rim of the apron with a strong layer of concrete at least 100mm thick. The water run-off channel should also be built up in concrete. The mixture of concrete should be 4 parts stone, 2 parts washed river sand and 1 part cement. All surfaces should be smooth and sloped so that water runs away to waste down the channel.



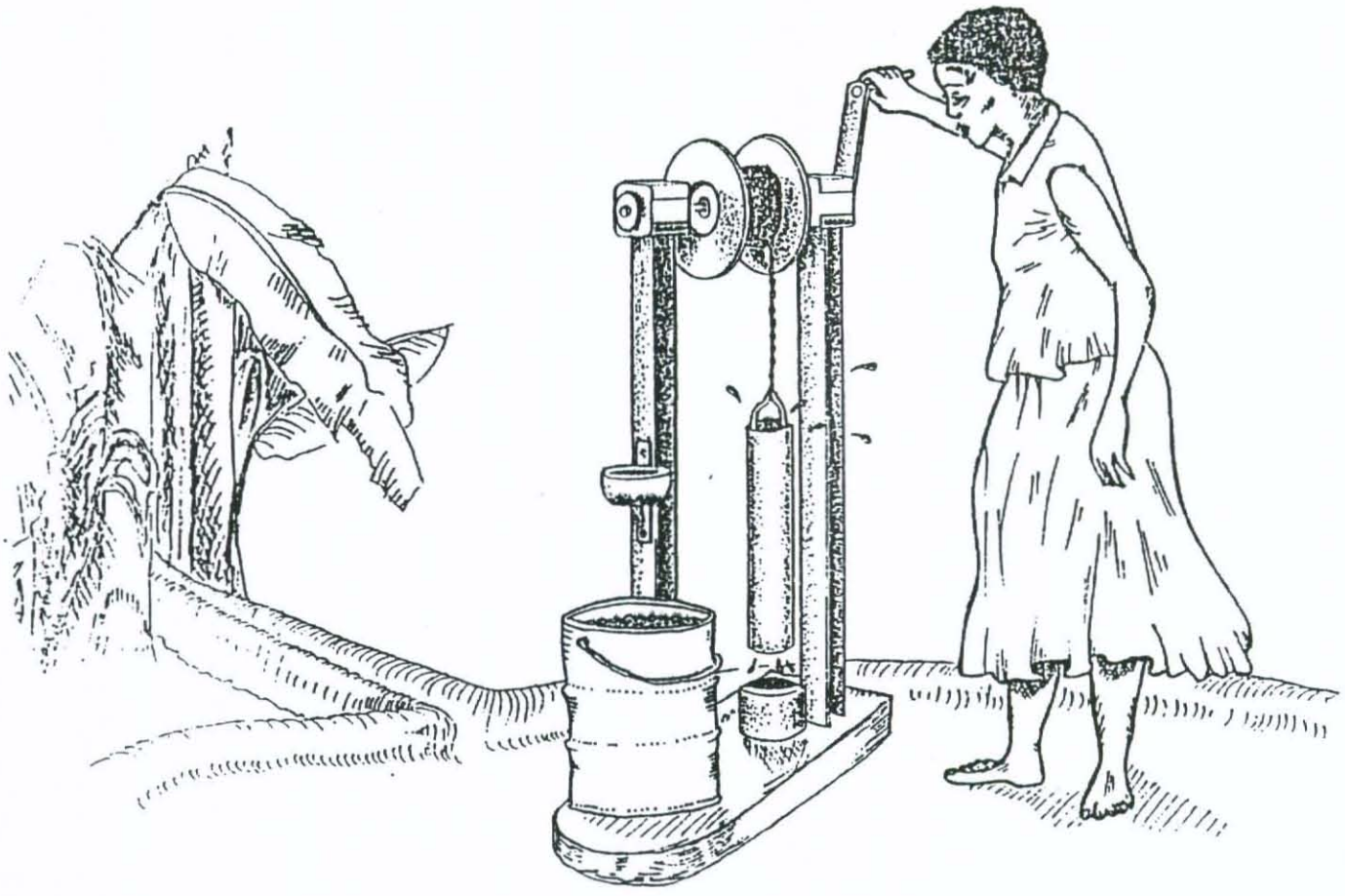
A soakaway or seepage area is built at the end of the run-off. This can drain into a vegetable garden.

STAGE 8. FINISHING OFF & CHECKING PUMP

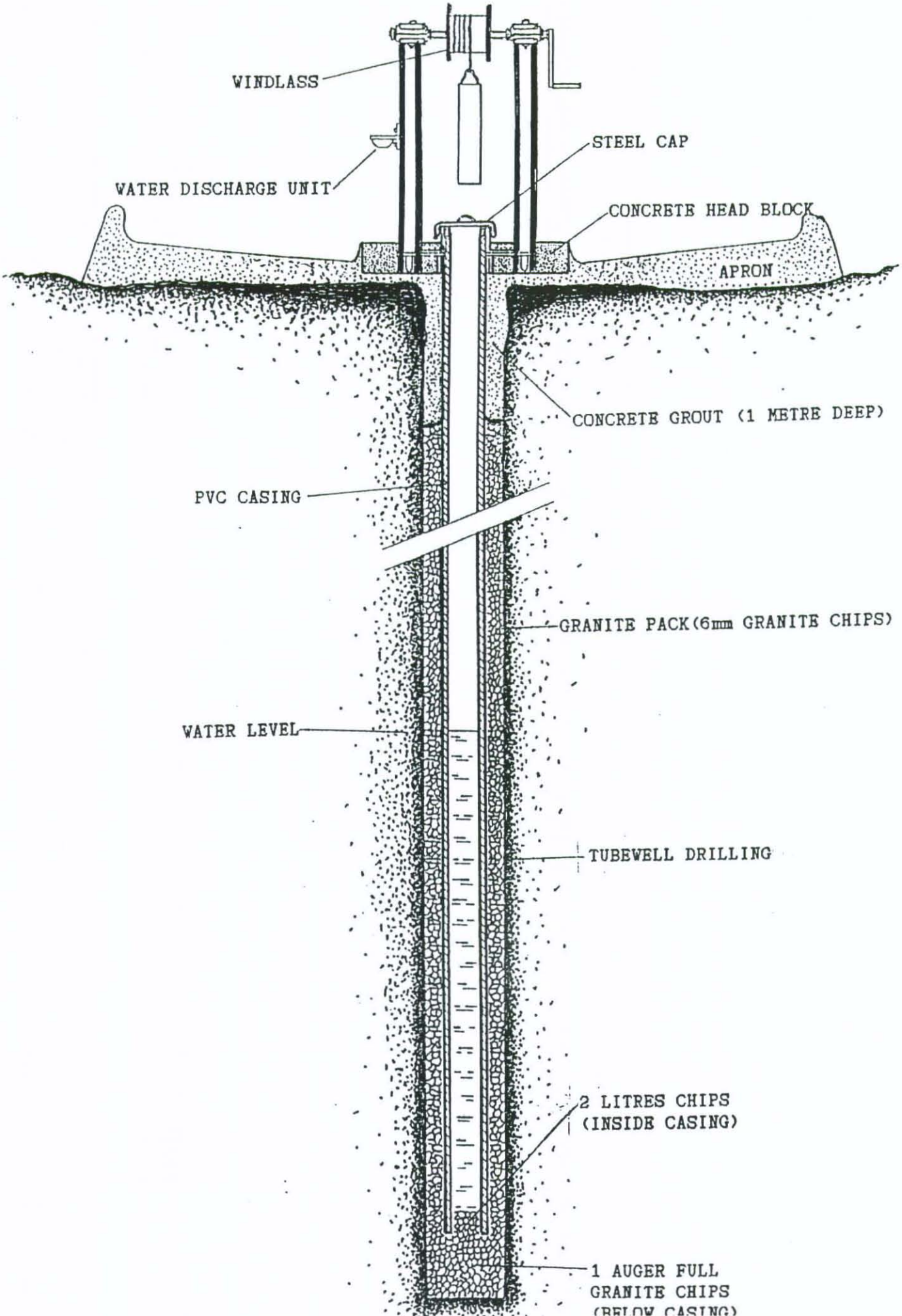
Ensure that all plaster work is neatly finished off and all waste water drains into the run-off and the seepage area.

Test the Bucket Pump and adjust chain so that the bucket does not strike the bottom of the tubewell. Ensure that the bucket valve is free of grit and holds water.

It is a good idea to wire up the chain connection to the bucket right from the beginning. Also the valve remains in place for longer if the lower valve nuts are removed and wire is looped through the cotter pin hole and wound round the stem of the valve.



BUCKET PUMP FITTED ON A TUBEWELL



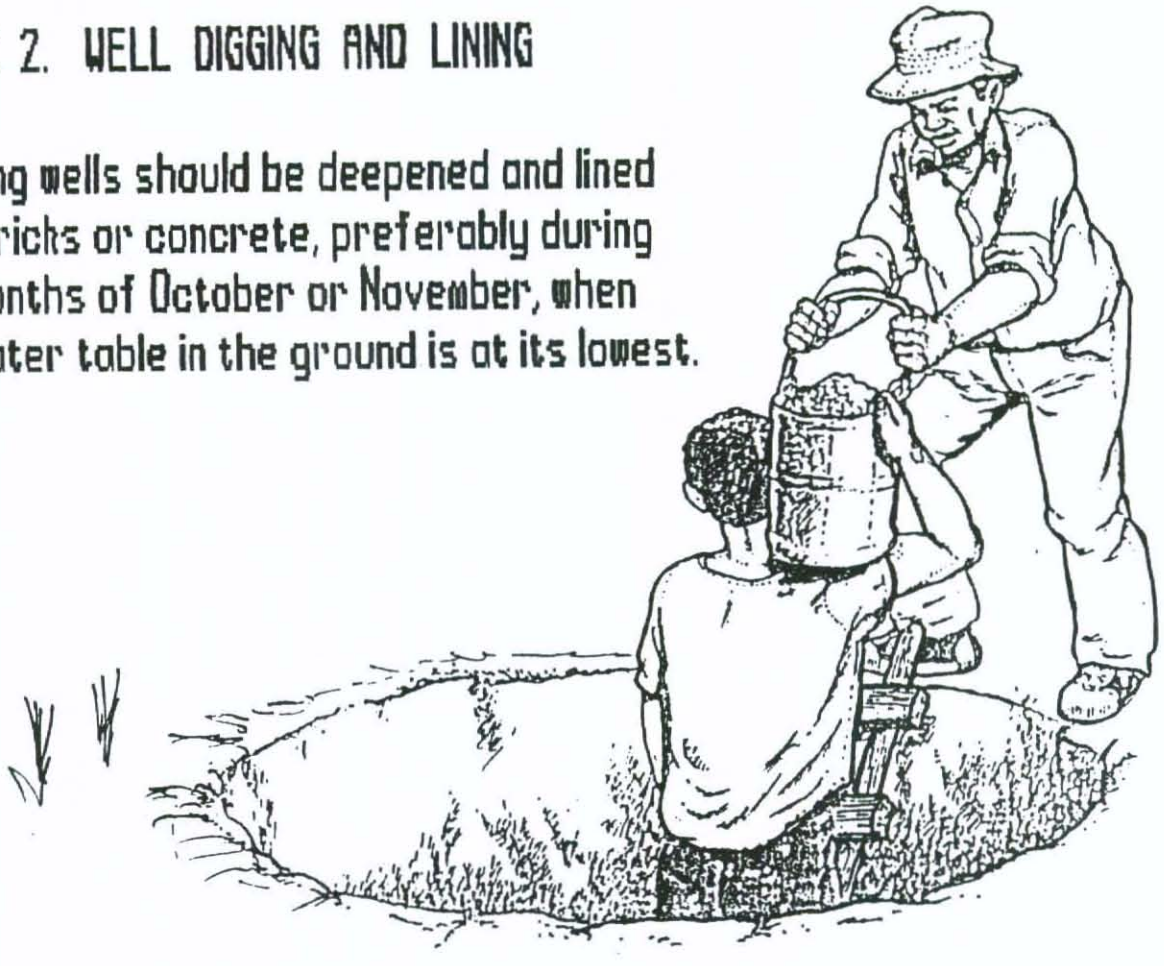
INSTALLING A BUCKET PUMP ON A WIDE DIAMETER WELL

STAGE 1. LOCATE A SITE

A good location should be sited at least 30 metres from a latrine or other site of contamination like a cattle kraal.

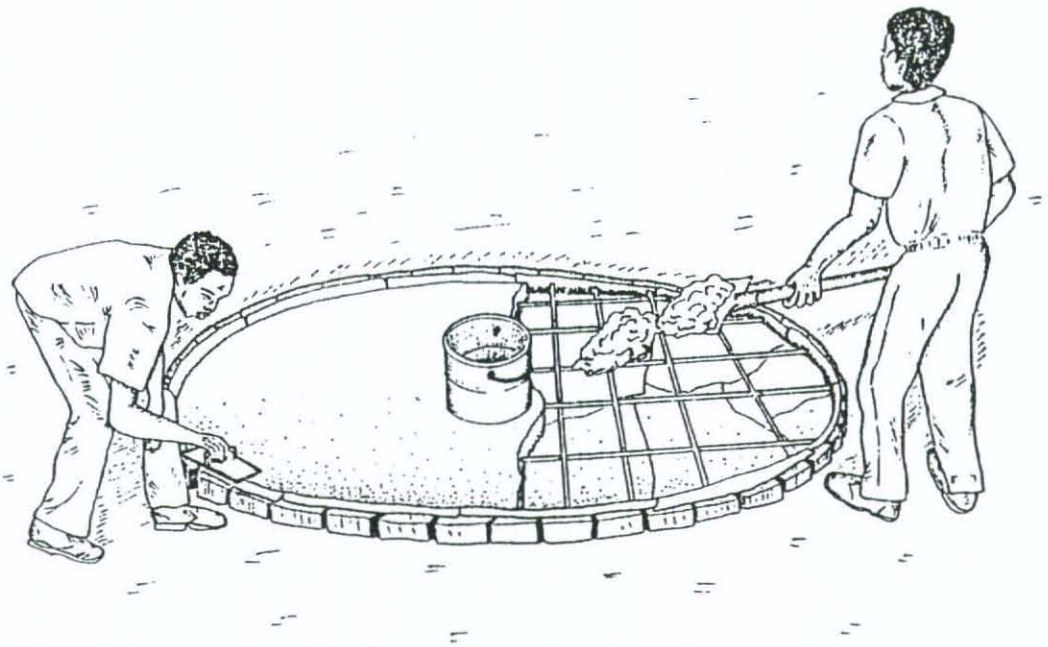
STAGE 2. WELL DIGGING AND LINING

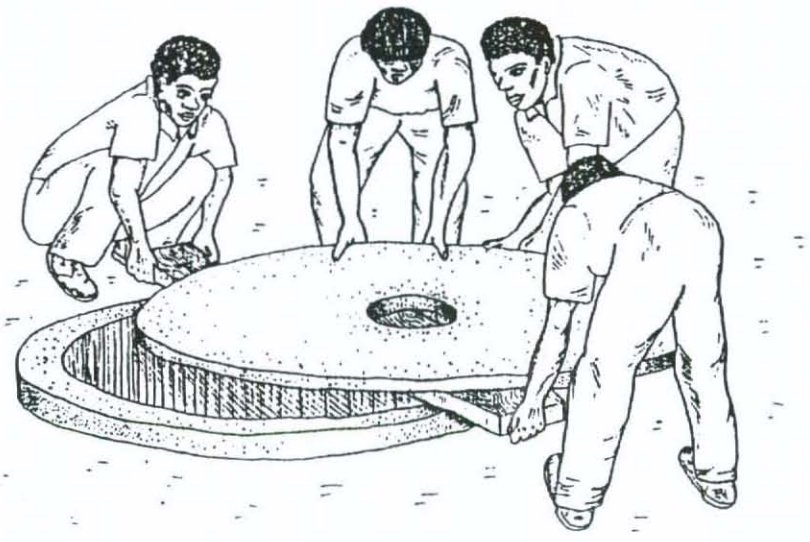
Existing wells should be deepened and lined with bricks or concrete, preferably during the months of October or November, when the water table in the ground is at its lowest.



STAGE 3. CASTING THE WELL SLAB

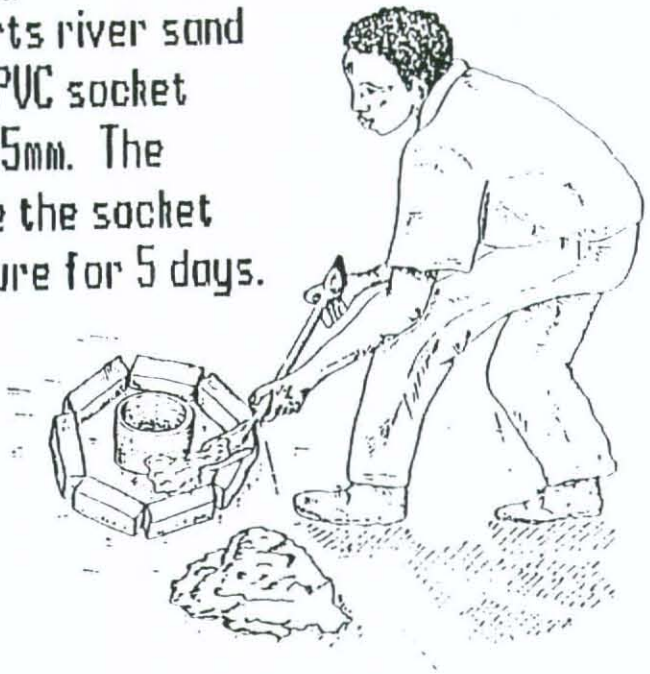
This should be caste near the well and made to fit the well. It should 75mm thick and made with a concrete mixture using 4 parts stone, 2 parts river sand and 1 part cement. A hole 350mm in diameter should be made in the middle of the slab. It should be left to cure for 5 days and kept wet. Then it is fitted to the well and cement mortared in position.





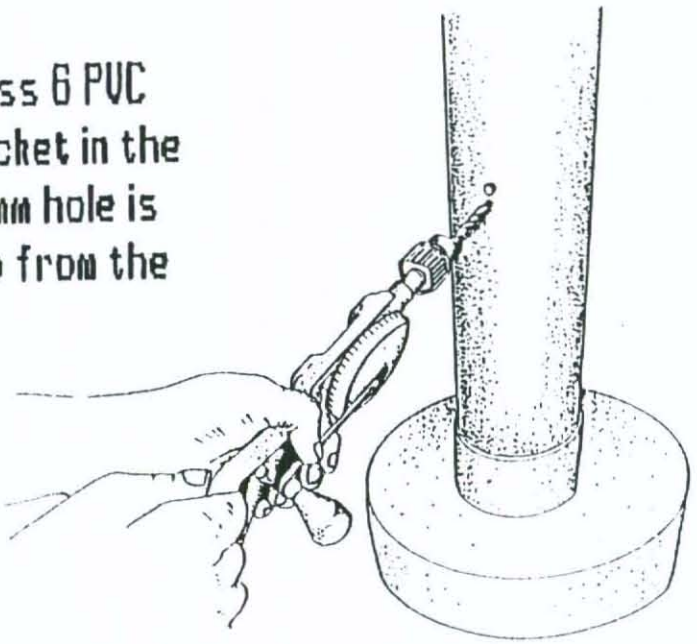
STAGE 4. MAKING CONCRETE FOOTING OF CASING

A 150mm length is cut off the socketed end of one length of the 125mm class 6 PVC casing. This piece is embedded in concrete by making a circle of bricks 300mm in diameter and inserting the PVC socket in the middle. A strong mixture of concrete, using 3 parts gravel, 2 parts river sand and 1 part cement is laid around the PVC socket within the brick mould to a depth of 75mm. The concrete mixture is also added inside the socket to a depth of 50mm. This is left to cure for 5 days.



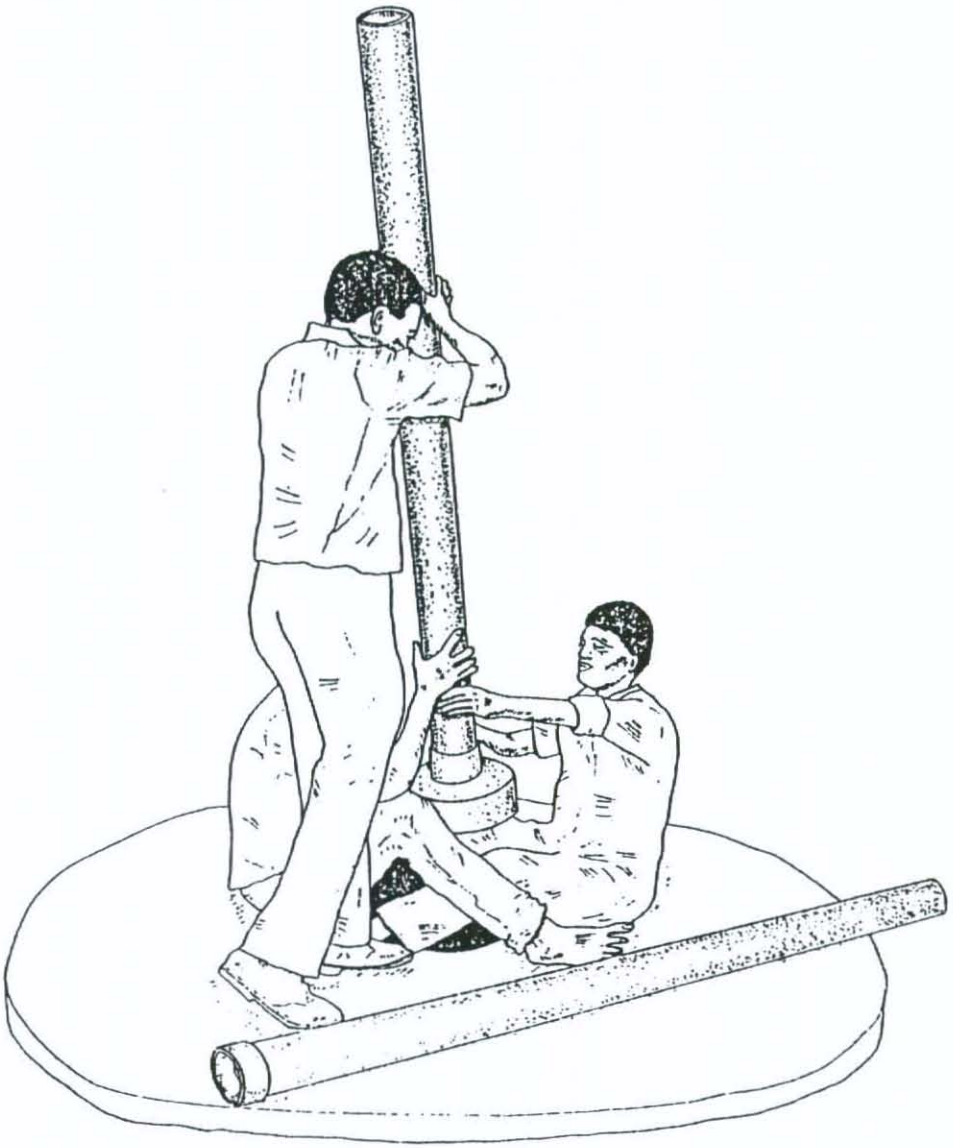
STAGE 5. PREPARING THE PVC CASING

The first length of 125mm class 6 PVC casing is cemented to the socket in the concrete footing. A single 8mm hole is drilled in the casing 500mm up from the bottom of the footing.



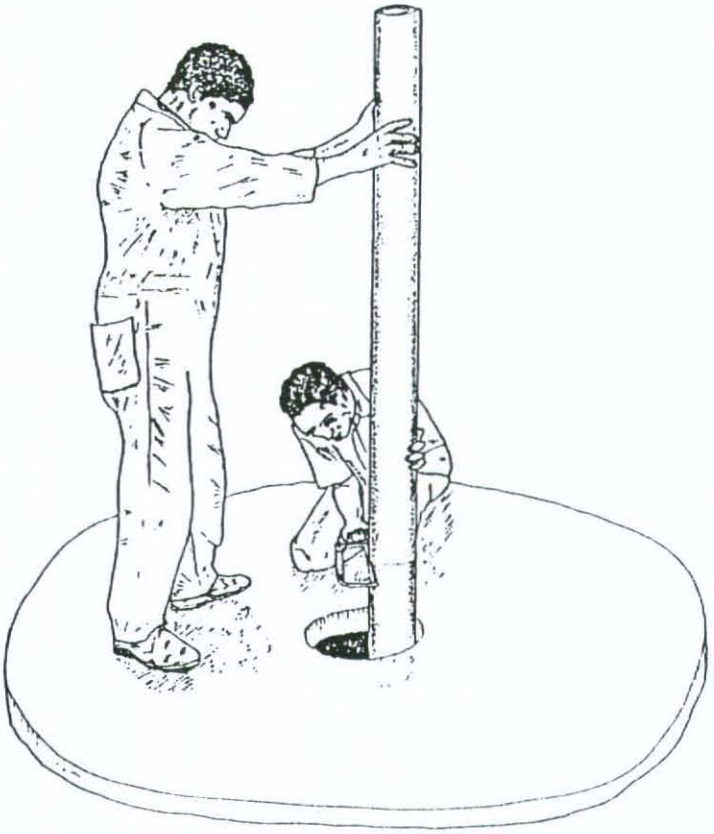
STAGE 6. LOWERING THE CASING

Lower the first casing with the footing attached. The next length is then cemented to the first, held for one minute and then lowered again. Further lengths of casing are added to the required depth. A length of at least 250mm should protrude above slab level. The casing should be allowed to settle for a day.



STAGE 7. CUTTING THE CASING

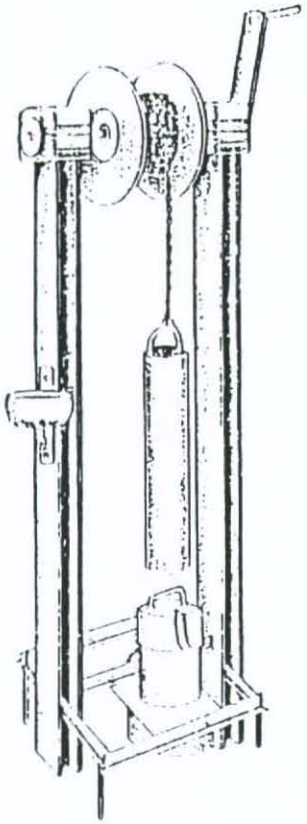
Once settled the casing should be cut off square. The Bucket Pump should be measured to see what length of PVC casing will slide into the steel tube at the base of the pump. This is normally 230mm. Allowing for 10mm thickness of cement for mounting the pump the casing should be cut off 240mm above the slab level.



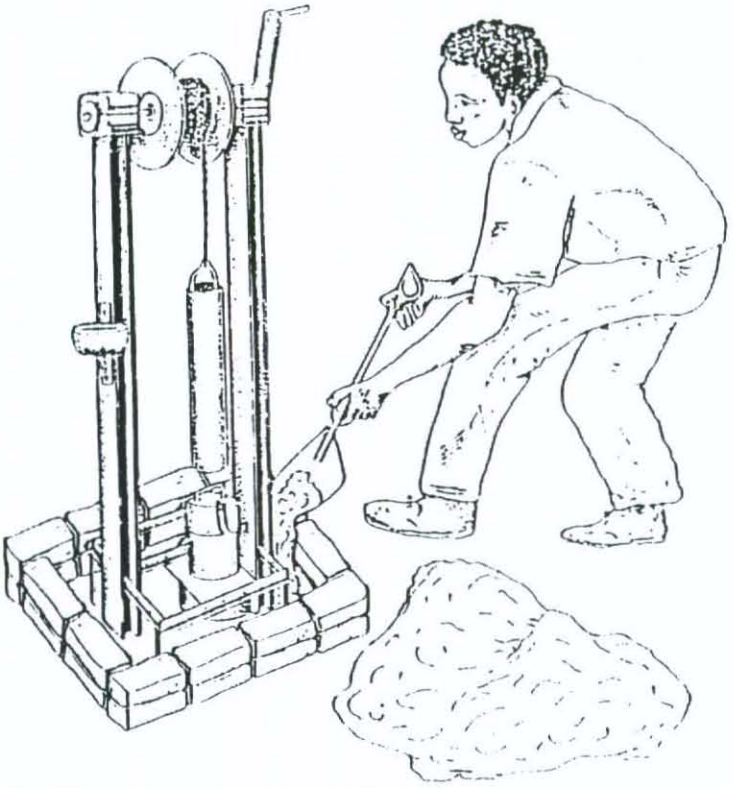
STAGE 8. MAKING THE PUMP HEAD BLOCK

When a Bucket Pump is fitted to a well, the pump must be mounted in a concrete block which rests on the well cover. The pump should be caste in the block to the side of the well. The pump is placed on a flat piece of ground covered with a plastic sheet. Two layers of bricks are placed in position around the base of the pump so that a mould is made 700mm long, 500mm wide and 150mm deep. This is filled with strong concrete with a mixture of 3 parts stone, 2 parts river sand and 1 part cement. This is levelled off and allowed to cure for several days being kept wet at all times.

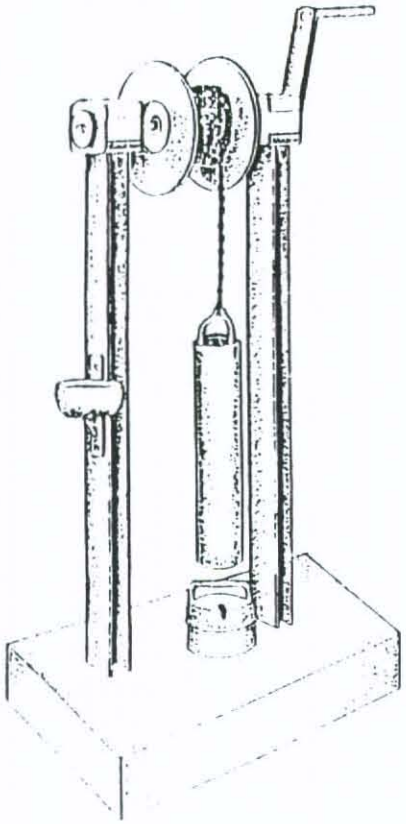
STAGES IN MAKING THE BUCKET PUMP CONCRETE HEAD BLOCK



THE STANDARD BUCKET PUMP



ADDING CONCRETE MIXTURE TO
THE BRICK MOULD

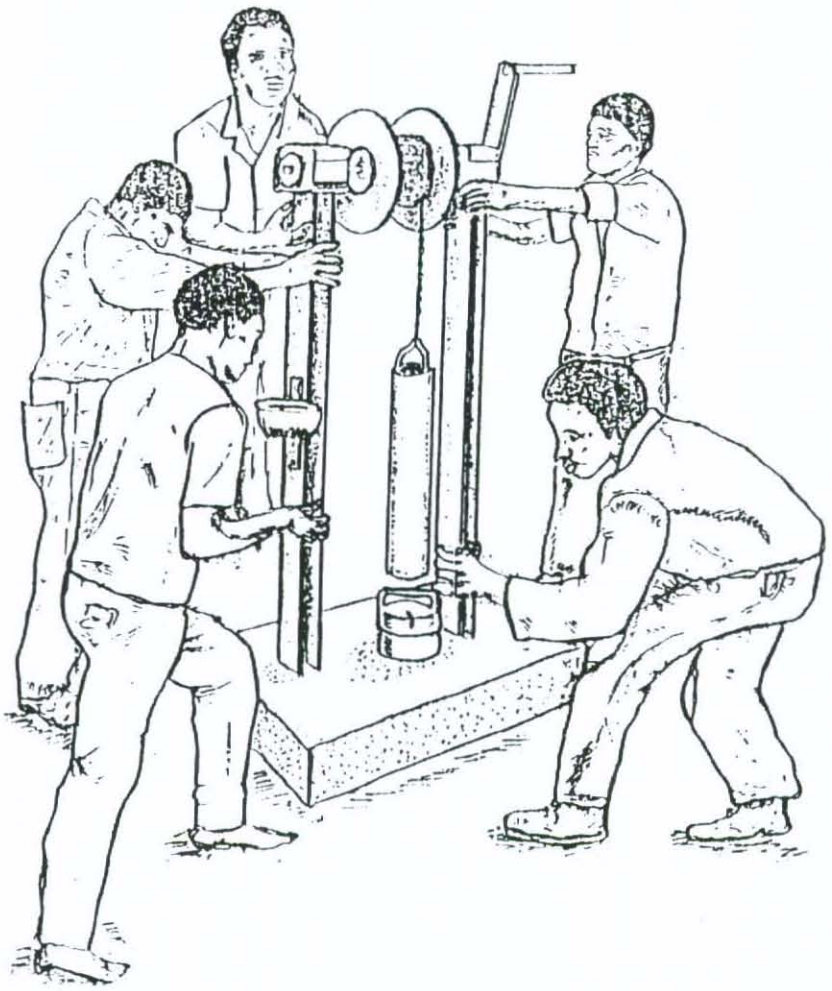


THE BUCKET PUMP WITH CONCRETE
HEAD BLOCK COMPLETED

STAGE 9. FITTING PUMP ON TO WELL

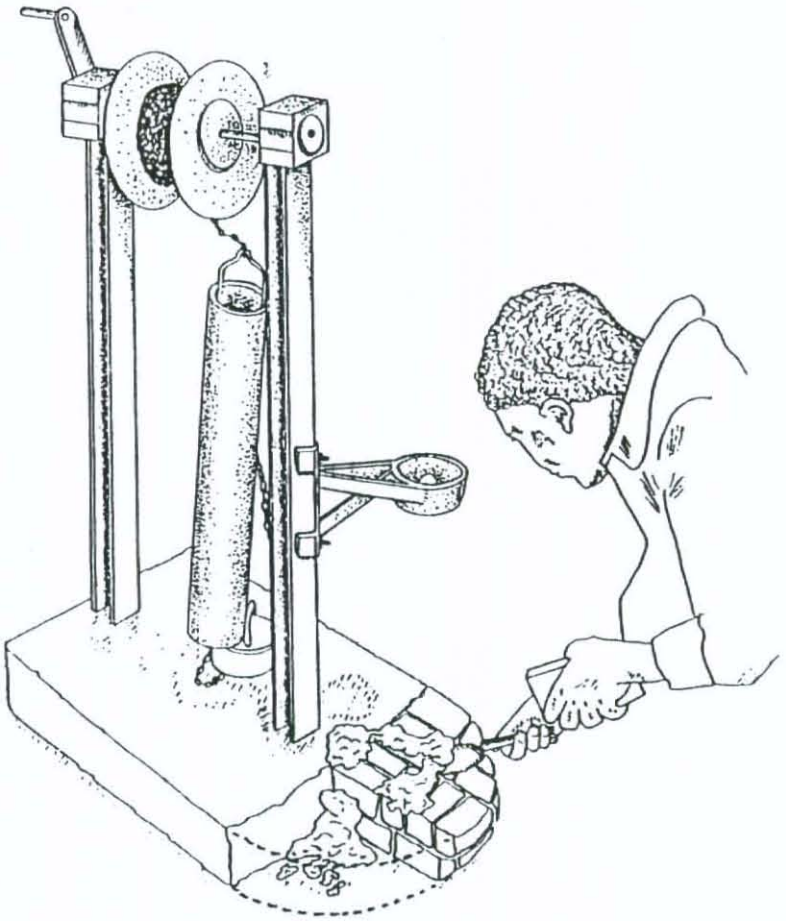
Ensure that the casing is cut off at the correct length and add a layer of cement mortar on the well slab around the central hole. With great care lift the pump and base up on to the well cover. The pump should then be raised up and lowered down in an upright position on the casing and bedded into the cement mortar.

The pump and base are very heavy and several people will be required to lift it carefully in position. It is best to move the pump in two stages , first lifting the pump and stand off the ground as shown in the diagram, and placing it in the well cover. In the second movement it should be lowered over the casing on to the well cover.



STAGE 10. ADDING BUCKET STAND

A brick extension of the concrete base should be made directly under the water discharge unit as shown in the diagram.



STAGE 11. MAKING APRON, WATER RUN OFF & DRAINAGE AREA

Make in the same way as for a tubewell. In this case place the apron around the well head. The apron should be made of strong reinforced concrete about 100mm thick and sloped down from the rim to the central well head. All surfaces should drain water into the run off. Make sure that the well head is sealed and that waste water cannot drain back into the well.

The drainage area can be a hole in the ground filled with rocks, or a depressed area filled with bananas, sugar cane or trees. Waste water can also be led into a vegetable garden.

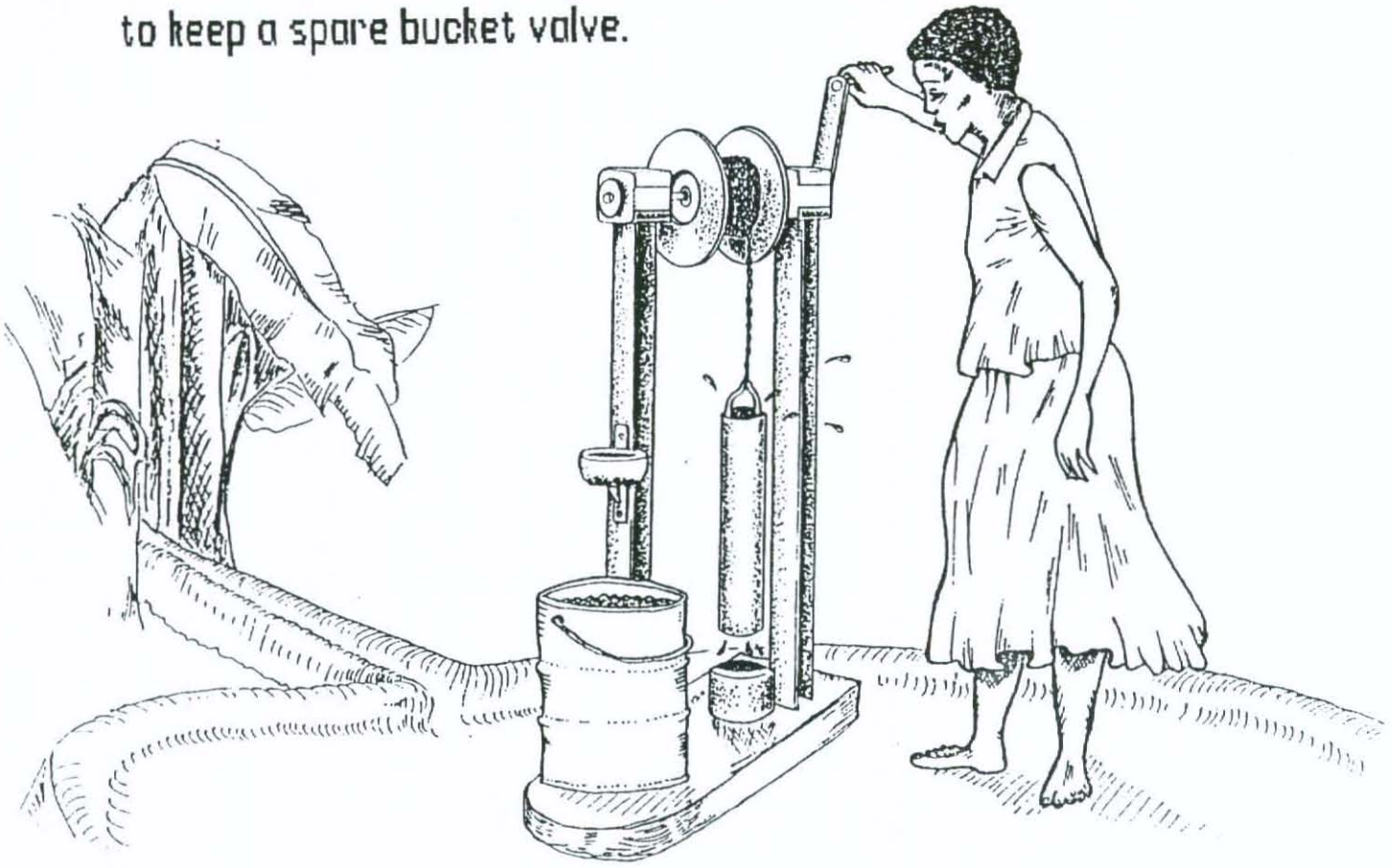
STAGE 12. FINISHING OFF & CHECKING PUMP

Ensure that all plaster work is neatly finished off and all waste water drains into the water run-off channel and seepage area.

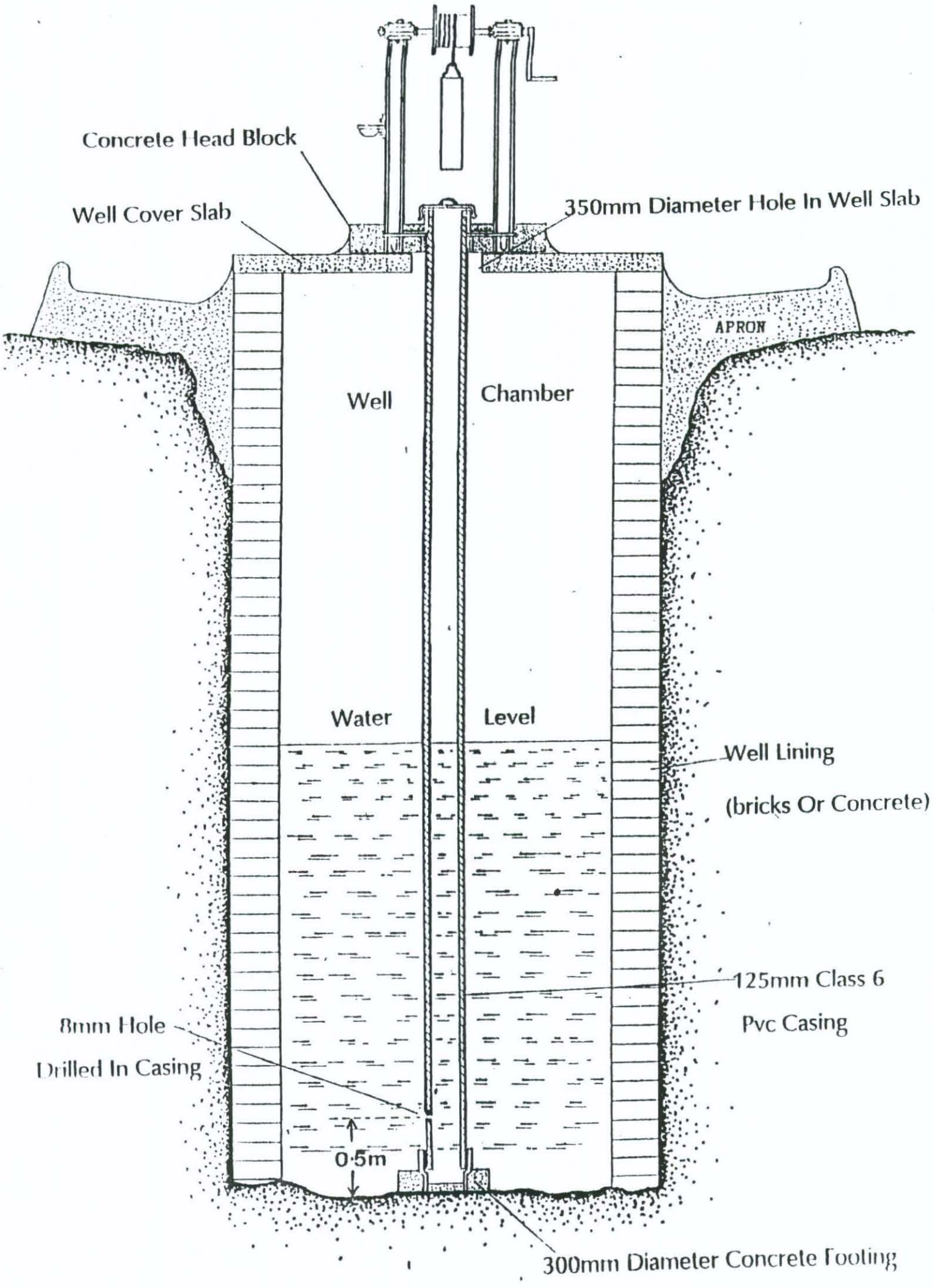
Test the Bucket Pump and adjust chain so that the bucket does not strike the bottom of the tubewell. The bucket valve should be free of grit and sand and should not leak.

It is a good idea to wire up the chain connection to the bucket right from the beginning. Also the valve remains in place for longer if the lower valve nut is removed and wire is looped through the cotter pin hole and wound round the stem of the valve.

Tools for maintenance should be held by the pump caretaker who lives near to the pump. It is wise for the pump caretaker to keep a spare bucket valve.



BUCKET PUMP FITTED ON WIDE DIAMETER WELL

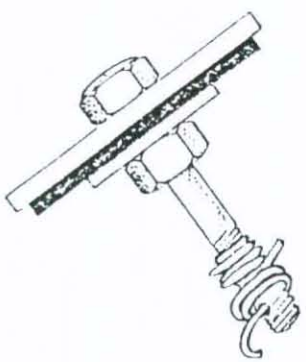


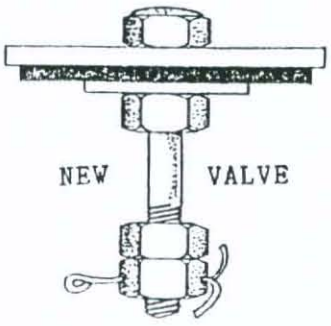
MAINTAINING THE BUCKET PUMP

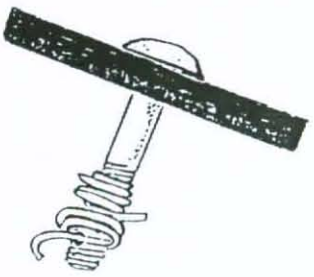
The Bucket Pump was designed so that it could easily be managed in a village setting. Spontaneous management of the pump is possible at village level because the Bucket Pump is a modern version of the traditional bucket and windlass system which is very familiar in most rural areas.

One part of the Bucket Pump, the bucket valve, is not found in traditional practice, but even this part is frequently repaired by the village craftsmen. None of the parts are concealed from view and even the single valve can be inspected each time the bucket is raised.

Like all machines the Bucket Pump is subject to wear. The links of the chain become thinner after a few years and the leading edge of the bucket also wears back and will require replacing from time to time. A new leading edge assembly for the bucket is available as a spare part. The main part which requires maintenance and renewal from time to time is the valve, which should be available either in local stores or stocked by the appropriate Government Department.

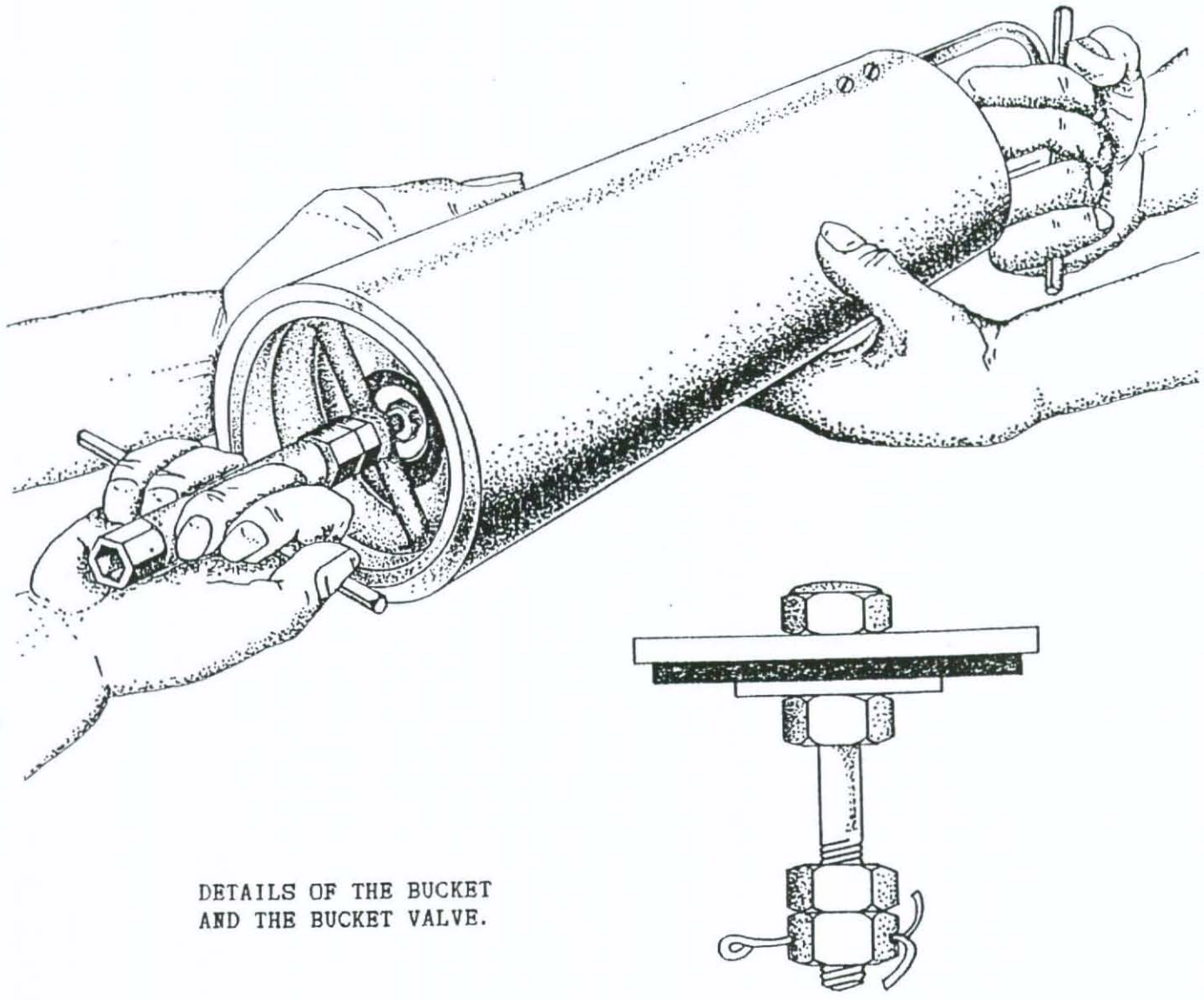






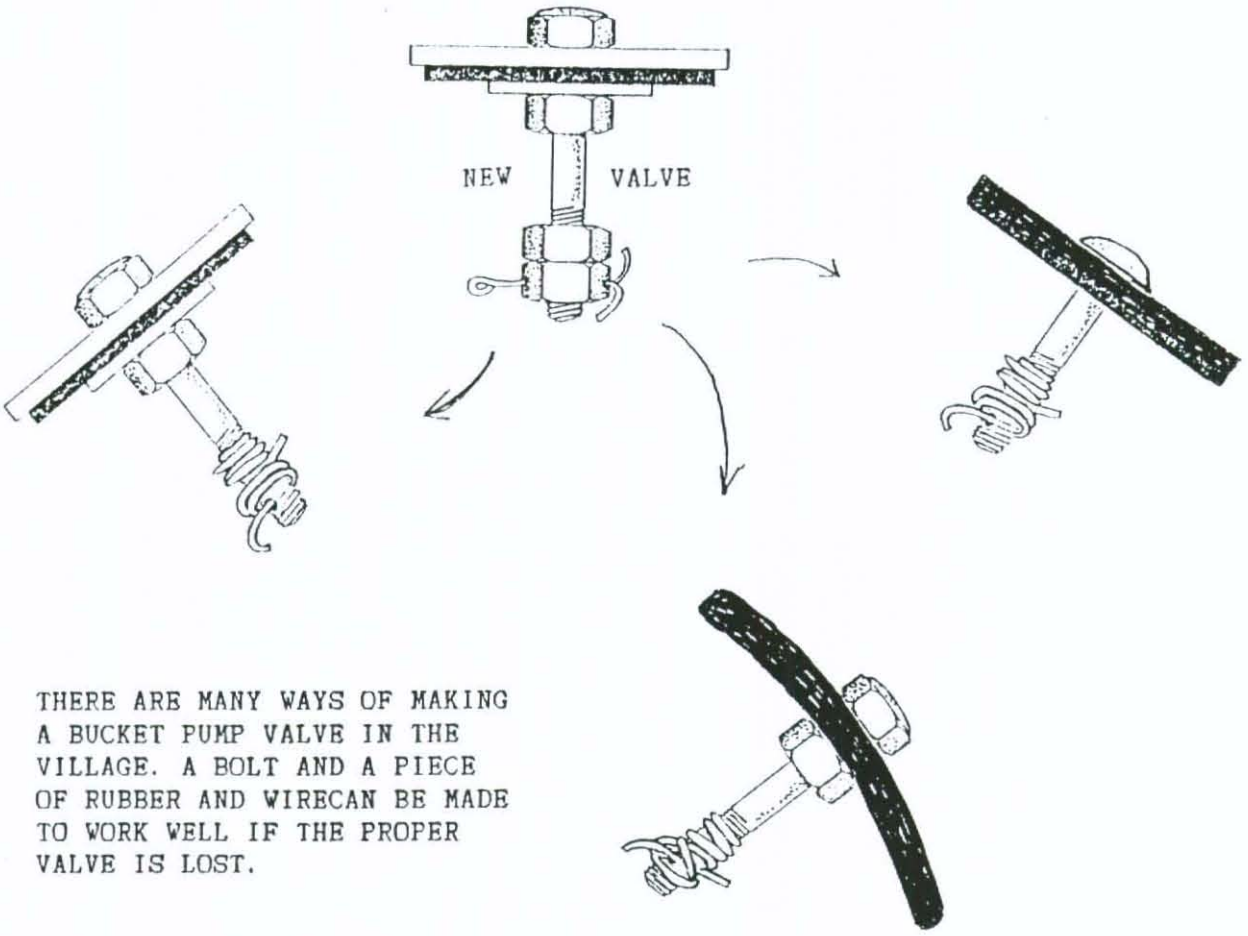
MAINTAINING THE BUCKET VALVE

Most of the maintenance problems found in the Bucket Pump are connected with the valve. The valve is assembled with nuts held with a cotter pin but these parts may come loose in use. Occasionally the rubber washer comes loose as well. It is important that all parts of the pump valve are kept tight.



DETAILS OF THE BUCKET
AND THE BUCKET VALVE.

Local users of the Bucket Pump have developed several ways of maintaining or even replacing the valve. These include cutting rubber discs from tyres and attaching these to a nut and bolt. The lower part of the valve stem is drilled with a hole for the cotter pin. A successful local technique is to completely remove the pin and the nuts and replace them with wire, which is threaded through the hole and wound and tied around the stem of the valve as shown below. This is a very effective method of keeping the valve in place.



THERE ARE MANY WAYS OF MAKING A BUCKET PUMP VALVE IN THE VILLAGE. A BOLT AND A PIECE OF RUBBER AND WIRECAN BE MADE TO WORK WELL IF THE PROPER VALVE IS LOST.

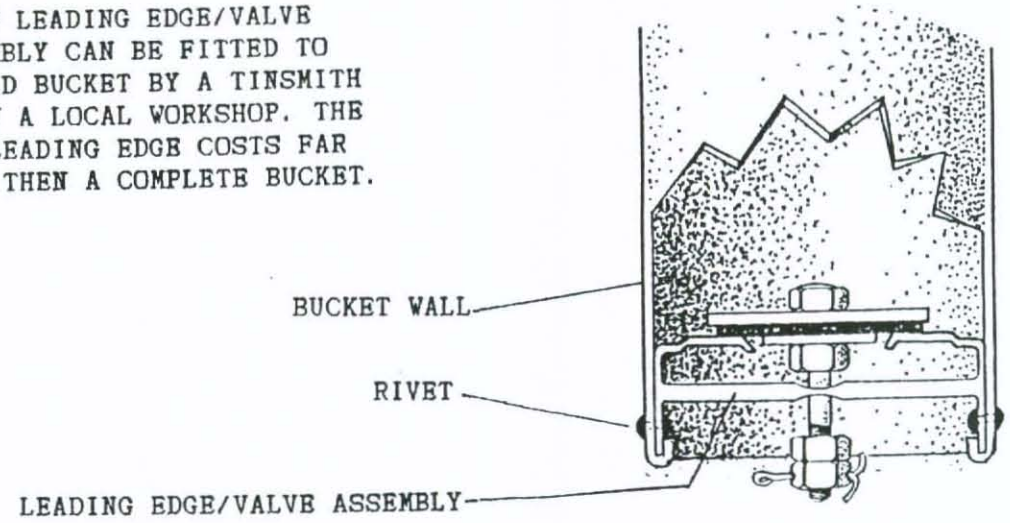
Leaky valves can be caused by grit sticking on the valve surfaces. The valve should be cleaned and the chain adjusted so that it cannot reach the bottom of the tubewell.

It is very important that the pump caretaker and other members of the community are fully trained in the management and replacement of the bucket valve. A great deal of emphasis should be placed on complete local management. Spare valves should be available close at hand.

MAINTAINING THE BUCKET

The leading edge of the bucket can wear away after a few years and will leak water. When this happens the leading the leading edge should be sawn off straight and replaced with a new leading edge. The alternative is to replace the bucket but this is more expensive. The new leading edge/valve unit is tapped into the old bucket and the wall of the bucket bent over to form a good seal. The unit is supplied with two rivets. Holes are drilled for these and the rivets passed through the holes and flattened with a hammer. This type of maintenance should be carried out by a tinsmith.

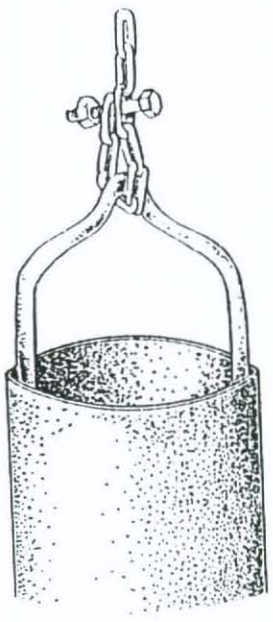
A NEW LEADING EDGE/VALVE ASSEMBLY CAN BE FITTED TO AN OLD BUCKET BY A TINSMITH OR IN A LOCAL WORKSHOP. THE NEW LEADING EDGE COSTS FAR LESS THEN A COMPLETE BUCKET.

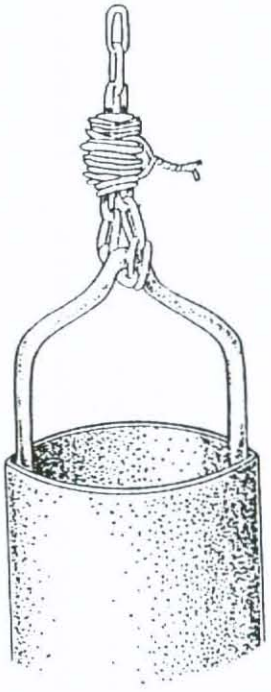


MAINTAINING THE CHAIN

The chain does wear out and can separate when the links become thinner. Broken links can be repaired by wire. The chain wears out more quickly on the bucket end than on the windlass end. When the chain is wearing thin on the bucket end it can be unwound from the windlass and rewound the other way round. Other materials like rope or cable can be used if the chain is lost. The chain can be fished out of the tubewell with a long piece of wire if it falls in.

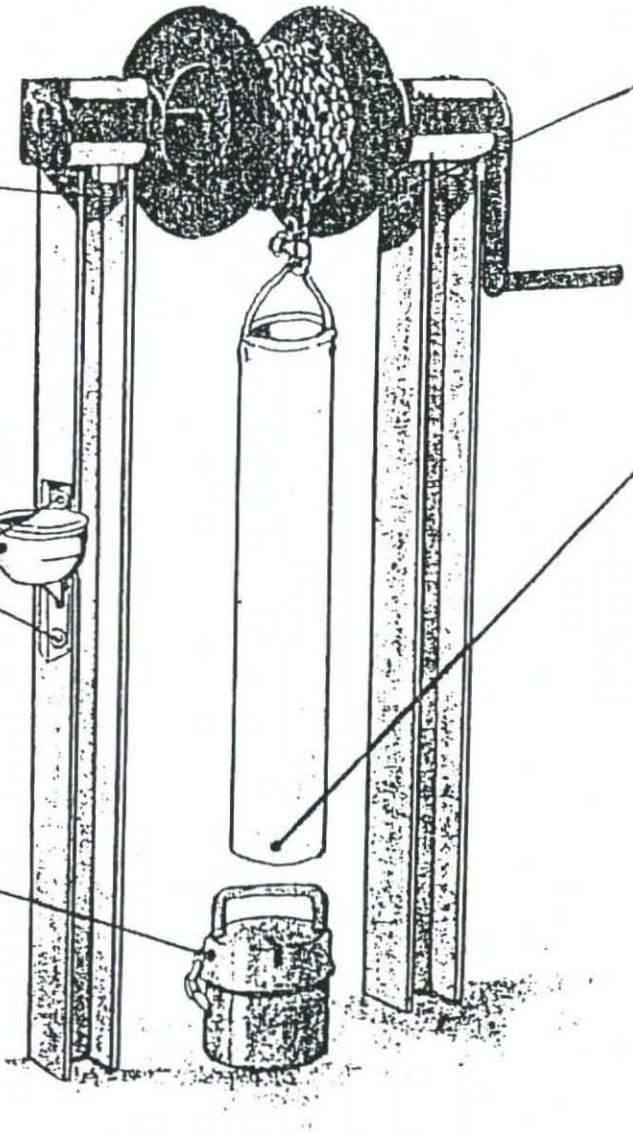
The attachment between the chain and the bucket should be wired together right from the start. Nuts and bolts do not work well at this point.





MAINTAINING THE PUMP HEAD

The nuts and bolts on the pump head should be kept tight with the spanners provided



Check 1
BEARING BLOCK
* Tighten nuts and bolts

Check 2
CHAIN
* Connect chain tightly to the chain barrel and bucket
* Use wire if necessary

Check 3
WATER DISCHARGER
* Tighten nuts and bolts

Check 4
BUCKET VALVE
* Inspect the valve
* Tighten valve nuts
* Check valve seal, replace if necessary
* Remove sand and grit
* Inspect valve pin

Check 5
STEEL HEAD
* Keep the lid on

Check 6
* Check all tools and spares

The headworks should be kept clean at all times and the seepage area kept in good order. It is important to keep the area around pump clean and tidy.

COMMUNITY PARTICIPATION

It is very important that the community participate at all stages of the their Bucket Pump Programme. This includes siting, drilling, lining, fitting the pump, making the headworks, and most important of all the maintenance.

A complete pump demonstration should be given by local Health Assistants and the pump itself should be handed over to the community in a ceremony. It is very important that the users know that the pump belongs to them, and that they must take much of the responsibity for maintenance.

Simple lessons in the maintenance of the pump should be given by Health Assistants and these should concentrate on wiring techniques and maintenance of the valve.

The importance of keeping the steel cap in place and the apron and water run off clean should be emphasised. Children should be taught not to throw stones down the tubewell.

THE BUCKET PUMP WAS DESIGNED FOR VILLAGERS TO MAINTAIN

THEMSELVES

SOME IMPORTANT POINTS

THE BUCKET PUMP WAS DESIGNED IN ZIMBABWE FOR USE IN THE RURAL AREAS. IT IS A HAND OPERATED PUMP USED FOR LIFTING WATER FROM WELLS AND TUBEWELLS.

BUCKET PUMPS ARE SIMPLE TO OPERATE AND USE SIMPLE PARTS WHICH CAN BE MAINTAINED BY VILLAGERS.

BUCKET PUMPS SHOULD BE USED BY SMALL COMMUNITIES OF UP TO 10 FAMILIES OR 60 PERSONS. THEY SHOULD BE SITED CLOSE TO WHERE PEOPLE LIVE. THEY ARE NOT DESIGNED FOR HEAVY DUTY USE AS THE WATER DELIVERY RATE IS TOO SLOW.

BUCKET PUMPS CANNOT BE USED ON DEEP WELLS OR BOREHOLES AND NORMALLY 15 METRES IS A MAXIMUM DEPTH.

IT IS VERY IMPORTANT THAT VILLAGE COMMUNITIES ARE INVOLVED WITH SITING, INSTALLING AND MAINTAINING THE BUCKET PUMP. VILLAGE WATER COMMITTEES AND PUMP CARETAKERS SHOULD BE ABLE TO FULLY MAINTAIN THE PUMP. PARTICULAR ATTENTION SHOULD BE PAID TO MAINTENANCE OF THE BUCKET VALVE.

BY FOLLOWING THE INSTRUCTIONS IN THIS FIELD MANUAL IT IS POSSIBLE TO INSTALL A BUCKET PUMP THAT CAN PROVIDE SAFE DRINKING WATER FOR MANY YEARS.