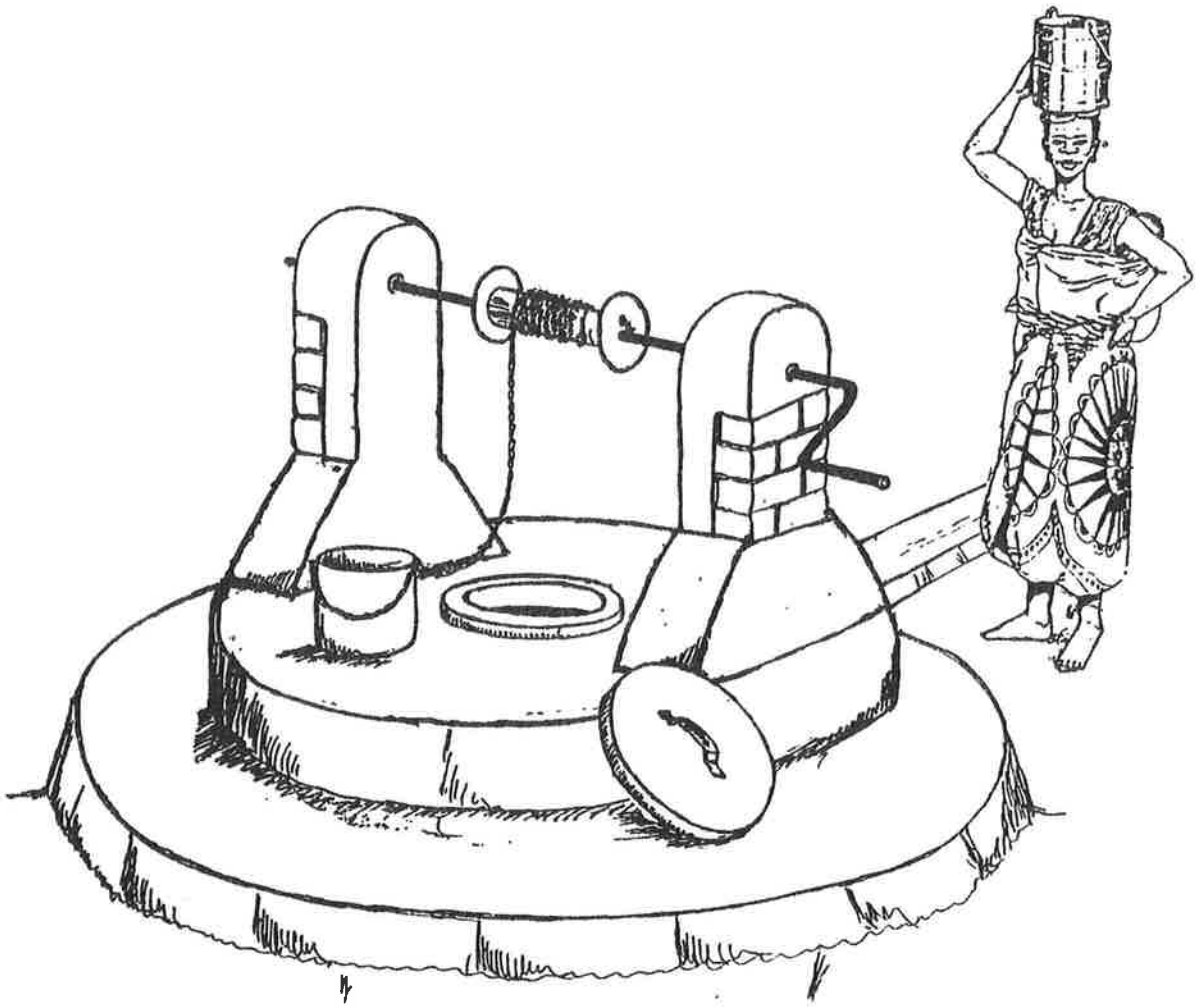
UPGRADED WELL MANUAL

FOR

FIELD WORKERS



MVURAMANZI TRUST

ACKNOWLEDGEMENTS

This field manual brings together our current knowledge on the technique of upgrading simple shallow wells, a method ideally suited to the family homestead.

The simple technique of upgrading simple shallow wells has been investigated and tested by staff of the Blair Research Laboratory and subsequently by staff of the Mvuramanzi Trust for many years, and now, nearly ten years later, it is well established in many areas of Zimbabwe. Particular thanks are due to Ephraim Chimbunde, Nason Mtakwa, Fambi Gono, Philimon Kademeteme, Joshua Mazanza and Wonderful Kawungwa for their efforts over many years, both in technical development and also in training and extension work. Felix Chawira, Michael Jere and Grace Rukure played a major role in undertaking the bacteriological work that supports the technical development.

The Upgraded Family Well is a logical extension of a technique already used widely in traditional practice. The techniques of lining a well with bricks, adding an improved apron and water run-off and fitting a windlass and tin lid are already used widely in the rural areas of Zimbabwe. Such improvements have long been promoted by staff of the Ministry of Health. The technique described in this manual brings together all these improvements into a single technology, which has wide application within Zimbabwe and in many other countries. The upgrading process can be used with great benefit on tens of thousands of existing poorly protected wells used in the family setting in Zimbabwe.

The technique of upgrading family wells has now been fully endorsed by the Ministry of Health and Child Welfare and by the National Action Committee of the Zimbabwe Government. To date the Mvuramanzi Trust has assisted the Ministry of Health in supporting the construction of over 18 000 units in 20 districts selected from all eight provinces of Zimbabwe.

Acknowledgement is also due to the Department of Environmental Health, who have encouraged the use of this technique and have supported the research and development for many years. Particular thanks are due to the Director of the Department of Environmental Health, Shadreck Musingarabwe and his predecessor John Mvududu , for supporting this initiative and also to the Chief Environmental Health Officer, Nathan Tembo and his predecessor David Proudfoot. Thanks are also due to all the Provincial Environmental Health Officers and their staff for their support.

The illustrations used in this manual are taken from the work of Kors de Waard. Many of his splendid original drawings have been modified to show more recently evolved technology.

Thanks are also due to Norad,The Oak Foundation, ODA, Rotary , Save the Children's Fund (U.K.), SIDA, UNICEF and WaterAid U.K. who have given their support to more recent implementation programmes which have increased our knowledge and understanding of the technology and the most effective method of implementing in the rural areas of Zimbabwe.

Particular thanks are due to SIDA for their ongoing support and encouragement to the research and development aspects of this technology and its dissemination throughout the continent. This manual was printed with generous support from UNICEF.

Peter Morgan

Mvuramanzi Trust

Harare
October 1995

INTRODUCTION

Very large numbers of family wells are in daily use in Zimbabwe - tens of thousands of them. Most wells are either unprotected or inadequately protected and can become heavily contaminated, especially during periods of heavy rain. Many are dangerous, especially for children, because they are poorly lined and have little or no protection at the well head. Most family wells in Zimbabwe have the potential to be upgraded. When the upgrading process is complete, the well is less liable to collapse, safer for children and significant improvements in water quality can be expected without the use of a handpump.

Family wells are close at hand and very convenient for use. The technology is simple, logical, cheap and easy to build - it has grown out of traditional practice. The ownership is well defined and there is no debate about the responsibility for maintenance - it lies with the family itself. Because water is conveniently taken, more water is used in every aspect of home life, including preparing food, washing cloths and for personal hygiene. More water is available for growing food, especially vegetables which are important in a good diet. Vegetables can be sold to earn money to buy soap and other things which improve the home. Improvements made to family wells are considered as family investments and often have prestige value. Where there is a choice they are always prefered to communal systems and evoke a stronger sense of ownership and willingness to sustain maintenance. They are known to be reliable, and the protection endowed by the cover leads to improved confidence in the supply itself.

The technique should be chosen in areas where family wells are common or where the potential for family wells exists. This will normally be where the water table lies less than 15 metres below ground level, although wells of up to 30m depth have been upgraded in the Zimbabwe programme. Priority should be given to family installations because the responsibility for maintenance of the finished well lies with the owners. Maintenance includes daily upkeep of the well head and also involves replacement of the chain/rop, bucket, tin lid, and windlass supports when these are worn. The owner also has the responsibility of deepening the well when necessary.

Where special funding arrangements have been made, a family owner will receive a subsidy to upgrade his or her well. The owner of the well is expected to provide the following: a fully lined well, the bucket and chain or rope, sand, stone, and all the labour required including any payment for the hire of a builder. The subsidy will normally be a windlass, a tin lid and three bags of cement. The offer of this subsidy very often encourages the family to build a new well on its property where there was none before. Where no special funding arrangements have been made, the family should be encouraged to upgrade its own well with itsown resources.

Upgraded wells are intended for familu use only and not by communities. Upgraded wells can be used by an extended family where members are related and this will normally be up to 20 members. Only one bucket should be used to withdraw water from the well. Family well programmes should be accompanied by active health education programmes directed specifically at personal and family hygiene and the hygienic use of water. Vegetable gardening and tree planting should be encouraged.

Attempts should be made to provide full coverage for family wells. A high proportion of the homesteads should have an upgraded well. Upgraded wells can be further improved by fitting a handpump. For shorter term investments the Blair Pump can be chosen for shallow wells. down to 11m depth. For longer term investments the Bush Pump should be recommended. Where handpumps are fitted on the family well, they should be purchsed and maintained by the owners. Good maintenance is the key to a reliable water supply.

HAND DUG WELLS

In Zimbabwe very large numbers of shallow wells are used for the collection of drinking water. Shallow wells are used by more people than any other single source of water. In many villages large numbers of wells have been dug by individual families and these are put to daily use. Remarkably, family owned wells are now being dug in some areas that have hitherto been thought of as fit only for deeper handpumps. Such a trend supports the view that given the choice, families prefer to use their own source of water, and are prepared to invest and maintain it.

Many family wells in Zimbabwe are poorly protected and can yield water of poor quality. Many are unlined and are subject to collapse and provide unhealthy conditions at the well head. These features make poor wells unsafe for children and a threat to family health.

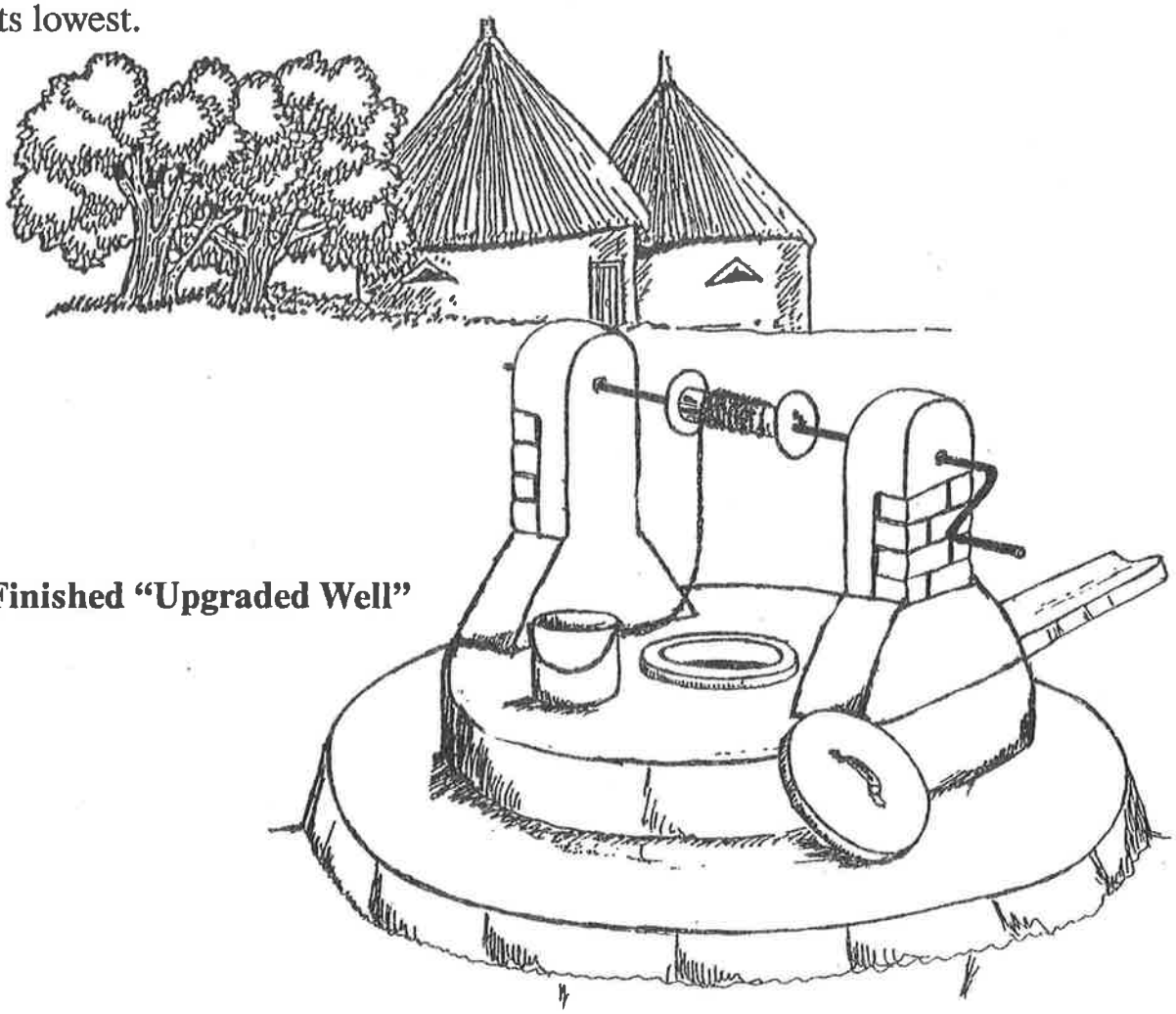
The instructions in this manual describe how to upgrade a family well so that the water quality is improved, the surrounding area is kept more hygienic and much safer for children.

HOW CAN WELLS BE UPGRADED TO YIELD BETTER WATER?

Several steps can be taken to improve an existing well. These include:

1. Deepening the well and thoroughly cleaning it out
2. Lining the well from top to bottom with bricks or concrete rings
3. Raising the well lining above ground level
4. Fitting a concrete well cover slab
5. Building a raised collar on the cover slab
6. Fitting a tin lid over the raised collar
7. Fitting a strong windlass, chain and bucket
8. Making a strong concrete apron to surround the well
9. Making a strong concrete water run-off channel to lead waste water away

It is best if wells are made as deep as possible. Deepening is best done during the months of September, October, November and December, when the ground water is at its lowest.



The Finished "Upgraded Well"

ADVANTAGES OF THE FAMILY UPGRADED WELL

The are several advantages to a family having its own upgraded well. These include:

1. The well is owned by the family
2 The responsibility for maintenance lies with the family
3. The water is close at hand and can be used in quantity
4. Waste run-off water can be fed directly into a vegetable garden
5. Water quality is far better than in a poorly protected wells
6. The water should be clearer and taste better
7. The family is able to take proper care of the well
8. No specialised spare parts are required for maintenance
9. Upgraded wells are safer for children and animals
10. The use of greater quantities of better water improves hygiene
11. The well can be fitted with a handpump later

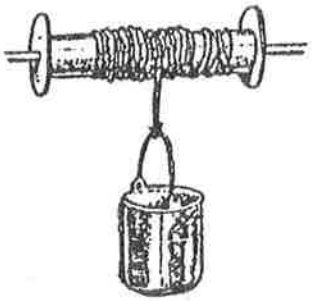
Many family wells already have been improved in some way in traditional practice. The skills required to further upgrade family wells already exists in village life. In most cases upgraded wells are built on existing well sites. However it is possible to build a new upgraded well where no well existed before.

The most important features of upgraded family wells are:

1. They are close to where people live
2. They provide cleaner water than before
3. They are regarded as a family investment
4. They are maintained completely by the family
5. They promote greater use of protected water
6. They build upon techniques already used in traditional practice

WHAT MATERIALS ARE NEEDED

These materials are required to upgrade a family well

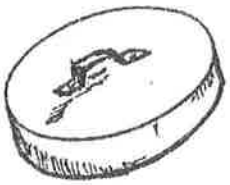


Bucket and Chain (or Rope)

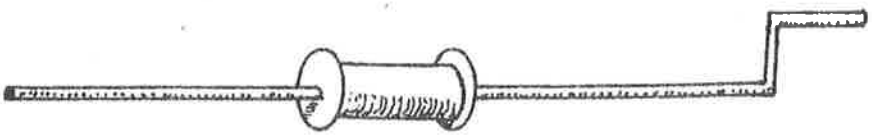
Cement

1 - 6 bags of cement are required to line the well depending on depth. 3 bags of cement are required to build the well cover, the apron and water run-off, and the windlass supports.

Wire for Reinforcing

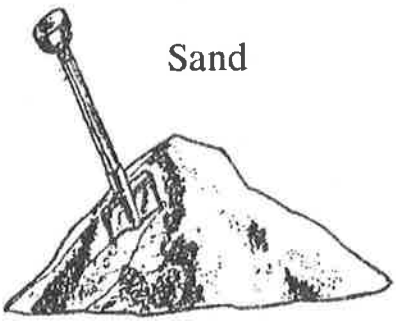


Tin Lid Cover



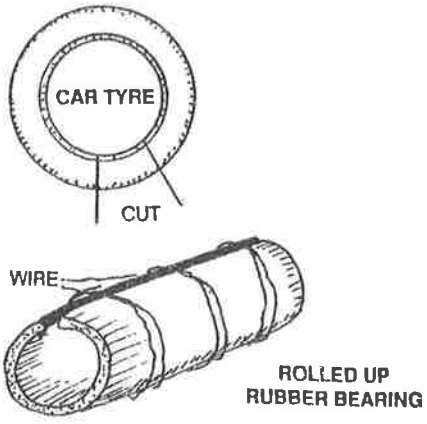
Windlass

Bricks for Lining Well and making Apron and Water Run-off



Sand

River sand for slab
Pit sand for plaster work and mortaring brickwork.



Old rubber tyre
(for windlass bearing)

STAGES IN MAKING AN UPGRADED WELL

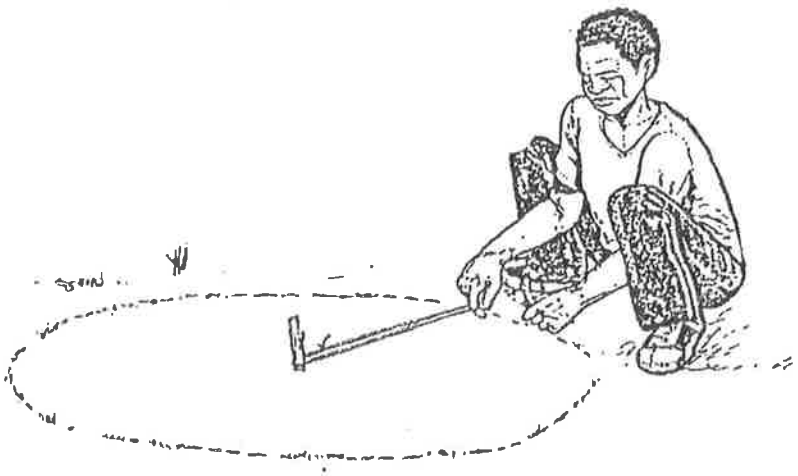
In most cases existing wells will be upgraded. However, new wells can be dug and built in the same way as "Upgraded Wells".

STAGE 1. SITING THE WELL

The well should be sited in a raised position at least 30 metres from a latrine or cattle krall. It should be placed in a convenient place close to the family homestead. Environmental Health Technicians and water diviners should assist in siting.

STAGE 2. MARKING THE SITE FOR DIGGING

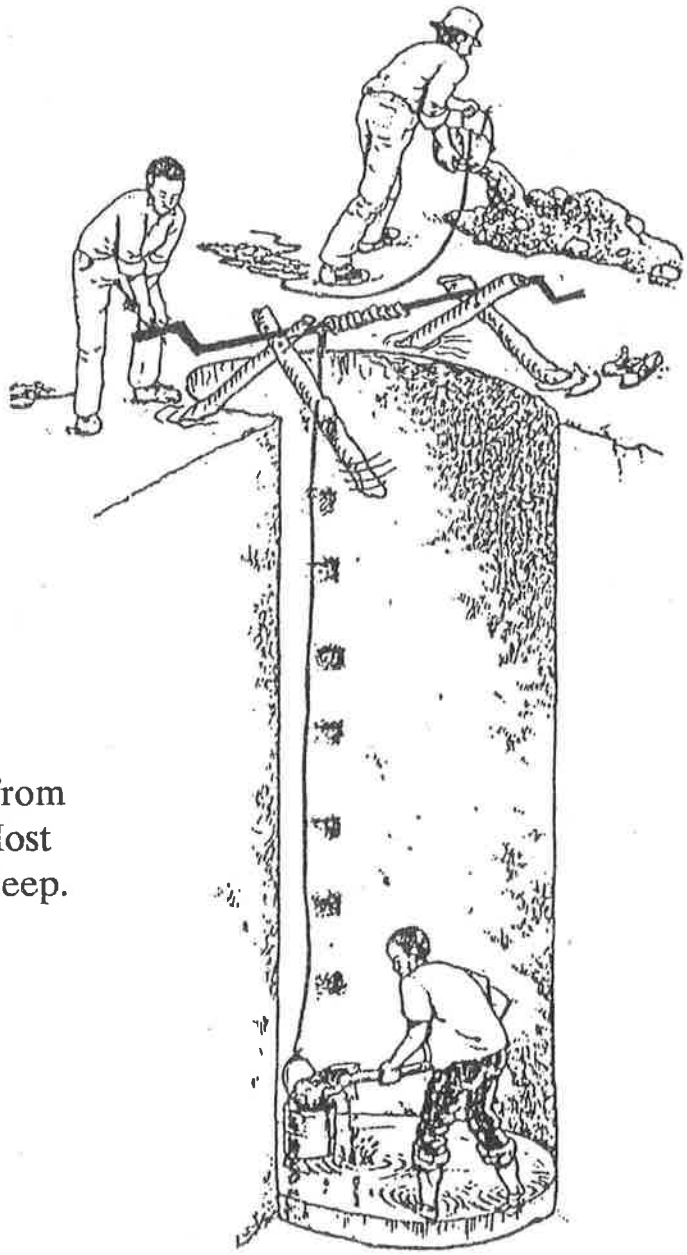
When a new well is dug a 1.5 metre diameter ring should be marked on the ground in the chosen site.



STAGE 3. DIGGING AND DEEPENING THE WELL

A new well should be dug down with straight sides 1.5 metres in diameter. Several people should help, one at the base of the well, and at least two at the head of the well. A windlass should be used to lower and raise the bucket. Steps can be cut in the walls of the well to assist the well digger to climb in and out.

When existing wells are being upgraded, it is wise to deepen them as much as possible during the months of October, November or December when the water table is at its lowest. The deeper a well can be dug, the more reliable it will be in future years. A great effort should be made at the last stage of deepening to locate at least 2 or 3 metres depth of water in the driest part of the year.



If possible 2 buckets should be used at the same time to increase the amount of water extracted, from the well as it enters more deeply into the water table.

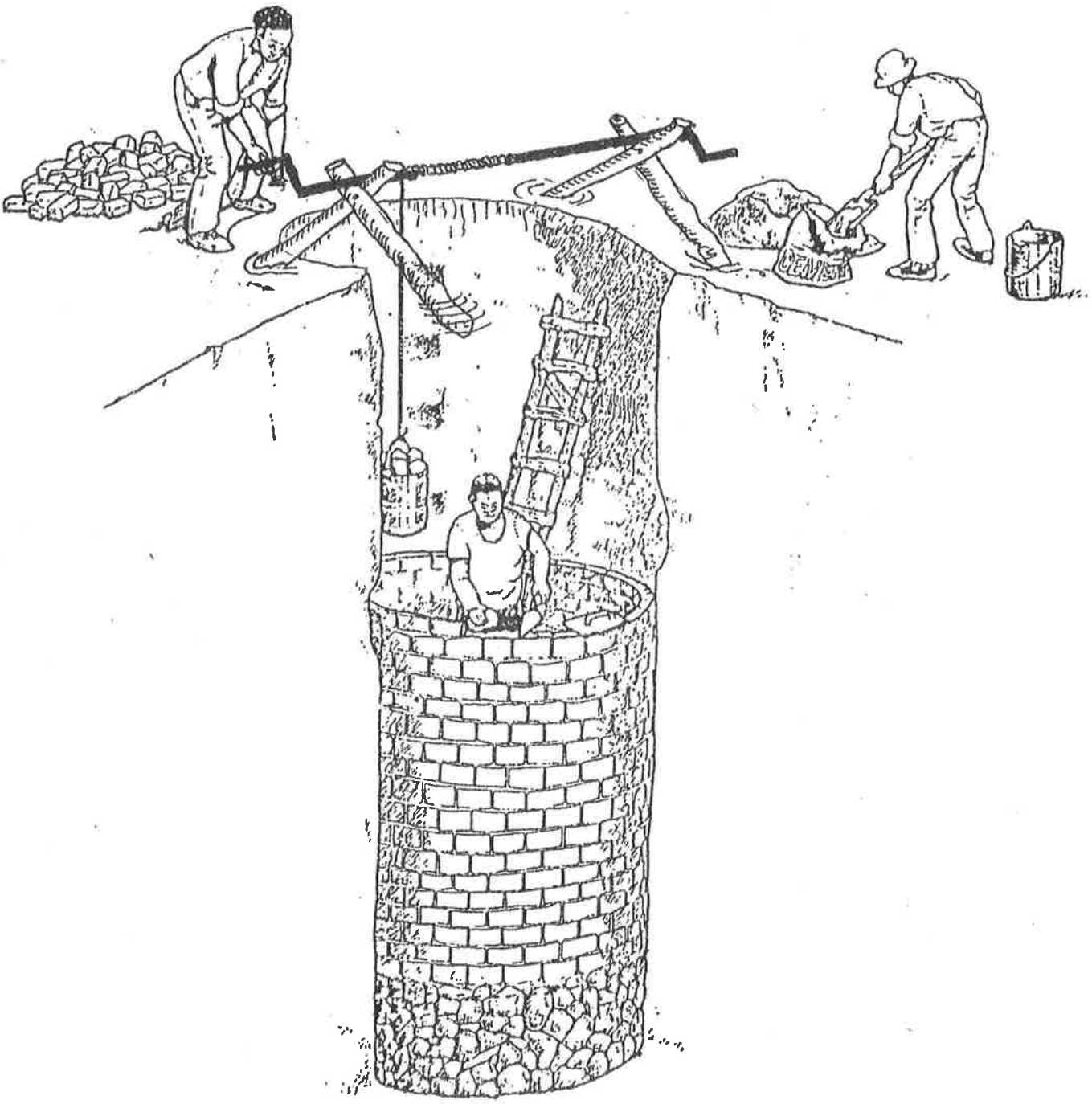
Family wells vary greatly in depth from a few metres down to 30 metres. Most are dug between 4 and 10 metres deep.

NOTE: If an existing well is to be upgraded it must be thoroughly cleaned out before the cover is fitted.

Note: if a subsidy is given for assisting a family to upgrade its well, the well should have been lined with bricks to ground level and thoroughly cleaned out. In addition an effort should have been made to deepen the well. The subsidy is given to improve the headworks only. Normally 3 bags of cement are required for the headworks.

STAGE 4. LINING THE WELL

All upgraded wells should be lined from the top to the bottom. Beneath water level it is difficult to mortar bricks together and the best traditional method is to line this section of the well with flat rocks arranged to form a stable lining. Above the water level, well fired bricks can be used. These should be cement mortared together and built up to the top of the well.



Lining the well under the water with cement mortared bricks

With skill it is possible to line the well with cement mortared brickwork beneath the final water level. Use a strong mixture of cement mortar (3 parts sand to one of cement). Brick up the well lining from the bottom whilst bailing water out of the well continuously for several hours. After about 5 hours allow water to rise up into the well. By this time the brickwork should have risen well above the resting water level, and the first mortar used should be starting to cure. This will continue to cure under the water. Continue to line the rest of the well to ground level.

STAGE 5. ARRANGEMENT OF BRICKS AT WELL HEAD

Most of the well is lined with a brick wall 110mm thick. However the top section should be 225mm thick - this isa double width of brickwork. The 225mm thick wall should begin 3 courses below ground level and rise 3 courses above ground level. The arrangement of bricks is shown in the diagram (Fig.A.). The third course of bricks above ground level is arranged so that the bricks are placed radially as shown in Fig. B.

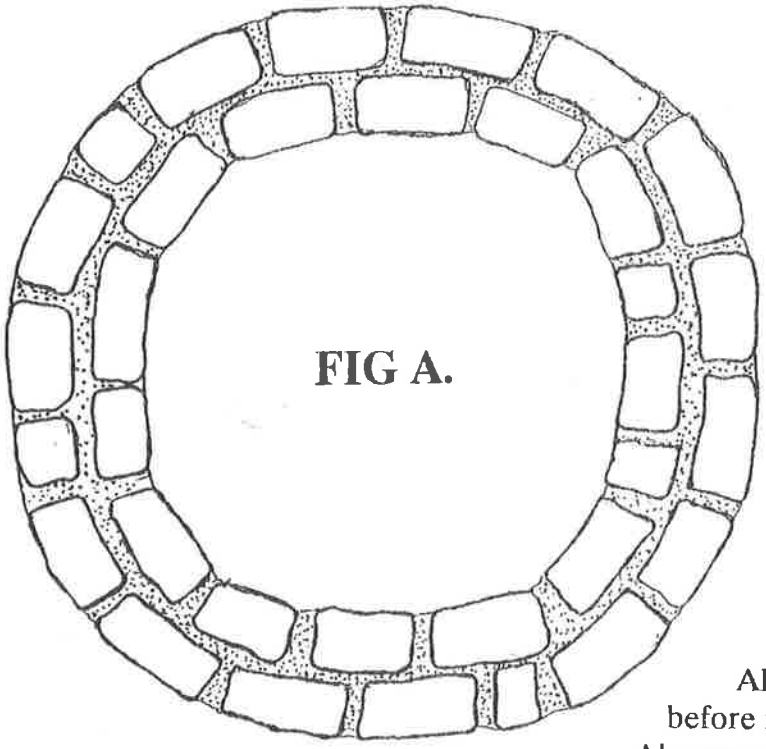


FIG A.

Always soak bricks in water before making the brick column. Also use strong mortar to bond the bricks. This strengthens the brick column

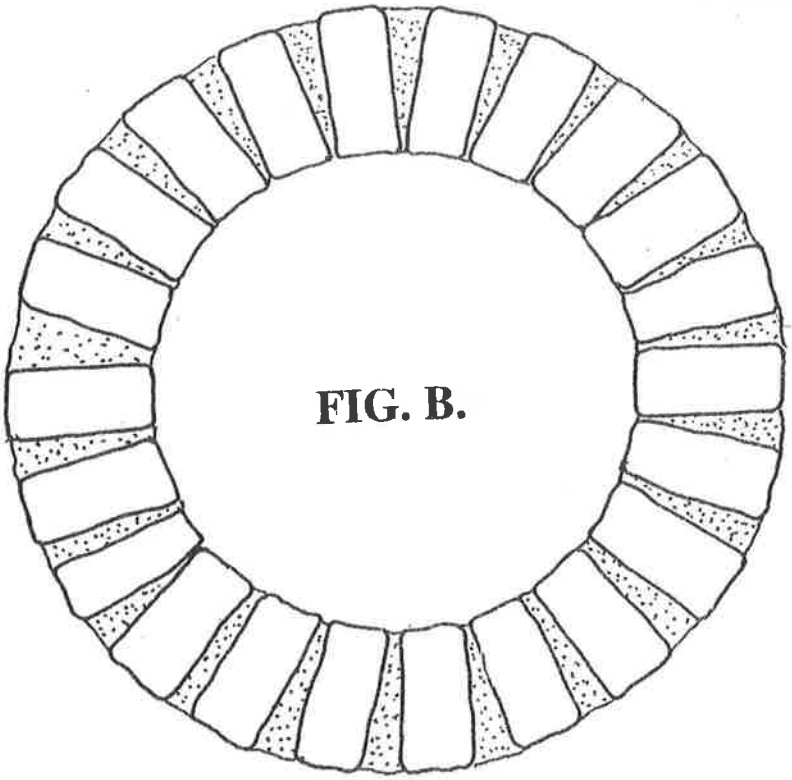
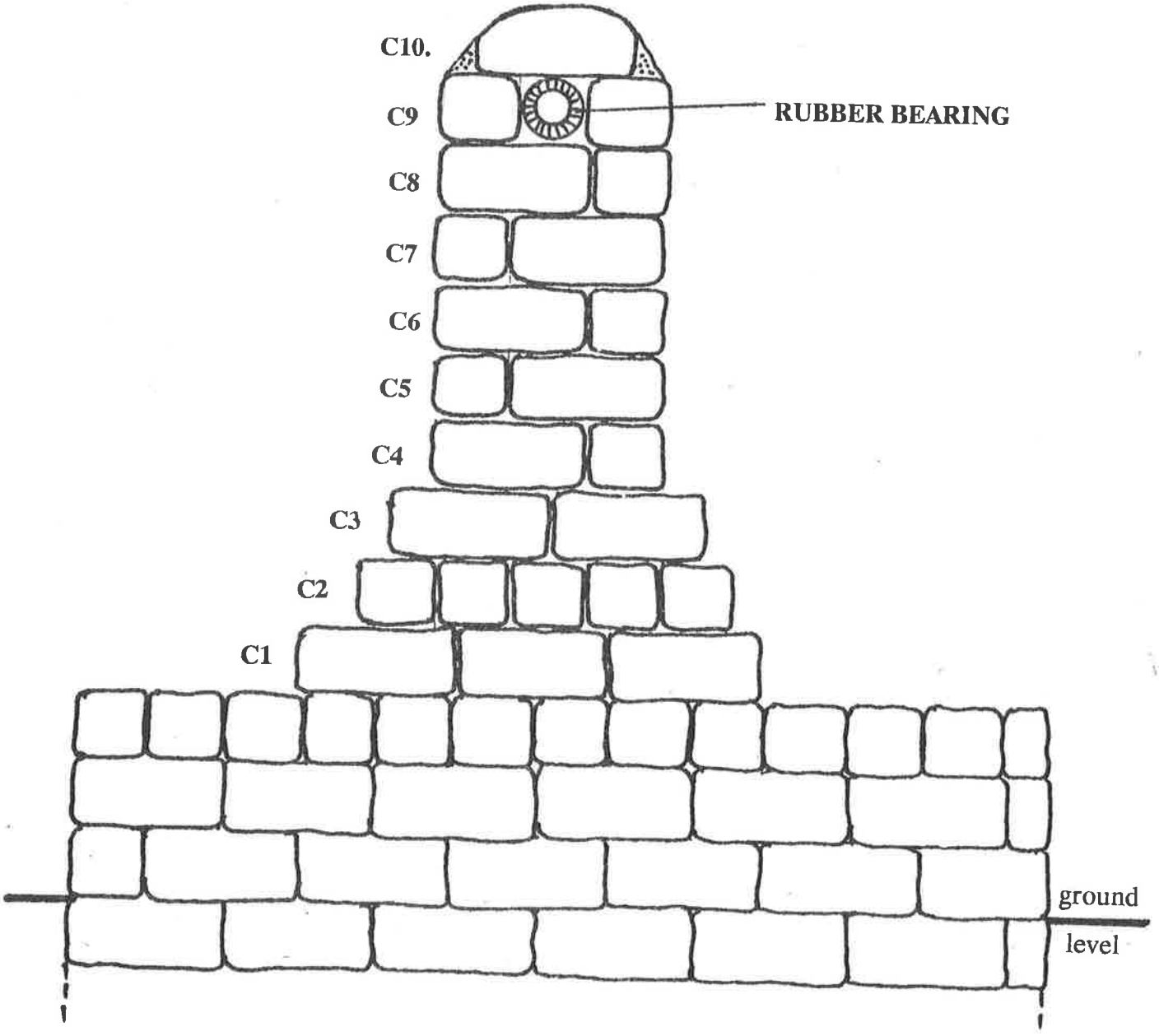


FIG. B.

STAGE 6. BUILDING THE BRICK COLUMNS

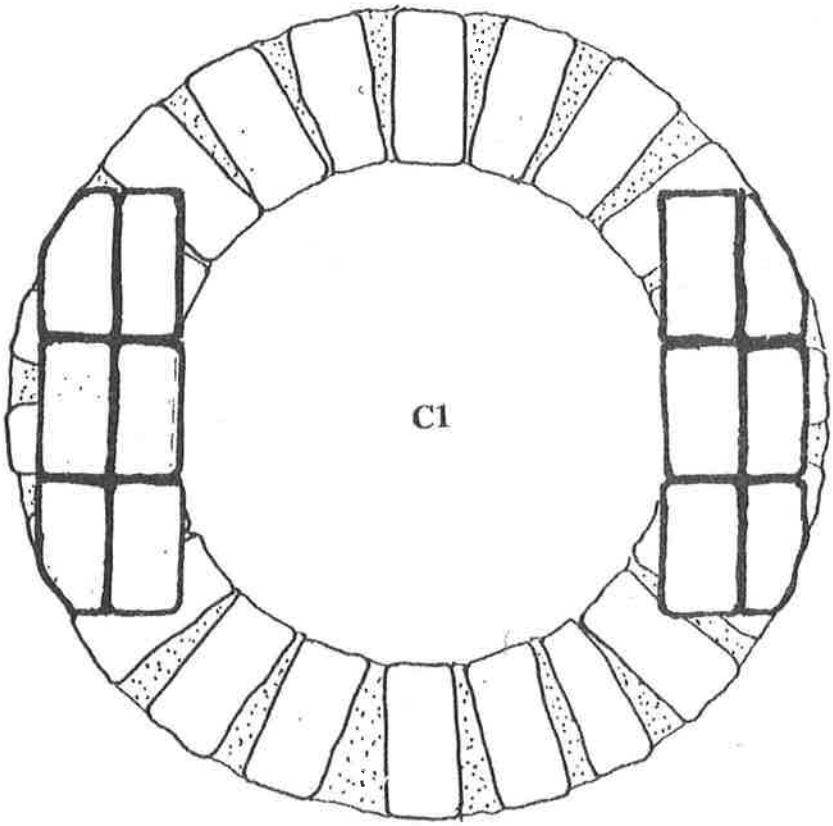
The diagram below shows detail of the arrangement of the brick columns which support the windlass. Note that the base of the column is wider than the upper section. The column is built with a broader base because this adds strength to the structure. Note the position of the rubber bearing which is surrounded by mortared brickwork. The bricks used in the column should be strong and soaked in water before construction. A strong mortar mix should be used throughout, 5 parts sand to one part cement.



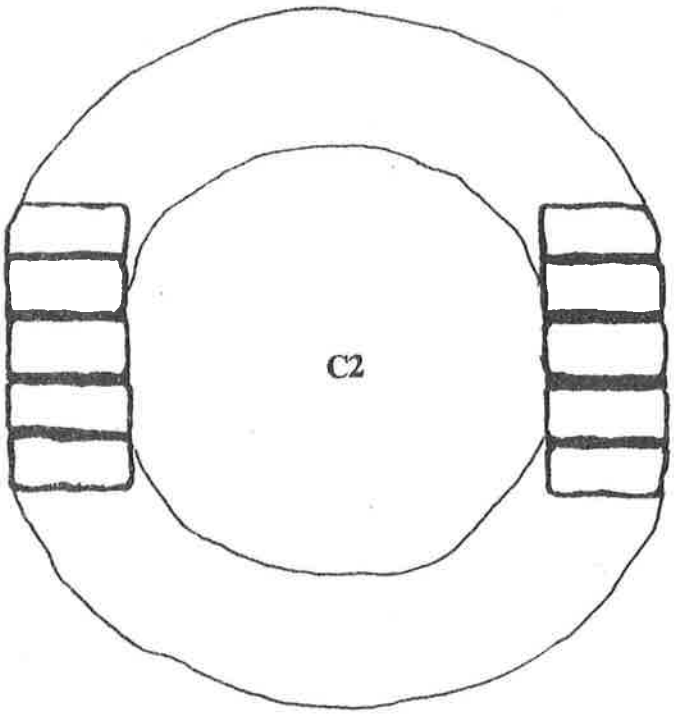
Note the courses in the brick column are labelled C1 to C10. The arrangement of bricks in each column is shown in more detail in the following pages of this manual.

STAGES IN MAKING THE BRICK COLUMN

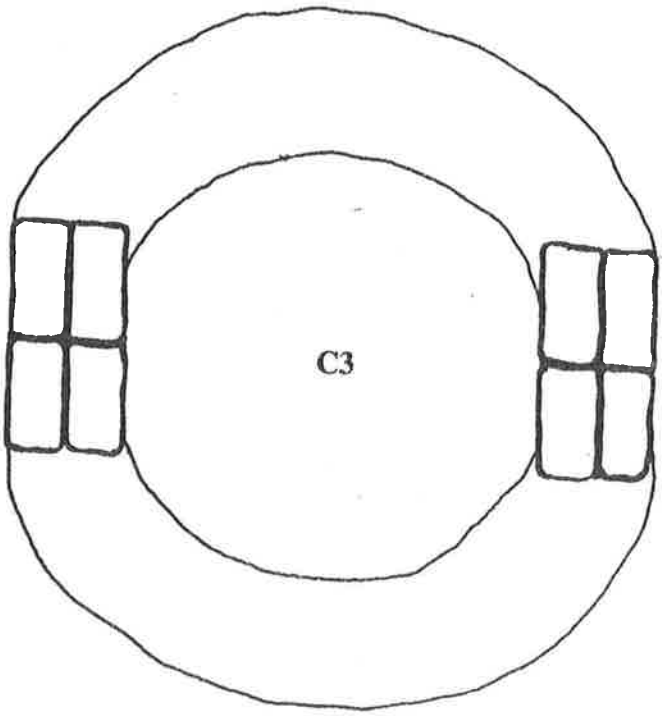
The following sequence of diagrams shows how the column is built . For clarity the courses in the column are numbered 1 - 10. The base of the column which sits on the 225mm thick well lining is made with 6 full bricks as shown in C1 (course 1.). Course 2 (C2) has 5 full bricks laid side by side. C3 is made with 4 full bricks and courses C4 and upwards each has 3 full bricks arranged as shown in the diagrams.



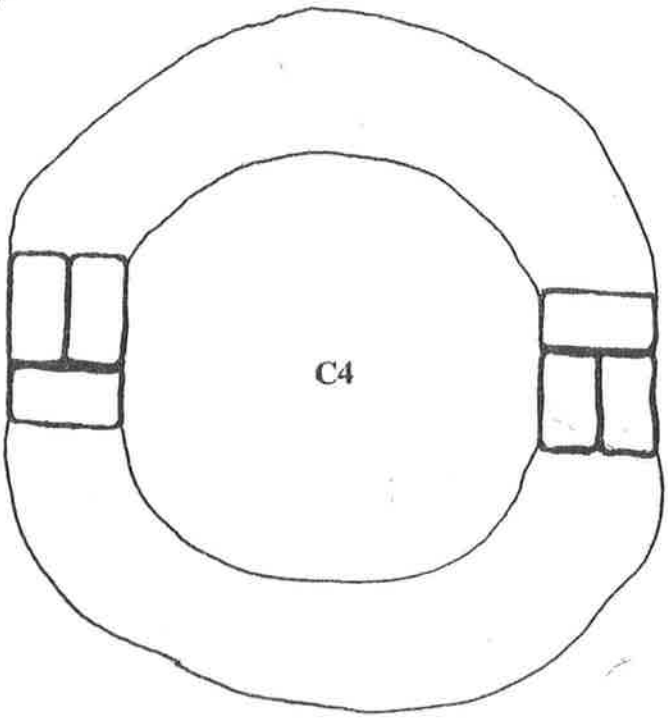
1st course of brickwork in column



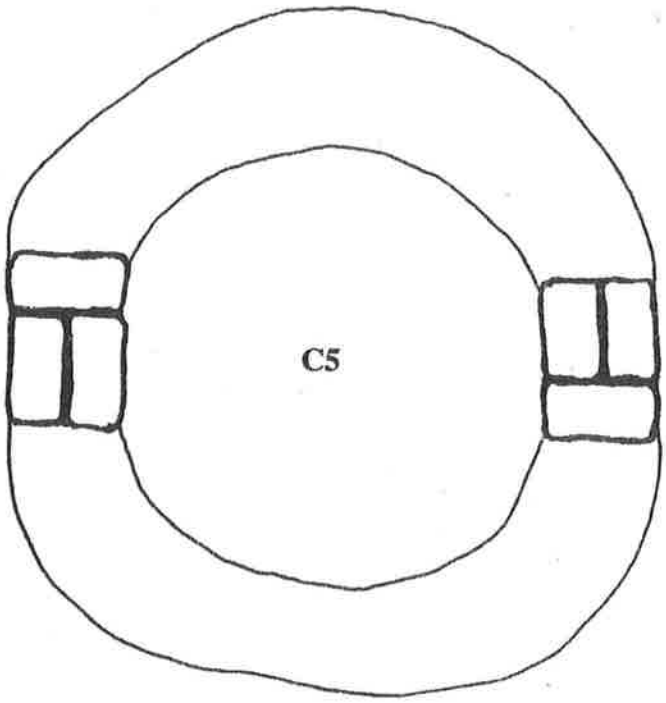
2nd course of brickwork in column



3rd course of
brickwork in column



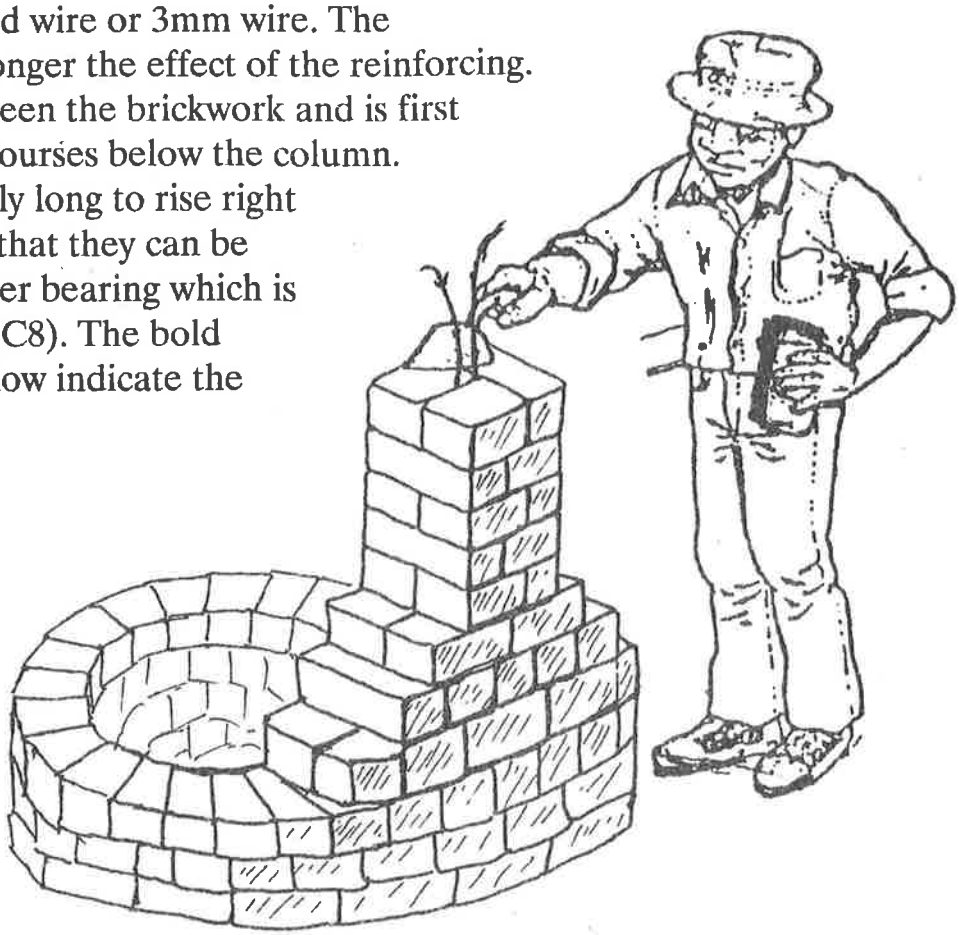
4th course of
brickwork in column



5th course of
brickwork in column

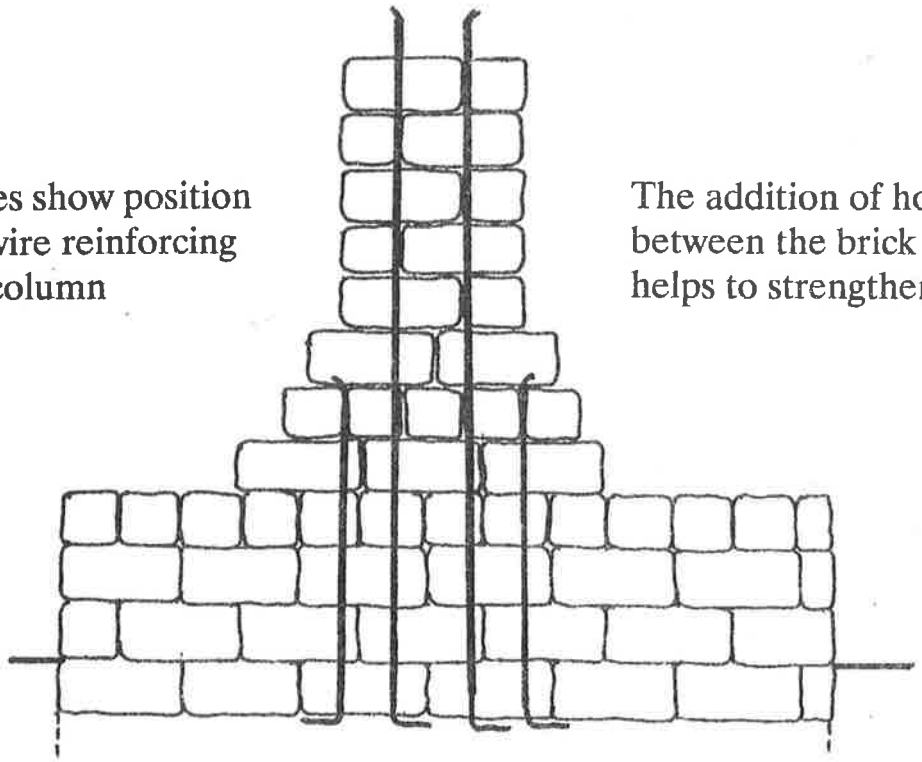
THE WIRE REINFORCING

Note that the brick columns are strengthened with steel wire reinforcing. The wires should be made with strong barbed wire or 3mm wire. The thicker the wire the stronger the effect of the reinforcing. The wire is placed between the brickwork and is first laid down in the brick courses below the column. The wires are sufficiently long to rise right through the column so that they can be used to secure the rubber bearing which is placed above course 8 (C8). The bold lines in the diagram below indicate the positions of the wires.



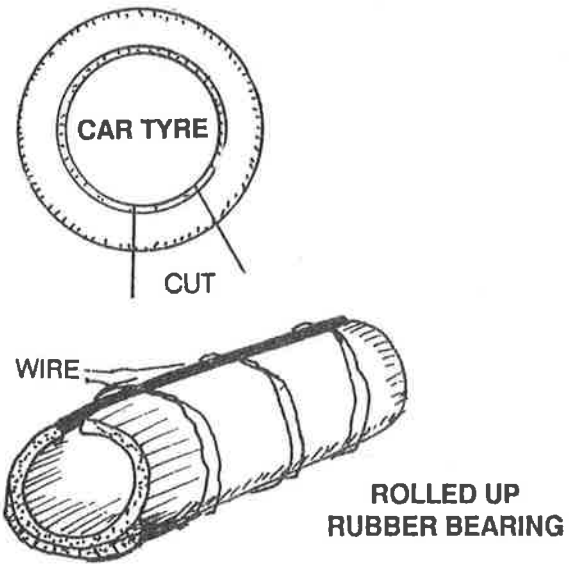
Dark lines show position of steel wire reinforcing in brick column

The addition of horizontal wires between the brick courses also helps to strengthen the column



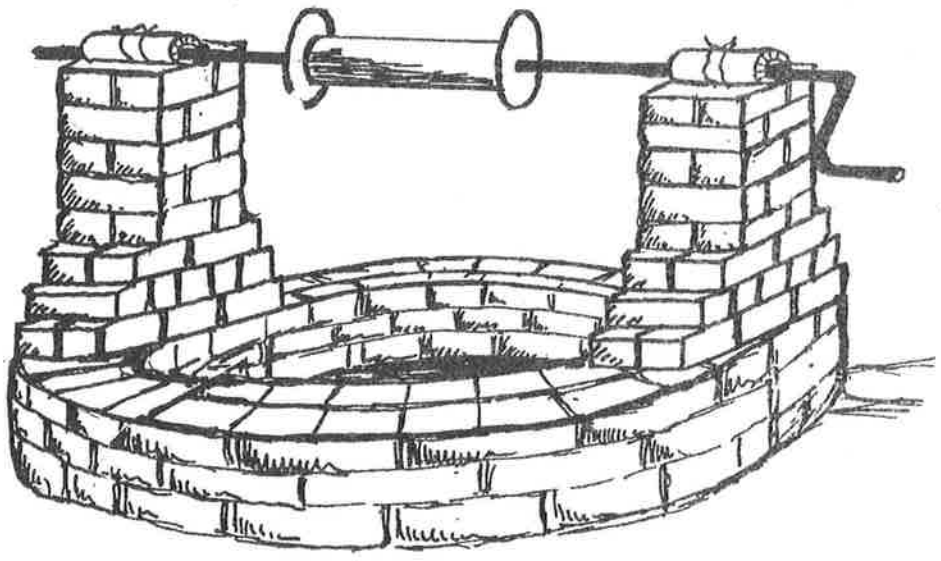
STAGE 7 ADDING THE WINDLASS AND ITS BEARINGS

The windlass which is mounted on the brick columns is supported within a bearing made of a cut piece of old car tyre. The section of tyre is cut and rolled up and held in position with wire as shown in the diagram. The two longer pieces of wire set within the brick columns are used to tie the bearing in position. The bearings are mounted in the correct place, with the windlass attached, and bound with the wire The final bricks of the column are built up over the bearing and mortared in position. The upper end of the column is plastered to increase its strength. Grease is applied to the surface between the bearing and the windlass.



MAKE THE RUBBER BEARING AS THICK AS POSSIBLE - THE THICKER THE BEARING THE LONGER THE LIFE.

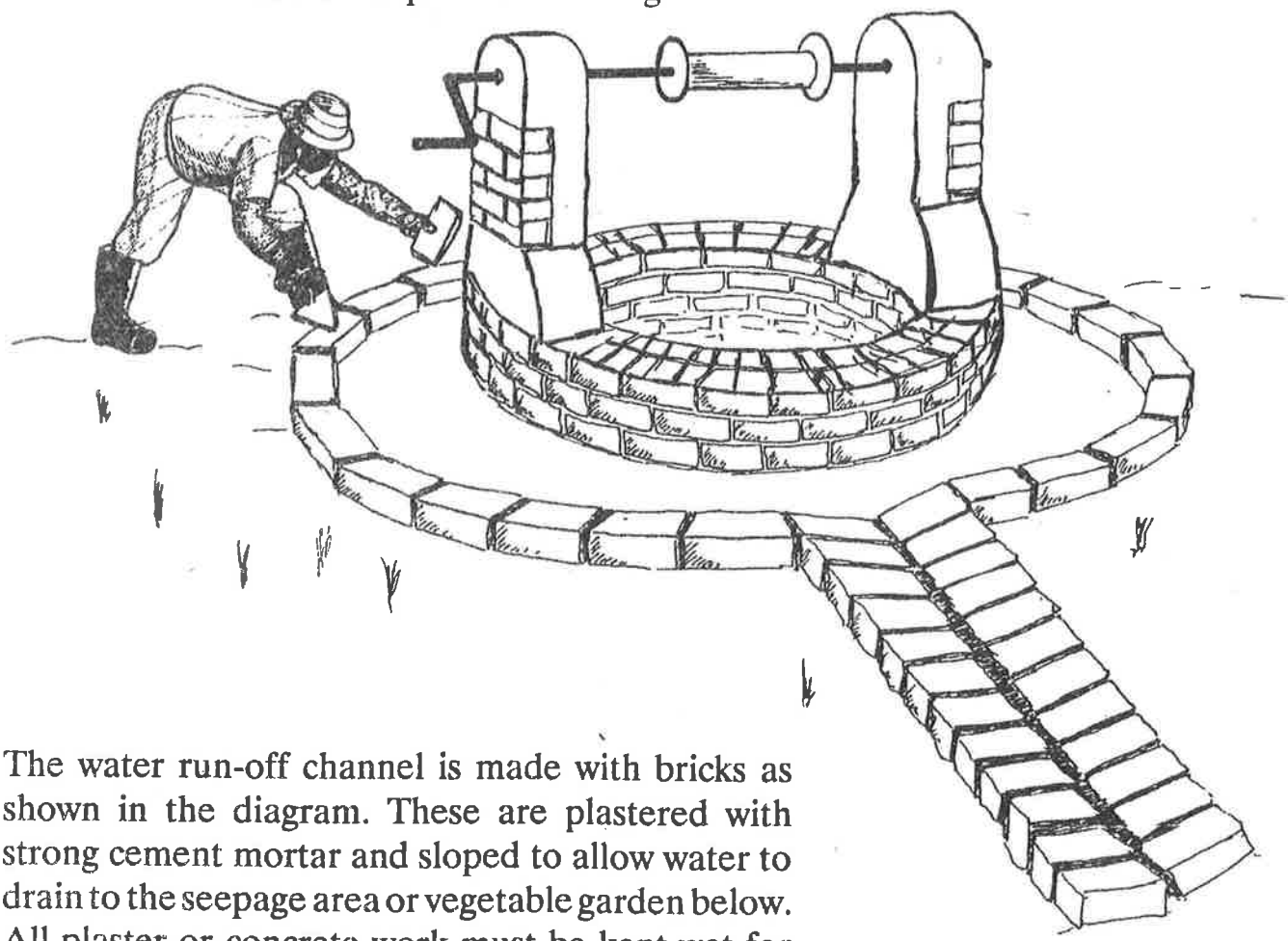
PROLONG BEARING LIFE BY GREASING REGULARLY



STAGE 8 MAKING THE APRON AND WATER RUN-OFF CHANNEL

After plastering the internal walls of each brick column as shown, the well apron and water run-off channel can be made. The apron extends at least 0.5 metres around the outside of the well lining. The water run-off channel should be at least 2 metres long but may be increased to 3 or 4 metres if cement is available. The apron provides a clean surface on which water can be collected and also a drainage area to carry waste water from the well to a seepage area or vegetable garden some distance away.

A circle of bricks is laid around the well as shown and some half bricks are laid within this. Concrete is now laid about 100mm deep within the circle of bricks which form the rim of the apron. The rim should be raised higher that the apron itself and all surfaces should be sloped so that all water drains towards the run-off channel. The concrete mixture is either 5 parts washed river sand and 1 part cement or 4 parts stone, 2 parts river sand and 1 part cement. The apron should be reinforced with wire to prevent cracking.

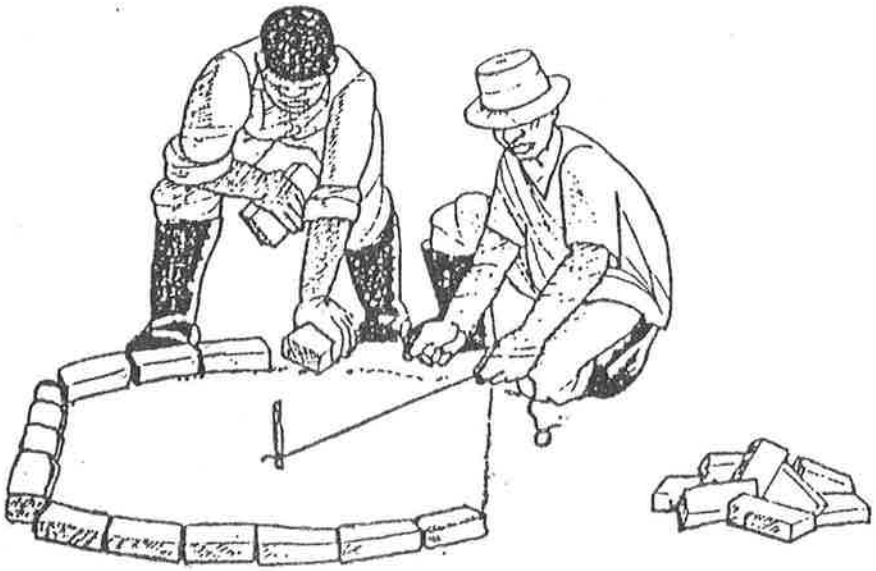


The water run-off channel is made with bricks as shown in the diagram. These are plastered with strong cement mortar and sloped to allow water to drain to the seepage area or vegetable garden below. All plaster or concrete work must be kept wet for several days to allow it to cure properly and develop strength.

Poorly made aprons and run-off channels have a tendency to crack, and this can lead to pollution of the well if waste water is allowed to find its way from the apron into the well chamber.

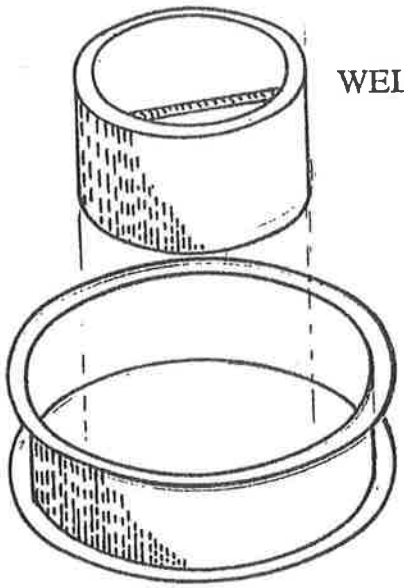
STAGE 9. MARK OUT THE WELL COVER SLAB

A concrete well cover slab must now be made. This fits between the brick columns over the well chamber. Measure the diameter of the well and the distance between the two brick columns and mark this shape on the ground near the well. Place bricks around the mark to form a mould in which the concrete is laid.

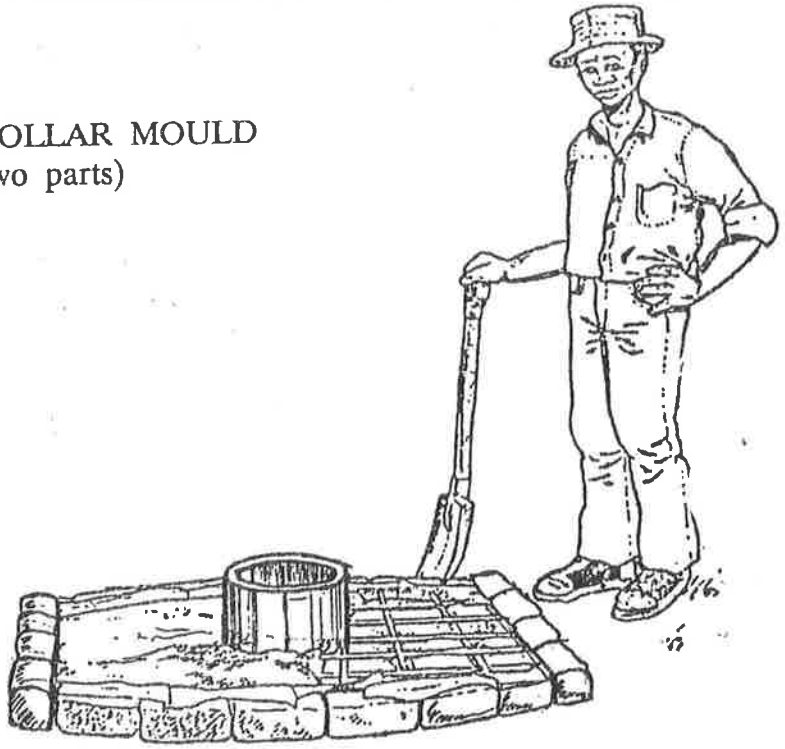


STAGE 10. CASTING THE WELL COVER SLAB

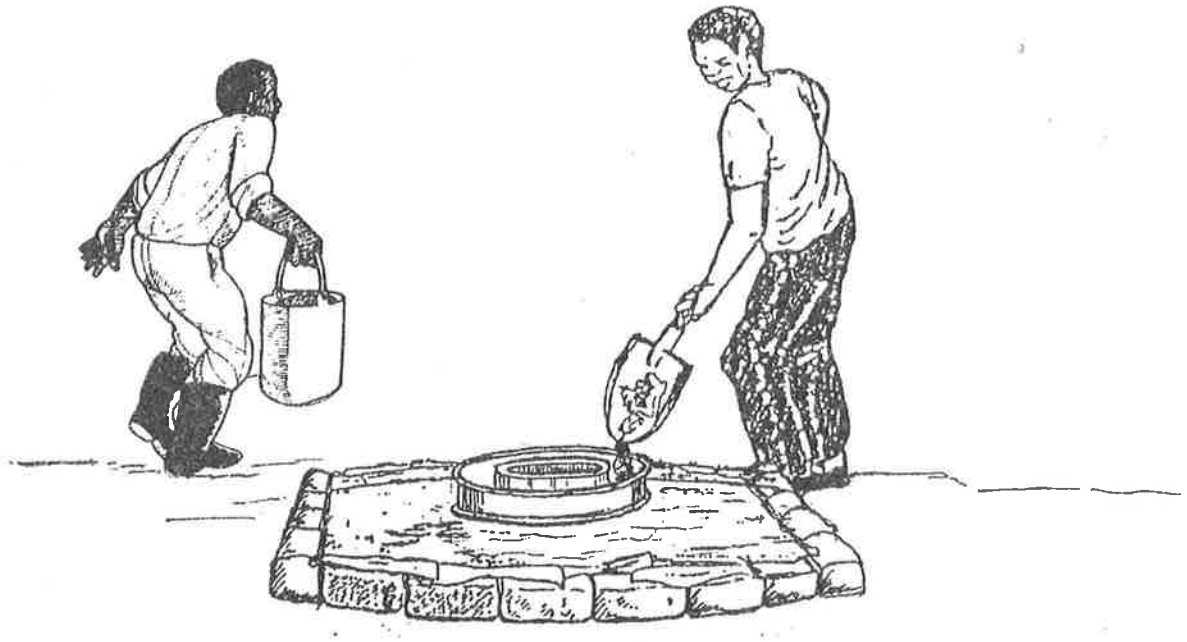
This is best made in one piece including the raised central collar on which the tin lid fits. A special mould is available to make the central hole and raised collar and comes in two parts, an inner deeper mould which forms the central hole and an outer shallower mould which forms the shape of the raised collar. These are shown in the diagram. If these moulds are not available a tin container can be used for the inner mould and bricks for the outer mould. The central hole is 40cm in diameter and the outer rim 55cm in diameter, over which the tin lid fits.



WELL COLLAR MOULD
(Two parts)



The slab is made with a mixture of concrete containing 5 parts of clean river sand and 1 part of cement (or 3 parts stone, 2 parts river sand and 1 part cement). The inner steel mould is placed in the middle of the brick mould. Some 3mm reinforcing wire is now cut and laid in a grid pattern within the mould with 150mm spaces between. The wire is removed and a layer of wet paper or plastic is laid within the mould. The concrete mixture is now added to half fill the mould. The wires are then added and then the remaining concrete is added and levelled to form a slab 75mm thick. This should take about half a bag of cement, but depends on the size of the well.



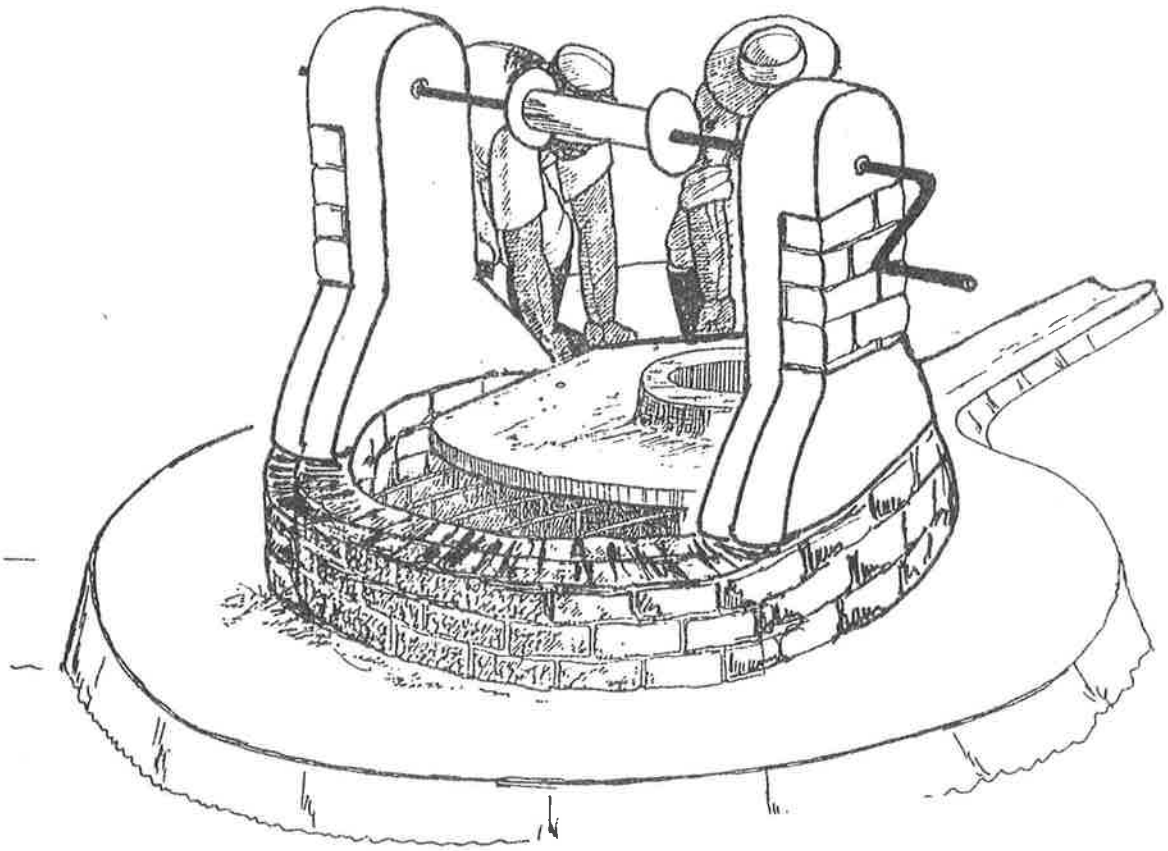
The outer mould is then added so that it is placed centrally around the inner mould. The upper ends of both moulds should be at the same level. The space between the inner and outer mould is then filled with a mixture of 3 parts river sand and 1 part cement. This is rammed firmly and trowelled flat. This section forms the raised collar of the well cover. This is left to cure for another hour. After this period the moulds are removed - the inner mould is carefully removed first with a circular motion. The outer mould is then carefully removed in the same way. After the moulds have been removed the collar is finally shaped and smoothed carefully with a thin piece of plastic which is used to round off the two upper corners of the collar.

THE TIN LID

The tin lid can be made by a tinsmith in galvanised tin sheet. It should be about 560mm wide and about 75mm deep. It should also be fitted with a handle. The tin lid should fit neatly over the raised collar of the well slab.

STAGE 11. FITTING THE WELL COVER SLAB

The well cover slab is left to cure for at least 5 days and kept wet at all times. Next, the well cover is carefully lifted (with a twisting motion), cleaned and moved to the well where it is placed on a bed of cement mortar laid centrally over the well lining brickwork. The corners at either end of the brick columns are build to up with half bricks to the level of the slab and mortered in position. Final mortar work is now laid around the slab and the side walls of the well to neaten and strengthen the structure.



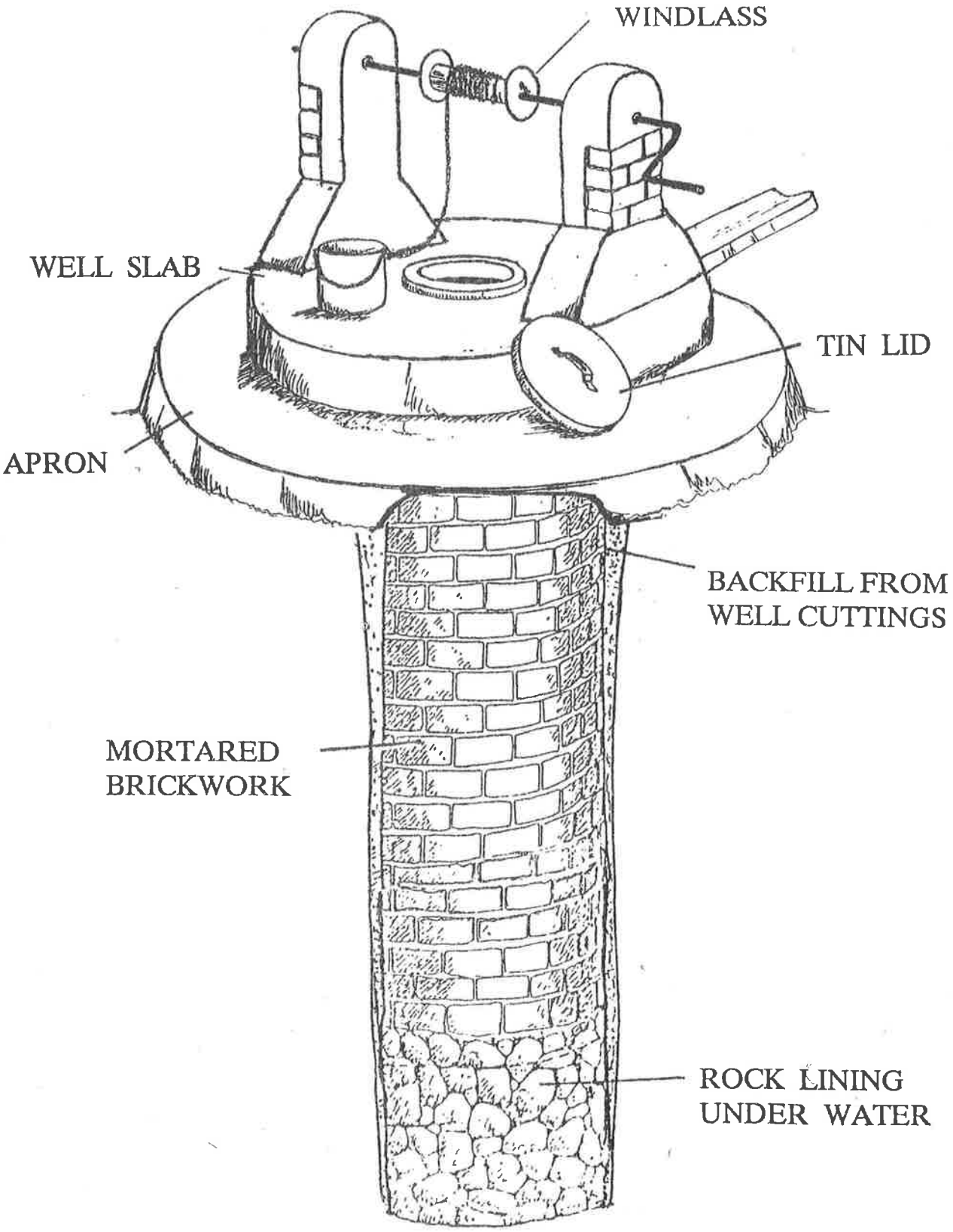
THE WINDLASS

This is an important part of the upgraded well and provides a hygienic place for wrapping the rope or chain as well as a means of lifting the bucket from the well. Where a strong windlass is found on an existing well, this can be used on the upgraded well. If the existing windlass is not strong, a new windlass should be used. A new windlass is required on a newly built well.

THE BUCKET AND CHAIN

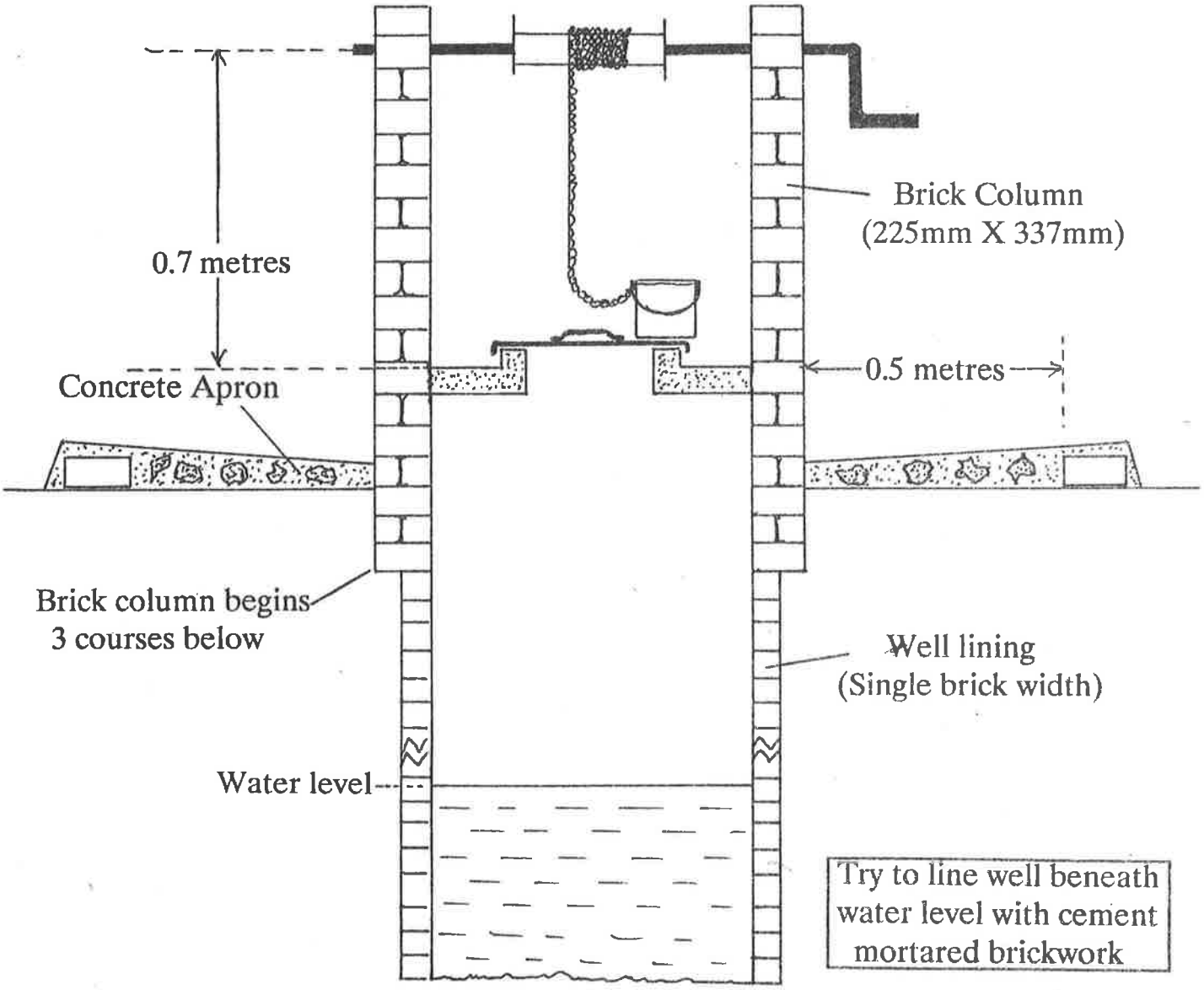
A strong 10 litre bucket should be used with the upgraded well. The bucket should be weighted on one side so that it tips up and fills with water easily. Chains are more hygienic than rope since they dry out more rapidly and should be fitted to the bucket and windlass with wire. 3mm steel cable can also be used. If nothing else is available rope can be used.

CROSS SECTION OF UPGRADED WELL



CROSS SECTION OF UPGRADED WELL

(Showing arrangement of brickwork)



LOOKING AFTER THE UPGRADED WELL

A carefully made upgraded well fitted with a strong windlass, chain and bucket, will provide many years of service with little maintenance being required. Ideally two to three metres of water should be retained in the well. It is possible for a well digger to enter the well head through the opening, in order to deepen the well should the water table fall. It is also important that the well is cleaned out periodically to ensure the best quality water.

The following points are important:

1. Keep the bucket clean and off the ground
2. Hang the bucket on the windlass or upside down on the lid when not in use
3. Keep the tin lid in place
4. Keep the apron, run-off and seepage area clean
5. Always use the same bucket in the well
6. Keep the chain wrapped around the windlass
7. Repair damage to the well and its components as soon as possible
8. Replace parts which are worn out as soon as possible
9. Grease the rubber bearings regularly

Family health will be improved if:

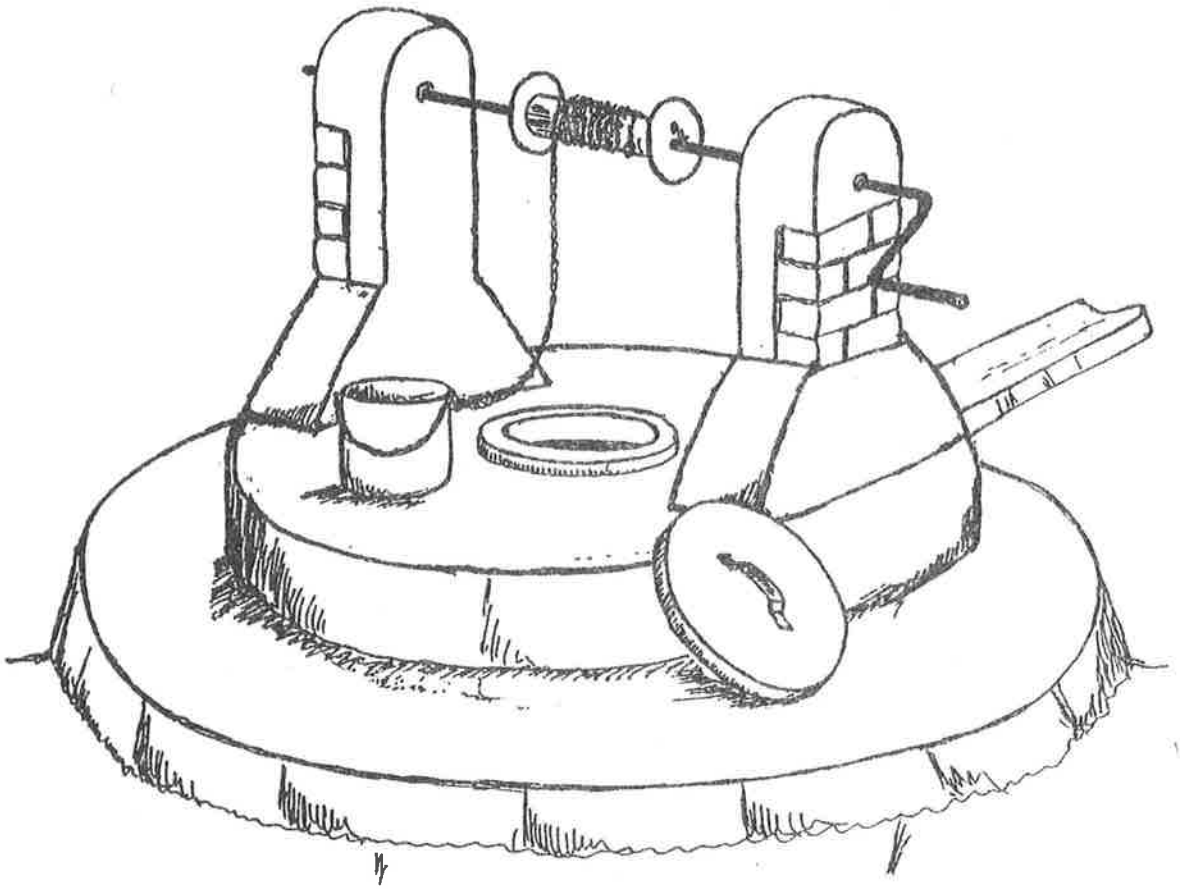
1. Stored water is kept in a clean covered container
2. Vegetables are grown near the well and eaten regularly
3. Plenty of water is used with soap to clean the hands and the body
4. Water is drunk regularly, especially in hot weather
5. The hands are washed before eating and after every visit to the toilet
6. The living environment of the homestead is kept clean and dry
7. The kitchen and the utensils used in it are always kept clean
8. All waste material is disposed of in a garbage pit
9. Food should be stored in a dry well ventilated pantry

REMEMBER

IT IS POSSIBLE TO IMPROVE THE WELL FURTHER BY FITTING A HANDPUMP

HOW TO LOOK AFTER YOUR WELL

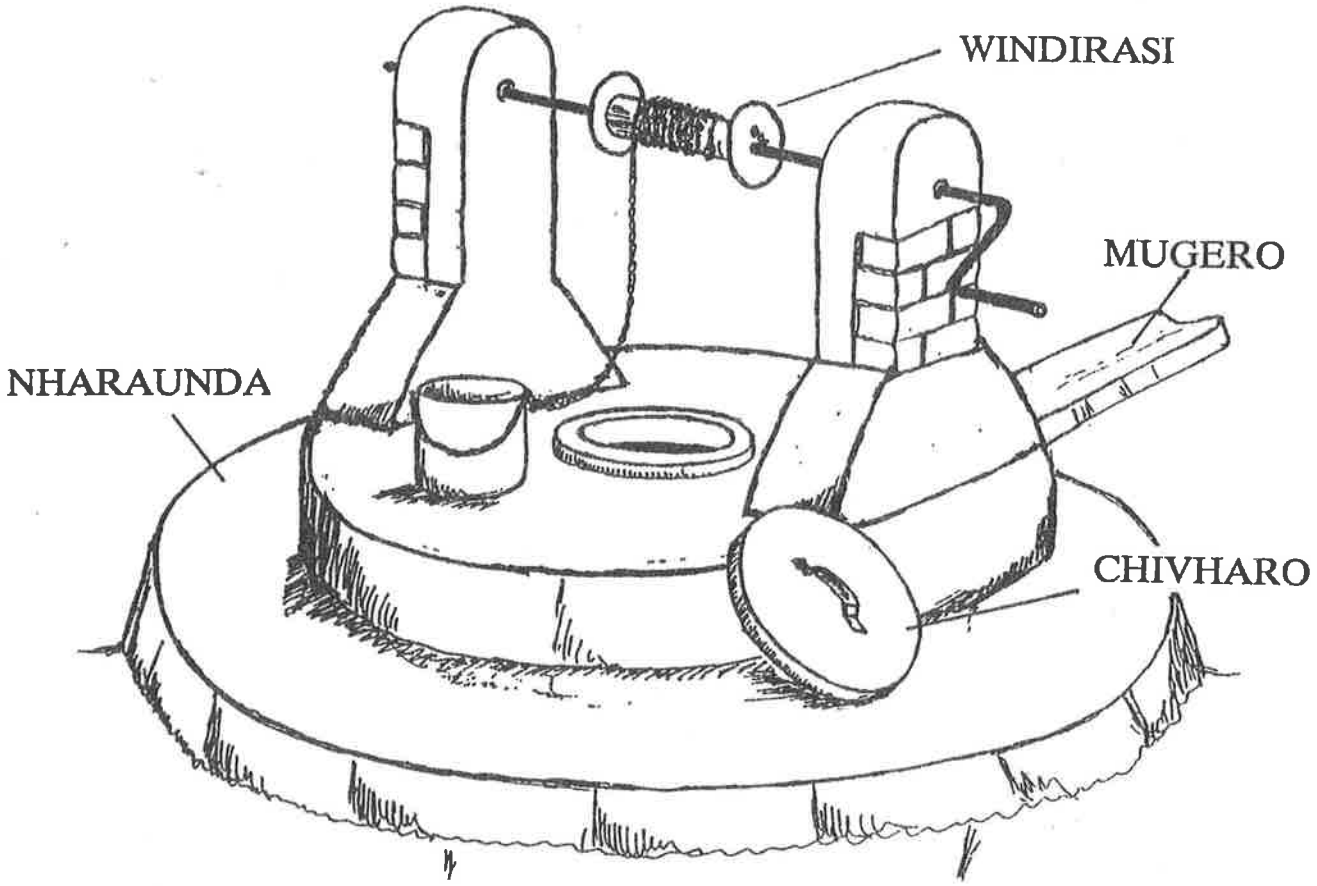
You can make sure the water from your upgraded family well is clean by maintaining the well as follows:



1. **Keep the bucket clean and off the ground**
2. **Place the bucket on the well cover or windlass handle when not in use**
3. **Keep the tin lid in place**
4. **Keep the apron and water run-off clean**
5. **Always use the same bucket in the well**
6. **Keep the chain wrapped around the windlass**
7. **Keep the rubber bearing well greased**

KUCHENGETEDZWA KWE TSIME

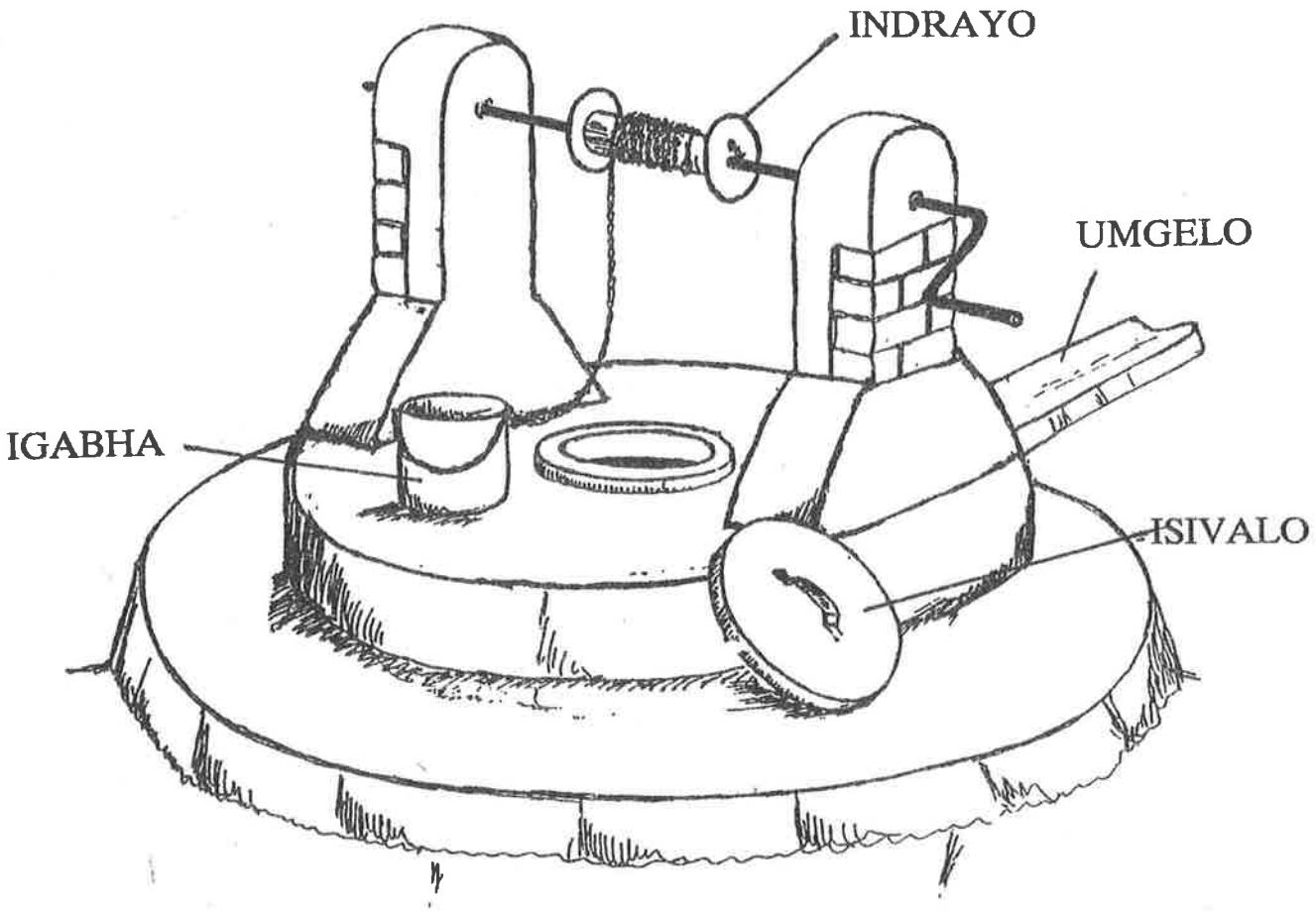
MUNOKWANISA KUNWA MVURA YAKANAKA YAKACHENA KUBVA MUTSIME RAKAVAKIRWA KANA MUCHICHENGETA TSIME RACHO PAMWE NE GABA ZVAKANAKA



1. CHENGETAI GABA RAKACHENA
2. REMBEDZAI GABA PACHIBATO CHE-WINDIRASI KANA KUKWIDIBIRA PAMUSORO PE TSIME
3. GARAI MAKAVHARA TSIME NECHIVHARO
4. CHENGETEDZAYI NHARAUNDA YETSIME YAKANAKA YAKACHENA
5. SHANDISAYI GABA RIMWE CHETE PAKUTEKESA MVURA MUTSIME
6. CHENI NGAIGARE YAKAMONERWA PA WINDIRASI
7. ONAYI KUTI MABEYARINGI ENYU AGARE ANE GIRISI

UKUPHATHWA KOMGODI

LINGANATHA AMANZI AHLANZEKILEYO AVELA EMGODINI OWAKHIWEYO NXA UMGODI LEGABHA KUHLALA KUHLANZEKILE



1. GCINANI IGABHA LIHLANZEKILE
2. BEKANI IGABHA PHEZU KWESANDLA SENDRAYI
3. HLALANI LIVALILE UMGODI NGESIVALO SAWO
4. MAYIHLALE IHLANZEKILE INDAWO EGOMBOLOZELE UMGODI
5. SEBENZISANI GABHA ONALELO KHUPHELA UKUKHISA AMANZI
6. ITSHEYINI MAYIHLALE ITHANDELWE ENDRAYINI
7. OYILANI AMARABHA ASENDRAYWENI

HOW TO IMPLEMENT UPGRADED WELL PROGRAMMES

Public Health improvements arising from upgraded well programmes can be expected if the coverage in any one area is good and also if the physical programme is accompanied by health educational campaigns which emphasise the importance of personal hygiene and proper use of water in the environment.

Upgraded well programmes currently being undertaken by the Ministry of Health in Zimbabwe are geared to the improvement of several hundred units per active Ward per year. The yearly total is several thousand units, nation-wide. The following points must be followed if an implementation programme is to be successful.

1. Upgraded well programmes require close supervision by District Environmental Health Officers and their staff. Ideally each District should identify its own District Trainer who should be a senior member of the team.

2. Projects should be based at the Ward level, so that they are manageable in size.

3. There should be no limit to the number of craftsmen (builders) to be trained. Builders should be paid collectively during the period of training, and individually when the local Environmental Health Technician has been satisfied that the builder has the necessary skills. Only builders who have their own tools can present themselves for training.

4. Districts and Wards that show more commitment towards project implementation should receive generous support and be allowed to upgrade more units per given period. The following factors should also be taken into consideration:

a) The Ward should have large numbers of family wells
b) The wells should be reliable during the dry season
c) The MOH staff should be motivated and have access to transport
d) The community and local leaders should be motivated
e) The families and leadership should express a felt need
f) Transport should be available at district level to ferry materials

5. Training of local builders and MOH staff is an important part of the upgrading exercise.

6. Village Community Workers should be involved from the beginning and they should regularly hold meetings to check on progress.

7. Involvement of the VIDCO Chairpersons, Councillors and other influential people from different organisations should be encouraged.

8. Record keeping and reporting should be seen as important parts of good management.

9. Many new wells are dug in areas where upgraded well projects are in progress. This should be encouraged.

10. Where special funding arrangements have been made, the subsidy of 3 bags of cement, a windlass and tin lid should be made available to those householders who own a brick lined well and who are able and willing to take advantage of the subsidy.

11. If householders are able to provide their own cement, then this should be encouraged.

MAP OF ZIMBABWE SHOWING SHALLOW WELL & DEEP WELL/BOREHOLE AREAS