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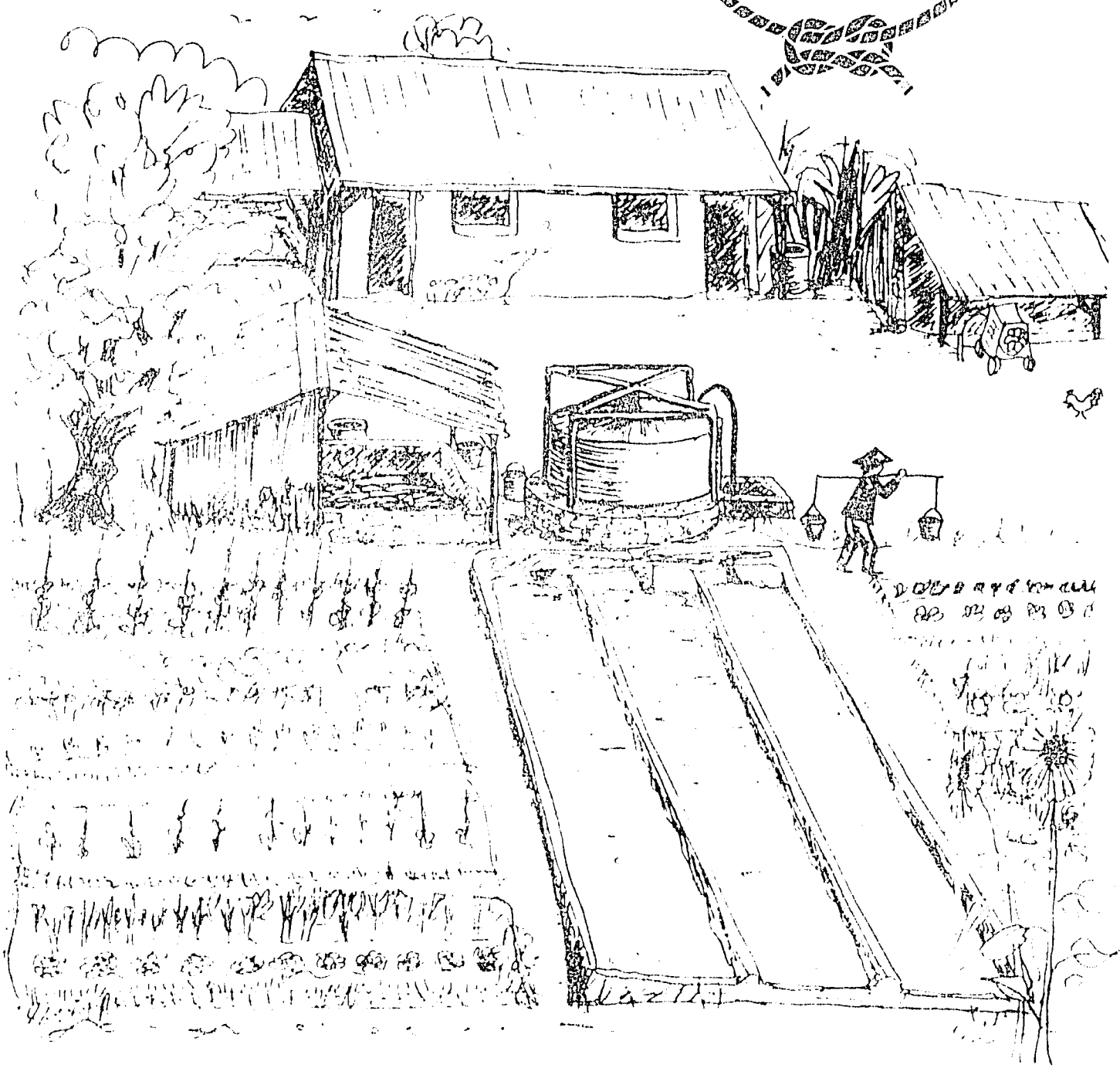
SCOUTING, DEVELOPMENT AND APPROPRIATE TECHNOLOGY



PART 3. - "HOW TO..." - SCOUT PROJECT No. 7

(A Bio-Gas Plant)

SCOUTING, DEVELOPMENT AND APPROPRIATE TECHNOLOGY

SUMMARY

PART 1. - UNDERSTANDING THE PROBLEM - WHAT SCOUTS CAN DO

Part 1 is a simple outline of the problems and possibilities of technology in the process of community development. It discusses how the right kind of technology can improve the standard of living in the community. It shows also what Scouts can do to make the community aware of more appropriate technology, and to develop and utilize it themselves.

PART 2. PART 3. - "HOW TO..."

Parts 2 and 3 provide technical descriptions for several simple projects that Scouts could work on in their communities. They include projects to make water cleaner, to preserve food longer, and several others. You will need to choose the ones most appropriate to your situation.

HOW TO USE THESE BOOKLETS

These booklets are written for National Scout Associations, Scout leaders and other interested organizations. They can be used :

(a) in regular Scout leader training meetings and Scout activities,

(b) in workshops on community development and appropriate technology,

(c) as a basis for producing material on appropriate technology in other languages,

(d) as a manual for appropriate technology projects.

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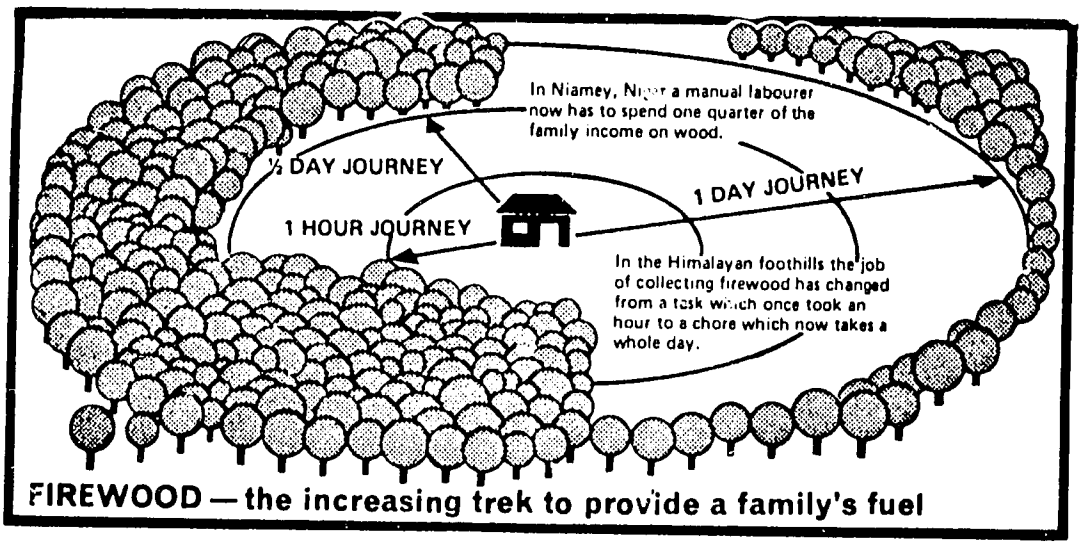
PROJECT 7. BIO-GAS - AN ALTERNATIVE FUEL

THE PROBLEM

Energy has become very expensive. Great areas of forests have been cut down for timber, because timber provides energy for cooking in most villages and many towns. Not only do villagers have to walk much further to collect firewood sometimes up to a day's journey - it also means the towns people have to pay a greater part of their basic income for it. Furthermore, erosion is increasing where the trees have been cut down and no new trees planted. Eroded land may mean less food production and more malnutrition; and less human energy for collecting firewood and the other tasks. For villagers spend a great deal of time and energy doing their daily tasks.



FIREWOOD — the increasing trek to provide a family's fuel

CREDIT: NEW INTERNATIONALIST

Oil is also used for fuel, especially in the towns, and also for fertilizer, and the price of oil has risen. Cooking becomes more expensive in the towns; meanwhile, in the villages the farmer has to pay more for the fertilizer to maintain the same level of production.

Many families use dried cattle-dung as a cooking fuel. But this prevents its use as fertilizer for agricultural production, and the need for more food is urgent.

The bio-gas plant, already in wide-spread use in a few countries, like India, overcomes two of the problems :

(1) it retains the cattle waste to be used as a high-grade fertilizer,

(2) it extracts bio-gas from the waste, and it can then be used as a fuel for cooking and lighting.

Such a plant is ideal for a family, or cooperative farm with 4 cows or more, as well as for larger communities. It is simple, easy to construct, operate and repair in villages and rural areas.

School and community Scout troops could try it out on their own farms, or introduce it into their schools and communities. Help from an Agricultural Officer and a Technical School or a small workshop may be necessary.

HOW IT WORKS

The plant produces a gas from cattle-waste through a process of fermentation. A brick-lined well is supplied regularly with a mixture of 50% cattle-dung and 50% water. Gradually, gas is generated and collected under a floating iron gas cap.

A pipe connected to the top of the cap takes the gas to the point of consumption. Continuous production is maintained by the daily addition of quantities of dung and water to the well.

The gas is mainly methane gas, and it may be used directly, without further refining, for cooking and lighting.

The slurry (left-over mixture) may be applied wet to a crop, or it may be sun-dried in pits and collected, stored and spread when needed.

COST

Initial capital expenditure is relatively high - approximately U.S. $ 300 for the plant described here (though this will vary considerably from place to place).

The dung from four or five cows can produce enough gas to meet the cooking and lighting requirements for a family of five.

Initial costs can be recovered within 5 years in the form of fuel, fertilizer, and improved crop yields.

Maintenance and operating costs are negligible.

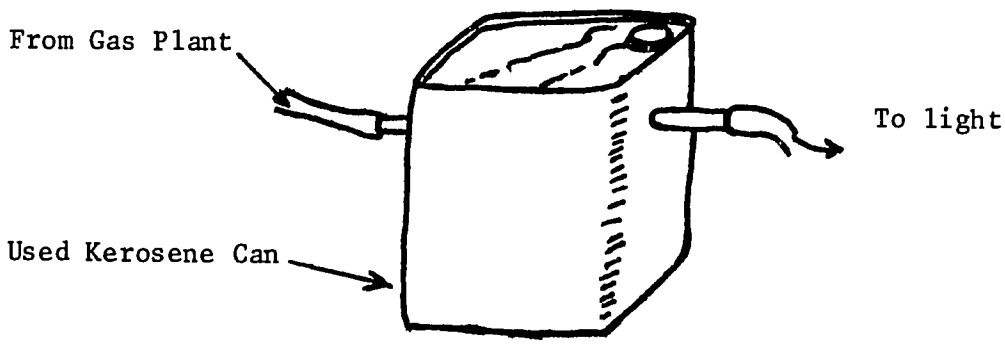
HOW THE GAS IS USED

In some countries (e.g. India), you can buy bio-gas stoves. Pressure is controlled by putting rocks or sand bags on the gas cap. When the air-jet is adjusted properly, the flame is hot, blue and smokeless, and it does not smell.

Or you can make your own stove quite simply. A description of one is given on page 7 of this booklet.

Bio-gas lamps are available on the market. It is advisable to use them rather than home-produced units. The light can be improved by using a petrol trap.

PETROL TRAP



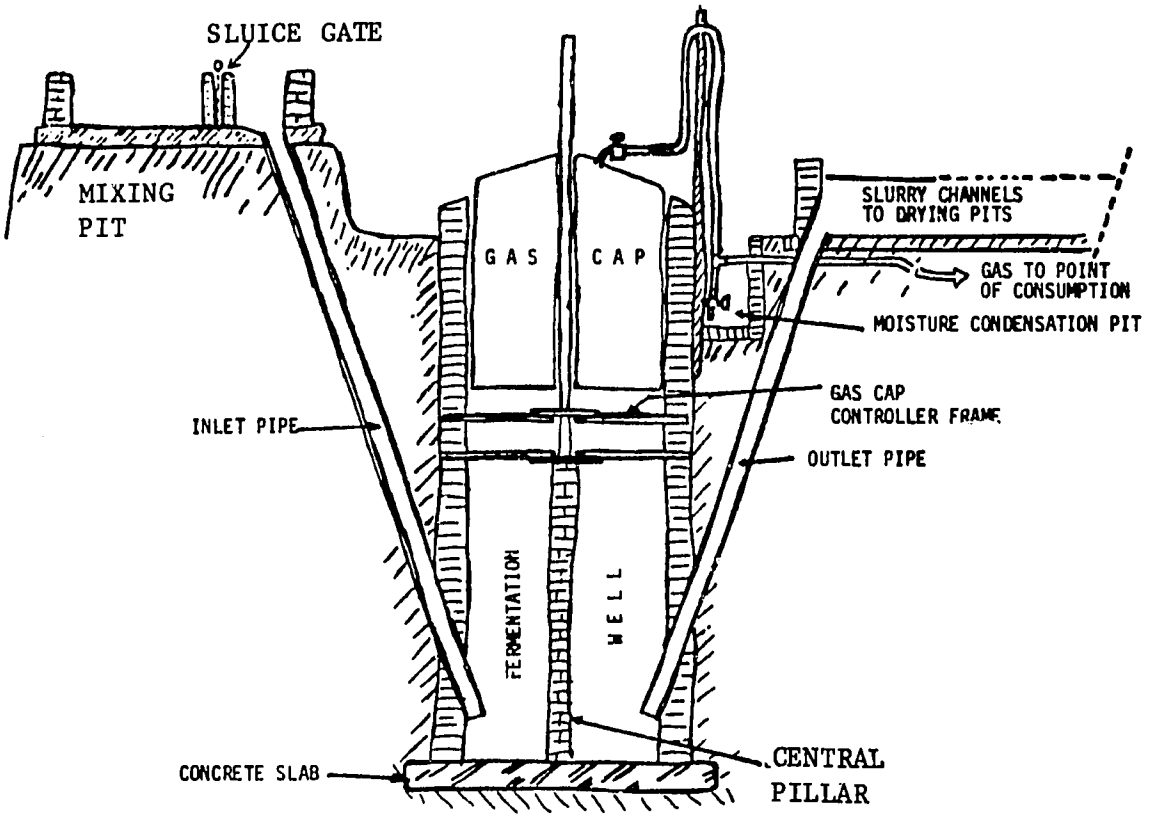
You first have to pass the gas through a can containing 4 litres of petrol (enough for one year). The petrol enriches the gas.

TECHNICAL DESCRIPTION

SITE

The plant itself takes up a small area. But the slurry pits should be large and expandable; in the rainy season you will need a larger area to dry the slurry.

A 4-METRE BIO-GAS PLANT



The plant should be built :

(1) near where the gas is used. This reduces the loss of pressure and the cost of piping. As the plant neither attracts flies or mosquitoes, nor does it produce a smell, it can be built near the home;

(2) close to the source of raw manure and water;

(3) exposed to the sun.

SIZE

The size of the plant is largely determined by the number of animals that are providing the manure.

- One average cow produces 10 kg of dung per day (same as 10 people).
- 0.6 metre of gas satisfies 1 person's daily cooking and lighting needs.
- The volume of the fermentation well should be 40 times larger than the daily manure input.
- 1,000 kg. of dung and water occupy approximately 1 cubic metre.
- A 2-cubic metre well, with a gas cap of 1.50 m X 1.40 m is enough for a family/farm/troop with 4 cows.

CONSTRUCTION

(of a plant for 4 cows)

THE FERMENTATION WELL

1. The well is almost totally underground, with only 30cm above ground level. The hole should be 4.00 m deep and 2.50 m in diameter.
2. A circular concrete slab, 2.30 m in diameter, is poured (mixture of cement, sand, gravel should be 1:4:8). It should be 30cm thick.
3. The walls of the well are built up with bricks to the 2-metre mark. The inside diameter will be 1.50 m.

   The inlet and outlet pipes are installed at the same time. They should be concrete and 10cm in diameter. The bottom ends of each pipe should be 20cm off the concrete slab-base. The upper end of the inlet pipe should be 50cm above ground; of the outlet pipe 20cm above ground. The outlet pipe must be lower than the top of the well, and also lower than the top of the inlet pipe at the mixing pit.
4. A central pillar, 20cm thick, is built up to the 2-metre mark. The gas cap controller is positioned on this, with its lower arms along the top of the wall.
5. The well walls are then continued up to the full 4-metre height above the slab-base, thus firmly fixing the controller in place.
6. The inside and outside of the well walls are plastered to prevent leaks. The highest quality masonry work should be used to make sure no cracks develop which could pollute drinking water in a nearby water well.

THE MIXING PIT

1. The mixing pit is 80cm square and 40cm deep. It is built of plastered bricks.
2. Before the inlet pipe is fitted, a sluice-gate is installed so that dung and water can be mixed in the pit; the gate is opened to allow the mixture to flow into the well.
3. The pit should have a cover.
4. The mixing pit may have to be raised slightly above ground level to ensure that the top of the inlet pipe is above the top of the outlet pipe.

THE SLURRY PIT

This measures 4.00 m X 4.00 m and is lined with earth mud bank walls. You may have 2 or 3 pits of equal size and the liquid slurry is channelled to the pits. This makes it easy to fill one pit completely, then close the channel, and let the slurry in the pit dry in the sun while another pit is filling.

THE CONDENSATION PIT

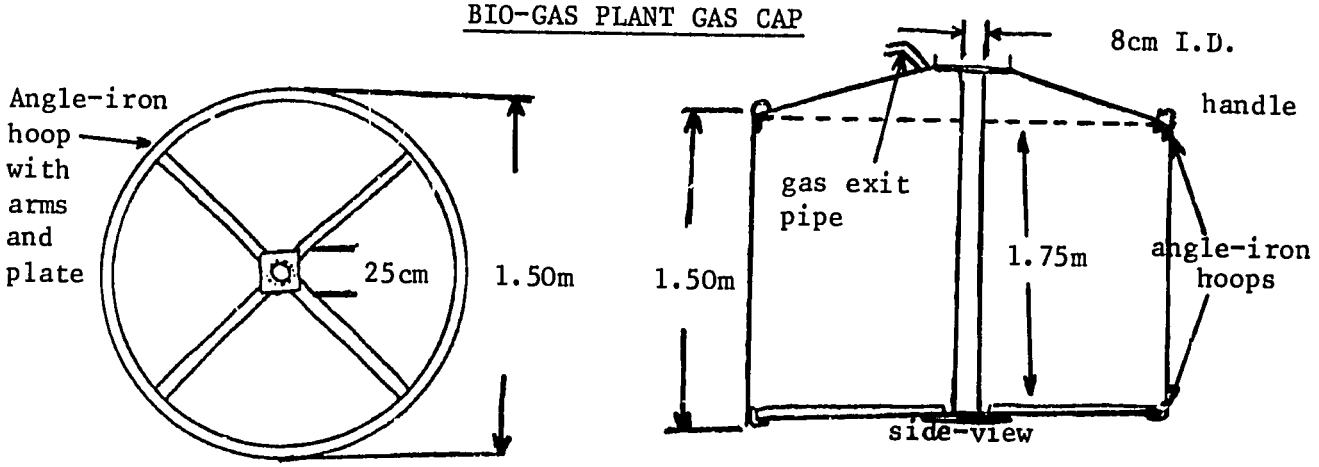
A small unmortared brick-lined pit is built close to the well wall in order to allow the condensed water in the gas pipe line to drain.

THE GAS CAP

1. The circular cap is made of 14 or 12 gauge mild steel sheet. The closed top is conical (grade 1:8) to allow rain to run off. Angle iron hoops (2cm X 2cm) are used inside the bottom and top to give the cap its circular shape.

2. A metal pipe (8cm inside diameter), 1.75 m long, is inserted in the cap so that the bottom end of the pipe is flush with the bottom of the cap. The pipe is held in a central position by arms and plates.

BIO-GAS PLANT GAS CAP



3. The mild steel sheet is wrapped around the angle iron hoops and all edges are welded.

4. The gap between the gas cap and the well wall is 5cm to 10cm, so that the cap can move vertically. Thus the cap must be about 1.30 m to 1.40 m in diameter.

5. Close to the top centre of the cap, a gas exit pipe and flame check are installed.

6. Four handles of bent metal rod are welded to the top circumference of the cap. The cap is usually lowered into place by means of large bamboo poles inserted through the loop handles. Several men can lift the cap onto the controller.

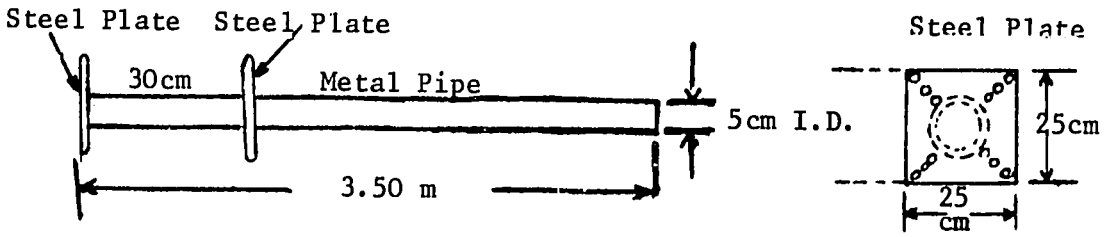
7. The cap must be airtight. This can be checked by partially filling it with water upside down to look for leaks.

8. The finished cap is painted with a tar-based black paint to absorb more of the sun's heat.

THE CONTROLLER

1. A plate of mild steel, 25cm square, is welded to one end of a pipe, 5cm inside diameter, and 3.50 m long.

GAS CAP CONTROLLER

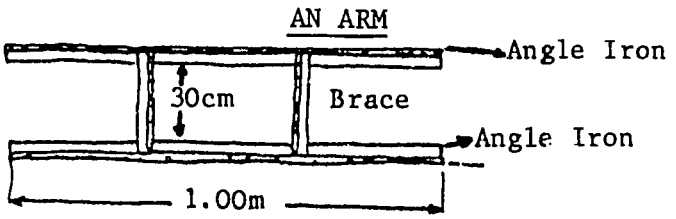


2. A similar plate, with a 5.5cm hole cut in its centre, is welded to the pipe 30cm away from the first plate.

3. Four arms are constructed, each having two angle-iron pieces about 1.00 m long. The two angle iron pieces in each arm are held 30cm apart by two braces.

4. The four arms are connected to the plates by four screws each (the controller can be transported to the site dismantled).

5. All parts of the controller, except the pipe, should be tar painted.



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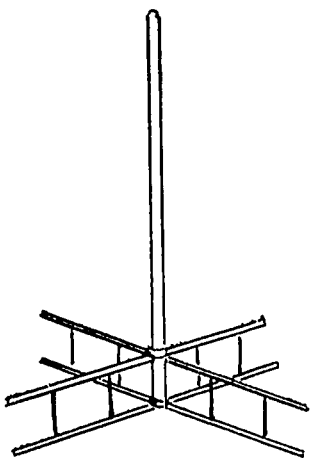
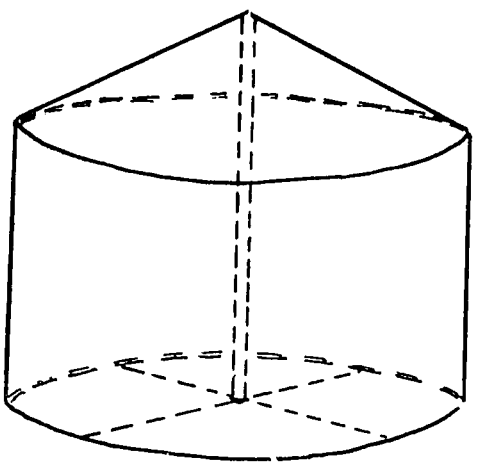
THE GAS CAP AND CONTROLLER





THE GAS PIPING

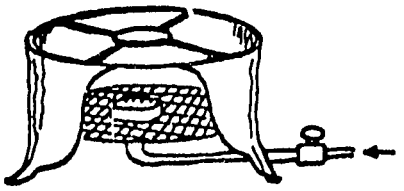
1. A length of flexible rubber or plastic hose is attached to the gas exit pipe on the gas cap, and the hose is looped over a pole fixed in the ground beside the well. The hose loop allows the gas cap to ride unhindered up and down on the controller.
2. The hose is attached to a galvanized metal pipe which leads to the condensation pit where a tap is attached, an on to the gas burner, or lamp, in the home.
3. The pipe should be buried and slope slightly upwards away from the condensation pit to allow condensation to run back into the pit.
4. Keep all piping the same diameter to conserve gas pressure.

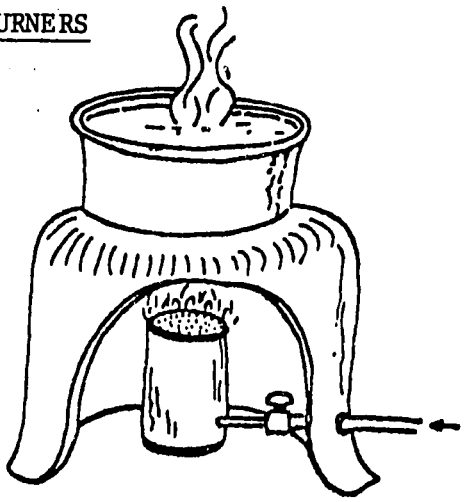
THE GAS BURNER

1. A small length of copper tubing, complete with gas tap and flame check, is soldered into a hole cut in the side of a tin can. The lid of the can is perforated with a series of small holes spaced about 2cm apart.
2. The can is filled with pebbles which stabilize the burner and cause the gas to spread more evenly.
3. An arrangement to support the cooking pots is then built around the home-made stove.
4. Lack of control over air-intake reduces the efficiency of the burner a little.
5. Two important rules of use are :

   - clean the tin can regularly,
   - keep the kitchen well-ventilated.

HOME-MADE BIO-GAS BURNERS





PLANT OPERATION

AT THE BEGINNING

1. A new well should be half-filled with manure which has already been partly decomposed in the air for a couple of weeks.
2. Three days of fermentation should be allowed in the well to let the material reach a high temperature.
3. Then the well should be topped up with water and sealed with the gas cap.
4. The cap will start to rise after about two weeks. The first lot of gas will not be rich in methane and should be allowed to escape.
5. The cap will build up new gas pressure and after a month the gas should be usable.

CONTINUOUSLY

1. Daily, all fresh manure, plus an equal volume of water, is mixed in the mixing pit. Leaves, spent hay, cornstalks, etc. should be chopped up finely before being added. Cattle urine should be added where possible. The mixture is then fed to the well.
2. A daily check should be made to see that the gas cap is free to move vertically. If exposed, slurry dries out around the top of the well, it should be dislodged with water and a long bamboo pole.
3. A twice-daily stirring of the slurry increases gas production. This can be done by inserting a bamboo pole into the outlet pipe. This also cleans out the pipe.
4. The collected gas is saturated with water vapour. It is, therefore, necessary to open the top in the moisture condensation pit occasionally.
5. The maintenance, cleaning and feeding of the gas plant, should take one person 15 minutes a day. Once a year, all metal parts should be repainted black.
6. The best temperature for gas production is 30°C - 35°C.
7. Materials rich in sugar and starch - like sugar cane bagasse - should be used as bedding for the cattle for some time, and then be left to decompose in the open air for a month before being added to the well; otherwise such materials reduce the methane content of the gas.