OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

17407

Distr.
LIMITED

ID/WG.480/2(SPEC.)
3 April 1989

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting on Design, Development and Manufacture of Simple Food Processing and Preserving Equipment*

Lusaka, Zambia, 9-13 January 1989

FOOD PROCESSING AND ITS APPROPRIATE EQUIPMENT**

Prepared by

Ruraduma Capitoline***

---

* Organized by UNIDO in co-operation with the Government of Zambia and the Village Industry Service

** The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development (UNIDO). This document has not been edited.

*** Food Technologist, P.O. Box 795 ISABU, Bujumbura, Burundi

V.89-54010

CONTENTS

Introduction

Ninety per cent of the population of Burundi live in rural areas where agriculture is the main activity. As the peasants were able to adapt their skills to local conditions, the country could rely on itself for food. Studies indicate that this capacity has reached its limits. This is evident by the decrease in agricultural production, which is due to the deterioration of arable land. Erosion, over-exploitation, inadequate fertilization and decaying seeds have contributed to this deterioration. In addition, traditional methods of storage and food-crop transformation in rural Burundi are precarious: the loss of harvested crops has reached high proportions--sometimes as high as 60 per cent. Today, the population increase is faster than the increase in agricultural production. This radically affects the available food supply for the individual.

The economic and social consequences of such a lack of equilibrium are known, especially in the rural areas. Food shortages cause diseases, which attack the weaker categories of people: children, mothers and old people.

The increase of urban demands turn the tide to greater imported products, a trend which seriously imbalances the economic equilibrium. Because of this situation, concrete actions to reduce food shortages are being designed to provide self-reliance on local food supplies and limit the dependance on imports. The government, with the help of international organizations (the United Nations Development Programme and the Food Agricultural Organization), has started food programmes based on the use and revalorization of local products.

The work presented in this paper is among those measures being taken to avoid the loss of harvests and to ensure a certain alimentary security to the population. Indeed, the transformations of rice and cassava and the manufacture of appropriate equipment are those activities that are mainly discussed.

I. THE STERILIZATION AND DRYING OF RICE BY STEAM PROCESSING (ETUVAGE); THE CONCEPTION OF AN ARTISANAL OVEN

Rice cultivation has become very important in Burundi. Rice is becoming a national staple food. So far, treatments on this crop have only produced whitened rice (Cargo). This white rice has lost its vitamin (especially vitamin B12) and mineral-salt contents. Husking and pounding in the factory causes breakage, which does affect rice production.

The government, together with the FAO project in the Ministry of Rural Development, has recently introduced the technology of drying rice to provide its population with quality of food products. The purpose of this technology is to modify the physical and chemical properties of rice to make it more nutritious and economical.

General principle for sterilizing and drying rice

- Position in transformation:
- Rice - beating - paddy - sterilization and drying - husking - whitened rice.

The production of treated rice is based on a general principle, which uses two main elements--water and heat. After the rice has been soaked in water and heated by vapor, it is dried and and stored.

Soaking

With the help of a valve, the paddy is cleared and put in a barrel full of water (see Figure B), which can contain 25kg. It is then heated on a fire with three large, supporting stones. Drenching was formerly accomplished by using small clay jugs.

The present system offers more advantages. Inside the barrel vapor is produced for drying and sterilization. The size of the barrel is designed to economize energy; its space can take a much larger quantity during the operation.

During this phase the grain must absorb at least 30 per cent of the humidity to allow a homogenzied redistribution of soluable substances in the grain and a homogenized transmission of heat from the surface of the grain to the center of the endosperm during the drying process--a gelatinization of the starch. The soaking process lasts only 4.5 hours in hot water instead of 12-48 hours at the ordinary temperature.

Drying and sterilization process

The drenched rice is put on an oven, which was designed and manufactured by the FAO (see figure A). The oven is perforated with small holes from which the vapor escapes. This vapor is produced by a one-hour heating process that occurs in the first half barrel, which served for the soaking procedure. The operation concludes once the heavy vapor pushes through the edges of the cover.

Afterwards, the rice is dried and, consequently, ready for further processing. In this phase the starch gelatinizes and biological processes, such as germination and mushroom spores, are suppressed.

Vapor treatment yields economic advantages--production output, storage and alimentary improvements, namely firmness, enriched vitamin and mineral salt contents.

Design and manufacture of drying kiln

In countries such as India, traditional ovens are made in large, metallic containers. They are placed on a heated furnace during the drying process. The rice, approaching the final desired stage, is heated more than the other rice; hence, carbonization results. Sometimes the wet rice must be stirred continuously. Water must be occasionally added to compensate for the vaporization. As the steam is not evenly distributed in this process, the drying process is incomplete; therefore, the desired result is not achieved.

To overcome these problems, the project has designed and adapted ovens made from locally available materials. A 200 liter-capacity barrel (figure 1a), which is cut in the middle, forms the oven. One half (B) serves to soak the rice and to retain water to produce vapor needed for sterilization and drying. The second half (A), which is the actual oven, has a basis perforated with many holes (Figure 1f). Four tubes are vertically joined to the base, which is also perforated with many holes (figures Ad, Ae and Ag).

During the operation the oven is set on the first barrel as a couscous pan. The vapor travelling from barrel B passes through the perforations and spreads homogenously in the oven (Figure 1h).

This operation was first demonstrated at Gihanga in the Imbo plain, which is the most vital region for rice production. Today the oven is used everywhere, even in Rumonge.

The first experiments focused on the drying and sterilization of a new, product variety of rice: its name is "IRON". IRON was introduced two years ago by the Regional Society for the Development of Imbo (SRDI), which promotes rice production in the plain. This variety yields up to 10 tons per hectare. Unfortunately, the husking process makes a large amount of breakage, which does affect the output. Depending upon the method used, the output varies from 50-60 per cent. The table below compares the output from husking with a pounder to the output from husking with an Engleberg machine.

	Husking with a pounder		Husking with an Engleberg machine	
	Output in weight	Breaks	Output in weight	Breaks
untreated rice	55-60%	75%	50-55%	83.6%
treated rice	70-75%	5.4%	70-73%	35%

Conclusion

Taking into account the socio-economic conditions in Burundi, drying and sterilization process using vapor presents a particular interest at the domestic or artisanal level because of its practical advantages:

(a) the pounding process become easier;

(b) the period for conservation is longer;

(c) the output in grinding is improved (less grain is broken);

(d) the taste and consistency of the product are more pleasant.

II. THE PROCESSING OF CASSAVA

The artisanal process of cassava is still a family affair in Burundi. The applied treatments, the manipulations and processing aim at the elimination of the hydrocyanic acid in tubers.

The major processes used in Burundi are based on dry or water retting. Such technologies yield a weak output and a low quality final product whose conservation does not survive a period longer than one week. To overcome these problems, the farmers store their produce in the ground. Cassava is harvested depending on the need, thus sometimes it is kept in the ground too long. Not only does this prohibit the soil from being used for another crop, but also this diminishes the root quality and increases the fiber rate.

Distribution is an additional problem: some regions have excess crops while others have hardly any. Therefore, it is essential to create an interregional flux to improve the storage systems and processing of food crops, particularly of tubers. Thus, programmes geared mainly to cassava processing have been initiated.

Processing of cassava and gari using appropriate equipment

Gari is a fermented, final product of cassava, which has been gelantinized and dried. It is the staple food found in Benin, Togo and Chana. Nowadays, it is found in other African countries.

The processing technique used to produce gari has been introduced because of the following advantages:

(a) it is a product that has a storage capability of more than one year, which is contrary to the cassava flour, which cannot be kept longer than one week;

(b) it can be produced at any season since it does not require drying;

(c) it is a product cooked in advance for ready consumption or preparation in association with other flours.

Process of gari fabrication

The sequence of the operation is: peeling, washing, rasping, fermentation in bags, pressing in bags, garification, granulation and shifting.

Finally, many operations are identical to those used to manufacture traditional cassava flour; the purpose is to eliminate the hydrocyanic acid. The details of these operations are not discussed in this paper.

Indeed, the production of gari has two phases: pressing and torrefaction. These phases are the main constraints and vary among countries. For this purpose the project has attempted to adapt artisanal types of: a press, the type of screw press and a torrefaction device.

Design and manufacture of a press equipment to extract water from the fermented pulp

Traditionally, this operation was performed simultaneously with fermentation. The pulp is put into bags made of strong materials. With a piece of wood, the top of the bag is twisted to that the water can be partially eliminated. Big stones are then put on the bags and all is kept stationary for three to six days. In this case, fermentation and draining are combined into one operation.

Local differences in this operation exist. Sometimes one type of traditional fermentation is constituted of a system of cords and boards between which bags of pulp are tied. Other times the pulp is kept in cloth-covered baskets upon which heavy objects are placed to apply additional pressure. All these operations serve the same purpose: that is, to reduce the quantity of water in the pulp to facilitate the drying and garification processes.

However, this operation is long and is less efficient. The pressure exerted by such a practice is insufficient to decrease the humidity to a reasonable level. The cost of energy for drying or garification remains high.

The use of a screw press is a possible small-scale solution. The produced pressure reduces the humidity rate from 45-50 per cent. This economizes energy during the garification operation. The press element is composed of:

(a) a press screw;

(b) a press lever;

(c) four metallic supports;

(d) a recovery container;

(e) a compressor disc;

(f) a perforated plate containing a pressed pulp (Figure 2).

The pressing operation consists of putting about 15kg of grated cassava in a polyethylene bag into the press by turning the press bars. This allows the compressor disc moving down to the cassava masses. In this process the juice or water from the cassava is extracted and removed by the draining channel on the lower edge of the equipment. The longer the pressing time, the easier it is to grill the cassava. The press equipment has a capacity of 140-150kg.

Design and manufacture of a stationary roasting device

According to traditional operation, garification took place in a big metallic stove, often in an ceramic vessel of 60cm in diameter, over a groundfire. Gari should be continuously stirred with a triangular calabash pallet to mix it and to prevent it from burning. The gari is then put in the sun to reduce roasting costs. A low quality gari is obtained: it has a very low swelling capacity. Garification is an unpleasant operation because the equipment is uncomfortable to handle and the worker is constantly exposed to smoke.

These traditional methods cause a low production of gari. The quality is unsatisfactory and the energy consumption of grilling is high. To overcome these problems, the project improved the roasting device to economize energy, improve the quality and increase the production capacity.

The first attempts took place in Rushubi, in the Bujumbura province. It has presently spread to Rugombo, in the province of Cibiroke, which daily produces 70-80kg of gari, consists of the following items:

(a) an oven made of bricks in a rectangular form;

(b) an oven to insert wood or charcoal to be used for heating;

(c) a tray (the roasting device itself) with elevated edges, which is put on the oven;

(d) a chimney outlet for smoke.

The fermented and pressed pulp is pulverized on the roasting device heated by the oven. The flour is slowly roasted until all the moisture is drained; the remaining cyanide substance also disappeared. Two women with wooden spatulas supervise the operation to avoid carbonization. The heat should be continuously controlled. Garification occurs when the flour obtained becomes slightly yellow and the cassava pieces shrink and become dry.

Grinding process

Dry flour can be ground with the help of a mill. There have been previous attempts to manufacture a mill in the experimental area. Presently a hammer mill is being constructed but the drawing plans are not finalized; therefore, they are not reproduced here. The hammer mill can replace the rasping device.

Conclusions

In Burundi, the transformation of food crops is meaningless at the national level, despite efforts made to reduce the post-crop loss. Programmes initiated by international bodies sometimes present shortcomings: for some interesting projects designed for the rural area have failed because there are no clear guidelines to carry out the programme. Therefore, we try to introduce and adapt an improved technology. The technology is valuable if it answers a specific need of the population. This, in fact, requires a good knowledge of the milieu.

Finally, analyses of the local technologies of food processing and conservation should become the basis to solve the problems and define the priorities. It is also indispensable to strengthen the contact among national, regional and international researchers to allow the exchange of information on existing work performed in Africa and elsewhere, as well as on improved material.

REFERENCES

F. Gariboldi: "L'ètuvage du riz", FAO, Rome, 1974.

J. Muchnik, D. Vinck: "La transformation du manioc" ACCT, 1984.

DRYING AND STERILIZATION EQUIPMENT (KILN)

Fig.1 a) Drum

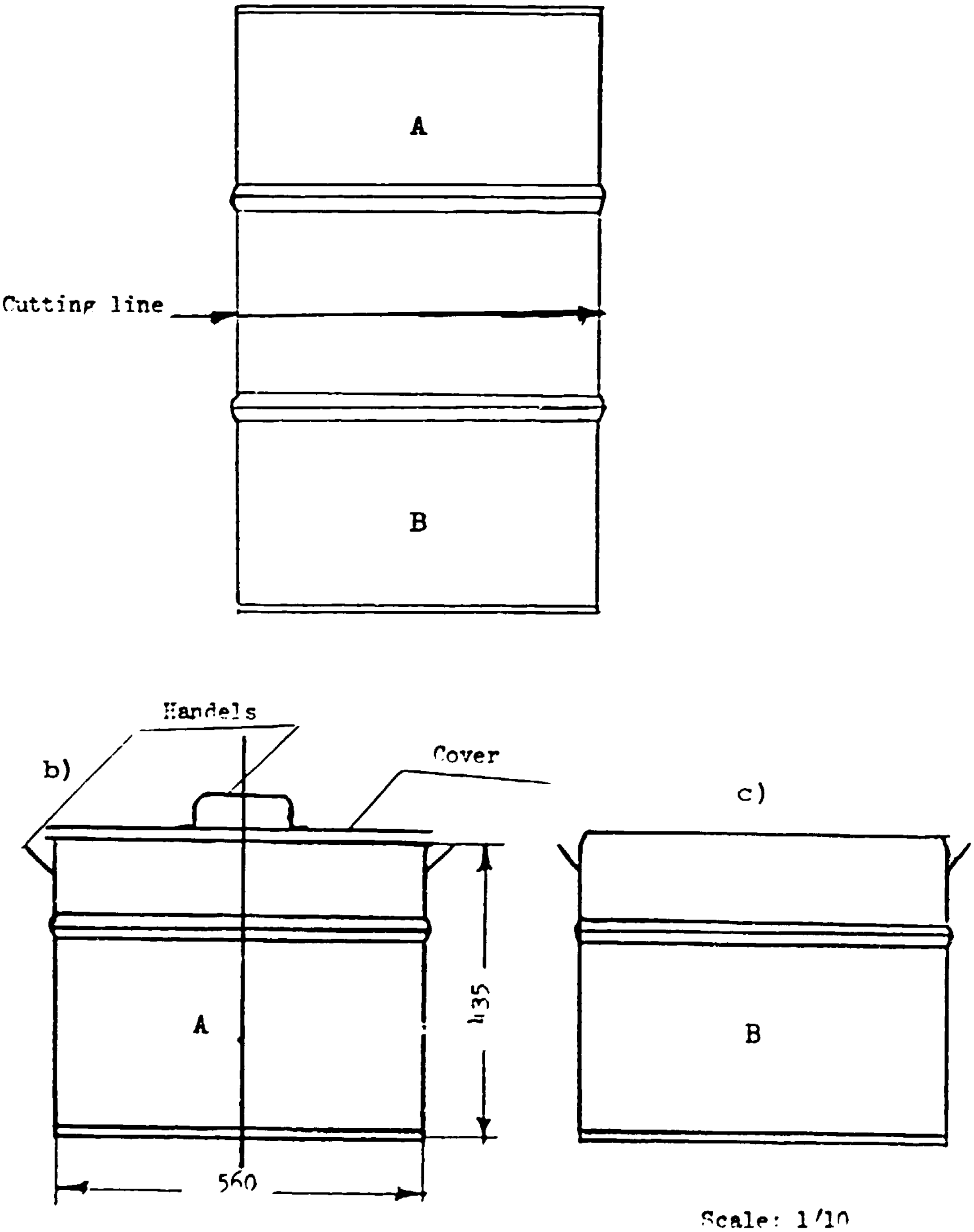


Figure: 1A.

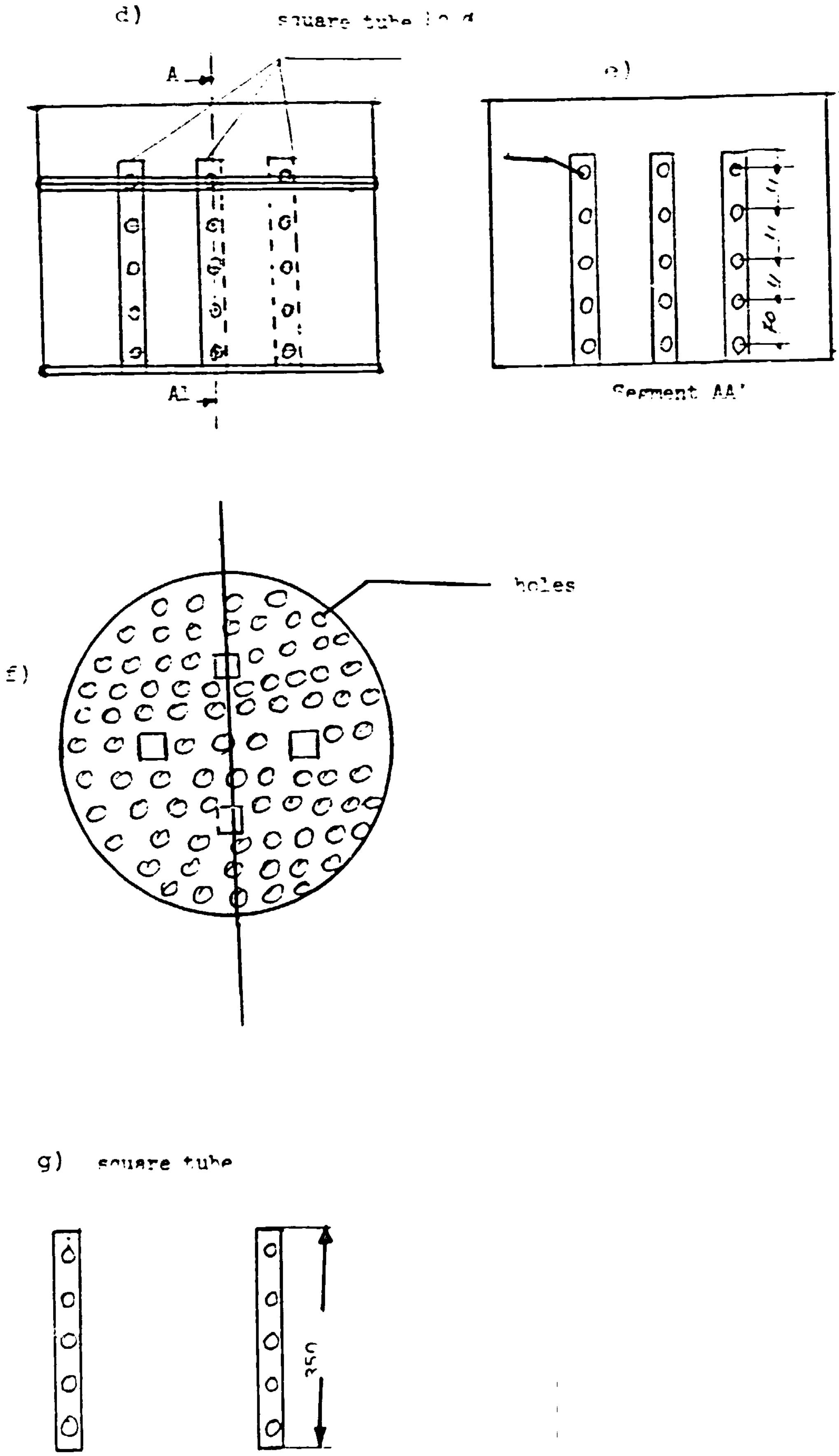
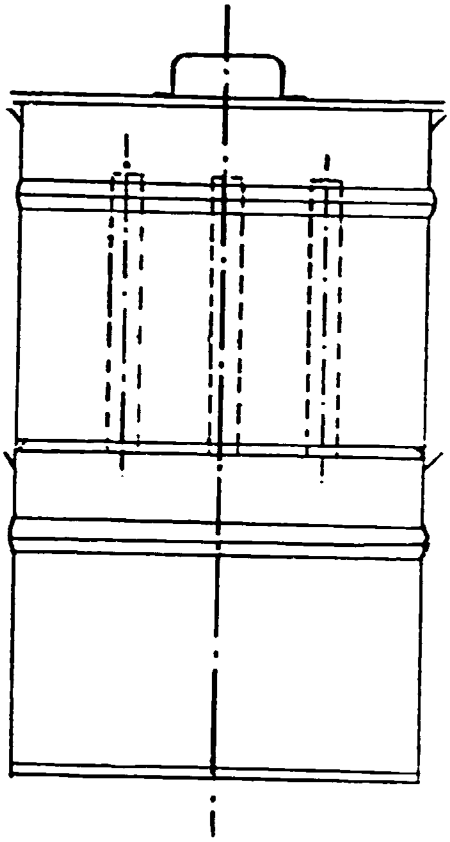


Figure: 1B.

A READY-TO-USE DRYING AND STERILIZATION EQUIPMENT

h)



- SCREW PRESS -

Fig. 2.

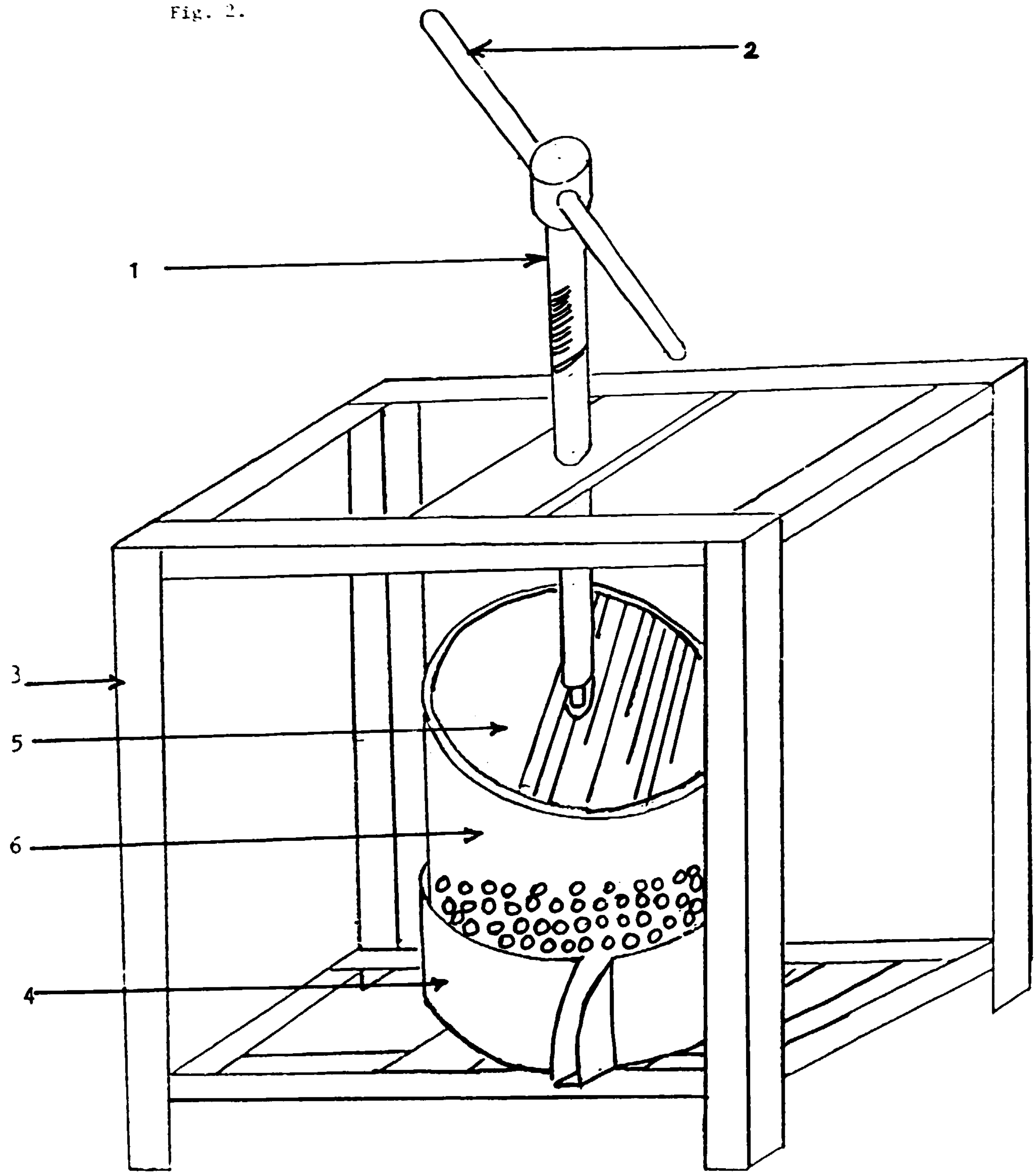


Fig. 3.

STATIONARY ROASTING DEVICE