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Manufacture of Simple Food Processing and
Preserving Equipment*

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DESIGN, DEVELOPMENT AND MANUFACTURE OF SIMPLE
FOOD PROCESSING AND PRESERVING EQUIPMENT IN TANZANIA**

Prepared by

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* 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.

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1.0 INTRODUCTION

Tanzania has policies on industrialization and development of indigenous capabilities to design, develop and manufacture machinery and equipment including those for the food processing and preservation sector. Such policies give emphasis among others on the establishment of industries producing consumer goods and services required by the majority of the population; industries to process agricultural commodities for exports to increase the country's foreign exchange earning potential; handicrafts and small industries using simple technologies; national resource-based industries and industries producing engineering goods within the national economic and technological competence.

The paper outlines efforts being made in Tanzania to promote the design, development and manufacture of food processing and preserving equipment. It also discusses existing technological and economical constraints faced by institutions engaged in the design, development and manufacture of food processing and preserving equipment. Finally proposals and recommendations for the promotion of design, development and manufacture of related equipment are given.

2.0 DEMAND OF SIMPLE FOOD PROCESSING AND PRESERVING EQUIPMENT

National economies of most African countries depend on agricultural output, and most of the population is engaged in this sector. However, only a few big farms have adequate imported equipment for crop harvesting, handling, and food processing, and even these are imported using the meagre available foreign exchange.

It is of utmost importance, therefore, that African countries look for means and ways of developing and promoting the design, development and manufacture of food processing and preserving equipment. It cannot be over-emphasized that the demand is huge because the majority of the population, which dwells in the rural areas need these equipments to meet food requirements of the ever-growing number of the employed labour force.

3.0 INSTITUTIONAL SUPPORT SERVICES FOR DESIGN AND DEVELOPMENT OF MACHINERY AND EQUIPMENT

In order to implement government policies on the industrialization and development capabilities to design and develop machinery and equipment a technical institutional infrastructure has to be developed. The development of such infrastructure is not easy, however, because it requires substantial foreign funding. Some achievement, albeit small, has been made over the last decade.

To sustain economic growth Tanzania needs to have its own engineers, technicians and craftsmen because these form the required technical manpower to spearhead industrial development. Efforts to train technical personnel both in local and overseas institutions are still continuing.

In the establishment of technical institutional infrastructure, the Government has established among others, the Tanzania Engineering and Manufacturing Design Organization (TEMDO) whose major objectives are to design and to promote the designing and adaptation of machinery for manufacture in Tanzania; to provide technical support services to industry and entrepreneurs in product design and manufacture.

3.1 Design and Product Development in Tanzania

Designing is an intellectual attempt to meet demands in the best possible way by applying scientific knowledge to the solution of technical problems and to optimise that solution with available material, technological and economical constraints. The designers' ideas, knowledge and abilities have a fundamental effect on the nature of manufactured products, their customer appeal and their overall profitability. Machine design is a new venture in Tanzania, and TEMDO is giving due emphasis on the training of its designers.

Two types of projects are undertaken at TEMDO, i.e. those which are in-house and those that result from customer enquiries.

All in-house projects are government funded and TEMDO conducts preliminary feasibility studies to determine viability of such projects. The final goal is that any product development should be focused on meeting the needs of the majority of the population and in this context emphasis has been directed to agricultural and food processing machinery and equipment.

Other design projects are undertaken for industry, entrepreneurs and individuals. TEMDO markets its design services through industrial visits and advertisements in local papers. An engineer or a project team is normally assigned a design project and in addition to the information given by a customer, a preliminary study is normally conducted to determine design requirements and specifications. Fees are charged for design and manufacturing services provided.

At present TEMDO is still developing her physical facilities and prototype development is undertaken by use of facilities available in the metal working industry through sub-contracting. In most cases TEMDO engineers supervise product manufacturing to ensure that parts and components are made to specifications. This method has also assisted in training technicians and artisans of these industries especially in blue print reading and economical parts manufacturing methods.

3.2 Design Constraints

At the beginning of a new project the designer must know exactly what kind of new project/product he is expected to design, what it may cost, what production facilities will be available to make it and how much time he can spend. However, experience has shown that in the design process the designer confronts a wide range of problems and in order to increase the probability of success in executing the project the designer must be equipped with possible alternatives to achieve the same goals. Just to mention a few, such range of problems include:-

- Lack of comprehensive costing references to enable the designer estimate his project cost, and these include cost of manufacturing processes, cost of materials to be used, availability of standard parts and their cost.

- Lack of comprehensive manufacturing facilities references. The designer might not know the range of available manufacturing facilities in his own country, thus limiting design decisions.

4.0 PRESENT STATUS OF FOOD PROCESSING AND PRESERVING EQUIPMENT DEVELOPED IN TANZANIA

- 4.1 In the five year period 1984/85 - 1988/89 TINDO has selected a few simple post harvest food processing machines for design and promotion of local manufacture. Completed designs include those of thresher, maize sheller, grain cleaner, oil expeller, sugarcane crusher, batch drier, seed dresser and animal feed mill and mixer. Refer Appendix I (fig 1-9).

4.1.1 Threshers

TINDO has adapted two types threshers which can thresh paddy, sorghum, wheat, beans etc.

- The first one - a single operation thresher is made mainly of wood. A similar design is commonly used by peasants in China, India and other countries in South Asia. It is hand operated and incorporates a drive of bicycle chain and sprockets. The device is light weight and portable. TINDO made 6No. such threshers for demonstration and popularization in major rice growing areas.

The threshers were tested during the 1986 harvest season and the response was generally good. Arrangements are being made to interest an entrepreneur who can go into batch production of these threshers.

- The other type, a double operation thresher is bigger and mainly fabricated from angle irons, flats and steel sheets. The drive is again of bicycle chain and sprockets. This type of thresher has shown very good results in the threshing of paddy, wheat, sorghum and beans. TINDO entered into a manufacturing technology transfer arrangements with Ligulani National Service Camp to train his technicians to manufacture these threshers using TINDO blue prints.

4.1.2 Maize Shellers

The snelling components are made of cast iron while the rest of the machine is fabricated from steel shafts, angles, flats and sheets. It can be operated manually or by connecting a flat belt drive to the auxiliary P.T.O. pulley of a tractor.

Husked cobs are hand fed from a hopper into two feed ways with an adjustable mechanism for handling large or small cobs.

A rotating serrated disc and two level shaped rollers rotating in the opposite direction provide the shelling action.

A reciprocating motion, actuated by the use of a crank mechanism provides the sieving action necessary for cleaning, grading and guiding the grain through the sieves to the grain collecting ends.

TEIDO is currently manufacturing such machines jointly with the Small Industries Development Organisation (SIDO) Common Facility Workshop, Arusha and the National Engineering Company, Dar es Salaam. Tests have been conducted and improvements made after field test reports were received.

4.1.3 Grain Cleaners (Winnowers)

TEIDO has also adapted a grain cleaner from the International Rice Research Institute (IRRI) of Philippines. It is a metal fabricated machine where cleaning is effected by an air current produced by a blower incorporated in the machine. Different types of cereals can be handled on this machine by changing the sieve size. Tests conducted have shown good results with paddy, beans, maize and sorghum. These machines are also being manufactured by the Migotani National Service Camp in Dar es Salaam after TEIDO engineers trained their technicians and artisans in manufacturing the winnowers.

4.1.4 Oil Expellers

The oil expeller is powered by an electric motor and is of the screw type. When the machine is running, oil bearing seeds are fed into the hopper and the seeds are transported to the crushing chamber by means of a screw with tapering core shaft.

Seeds are crushed inside the chamber and oil is extracted and drips through the spacers onto a tray and finally into a container. Dry cake comes out at the conical end of the screw.

A sedimentation process is used to refine the oil whereby large particles are left to settle at the bottom of the container and clear oil is poured out into another container. The clear oil is then pasteurised before it is corked in bottles ready for use. Two such machines have been manufactured and supplied to clients and are now being used commercially. However other entrepreneurs are interested in a bigger capacity expeller and arrangements are being made to design an expeller of a larger output.

The major parts of the machine are made of cast iron while the screw and the spacers which forms the crushing chamber are made of medium carbon steel.

4.1.5 Sugar cane Crusher

Sugarcane, a perennial crop is grown both on large plantations and small holdings. The former are mainly in the neighbourhood of sugar factories. The latter are scattered around these plantations or in other parts of Tanzania for utilization of the sugarcane to produce brown sugar.

Another utilization is the making of sugarcane juice a favourite drink in major coastal towns where the climate is hot.

The sugarcane crusher developed by T.M.D.O, which is powered by an electric motor is suitable for both applications although for brown sugar production a bigger capacity crusher is preferred. The crusher is of fabricated construction with electroplated cast iron crushing rollers. Five sugarcane crushers are now under production for sale.

4.1.6 Batch Drier

The batch drier designed and manufactured by TEMDO was basically meant to dry fish but it can be used to dry any other agricultural crop with minimal modifications.

The drier is electric heated with a thermostat temperature control. Racks are mounted on wheeled frames which can conveniently be pushed in and out of the drier during loading and offloading.

4.1.7 Seed Dresser

The seed dresser is used for the application of insecticides to cereals before storage. Seeds and the insecticide (usually in powder form) are dropped at the top and in the centre cone, the seeds are dispersed to the sides thus causing a mixing operation between the seeds and the insecticide.

The seed dresser is wholly made of fabricated construction with the main body made out of steel sheets. The dresser is galvanized to protect it from rust.

4.1.7 Animal Feed Mill and Mixer

This design was developed as in-house project after a feasibility study conducted by TEMDO showed that it is a viable project as the mixers are currently in demand especially for the preparation of poultry feed. It is of fabricated construction and is powered by an electric motor which drives the auger.

The auger continuously lifts the feed and drops it at the top onto the hopper for the next mixing turn. The additives are poured onto the mixer through an inlet at the top, while the main feed is pneumatically transported from a mill to the mixer.

Upon its completion, the mixer prototype was tested and immediately purchased after the tests showed very good results.

A manufacturer has already entered into an Agreement with TEMDO to manufacture the mixers for sale.

4.2 Food processing and preservation equipment developed by other companies are shown on Appendix II.

5.0 CONSTRAINTS IN THE DISSEMINATION AND PROMOTION OF MANUFACTURE OF DEVELOPED EQUIPMENT

Some of the machines developed by TEMDO have been tested in the regions, exhibited at the Dar es Salaam International Trade Fair, and in some cases demonstrated at selected villages especially within Arusha Region.

The many advantages of using these machines have made people realise the need to use such machines because in most cases they replace the traditional methods which are highly labour intensive and time consuming.

In some cases, some modifications have been suggested to take into account prevailing social factors in those areas especially in operating the machines. TEMDO has responded by taking into consideration such factors. Generally, up to now only a small proportion of the would be end-users have witnessed the testing of these machines because there have been many problems in disseminating information on machines developed.

TEMDO has tried to invite potential manufacturers to undertake batch level production of successfully tested designs, but the response has not been good because many manufacturers have fears on marketing problems. The market demand of these new machines is not exactly known. Others say they cannot venture into new products as even the little raw materials they have is not adequate for manufacture of their traditional products. Low income of peasants, hence their inability to acquire and use newly proven technologies is another constraint. In most cases the purchasing power of the peasant governs his acceptability of the technology being introduced.

Also the supply of the necessary raw materials (steel and standard parts) for manufacturing developed machines is inadequate because of lack of adequate foreign exchange to import them, as a result would be manufacturers are reluctant to venture into new products.

6.0 CONCLUSION AND RECOMMENDATIONS

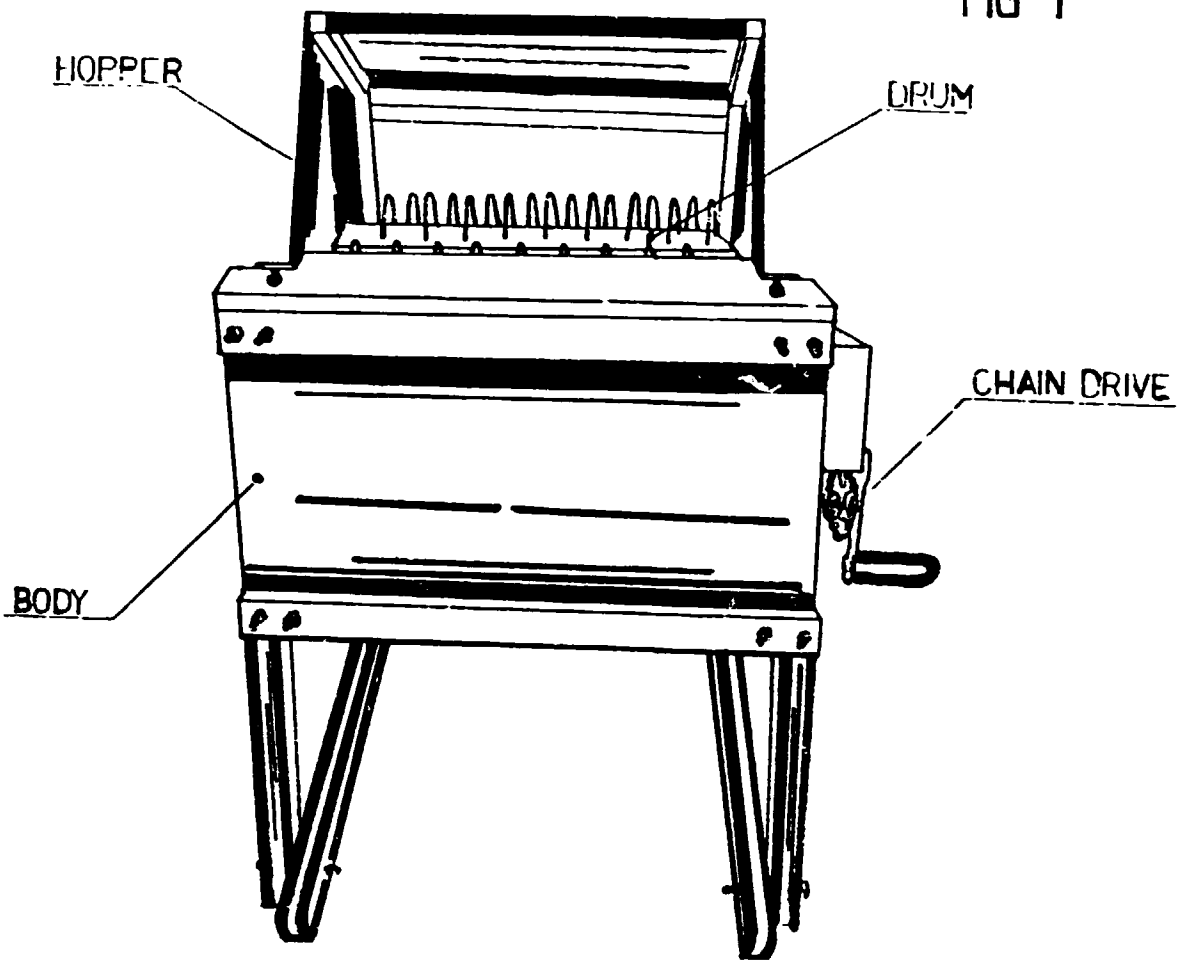
As outlined in this paper there are several designs developed in Tanzania by TENDO and other institutions and industries, however, promotion of their manufacture and use has not been adequate. It is therefore recommended that:

- 6.1 Efforts be made to strengthen and further develop the exchange of technical know-how between National Design Centres on available designs to begin with, in the East and South African sub-region.
- 6.2 Designs must be low cost and must be based on available raw materials, manufacturing facilities, skills, etc.
- 6.3 Training of designers is expensive and in many cases involves training overseas. UNIDO is especially called upon to further assist in the training of specialised personnel so as to accelerate the process of industrialization of developing countries.
- 6.4 Exchange of design personnel between countries in the sub-region.
- 6.5 Strengthening of TENDO already an existing national engineering design centre in the sub-region through provision of physical manufacturing facilities.
- 6.6 Free exchange of drawings/designs for food processing equipment in the sub-region. One centre to be focal point for exchange of information in the sub-region.

S/N	EQUIPMENT	MANUFACTURER	REMARKS
1.	Groundnut decorticators	Themba Farm Implements, ARUSHA	Designs were developed by the Institute of Production Innovation, University of Dar es-Salaam
2.	Sunflower decorticators		
3.	Manual oil mills		
4.	Grain hammer mills	Various workshops and metal industries	Designs adapted from imported makes
5.	Dehullers		
6.	Sorghum polishers	CAMARTEC	Designs developed by CAMARTEC
7.	Manual oil presses		
8.	Sunflower decorticators	Institute of Production Innovation (IPI)	Developed their own designs. Manufacture is on a batch-level only.
9.	Animal feed mixers		
10.	Hammer mills		

SINGLE OPERATION MANUAL THRESHER

FIG 1

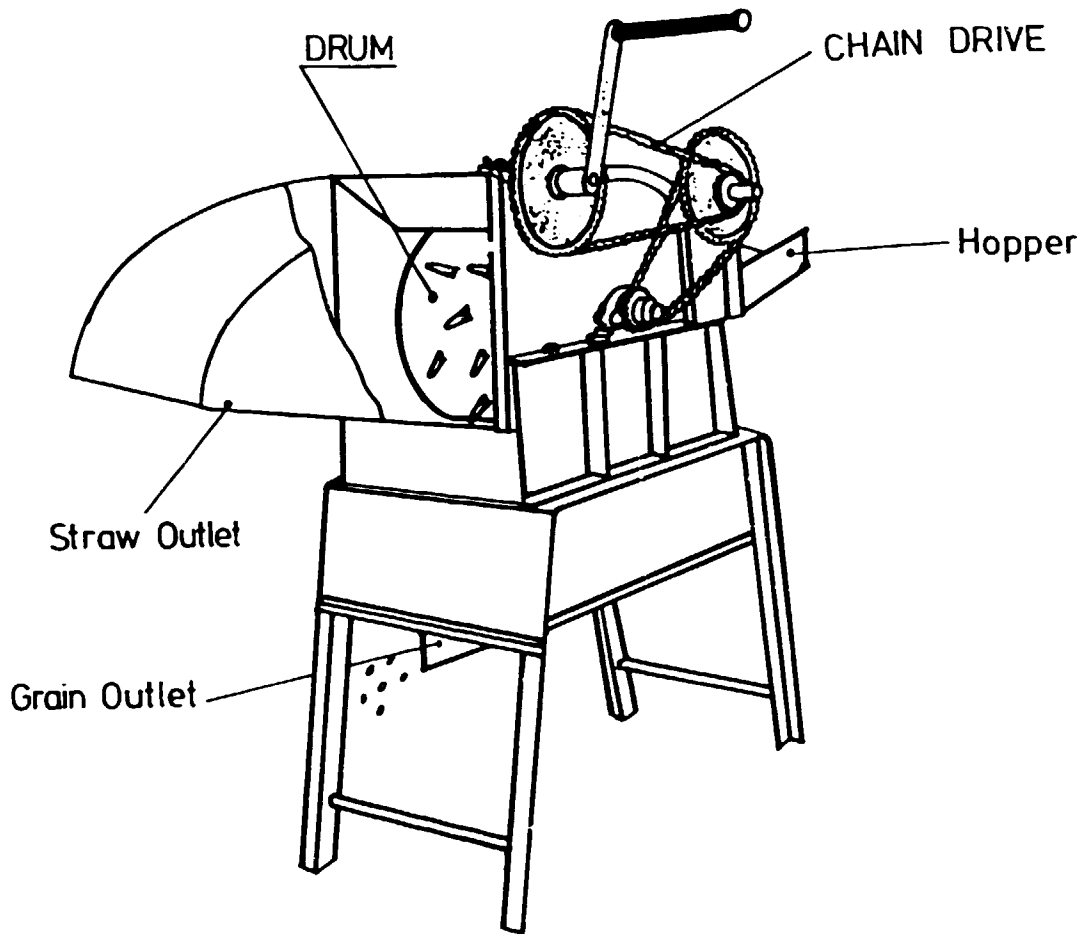


TECHNICAL SPECIFICATIONS

Weight	50kg
Height	100cm
Width	66cm
Length	76cm
Manual speed	Up to 300rpm
Output	Up to 1000kg of dry paddy per day
Operation	Two people required

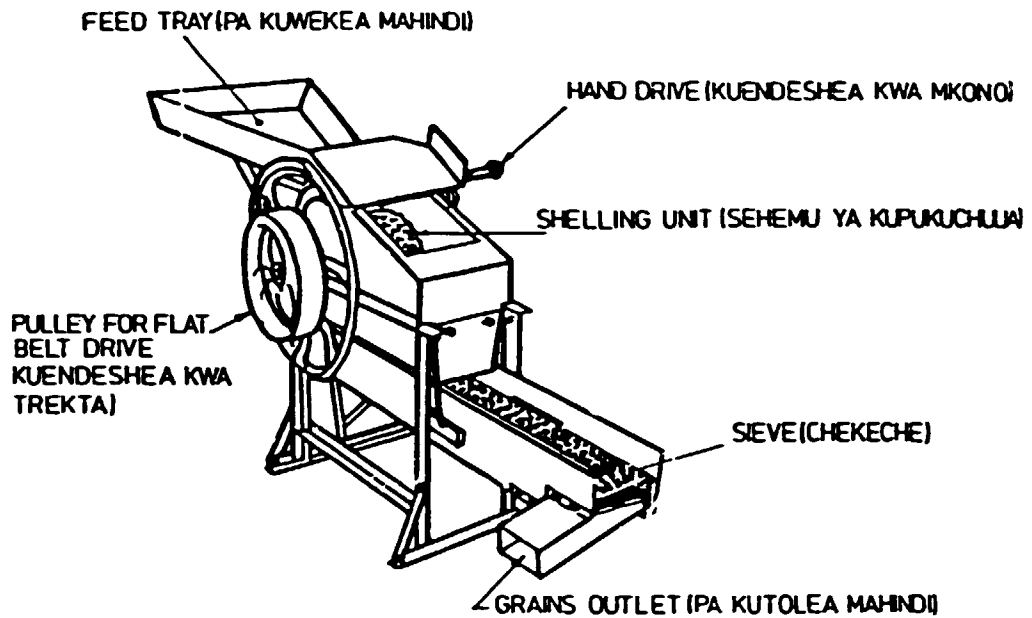
DOUBLE OPERATION MANUAL THRESHER

FIG 2



TECHNICAL SPECIFICATIONS

Weight	130 Kg
Height	135 cm
Width	60cm
Length	179cm
Threshing Speed	Up to 1000rpm
Output	Up to 1500Kg of the dry paddy per day
Operation	Two people required



MAIZE SHELLER

TECHNICAL DATA

SPEED : Manual 180 - 250 RPM-CAPACITY-500kg/hr

Powered 320- 380 RPM-CAPACITY-750kg/hr

WEIGHT : 160KG

HEIGHT : 1100mm

LENGTH: 2140mm

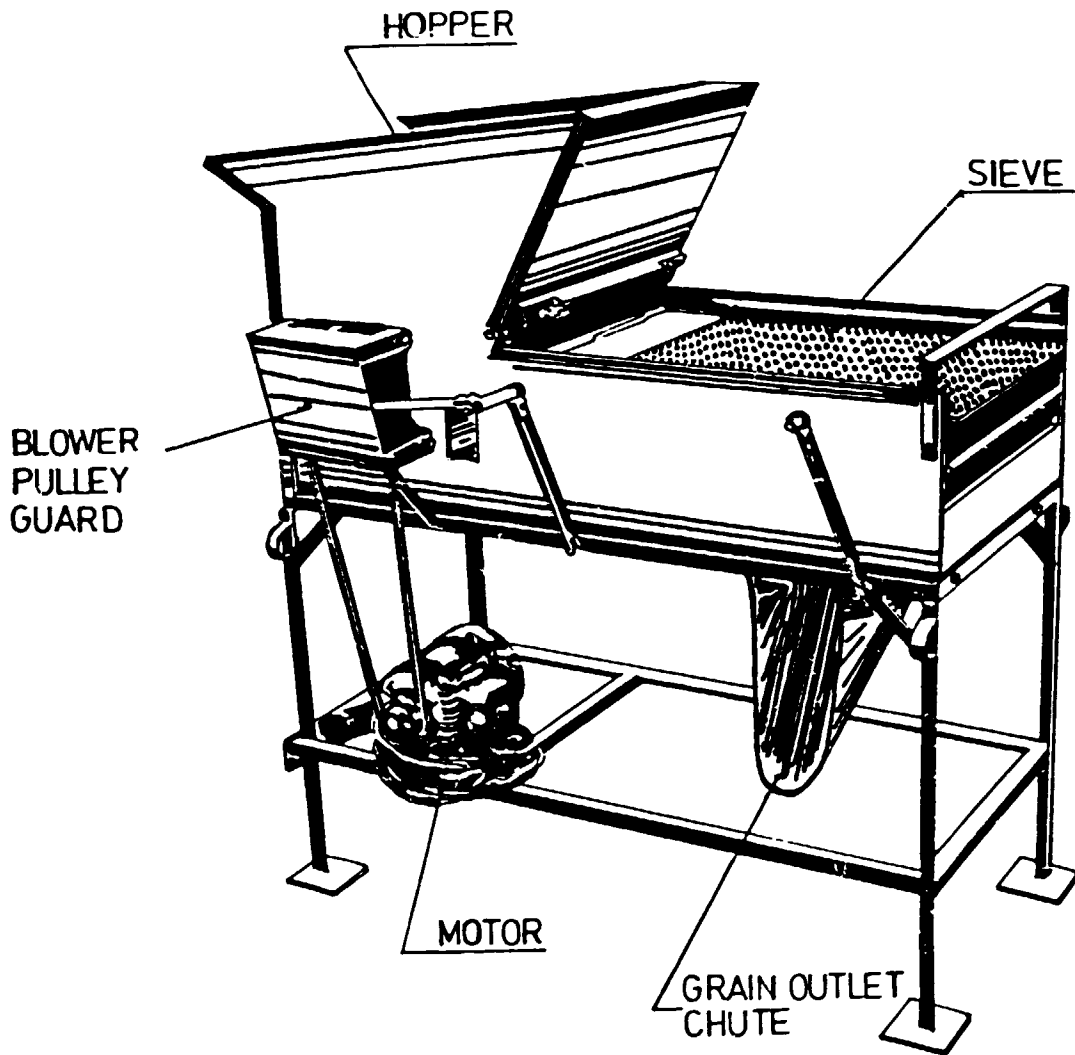
WIDTH: 870mm

FLAT BELT PULLEY: DIAMETER: 390mm

WIDTH: 90mm

PORTABLE GRAIN CLEANER

FIG 4

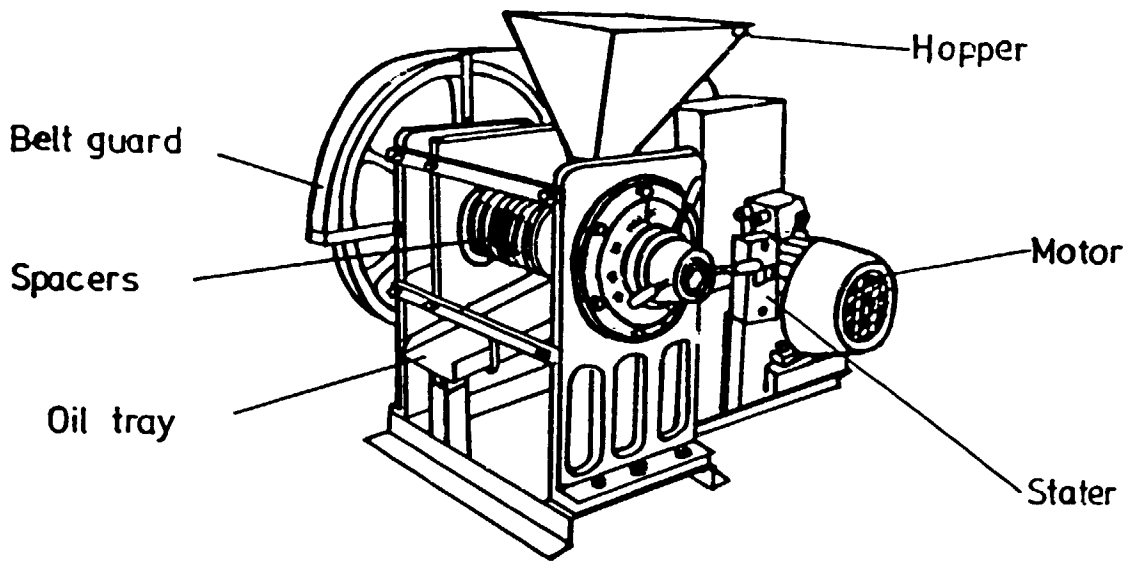


Features

- HIGH CAPACITY Up to one ton of paddy per hour
- LOW HORSEPOWER REQUIREMENT 0,5 hp electric motor
- LOW LABOR REQUIREMENT One to two men to feed and bag grain
- EASE OF OPERATION Minimum adjustments reduce operation and maintenance problems
- MULTICROP CAPABILITY Two screens with interchangeable top screen
- SIMPLE DESIGN Single shaft, horizontal oscillating screen and fan
- HIGHLY MOBILE Can be carried by two men
- TYPES OF SEEDS: (With screen changes) Maize, Sorghum, Millet, Beans, Wheat and many other types of cereals

SCREW TYPE OIL EXPELLER

FIG 5



SPECIFICATIONS

1. DRIVE: Electric Motor
2.2Kw, 50Hz, 220/380V, 3Ph
960rpm

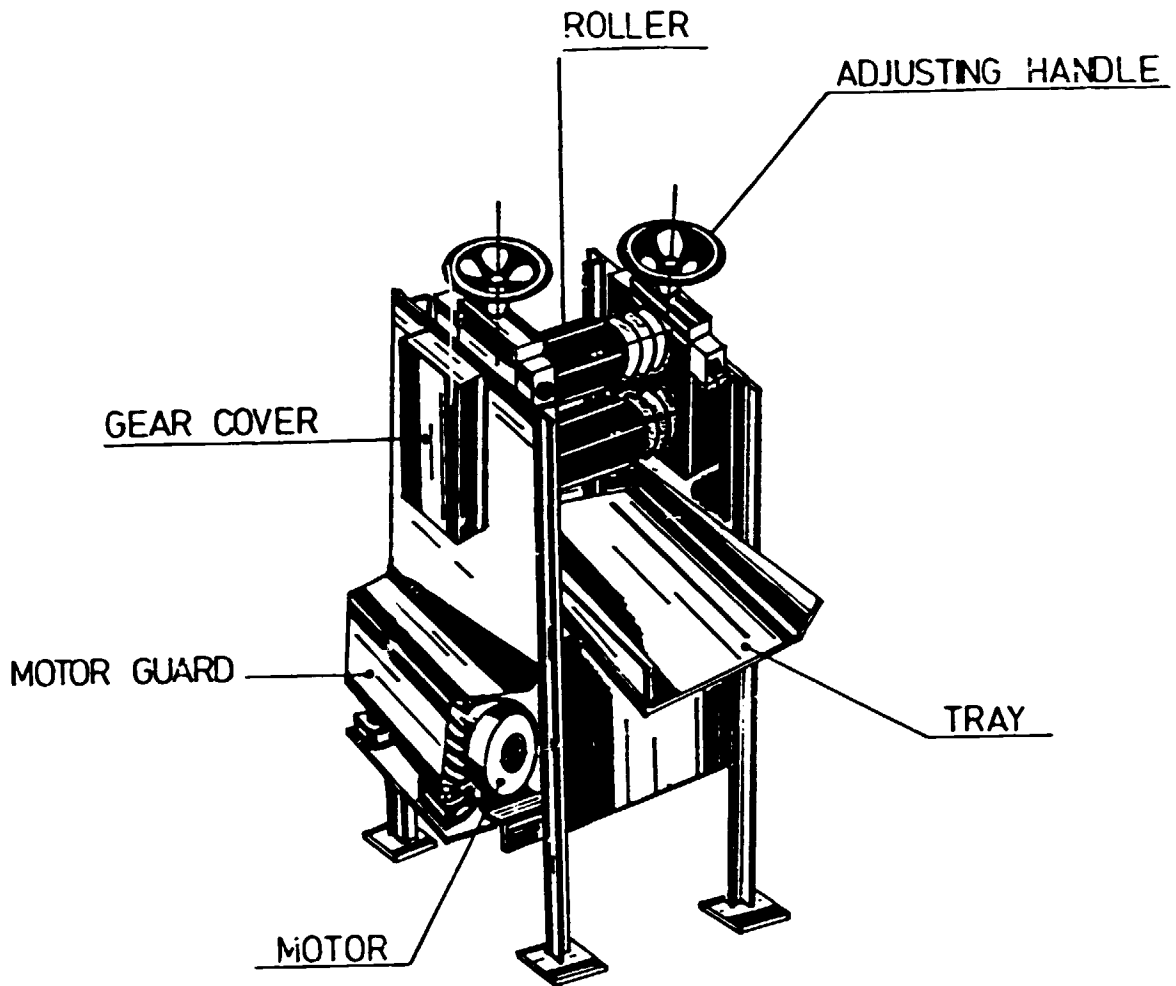
2.CAPACITY
In put 40-50 Kg/ hr
Sunflower Seeds
35-40 Other Seeds
Out put 8-10 Lt/hr
of oil

3 DIMENSIONS
Length 1060mm
Width 720 mm
Heigth 745mm

4.WEIGHT 200 KG

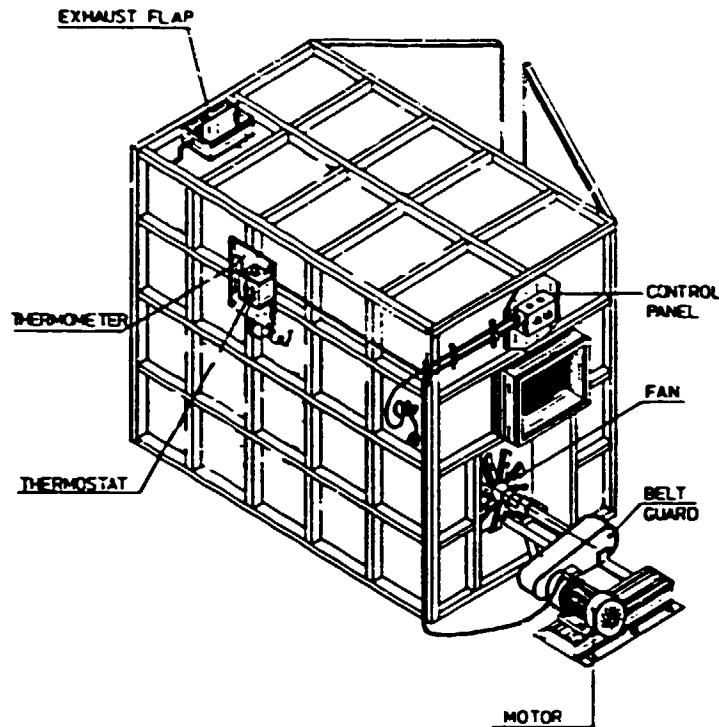
SUGAR CANE CRUSHER

FIG 6



TECHNICAL SPECIFICATIONS

Weight	250Kg
Height	1280mm
Width	340mm
Length.....	580mm
Output.....	20 Litres / Per hour
Operation	2 People



FISH DRIER

TECHNICAL DATA

POWER	-----	3 hp / 2.2 Kw electric motor 1500 rpm; 4 electric heaters @ 1Kw.
WEIGHT	-----	350 Kg.
LENGTH	-----	3M.
WIDTH	-----	1M.
HEIGHT	-----	2M.
CAPACITY	-----	250 Kg / Load.
CONSTRUCTION	-----	Wood.
FAN	-----	Axial type with 8 blades 500mm Diameter
BLOWER SPEED	-----	2200 rev/min.
TROLLEYS	-----	2 Nos. steel construction mounted on wheels, with sliding rocks for 40 trays.
DRYING RATE	-----	6% per hour average.
OPERATING TEMPERATURE	-----	43°C air temperature.
TEMPERATURE CONTROL	-----	Thermostat and chimney flap setting.

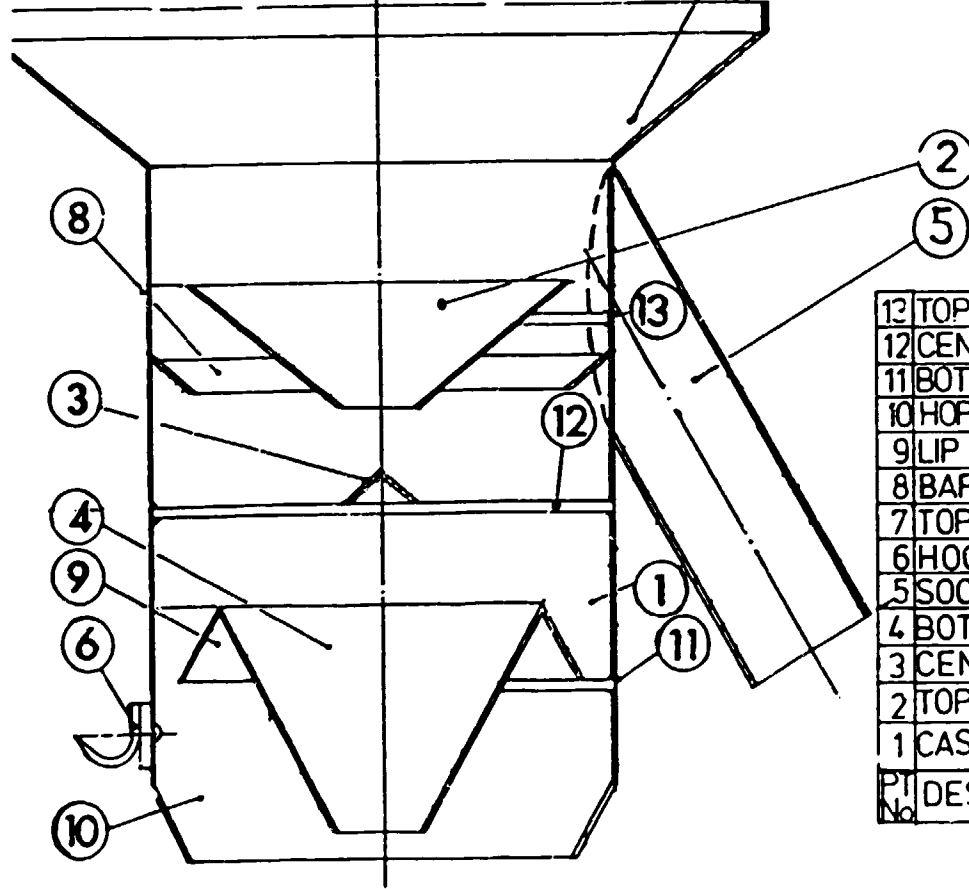
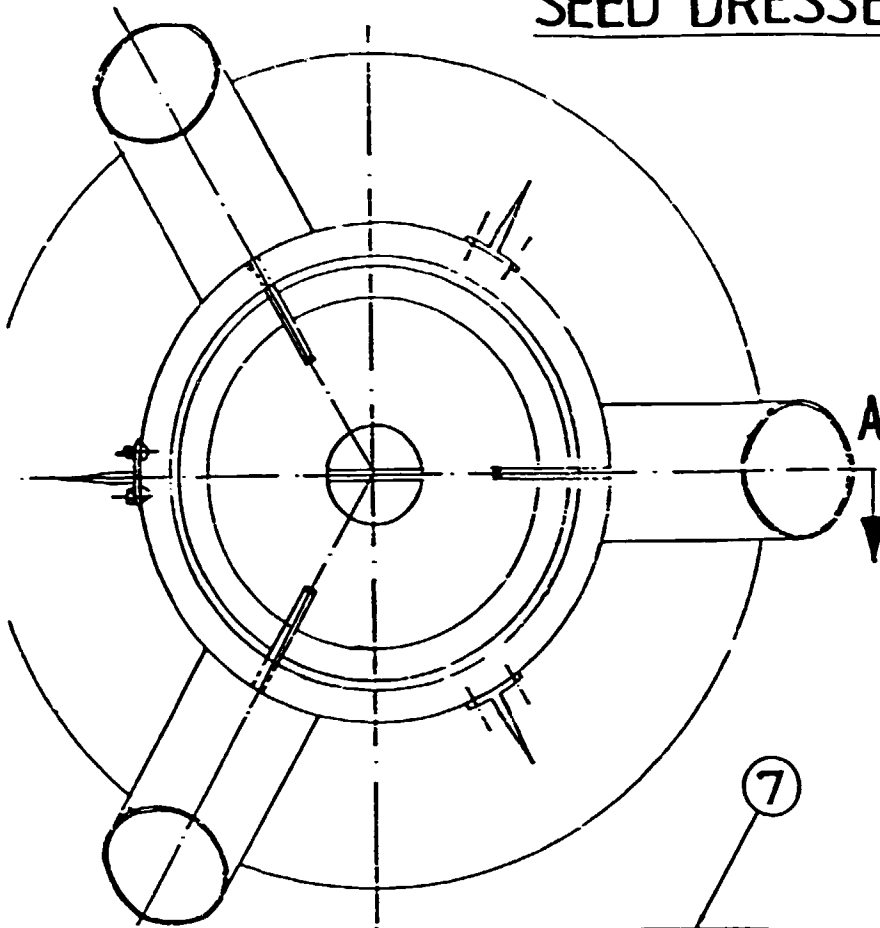
FEATURES

DESIGN SIMPLICITY	-----	Drying bin is of wooden construction; electric heaters and blower assembly uses locally available materials, parts and standard items.
COMPACTIBILITY/PORTABILITY	-----	Bolted bin construction allows for easy assembly and disassembly. occupies about 3.5 sq m of floor area.
LOW POWER REQUIREMENT	-----	2.2 Kw electric motor.
EASY TO OPERATE	-----	Minimum adjustment reduces operational and maintenance problems.
FAST DRYING RATE	-----	About 6% moisture reduction per hour. for higher rate it is recommended to prepare all fish to increase drying area.

SEED DRESSER

FIG 8

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SECTION A-A

12	TOP CONE SUPPORTS
12	CENTRE CONE SUPPORT
11	BOTTOM CONE SUPPORTS
10	HOPPERED OUTLET TO CASING
9	LIP TO BOTTOM CONE
8	BAFFLE PLATE
7	TOP HOPPER
6	HOOK
5	SOCKET
4	BOTTOM CONE
3	CENTRE CONE
2	TOP CONE
1	CASING
Pt No	DESCRIPTION

ANIMAL FEED
MIXER

BELT COVER

PULLEY

FIG 9

- 19 -

MIXER

BELT

TANK

MOTOR

MOTOR
ADJUSTING SCREW

DISCHARGE CHUTE

STAND

TECHNICAL DATA

SPEED : 280 RPM CAPACITY 1 ton Per/hr

HEIGHT: 3200mm

DIAMETER 1300mm

V - BELT PULLEY - DIAMETER 500

