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DESIGN, DEVELOPMENT AND EVALUATION OF A LOW COST PADDY THRESHER

By

MATHEW JOHN

THESIS

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Faculty of Agricultural Engineering & Technology
Kerala Agricultural University

Department of Farm Power Machinery and Energy
Kelappaji College of Agricultural Engineering and Technology
Tavanur - 679 573
Malappuram

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DECLARATION

I hereby declare that this thesis entitled **"Design, Development and Evaluation of a Low Cost Paddy Thresher"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society

MATHEW JOHN

Tavanur,

25 01.1991

CERTIFICATE

Certified that this thesis, entitled **"Design, Development and Evaluation of a Low Cost Paddy Thresher"** is a record of research work done independently by **Mr. Mathew John** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him

M R. Sankaranarayanan
(Chairman, Advisory Board)
Assistant Professor
Dept of Agril Engng
College of Horticulture
Vellanikkara - Thrissur

Vellanikkara,

28 01 1991

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To my loving parents

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ABBREVIATIONS

Agric.	-	Agricultural
ASAE	-	American Society of Agricultural Engineers
CIAE	-	Central Institute of Agricultural Engineering
cm	-	centimetre(s)
contd.	-	continued
Dept.	-	Department
dia	-	diameter
edn.	-	edition
Engng.	-	Engineering
Engr	-	Engineer
etc.	-	et cetera
et al.	-	and other people
e.g.	-	for example
Fig.	-	Figure
FIM	-	Farm Implements and Machinery
g	-	gram(s)
GI	-	Galvanized Iron
h	-	hour(s)
ha	-	hectare(s)
hp	-	horse power
HYV	-	High yield variety
ICAR	-	Indian Council of Agricultural Research
i.e.	-	that is

IRRI	-	International Rice Research Institute
ISAE	-	Indian Society of Agricultural Engineers
ISI	-	Indian Standard Institution
J.	-	Journal
kg	-	kilogram(s)
kg/h	-	kilogram(s) per hour
kg/ha	-	kilogram(s) per hectare
l	-	litre(s)
LV	-	Local variety
m	-	metre(s)
min	-	minute(s)
mm	-	millimetre(s)
m/min	-	metre(s) per minute
MS		Mild Steel
No.	-	number
pp	-	pages
q/h	-	quintal per hour
Res.	-	Research
RNAM	-	Regional Network for Agricultural Machinery
rpm	-	revolution per minute
Rs.	-	Rupees
s	-	second(s)
viz.	-	namely
/	-	per
%	-	percentage

Introduction

INTRODUCTION

Agriculture is the backbone of the nation. Without prosperous agriculture there can be no real national prosperity. Without modern and efficient farm machinery there can be no profitable agriculture. The progress and development of Indian Agriculture has been closely related to the utilization of labour saving equipment. Human labour is the most expensive power in the world. The development of machinery and mechanical power to make man's efforts more effective and productive is one of the most prominent features of development.

Agriculture is the prime mover in the industrial life of the nation which is concerned with the mechanics of production. The mechanization of agriculture is a new art. This art is the most visible and easily recognized form of technological change in rural areas of the developing countries. Machinery is now an unavoidable part of farming. Use of modern equipment is in vogue in agriculture now. Human power output is limited by the stress of high temperature, humidity, debilitating diseases and imbalanced diet. Similarly the animals also suffer from the same stress of temperature, humidity, disease and malnutrition and the potential power of animals can seldom be realized in practice.

The use of drought animals in agriculture does not appreciably reduce the amount of physical labour required by the farmers in the farm operations.

Rice (Oryza sativa) is one of the most important foods on which depends about one-fourth of the world's population (Kent, 1966). Rice is the major cereal crop grown in India with an annual production of 70.50 million tonnes contributing about 41 per cent of total food grains (Manorama Year Book, 1990).* In Kerala an area of 604.1 thousand hectares is under rice cultivation with an annual production of 1.04 million tonnes (Farm Guide, 1990)**.

The main problem of rice cultivation in Kerala is the high cost of production and the low price for the produce. These two, along with some technological constraints, have made rice cultivation one of the least remunerative agricultural enterprises in Kerala. Labour is the costliest single input in rice cultivation, contributing to about 55 to 60 per cent. The wages of agricultural labourers have increased tremendously while there was only a marginal increase in the price of paddy. If we could meaningfully reduce the cost of labour, the cost of production can be

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* Malayalam Manorama Press, Kottayam

** Farm Information Bureau, Government of Kerala brought down considerably. It is very difficult to get sufficient number of labourers especially during peak periods of farm operations like planting, harvesting and threshing. Moreover, labour productivity in the farm sector has to be improved. An area which gives us hope for cost reduction is meaningful and selective mechanization.

Threshing is one of the critical post-harvest operations in rice cultivation. Adoption of improper threshing methods results in post harvest losses thereby reducing the net recovery of paddy. The traditional method of seed separation from the stalks are uneconomical, time consuming and laborious. Mechanical threshers clearly have an edge over conventional ones as they reduce the drudgery of work to a great extent. The use of these mechanical threshers is based on a functional requirement, level of performance and economy. Thresher is very necessary to handle large volumes of paddy crop in time so as to protect the crop against weather hazards and for timely sowing of next crop.

The development of mechanical threshers in India was started with the manufacture of beater type threshers for wheat at Allahabad Agricultural Institute, Allahabad, which was adopted on large scale by Ludhiana manufactures in late sixties The manually operated threshers introduced in Kerala a couple of decades back were not accepted well by the farmers, mainly due to their low output and simultaneous feeding and pedalling by the same operator though several types of high capacity and efficient power paddy threshers are available in our market, their high investment, sophisticated construction and operation, wastage of paddy straw and lack of portability limit their acceptance among the small and marginal farmers of Kerala. Thus most of the farmers are still depending upon the conventional methods of threshing. Small threshers operated by motor or engine may be used efficiently for this purpose. Some improvement and modifications can be made on these threshers to make them more efficient and suitable for small farms. The development of a suitable low cost, light weight and power operated thresher will be quite appropriate in the present context of rice cultivation in Kerala.

Hence it is proposed to design and develop a low cost paddy thresher with the following objectives.

1. To design a power operated low cost paddy thresher for use in Kerala with a capacity of 200 kg/h and to be operated by a prime mover of 0.25 to 1.0 hp electric motor.
2. To optimise cylinder rpm and crop feed conditions of the developed paddy thresher.
3. To evaluate the performance of the low cost paddy thresher in threshing paddy produced in Kerala.

Review of Literature

REVIEW OF LITERATURE

A brief review of cultivation techniques and previous research studies on threshing practices, different type of threshers and their testing and performance evaluation are presented in this chapter.

2.1 Cultivation

In Kerala rice can mainly be grown either by broadcasting or by transplanting during three seasons as shown below depending on the availability of water and other local conditions.

'Virippu'	-	First (Autumn) crop April-May to September-October
'Mundakan'	-	Second (Winter) crop September-October to December-January
'Punja'	-	Third (Summer) crop December-January to March-April

The system of rice cultivation in various rice growing areas of the country are largely dependent upon the rice growing conditions prevalent in the respective regions. The principal systems followed in India are 'dry', 'semidry and wetland' cultivation (ICAR, 1980).

2.2 Harvesting

Govindaswami (1975) reported that varieties differ with respect to harvesting time, threshing and milling variability exists as regards their characteristics. As a matter of fact harvesting time differs according to the variety. But most of the varieties reach a uniform state of maturity (95-98 per cent of all the kernels on the stalk are mature if there is perfect synchronization of flowering in all tillers) at a high grain moisture level of 25 to 26 per cent.

In our country paddy is allowed to stand in the field after maturity until it sundries to 14 to 15 per cent moisture level before harvesting. In some areas paddy stalks are cut at 20 to 26 per cent moisture and stacked until it sundried to a lower moisture level before threshing.

Rice spikelet generally take 21 to 23 days to become biologically mature after fertilization and then dehydration of the grain starts. Moisture content of the grain during this period is sufficiently high and ranges from 25 to 30 per cent. Studies of larger number of varieties belonging to different duration group (early, medium and late) have shown that the grain of the rice varieties once biologically mature losses moisture at a rapid rate (1.0 to 1.5 per cent per day) during early range of drying and the rate gets reduced (0.5 to 1.0 per cent) when it reaches below 18 per cent moisture. Study also indicate that 14 to 15 per cent moisture content in the grain under field conditions is a critical stage at which it become susceptible to moisture changes by weather conditions.

Tomar (1985) reported that the paddy crop should be harvested about 30-35 days after 50 per cent of flowering. At this stage the moisture content in the grains should be around 16 to 20 per cent. Early or late harvesting deteriorates the seed quality.

Bal and Ojha (1975) reported that paddy samples harvested during the optimum harvest period were observed to give maximum total rice yield and heard rice yield in addition to the maximum rice yield during that period. This is about 3 to 5 per cent.

2.3 Threshing

Threshing may be defined as the group of operations that are designed to detach the desired product from the mass of the harvested crop materials and their separation from the mass (Trivedi and Arya, 1965).

Sarajpati et al. (1981) reported that the farmers thresh paddy immediately after harvest or they stack the bundles and thresh at a favourable time. Sometimes threshing is done 10-15 days after harvest. Delay in threshing of stacked paddy often results in qualitative and quantitative losses due to warm and moist condition inside the stack.

According to RNAM (1983) threshing is the first post harvest operation for separating the grain. It is generally laborious and the harvesting in rainy season introduced by the double or multicropping would have the danger of deteriorating the quality of grain if the crop is not threshed in a short time.

Trampling by bullocks and beating of the crop on a stone or wooden log have been the most popular methods of threshing till mechanical threshing devices were introduced in the country during early 1960's (CART, 1986)

Threshing methods

The common methods of threshing are:

(a) Manual threshing

(b) Animal threshing

(c) Mechanical threshing

a. Manual threshing

Threshing by manual labour is slow and labour consuming. Process of beating the harvests on a floor or beating by stick or treading the grain under the feet of men (Plate I & II) is the method for small quantity of harvests (Verma and Irshad Ali, 1970).

b. Animal threshing

Threshing by bullocks is very common method used in villages. The harvest is spread on a clean threshing space, the bullocks are tied in line one after the other with the help of a strong pole fixed in the centre of the threshing space. Bullocks move round and round on the harvest and trample them continuously till the grains are completely separated from straw. One man drives the bullock from the back (Jagdishwar Sahay, 1977).

There are some other threshing methods which are mainly used for wheat, reported by Peter (1965).

Tree branch threshing

In order to accelerate the threshing process some farmers use a bushy branch of tree hitched behind the bullock pair, loaded with sackful of earth or bundles of crop. This method in addition to the process of threshing by bullock trampling reduces the labour involved in shaking the crop, which is done to allow the threshed grain to trickle down to the threshing floor.

Figure I a ti Conve tora hreshing e ho n K o

Punched sheets threshing

Corrugated metal sheet with punched holes has been used for threshing. The jaggered edges formed by punching holes in the sheet help to cut and tear the crop underneath, when dragged over it. Suitable weights are put on top of the sheet to make it work more effectively.

Disk harrow threshing

The use of bullock drawn disk harrow for threshing has been demonstrated successfully. A single action disk harrow with eight or six disks compare favourably with the Olpad thresher in work output. The disk harrow has an added advantage that the churning effect due to angling of the gangs helps in allowing the grain to sift down to the bottom, thereby reducing the labour of shaking the crop. The farmer who owns a disk harrow primarily for tillage operations can make use of it with advantage without added investment in another threshing machine, if he desires to use onl bullock power for the operation.

Olpad threshing

The Olpad thresher was developed over six decades ago in the western part of India and has gained popularity in recent years. It has three parallel gangs one behind the other of serrated vertical discs numbering 14 or 20 in a thresher. It is hitched behind a pair of bullocks and drawn over the spread crop with the driver sitting over it. Loading the thresher with weights increases its efficiency. The end product is similar to that obtained by bullocks trampling. Care is needed to keep the crop pile thick enough so that the disks do not penetrate to the threshing floor below.

Abbott (1964) reported that the farmers in Iran have for centuries used a thresher which has much to recommend it to Indian farmers whose circumstances are similar. An Iran thresher with minor modifications has been built at Rasulia Hoshangabad (M.P.). It has been found that with this thresher two bullocks are able to accomplish what five bullocks could do in the same time by the old treading method. It is so simple that it could be constructed by any village artisans.

c. Mechanical threshing

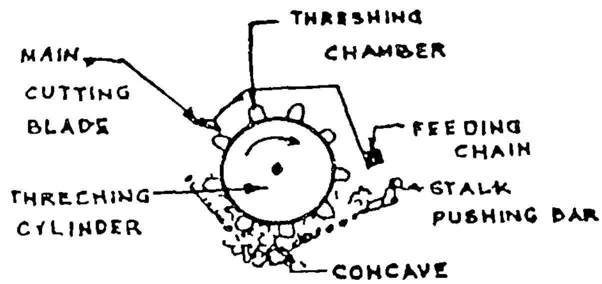
Sridharan (1976) reported that, in view of the importance of timely threshing of paddy especially on small and medium farms, Government of India imported several low H.P threshers namely Kubota, Yanmar and Cecoco from Japan, which were tested at the Indo-Japanese farms and other research testing centres in the country. The performance of these machines was considered to be generally satisfactory at several places. Rapid indigenous developments have taken place during 1960's with the ICAR announcing a prize award competition in 1965-66 for low H.P threshers. Several design engineers, manufactures and Research Institutions took special interest in the design and development with the result that a large number of these had been reported. The threshing mechanisms of the existing threshers are of the following types (Fig.1).

1. (a) Beater cylinder (hammer mill) and bar mesh concave and aspirating fan (mainly for wheat)

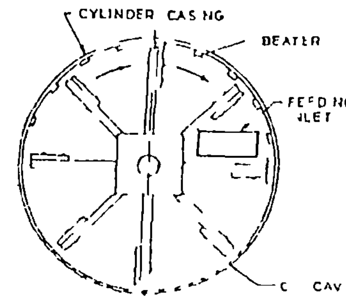
   (b) Drummy threshers as above but with blower (mainly for wheat)

2. Spike cylinder and wire mesh concave (rice/wheat)
3. Chaff cutter-cum-thresher (especially for wheat when wet with rain)
4. Spike cylinder with spike concave (pass through for rice)
5. Spike or raspbar cylinder with straw walker (wheat/rice)

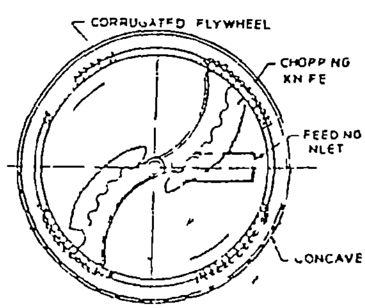
Salient specifications of available paddy threshers are given in Appendix III. It is clear from these details and specifications that the power-grain output ratio varies widely from make to make. There is considerable scope for improving the qualitative aspects of these machines.



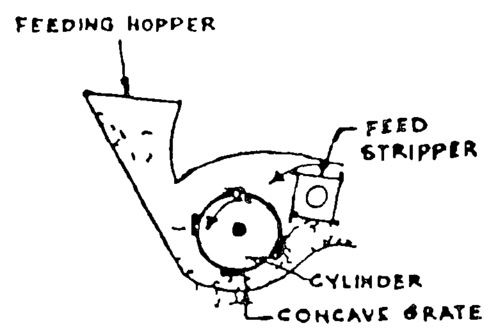
(A) JAPANEESE, WIRE LOOP PADDY THRESHER



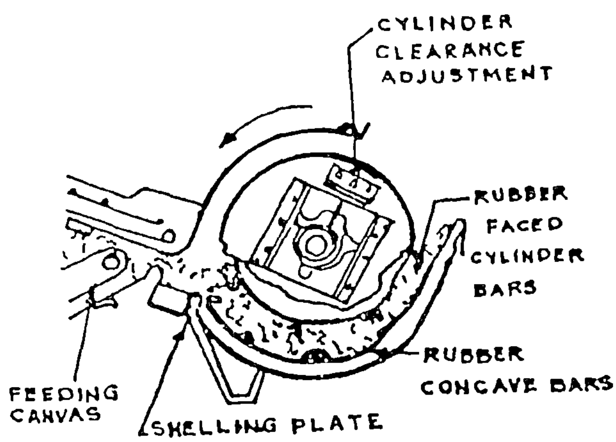
(B) BEATER TYPE AND DRUMMY THRESHER



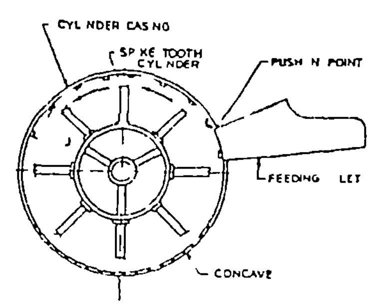
(C) SYNDICATOR THRESHER



(D) RASP BAR THRESHER



(E) ANGLE BAR CYLINDER THRESHER



(F) SPIKE TOOTH THRESHER

Fig.1 DIFFERENT TYPES OF THRESHING SYSTEMS

According to ISI (1982) and Irshad Ali (1983) the rotary or Japanese pedal paddy thresher is one of the simplest devices which perform threshing efficiently. It consists of a wooden threshing drum with wire teeth (Fig.2). The teeth in different rows are staggered. The drum is mounted on angle iron frame and covered from the sides and bottom by MS sheets. The bottom side of the covered sheet is made sloping for collection of the threshed grain. The drum is pedal operated through gears. The cast iron gears providing an overall ratio of 1:4 speed gain from a treadle to achieve cylinder speed of about 400 rpm constitute the main driving mechanism. The diameter of the cylinder is 43 cm. One man operating the thresher can thresh about 1.5 to 2 quintals per day. Threshing is done by holding paddy crop bundles close to the teeth on the rotating drum. The wire teeth rotating in high speed hit the grain resulting in separation from the earheads. The threshed grains falls down and are collected after threshing.

The mechanical threshers were introduced to do the job efficiently and quickly. The pedal threshers were recommended for threshing paddy, but the bundles which have to be lifted, held against the rotating drum and turned manually do not allow saving of energy, labour of time (Trivedi and Arya, 1966)

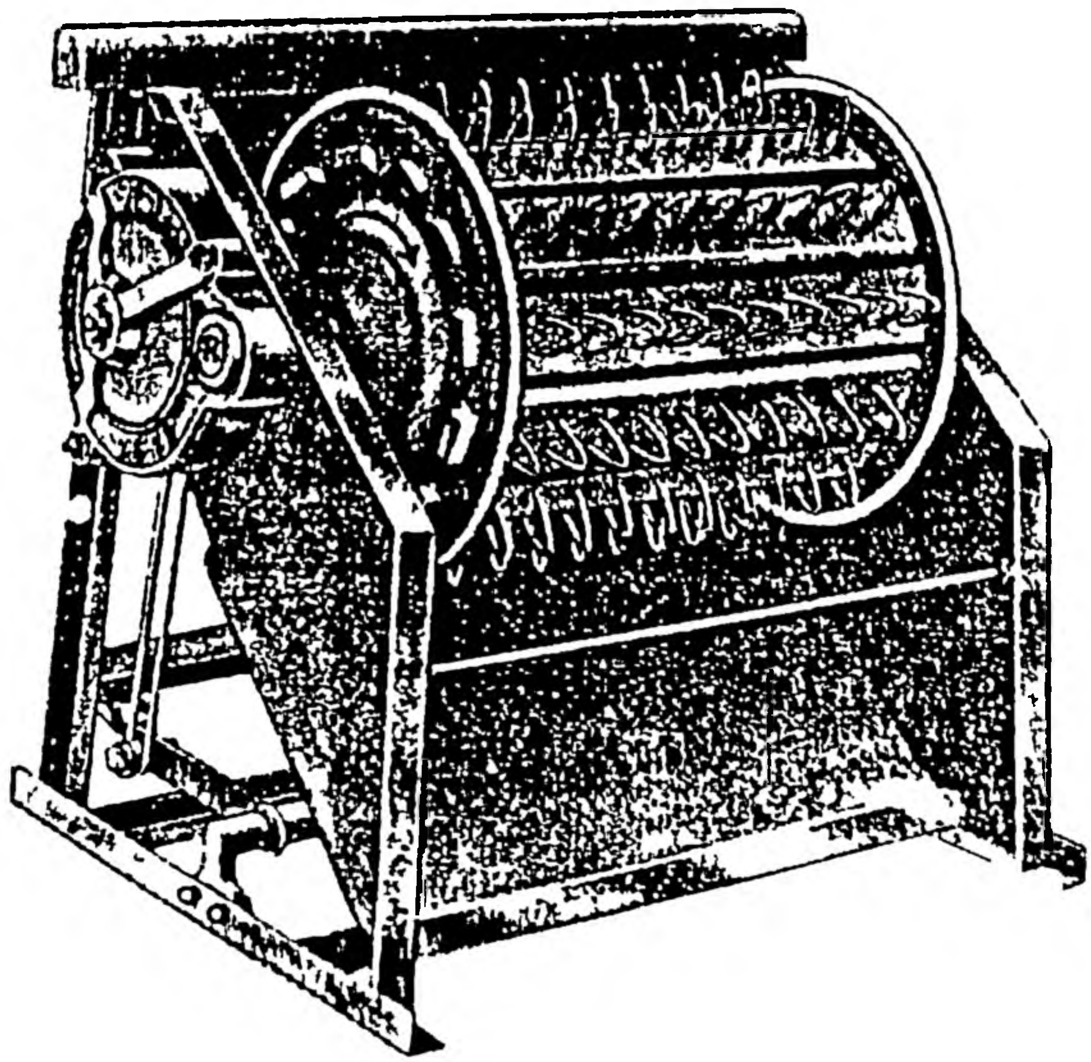


Fig.2 JAPANESE PEDAL PADDY THRESHER

Sridharan (1972) reported that the pedal operated paddy thresher had been imported and tried out in several parts of the country in the fifties. The output was very low (upto 50 kg/h) and proved useful for hills and other areas where labour and animals were difficult to get. In Patna the pedal thresher was improved further by giving it a speed set up gear box working by means of a pair of bullocks.

Kherdekar (1967) reported that threshing of paddy is mostly done in the dry season by beating or trampling by bullocks. But threshing machines are necessary when large areas have to be covered. The high yielding varieties like Tainan-3 and K-20 present difficulty in threshing and the need for machines is keenly felt. The pedal threshers have a rotary drum which is worked with a pedal. The drum revolves at 400 rpm. Since most farmers in paddy growing areas are very small, i.e., less than one acre, it was difficult for farmers to purchase a machine due to its high cost. An effort has been made to design a machine that costs less than the Japanese pedal operated thresher. The newly designed paddy thresher can be operated with the help of bicycle. The capacity of both these machines is about 91 kg per hour. In areas where electric power is available, and farms are large, a power operated paddy thresher has been indigenously manufactured on the same principle. The capacity of this thresher is 681 to 908 kg per hour. It can be worked by a 3 hp oil engine or an electric motor. A winnowing attachment is also provided for this thresher which gives the farmer clean grain after threshing.

Power driven threshers

According to Pradhan (1968) and Johson (1969) power driven threshers are becoming popular due to the following reasons.

1. Unavailability of sufficient labourers during the harvest season
2. Quick and time saving
3. Some improved varieties are more difficult to thresh by the traditional methods
4. Minimises the grain loss irrespective of the threshable character of the variety
5. Studies show that crack ratio is higher in paddy samples threshed by beating
6. Most of the improved varieties of paddy are weekly dormant and there is greater possibility of germination in the field
7. Even small quantity of crop can be threshed separately without deterioration in the quality.

Several works have been reported on the threshers and combine to determine the effect of different parameters on threshing of different crops. Several types of power operated grain threshers have been developed in various parts of the country for the last few decades.

More than 60,000 threshers are manufactured every year for threshing wheat alone all over the country. These are operated by 5, 7.5 or 10 hp electric motors or tractors. The capacity ranges from 200 kg/h to 1500 kg/h. These mechanical threshers not only thresh the crop but also clean the grain and thus the quality of the grain is considerably improved as compared to traditional threshing. Efforts are being made to develop multicrop threshers which can thresh all major crops like wheat, paddy, soyabean, pigeon pea, sorghum, maize etc. (CART, 1986).

Olpad thresher has become popular in sixties, in spite of its high initial cost, single purpose use and poor efficiency as compared to mechanical threshers. Now-a-days several low horse power and high efficient units have been under development. They are being improved upon with a greater scope for the widespread adoption of stationary mechanical threshers in the country (Roy, 1967). Ghaly (1973) observed that the threshing process that required four days using the disc implement may be accomplished in less than two hours using mechanically operated stationary threshers

According to Irshad Ali (1983), small power threshers are becoming increasingly popular among the Indian farmers. They are operated by 5 to 10 hp stationary engine, electric motor or tractor. Power is transmitted by belt and pulley. A variety of threshers with varying cylinder designs and sizes are available. The threshing drum or cylinder is cylindrical in shape and is generally provided with pegs on the periphery. The drum is rotated at about 600 to 700 rpm. The crop is threshed by the impact and rubbing action between the drum and the concave. A 5 hp thresher can thresh about 4.5 to 5.6 quintals of grains per hour.

A cone-type thresher was designed, fabricated and tested at International Rice Research Institute which showed that the principle of the cone-type thresher was sound and gave a maximum output of 300 kg/h paddy using a 6 hp engine (IRRI, 1963). A PTO driven model (Fig.3) with more power and screen area was fabricated (IRRI, 1964). A 36 hp tractor stalled when the thresher was fed with straw and grain at a rate of 60 kg/min. The centrifugal nature of the cone thresher resulted in increased friction on the screen and drag on the drum, creating a high power requirement. Complete threshing was achieved, but even a 4.5 m screen did not fully separate the grain from the straw. Efforts were made to improve the cone thresher (IRRI, 1973, 1974). It gave high threshing output but the grain cleaning performance was not satisfactory.

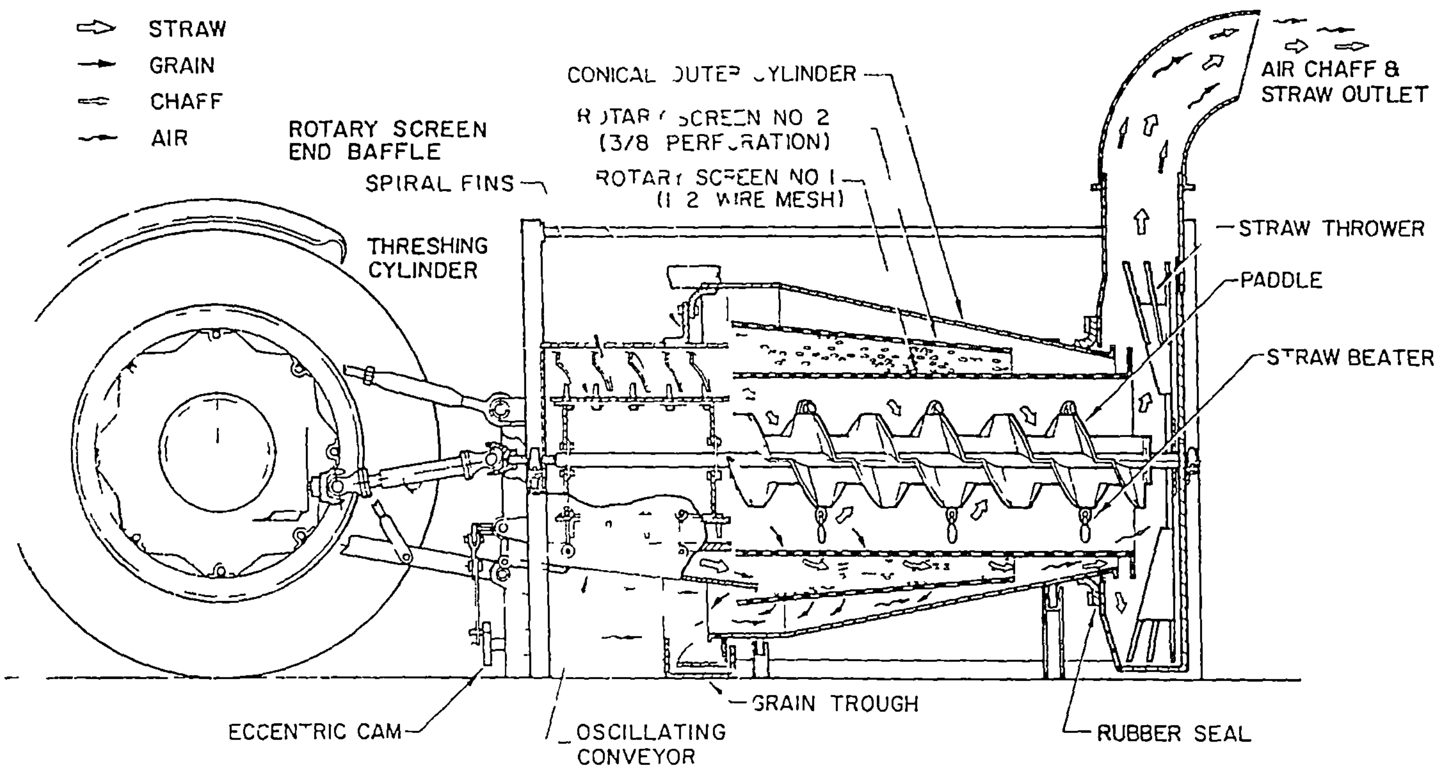


Fig.3 PTO - DRIVEN THRESHER

A drum type power thresher was designed and developed by IRRI (1967, 1968) for freshly harvested paddy. The machine was powered by a 4 hp air cooled engine and utilized the U-shaped wire loop type threshing drum. It had a 6 feet long hollow threshing drum which was mounted within a sheet metal housing. Rubber flaps were placed in spiral arrangement on the drum to sweep the housing bottom and to deliver the threshed material to the real mounted rotary screen separator. An axially mounted fan was used to blow air through the drum and separator. The threshing drum, therefore, served not only for threshing but also as an auger for moving threshed materials and as a duct for moving air to the separating mechanism. The machine was capable of threshing both dry (14% moisture content) and wet (over 30% moisture content) paddy.

Peter and Garg (1968) developed a power wheat thresher at Allahabad Agricultural Institute, Allahabad. It was power operated peg tooth type, operated by 5 hp electric motor or 7.5 hp diesel engine and required three persons for the entire operations. It was suitable for threshing wheat, sorghum, gram, barley etc. The weight of the thresher was 400 kg. On testing with wheat crop at 800 rpm output was 178 kg/h at a threshing efficiency of 96.9 per cent and cleaning efficiency of 99.8 per cent. Damage to grain was found to be negligible.

Pradhan (1968) reported about the plot type thresher of U.S.A. The turnout of these types of power threshers is quite high. The thresher is operated by 3 to 3.5 hp motor. Three persons are rquired to operate this thresher. The output is varying from 175 to 200 kg grain per hour. The cost of threshing and the daily output are comparable to conventional threshing by 7 to 9 bullocks and three persons.

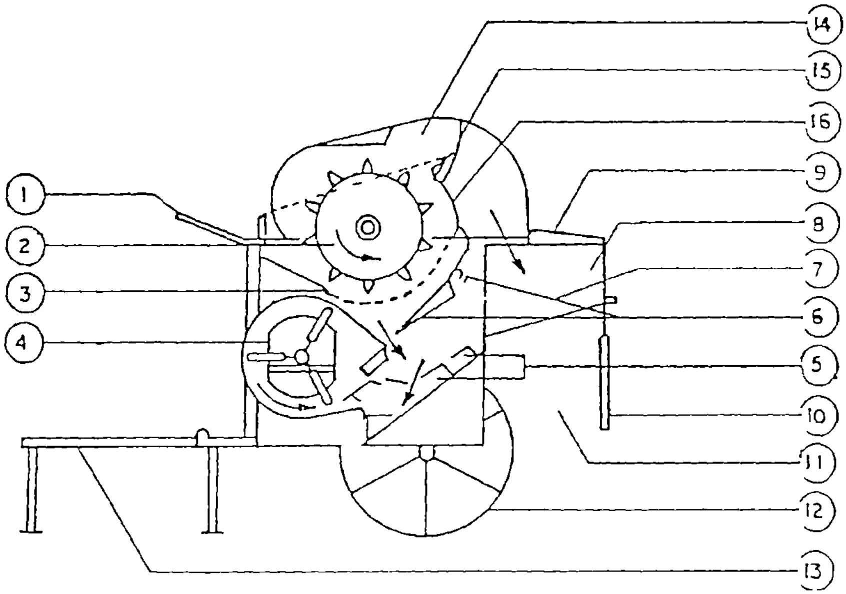
Harrington (1970) designed a multicrop thresher having spike tooth cylinder and fixed concave on the basis of acceptance of Japanese paddy threshers and American wheat threshers which used spike-tooth cylinders. The losses in paddy and wheat were 3 per cent. The thresher was not suitable for straw making as it normally reduced wheat straw to 25 to 50 per cent of original length depending upon cylinder speed and moisture condition. The cylinder tip speed ranged between 1200 to 1400 m/min resulting in less than 0.1 per cent unthreshed grain and between 800 to 1000 m/min resulted in less than 0.1 per cent visible damage. The unthreshed grains were less than 1.0 per cent.

Peter (1970) designed and developed a power operated paddy thresher to meet the needs of small and marginal farmers who grow paddy, wheat, jowar and bajra etc. The threshing capacity of this thresher was 200-400 kg/h (paddy), 75-125 kg/h (wheat) and 400-600 kg/h (jowar) respectively. This was operated by 3.5 hp engine. Speed of the drum was 550-850 rpm. It required three persons to operate (Appendix IV, Fig.4).

An all crop thresher was developed by FIM scheme APAU, Hydrabad (1972). It was operated by 7.5 hp engine or electric motor and required four persons. Rice, wheat, sorghum, maize and pearl millet are threshed by this thresher. The output on different crops are 560 kg paddy, 400-500 kg wheat and 1200 to 1500 kg of sorghum and maize per hour, respectively (Appendix V).

A throw-in type multi-crop axial flow thresher was developed at IRRI (1972). It had wireloop threshing drum of 35 cm diameter and 127 cm length with a concave screen enclosing the full length of the cylinder. A 6.5 hp air-cooled engine was used as prime mover. An axial flow thresher having peg-tooth cylinder with bolts of 1.1 cm in diameter as pegs (Fig.5) gave better threshing performance and longer life in comparison with wire loop threshing cylinder.

Chabbra (1975) developed and tested an axial flow thresher on the basis of drawing procured from IRRI. He found that it can thresh paddy and wheat quite efficiently. In paddy threshing at 500 rpm (794 m/min peripheral speed) the threshing efficiency was 100 per cent and feed rate was 710 kg/h, which resulted into an output of 213 kg clean grain per hour. To achieve 99 per cent cleaning efficiency the



1 FEEDING TROUGH	9 CURTAIN COVER
2 THRESHING CYLINDER	10 GRAIN RECOVERY PLATE
3 CONCAVE SCREEN	11 REAR OPENING
4 BLOWER	12 TRANSPORT WHEEL
5 AIR PASSAGES	13 STANDING PLATFORM
6 GRAIN SLIDE PLATE	14 TOP COVER
7 STRAW SHAKER	15 DUST REMOVING LOUVRE
8 SIDE CURTAIN	16 STRAW RELEASE LOUVRE

Fig.4 AAI POWER PADDY THRESHER (NAINI JUNIOR)

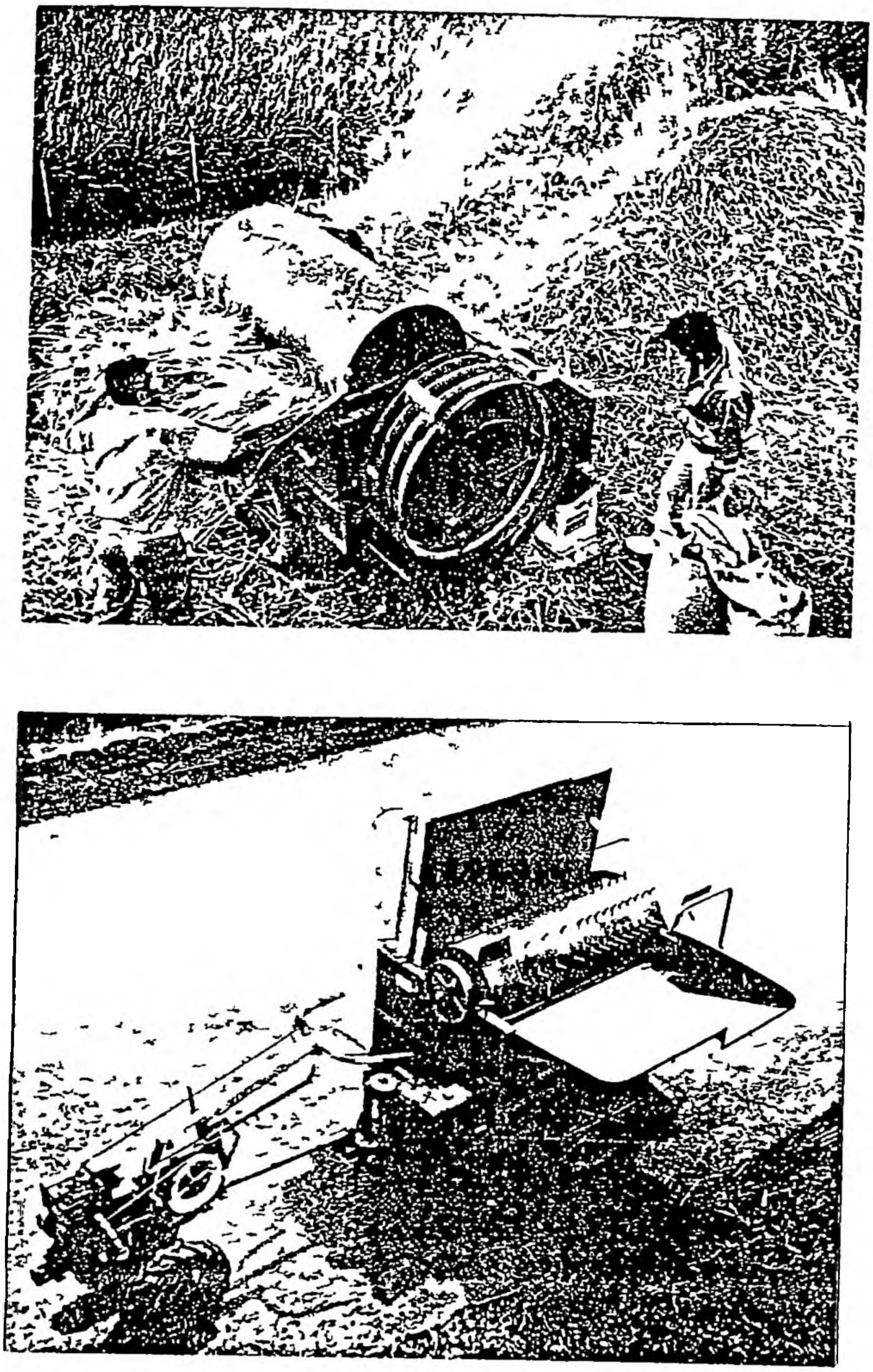
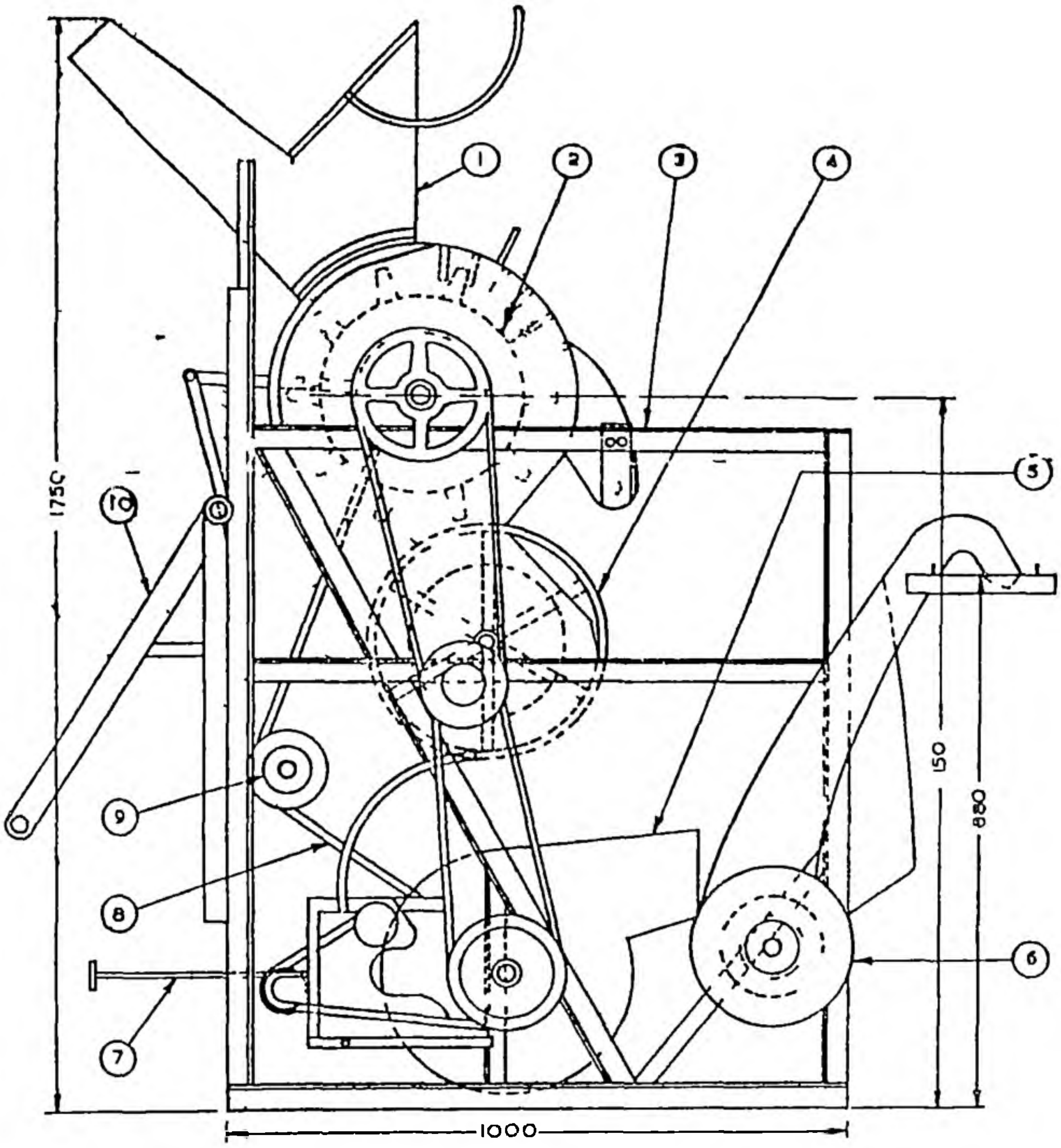


Fig.5 AXIAL FLOW THRESHER

blower losses were 9 per cent. In wheat threshing at 700 rpm (1,111 m/min peripheral speed) and 63.5 mm peg spacing threshing efficiency, external damage, cleaning efficiency and separation losses were 99.63, 0.47, 96.47 and 2.4 per cent respectively. A feed rate of 960 kg/h gave 340 kg/h clean grain. However, the quality of wheat straw was poor and only 65 per cent of the straw was worth cattle feed.

Nirmal and Sirohi (1976) developed a multicrop thresher at IARI, New Delhi. The thresher was named as Pusa 40 thresher (Fig.6) and the specifications are given in Appendix VI. It was powered by 5 hp electric motor and required five persons to operate. It was designed to thresh wheat, rice, barley, pearl millet, safflower and sorghum. The capacity of the thresher is 200 kg of wheat/h.

Singh (1976) designed a multicrop thresher at College of Agricultural Engineering JNKVV, Jabalpur. 3 hp engine or 2 hp electric motor and two persons were required to operate this machine. It was suitable for threshing wheat, rice, soybean, gram and sorghum. The output were 160 kg of wheat, 200 kg of paddy, 300-320 kg of sorghum, gram and soybean per hour respectively. The unit was a modified version of 'Akshat' power paddy thresher to suit different crops. The additional features were a modified concave and an additional screen which improve the threshing and cleaning efficiencies (Appendix VII).



1	FEED HOPPER	6	ELEVATOR GRAIN CHUTE
2	THRESHING DRUM	7	AIR BLAST REGULATOR
3	ANGLE IRON FRAME	8	V BELT DRIVE
4	BEATER DRUM	9	SHAKER
5	BLOWER FAN	10	HITCH

Fig.6 PUSA 40 THRESHER

Khan (1977) successfully developed IRRI-Pak axial flow thresher. This can be operated by a 35 hp tractor or 8 hp diesel engine or motor. This is having spike tooth type threshing cylinder and a bar type concave. The recommended speed is 1200 rpm (Fig.7a&b). Ahuja et al. (1986) reported that the IRRI-Pak axial flow thresher could save labour about 120 man-h/ha as compared to traditional manual method of paddy threshing when the yield levels are 7500 kg/ha, and low grain losses 1.53 to 2.73 per cent. The machine's performance on wheat was unsatisfactory in terms of high grain losses, poor quality of 'bhusa' (straw) and lesser 'bhusa' throwing distance requiring frequent thresher shifting. The machine has high cost in comparison to a similar capacity paddy thresher in view of its satisfactory performance of paddy alone (Appendix VIII).

Singh and Joshi (1977) reported that the Japanese type thresher of 40 cm drum diameter and 90 cm width rotating at 400 rpm by a 3 hp electric motor gave an output of 145 kg/h paddy. A raspbar thresher of 28.5 cm drum diameter and 32 cm width gave an output of 139 kg/h of clean paddy. The energy needed per quintal of threshing and cleaning was 0.36 hp/h of manual and 1.64 hp/h of electric energy. For through feed raspbar thresher it was 0.44 hp/h of manual and 0.72 hp/h of electrical energy.

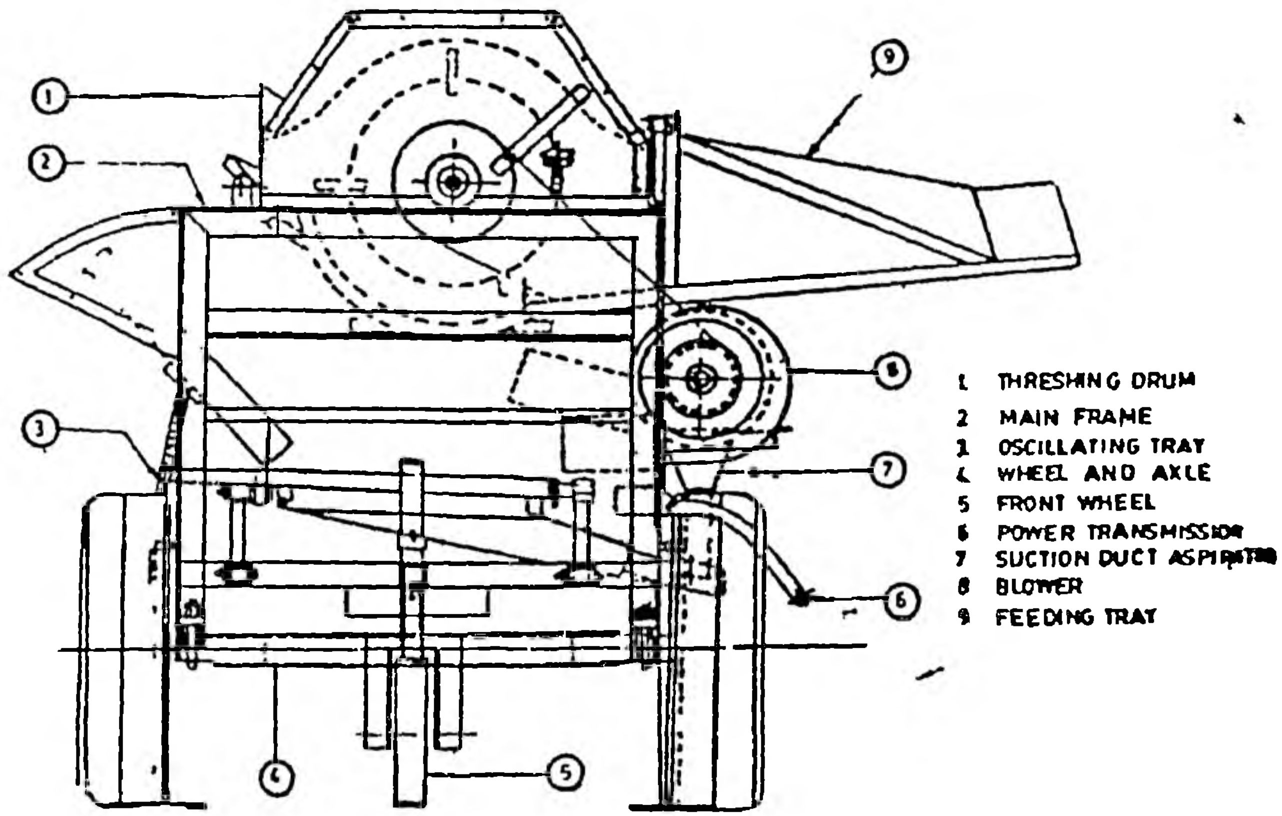
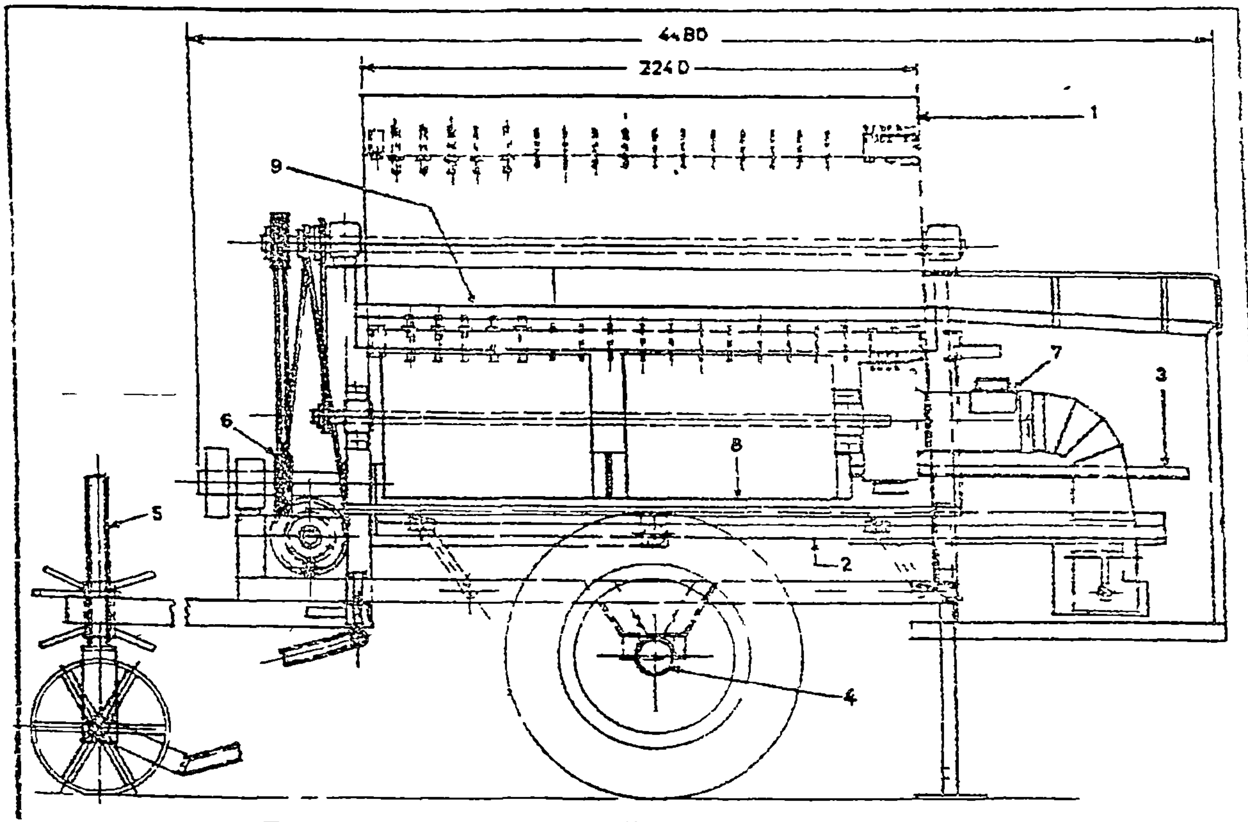


Fig.7 a FRONT VIEW OF IRRI-PAK AXIAL FLOW MULTICROP THRESHER



1. Cylinder
2. Sieves
3. Oscillating tray
4. Axle assembly
5. Front wheel
6. Drive pulley
7. Cleaning blower
8. Blower
9. Feeding tray

Fig.7b SIDE VIEW OF IRRI-PAK AXIAL FLOW MULTICROP THRESHER

Singh and Joshi (1979) developed a multicrop thresher at College of Technology GBPUAT, Pantnagar. It is a power operated, axial flow, peg type thresher operated by 20 hp tractor or oil engine or 6 to 7.5 hp motor. It requires 3 persons to operate. It is suitable for threshing wheat and rice. The capacities are 400 kg/h for wheat and 600 kg/h for paddy. This unit incorporates features of peg tooth cylinder type thresher of India and axial flow thresher of IRRI, Philippines (Appendix IX, Fig.8).

According to SISI (1980), Das (1981) and Shanmugham (1981) a paddy thresher was designed and developed at College of Agricultural Engineering, TNAU, Coimbatore. It is a power operated raspbar type and is operated by 5 hp motor or 6 hp oil engine and requires three persons to operate. The weight of the whole unit is 650 kg. It is suitable for threshing all varieties of rice and output is 675 kg/h. The threshing and winnowing efficiencies of the thresher are 99 per cent and 95 per cent respectively (Appendix X, Fig.9).

Three types of paddy threshers were manufactured at IRRI, Philippines - IRRI Portable, IRPI TH 7 axial flow and IRRI TH 8 axial flow threshers (Fig.10, 11 & 12). The capacity of these threshers are 600 kg, 500 kg and 1000 kg per hour respectively. 5-10 hp engines are required for operating these machines (Appendix XI, XII, & XIII) (IRRI, 1981).

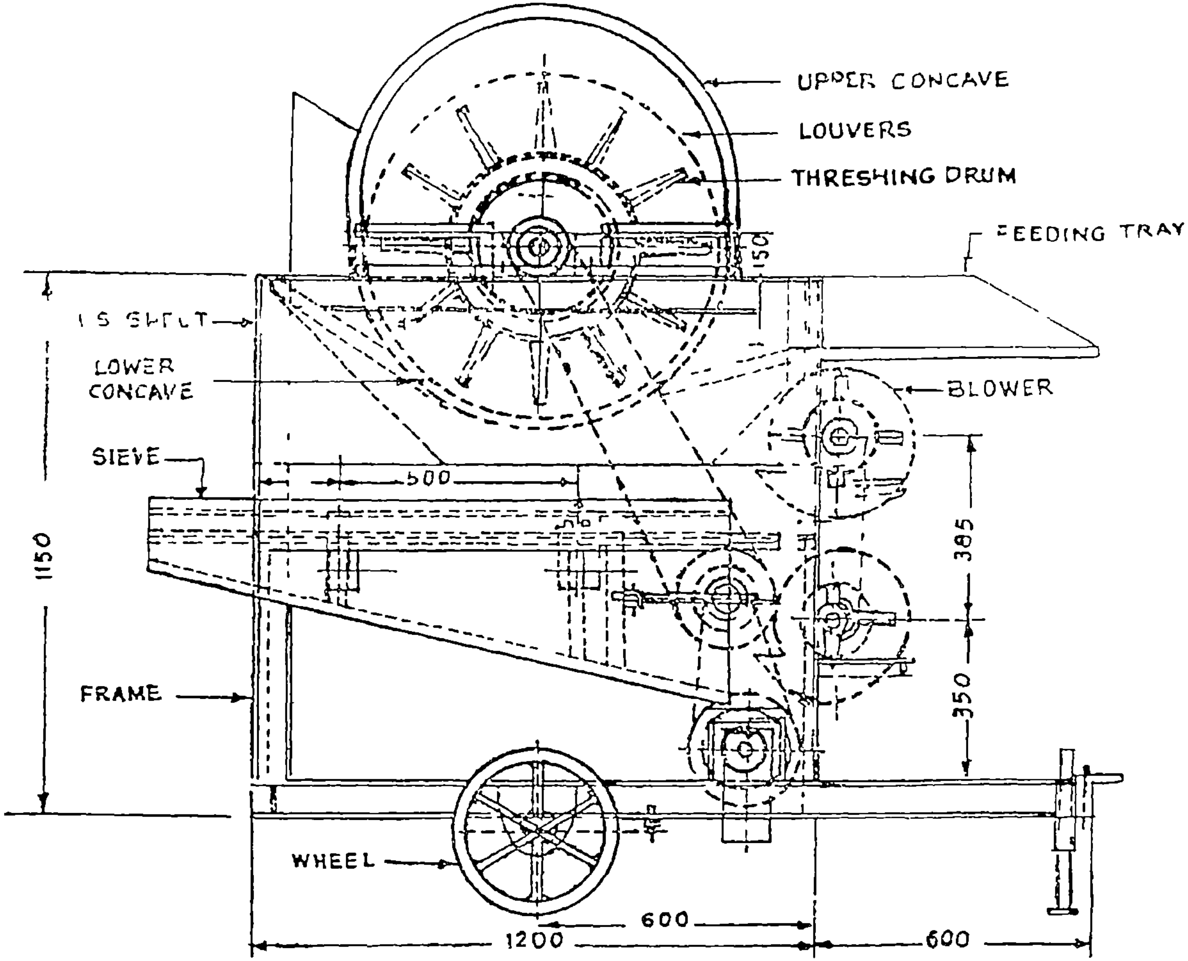
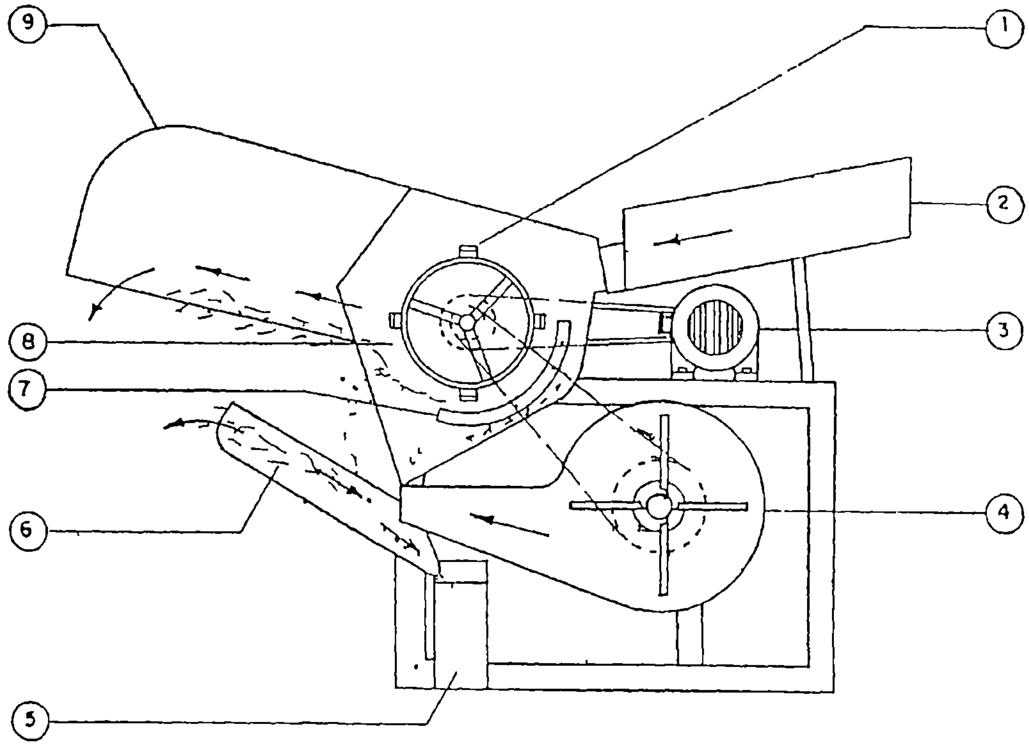


Fig.8 IRRI-PANT AXIAL FLOW MULTICROP THRESHER



1 RASP BAR
2 FEED HOPPER
3 ELECTRIC MOTOR
4 BLOWER
5 GRAIN OUTLET
6 CHAFF AND DUST OUTLET
7 CONCAVE
8 THRESHING DRUM
9 THRESHED PADDY STRAW OUTLET

Fig.9 TNAU PADDY THRESHER

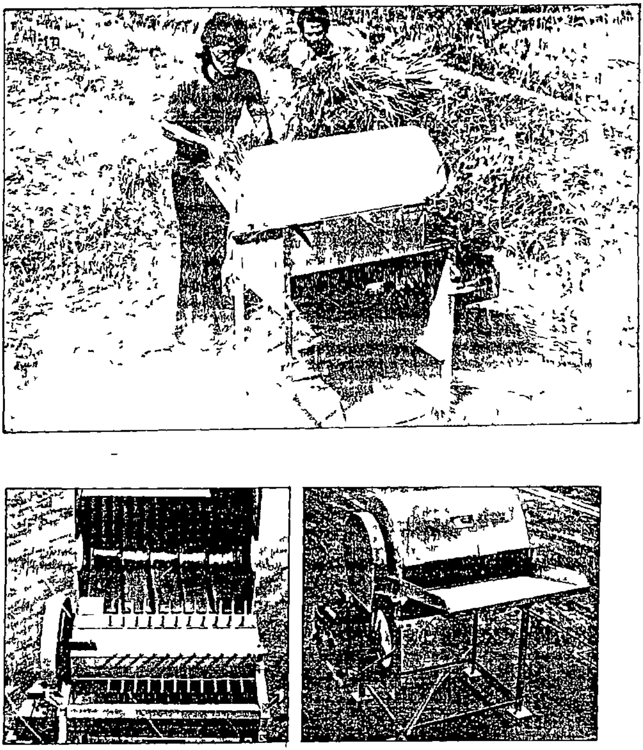


Fig.10 IRRI PORTABLE THRESHER

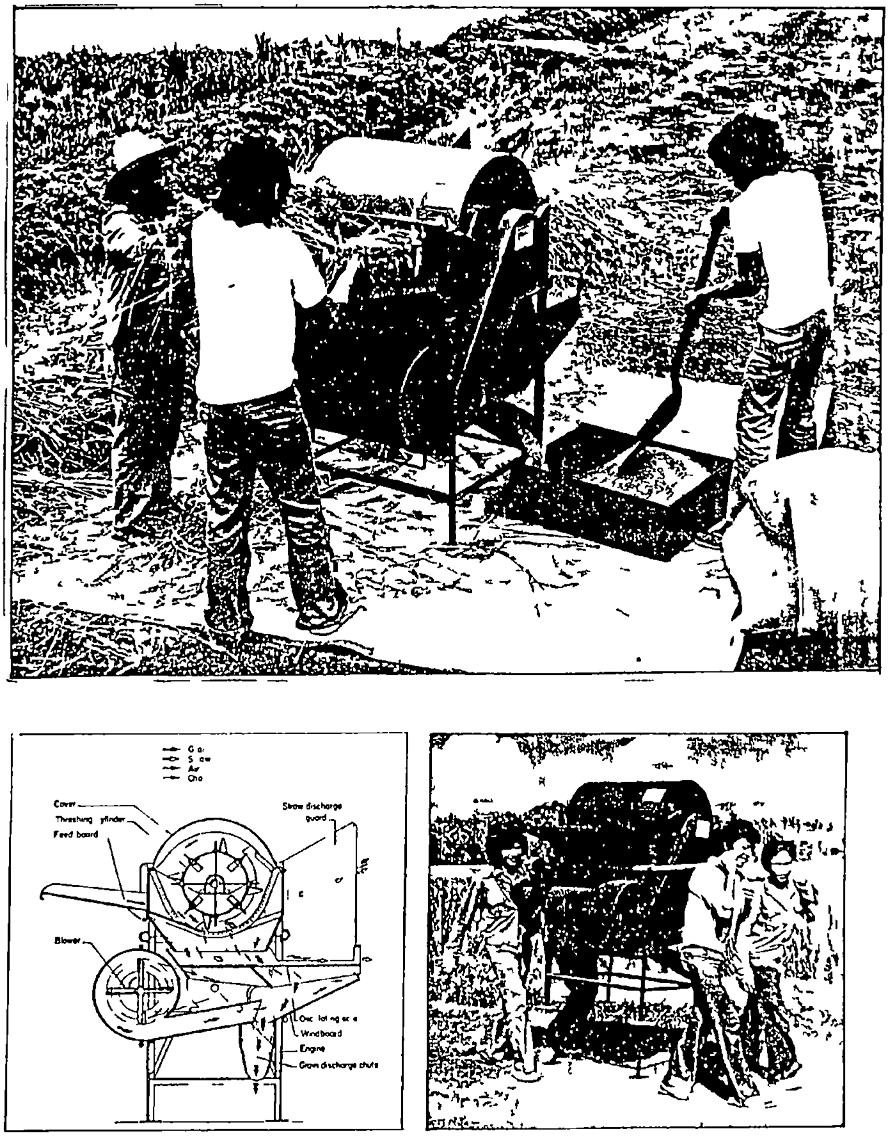


Fig.11 IRRI TH 7 AXIAL FLOW THRESHER

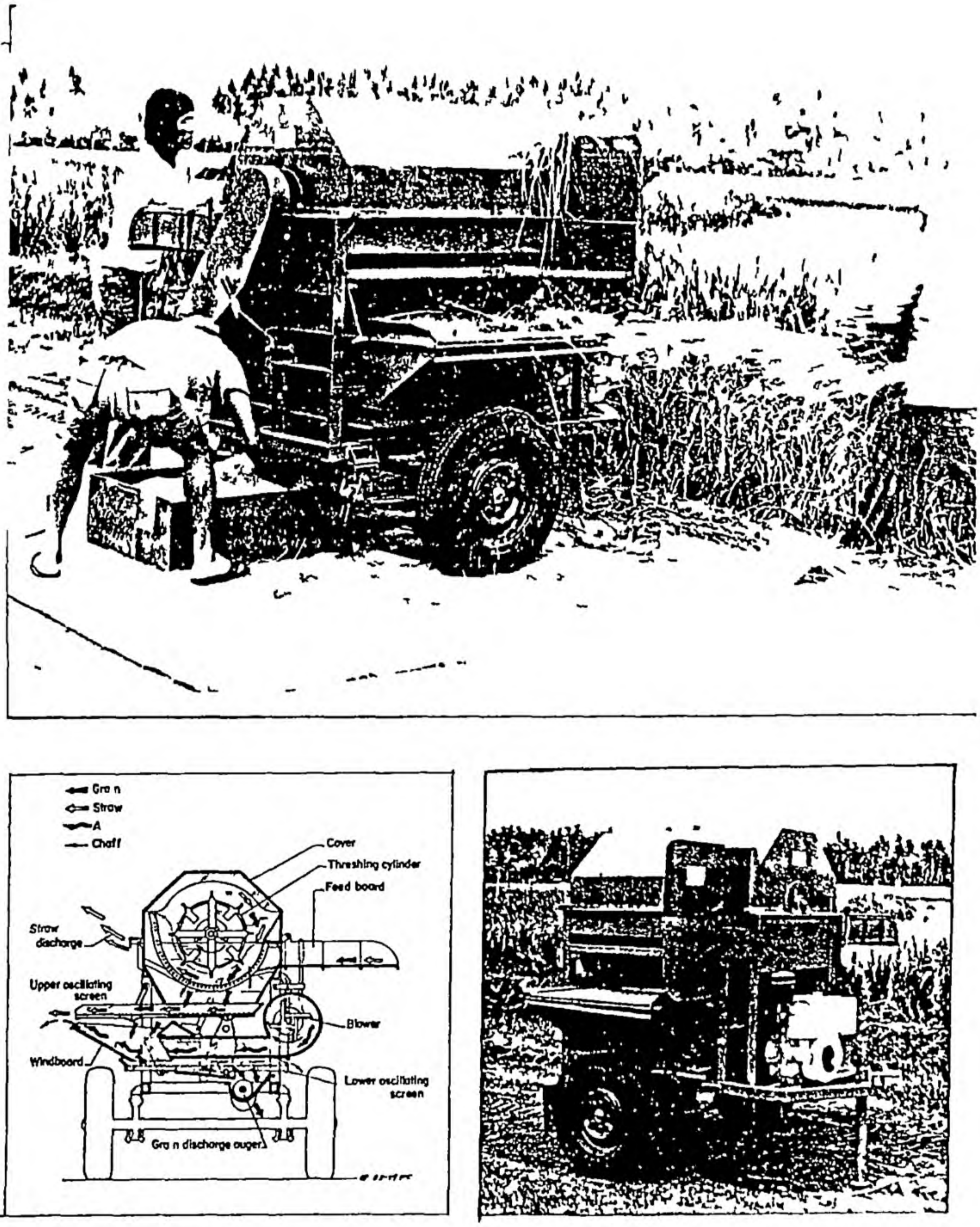


Fig.12 IRRI TH 8 AXIAL FLOW THRESHER

Shanmugham (1981) reported that a power paddy thresher was developed at RTTC, Vellayani, Kerala. It required 3 hp electric motor and two persons to operate. The threshing cylinder has wire loops on its periphery (Appendix XIV).

Sharma et al. (1983) designed and developed a multicrop thresher for wheat and paddy at Punjab Agricultural University, Ludhiana. This was operated by a 30 hp tractor or an equivalent prime mover. The spike tooth system of wheat threshing used in conventional thresher and axial flow threshing system of paddy were combined in this machine. Eight persons were required for continuous operation of the thresher. The weight of the machine was 685 kg. The operating rpm for threshing paddy and wheat were 700 and 750 and the outputs were 800 and 400 kg/h respectively (Appendix XV and Fig.13).

Manjumdar (1983) designed and developed a multicrop thresher suitable for threshing paddy, wheat, jowar, maize and soybean. It was a spike tooth machine operated by 5 hp motor developed at CIAE, Bhopal (Fig.14). The weight of the machine was 400 kg and capacity on paddy was 300 kg at a peripherial speed of 15 m/sec (Appendix XVI).

Sharma et al. (1984) developed a thresher at Punjab Agricultural University, Ludhiana (Fig.15). The thresher was named as PAU wheat cum paddy thresher. The machine can thresh

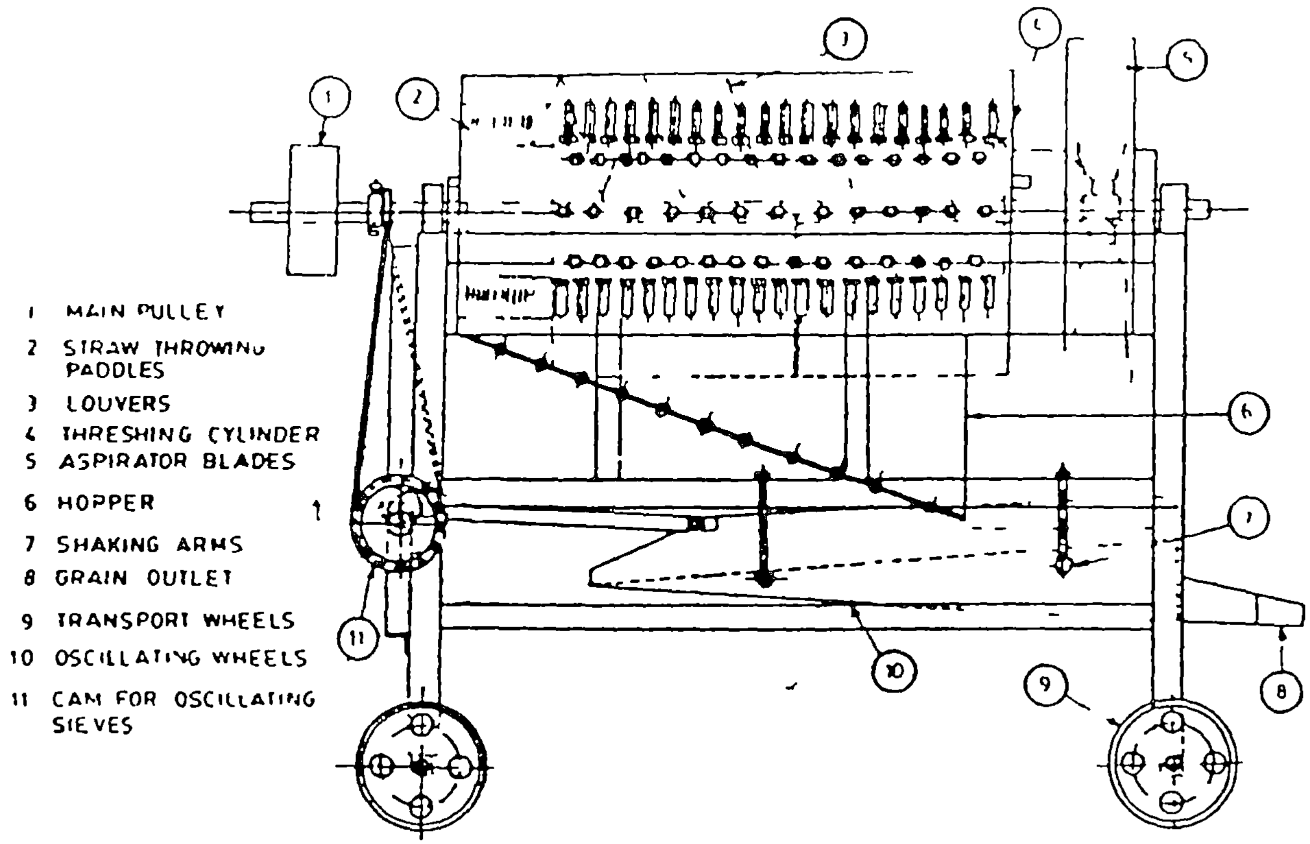
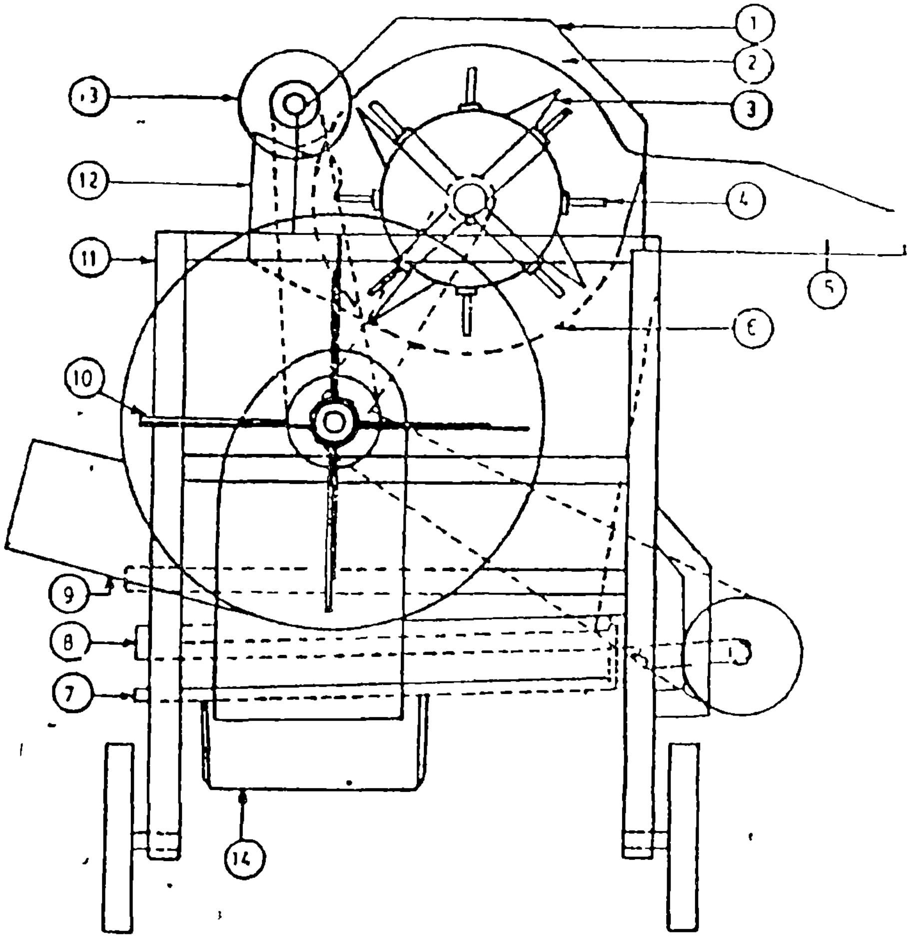
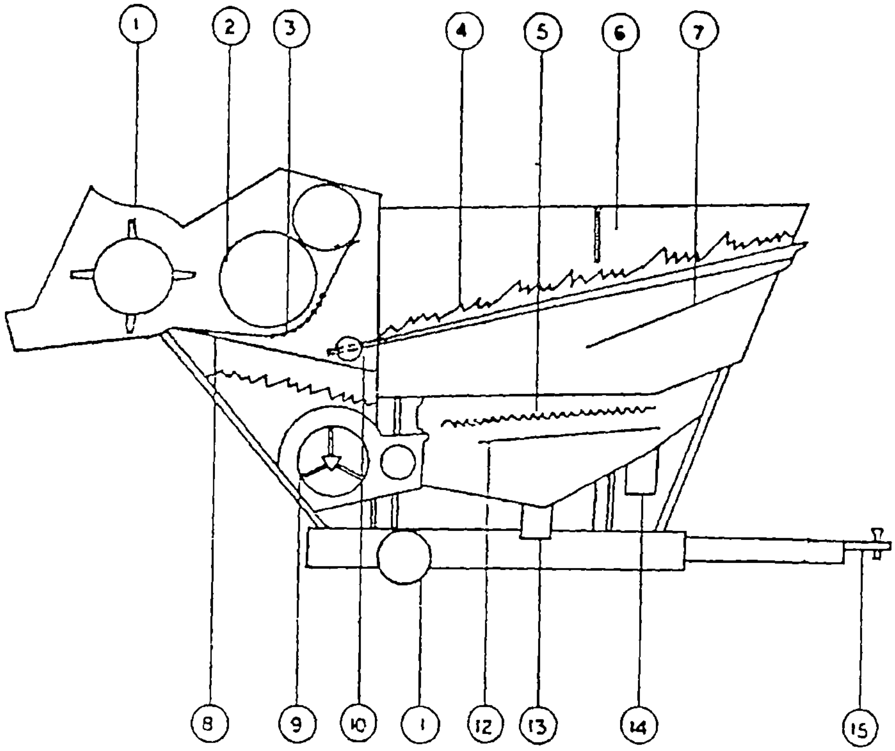


Fig.13 PAU HIGH CAPACITY MULTICROP THRESHER WITH STRAW BRUISING ATTACHMENT



1 CYLINDER DRUM	2 LOUVERS	3 STRAW THROWER
4 THRESHING CYLINDER	5 FEEDING TRAY	6 CONCAVE
7 LOWER SIEVE	8 TOP SIEVE	9 BLOWER OUTLET
10 BLOWER	11 FRAME	12 CYLINDER OUTLET
13 ELECTRIC MOTOR	14 MAIN GRAIN OUTLET	

Fig.14 CIAE MULTICROP THRESHER



1 AUGER BEATER
2 THRESHING DRUM OR CYLINDER
3 CONCAVE
4 STRAW WALKER
5 SIEVE BOX
6 KERNEL CANVAS
7 RETURN PANS
8 GRAIN PANS
9 BLOWER
10 CRANK SHAFT
11 SUPPORT WHEEL
12 CHANGEABLE SIEVE [FLAT SIEVE]
13 SPOUT I FOR CLEAN GRAINS
14 SPOUT II FOR TAILINGS
15 TOW BAR

Fig.15 PAU MULTICROP THRESHER

wheat as well as paddy with minor adjustments. The machine when operated by a 5 hp electric motor or equivalent prime mover can give 200 kg and 400 kg clean grain of wheat and paddy per hour respectively. Comparison on labour requirements for paddy threshing by the multicrop thresher with the traditional manual method indicated that there is labour saving of 12.5 man-days/ha as compared to the traditional manual method of threshing, assuming 7500 kg/ha as the average yield of paddy. Labour requirement and cost of operation for threshing with this multicrop thresher were almost same as that of the traditional wheat thresher (Appendix XVII).

Datt (1987) reported that the axial flow threshers designed by IRRI are being used in many South-East Asian countries with minor modifications for threshing paddy. Some entrepreneurs manufactured these machines in India and several demonstrations were organised. But the sales of these machines remained very much limited mainly because the straw is cut into two or three pieces which is not acceptable to the farmers. To overcome this problem a straight through peg tooth type thresher model IEP-2 has been developed at CIAE - IRRI Industrial Extension Project (Fig.16). This thresher has a capacity of 600 to 800 kg/h of clean grain. The cost is about half of the cost of axial flow thresher of same capacity. This can be operated by the same 6 hp engine which

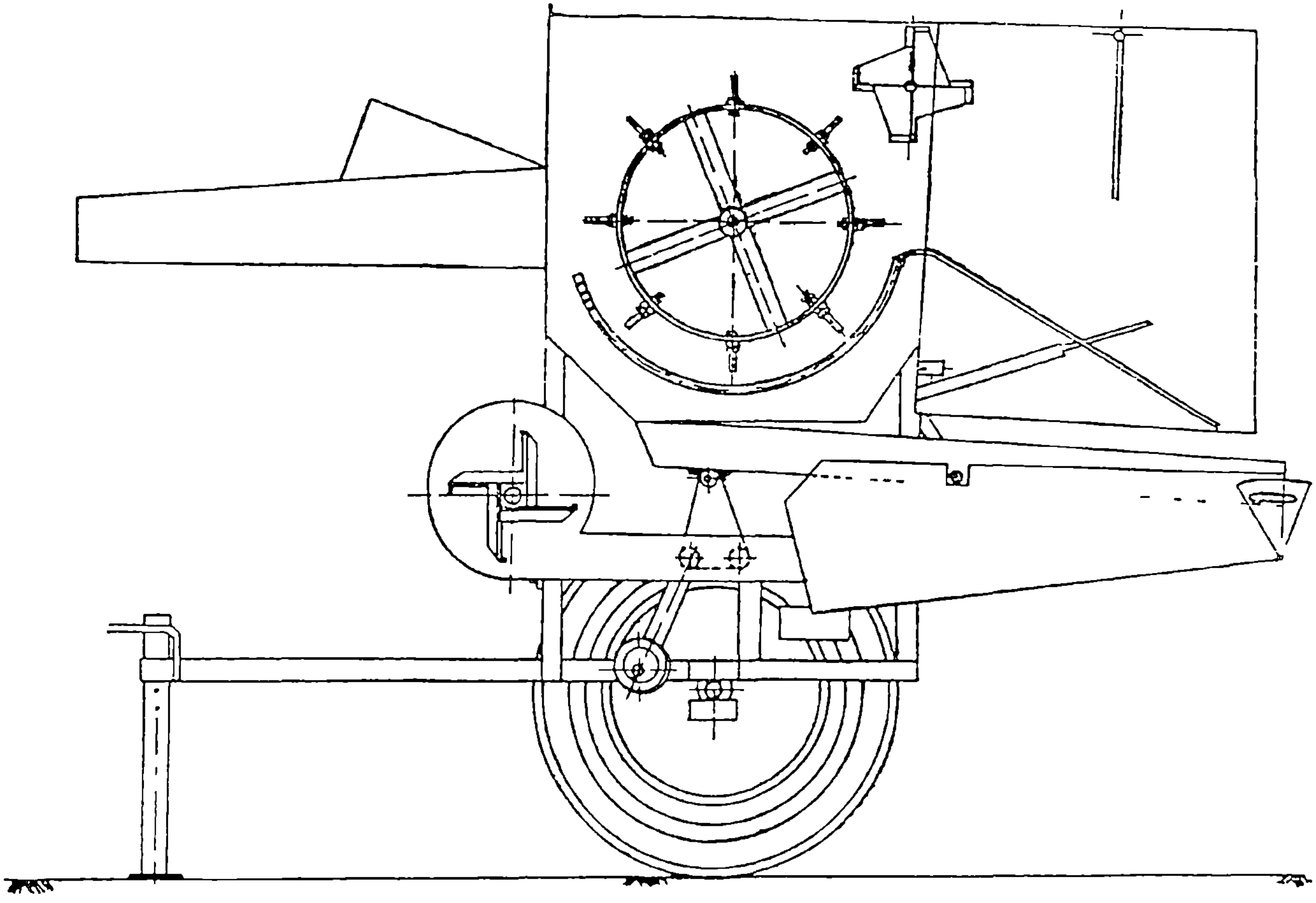


Fig.16 IEP-2 THRESHER

is mounted on the one metre self propelled reaper. Thus the farmer purchasing both the reaper and thresher can save the cost of one engine. The specifications and details of modified Askhat paddy thresher, double drum paddy thresher and ICAR axial flow thresher are given in Appendix XVIII, XIX, & XX.

Singhal et al. (1987) reported that some of the problems for development and adoption of multicrop threshers in India are:

a) Crop variations

A thresher designed for a particular agro-climatic region is not usually suitable for threshing the crops of other regions due to difference in crop variety and harvesting conditions. A good thresher must be able to thresh a wide range of crops efficiently (minimum threshing efficiency of 95 per cent) with minimal separation losses. The threshed grain should be clean and contain least amount of broken grains. It becomes functionally difficult to design a single multicrop thresher incorporating these features. The variation in type of crops and their variety is a major constraint in the design of a multicrop thresher. In case of wheat threshing, 'bhusa' (hay) making is necessary in our country, however, for paddy threshing 'bhusa' is not required. The problems with pulse threshing is that they are sensitive to impact and result in higher breakage.

b. Manufacturing problems

More than 1000 firms are engaged in the manufacture of threshers in the country. Very few threshers meet the ISI standards. The threshers are usually bulky and difficult to transport. These are not tested extensively on different crops. In the absence of availability of detailed production drawings, the threshers are produced with poor workmanship. Most of the threshers do not have safe feeding devices to prevent accidents. The cost and machine simplicity have also not been given due consideration.

c. Labour problems

The manual threshing and subsequent cleaning of cereal crops is very labour consuming. Mechanical threshing needs less manpower than manual threshing. In paddy growing areas, the labour which harvests the crop at farmers' field, also thresh it on contract basis. The mechanization of paddy threshing does not help the farmers unless harvesting is also mechanised.

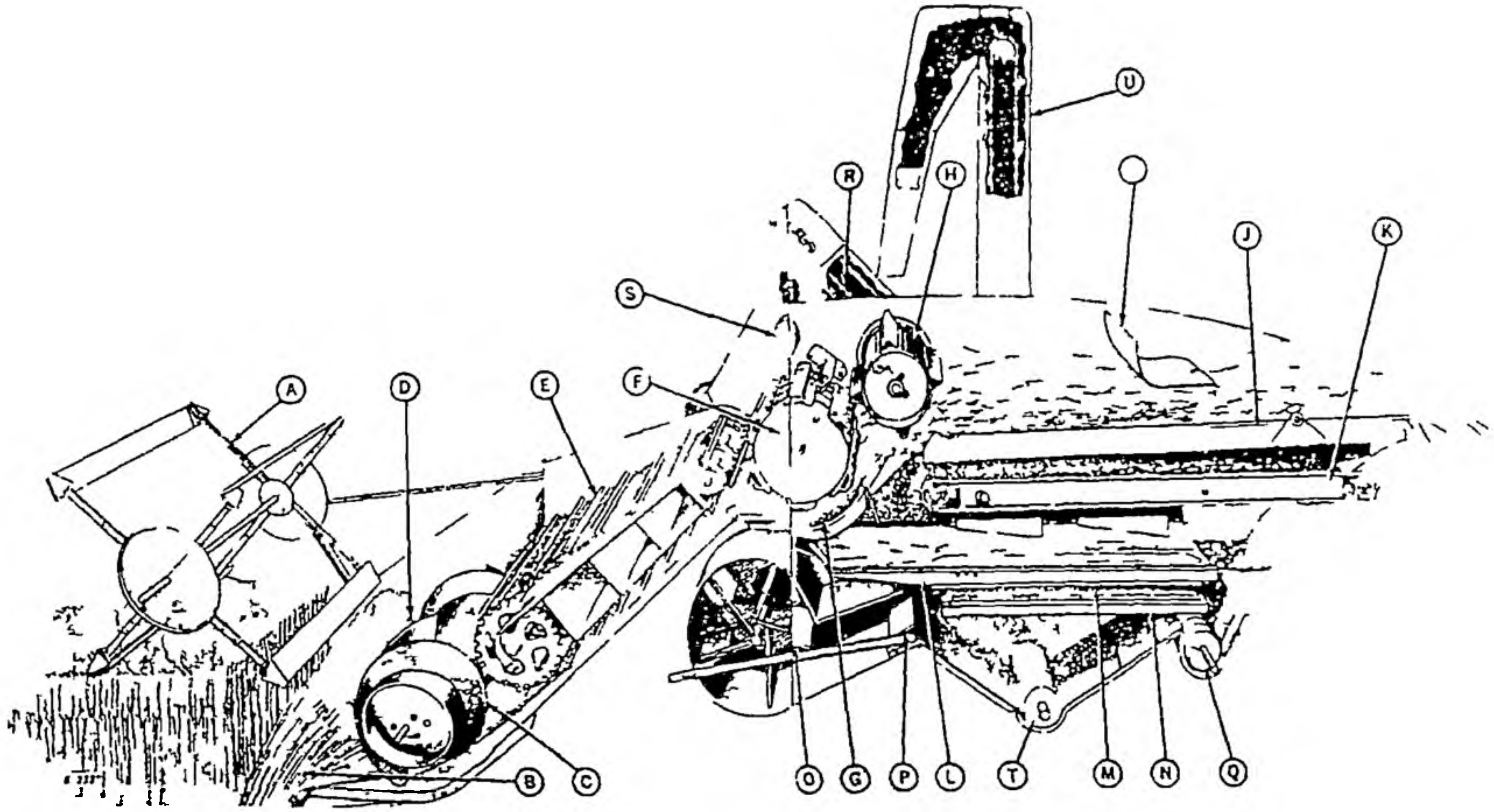
d. Power matching problems

The other reason for non-adoption of multicrop threshers is high power requirement of these threshers. The farmers usually have a 5 hp engine or an electric motor for running their irrigation pump or threshing their crops, but the multicrop threshers developed so far require 10 hp engine or 7.5 hp motor. This is one of the reasons for non-adoption of these multicrop threshers.

Combine

Mason Vaugh, the father of Agricultural Engineering, (1962) reported that threshing of small grains was one of the first uses to which the steam engine (mechanical power) was put. The combine harvester thresher commonly called the combine has very largely replaced all other equipments for harvesting small grains in the West, but does not seem adopted to Indian use. It has several drawbacks. It is large and expensive to make, is not adopted to use even on hire in small fields. One of the serious drawbacks to the combine is that it does not provide for the saving or for the processing of straw which often worth half to two thirds as much as the grain in the market.

Paras et al. (1967) reported about the Western and Japanese combines. A Western combine consists of components for gathering, cutting, feeding, threshing, cleaning and temporary storing (Fig.17). The John Deere combine is equipped with a raspbar type threshing cylinder. Western combines may be trailed or self propelled. The Japanese combine is known as the head feeding type combine because only



This cutaway view of the John Deere 30 Straight Through Combine shows how the grain and straw are handled from the cutter bar straight through the machine

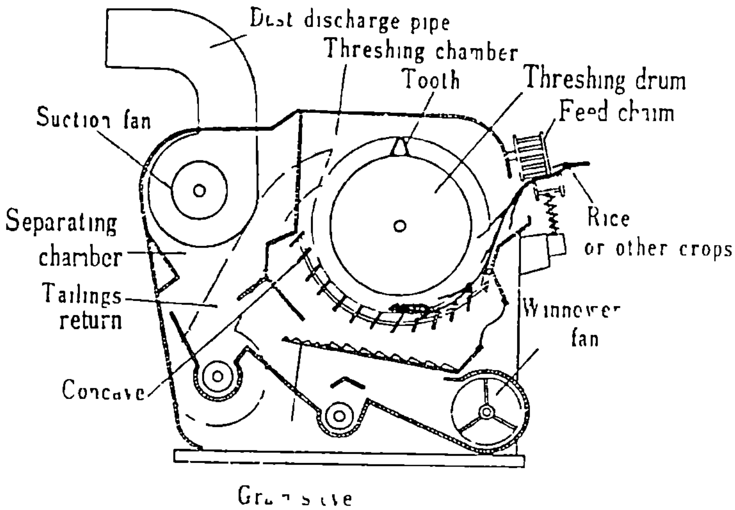
The four slat ground driven reel A divides the grain and holds it to the cutter bar B until cut The continuous auger C carries the grain from both ends of the platform to the center of the auger where retracting fingers in the auger at D feed the material positively to the floating undershot feeder conveyor chain E The feeder conveyor chain E delivers the grain in a steady positive stream to the full width rasp-bar cylinder F

As the grain travels between cylinder F and concave grate G and back against beater behind cylinder H the greater part of the separation takes place The grain falls through the grate to shoe pan L and is moved back to shoe chaffer—grain is not remixed with straw to overload straw rack Beater H deflects grain down through the chaffe section at the front end of the straw rack and passes the straw onto full width straw rack J Curtain I deflects and retards straw and grain so full length of rack is utilized During its rearward movement the remaining grain falls through cells in rack onto grain conveyor K and is delivered back to shoe pan L which moves it to front end of chaffer Straw is then tossed out on the ground in a wide even spread

A blast of air from fan O is directed by windboard P against shoe chaffer M and shoe sieve N This blast with the aid of chaffer and sieve agitation blows chaff away and moves the tailings to tailings auger Q This auger carries them to tailings elevator R which conveys them to distributing auger S where they are delivered to the center of the cylinder for re threshing

Clean grain after dropping through shoe chaffer M and shoe sieve N is carried by clean grain auger T to elevator U on opposite side of combine and delivered to grain tank

Fig.17 WESTERN COMBINE



Japanese combine threshing unit

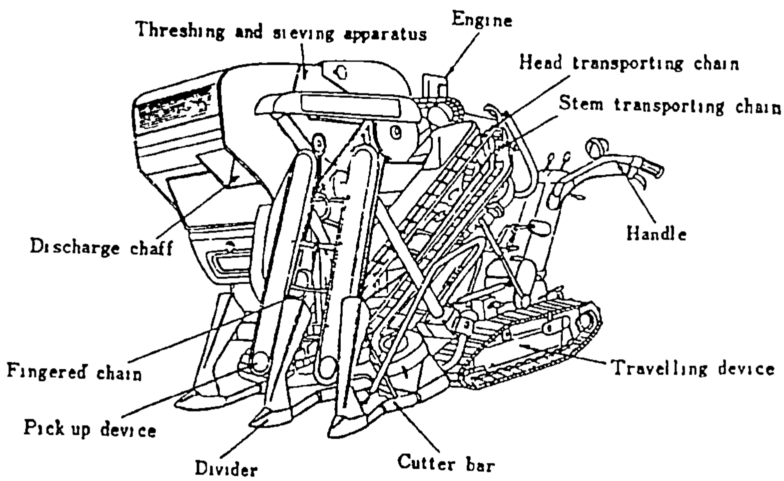


Fig.18 JAPANESE COMBINE

the panicles are feeding into the thresher (Fig.18). The basic difference in function between the threshing unit of the Western combine and Japanese combine is that in the Western, the whole stalk is fed straight through at a right angle to the threshing drum, while for the Japanese model only head are stuck against the drum and stems are held by a feed chain and guide rail in front of the threshing chamber. The rice bundles are damped between the feed chain and guide rail and are fed in the axial direction of drum at a speed of 0.2 to 0.3 m/s.

Threshing losses

Sarath Ilangantlleke et al. (1981) evaluated the threshing losses while threshing five varieties of paddy by four different threshing methods. These methods are:

1. A pair of buffalos treading on a cracked mud floor
2. 35 hp tractor circulating on a floor covered with a large jute sheet
3. A Izeki self feed mechanical threshing machine
4. A foot pedal drum type thresher

In this study they observed that threshing losses were mostly qualitative and measured by the percentage of broken kernels. The pedal drum threshing method consistantly showed the lowest percentage of cracked kernels for five varieties studied. While the buffalo and tractor treading methods had the highest levels, it is only 5 to 10 per cent. The other threshing methods had cracked kernels as high as 30 to 40 per cent. The foot pedal thresher represents a lesser investment than any of the other three threshing methods. Also the stalk paddy transporting losses are eliminated by pedal threshing as it can be done in the field when the stalk paddy is cut.

Effect of moisture content of grains on threshing

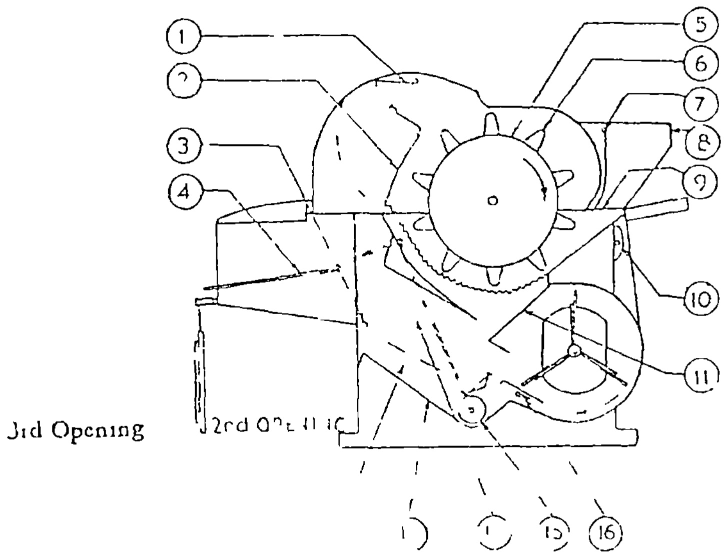
Bainer and Borthwick (1934) found that the threshing percentage increased with increase in cylinder speed and decreased with increase in moisture content.

Prasad and Gupta (1973) found that when the moisture content increases the paddy grain sustains more impact force for the same amount of deformation. The explanation for such behaviour of paddy grain is the water molecules present in the grain absorb a part of the impact energy and therefore the deformation of solid constituent of paddy grain is less at a higher moisture content under the same impact force.

The paddy grain sustain higher impact force and energy at higher moisture content. The maximum impact force and energy that a IR-8 paddy grain can sustain at 21 per cent moisture content are 7.5 kg and 0.28 kg cm respectively. Therefore it may suggested that threshing operation of paddy should be carried out at higher moisture content for IR-8 variety of paddy the moisture content at the time of threshing should be around 21 per cent (dry basis).

Effect of some selected parameters on threshing

Trivedi and Arya (1966) evaluated the performance of the Japanese semi automatic power thresher model ATA-45 (Fig.19) for its successful introduction and proper utilization in the field. These threshers incorporated the basic operations of threshing, separating and cleaning of the grain. Their main aim was to study the effect of cylinder speed on threshing of paddy. Speed of the threshing cylinder is one of the important factors affecting threshing efficiency. Higher speed of cylinder results in more seed damage and grain loss whereas lower speed causes low output. The investigation was carried in the Department of Agricultural Engineering, Indian Institute of Technology, Kharagpur. They found that the output of paddy is directly proportional to the speed of the cylinder. For maximum output the threshing should be performed within the range of 550 to 650 rpm. For minimum grain loss the threshing should be done at 550 rpm. The visible damage of grain is directly proportional to the cylinder speed.



1 Auxiliary dust removing plate
2 Dust removing plate
3 Intermediate blow adjusting damper
4 Sieve line
5 Threshing drum
6 Threshing Teeth
7 Shutter
8 Hopper
9 Thresher inlet
10 Air adjusting handle
11 Grain sliding plate screen
12 Lower air way
13 Flow plate for screen
14 Upper air way
15 Screw conveyor
16 Lower air adjusting damper

Fig.19 JAPANESE POWER THRESHER (MODEL ATA-45)

Singh and Kumar (1976) studied the effect of swinging hammer spike tooth and raspbar cylinders on threshing effectiveness and damage of wheat. The cylinder speed was found to be an important variable in threshed grain and damaged model. Increase in cylinder speed and decrease in concave clearance decreased the rate of unthreshed grain and increased grain damage and power requirement. The swinging hammer type cylinder consumed more power than the raspbar and spike tooth cylinders.

Ghaly (1985) reported that the total seed damage visible and invisible was affected by cylinder speed. When the cylinder speed increases, a rapid damage of grain was found.

According to Brain Bell (1979) the peripheral speed can be calculated by multiplying the cylinder diameter (m) by the rpm and then by 3.142. The result of this calculation is expressed in metres per minute.

Sakun (1963) reported that wire loop cylinders come into existence as an alternative design to raspbar. Loops of different configuration and in different set-ups have been used to increase the threshing efficiency. In a comparative study using combine, wire loop cylinders consumed 23.4 per cent less fuel and gave higher threshing performance than the raspbar cylinders.

A comparative performance of wire loop, peg tooth and raspbar cylinder on paddy was studied at IRRI (1969). The effect of hold-on feeding and throw-in feeding on threshing performance and damage was investigated. The test indicated that high cylinder velocities gave less semi-threshed paddy. Except for the wire loop cylinders without concave, the throw-in feeding gave poorer performance than hold-on feeding at low cylinder velocities. It was accepted that the throw-in type threshers are better suited for high output than the hold-on type.

Jakhro and Khan (1987) reported that the raspbar cylinder has higher threshing efficiency than the wire loop cylinder. But at the same operating conditions the grain damage for the latter was considerably high. They studied that there is avenue for wire loop to be operated at higher speeds to increase the threshing efficiency and with this margin the performance of wire loop was more comparable for threshing the rice crop than for raspbar.

Lamp and Buchele (1960) reported that wheat and other grains can be threshed by application of centrifugal force. In the case of wheat a force of 0.14 kg was sufficient to thresh 98 per cent or more of mature grains independent of the method of holding the head. In typical harvesting conditions the force required was only 0.09 kg. The threshing and separating conditions could be integrated by eliminating the need of special straw separating equipment for centrifugally threshed grain.

An axial flow cone shaped apparatus was tested on wheat by Lalor and Buchele (1963) and for 300 to 500 rpm speed of the rotor, 99 per cent threshing efficiency was attained. Below 350 rpm there was problem in the feeding mechanism whereas it worked satisfactorily for higher speeds. There was decrease in overall separating efficiency from 77 to 68 per cent as the rotor speed was increased from 300 to 500 rpm. A cone length of 213.4 cm was extrapolated to achieve 98 per cent separation efficiency.

Materials and Methods

MATERIALS AND METHODS

The design criteria, selection of individual components of the thresher and experimental programme are presented in this chapter.

It is evident that a suitable paddy threshing machine is urgently needed for Kerala. Meeting all the desirable needs for threshing may result into an unwieldly unit. Therefore only those characters which are most beneficial are incorporated. On the basis of analysis of the present situations regarding threshing of paddy, the following factors are listed which would point out to the desirable requirements of a paddy threshing machine for Kerala today.

1. It should be of simple design and construction so as to require minimum technical knowledge for operation and maintenance.

2. It should comprise of parts which can be easily fabricated.

3. It should manufacturable with reasonable cost.

4. It should posses a high degree of efficient in threshing.

5. The number of components should be least for higher reliability, easy manoeuvrability and maintenance by the farmers.

6. It should be repairable by local artisans.
7. It should be operatable by 0.25 to 1.00 hp motor.
8. The whole threshing process should be done by one or two men.
9. It should have the following salient features
    a. No skill is required for operation
    b. Negligible losses
    c. Practically no breakage of grain
    d. Light weight
    e. Low power consumption
    f. Portable

3.1 General layout and details of the threshing machine

In Kerala the Japanese paddy thresher was successfully used in 1960's. This was mainly used to thresh the Tainan-3 rice variety. These threshers were neglected after the arrival of the other high yielding varieties which replaced Tainan-3. The low acceptance of the Japanese pedal paddy thresher was due to its low efficiency and simultaneous feeding and pedalling by the same operator. It was assumed that this type of paddy thresher with an electric prime mover will increase the efficiency of the machine and will suit the small and marginal rice farmers of Kerala. Hence Japanese paddy thresher was selected for the study to bring about suitable modifications. Instead of the pedal a variable speed dynodrive motor was used to rotate the cylinder (Appendix II). This motor was used for fixing the optimum rpm of the thresher. The rpm of the motor was controlled by an electronic regulator in the unit (Fig.20).

A three phase 0.5 hp variable speed dynodrive motor was used as the prime mover for the thresher for the present study. The motor was fixed on a mild steel sheet plate down below the slanting sheet of the thresher. An 'A' section V-belt and two pulleys of same size were used for transmitting the power from the motor. Holes were provided on this plate for tightening the belt if necessary. The test was conducted according to the RNAM test code. In order to establish a recommended speed the thresher was tested at different rpm ranging from 200 to 600. The grain damage, output and efficiency were determined according to the RNAM test procedure for paddy threshers.

The paddy thresher mainly consists of a well balanced cylinder with series of threshing teeth fixed on slats. While the cylinder is kept in rotary motion at test speed, the paddy sheaves of suitable size are held in contact with the teeth. The grains are separated by the combing as well as beating action of the threshing teeth. The whole operation is carried out by two men - one for holding the paddy sheaves against the

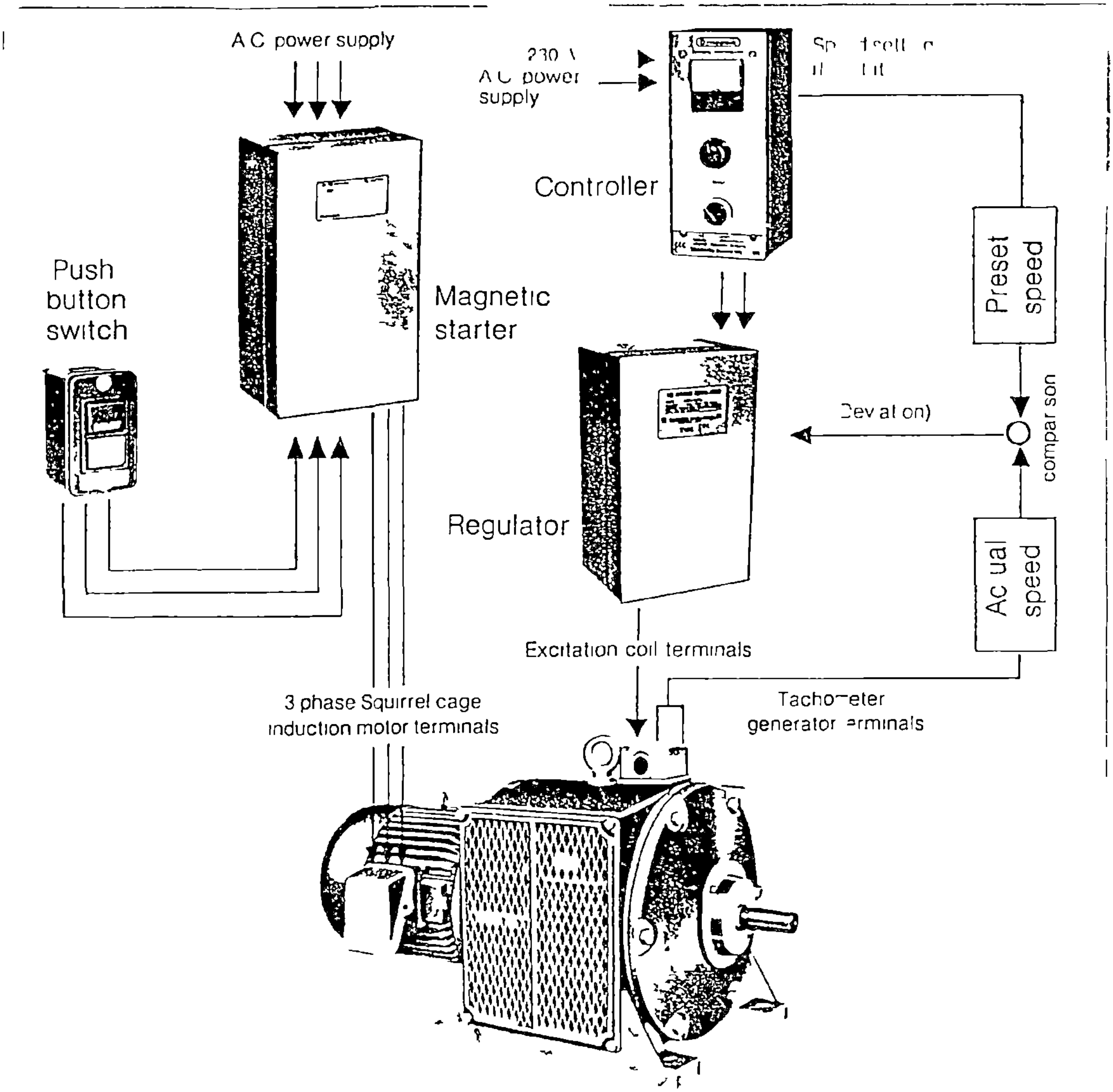


Fig.20 DYNODRIVE VARIABLE SPEED MOTOR UNIT

rotating cylinder and the other for transferring the sheaves to the operator.

The threshing length of the cylinder is referred to as the size of a thresher. It is 435 mm in the thresher under study. The threshing teeth are fitted on the slats. There are twelve 62 mm wide slats made of Teak wood each having a thickness of 16 mm. The threshing teeth, generally known as wire loops, made of 3 mm dia spring steel iron are arranged on the slats. There are 10 teeth on each slat.

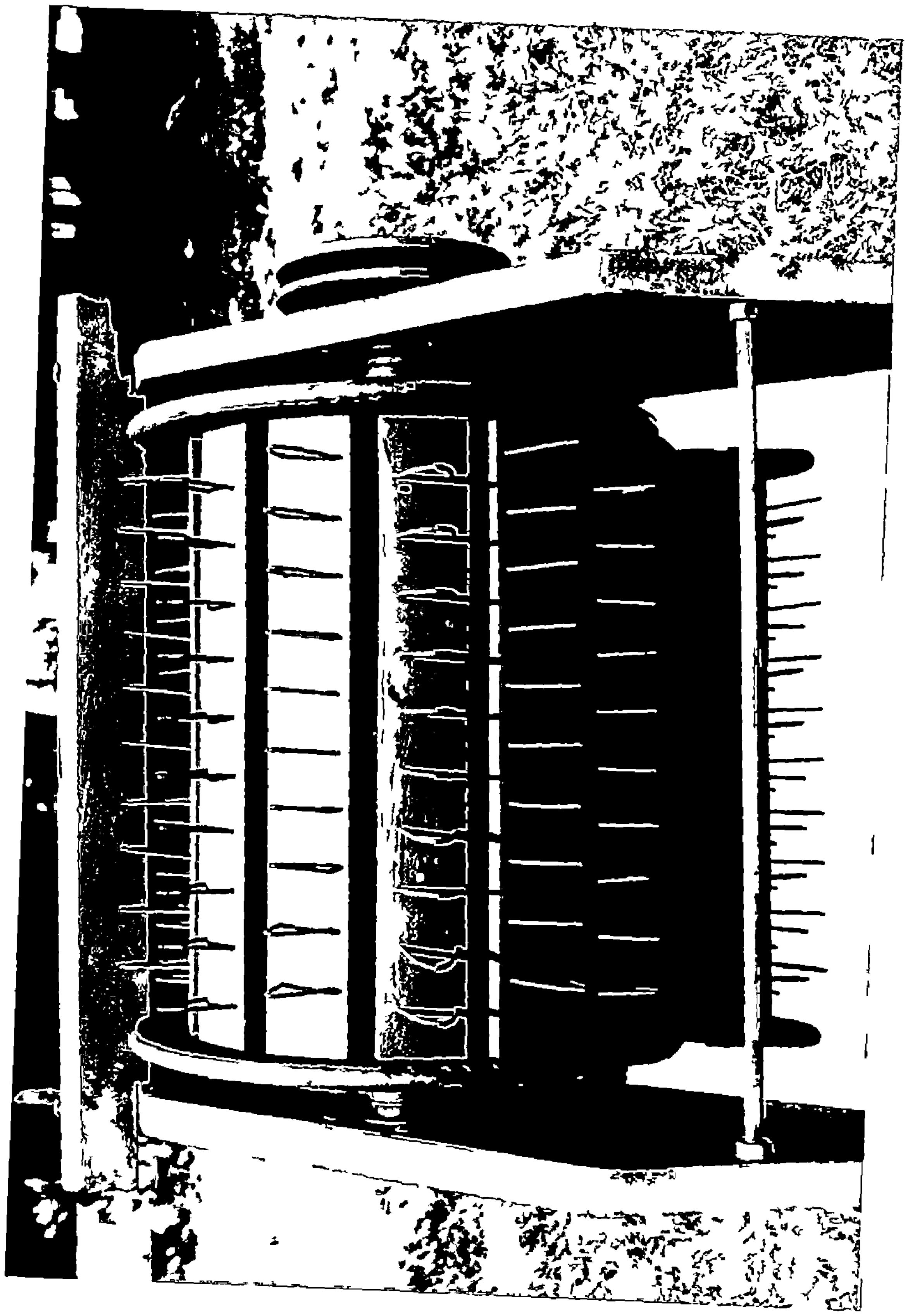
The body frame of the thresher consists of the base, the side frames and the front grain shield. The base and side frames made of mild steel angle section of 30 x 30 x 3 mm size are welded together. The side boards made of mild steel sheet of thickness 0.5 mm are supported by the side frames. The front grain shield is a 12 mm thick wooden plank covered by a 0.6 mm thick mild steel sheet and it is fixed to the side frames. A wooden plank of size 745 x 45 x 55 mm is fixed on the top of the side frames, above the front grain shield for easy transportation.

The diameter of the cylinder across the end discs is 380 mm. The slats are fixed to the cylinder end discs. The diameter of the cylinder across the slats is 305 mm. The distance between two adjacent slats is 20 mm. The two cylinder end discs which support the slats at both ends are made of 1.5 mm thick mild steel sheet. Mild steel rod of 13 mm diameter is welded along the edges of the discs. The threshing teeth are fixed to the slats in such a way that the distance between the bottom ends of each teeth is 40 mm. The teeth project out 50 mm above the surface of the slats. The threshing teeth are fixed on the slats in such a way that when assembled the teeth on the two adjacent slats come staggered to each other (Plate III). The distance between the tips of the two adjacent teeth is 43 mm. The eccentric type transmission consists of two pulleys of 102 mm dia and a 1016 mm 'V' belt. The cylinder axle made of 20 mm dia mild steel round bar is supported by ball and bush bearing and they are guarded suitably.

3.2 Selection of paddy sheaves

The sickle harvested paddy sheaves for laboratory tests were collected from the farm of Agricultural Research Station, Kerala Agricultural University, Mannuthy. Similar type of bundles were used both for mechanical and manual threshing. The weight of the bundles ranged from 1.8 to 2.1 kg. The moisture content of the grain at the time of threshing was 14.26 per cent (wet basis).

Plate III Threshing cylinder showing serrated arrangement of wire loops



3.3 Experimental programme

Various tests were conducted in the laboratory to evaluate the thresher as per RNAM test code and procedure for powergrain threshers.

rpm optimisation

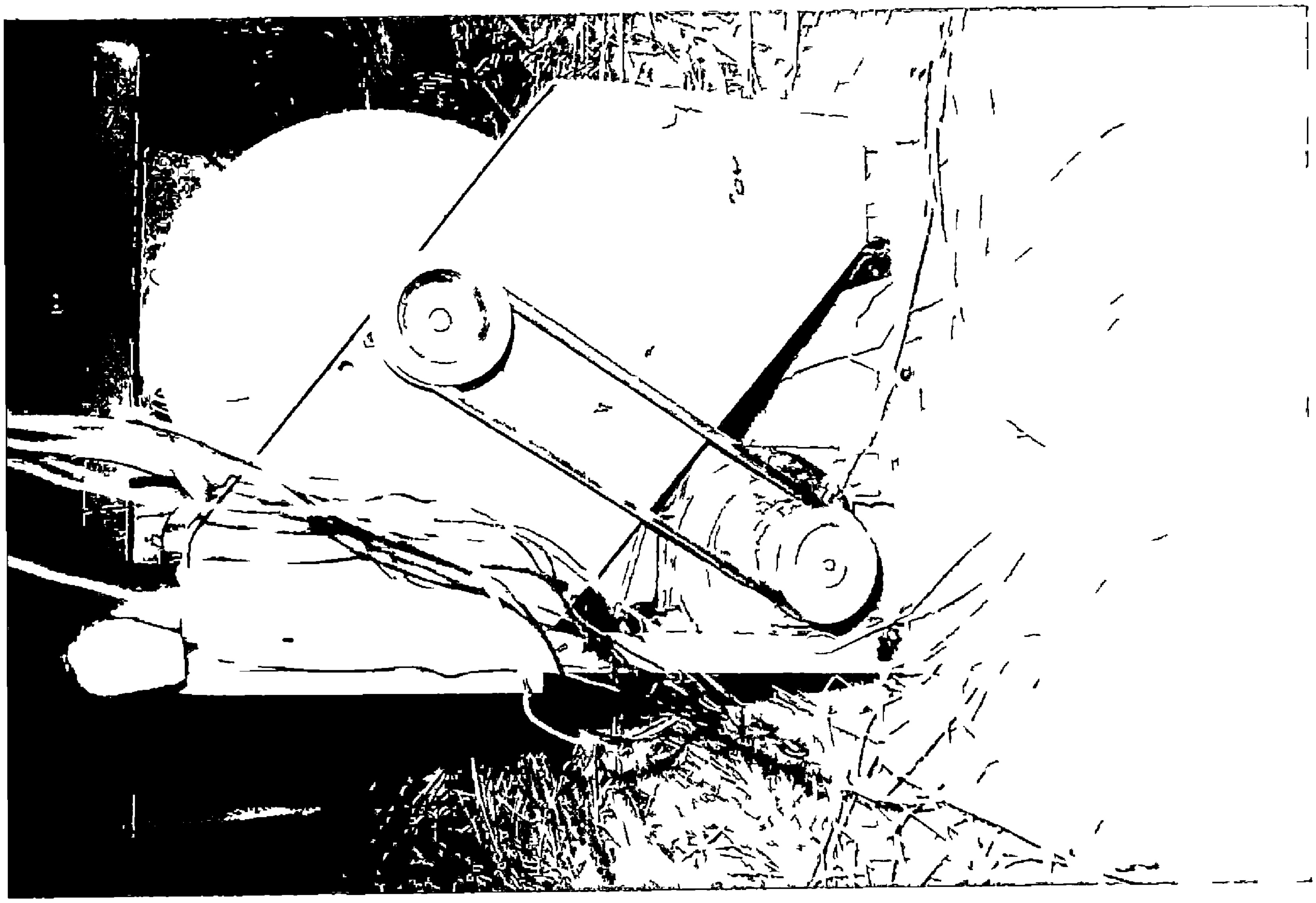
The thresher was tested at different rpm from 200 to 600 viz., 200, 250, 300, 350, 400, 450, 500, 550 and 600 for finding out the best rotating speed for this thresher. The trials were repeated four times under each rpm.

The test samples were winnowed manually. The whole grains and broken grains were collected, weighed and expressed in kg/h. Unthreshed grains in the threshed straw and on the broken earheads were separated and weighed. They are expressed in percentage. The grain-straw ratio was found out by weighing the sample sheaves before and after threshing. Weight of chaff was also noted.

3.4 Developed thresher

The variable speed motor used for optimising the rpm of the threshing cylinder was replaced by a 0.5 hp single phase motor having 1440 rpm. In order to obtain the optimised

Plate [illegible] experimental setup for the [illegible] tests – [illegible] sher of variable speed moto[illegible]



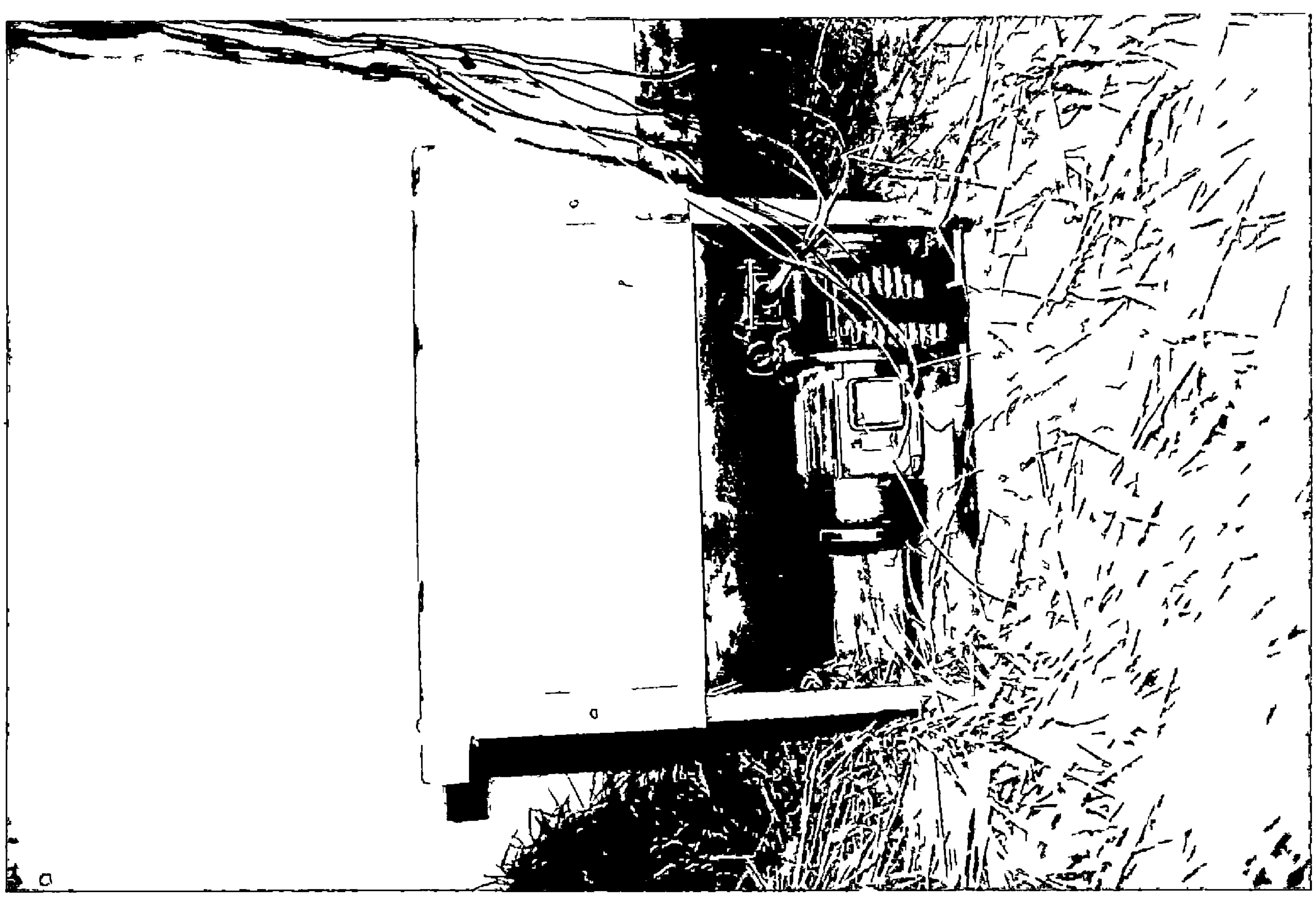
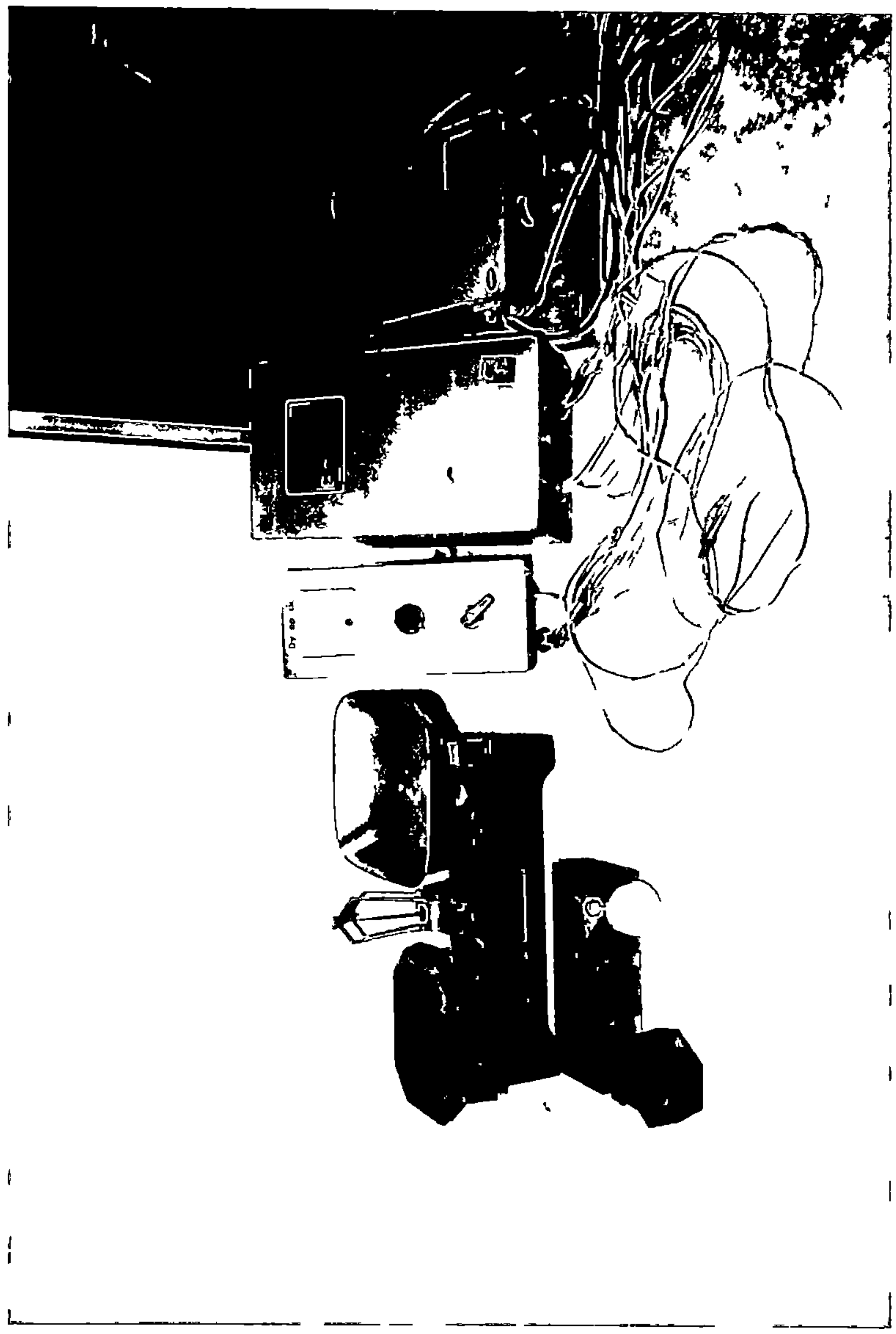


Plate [illegible] Experimental set up for the lab tests - speed setting rheostat, regulator etc



rpm of 400, two pulleys of 51 mm and 183 mm diameter were used as drive and driven pulleys respectively (Fig.21, Plates VII & VIII). The dimensions of the thresher are the following.

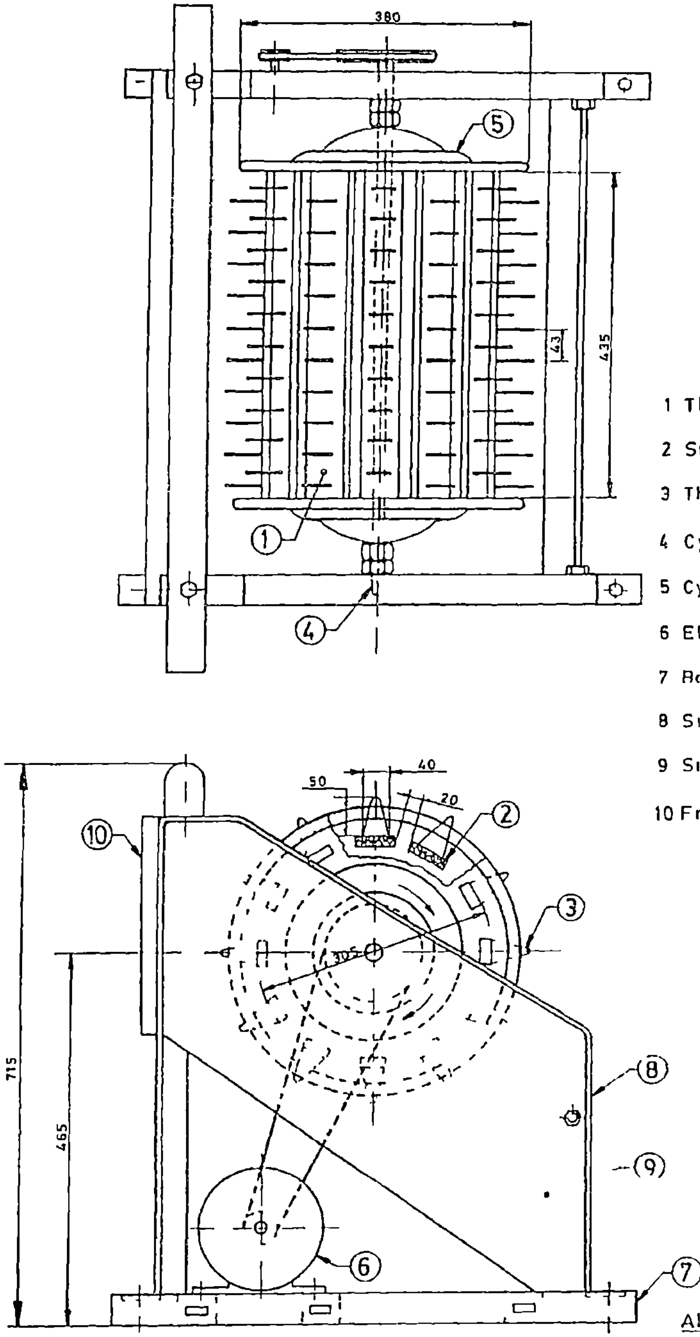
Overall length	**:**	**635 mm**
Overall width	**:**	**500 mm**
Overall height	**:**	**715 mm**
Gross weight	**:**	**47 kg**

3.5 Field tests

Field tests were conducted to study the efficiency of the thresher under different moisture contents. Tests were done on both high yielding variety and local variety of paddy. 'Triveni' was used as the high yielding variety and 'Cheera' as the local variety.

Long run test

Long run field tests were conducted both in the suitable and abruptive weather conditions ie. during summer and rainy season to study the efficiency of threshing and farmers' adaptability of the thresher.



1 Threshing Cylinder

2 Slat

3 Threshing Teeth

4 Cylinder Axle

5 Cylinder End Disc

6 Electric Motor

7 Base

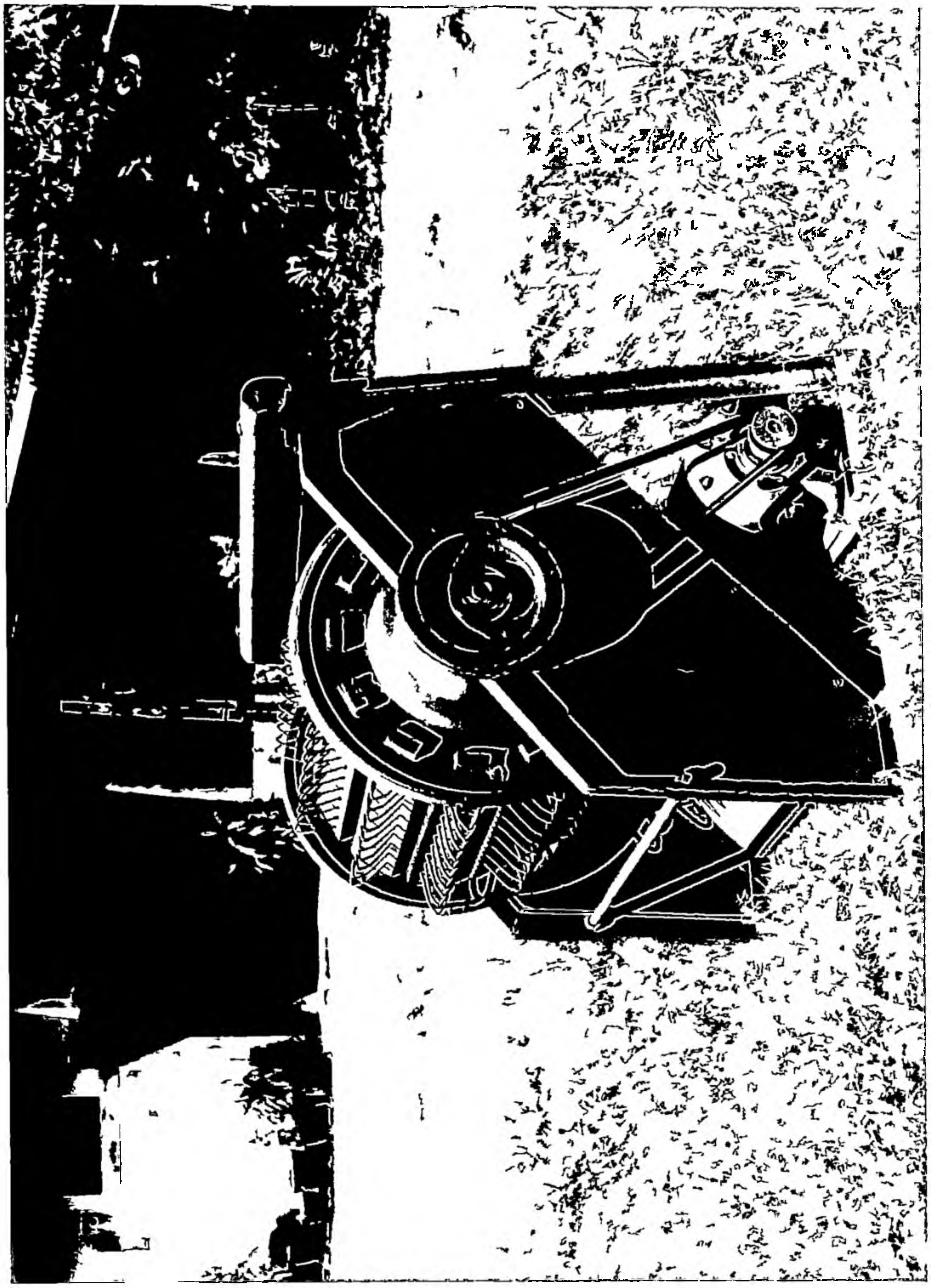
8 Side Frame

9 Side Board

10 Front Grain Shield

All dimensions in mm

Fig 21 LOW COST PADDY THRESHER



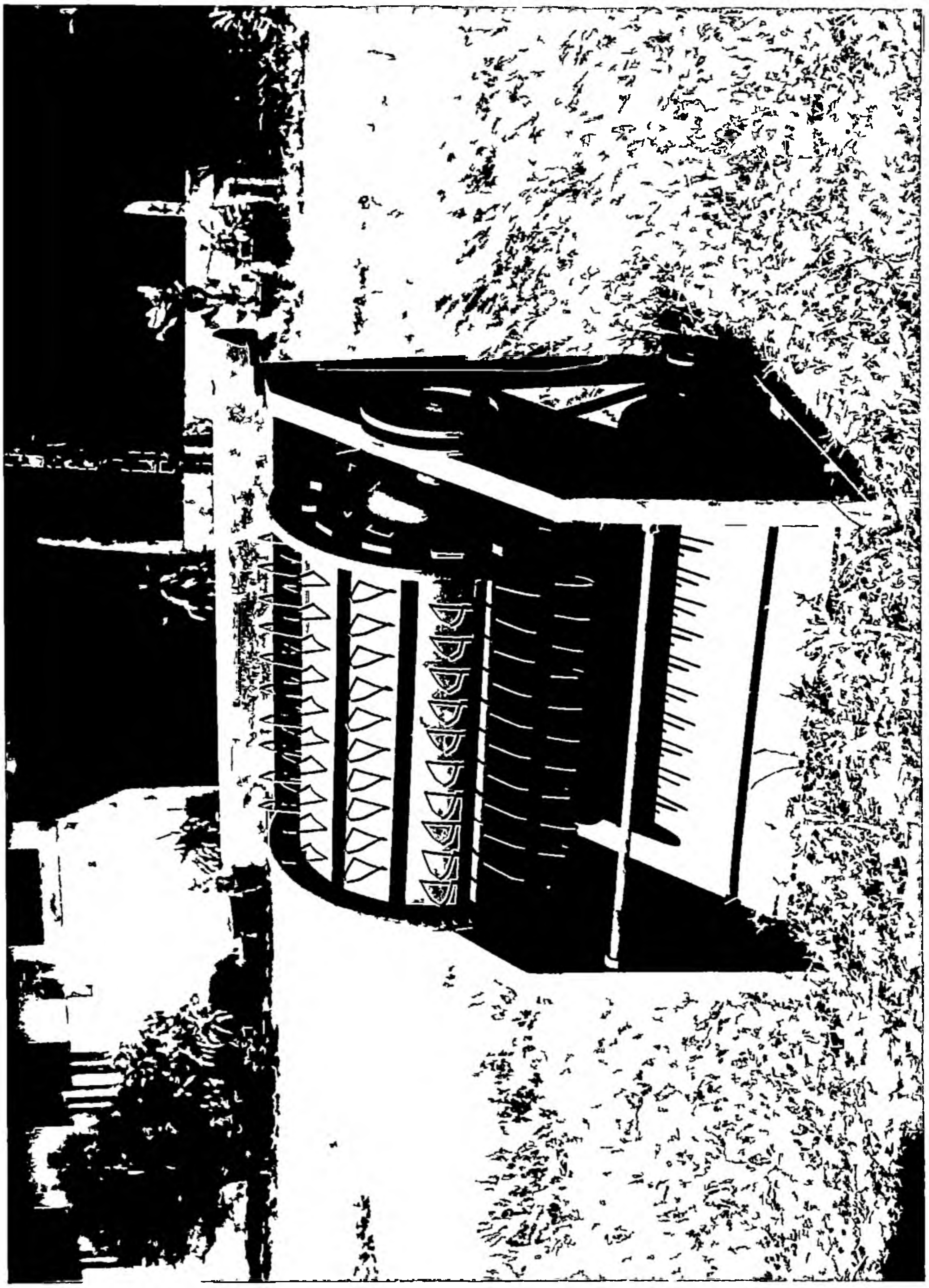


Plate IX. Paddy thresher under field test - crop harvested in summer season

Plate X Paddy thresher under field test - crop harvested in rainy season

3.6 Calculations

1. Total grain input

$$A = B + C$$

where,

A = total grain input per unit time by weight

B = weight of the threshed grain (whole and damage) collected per unit time

C = weight of the unthreshed grain collected per unit time

2. Percentage of damaged grain (broken grain)

$$= \frac{E}{A} \times 100$$

where,

E = quantity of damaged grain collected per unit time in kg

3. Percentage of unthreshed grain

$$= \frac{H}{A} \times 100$$

where,

H = weight of unthreshed grain per unit time in kg

4. Threshing efficiency

= 100 - percentage of unthreshed grain

Results and Discussion

3.7 Some definitions and terminology connected with power thresher

a. Throw-in type thresher

A type of thresher where the cut crops are fed into the machine in full.

b. Hold-on type thresher

A type of thresher where the heads of the cut crop are fed into the threshing drum with the lower part of straw being manually or mechanically held.

c. Whole grain : Mature unbroken grain

d. Damaged grain

Threshed grain which is partially and wholly broken and dehulled.

e. Unthreshed grain

Whole grain attached to the straw or broken earheads after threshing.

f. Threshing efficiency

The threshed grain received at all outlets with respect to total grain input expressed as per cent by weight.

RESULTS AND DISCUSSION

The results of laboratory and field studies conducted and economics of the low cost paddy thresher are presented and discussed in this chapter.

4.1 Laboratory tests

The lab tests were conducted as explained under chapter three following the test code proposed by RNAM.

Optimisation of rpm of the thresher

The dynodrive 0.5 hp variable speed motor was used as the prime mover of the thresher. The grain-straw weight ratio, the weight of the paddy sheaves, straw and the weight of the uncleaned grain (input) are presented in Table 1 The weight and percentage of whole grain received after winnowing (output) is given in Table 2. The other readings such as weight of the broken grains and weight of the unthreshed grains on broken earheads and in straw are given in Tables 3, 4 and 5 respectively. The Table 6 shows the percentage ratio of whole grains (output) to broken grains and whole grains to unthreshed grains based on the average values of each rpm tried. The average of the Tables 2, 3, 4 and 5 is given in

Table 7. From the graph (Fig.22) it is clear that the output (whole grain threshed) is proportional to the increase in the rpm of the threshing cylinder. This is an advantageous trend. But there are two unfavourable factors here. At 600 rpm the whole grains (output) (566 03 kg/h) as well as the weight of the broken grains (13.642 kg/h are maximum. At the same time the weight of the unthreshed grains is minimum (11 330 kg/h). While conducting the tests it was observed that the vibration of the thresher was too high to operate the machine continuously at 600 rpm. But from 200 to 400 rpm the vibration was negligible and the same increased from 450 rpm onwards. It is seen from the Table 6 that at 400 rpm, the broken grain to output percentage ratio is only 2.1 and that of unthreshed grains is 3.02. The percentage of whole grain received at 400 rpm is 83.2 per cent. Hence for developing the low cost paddy thresher, 400 rpm was selected as the optimum speed of the threshing cylinder. To assess the other parameters of the performance of the threshing unit further tests were conducted at 400 rpm only. The details of the thresher is given in Appendix I.

The rpm of the cylinder and the weight of unthreshed grains are the main two factors deciding the threshing efficiency of the thresher. From the graph (Fig.23) it is clear that threshing performance is directly proportional to

Table 1. Test results of optimising the rpm of the thresher (Grain-straw ratio)

Sl. No.	Test No.	rpm	Weight of paddy sheaf (kg)	Weight of uncleaned grains (input) (g)	Weight of straw (kg)	Weight of grains in sheaf (%)	Grain straw ratio (%)
1	1		2.0	562.0	1.438	28.1	1:2.6
2	2	200	1.8	514.8	1.285	28.6	1:2.5
3	3		2.0	542.0	1.458	27.1	1:2.7
4	4		1.8	556.2	1.244	30.9	1:2.2
5	1		2.0	578.0	1.422	28.9	1:2.5
6	2	250	2.0	582.0	1.418	29.1	1:2.4
7	3		1.8	556.2	1.244	30.9	1:2.2
8	4		1.9	566.2	1.334	29.8	1:2.4
9	1		1.9	533.9	1.366	28.1	1:2.6
10	2	300	1.9	535.8	1.364	28.2	1:2.5
11	3		1.7	528.7	1.171	31.1	1:2.2
12	4		1.8	541.8	1.258	30.1	1:2.3
13	1		1.7	540.6	1.159	31.8	1:2.1
14	2	350	1.9	554.8	1.345	29.2	1:2.4
15	3		2.0	546.0	1.454	27.3	1:2.7
16	4		2.0	562.0	1.438	28.1	1:2.6
17	1		1.9	516.8	1.383	27.2	1:2.7
18	2	400	2.0	534.0	1.466	26.7	1:2.7
19	3		2.1	548.1	1.552	26.1	1:2.8
20	4		1.9	522.5	1.378	27.5	1:2.6

Contd.

Table 1 (contd.)

Sl. No.	Test No.	rpm	Weight of paddy sheaf (kg)	Weight of uncleaned grains (input) (g)	Weight of straw (kg)	Weight of grains in sheaf (%)	Grain straw ratio (%)
21	1		1.9	556.7	1.343	29.3	1:2.4
22	2	450	2.0	538.0	1.462	26.9	1:2.7
23	3		1.8	532.8	1.267	29.6	1:2.4
24	4		2.0	546.0	1.454	27.3	1:2.7
25	1		1.9	520.6	1.379	27.4	1:2.6
26	2	500	2.0	530.0	1.470	26.5	1:2.8
27	3		1.9	541.5	1.359	28.5	1:2.5
28	4		1.8	495.0	1.305	27.5	1:2.6
29	1		1.9	549.1	1.351	28.9	1:2.5
30	2	550	2.0	558.0	1.442	27.9	1:2.6
31	3		1.7	545.7	1.154	32.1	1:2.1
32	4		1.7	554.2	1.146	32.6	1:2.1
33	1		1.9	532.0	1.368	28.0	1:2.6
34	2		1.9	537.7	1.362	28.3	1:2.5
35	3	600	1.7	549.1	1.151	32.3	1:2.1
36	4		2.0	542.1	1.458	27.1	1:2.7

Table 2. Test results of optimising the rpm of the thresher (Whole grains threshed)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the whole grain threshed (output) (g)	(%)	(kg/h)	Average (kg/h)
1	1	200	8.2	562.0	475	84.52	208.54	202.33
2	2		7.3	514.8	420	81.59	207.12	
3	3		8.5	542.0	460	84.87	194.82	
4	4		8.8	556.2	486	87.38	198.82	
5	1	250	7.6	578.0	490	84.78	232.11	247.17
6	2		7.1	582.0	485	83.33	245.92	
7	3		6.8	556.2	462	83.09	244.59	
8	4		6.4	566.2	473	83.54	266.06	
9	1	300	5.2	533.9	436	81.66	301.85	307.59
10	2		5.5	535.8	452	84.36	295.85	
11	3		5.3	528.7	447	84.55	303.62	
12	4		5.0	541.8	457	84.35	329.04	
13	1	350	4.4	540.6	443	81.95	362.45	368.60
14	2		4.8	554.8	463	83.45	347.25	
15	3		4.3	546.0	456	83.52	381.77	
16	4		4.4	562.0	468	83.27	382.91	
17	1	400	3.7	516.8	429	83.01	417.41	451.84
18	2		3.7	534.0	448	83.90	435.89	
19	3		3.4	548.1	457	83.38	483.88	
20	1		3.3	522.5	431	82.49	470.18	

Contd.

Table 2 (contd.)

Sl No.	Test No.	rpm	Time (s)	Input (g)	Weight of the whole grain threshed (output)			
					(g)	(%)	(kg/h)	Average (kg/h)
21	1	450	3.3	556.7	463	83.17	505.09	486.71
22	2		3.5	538.0	441	81.97	453.62	
23	3		3.0	532.8	436	81.83	523.21	
24	4		3.5	546.0	452	82.78	464.91	
25	1	500	3.1	520.6	427	82.02	495.87	510.77
26	2		2.9	530.0	431	81.32	535.03	
27	3		3.1	541.5	444	81.99	515.61	
28	4		2.9	495.0	400	80.81	496.55	
29	1	550	3.1	549.1	451	82.13	523.74	546.28
30	2		3.0	558.0	462	82.80	554.40	
31	3		2.9	545.7	449	82.28	557.38	
32	4		3.0	554.2	458	82.64	549.60	
33	1	600	2.9	532.0	436	81.95	541.24	566.03
34	2		2.8	537.7	442	82.20	568.28	
35	3		2.8	549.1	452	82.32	581.15	
36	4		2.8	542.1	446	82.27	573.43	

Table 3. Test results of optimising the rpm of the thresher (Broken grains)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the broken grains (g)	(%)	(kg/h)	Average (kg/h)
1	1		8.2	562.0	8.37	1.49	3.675	
2	2	200	7.3	514.8	7.72	1.50	3.807	3.545
3	3		8.5	542.0	7.86	1.45	3.329	
4	4		8.8	556.2	8.23	1.48	3.367	
5	1		7.6	578.0	8.96	1.55	4.244	
6	2	250	7.1	582.0	9.20	1.58	4.665	4.540
7	3		6.8	556.2	8.45	1.52	4.474	
8	4		6.4	566.2	8.49	1.50	4.776	
9	1		5.2	533.9	8.49	1.59	5.878	
10	2	300	5.5	535.8	8.63	1.61	5.649	5.896
11	3		5.3	528.7	8.51	1.61	5.780	
12	4		5.0	541.8	8.72	1.61	6.278	
13	1		4.4	540.6	8.92	1.65	7.298	
14	2	350	3.8	554.8	9.10	1.64	6.825	7.359
15	3		4.3	546.0	9.17	1.68	7.677	
16	4		4.4	562.0	9.33	1.66	7.634	
17	1		3.7	516.8	8.68	1.68	8.445	
18	2	400	3.7	534.0	9.08	1.70	8.835	9.265
19	3		3.4	548.1	9.48	1.73	10.038	
20	4		3.3	522.5	8.93	1.71	9.742	

Contd.

Table 3 (contd.)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the broken grains (g)	(%)	(kg/h)	Average (kg/h)
21	1	450	3.3	556.7	9.69	1.74	10.571	10.481
22	2		3.5	538.0	9.58	1.78	9.854	
23	3		3.0	532.8	9.54	1.79	11.448	
24	4		3.5	546.0	9.77	1.79	10.049	
25	1	500	3.1	520.6	9.53	1.83	11.067	11.626
26	2		2.9	530.0	9.86	1.86	12.240	
27	3		3.1	541.5	10.13	1.87	11.764	
28	4		2.9	545.0	9.21	1.86	11.433	
29	1	550	3.1	549.1	10.49	1.91	12.182	12.739
30	2		3.0	558.0	10.83	1.94	12.996	
31	3		2.9	545.7	10.48	1.92	13.010	
32	4		3.0	554.2	10.64	1.92	12.768	
33	1	600	2.9	532.0	10.43	1.96	12.948	13.642
34	2		2.8	537.7	10.65	1.98	13.693	
35	3		2.8	549.1	10.93	1.99	14.053	
36	4		2.8	542.1	10.79	1.99	13.873	

Table 4. Test results of optimising the rpm of the thresher (Unthreshed grains on broken earheads)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the unthreshed grains (g)	(%)	(kg/h)	Average (kg/h)
1	1		8.2	562.0	11.13	1.98	4.886	
2	2	200	7.3	514.8	10.24	1.99	5.049	4.752
3	3		8.5	542.0	10.79	1.99	4.569	
4	4		8.8	556.2	11.01	1.98	4.504	
5	1		7.6	578.0	11.44	1.98	5.419	
6	2	250	7.1	582.0	11.41	1.96	5.785	5.782
7	3		6.8	556.2	10.79	1.94	5.712	
8	4		6.4	566.2	11.04	1.95	6.210	
9	1		5.2	533.9	10.25	1.92	7.096	
10	2	300	5.5	535.8	10.07	1.88	6.591	6.897
11	3		5.3	528.7	9.78	1.85	6.643	
12	4		5.0	541.8	10.08	1.86	7.258	
13	1		4.4	540.6	10.27	1.90	8.403	
14	2	350	4.8	554.8	10.37	1.87	7.778	8.264
15	3		4.3	546.0	10.05	1.84	8.414	
16	4		4.4	562.0	10.34	1.84	8.460	
17	1		3.7	516.8	9.25	1.79	9.000	
18	2		3.7	534.0	9.61	1.80	9.350	9.621
19	3	400	3.4	548.1	9.65	1.76	10.218	
20	4		3.3	522.5	9.09	1.74	9.916	

Contd.

Table 4 (contd.)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the unthreshed grains (g)	(%)	(kg/h)	Average (kg/h)
21	1	450	3.3	556.7	9.41	1.69	10.265	9.763
22	2		3.5	538.0	8.88	1.65	9.134	
23	3		3.0	532.8	8.79	1.65	10.548	
24	4		3.5	546.0	8.85	1.62	9.103	
25	1	500	3.1	520.6	8.38	1.61	9.732	9.879
26	2		2.9	530.0	8.37	1.58	10.390	
27	3		3.1	541.5	8.50	1.57	9.871	
28	4		2.9	495.0	7.67	1.55	9.521	
29	1	550	3.1	549.1	8.51	1.55	9.883	10.068
30	2		3.0	558.0	8.48	1.52	10.176	
31	3		2.9	545.7	8.19	1.50	10.167	
32	4		3.0	554.2	8.37	1.51	10.044	
33	1	550	2.9	532.0	7.98	1.50	9.906	10.175
34	2		2.8	537.7	8.01	1.49	10.299	
35	3		2.8	549.1	8.13	1.48	10.453	
36	4		2.8	542.1	7.81	1.44	10.041	

Table 5. Test results of optimising the rpm of the thresher (Unthreshed grains in the straw)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the unthreshed grains in the straw (g)	(%)	(kg/h)	Average (kg/h)
1	1	200	8.2	562.0	50.018	8.90	21.959	18.982
2	2		7.3	514.8	35.573	6.91	17.543	
3	3		8.5	542.0	48.509	8.95	20.545	
4	4		8.8	556.2	38.823	6.98	15.882	
5	1	250	7.6	578.0	51.789	8.96	24.532	22.709
6	2		7.1	582.0	46.327	7.96	23.490	
7	3		6.8	556.2	38.878	6.99	20.582	
8	4		6.4	566.2	39.521	6.98	22.231	
9	1	300	5.2	533.9	37.159	6.96	25.725	25.326
10	2		5.5	535.8	36.113	6.74	23.638	
11	3		5.3	528.7	36.322	6.87	24.672	
12	4		5.0	541.8	37.872	6.99	27.268	
13	1	350	4.4	540.6	32.004	5.92	26.185	21.268
14	2		4.8	554.8	26.797	4.83	20.098	
15	3		4.3	546.0	22.659	4.15	18.970	
16	4		4.4	562.0	24.222	4.31	19.818	
17	1	400	3.7	516.8	20.000	3.87	19.459	16.998
18	2		3.7	534.0	15.486	2.90	15.067	
19	3		3.4	548.1	15.456	2.82	16.365	
20	4		3.3	522.5	15.675	3.00	17.100	

Contd.

Table 5 (contd.)

Sl. No.	Test No.	rpm	Time (s)	Input (g)	Weight of the unthreshed grainsin the straw (g)	(%)	(kg/h)	Average (kg/h)
21	1		3.3	556.7	22.212	3.99	24.231	
22	2	450	3.5	538.0	15.441	2.87	15.882	18.849
23	3		3.0	532.8	15.877	2.98	19.052	
24	4		3.5	546.0	15.779	2.89	16.230	
25	1		3.1	520.6	13.640	2.62	15.840	
26	2		2.9	530.0	15.529	2.93	19.277	17.934
27	3	500	3.1	541.5	15.920	2.94	18.488	
28	4		2.9	495.0	14.603	2.95	18.129	
29	1		3.1	549.1	9.720	1.77	11.288	
30	2		3.0	558.0	11.270	2.02	13.524	12.575
31	3	550	2.9	545.7	9.821	1.80	12.190	
32	4		3.0	554.2	11.083	2.00	13.296	
33	1		2.9	532.0	9.634	1.81	11.954	
34	2	600	2.8	537.7	9.952	1.85	12.793	12.484
35	3		2.8	549.1	10.271	1.87	13.204	
36	4		2.8	542.1	9.323	1.72	11.983	

Table 6. Test results of optimising the rpm of the thresher (Percentage ratio of broken grains* and unthreshed grains** to the whole grains)

Sl. No.	rpm	Whole grains (output) (kg/h)	Broken grains (kg/h)	Unthreshed grains (kg/h)	Percentage ratio	
					Broken grains	Unthreshed grains
1	200	460.25	3.545	11.867	0.77	2.58
2	250	477.50	4.540	14.246	0.95	2.98
3	300	448.00	5.896	16.112	1.32	3.60
4	350	457.50	7.359	14.766	1.61	3.23
5	400	441.25	9.265	13.310	2.10	3.02
6	450	448.00	10.481	14.306	2.34	3.19
7	500	425.50	11.626	13.907	2.73	3.27
8	550	455.00	12.739	11.322	2.80	2.49
9	600	444.00	13.642	11.330	3.07	2.55

$$* \ \frac{\text{Weight of broken grains}}{\text{Weight of whole grains}} \times 100$$

$$** \ \frac{\text{Weight of unthreshed grains}}{\text{Weight of whole grains}} \times 100$$

Table 7. Test results of optimising the rpm of the thresher (Averages of the values in the tables 2, 3, 4 & 5)

Sl. No.	rpm	Time (s)	Grains input (g)	Whole grains (output)			Broken grains			Unthreshed grains*		
				g	%	kg/h	g	%	kg/h	g	%	kg/h
1	200	8.2	543.75	460.25	84.59	202.33	8.045	1.48	3.545	54.023	9.92	23.734
2	250	7.0	570.60	477.50	83.69	247.17	8.775	1.54	4.540	55.300	9.68	28.492
3	300	5.3	535.05	448.00	83.73	307.59	8.588	1.61	5.896	46.912	8.77	32.224
4	350	4.5	550.85	457.50	83.05	368.60	9.130	1.66	7.359	36.680	6.67	29.532
5	400	3.5	530.35	441.25	83.20	451.84	9.040	1.71	9.265	26.054	4.92	26.620
6	450	3.3	543.38	448.00	82.44	486.71	9.645	1.78	10.481	26.310	4.83	28.612
7	500	3.0	521.78	425.50	81.54	510.77	9.683	1.86	11.626	23.154	4.44	27.814
8	550	3.0	551.75	455.00	82.46	546.26	10.610	1.93	12.739	18.862	3.42	22.646
9	600	2.8	540.23	444.00	82.19	566.03	10.700	1.98	13.642	17.778	3.29	22.660

* Weight of unthreshed grains on broken earheads and in the straw

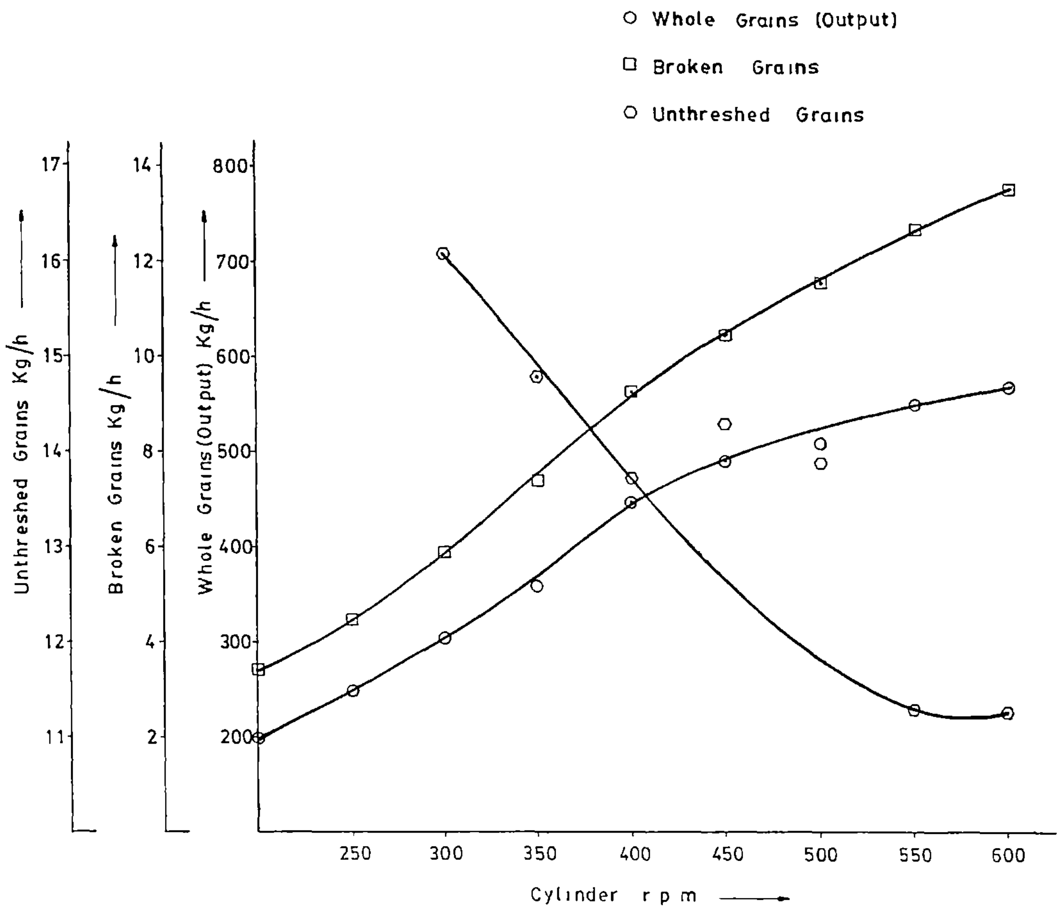


Fig 22 PERFORMANCE OF THE THRESHER AT VARYING CYLINDER rpm

Table 8. Test results of quantity of chaff obtained at varying rpm

Sl. No.	Test No.	rpm	Input (g)	Weight of chaff (g)	Weight of chaff (%)
1	1	200	562.0	17.478	3.11
2	2		514.8	41.235	8.01
3	3		542.0	14.850	2.74
4	4		556.2	12.125	2.18
5	1	250	578.0	15.779	2.73
6	2		582.0	30.089	5.17
7	3		556.2	35.931	6.46
8	4		566.2	34.142	6.03
9	1	300	533.9	42.018	7.87
10	2		535.8	23.629	4.41
11	3		528.7	27.069	5.12
12	4		541.8	28.119	5.19
13	1	350	540.6	46.383	8.58
14	2		554.8	45.549	8.21
15	3		546.0	48.103	8.81
16	4		562.0	50.130	8.92
17	1	400	516.8	49.871	9.65
18	2		534.0	51.798	9.70
19	3		548.1	56.509	10.31
20	4		522.5	57.789	11.06

Contd.

Table 8 (contd.)

Sl. No.	Test No.	rpm	Input (g)	Weight of chaff (g)	Weight of chaff (%)
21	1	450	556.7	52.385	9.41
22	2		538.0	63.107	11.73
23	3		532.8	62.604	11.75
24	4		546.0	59.623	10.92
25	1	500	520.6	62.056	11.92
26	2		530.0	65.243	12.31
27	3		541.5	62.976	11.63
28	4		495.0	63.509	12.83
29	1	550	549.1	69.406	12.64
30	2		558.0	65.398	11.72
31	3		545.7	68.213	12.50
32	4		554.2	66.116	11.93
33	1	600	532.0	67.990	12.78
34	2		537.7	67.105	12.48
35	3		549.1	67.759	12.34
36	4		542.1	68.196	12.58

Table 9. Test results of optimising the rpm of the thresher (Threshing efficiency)

Sl. No.	Test No.	rpm	Input (g)	Weight of unthreshed grains %*	%**	Total %	Threshing efficiency (%)	Average (%)
1	1		562.0	1.98	8.90	10.88	89.12	
2	2	200	514.8	1.99	6.91	8.90	91.10	90.08
3	3		542.0	1.99	8.95	10.94	89.06	
4	4		556.2	1.98	6.98	8.96	91.04	
5	1		578.0	1.98	8.96	10.94	89.06	
6	2	250	582.0	1.96	7.96	9.92	90.08	90.32
7	3		556.2	1.94	6.99	8.93	91.07	
8	4		566.2	1.95	6.98	8.93	91.07	
9	1		533.9	1.92	6.96	8.88	91.12	
10	2	300	535.8	1.88	6.74	8.62	91.38	91.23
11	3		528.7	1.85	6.87	8.72	91.28	
12	4		541.8	1.86	6.99	8.85	91.15	
13	1		540.6	1.90	5.92	7.82	92.18	
14	2	350	554.8	1.87	4.83	6.70	93.30	93.34
15	3		546.0	1.84	4.15	5.99	94.01	
16	4		562.0	1.84	4.31	6.15	93.85	
17	1		516.8	1.79	3.87	5.66	94.34	
18	2	400	534.0	1.80	2.90	4.70	95.30	95.08
19	3		548.1	1.76	2.82	4.58	95.42	
20	4		522.5	1.74	3.00	4.74	95.26	

Contd.

Table 9 (contd.)

Sl. No.	Test No.	rpm	Input (g)	Weight of unthreshed grains %*	%**	Total %	Threshing efficiency (%)	Average (%)
21	1		556.7	1.69	3.99	5.68	94.32	
22	2	450	538.0	1.65	2.87	4.52	95.48	95.17
23	3		532.8	1.65	2.98	4.63	95.37	
24	4		546.0	1.62	2.89	4.51	95.49	
25	1		520.6	1.61	2.62	4.23	95.77	
26	2	500	530.0	1.58	2.93	4.51	95.49	95.56
27	3		541.5	1.57	2.94	4.51	95.49	
28	4		495.0	1.55	2.95	4.50	95.50	
29	1		549.1	1.55	1.77	3.32	96.68	
30	2	550	558.0	1.52	2.02	3.54	96.46	96.58
31	3		545.7	1.50	1.80	3.30	96.70	
32	4		554.2	1.51	2.00	3.51	96.49	
33	1		532.0	1.50	1.81	3.31	96.69	
34	2	600	537.7	1.49	1.85	3.34	96.66	96.71
35	3		549.1	1.48	1.87	3.35	96.65	
36	4		542.1	1.44	1.72	3.16	96.84	

* Percentage weight of the unthreshed grains on the broken earheads

** Percentage weight of the unthreshed grains in the straw

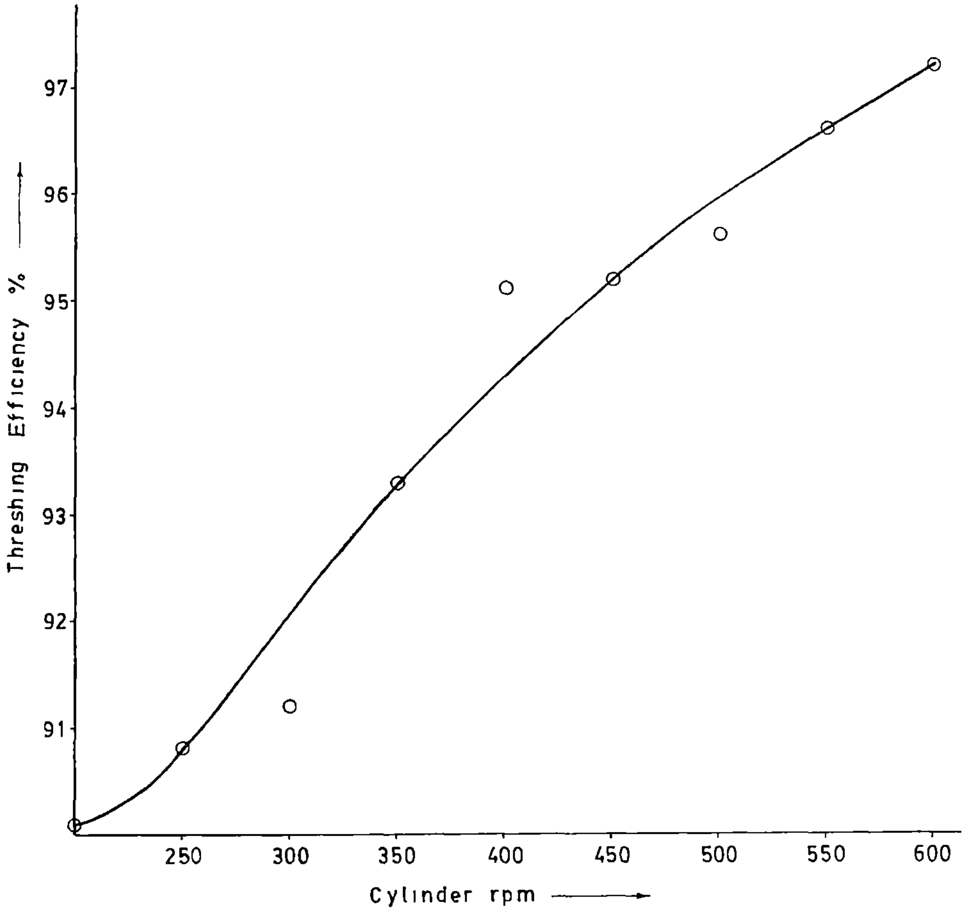


Fig 23 EFFECT OF CYLINDER rpm ON THRESHING EFFICIENCY

the cylinder rpm. When cylinder speed increased the weight of unthreshed grains decreased. So threshing efficiency is high at higher cylinder rpm. At 600 rpm the threshing efficiency is 96.71 per cent. At 400 rpm it is 95.08 per cent and at 200 rpm it is 90.08 per cent. The results are detailed in Table 9. The threshing efficiency at 400 rpm (95.08%) is closely comparable with that at 600 rpm (96.71%).

Effect of moisture content on the performance of the thresher

After optimisation of the speed of the thresher at 400 rpm, the low cost thresher was subjected to some more laboratory tests to study the performance on both high yielding and local varieties of paddy at different moisture contents. According to RNAM (1983) the optimum moisture content for threshing paddy is 14 per cent. The weight of the paddy sheaf, straw and grain-straw weight ratio are given in Table 10.

In high yield variety and local variety, when the moisture content increases the output decreases (Table 11). The output decreased rapidly in the case of high yield variety whereas it is almost steady in local variety.

Table 12 shows the effect of moisture content on broken grains. With an increase in moisture content the rate of broken grains decreases.

Tables 13 and 14 give the details of the weight of unthreshed grains left on the broken earheads and in the straw respectively. It is clear that the unthreshed grain rate is directly proportional to the moisture content. When the moisture content increases, in both the cases, the quantity of unthreshed grains also increases.

While studying the Table 15 and the graph (Fig.24), it is clear that when the moisture content increases the threshing efficiencies of both the varieties decrease rapidly.

If the moisture content is low, the field losses due to natural shattering of the grain will be high. It is observed that the moisture content around 14 per cent is suitable for threshing the paddy grain. This is consistent with the RNAM recommendations.

Chaff which are the unfilled grains, are not found to be affecting the threshing efficiency but it affects the output in terms of the quantity and quality of the paddy grain. The weight of chaff presented in the grain is shown in Table 8.

Table 10. Effect of moisture content on the performance of the thresher at 400 rpm (Grain-straw ratio)

Sl. No.	Test No.	Weight of paddy sheaf (g)	Weight of uncleaned grains (input) (g)	Weight of straw (kg)	Weight of grains in sheaf (%)	Grain straw ratio	Moisture content (%)	Paddy variety
1	1	1.8	525.6	1.274	29.2	1:2.4		
2	2	2.0	546.0	1.454	27.3	1:2.7	12.3	HYV
3	3	2.0	554.0	1.446	27.7	1:2.6		
4	4	2.1	539.7	1.560	25.7	1:2.9		
5	1	2.3	512.9	1.787	22.3	1:3.5		
6	2	2.2	508.2	1.692	23.1	1:3.3	12.1	LV
7	3	2.5	515.0	1.985	20.6	1:3.9		
8	4	2.5	525.0	1.975	21.0	1:3.8		
9	1	1.9	513.0	1.387	27.0	1:2.7		
10	2	1.9	518.7	1.381	27.3	1:2.7	14.2	HYV
11	3	2.1	529.2	1.571	25.2	1:2.9		
12	4	2.0	524.0	1.476	26.2	1:2.8		

Table 10 (contd.)

Sl. No.	Test No.	Weight of paddy sheaf (g)	Weight of uncleaned grains (input) (g)	Weight of straw (kg)	Weight of grains in sheaf (%)	Grain straw ratio	Moisture content (%)	Paddy variety
13	1	2.5	510.0	1.990	20.4	1:3.9		
14	2	2.6	520.0	2.080	20.0	1:4.0	14.3	LV
15	3	2.4	530.4	1.870	22.1	1:3.5		
16	4	2.3	522.1	1.778	22.7	1:3.4		
17	1	1.8	520.2	1.280	28.9	1:2.5		
18	2	1.9	507.3	1.393	26.7	1:2.7	15.3	HYV
19	3	1.8	523.8	1.276	29.1	1:2.4		
20	4	1.7	518.5	1.182	30.5	1:2.3		
21	1	2.6	507.0	2.093	19.5	1:4.1		
22	2	2.4	518.4	1.882	21.6	1:3.6	15.6	LV
23	3	2.4	523.2	1.887	21.8	1:3.6		
24	4	2.3	515.2	1.785	22.4	1:3.5		

Table 11. Effect of moisture content on the performance of the thresher at 400 rpm (Whole grainsthreshed)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the whole grainsthreshed (output)				Paddy variety
					g	%	kg/h	Average	
1	1	12.3	3.3	525.6	426	81.05	464.727	457.353	HYV
2	2		3.5	546.0	448	82.05	460.800		
3	3		3.5	554.0	451	81.41	463.886		
4	4		3.6	539.7	440	81.53	440.000		
5	1	12.1	3.7	512.9	414	80.72	402.818	404.565	LV
6	2		3.6	508.2	409	80.48	409.000		
7	3		3.7	515.0	416	80.78	404.756		
8	4		3.8	525.0	424	80.76	401.654		
9	1	14.2	3.2	513.0	416	81.09	468.000	449.225	HYV
10	2		3.3	518.7	420	80.97	458.152		
11	3		3.4	529.2	431	81.44	456.353		
12	4		3.7	524.0	426	81.30	414.486		

Contd.

Table 11 (contd.)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the whole grains threshed (output)				Paddy variety
					g	%	kg/h	Average	
13	1	14.3	3.9	510.0	415	81.37	383.007	399.754	LV
14	2		3.8	520.0	412	79.23	390.316		
15	3		3.9	530.4	433	81.64	399.622		
16	4		3.6	522.1	426	81.59	426.000		
17	1	15.3	3.4	520.2	420	80.74	444.706	441.619	HYV
18	2		3.3	507.3	409	80.62	446.152		
19	3		3.5	523.8	422	80.57	434.057		
20	4		3.4	518.5	417	80.42	441.529		
21	1	15.6	3.7	507.0	401	79.09	390.162	390.836	LV
22	2		3.8	518.4	413	79.67	391.263		
23	3		3.8	523.2	421	80.47	398.842		
24	4		3.9	515.2	415	80.55	383.077		

Table 12. Effect of moisture content on the performance of the thresher at 400 rpm (Broken grains)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the broken grains (g)	%	kg/h	Average	Paddy variety
1	1	12.3	3.3	525.6	9.671	1.84	10.550	10.335	HYV
2	2		3.5	546.0	9.937	1.82	10.221		
3	3		3.5	554.0	10.027	1.81	10.313		
4	4		3.6	539.7	10.254	1.90	10.254		
5	1	12.1	3.7	512.9	10.822	2.11	10.530	10.692	LV
6	2		3.6	508.2	10.520	2.07	10.520		
7	3		3.7	515.0	11.124	2.16	10.823		
8	4		3.8	525.0	11.498	2.19	10.893		
9	1	14.2	3.2	513.0	9.183	1.79	10.331	10.255	HYV
10	2		3.3	518.7	9.440	1.82	10.298		
11	3		3.4	529.2	10.157	1.92	10.754		
12	4		3.7	524.0	9.904	1.89	9.636		

Contd.

Table 12 (contd.)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the broken grains				Paddy variety
					g	%	kg/h	Average	
13	1	14.3	3.9	510.0	9.945	1.95	9.180	10.395	LV
14	2		3.8	520.0	11.492	2.21	10.887		
15	3		3.9	530.4	10.237	1.93	9.450		
16	4		3.6	522.1	12.061	2.31	12.061		
17	1	15.3	3.4	520.2	9.520	1.83	10.080	9.930	HYV
18	2		3.3	507.3	8.675	1.71	9.464		
19	3		3.5	523.8	9.900	1.89	10.183		
20	4		3.4	518.5	9.437	1.82	9.992		
21	1	15.6	3.7	507.0	9.582	1.89	9.323	9.083	LV
22	2		3.8	518.4	9.072	1.75	8.595		
23	3		3.8	523.2	10.098	1.93	9.567		
24	4		3.9	515.2	9.583	1.86	8.846		

Table 13. Effect of moisture content on the performance of the thresher at 400 rpm (Unthreshed grains on broken earheads)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the unthreshed grains g	%	kg/h	Average	Paddy variety
1	1		3.3	525.6	11.143	2.12	12.156		
2	2	12.3	3.5	546.0	11.903	2.18	12.243	11.992	HYV
3	3		3.5	554.0	11.634	2.10	11.966		
4	4		3.6	539.7	11.604	2.15	11.604		
5	1		3.7	512.9	11.489	2.24	11.178		
6	2	12.1	3.6	508.2	11.536	2.27	11.536	11.145	LV
7	3		3.7	515.0	11.330	2.20	11.024		
8	4		3.8	525.0	11.445	2.18	10.843		
9	1		3.2	513.0	11.645	2.27	13.101		
10	2	14.2	3.3	518.7	11.982	2.31	13.071	12.745	HYV
11	3		3.4	529.2	12.114	2.29	12.827		
12	4		3.7	524.0	12.314	2.35	11.981		

Contd.

Table 13 (contd.)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the unthreshed grains g	%	kg/h	Average	Paddy variety
13	1		3.9	510.0	11.781	2.31	10.875		
14	2	14.3	3.8	520.0	12.792	2.46	12.119	11.369	LV
15	3		3.9	530.4	11.404	2.15	10.527		
16	4		3.6	522.1	11.956	2.29	11.956		
17	1		3.4	520.2	12.017	2.31	12.724		
18	2	15.3	3.3	507.3	11.972	2.36	13.060	13.055	HYV
19	3		3.5	523.8	12.624	2.41	12.985		
20	4		3.4	518.5	12.703	2.45	13.450		
21	1		3.7	507.0	11.915	2.35	11.593		
22	2	15.6	3.8	518.4	12.442	2.40	11.787	11.915	LV
23	3		3.8	523.2	13.028	2.49	12.342		
24	4		3.9	515.2	12.932	2.51	11.937		

Table 14. Effect of moisture content on the performance of the thresher at 400 rpm (Unthreshed grains in the straw)

Sl. No	Test No	Moisture content (%)	Time (s)	Input (g)	Weight of the unthreshed grains in the straw				Paddy variety
					g	%	kg/h	Average	
1	1		3 3	525.6	11.616	2.21	12.672		
2	2	12.3	3 5	546.0	11 903	2.18	12.243	9.902	HYV
3	3		3.5	554.0	7.147	1.29	7.351		
4	4		3.6	539 7	7 340	1.36	7.340		
5	1		3.7	512.9	11.643	2.27	11.328		
6	2	12.1	3.6	508.2	6.708	1.32	6.708	7.629	LV
7	3		3.7	515.0	6.644	1.29	6.464		
8	4		3.8	525.0	6.353	1.21	6.019		
9	1		3.2	513.0	12.569	2.45	14.140		
10	2	14 2	3.3	518.7	13.091	2.51	12.281	13.804	HYV
11	3		3.4	529.2	13.172	2.49	13.947		
12	4		3.7	524.0	13.205	2.52	12.848		

Contd.

Table 14 (contd.)

Sl. No.	Test No.	Moisture content (%)	Time (s)	Input (g)	Weight of the unthreshed grains in the straw				Paddy variety
					g	%	kg/h	Average	
13	1		3.9	510.0	10.455	2.05	9.651		
14	2	14.3	3.8	520.0	10.972	2.11	10.395	10.303	LV
15	3		3.9	530.4	11.616	2.19	10.722		
16	4		3.6	522.1	10.442	2.00	10.442		
17	1		3.4	520.2	14.618	2.81	15.478		
18	2	15.3	3.3	507.3	15.067	2.97	16.437	15.840	HYV
19	3		3.5	523.8	14.719	2.81	15.140		
20	4		3.4	518.5	15.399	2.97	16.305		
21	1		3.7	507.0	12.523	2.47	12.185		
22	2	15.6	3.8	518.4	13.116	2.53	12.426	12.196	LV
23	3		3.8	523.2	12.714	2.43	12.045		
24	4		3.9	515.2	13.138	2.55	12.127		

Table 15. Effect of moisture content on threshing efficiency at 400 rpm

Sl. No.	Test No.	Moisture content (%)	Input (g)	Weight of unthreshed grains %*	%**	Total %	Threshing efficiency %	Average	Paddy variety
1	1	12.3	525.6	2.12.	2.21	4.33	95.67	96.10	HYV
2	2		546.0	2.18	2.18	4.36	95.64		
3	3		554.0	2.10	1.29	3.39	96.61		
4	4		539.7	2.15	1.36	3.51	96.49		
5	1	12.1	512.9	2.24	2.27	4.51	95.49	96.26	LV
6	2		508.2	2.27	1.32	3.59	96.41		
7	3		515.0	2.20	1.29	3.49	96.51		
8	4		525.0	2.18	1.21	3.39	96.61		
9	1	14.2	513.0	2.27	2.45	4.72	95.28	95.18	HYV
10	2		518.7	2.31	2.51	4.82	95.18		
11	3		529.2	2.29	2.49	4.78	95.22		
12	4		524.0	2.35	2.52	4.87	95.13		

Contd.

Table 15 (contd.)

Sl. No.	Test No.	Moisture content (%)	Input (g)	Weight of unthreshed grains %*	%**	Total %	Threshing efficiency %	Average	Paddy variety
13	1		510.0	2.31	2.05	4.36	95.64		
14	2	14.3	520.0	2.46	2.11	4.57	95.93	95.74	LV
15	3		530.4	2.15	2.19	4.34	95.66		
16	4		522.1	2.29	2.00	4.29	97.71		
17	1		520.2	2.31	2.81	5.12	94.88		
18	2	15.3	507.3	2.36	2.97	5.33	94.67	94.73	HYV
19	3		523.8	2.41	2.81	5.22	94.78		
20	4		518.5	2.45	2.97	5.42	94.58		
21	1		507.0	2.35	2.47	4.82	95.18		
22	2	15.6	518.4	2.40	2.53	4.93	95.07	95.07	LV
23	3		523.2	2.49	2.43	4.92	95.08		
24	4		515.2	2.51	2.55	5.06	94.94		

* Percentage weight of unthreshed grains on earheads

** Percentage weight of unthreshed grains in the straw

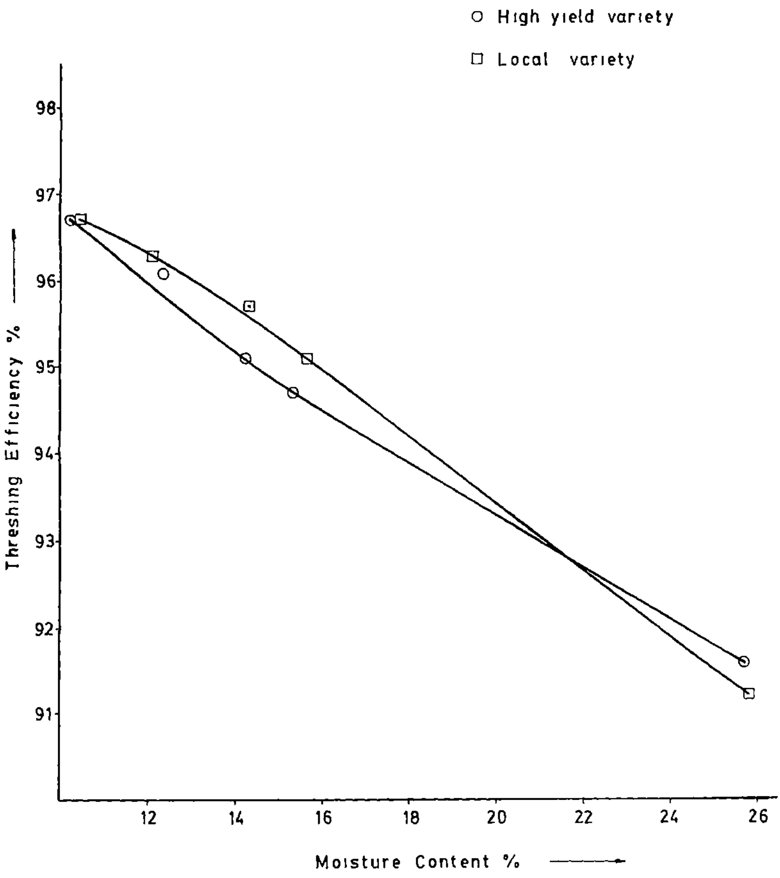


Fig 24 EFFECT OF MOISTURE CONTENT ON THRESHING EFFICIENCY

4.2 Field tests

Long run field tests were conducted at the Agricultural Research Station, Mannuthy to study the performance of the thresher in the actual field conditions. The thresher was operated both in the suitable atmospheric condition and in the abruptive rainy season. The results are shown in Table 16. Two men were required for the whole operation - one for operating the machine and other for giving the paddy stalk to the operator and removing the threshed grain from the front side of the thresher.

The first series of tests were conducted in dry weather condition the moisture content of the grains being 16.2 per cent. The effective cumulative time for this test was 5 hours 30 minutes. The output recorded was 1964.75 kg paddy. The second series of tests were done during the rainy season where the moisture content of the grains was 35.49 per cent. The effective duration of this test was 5 hours 40 minutes which gave an output of 658.5 kg. From the test results it is obvious that in the most favourable condition for threshing the output of the thresher was about 357 kg/h and in the unfavourable condition the output was 116 kg/h.

Table 16. Field test results of threshing capacity during summer and rainy season

Trial No.	Time taken (min)	Interval (min) 1	2	3	Total	Effective operational time (min)	Total elec. energy consumed (units)	Weight of cleaned paddy (kg)	Capacity of the thresher (kg/h)	Remarks
1	105	7	10	8	25	80				Moisture content at the time of threshing was 16.2% i.e., in the summer season
2	85	5	5	10	20	65				
3	155	10	10	10	30	125				
4	80	5	5	10	20	60				
Total	425				95	330	2.015	1964.750	357.227	
1	120	15	10	15	40	80				Moisture content at the time of threshing was 35.49% i.e., in the rainy season
2	165	25	20	30	75	90				
3	130	15	25	25	65	65				
4	165	20	20	20	60	105				
Total	580				240	340	2.254	658.500	116.206	

4.3 Cost of operation of the low cost paddy thresher

One of the major requirements for the acceptance of any equipment by the farmers is its economic feasibility. Along with other desirable qualities, the equipment should offer to the farmer, increased economic benefits over the existing or conventional equipment/method. The detailed cost analysis of the low cost paddy thresher is based on actual figures obtained during laboratory and field evaluation of the machine and based on the assumptions given in Appendix XXI. The annual use of the machine was taken as 500 hours for the cost analysis. The effective life of the equipment was taken as 10 years with 10 per cent salvage value. The thresher could give an output of 451 kg/h. The cost of operation obtained was Rs.13.00 per hour. Therefore the cost of threshing one quintal of paddy is Rs.3.00.

The cost of conventional manual threshing comes around Ps 33.00 per quintal paddy.

Summary

SUMMARY

Threshing is one of the critical post-harvest operations in paddy production. The present available power operated threshers have adequate capacity and good threshing efficiency but their cost, sophisticated construction and operation are prohibitive for small farmers. Therefore a simple low cost and portable thresher, having reasonable capacity with a good threshing efficiency and operated by a 0.5 hp electric motor has been developed and tested at the Kelappaji College of Agricultural Engineering & Technology, Tavanur and Agricultural Engineering Research Workshop, Kerala Agricultural University, Mannuthy.

The threshing cylinder is constructed of a series of slats arranged at a spacing of 20 mm supported at both ends by cylinder end discs. The slats carry the threshing teeth. The diameter of the cylinder across the end disc is 380 mm. Each slat is 16 mm thick and 62 mm wide.

The 3 mm dia threshing teeth project out 50 mm above the surface of the slats. The threshing teeth on two adjacent slats are staggered to each other.

A 0.5 hp motor is used as the prime mover. Belt and pulleys are used for power transmission.

The base and the side frames are made of 30 x 30 x 3 mm mild steel angle section. The supporting sideboards are made of 0.6 mm MS sheet and are webbed. The front grain shield is a 12 mm thick wooden plank covered by a 0.6 mm MS sheet. This is fixed to the side frames.

The overall dimensions of the thresher are - Length : 635 mm, Width : 500 mm, Height : 715 mm and Weight : 47 kg.

The test results obtained are summarised below.

The optimum speed of the thresher is 400 rpm.

The capacity of the thresher at this rpm at 14.26 per cent moisture content is 451.84 kg grains per hour.

The threshing efficiency is 95.08 per cent.

The mechanical damage is only 1.71 per cent.

The thresher can be used for threshing both high yield and local varieties of paddy.

Two labourers are required for the whole operation.

Cost of threshing one quintal of paddy is Rs.3.00.

The following future lines of works are suggested for further investigation related to this study.

1. Study the performance of the thresher at higher cylinder size with suitable prime mover.

2. Design and develop suitable winnower to the thresher such that both will function as an integral unit.

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Appendices

Appendix I

Low cost paddy thresher

1.	Function	: Threshing of paddy
2.	Specifications	
	Overall length	: 635 mm
	Overall width	: 500 mm
	Overall height	: 715 mm
	Gross weight	: 47 kg
	Type	: Wire loop
	Nominal capacity	: 450 kg/h
	Cylinder size	
	Diameter	: 380 mm
	Width	: 620 mm
	Portable/stationary	: Portable
	Power source	: 0.4 kw (0.5 hp) motor
	Labour requirement	: Two persons
3.	Developed at	: Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University Tavanur, Malappuram Kerala - 679 573
4.	Source of availability	: KCAET Tavanur, Malappuram
5.	Cost (approximate)	: Rs.1000/- (without motor) Rs.3600/- (with motor)
6.	Working principle	

The unit consists of 460 mm long and 380 mm diameter drum which has got 10 spring steel wire loops in a row.

There are 12 rows of such loops on the cylinder. Power is transmitted from a 0.5 hp motor through belt and pulleys. In this hold-on type thresher the impact and combing action of the wire loops on the paddy sheaves separates the grains. It requires two men for the whole operations.

7. Test results

Crop	:	Rice
Variety crop	:	Triveni
Moisture content of crop	:	14.26% (wb)
Output (grain)	:	451.84 kg/h
Cylinder speed	:	400 rpm
Concave clearance	:	Not applicable
Power requirement	:	0.4 kw
Cost of operation	:	Rs.3/q
Unthreshed grains	:	4 92%
Crackage	:	1 71%
Threshing efficiency	:	95.08%

Appendix II

Details of dynodrive variable speed motor

1. Dynodrive

Type	:	OBOMN
H_Z	:	50
Torque	:	0.26 kg m
Speed range	:	120-1200 rpm
Maximum exciting current	:	1.7
Exciting voltage	:	80
Weight	:	42 kg
Generator	:	Tacho generator

2. Motor (Hindustan Brown Boveri) - 3 phase induction motor

KW	:	0.37
HP	:	0.5
CR	:	50 c/s
rpm	:	1390

3. Ratings and specifications - Electronic regulator

Power supply	:	200/220 V (+ 10%-15%)
Cycles	:	50/60
Output circuit		
Capacity (W)	:	200
Current (A)	:	2.5
Voltage (VD.C)	:	80

Connection of thyristor	:	Single phase, halfwave rectifying connection with free-wheel diode
Speed setting input	:	12 V D-C (adjustable within ± 20%) input current upto 0.5 mA
Speed setting power supply (built-in)	:	13 V 150mA (short circuiting at 100 mA transistor series control system)
Dynodrive speed variation (for load change from 100% to 10%)	:	Less than 1 or 2% maximum speed

Dimensions

Length	:	300 mm
Width	:	180 mm
Depth	:	140 mm

Manufactured in collaboration with

Yaskawa Electric Mfg. Co. Ltd., Japan

Eddy Current Controls (INDIA) Ltd., Eddypuram,
Chalakudi - 680 307, Kerala, India.

Appendix III

Details of known paddy threshing/threshers

Sl No	Type of threshing/Name of machine	Power / H P	rpm	Grains output (kg/h)	Name of the designer/ Research centre/ Manufacturer
1	By hand beating	1 man	-	17-20	
2	Bullock driven pedal thresher	1 bullock+4 men	-	150	Gear box made by cossul
3	Bullock driven pedal thresher	2 bullocks+4 men	-	230	Gear box made by cossul
4	Bullock threshing	9 bullocks+3 men	-	200	
5	Tractor trampling			750	
6	Kawable pedal thresher (Japan)	2 men	370	30	
7	Peepal pedal thresher	2 men	210	20	M/s Peepal Iron Works Kanpur UP
8	Nahan pedal thresher	2 men	180	20	Nahan Foundry works Nahan ([illegible] P)
9	Akolat pedal thresher	2 men	260	20	M/s American Spring & Pressing Works Bombay
10	Kaypee pedal thresher	2 men	350	30	M/s Kaypee & Co Ranchi Bihar
11	Pedal thresher Japan	3 men		50	
12	Pedal thresher converted for bullock drive	50 kg draft	450	250	
13	Kubota semi automatic (Japan)	2 hp	750	100	
14	Kubota automatic (Japan)	5 hp	600	300	
15	Cecoco Japan	2 hp	600	100	
16	Plot thresher (USA)	3 5 hp	-	170	
17	Yanmar	5 hp	1800	600	M/s Kyowa Agricultural Machinery Co Ltd Kochi (Japan)
18	IRRI table thresher	4 men	215	350	
19	Allahabad power thresher	3 hp		200	
20	Nomco	5 hp	600	150	M/s National Mettalurgical Corporation Kanpur U P
21	Power paddy thresher	3 5 hp	750	400	Dept of Agrl Engg Allahabad Agrl Institute Allahabad U P
22	Naini Junior	2 5 hp	725	200	M/s Agrl Development Society Naini Allahabad U P
23	Qualitex	5 hp	650	500	Qualitex Faridabad Hariyana
24	Sherpur	5 hp	-	500	M/s Union Forgings Sherpur G T Road Ludhiana
25	Kissan sewak	5 hp	1100	300	M/s Modern Foundary Works, Ahamad Nagar Maharastra
26	Multicrop thresher	3 hp		200	JNKVV Jabalpur M P
27	Paddy thresher	2 hp	250	130	RTTC Coimbatore Tamil Nadu
28	Sri Ram thresher	3 hp	-	400	Sri Ram Industries Coimbatore
29	DISW	5 hp	-	150	M/s Damodar Enterprises Ltd I A Vanstratt Row Culcutta
30	EMBEE	2 hp		80	M/s Martin Burn Ltd 12 Mission Road Calcutta
31	Double drum 10 length	4 hp	400	250	RTTC Rajendra Nagar Hydrabad A P
32	LDL all crops thresher	6 5 hp		600	Karshak Industries 18 14 Boiguda Hydrabad (A P)

Contd

Appendix III (contd)

Sl No	Type of threshing/Name of machine	Power / H P	rpm	Grains output (kg/h)	Name of the designer/ Research centre/ Manufacturer
33	Aurbindo	-	1120	8	Aurbindo Aurbindo Ashram Pondicherry
34	Drum type with belt and pulley	2 hp	500	70	
35	Double drum thresher	5 hp	720	1000	M/s New Maharashtra Engg Maharashtra Mandal Compound, Tilak Round Pune
36	LCT Multicrop grain cum paddy thresher	7 5 hp	-	1500	Elseetee Ind Coimbatore
37	Multicrop thresher (PAU)	30-35 hp tractor	800-1260	1000	College of Agril Engg PAU Ludhiana
38	Multicrop thresher (Pant Nagar)	20 hp tractor	-	600	College of Technology GBPUAT, Pantnagar
39	All crop thresher	7 5 hp	-	500-600	FIM Scheme APAU Hydrabad
40	Power paddy thresher	3 hp	-	500	RTTC, Vellayani, Trivandrum Kerala
41	Double drum paddy thresher	5 hp	-	350	FIM Scheme, APAU Hydrabad
42	Axial flow paddy thresher (Pantnagar)	7 5 hp	-	550	College of Technology GBPUAT Pantnagar
43	Paddy thresher	6 hp	1150	675	College of Agril Engg TNAU Coimbatore
44	Modified AKSHAT paddy thresher	2 men	-	70	College of Agri Engg and Technology OUAT Bhubaneswar
45	Pusa 40	5 hp	-	200	IARI, New Delhi

Appendix IV

Power paddy thresher (Naini Junior)

1.	Function	: Threshing, cleaning and separation
2.	Crops to be threshed	: Paddy, wheat, barley, Jowar and bajra
3.	Specifications	
	Overall length	: 1090 mm
	Overall width	: 1175 mm
	Overall height	: 1410 mm
	Weight	: 155 kg (without engine)
	Type	: Wire loop
	Nominal capacity	
	Paddy	: 200-400 kg/h
	Wheat	: 75-125 kg/h
	Jowar	: 400-600 kg/h
	Cylinder size	
	Diameter	: 446 mm
	Width	: 460 mm
	Portable/stationary	: Portable
	Power requirement	: 3.5 hp engine
	Labour requirement	: 3 men
4.	Developed at	: Department of Agricultural Engineering, Allahabad Agricultural Institute, Naini, Allahabad - 211 007 U.P., India

5. Source of availability : (i) Agricultural Development Society, Naini, Allahabad, U.P. - 211 007

(ii) Allahabad Agricultural Institute, Allahabad

6. Working principle

The thresher consists of a feed chute, threshing drum, concave, blower, baffle plates and sieves. The crop is fed through the feeding chute to the gap between rotating threshing cylinder and concave. The impact of the wire loop on the threshing cylinder separates the grain. Further threshing is obtained by rubbing action as the material passes through the restricted clearance space between the cylinder and the concave. The threshed grains then fall on the slide plate through the concave and chaffs are blown away by blower. The straw is removed over the straw walker.

7. Test results

Variety of crop	:	Sorghum
Moisture content	:	14.63 to 16.3% (wb)
Straw grain ratio	:	3:1
Output	:	219 kg/h
Cylinder speed	:	1015 m/min (725 rpm)
Concave clearance	:	7 mm
Power requirement	:	3.5 hp engine
Damaged grain	:	0.9%
Grain loss in separation	:	1%
Cleaning efficiency	:	98.5%
Overall threshing efficiency	:	NA

Appendix V

All crop thresher

1.	Function	:	Threshing and winnowing of different crops
2.	Specifications		
	Type	:	Raspbar
	Power requirement	:	7.5 hp engine or electric motor
	Labour requirement	:	4 persons
	Overall length	:	2840 mm
	Overall width	:	1120 mm
	Overall height	:	1600 mm
	Weight	:	250 kg
3.	Test results		
	Crops for which machine is adoptable	:	Rice, wheat, sorghum, maize, pearl millet
	Work capacity	:	Paddy : 5-6 q/h Wheat : 4-5 q/h Sorghum : 12-15 q/h Maize : 12-15 q/h
4.	Developed at	:	FIM Scheme, APAU, Hyderabad - 500 030
5.	Source of availability	:	Agricultural Research Institute, APAU, Rajendranagar, Hydrabad - 500 030
6.	General information		

The raspbar type of cylinder is driven by the power source through 'V' belt arrangement. There is a semi-circular concave beneath the cylinder and a feeding chute in front and a cover on top. By adjusting the cylinder concave clearance different crops can be threshed with this thresher. The threshed crops is cleaned by the blowing action of blower and clean grain can be collected in the bags.

7. Persons associated with the development : Agricultural Engineer (Research)

Appendix VI

Pusa-40 thresher

1.	Function	:	Threshing and cleaning of different crops
2.	Specifications		
	Overall length	:	1650 mm
	Overal width	:	1500 mm
	Overall height	:	1750 mm
	Weight	:	350 kg
	Power requirement	:	5 hp electric motor
	Labour requirement	:	5 persons
	Crops for which the machine is adopted	:	Wheat, paddy, barley, pearl millet, safflower and sorghum
	Capacity	:	2 q/h (wheat)

3. General information

It is a multicrop thresher and it consists of a cylinder of 1015 mm length, a concave, a blower, an auger, sieves, an elevator and V-belt transmission mechanism. It is membered on four wheels for easy transportation.

4.	Developed at	:	IARI, New Delhi
5.	Persons associated with the development	:	T.H. Nirmal and B.S. Sirohi
6.	Source of availability	:	Agricultural Engineering Division, Indian Agricultural Research Institute, New Delhi - 110 012

Appendix VII

Multicrop thresher
(JNKVV)

1.	Function	:	Threshing and cleaning of different crops
2.	Specifications		
	Type	:	Peg type
	Power requirement	:	3 hp engine/2 hp electric motor
	Labour requirement	:	2 persons
	Overall length	:	1770 mm
	Overall width	:	1340 mm
	Overall height	:	1390 mm
	Weight	:	not available
3.	Test results		
	Crops for which machine is adoptable	:	Wheat, rice, soybean, gram and sorghum
	Work capacity	:	Wheat - 1.6 q/h Paddy - 2 q/h Sorghum, gram and soybean - 3 to 3.2 q/h
4.	Developed at	:	College of Agricultural Engineering, JNKVV, Jabalpur - 482 004
5.	Source of availability	:	College of Agricultural Engineering, JNKVV, Adhartal, Jabalpur - 482 004

6. General information

The unit is a modified version of AKSHAT power paddy thresher to suit different crops. The additional feature is a modified concave and additional screen which improve the threshing cleaning efficiencies.

7.	Persons associated with the development	:	L.P. Singh

Appendix VIII

IRRI - Pak axial flow thresher

1. Function	:	Threshing, cleaning and separation
2. Specifications		
Overall length	:	3150 mm
Overall width	:	1680 mm
Overall height	:	1730 mm
Weight	:	650 kg
Crop for which the machine is adoptable	:	Wheat, paddy and other crops
Power source	:	8 hp motor
Threshing cylinder		
Type	:	Spike tooth
1. Construction	:	Bolts in the threshing portion, spikes in the separating portion
2. Diameter	:	520 mm in threshing portion 495 mm in separating portion
3. Width	:	1200 mm
4. Number and shape of beaters	:	44 round, 88 flat
Concave		
Type	:	Bar type
Major dimensions	:	1082 mm x 565 mm
Straw thrower		
Width	:	180 mm
Diameter	:	520 mm

Sieve

Total length & width	:	Upper : 570 mm x 1770 mm Lower : 570 mm x 1770 mm
Blower type	:	Centrifugal
Number of blades	:	4
Diameter	:	320 mm
Blade width	:	75 mm

3. Developed at : IRRI/PAK Machinery Programme, C/o LAPSA, P.O. Box. 1237 Islamabad, Pakistan

4. Test results

Grain output	:	519 kg/h (paddy) 294 kg/h (wheat)
Blower loss	:	4.11% (wheat) 0.21% (paddy)
Crackage	:	3% (wheat) 2.38% (paddy)

Appendix IX

IRRI - Pant multicrop thresher

1. Function	:	Threshing, separation and cleaning of paddy and wheat
2 Specifications		
Overall length	:	1900 mm
Overall width	:	1700 mm
Overall height	:	1810 mm
Weight	:	1000 kg
Type	:	Spike tooth (axial flow)
Nominal capacity	:	5.5 q/h (paddy) 3 q/h (wheat)
Cylinder size		
Diameter	:	680 mm
Width	:	1395 mm
Concave	:	Bar type
Sieves		
Number	:	Two
Length	:	900 mm
Width	:	1220 mm
Size of holes	:	8 mm (upper), 1 mm (lower)
Blower		
Type	·	Centrifugal
Number of blades	:	4
Diameter	:	352 mm
Blade width	:	80 mm

Portable/stationary	:	Portable
Power source	:	5.6 kw (7.5 hp), Electric motor
Labour requirement	:	5 persons

3. Developed at : G.B. Pant University of Agriculture and Technology, Pantnagar, Uttar Pradesh - 263 145 India

4. Source of availability : M/s Ashok Kumar Ashok Nagar Pillibit, Nainital U.P. India.

5. Working principle

The thresher has a feeding trough, spike tooth cylinder, upper concave, reciprocating screen screen conveyor and blower assembly The crop is fed to the cylinder from one end of the cylinder and then it moves axially inside the cylinder where the crop is successively threshed due to impact of the pegs. The first half of the sieve acts as threshing portion and the remaining half works as a separation area, where the grain is separated from the straw. To facilitate axial movement of the crop, the top concave is provided with louvers. The threshed straw is thrown out with the help of paddles The cylinder is provided with 120 pegs made of 18 mm diameter MS rods of 150 mm length. It is provided with two separate upper concave for paddy and wheat threshing. The concave is made of 6 x 6 mm mild steel square bars spaced at 12 mm. The cleaning is attached with the help of two sets of blowers and one set of reciprocating screen. The screen conveyor is placed at the end of lower sieve to collect material coming from the screen

7. Test results

Variety of crop	Paddy - NA, Wheat - RR 21
Moisture content of crop	Paddy 21.3% (wb) wheat 12.5% (wb)
Straw grain ratio	0.81:1 (paddy), 1.29:1 (wheat)
Output	wheat 317 kg/h, paddy 550 kg/h
Cylinder speed	1065 to 1171 m/min (550 rpm for wheat, 500 rpm for paddy)
Concave clearance	20-30 mm
Power requirement	5.6 kw
Unthreshed grain	Paddy 0.07%
Crackage	5.5% for paddy at 20 mm concave clearance 1.4% for wheat at 25 mm concave clearance
Grain loss in separation	4.2% (wheat)
Cleaning efficiency	97% (wheat)
Overall threshing efficiency	NA

5. Working principle

The paddy thresher consists mainly of a feeding tray, a threshing drum with four raspbars, a blower and sieves. The harvested crop is fed through the tray. When the crop reaches the concave, the beating action of raspbar separates the grain from the straw. The paddy and straw fall below on the sieve and the blower sends a blast of air which separates the straw from the paddy. The straw is then thrown out and the clean paddy is collected at the bottom.

6. Test results

Crop	:	Rice
Variety of crop	:	IR-20
Moisture content of crop	:	19.5% (wb)
Straw-grain ratio	:	1.25:1
Output	:	675 kg/h
Cylinder rpm	:	1150 rpm
Concave clearance	:	2.0 mm
Power requirement	:	3.65 kw
Unthreshed grain	:	1.4%
Crackage	:	Nil
Grain loss in separation	:	1.3%
Cleaning efficiency	:	76%
Overall threshing efficiency	:	98.6%

Appendix X

TNAU paddy thresher

1. Function	:	Threshing, separation and cleaning of paddy
2. Specifications		
Make	:	TNAU
Type	:	Raspbar
Overall length	:	2150 mm
Overall width	:	850 mm
Overall height	:	1450 mm
Weight	:	400 kg
Nominal capacity	:	700 kg/h
Cylinder size		
Diameter	:	378 mm
Width	:	459 mm
Portable/stationary	:	Portable
Power source	:	3.7 kw (5 hp) electric motor or 4.5 kw (6 hp) diesel engine or PTO of tractor
Labour requirement	:	One person
3. Developed at	:	College of Agricultural Engineering, Tamil Nadu Agricultural University Coimbatore - 641 003 Tamil Nadu, India
4. Source of availability	:	TNAU, Coimbatore Tamil Nadu, India

Appendix XI

IRRI Portable thresher

1.	Function	:	Threshing and winnowing of paddy
2.	Specifications		
	Overall length	:	950 mm
	Overall width (with feed tray folded)	:	760 mm
	Overall height (with feed tray folded)	:	1380 mm
	Weight (with engine)	:	105 kg
	Cylinder		
	Type	:	Spike tooth
	Length	:	711 mm
	Diameter	:	305 mm
	Power requirement	:	5 hp engine
	Labour requirement	:	2-3 men
	Capacity	:	300-600 kg/h (rough rice) depending on crop condition
	Separation recovery	:	98% (wet basis)
	Grain purity	:	94%
	Grain breakage	:	Less than 2%
	Component speeds		
	Cylinder	:	600-630 rpm
	Winnowing fan	:	Engine speed
	Fuel consumption (Approx.)	:	One litre petrol per hour
	Construction	:	All steel

3. General information

Simplicity of design reduces operation and maintenance problems. It requires two to three men to feed thresh and bag grain. This can be carried by two men. In this thresher 'throw-in' or 'hold-on' threshing combined with air winnowing.

4. Information available from : Agricultural Machinery Development Programme
International Rice Research Institute,
P.O. Box 933
Manila, Philippines

Appendix XII

IRRI TH 7 axial flow thresher

1.	Function	:	Threshing and cleaning of paddy
2.	Specifications		
	Type	:	Spike tooth
	Overall length	:	1190 mm
	Overall width	:	1320 mm
	Overall height	:	1500 mm
	Weight (with engine)	:	119 kg
	Power requirement	:	7 hp engine
	Labour requirement	:	3-4 men
	Field capacity	:	400-500 kg/h (rough rice)
	Grain breakage	:	Less than 4%
	Separation recovery	:	98% (wet basis)
	Cylinder (open type)		
	Length	:	710 mm
	Diameter	:	305 mm
	Component speeds		
	Cylinder	:	600-650 rpm
	Fan	:	800 rpm
	Oscillating screen		
	Frequency	:	800 cycles/min
	Stroke	:	4.76 mm
	Adjustments	:	Blower shutter, angle of wind board
	Portable/stationary	:	Portable (can be carried by 4 men)
3.	Information available	:	International Rice Research Institute, P.O. Box. 933, Manila, Philippines

Appendix XIII

IRRI TH 8 axial flow thresher

1. Function : Threshing and cleaning of paddy

2. Specifications

Type	:	Spike tooth
Overall length	:	1900 mm
Overall width	:	1500 mm
Overall height	:	1780 mm
Weight (with engine)	:	465 kg
Power requirement	:	10 hp engine
Labour requirement	:	3-4 men
Field capacity	:	800-1000 kg/h (rough rice)
Grain breakage	:	Less than 4%
Separation recovery	:	98% (wet basis)

Cylinder

Diameter	:	394 mm
Length	:	1110 mm

Component speeds

Cylinder	:	540-600 rpm
Fan	:	800 rpm

Oscillating screen

Frequency	:	340 cycles/min
Stroke	:	32 mm
Adjustment	:	Blower shutter, angle of wind board

3. General information

In this 'throw-in' threshing combined with an air and double screen cleaning system. For transporting, this can be pulled by a power tiller, light truck or animal.

4. Information available from : International Rice Research Institute, Post Box. 933 Manila, Philippines

Appendix XIV

Power paddy thresher

1.	Function	: Threshing of paddy
2.	Specifications	
	Type	: Wire loop
	Length	: 1100 mm
	Width	: 1000 mm
	Height	: 1250 mm
	Weight	: NA
	Power requirement	: 3 hp electric motor
	Labour requirement	: Two persons
	Capacity	: 5 q/h
3.	Developed at	: RTTC, Vellayani, Trivandrum, Kerala
4.	Source of availability	: RTTC, Vellayani, Trivandrum, Kerala

5. General information

The thresher consists of a cylinder having wire loops in its periphery.

6. Persons associated with the development : J.J. Fenn and A.G. Mathew

Appendix XV

High capacity (PAU) multicrop thresher

1.	Function	:	Threshing, separation and cleaning of crops like wheat, paddy, maize and pulses. Straw bruising optional
2.	Specifications		
	Overall length	:	3900 mm 5300 mm (with bruiser)
	Overall width	:	1250 mm
	Overall height	:	1900 mm
	Weight	:	750 kg 1200 kg (with bruiser)
	Cylinder size		
	Diameter	:	440 mm
	Width	:	670 mm
	Concave type	:	grate of flats and round bars
	Width	:	680 mm
	Number of sieves	:	one
	Portable/stationary	:	Portable
	Power source	:	30-35 hp tractor
	Labour requirement	:	6 persons

3. Developed at : College of Agricultural Engineering, Punjab Agricultural University, Ludhiana - 141 004 Punjab, India.

4. Source of availability : M/s Amer Agricultural Implements, Gill Road, Janata Nagar, Ludhiana

5. Working principle

The thresher consists of an auger beater, threshing cylinder, concave, straw walker, sieve box kernel canvas, return pan, grain pan, blower and towbar. The feeding is done by auger beater The crop then pass through the gap between threshing cylinder having 6 raspbars and the concave. The concave is open type having finger spacing of 20 mm and finger length of 210 mm. The clearance between cylinders and concave is adjustable. For separation of grain from the long straw there is straw walker in three sections and four steps For cleaning, there is a chaffer box 1290 mm long and 675 wide and a blower. The sieves has round holes of 8 mm diameter. The chaffs are blown away by blower Wheat straw bruising attachments consists of a spike tooth cylinder with counter teeth on concave and aspirator blower for straw disposal. Straw bruising is optional.

Test results

Variety of crop	:	NA
Moisture content	:	NA
Straw grain ratio	:	NA

Appendix XVI

CIAE thresher

1. Function : Threshing and cleaning different crops

2. Specifications

Type	:	Spike tooth
Overall length	:	1430 mm
Overall width	:	1360 mm
Overall height	:	1700 mm
Weight	:	400 kg
Cylinder diameter	:	500 mm
Concave type	:	Square bars
Width	:	600 mm
Clearance	:	7 mm (wheat, paddy, sorghum) 9 mm (gram, soybean) 25 mm (maize)
Sieves		
Number	:	Two
Length	:	420 mm
Width	:	80 mm
Size of holes	:	5 mm (wheat, paddy, sorghum) 7.8 mm (gram, soybean) 10 mm (maize)
Blower		
Type	:	Aspirator
No. of blades	:	4
Diameter	:	720 mm
Blade width	:	140 mm
Power requirement	:	5 hp electric motor or 7.5 hp diesel engine

Output	:	Wheat and paddy (8 to 10 q/h)
		Maize and husk (30 to 35 q/h)
		Dehusked maize (35 to 40 q/h)
Cylinder speed	:	125 m/min (800 to 1260 rpm)
Concave clearance	:	10-18 mm (adjustable)
Power requirement	:	5 kw (without straw bruiser)
		13.2 kw (with straw bruiser)
Fuel consumption at rated capacity	:	3 to 4 l/h
Unthreshed grain	:	NA
Crackage	:	1.5 to 3% (paddy)

Output capacities

Paddy	:	392 kg/h
Wheat	:	276 kg/h
Soybean	:	200 kg/h
Gram	:	348 kg/h
Maize	:	1635 kg/h

Cylinder speed : 300-800 (depending upon nature of crop)

3. Developed at : Central Institute of Agricultural Engineering, Bhopal

4. Source of availability : The Director, CIAE, Nabi Bagh, Berasia Road Bhopal - 462 018, M.P.

5. General information

Wheat, paddy, gram and soybean are threshed by feeding the whole crop whereas sorghum threshing is done by feeding the earhead only. In the case of maize dehusked cobs are fed. The material is threshed by a specially designed cylinder and concave falls on an oscillating sieve. Material like the long straw of the paddy is thrown out from the cylinder outlet. An aspirator - blower sucks lighter materials and clean grain comes out at the main grain outlet. The provision for 'Bhusa' (hay) making is similar to the IRRI - Pant thresher. The cylinder length of the thresher is short which is suitable for short paddy varieties only (about 60-65 cm).

Appendix XVII

PAU Multicrop thresher

1.	Function	:	Threshing, cleaning and separation
2.	Specifications		
	Overall length	:	3260 mm
	Overall width	:	1600 mm
	Overall height	:	2030 mm
	weight	:	585 kg
	Type	:	Spike tooth
	Nominal capacity	:	4.3 q/h (paddy) 2.0 q/h (wheat)
	Cylinder size		
	Diameter	:	640 mm
	Width	:	1245 mm
	Portable/stationary	:	Portable
	Power source	:	15 hp motor
	Labour requirement	:	5 persons
3.	Developed at	:	College of Agricultural Engineering, Punjab Agricultural University, Ludhiana - 141 004 Punjab, India
4.	Source of availability	:	College of Agricultural Engineering, Punjab Agricultural University, Ludhiana

6. Working principle

The machine consists of a threshing cylinder, an aspirator blower and a reciprocating sieve system. The direction of rotation of the threshing cylinder is opposite while handling paddy and wheat. The cylinder concave clearance in the first section of the threshing system has to be more while handling paddy than that of wheat.

7. Test results

Crop	:	Wheat and paddy
Moisture content	:	NA
Grain straw ratio	:	NA
Output	:	2 q/h wheat 4.3 q/h paddy
peripheral speed	:	25.0 m/s (wheat) 20.0 m/s (paddy)
Concave clearance	:	35 mm (paddy) 15 mm (wheat)
Feed rate	:	6 q/h (wheat) 13 q/h (paddy)
Crackage	:	0.8% (wheat) Nil (paddy)
Cleanliness	:	97% (wheat) 95% (paddy)

Appendix XVIII

Modified 'AKSHAT' paddy thresher

1. Function : Threshing of paddy

2. Specifications

Type	:	Manual, peg, cycle
Power requirement	:	Two persons
Length	:	450 mm (drum)
Width	:	400 mm (dia of drum)
Height	:	NA
Weight	:	NA
Capacity	:	0.7 q/h

3. Developed at : College of Agricultural Engineering and Technology, OUAT, Bhubaneswar, Orissa

4. Source of availability : College of Agricultural Engineering and Technology, OUAT, Bhubaneswar, Orissa

5. General information

The unit consists of a drum 450 mm long and 400 mm diameter which has got 12 'A' loops in a row. There are 10 rows of such loops on the cylinder. Power is transmitted through 44:18 gear ratio from the cycle. By adjusting cylinder concave clearance, threshing is obtained. It requires two men, one to operate and another to feed. It given 33% more output as compared to the original model.

Appendix XIX

Double drum paddy thresher

1. Function : Paddy threshing and winnowing

2. Specifications

Type	:	Drum type
Power requirement	:	5 hp engine or motor
Labour requirement	:	4 persons
Overall length	:	2370 mm
Overall width	:	1370 mm
Overall height	:	1100 mm
Weight	:	Not available
Capacity	:	3.5 q/h

3. Developed at : FIM Scheme
Agricultural Research Institute, Andhra Pradesh Agricultural University, Hyderabad

4. Source of availability : Agricultural Research Institute, Andhra Pradesh Agricultural University, Hyderabad

5. General information

The thresher consists of rotating drums having wire loops on it to which are fed the earheads by holding butt ends of the sheaves manually. Due to impact, the grain gets separated from the earheads after which the straw can be thrown out by the operator. Four men, two on each side of the machine can work simultaneously.

6. Persons associated with the development : G. Ramana Reddy

Appendix XX

Axial flow paddy thresher (ICAR)

1. Function : Threshing and cleaning of all the varieties of paddy

2. Specifications

Type	:	Spike tooth
Overall length	:	950 mm
Overall width	:	760 mm
Overall height	:	1380 mm
Weight	:	100 kg
Power requirement	:	5 hp electric motor
Threshing efficiency	:	98%
Cleaning efficiency	:	92% (approximate)
Working capacity	:	110 kg/h
Cylinder diameter	:	305 mm
Cylinder width	:	711 mm

3. Contact agency : ICAR Research Complex
Cedar Lodge, Jowai Road
Shillong - 793 003
Meghalaya

4. General information

It is a light weight, portable type power paddy thresher based on the axial flow threshing principle. It is a modification of the IRRI design and can be used with an electric motor, a power tiller, or a stationar diesel engine. It is simple to adopt in paddy growing areas. It is being used in the farms of the hilly regions of North-East India. eg. Meghalaya, Sikkim etc.

Appendix XXI

Cost of operation of low cost paddy thresher

Total cost of threshing	=	Fixed cost + variable cost
Approximate cost of thresher (P)		
Prime mover - 0.5 hp motor	=	Rs.2200/-
Cost of transmission items -		
Pulleys and V-belt	=	Rs. 145/-
Cost of electrical items -		
Board, wires, plugs, sockets, etc.	=	Rs. 75/-
Cost of threshing drum, frame and fabrication charges including overhead charges @ 5%	=	Rs.1180/-
Total		Rs.3600/-

Other assumptions are:

a. Working hours per year (H) 500 h

b. Life of the thresher (L) 10 y

c. Salvage value 10% of the cost of the thresher (S) } Rs.360/-

I **Fixed cost**

1. Depreciation/hour

$$= \frac{P-S}{LxH}$$

$$= \frac{3600 - 360}{10 \times 500}$$

$$= Rs.0.65$$

2. Interest per hour @ 12% per year on average investment

$$= \frac{P + S}{2} \times \frac{12}{100} \times \frac{1}{H}$$

$$= \frac{3600 + 360}{2} \times \frac{12 \times 1}{100 \times 500}$$

$$= Rs.0.48$$

3. Taxes and insurance = Nil

4. Housing charges = Nil

5. Repair and maintenance charges per hour @ 10% of initial cost of the thresher per year $= \frac{P}{H} \times \frac{10}{100}$

$= \frac{3600}{500} \times \frac{10}{100}$

= Rs.0.72

Total fixed cost per hour = 0.65 + 0.42 + 0.72

= Rs.1.85

=======

II Variable cost (operating cost)

1. Labour charges

Number of labourers	=	2
Working hours per day	=	8 h
Labour charges/day/person	=	Rs.40/-
Labour charges per hour	=	$\frac{2 \times 40}{8}$
	=	Rs.10/-

2. Energy consumption

Energy consumption per hour of 0.5 hp motor	=	0.4 electrical units
Electricity charges/unit	=	Rs.0.40/-
Electricity charges/hour	=	0.4 x 0.4
	=	Rs.0.16

3. Lubrication charges

@5 ps per hour = Rs.0.05

Total operating cost = 10.00 + 0.16 + 0.05

= Rs.10.21/-

Total cost of threshing per hour = I + II

= 1.85 + 10.21

= Rs.12.06/-

Assume an establishment charge @ 5% of total cost of threshing = $12.06 \times \frac{5}{100}$

= 0.6

∴ Total cost of operation = 12.06 + 0.60

= Rs.12.66/-

Say Rs.13.00/-

Capacity of the thresher = 451 kg/h

= 4.51 q/h

Cost of threshing per quintal = Rs. $\frac{13.00}{4.51}$

= Rs.2.88

Say Rs.3.00/-

DESIGN, DEVELOPMENT AND EVALUATION OF A LOW COST PADDY THRESHER

By

MATHEW JOHN

ABSTRACT OF A THESIS

submitted in partial fulfilment of the
requirements for the degree

Master of Science in Agricultural Engineering

Faculty of Agricultural Engineering & Technology
Kerala Agricultural University

Department of Farm Power Machinery and Energy
Kelappaji College of Agricultural Engineering and Technology
Tavanur - 679 573
Malappuram

1991

ABSTRACT

Though several high capacity threshers are available in the country for different crops, no thresher is found suitable for small and marginal rice farmers. Hence a low cost portable paddy thresher was developed and tested.

The power operated machine consists of base, side frames, front grain shield and wire-loop cylinder. The power from the 0.5 hp motor is transmitted to the cylinder shaft by belt and pully arrangement.

The optimum cylinder speed is 400 rpm. The capacity of the thresher at 14.26 per cent moisture content is 451.84 kg paddy per hour and threshing efficiency is 95.08 per cent. The mechanical damage of the grain is negligible. Two labourers are required for the whole operation. The size of the thresher is 635 x 500 x 715 mm having a gross weight of 47 kg.

The cost of the thresher was worked out to be around Rs.3600 and the cost of operation for threshing paddy was Rs.3.00 per quintal.

The unit can be fabricated by local artisans from the readily available materials and can successfully be maintained by small and marginal farmers.