DESIGN AND FABRICATION OF LOW COST PADDY THRESHER

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PROJECT REPORT

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DECLARATION

We hereby declare that this project report entitled **"Design and Fabrication of Low Cost Paddy Thresher"** is a bonafide record of project work done by us and that this work has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title to us, of any other University.

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Tavanur,

14th Dec. 1992.

CERTIFICATE

Certified that this project report entitled **"Design and Fabrication of Low Cost Paddy thresher"** is a bonafide record of project work done jointly by **Sri. Babu.V., Sri. Saisundar.S.** and **Sri. Sunilkumar Pandey**, under my guidance and supervision and that it has not formed the basis for the award of any degree, diploma, fellowship, associateship or other similar title to them, of any other University or Society.

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Babu.V.

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Sunilkumar Pandey.

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

SYMBOLS AND ABBREVIATIONS USED

AFT	Axial flow thresher.
Agrl.	Agricultural
Anon	Anonymous
c/c	Centre to centre
CIAE	Central Institute of Agricultural engineering
cm	Centimetre(s)
Co.	Company
Cu	Unit cost
Ct	Cost of threshing
Dept.	Department
et al	and other people
etc.	et cetera
Engng.	Engineering
Fig.	Figure
FPME	Farm Power Machinery and Energy
GI	Galvanized Iron
h	hour(s)
ha	hectare(s)
hp	horse power
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
i.e.	that is
IEP	Industrial Extension Project
IIT	Indian Institute of Technology
IRRI	International Rice Research Institute

ISAE	Indian Society of Agricultural Engineers
IS	Indian Standard
J	Journal
KCAET	Kelappaji College of Agricultural Engineering and Technology
kg.	kilogram(s)
kg/h	kilogram(s) per hour
kg/min	kilogram(s) per minute
kg/s	kilogram(s) per second
kg-m	kilogram metre
kg-cm	kilogram centi metre
kg/cm	kilogram(s) per square centimetre
kW	kilo watt
Ltd	Limited
m	metre(s)
m.c.	moisture content
min	minute(s)
mm	millimetre(s)
m/min	metre(s) per minute
m/s	metre(s) per second
m^2	metre square
MS	Mild Steel
No.	Number
NRIAM	Nanjing Research Institute for Agricultural Mechanization
Oc	Operation cost
P-40	Pussa 40

PAU	Panjab Agricultural University
pp	pages
P.T.O.	power take off
q	quintal
q/h	quintal per hour
R & D	research and development
rpm	revolutions per minute
Rs	Rupees
s	Second(s)
SAC	Supportive and Allied Courses of Study
t	tonne(s)
Tech.	Technology
t/h	tonne(s) per hour
TNAU	Tamil Nadu Agricultural University
USSR	Union of Soviet Socialist Republic
VIKYNO	Vietnam Agricultural Machinery Company
W	Watt
w.b.	wet basis
/	per
%	percentage

INTRODUCTION

Adequate and appropriate agricultural machinary is a key element in programmes to enhance agricultural output and labour productivity. Agricultural mechanisation plays a vital role in modernizing agriculture. It includes the utilisation of hand tools, implements for draft animals and mechanically powered machinary for agricultural land development, production, harvesting and on farm processing. There are three major objectives of mechanization. The first one is to increase labour productivity by substituting mechanization for labour or by bringing a large area of land under cultivation with the same amount of labour. The second one is to increase land productivity and thirdly to decrease cost of production by reducing expenditures for labour and draft animals and by more efficient operation.

Land preparation, transplanting, weeding, harvesting and threshing are the major operations in paddy cultivation which involves high input of labour. During peak seasons as the entire area is often under cultivation, and there is always shortage of labourers. Delayed harvesting and threshing operations cause excessive grain loss. It has been reported that the adoption of improved system of threshing, by introducing a thresher had resulted in avoiding 6% to 12% of grain loss during the traditional threshing operation (Pillayar, 1988).

With the introduction of high yielding varieties (HYV) coupled with better management practices and pest control measures, more paddy is produced and if it is difficult to cope up with such a mass production with the existing harvest and threshing practices, particularly in double cropped areas when the land is to be cleaned soon after harvest to plant the next crop. Threshing loss in the form of grains left in panicles after threshing is a major concern. It is a common practice in many areas to leave the harvested sheaves in the field either as such or in heaps and to thresh the sheaves after a few days or weeks. Such a time gap between harvest and threshing causes considerable quantitative and qualitative losses.

Threshing losses are generally classified into two catagories. The straw losses and tub losses. Unthreshed paddy remaining on straw is known as straw losses which account about 11.7% and grain lost on ground during threshing is tub losses which is about 1.13%.

In traditional threshing method, relatively large bundles of paddy are beaten in the yard or tub. Paddy in the middle of the bundle at the bottom of the panicle is held by surrounding straw and is thus retained by the straw after threshing. The farmer cannot effectively control the quality of labour he employs, as a result the bundles are beaten only two or three times in some case against six times normally required for complete detachment of grain from straws. There are few varieties which are harder to thresh than others as a result more grains will be left in the straws.Some farmers tend to harvest immature paddy which is not easily detached during threshing. There are variations in the length of panicles during its maturity. These are the major causes of threshing losses.

It is found that mechanical threshing of paddy in wet and dry seasons significantly reduce the threshing loss. The other advantage of the mechanical threshers is that it overcomes the labour shortages during peak hours and it makes acceptable to young people by removing the dredgery. And it provides an outlet for their initiative and education. It is seen that the use of mechanical threshers in post harvest operation improved the field yield and rice recovery. The overall labour requirement was reduced by 70% per hectare and threshing cost by 60% by the use of threshers.

Though there are several types of threshers available in the country, a low cost thresher suitable for small scale farmers is not available. The pedal operated loop type threshers have got several limitations and the introduction of a suitable thresher is very essential at present. The farmers will accept only an efficient thresher whose price comes within their reach. Hence the project work entitled **"Design and Development of a Low Cost Paddy Thresher"** suitble for small scale farmers of the state was undertaken.

Objectives of the project.

1. Design and fabrication of a low cost paddy thresher

2. To study the performance of the machine.

REVIEW OF LITERATURE

In this chapter an attept is made to discuss the research works conducted in this field.

Threshing is the process of repeated poundings and dragging of plant mass over a surface or through an aperture. (Klenin et al,1985). Threshing can be achieved by three methods, rubbing action, impact and stripping (Araullo et al, 1976).

2.1. Methods of Threshing.

Depending on the power source threshing can be classified as.

1. Manual threshing.
2. Animal threshing.
3. Mechanical threshing.

2.1.1. Manual Thrshing.

The methods used for threshing rice manually are: treading by feet;flail- threshing; and hand -beating. In hand-beating, small bundles are beaten on drum and wooden logs. Some times stones,bench,base ground and other hard materials are also used. Depending upon bundle size, variety, and worker each bundle is beaten 5 to 10 times in order to shatter all grains. By this method a man can thresh from 15 to 340Kg of brown rice per hour. The only mechanical equipement used for mannual threshing is the pedal- threshers Mannual threshing is a slow and labour consuming process. Michael and Ojha(1978) reported that output of hand beating is about 17 to 20 kg/h.

2.1.2. Threshing by Animal.

Threshing by bullocks is a very common method used in villages. The bundles are initially placed around, with panicles positioning inward or on one side of the threshing floor, with a thin layer of harvested stalks spread for threshing by the animals. Two or four bullocks are generally used in single row tandem going around the materials to be threshed. A man always stays behind to drive the bullocks, tied loosely on a pole at the centre,to walk around the threshing floor. Well-off farmers sometimes use 6 or 8 bullocks in double row tandem to thresh more material at a time. In most parts of the country, bullock-treading is done as a second stage threshing after hand-beating to separate the remaining filled grain and to further soften the straw used for animal feed. Michael and Ojha (1978) reported that the output of treading with bullock is about 140 kg/h.

Tree Branch Threshing.

In some places, a bushy branch of tree is hitched behind the bullock pair in order to accelarate the threshing. These branches were loaded with sacks full of earth or bundles of crops. This method in addition to the process of threshing reduced the labour involved in shaking the crop, which is done to allow the threshed grain to trickle down to the threshing floor.

Punched Sheet 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 the top of the sheet to make it work more effectively.

Disc Harrow Threshing.

The use of bullock drawn disk harrow for threshing has been demonstrated successfully. A single action disk harrow with six or eight disks compare favourably with the olpad thresher in work out put. The disk harrow has an added advantage that the churning effect due to angling of the gangs help in allowing the grain to shift down to the bottom, thereby reducing the labour of shaking the crop.

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 if serrated vertical disks 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.

2.1.3. Mechanical Threshing.

Mechanical threshers have widely been accepted in Indian agriculture today due to their high efficiency. Technical threshers offer significant advantages over the traditional method of threshing (hand breaking, bullock treading, tractor treading, etc.). Some of the advantages are,

1. It separates the grain from straw with speed,
2. It produces clean grain, which can be sent directly to the market for sale,
3. Its operation is independent of weather,
4. It produces chaff (bhusa) of superior quality which is used as animal feed,
5. It reduces energy use,
6. Mechanical threshers are portable and thus can be moved from one threshing floor to another or other sites easily,
7. These can be operated with different power sourced like tractor, electric motor, oil engines,
8. It reduces dredgery of threshing without undue hazard to operators,
9. Almost all the principal crops can be threshed with mechanical threshers,
10. Cost of threshing becomes minimum with higher hours of usages and

11. Higher output per unit time is achieved.

Treading under tractor tyres.

This method of threshing paddy has been used in some Asian countries. It is quite popular in Sri lanka for custom threshing. The popularity of this method can be attributed only to the lack of suitable tractor P.T.O.- driven thresher. A threshing capacity of 640 kg/h. has been reported from Sri Lanka when two treshing floors are alternately with one tractor.

2.2. Power Threshing.

Power paddy threshers can be classfied based on feeding method as (1) hold-on type and (2) throw - in type.

In hold-on type of threshing, paddy stalk is held stationary while threshing is done by the impact on the panicle from the cylinder bars spikes or wire loops.

In throw-in type of machine paddy plants are fed into the machine and a major portion of the bars or spikes on the cylinder. The initial impact also accelarates the straw and further threshing is accomplished as the moving panicles hit the spikes or bars of concave.

2.3. Principles of threshing mechanism.

Threshing may be accomplished by

(a) impact of a fast-moving member upon the material

(b) rubbing

(c) squeezing pods

(d) a combination of two or more of these actions, or

(e) some other method of applying the required forces.

(Kepner et al, 1978)

Many different types and configurations of threshing devices have been deviced, but very few have reached the stages of even limited field use. The three types generally employed in present-day combines are cross-flow rasp-bar cylinder, axial-flow rasp-bar cylinder, and spike-tooth cylinders.

Cross-flow rasp-bar cylinder and spike-tooth cylinders are available interchaneably, Most cross-flow rasp-bar cylinders have open-gate concaves with rectangular bars parallel to the cylinder axis. The clearance between the concave bars and the corrugated cylinder bars is adjustable. In cereals the main threshing effect results from the impact or shattering action of the cylinder bars hitting the heads at high speeds. Although rubbing undoubtedly contributes to the threshing action, the primary function of the concave appears to be holding or bringing the material into the cylinder-bar path for repeated impacts.

The arrangements of spike-tooth cylinder and concave is such that the cylinder teeth pass midway between staggered teeth on the concave, thus producing a combing action in addition to the high-speed impacts upon the heads. The tooth cylinder has more positive feeding action than rasp-bar cylinder and requires less power.

2.4 Paddy Thresher

2.4.1. Manually operated paddy threshers

The mechanical equipement used for manual threshing in the pedal thresher that originated in Japan during the early stages of mechanisation. This thresher is also popular in Taiwan where a threshing team of 5-7 men work with each machine. The screw moves in a circle, while one or two men are threshing, the others collect and bring new paddy bundles. The cylinder rotates at about 300 rpm and the inertia of the cylinder keeps the drum rotating as men take turns at pedalling the machine. There is no cleaner with this thresher. Test at International Rice Research Institute (IRRI) with this thresher indicate an output of about 30-70 kg of paddy per hour. In Taiwan, 60-65 man-h-per ha are required for threshing with a pedal thresher, which gives an approximate output of about 50-80 kg/hr (Michael Graham et al, 1976)

The thresher which can be operated with the help of bicycle is also available. It has a capacity of 91 kg/h (Kherdekar, 1967)

2.4.2. Japanese Power Threshers.

These machines are equipped with a wire loop threshing drum and regular cleaning and winnowing mechanisms. Due to the hold-on method of feeding, output is not too high, but the machine can do a good job of grain cleaning. Relatively high labour is required because the paddy bundles have to be held by the operator until threshed. Gupta (1963) reported the visible and invisible seed damage with this type thresher in test conducted in India on Aman paddy.

Both single and double drum threshers are offered by Japanese manufacturers. These machines can be operated either as hold-on or throw-in threshers. Experience with the double drum thresher in Philippines indicates that it is quite well suited for threshing both wet and dry paddy and other agricultural crops such as wheat and sorghum.

2.4.3. Self feeding automatic threshers.

These machines are similar to the non-automatic thresher except that these machines are equipped with paddy gripping feed chains that automatically feed the paddy in a continuous layer. The threshing output is high and the machine reqiure less labour.

Test at IRRI on a Japanese automatic thresher equipped with a 4.2 hp engine indicated an output of about 200 kg/h with these operators. (Araullo et al, 1976)

2.4.4. Through-flow threshers.

In this type of thresher, paddy plants are completely fed into machine. This machines are eqiuped with threshing cylinder and concave and have some seperating and cleaning machanisms. The rasp-bar cylinder was previously considered siutable for rice, however, all of the new rice threshers and combines are eqiupped with spike-tooth cylinder. The spike-tooth cylinder can operate without clogging even with large amount of straw at a fairly high moisture content and the grain is subjected to lower intensity impact forces resulting in lower grain damage.

Large McCormick-type of threshers widely used for custom threshing in Philippines. These threshers are exact copies of the old threshers that are developed 50-70 years ago in Europe and America. Many small machineshop fabricate this machine in Philippines. A major portion of paddy in the Philippines is custom threshed with these threshers. These threshers are belt driven from 45000 W (60 hp) tractor P.T.O. pulley. Usually a crew of 8-12 men operates this machine, which thresh about 20-30t of paddy per day. Because of the high threshing capacity, the machine is moved often, which results in substantial down time. This type of thresher is equipped with an elevator feeder mechanism.

2.4.5. Axial- flow threshers.

The axial-flow thresher, which combines threshing with air and screen cleening mechanism, was developed by IRRI. It is lightweight and is mounted on wheels to provide good mobility in either wet or dry soil. It can be pulled behind a small hand tractor, a jeep, or a truck.

The machine consists of a steel cylinder equipped with peg tooth. The fins on the upper concave are positioned spirally to move the material axially to the discharge end. A blower is located under the concave, which winnows the chaff and empty grain that fall through the concave. An auger collects and conveys the winnowed grains to a rotory screen sieve. This sieve separates pieces of straw that pass through the perforated concave and that are not blown by the air from the full grain. The grain from the screen sieve drops to a trough and is then conveyed by elevator flaps to the bag.

The thresher is powered by a 7 hp air-cooled engine, and can handle freshly harvested paddy with good separation and cleaning performance. The operation requires three men to feed,thresh,and bag the paddy, and the output is 1 t/h. Because of the simplicity of design there are few operation and maintanance problems.

In this type of threshers the crop rotates between the

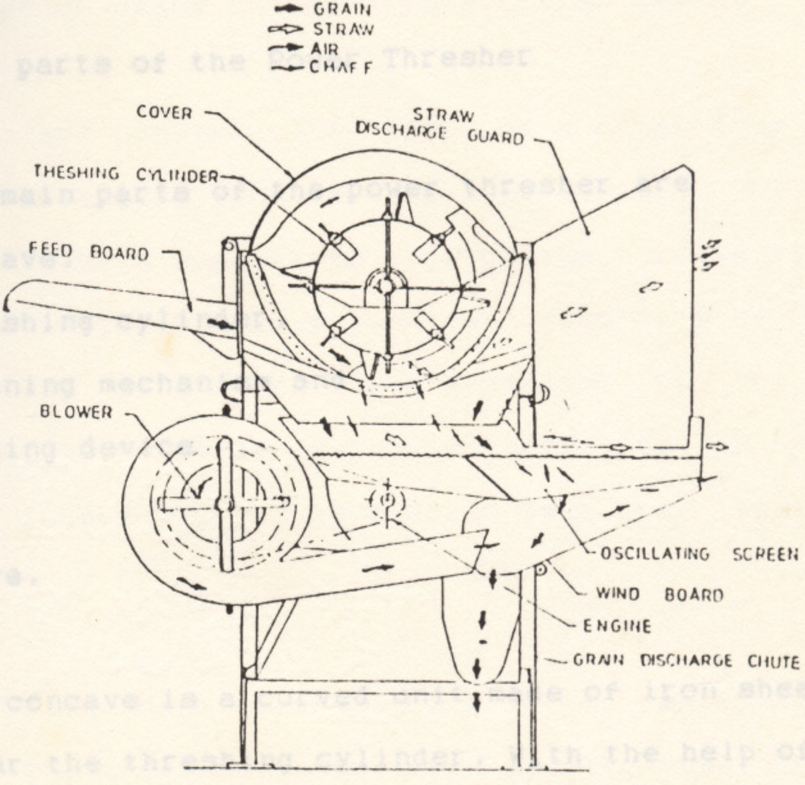


Fig. 1 : Schematic diagram of Axial flow thresher.

concave and cylinder two ort three times before throwing out the straw. The crop moves axially parallel to the axis of the cylinder.

2.5. The main parts of the Power Thresher

The main parts of the power thresher are

1. Concave,
2. Threshing cylinder,
3. Cleaning mechanism and
4. Feeding device

2.5.1. Concave.

The concave is a curved unit made of iron sheet or iron bar fitted near the threshing cylinder. With the help of concave the grains are seperated from the straw. The clearance between the cylinder and concave is adjustable depending upon the size and type of grains.

The main types of concaves used are open-gate concaves with rectangular bars parallel to the cylinder axis and spike-tooth concave. The teeth in the spike-tooth concave are mounted on perforated, removable sections, usually with two rows of teeth per section.

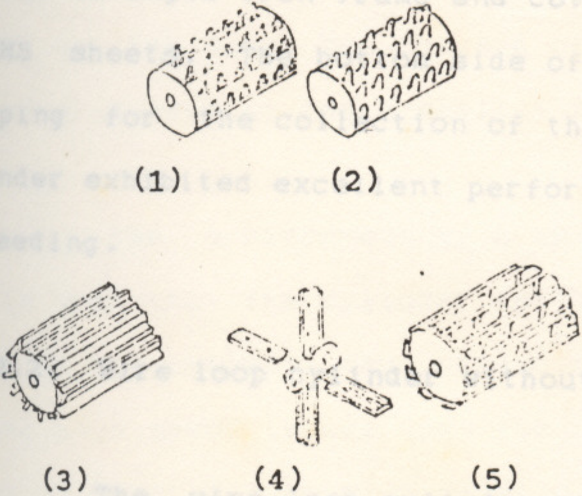
Increasing the concave length increases the seed seperation efficiency at a diminishing rate. Increasing the concave length increases the straw break up and tended to increase seed damage, especially with low moisture contents and high cylinder speeds. Under easy threshing conditions there was little advantage of using concaves longer than 300mm.

Neal and Copper (1970) compared a cross-flow rasp-bar cylinder and open gate concave with a spike-toth cylinder and concave regard to seed separation through the concave gate, using rice in laboratory tests. At a non-grain feed rate of 90 kg/mh, approximately 72% of the grain was separated by the rasp-bar concave gate but only 50% by the spike-tooth gate. A spike-tooth concave gate inhereatly has considered less open area than a rasp-bar gate.

The dimensions of the cncave significantly affect the threshing of the crop, grown spillage and the break up of the straw. When the length of the concave increased, the undermilling decreased. A longer concave increased grain spillage, reducing grain loss and load on the straw racks.

2.5.2. Threshing Cylinders.

The threshing cylinder is the most important component of a thresher. There are five type of threshing cylinders commonly used in the country (fig. 2). The commonly used threshing cylinders for paddy thresher are



1. Peg.
2. Loop.
3. Angle iron.
4. Hammer mill.
5. Rasp bar.

Fig. 2 : Types of threshing drum.

1) wire loop cylinder with concave,

2) wire loop cylinder without concave,

3) rasp-bar type and

4) peg-tooth (spike)type.

2.5.2.1. Wire loop cylinder with concave.

It consists of a wooden threshing drum with wire teeth. The teeth in the 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 slopping for the collection of threshed grain. The wire loop cylinder exhibited excellent performance with the hold-on method of feeding.

2.5.2.2. Wire loop cylinder without concave.

The wire loop cylinder without concave is similar to wire loop with concave,the only difference is that the concave is avoided.

2.5.2.3. Rasp - bar Cylinder.

In rasp-bar cylinders, groved beaters (rasps) are mounted parallel to the drum axis.

Some multicrop threshers having rasp-bar type cylinder are being used for thresjing paddy in some pockets of south India where the paddy crop can be reasonably dried before threshing. These rasp-bar type threshers have problems like low threshing efficiency, loss due to unthreshed grain going out with the straw, and choking of threshing cylinder, when used for threshing wet paddy crop without drying.

2.5.2.4. Peg-tooth cylinder type.

In spike-tooth drums (cylinder), spikes (teeth) are fixed on the bars. The concave of the spiked thresher is also fitted with pegs or teeth similar to those on the drum.

The arrangement of a spike-tooth cylinder and concave and is such that the cylinder teeth pass midway between staggered teeth on the concave, thus producing a combing action in addition to the high speed impact upon the heads. The concave assembly is adjusted laterally to give equal clearances on both sides of the cylinder teeth. The amount of radial overlap of the cylinder and concave teeth is adjustable. The lateral clearance is also changed slightly by this adjustment, since the teeth are tapered.

The teeth in the spike-tooth concave are mounted on perforated, removable sections, usually with two rows of teeth needed in the concave (usually 2,4 or 6) depends upon the crop and the threshing conditions. Perforated blank sections or grid-type grates are added to fill the concave space.

Test at International Rice Research Institute (IRRI) indicate that the spike tooth cylinder performs well both with the hold- on and its threshing quality is less affected by changes in cylinder speed.

A spike-tooth cylinder has a more positive feeding action than rasp-bar cylinder, does not plug as easily, and requires less power. (Kepner et al, 1978)

2.5.3. Cleaning Mechanisms.

The cleaning unit mainly consists of a fan and an air sucking duct known as aspirator and oscillating seive. The cleaning of grain involves the separation of bulk straw, chaff, empty kernals and very light and fine impurities from the grain. In the simplest form, straw amd chaff is manually separated and the grain is dropped through a cross wind to remove impurities that have different aerodynamic properties from the grain. Many different grain cleaning systems are used in threshers, depending mostly on the type of feeding method and the threshing capacity. In the throw-in type of thresher, a large amount of straw is handled through the machine. These machines use straw walkers to initially seperate the loose grain from the large bulk of straw and chaff. A chaff screen is used tc seperate chaff from the grain before the finer impurities are removed by an air blast. In the hold-on type of thresher, a major amount of straw does not pass through the machine and only the removal of the chaff and light materials from the grain is necessary. (Araullo et al, 1976).

2.5.4. **Feeding devices**

The feeding device is a part of the power thresher through which crop is guided to the threshing cylinder during threshing. Feeding devices used for thresher could broadly be classified into five types. They are,

(i) Chute-type feeding system

(ii) Hopper-type feeding system

(iii) Feeding system with positive feed-rollers and feed-reversing mechanism.

(iv) Conveyor feeding system, and

(v) Chain type feeding system (Varma et al, 1979).

2.5.4.1. Chute-type feeding system.

A good feeding chute should afford proper safety to the body parts of the operator, require minimum effort to feed the crop, ensure proper flow of material, eliminate back-feeding/scattering of material and be easy to manufacture and mount on the thresher. It whould have no shart corners, edges and protruding parts like nuts and bolts to eliminate chances of injury to the operator (s). It should be strong enough to prevent bending our bulging of the feeding device due to the weight of the material being fed and pressure of the hands/limbs of the operator while feeding the material.

An improved design of the feeding chute for proper safety, as already included in Indian Standard, is indicated in fig. 3. The dimensions of the feeding chute for hammer-mill

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An improved design of the feeding chute for proper safety, as already included in Indian Standard, is indicated in fig. 3. The dimensions of the feeding chute for hammer-mill and prike-tooth type threshers of various power ratings are indicated in tables.

2.5.4.2. Hopper -type feeding system.

The hopper-type feeding system can be used on any thresher which requires radial feeding of the material. This system is not practical for threshers with axial-feeding for obvious reasons. It, however, has advantages over the feeding chute when the width of the threshing cylinder is sufficiently large, say, 40cm or more, as in that case, the crop can be fed into the hopper by aligning the stalks along the axis of threshing cylinder. This is particularly true for cereal crops like wheat, barley, oats, etc. This system should, however, preferred over the chute system for threshers used for earhead threshing, especially for such crops like jowar, bajra, sunflower, etc. Other factors being equal, this system is undoubtedly a safer system. There is hardly any possibility of the occurance of an accident on this type of thresher unless an operator delibrately steps into the feed-hopper. This system is ideally suited to spike-tooth threshers of high output capacity as the material can be fed with greater care and efficiency to achieve higher through-put capacity. Another advantage of this system is that it forms an integral part of the thresher and it is not possible to detach it under any circumstance. Hence, the safety is in-built in a thresher with hopper-feeding system.

The important parameters for the hopper-feeding system are indicated in Table.

2.5.4.3. Feeding system with positive feed-rollers and feed-reversing mechanism.

This system is used on syndicator-type threshers. It comprices a feed- pressing roller, two corrugated feed-rollers, a gear-box for feed reversing, clutch lever, a joining shaft with universal joints as well as the power transmission system.

In this system, if the hand of the operator gets entrapped in the feed reversing mechanism the clutch lever is pressed by his hand/shoulder and the drive to the feed rollers is cut off in the neutral position or the direction of the upper and lower feed rollers is reversed. The specifications of the system are in Table.

The provision for a feed reversing device affords proper safety to the operator. The feeding system with positive feed rollers with or without feed-reversing mechanism is used both with a feeding-chute as as well as with a feed conveyor. The conveyor system is better though costlier.

2.5.4.4. Conveyor-feeding system.

This consists of a canvas or chain-conveyor. It is one of the oldest systems which has been extensively used on the threshers in the western countries. This system is now used in spike-tooth and rasp-bar type threshers also, apart from the syndicator type threshers.

The width of the chain / canvas conveyor normally coincides with the width of the threshing cylinder. Fenders are provided on both sides of the chain / canvas conveyor to prevent side spilling of material. It is recommended that at least 45cm length of the conveyor adjacent to cylinder should be covered from above to eliminate possibilities of the hands of the operator coming in direct contact with the revolving members of the thresher.

2.5.4.5. Chain type-feeding system

The chain-type feeding system has been widely used on Japanese paddy threshers of head-feeding type . This system is also not suited to threshers with high out put capacity. It is unlikely that this system will have much prospects of as adaptability to paddy threshers in India as all the threshers currently in vogue in the country require the whole plants / earheads to be fed into the thresher.

Table.1. Dimensions of Chute for Hammer-mill, Drummy and Syndicator type Thresher.

Sl. No.	Size of the prime mover for thresher kW (hp)	Dimensions (mm)							
		A	B min.	C	D min.	E	F	degree	degree
1.	3.7 (5)	500	900	350	450	50	125	10-15	25-30
2.	5.5 (7.5)	550	900	400	450	60	175	10-15	25-30
3.	7.5 (10)	600	900	450	450	60	190	10-15	25-30
4.	11 (15)&above	650	900	500	450	60	200	10-15	25-30

Dimensions A,C,E and F are recomendatory and are given for guidance only.

Table.2. Dimensions of chute for Spike-tooth Thresher.

Sl. No.	Size of the prime mover for thresher kW (hp)	Dimensions (mm)							
		A	B min.	C	D min.	E	F	degree	degree
1.	3.7(5)	440	900	350	450	60	190	10-15	25-30
2.	5.5(7.5)	480	900	400	450	60	190	10-15	25-30
3.	7.5(10)	540	900	480	450	60	190	10-15	25-30
4.	11(15)&above	590	900	530	450	60	210	10-15	25-30

Dimensions A,C,E and F are recommendatory and are given for guidance only.

Table.3. Dimensions of Hopper Feeding System.

Sl. No.	Size of the prime mover for thresher kW (hp)	B min.	C min.	D min.	E min.	F	G	K	degree
1.	7.5(10)	900	180	900	340	550	475	350	50
2.	11(15)	915	200	910	370	575	500	350	50
3.	15(20)	930	220	920	400	600	535	350	50
4.	18.7(25)	950	240	930	430	625	565	350	50

Note:- (i) Hopper feeding system is normally used with threshers of 7.5 kW(hp) or more power rating.

(ii) The dimensions F and G are recommendatory and are given for guidance only

Table.4. Specification of Power Transimission System for Feed Reversing Device for Syndicator Type Threshers.

Sl. N	Name of the gear	Type of gear	No: of teeth	Diameter (mm)	Mounting Shaft
1.	A	Bevel helical Pinion	8	70	Drive shaft
2.	B	Bevel helical Gear	39	195	Counter shaft
3.	C	Spur	43	163	Upper shaft
4.	D	Spur	33	127	-do-
5.	E	Spur	33	127	Lower shaft
6.	F	Spur	43	163	-do-
7.	G	Spur	24	93	Counter shaft

The development of thresher in India started principally for threshing of wheat with the introduction of olpad thresher in 1940 s. The concept of olpad thresher was borrowed from threshing rollers, chopping roller threshers and Egyptian threshing carts.

Much development took place after independence and in mid 1950 s, the first indigenous commercial power thresher was developed by a private manufacturer 'Friends Own Foundry', Ludhiana which is popularly known as 'Ludhiana Thresher'. The thresher threshed, cleaned and facilitated bagging in 1957, the

Indian Council of Agricultural Research (ICAR) honoured the inventor of Ludhiana Thresher. The thresher employs the hammer_mill principle.

It remained popular until 1970 s, but phased out with the development of other efficient and cheap threshers. These threshers were exported to neighbouring countries like Pakistan, Bhutan and even to Oman.

After the acceptance of power threshers in mid 1950 s, there was a sprut in evaluation of foreign designs and development of local threshers. In 1965-'66, a 'Drummy' thresher was developed in Punjab which is simple in construction and is in a position to thresh and winnow the wheat. It did not have any sieving mechanism, but simply a threshing cylinder, concave and a blower.

Due to its simple construction and low cost, it became quite popular. But cleaning is poor in this type of threshers. Later research and development (R & D) carried out at Allahabad Agricultural Institute under a Ford Foundation funded project developed a 5 hp unit, which was later commercialized under the trade mark 'Sherpun Thresher'. This thresher has a theshing drum with spikes in studs which acts as a beater, concave made up of square bars, aspirator for sucking chaff and an oscillating mechanism for sieves for seperation of grain from large flywheel.

This thresher is capable of producing fine 'bhusa' which is acceptable by the farmers. Besides this, the thresher is capable of threshing other crops like sorghum,maize, pearl millet, gram, soyabean etc. in addition to wheat. This type of thresher with minor modification is most common and still popular with Indian farmers and manufacturers.

The thresher described above are usually designed for dry crops and in threshing high moisture crops, clogging is a usual phenomenon. In order to overcome this problem, a thresher brand named as 'Syndicator' or 'Toka' type thresher was developed in Punjab, which is essentially an adaptation of chaff cutter. Stakes are fed into threshing chamber, and chopped by 2 to 4 serrated blades fastened on radial arms of the flywheel. Chopped material is rubbed between the concave and flywheel by corrugations or burrs on the flywheel rim. Additional beaters provide impact. Threshed material is cleaned by an aspirator and oscillating screens. These type of threshers became popular due to their high output and were in a position to thresh high moistured crop as well. But due to unsafe operation, their use has decreased. This type of thresher is suitable only for the wheat crop.

After these development, the research on thresher is continuing in various research organisations and universities as well as at manufacturers level. Some of the prototypes, fabricated and evaluated, are as follows.

Bennet et al (1970) reported about the Mysore minithresher, a low cost machine requiring about 3hp. It gave an output of 6 quintals of paddy per hour. But, cleaning is poor in this type of threshers.

Khan (1971) reported that a table type thresher with a capacity of 250 -350 kg/hr was designed at the International Rice Research Institute (IRRI).

Hota et al(1972) designed a set up to compare the operators comfort in threshing.Paddy using two power application modes. It was found that the rotary mode for threshing paddy was more comfortable to the operator and also gave better outturn.

Nirmal and Sirohi (1974) reported that a Pusa-40 thresher was developed at Indian Agricultural Research Institute (IARI), New Delhi. It had a spike tooth cylinder with an overshot concave, cleaning shaker, blower and auger. A bhusa making attachment was designed and developed seperately. This attachment had a conveyor for feeding long straw from the thresher into bruising drum. The capacity of Pusa-40 thresher (without 'Bhusa' making attachment) was 200Kg of grain per hour when operated by a 5hp motor. This thresher is suitable for threshing wheat, paddy, barley, soyabean and sunflower. The machine was relatively complex, costly and difficult to install with the Bhusa making attachment.

Prakash (1979) designed a pedal operated multicrop thresher which was tested for paddy and wheat. It was reported that at the peripheral velocity of 750m/min. and with peg height to tip clearence as 6/3.2 cm, the paddy output was 140 kg/h.

Ahuja et al(1979) reported that the axial flow threshing principle was developed at International Rice Research Institute(IRRI),Manila and used for threshing paddy. attempts were made to modify this design for threshing wheat and also to get fine straw.Prototype of this machine was developed. The machine consisted of a threshing cylinder and aspirator blower. Threshing cylinder had two portions namely threshing seperation / bruising. It had a grain output on an average of about 294 kg/h for wheat crop and power requirement of 5hp electric motor. The grain output of the machine on paddy was 500 kg/h when driven by a 5 hp electric motor.

Majumdar (1979)reported that a spike-tooth 'Naini' design was designed and developed at Allahabad Agricultural Institute, Allahabad (India). spike tooth thresher(Naini design) had a spike tooth theshing cylinder and an aspirator blower mounted on the shaft. A reciprocating sieve was provided for proper cleaning of grains. It can be used for threshing gram by providing a concave with bigger size opening. Soyabean could not be threshed with this thresher because at low speed choking was observed whereas at higher speeds grain damage was quite high. Therefore, it was considered desirable to provide the blower on a seperate shaft from that of the threshing cylinder so that the threshing speeds can be varied independently for various crops and crop condition.

Singh et al(1980) reported that a multicrop thresher developed at University of Agriculture and Technology, Pantnagar for use on wheat and paddy crop. The thresher has the axial flow system for paddy. A reciprocating sieve set and two blowers were provided for separation and cleaning, Ribber surface was filled in cylinder casing louvers while threshing wheat for making fine 'Bhusa'. These could be easily removed while handling paddy. The IRRI-PANT thresher when operated by a tractor of about 30hp gave 400 kg/h of wheat and 1200 kg/h of paddy.

Majumdar (1982) reported that a multicrop thresher was developed at Cental Institute of Agrl. Engg.(CIAE),Bhopal for crops like wheat,paddy,soyabean,gram etc.The machine has an axial flow threshing cylinder and an aspirator blower on different shafts. The provision for Bhusa making is similar to the IRRI-PANT thresher The cylinder length is short which is suitable for short paddy varities only.(about 60-65cms).

Majumdar (1982) reported that a Jyoti design was manufactured by M/s Jyoti Ltd, Broada. It has a threshing cylinder and aspirator blower mounted on different shafts. Reciprocating sieves were provided for different crops in spike tooth type thresher (Jyoti design). This machine also has a secondary blower. The capacity of Pusa-40 thresher (without 'Bhusa' making attachment) was 200 kg of grain per hour when operated by a 5 hp motor. The thresher was suitable for threshing wheat, paddy, barley, soyabeen and sunflower. The machine was relatively complex, costly and difficult to install with the 'Bhusa' making attachment.

Sharma et al (1983) reported that a high capacity multicrop thresher using raspbar cylinder,straw walker, chaffer and blower was developed at Punjab Agricultural Universitiy(PAU), Ludhiana wheat staw bruising attachements developed for this thresher consisted of spike tooth type drum and aspirator blower. The straw bruising attachements was not used while handling paddy or maize.An average power requirement in the range of 4.5- 9.2 kW for wheat bruises was expected corresponding to this power a throughput capacity of 1430 to 2400 kg/h was expected. The maximum output of this thresher was 800 kg/h for wheat, 1200 kg/h for paddy and 3000 kg/h for maize with husk. The machine losses were within the acceptable range. The cost of this machine was higher than the combined cost of wheat and paddy threshers. Besides, the machine was very bulky and posed problems in transportation and installation.

Sharma et al(1984)reported that a multicrop thresher which combined the salient features of the axial flow threshing system and traditionally used wheat threshing system was developed at the Punjab Agricultural University (PAU), Ludhiana. The prototype developed uses the axial flow system for paddy and the traditional spike tooth threshing system for wheat. THe machine consisted of a threshing cylinder, casing with louvers, an aspirator blower and a reciprocating sieve. The direction of rotation of the threshing cylinder is opposite while handling paddy and wheat. Grain output on wheat was 400 kg/h and 800 kg/h for 5 hp and tractor operated 25-30hp threshers respectively. Output of the machine on paddy was affected greatly by the length of straw and moisture content of the crop.

Majunder (1985) reported that a multicrop thresher was designed and developed for threshing wheat, Bengal gram, sorghum , maize and paddy. The prototype of the machine was developed in 1982 and evaluated during 1982-1985 on diffrent crops and neccessary modifications incorporated. The output of the machine for the above crop was 276, 348, 200, 540, 1635 and 392 kg/h respectively. For sorghum the earheads were fed and for maize dehusked cobs were fed. The threshing efficiency for the said crops were 99.00, 99.22, 91.90, 99.00 and 99.10 % respectively. The cleaning efficiencies were a little less for Bengal gram, soyabean, and paddy than ISI standards. The total grain loss ranged from 0.62%(for wheat) to 4.01% (for soyabean). The rate of loss was lowest for wheat and highest for soyabean.

It has been reported that IRRI was developed a portable thresher at the Agricultural Engineering Department, which was simple, easy to manufacture and operate, light in weight and portable for easy movement to the field on existing pathways. This machine was a smaller version of the IRRI axial flow thresher.It retained the throw-in and hold-on features and axial movement of the material inside the thresher which provided high threshing efficiency over awide range of moisture levels. It was driven by a 5 hp gasoline engine and had a capacity of 600 kg/h depending on crop condition. (Anon.1985.).

Majumdar et al. (1985) developed a low cost high capacity paddy thresher by incorporating IRRI axial flow arrangement and spike tooth type cylinder. The design consited of punched triangular spikes on cylinder and woven wire mesh concave at the bottom of the cylinder. Deflection louvers, were provided on upper concave to move crop from one end to the other end of the cylinder while threshing. The long straws were thrown out of the cylinder by a straw thrower and grain with little chaff fell through the concave and directed towards the air blast by a blower mounted under the threshing drum.The capacity of thresher was 434 kg/h clean grain at cylinder speed of 480 rpm and grain straw ratio of 1:2.3. The threshing efficiency was 99.99% and grain damage was negligible. The grain loss in the straw was 1.3%. The cleaning efficiency was 85%. The machine was operated by a 5 hp electric motor.

Duff,B. (1986) reported that developing and extension of the IRRI designed axial flow thresher led to its very rapid adoption among rice farmers in Thailand and Phillippines begining in 1974. Made widely available to local manufacturers in both countries, the machine were profitable to own and easy to use compared to traditional threshing methods. Devlopement of contract services were rapid and wide spread. Significant - reduction in threshing labour were found in both the countries,and slight output grains were observed in Phillippines.IRRI invested $1.5million in developement and extension of this thresher,or 2.6%of the value of machines sold during the same period. Returns to investment in engineering design of the thresher were high, but lower than funds expected at IRRI for varietal improvement and management research. Policy-induced economic distortions in exchange rates and credit policies that affected adoption of the thresher were minor in Thailand, but significantly increased the private profitability of the machine in Phillippines.

Shi,T.S.(1986) reported that the NRIAM (Nanjing Research Institute For Agricultural Mechanisation), created in 1956, continues to play a leading role in designing, developing and introducing motorized machinary in China's rice producing sector. The major achievements in this sphere to date are outlined. These include (i) A mechanical transplanter, in the form of an engine driven, single wheel, six row unit with hinged bottom boards, also known as the 'Dong Feng-25' mechanical transplanter and (ii) the developement of special wheels and tractors,suited to the sticky soils of rice farms of China. NRIAM has also played an active role in design and developement of reaper type harvesting and threshing machines, as well as crop protection machinary. Its current preoccupation is the introduction of motorized machinary in rice farming, to counteract labour shortfalls created by growing rural- urban population outflow in China.

Duff,B. (1986) reported that in both Thailand and the Philippines there has been a rapid shift from traditional to mechanical threshing techniques over the past 10 years. The technical basis for this change was the development and extension of the axial flow thresher by the International Rice Research Institute in the Philippines. The story of the machine's development and promotion through an international network of public institutions and private manufacturing enterprises provides the major focus of the chapter of particular interest are the factors which persuaded the Institute to invest resources in engineering development activities. To evaluate the adoption patterns and the farm-level impact of the axial flow threshers, field surveys of the thresher owners, uses and non users were undertaken at two sites in the Philippines and two sites in Thailand. A total of 370 farmers were involved. The output and distributive effects of the mechanical thresher on farmers, hired labour and mechanical through backward linkages, on employment and income in the nonagricultural sector are examined. The financial profitability of the thresher is evaluated, as well as how this has been affected by changing resources and product prices, utilization levels, the stock of machines and the institutional arrangements for contact services. The polices and public sector programmes which have affected acceptence and diffusion of the axial flow thresher are investigated.

Singh,M.P; Takur,T.C.and Bachan Singh (1987) developed an animal powered unit to operate various rotary powered systems,eg.thresher,chaff-cutter, oil expeller,flour mill,feed grinder,etc. It is based on mecanical gear reduction unit driven by a pair ofanimals. Preliminary tests of the unit while operating a loop type paddy thresher gave encouraging results. The cost of threshing and cleaning was Rs.6.37 / quintal of grain, compared with Rs.4.62 / quintal for manual threshing. The physiological responses of the animals (temperature, respiration, pulse) were well within the maximum capacities and the animals showed no signs of fatigue over two hours of continuous operation.

Hayami,Y.,Marciano,E.B; Bambo,L.M. (1988) reported that the major changes in harvesting system in 1988, in the difficult provinces and municipalities of Central Luzon and Lagnna are discussed. Rice threshing in Central Luzon is now dominated by portable axial-flow threshers. The regional distribution of the Upahan(fixed daily wages) Pakyan (area-rate) and Hunasan or Gama(crop-share) types of labour contracts has experienced little change.

Annamalai et al (1989) reported that a straight through peg tooth type thresher (Model IEP-2) was designed and developed at cental Institute of Agrl. Engg. (CIAE) - International Rice Research Institute (IRRI) Industrial Extension Project, Coimbatore, Tamil Nadu. The salient features of the thresher are its threshing efficiency of 99.98%, output of 640 kg/h, cleaning efficiency of 98.00%, low cost, $765 and low power requirement (6hp). The straw coming out of the thresher was almost of full length.

Garg et al.(1989) developed a high capacity axialflow paddy thresher and tested the applicability of the machine for threshing of sunflower at Punjab Agricultural University, Ludhiana. The output of the machine was 6 to 9 q/h with feed rate of 14 to 21q/h. The cylinder speed was 12.49 to 12.90m/s. However, the detailed study for determining the losses etc. could not be undertaken.

Dash,S.K.,and Das,D.K (1989)designed and developed a rice thresher,powered by a 1 hp electric motor and aimed at increasing threshing efficiency and reducing costs are described. Higher output and maximum threshing efficiency were achieved by threshing the rice crop at 16.5% m.c, at a peripheral velocity of 622 m/min . Threshing costs were 0.67% less than those for rice threshed by a pedal thresher.

Paunov et al (1989) made an analysis of existing designs of threshing machines for separated ears and experimental investigations were carried out. On the basis of known designs the MKS 1M threshing machine was developed in Moscow, USSR, on which experiments were conducted in Bulgarian conditions. result showed that this threshing machine satisfied agrotechnical requirments and its inclusion in selection and experimental work in Bulgaria was recommented.

Singh,M.P. and Thakur,T.C.(1990) developed an animal power system to operate various rotory powered machines such as a loop type paddy thresher, a groundnut decorticator, a maize sheller and other similar machines. The heart of the complex is a mechanical gear unit which increases the output shaft speed by 57.5 times, and is driven by a pair of buffaloes. The thresher output was 238 kg/h. The cost of threshing and cleaning with the thresher was found to be Rs 6.37 per 100 kg compared to Rs 4.62 manualy. The use of the thresher driven unit gave about 7 times more output compared to manual threshing, showing a substantial amount of time saving. The cost of operating this machine could further be reduced while using the animals during lean period.

Khan,A.V. (1990) reported that the special beater-type thresher are used in many developing countries for simultaneous threshing of wheat and tenderizing of straws for use as fodder.However,these threshers cannot thresh crops with tough straws and cobs such as paddy, sunflower,sorghum etc. which are grown in rotation with wheat. A dual- mode thresher was developed in Egypt which can be converted from beater to axial flow operation for threshing all the crops that are popularly grown in developing countries.

Khan,A.V.(1990) developed a machine which can be quickly converted in the field from a beater type mechanism for threshing wheat to an axial flow method for threshing paddy. The main features of the machine are dual concaves one of perforated sheet metal for wheat threshing, a bar type concave to block it when threshing wheat, an adjustable set of axial flow louvers which can be set at 90degree to the drum axis for beater type operation when threshing wheat and at 70degree for axial flow operation for paddy threshing;a hinged partial cover in the feed opening to permit full width feeding of wheat when in beater threshing mode. Improvements are being made to the prototype machine and it will be tested on all major cereal crops grown in Egypt.

James, Ma(1991) reported about a new vertical axial flow threshing machine, which was developed in China. It had a vertical cylinder with a 360 degree concave with high seperating efficiency. The design also adopted a pneumatic cleaning system which consisted of an air suction fan, a dispersing blade wheel and a circular vertical air duct in the outer layer of the threshing machine. The threshed materials passed through the circular concave and fell to the dispersing wheel. The impurities were lifted by an air stream and drawn out through the vertical air duct by a suction fan. The entire process of threshing, seperating and cleaning were accomplished within a vertical sheet metal of cylindrical body. The machine was simple and compact and had a pottential as the threshing unit for developing a tractor mounted low cost combine.

A new vertical axial flow threshing machine was developed. Some design were outlined . The machine is simple and compact and has potential as a threshing unit for developing a tractor mounted low cost combine.

Datt, P. and Annamalai, S.J.K (1991) designed and developed a peg tooth type thresher for paddy farmers in all regions of India. It had a threshing efficiency of 99.98%, output of 640 kg/h, cleaning efficiency of 98%, low power requirement (6 hp) and low cost ($ 765). The straw came out of the thresher almost at full length, as required by the farmers. The design details and performance data are discussed.

Dniyer et al (1991) reported that the bi-rotor cylinder, a new concept in combine harvester threshing cylinders was developed and tested. It utilizes an axial flow cylinder rotor and a 360 degree concave that rotates at a slower speed. Laboratory experiments were conducted to select the best combination of rotor and concave speed to achieve maximum threshing, grain separation and straw elimination. A bi-rotor unit installed in a 1480 CASEIH combine harvester was tested on wheat,maize and soyabeans results with the first prototype were very promising.

Phan Hieu Hien (1991) reported that development of Axial-flow Thresher (AFT) was introduced to Southern Vietnam in 1974 by the Vietnam Agricultural Machinery Co, (VIKYNO) through fabricating 50 units from IRRI drawings. Since then, farmers and mechanics in the Mekony Delta provinces have adopted the principle to local condition. The main modifications have been different shapes and cleaning systems. It is estimated that in 1988, there were about 50000 units in Vietnam, produced by hundreds of small scale manufacturers. From the development of AFT in Vietnam, the lessons and experiences learned for promoting a new machine are,

(i) The machine should satisfy farmers needs,

(ii) There should be an efficient prototype for farmers and mechanics to initiate and the machine should be compatible with locally available skills and materials and local land and field conditions,

(iii) The cost of machine used must be lower than equivalent mannual work and

(iv) Extension activities should be conducted in such a way that people in all provinces engage themselves in fabrication and using the machine.

Anvarul et al (1991) conducted a study to observe the rice post-harvest practices and to estimate the losses occuring in the country from threshing through sundrying operations. The post-harvest practices studied were threshing by hand beating, ox-treading,use of pedal threhsers, hand beating followed by ox-treading; cleaning of threshed paddy by winnowing basket "Kula" and sundrying of unparboiled paddy on packed ground, bamboo mat at courtyard and on road side.

The total loss estimates from threshing through sundrying varied between 3.1 to 4.0 % in three seasons studied with a weighted average of 3.5 %. This was equivalent to 0.7 million tone actual paddy loss. The 'Aus' season observed highest loss while 'Boro' season had the least. Loss in threshing and winnowing operation did not exceed 1 % except in hand beating with 1.6 % weighted loss.

Threshing by hand beating followed by ox-treading and pedal threshing experienced similar loss but the former method was more time consuming. Drying loss estimate was high (2.2 %), which was probably due to encroaching and eating by domestic animals and birds and small quantity of paddy dried by the farmers.

Preman,P.S et al (1991) designed, fabricated and tested a hold-on type power paddy thresher at K.C.A.E.T.,Tavanur,Kerala, India. The machine consist of a wire loop cylinder,feeding tray, cylinder cover,blower and frame. The power taken from a 2 hp electric motor. The capacity of the thresher at 16.7 percent moister content was 217 kg paddy per hour. Threshing and cleaning efficiencies were 98.3 and 88.53 percent respectively. The optimum speed was 420 rpm.

Wanderers (1991) developed a tangential flow thresher for small holders wetland rice region in Africa and Latin America. Requirements for the design concept were portability for a wide range of condition, both in field threshing of wet and dry, long or short rice crops, robust, ability to thresh other crops by interchangeable elements, suitable for assembly and manufacture in developing countries. The working principle of the thresher is explained with diagram. An air stream generated by the drum-fan supports the flow of crop through and out of the thresher and out of the thresher. The relatively high circumfrential speed of the spike teeth (16-23m/s) and the long concave of the drum-fan produces complete threshing. 85% of the grain is separated through the long concave, while 15% is collected on a cloth placced behind the thresher. The machine can produce 400-800 kg grain/h or 2-5 tonnes/day with a field efficiency of 65-75% depending on the work organization.

Okram Basudev Singh (1992) reported that the maximum output of the hold on type power paddy thresher developed at K.C.A.E.T., Tavanur, Kerala, India was 307.16 kg/h. The optimum peripheral velocity was 719.99 m/min. at a moisture content of 16.7% (w.b.) and the threshing efficiency was 98.45%, the highest.

Umeda,M.(1992) conducted an analysis of the threshing mechanism for a Japanese type head feeding combine. The detachment process in the threshing cylinder is described using reliability engineering. The collision rate was calculated using binomial distribution and the detachment rate was expressed by the product of the collision rate and the weight function which was deduced from the threshing tooth shape, tooth speed and detachment difficulty for rice. Aweibull distribution was applied to the distribution of grain collected under the concave. The distribution of the grain was evaluated using the shape parametre of the weibull distribution. This analysis method was found effective for studying the detachment difficulty of rice.

Umeda,M.(1992) studied the threshing mechanism of a Japanese type head feeding combine. Rice movement was analysed in order to consider the location of threshing tooth and grain at impact, the relation between impulse and detachment, and the probability of such a phenomenon. Flexural rigidity and mass of rice were measured and variation characteristics were analysed. The natural frequency of rice movement was low compared with the speed of the threshing tooth, and rachis and rachis branch moved along with the movement of the tooth. Rice movement on the threshing cylinder was thus analysed by considering the geometric relationship between the tooth and rice. The rice head moved perpendicular to the threshing cylinder axis because the frictional force between the tooth and rice.

The Coimbatore Centre, performance evaluated TNAU, Sri Ram, Vicon, Qualitex and LCT threshers. For each thresher the grain moisture, plant moisture, threshing time, threshing efficiency, breakage percentage and cost of threshing were assessed. Studies in the moisture has little effect on the performance in the range.

Table.5. Performance of Paddy Threshers.

Sl. No.	Name of thresher	Grain moisture % wb	Output kg/h	Threshing efficiency %	Breakage %	Unit cost Rs/t
1.	TNAU thresher **	21	396	98.6	Nil	10.0
2.	Sri Ram thresher	21	230	98.6	Nil	16.5
3.	Vicon thresher	21	720	98.2	1.0	12.4
4.	Qualitex thresher	21	250	98.5	1.5	18.9
5.	LCT thresher	21	240	98.9	Nil	16.3

* Number in the paranthesis refers to the source under reference

** Winnowing has to be done manually seperately.

MATERIALS AND METHODS

This chapter includes the design criteria, various materials and methods involved in the development and fabrication of the Low Cost Paddy Thresher.

3.1. Thresher requirements

1. Thresher must be suitable for a number of crops.
2. Besides threshing of grains, it must be able to make fine bhusa for cattle feed in wheat and long straw in rice for making thatch roof.
3. Seed damge must be minimum, less than 2%.
4. Grain losses must be minimum, less than 2%.
5. Cost of threshing must be low.
6. Thresher must be durable and reliable.
7. Easy and safe operation.
8. Low energy consumption for a high capacity machine.

3.2. Design requirements.

The general design requirements are,

1. Provision for proper lubrication.
2. Use of proper bearings to dis allow entry of dust and water.
3. Provisions for safe feeding devices.
4. Provisions of cylinder-concave clearance and screen slope.
5. Provision for belt-tightening.

6. Easy cleaning and replacement of sieves.
7. Static and dynamic balancing of threshing unit consisting of cylinder and fly wheel.

3.3. Performance requirements.

For guideliness of design, the following are the performance requirements as per IS; 6320.

1. Threshing efficiency greater than 99%.
2. Cleaning efficiency greater than 96%.
3. Total grain losses should not be more than 5% in which cracked grains should not be more than 2%

3.4. Details of the main parts of the threshing machine.

The newly designed paddy thresher has following units.

1. Threshing drum or threshing cylinder.
2. Cylinder cover.
3. Feeding chute.
4. Blower.
5. Frame.
6. Prime mover and
7. Power transmission system.

3.4.1. Threshing drum or threshing cylinder.

The diameter of the cylinder was selected as 350mm at the tip of the pegs. The length of the cylinder was selected as 350mm. The length of the shaft between the two bearing was 530mm. Six equally spaced bars of 30mm width 3mm thickness and 350mm length were welded to the rings.* The diameter of the ring was 244mm and was made of MS flat of 40 by 3mm. 3/8" nut and bolt having a length of 100mm was used as the threshing teeth. The threshing teeth project 50mm above the surface of the bar. The threshing teeth were fixed to the bar in such a way that when assembled, the teeth on the two adjacent bars come staggered to each other.

Design of threshing drum.

The throught or handling capacity of a peg tooth drum is directly proportional to the number of teeth 'z' and the permissible feed per tooth (Klenin et al, 1978), that is

$$qp = qo'z$$

The permissible feed qo' is assumed to be 0.0025 to 0.004 kg/s per tooth.

Let the straw grain ratio be 1:2 (by weight).

Therefore the handling capacity for a threshing capacity of 200 kg is 300 kg.

Therefore the number of peg teeth,

$$z = \frac{300}{0.0025 \times 3600}$$

$$= 34 \quad \text{(say)}$$

According IS:9129:1979, the length of the feeding chute at the threshing side is fixed as 350 mm. Hence we select the length of the threshing drum as 350 mm.

Working length of the threshing cylinder,

lp = c/c distance between the first and last peg.

Distance between the adjacent path of teeth is ranging from 25 to 29 mm.

therefore the maximum number of teeth provided

$$= \frac{350}{54} = 6.48$$

7 (say)

Therefore the working length lp,

that is, z = mp (lp/a +1)

where a = the distance between the adjacent path of teeth, mm (a= 25 to 29 mm)

mp = half the number of cross bar

that is 34 = mp (324/27 +1)

mp = 2.6

= 3 (say)

Therefore the number of cross bar,

M = 2 x 3

= 6

Details of the arrangement of pegs on the cross bars are shown in fig.3.

The total number of peg = [7*3] + [6*3]

=39.

As per IS:9019-1979 specification the rpm of the threshing drum

Plate I : Threshing drum showing the arrangement of pegs.

rages from 675 to 1000 and the peripheral velocity recommended by ICAR ranges from 14 to 16 m/min. In order to satisfy these conditions we select the diameter of the threshing drum as 350mm.

c/c distance between the cross bar

$$= \frac{D}{M-1} = \frac{X\ 350}{6-1}$$

$$= \underline{\underline{219.9 \text{ mm}}}$$

Actual handling capacity,

$$qp = qo'z$$

$$= 0.0025*39*3600$$

$$= \underline{\underline{351 \text{ kg/hr}}}$$

Fig.3 shows the development of a peg tooth drum with six cross bars and a three-pitch helical line over which the teeth are located. Direction of the helical path is given by the pitch.

$$tp = a.M.$$

The teeth are placed at the point of intersection of the helical lines with the cross bars. When the drum rotates, each tooth moves in a particular plane which is indicated by the lines AA, BB, CC, and so on on the periphery of the drum.

The number of adjacent planes in which the teeth move are,

$$P = lp/a + 1.$$

The number of teeth which lies in the same plane of rotation is equal to the number of pitches of the helical path.

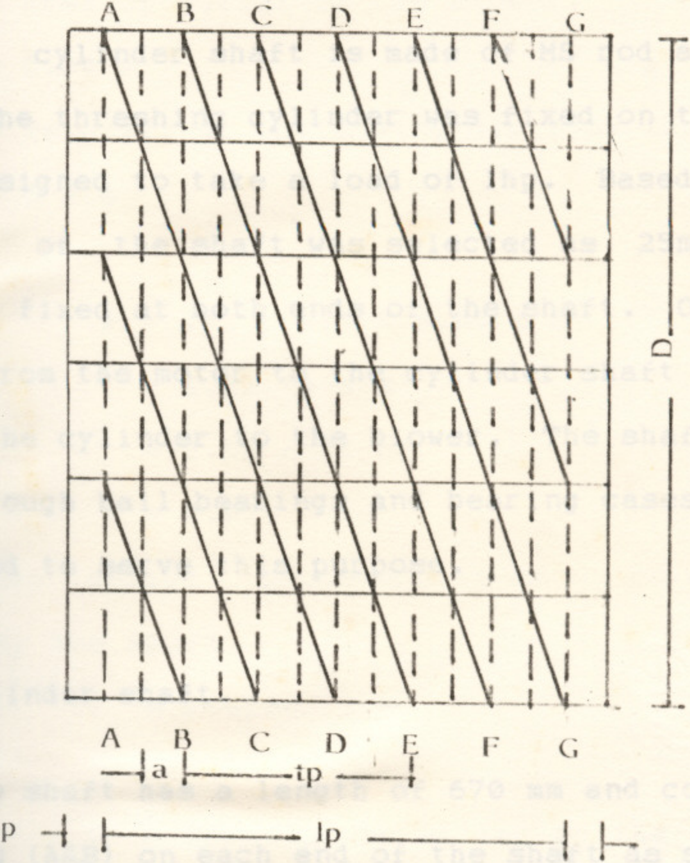

Fig. 3 : Development of the peg tooth drum with six cross bars.

Cylinder shaft.

The cylinder shaft is made of MS rod and had a length of 670 mm. The threshing cylinder was fixed on the shaft. The shaft was designed to take a load of 1hp. Based on the design the diameter of the shaft was selected as 25mm. Two V-belt pulleys were fixed at both ends of the shaft. One pulley is to take power from the motor to the cylinder shaft another to take power from the cylinder to the blower. The shaft was fixed to the frame through ball bearings and bearing cases. Ball bearings 6305 were used to serve this purpose.

Design of cylinder shaft.

The shaft has a length of 670 mm and consists of two V-belt pulleys (A&B) on each end of the shaft as shown in fig.4. The shaft is supported by two ball bearings at positions C&D. The weight of the cylinder is 8.75 kg and it is assumed that the weight is uniformly distributed throughout the length of the cylinder. The weight of the pulley A is 2.0 kg and that of pulley B is 2.33 kg. The shaft is designed to transmit a maximum load of 1 hp.

The power required to operate the blower is found out from the formula,

$$P = 1/2 \times \quad \times A \times V$$

where,

P = Power required to operate the blower

= Density of air

= 1.30 kg/m

A = Area of outlet of the blower

= 0.04 m

V = Velocity of out coming air from the blower

= 6 m/s

Therefore

P = 1/2 x 1.3 x 0.04 x 6

= 5.62 kg-m/s

= 5.62 / 75 hp

= 0.075 hp

The design procedure is shown below, The torque transmitted by the shaft,

T = P*4500/ 2 N

where

P = Horse power acting on the shaft

N = rpm of the shaft

Considering the pulley side A,

Maximum hp acting on the shaft = 1 hp

rpm of the shaft = 675

Therefore

$$T = \frac{1 \times 4500}{2 \times 675}$$

= 1.06 kg-m.

Let T1 amd T2 be the tensions on the tight side and slack side of the belt on pulley A.

T = (T1-T2) x r

where,

r = radius of pulley A

and

T1/T2 = e

where

= coefficient of friction between pulley and belt

= 0.3

= Angle of the direction of force acting

= radians

i.e.,

1.06 = (T1-T2) x 75 x 10

T1-T2 = 1.06 / 7.5 x 10

= 14.13 --------- (1)

T1 / T2 = e

T1 / T2 = 2.57 --------- (2)

From (1) & (2)

T1 = 2.57 x T2

2.57 x T1-T2 = 14.13

T2 = 9

T1 = 23.13

The force acting at A = T1 + T2 + W1

where

W1 = weight of pulley A

= 2.0 kg

= 23.13 + 9 + 2

= 34.13 kg

========

Considering the pulley side B,

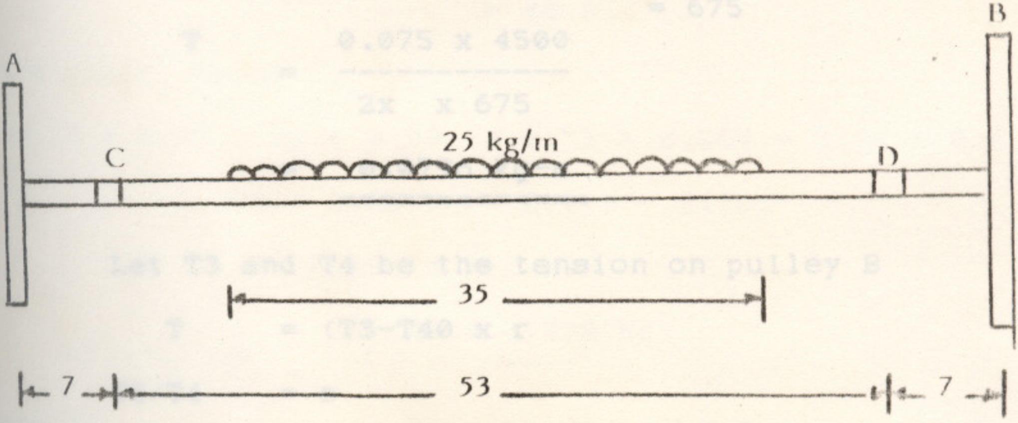

Fig. 4 : Force on cylinder shaft.

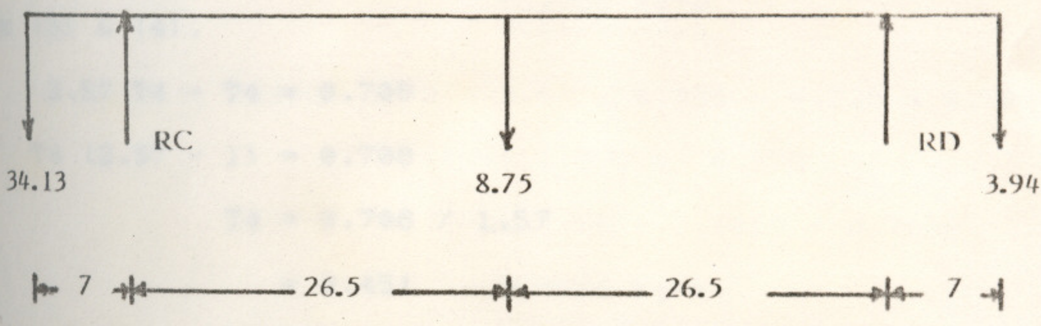

Fig. 5 : Positions of forces and reactions on cylinder shaft.

The horse power taken from the shaft = 0.075 hp

rpm = 675

$$T = \frac{0.075 \times 4500}{2x \times 675}$$

= 0.0796 kg-m

Let T3 and T4 be the tension on pulley B

T = (T3-T40 x r

T3/T4 = e

i.e.,

0.0769 = (T3-T4) 0.1125

T3-T4 = 0.708 ----------(3)

T3/T4 = e

T3/T4 = 2.57

T3 = 2.57 T4 ----------(4)

From (3) & (4),

2.57 T4 - T4 = 0.708

T4 (2.57 - 1) = 0.708

T4 = 0.708 / 1.57

= 0.451

T3 = 1.159

Weight of pulley B,

W2 = 2.33 Kg

Force acting on side B = T3 + T4 + TN2

= 1.159 + 0.451 + 2.33

= 3.94 Kg.

To find reactions at C & D,

let Rc and Rd be the reactions at C and D respectively.

From fig.(5) it is clear that the sum of the reactions

Rc + Rd = 34.13 + 8.75 + 3.94

= 46.82

Taking moment about C,

34.13 * 0.07 + Rd * 0.53 = 8.75 * 0.265 + 3.94 * 0.6

2.389 + 0.53 Rd = 2.319 + 2.364

0.53 Rd = 2.294

Rd = 4.328 Kg

Therefore, Rc = 46.82 - 4.328

= 42.492 Kg

Taking bending moments,

Bending moment at B = o

Bending moment at D = 3.94 x 0.07

= 0.2758 kg-m

Bending moment at E = 3.94 x 0.335 - 4.328 x 0.265

+ 4.375 x 0.175

= 1.3199 - 1.1469 + 0.7656

= 0.9386 kg-m.

Bending moment at C = 3.94 x 0.6 - 4.328 x 0.53

+ 8.75 x 0.265

= 2.364 - 2.2938 + 2.3188

= 2.3890 kg-m

Bending moment at A = 3.94 x 0.67 - 4.328 x 0.6

+ 8.75 x 0.335 - 42.492 x 0.07

= 2.6398 - 2.5968 + 2.9313 - 2.9744

= - 0.0001 kg-m

Maximum bending moment, M = 2.3890 kg-m

Torque, T = 1.06 kg-m

We know that the equivalent twisting moment,

Tc = M + T

= 2.3890 + 1.06

= 2.6136 kg-m

We also know that,

Tc = (/16) x fs x d

where, fs - permeable shear force

= 400 kg/cm

i.e., 261.36 = (/16) x 400 x d

d = 3.3277

Therefore, d = 1.4929 cm

Considering the pulley side B,

M = 2.3890 kg-m

and T = 0.0796 kg-m

Tc = M + T

= 2.3890 + 0.0796

= 2.3903 kg-m.

Tc = (/ 16) x FS x d

d = 239.03 x 16/(x 400)

= 3.0434

Therefore, d = 1.449 cm

say, d = 25 mm

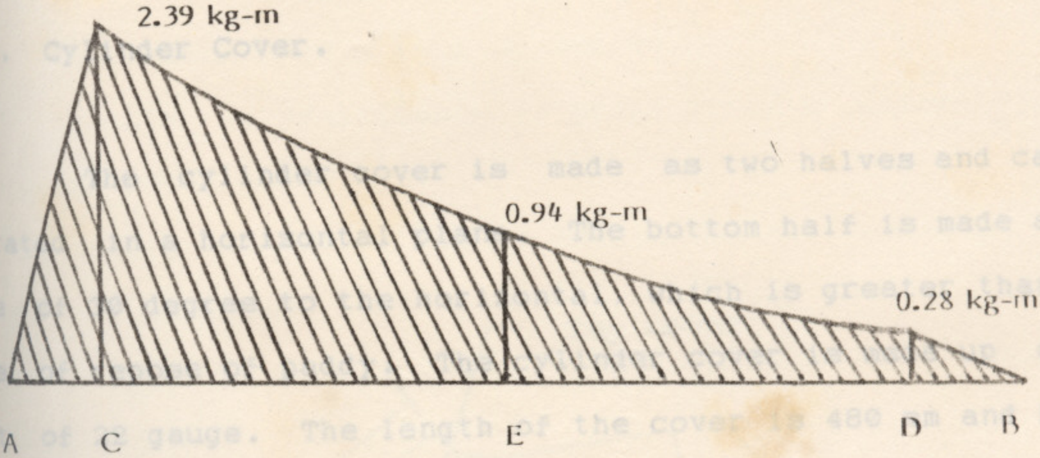

Fig. 6 : Bending moment diagram of cylinder shaft.

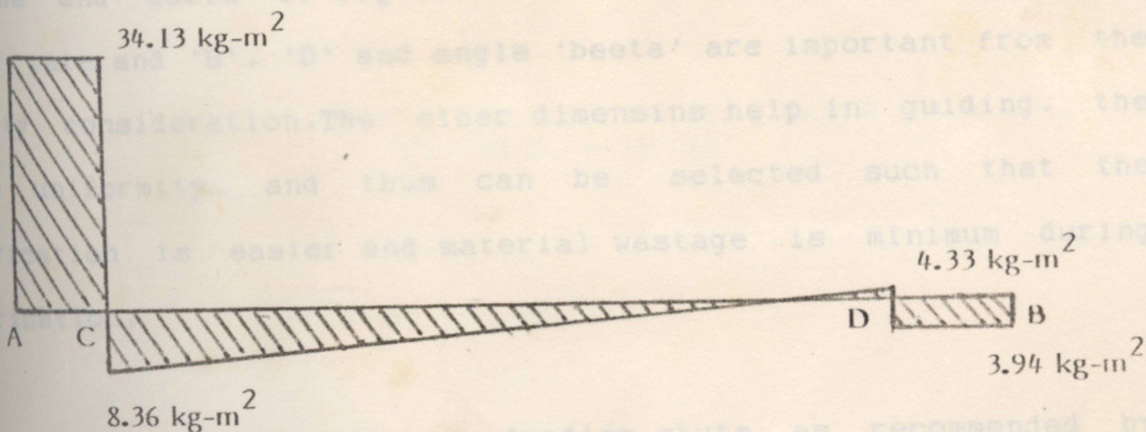

Fig. 7 : Shear force diagram of cylinder shaft.

3.4.2. Cylinder Cover.

The cylinder cover is made as two halves and can be separated in a horizontal plane. The bottom half is made at an angle of 30 degree to the horizontal, which is greater than the angle of repose of paddy. The cylinder cover is made up of GI sheet of 22 gauge. The length of the cover is 480 mm and has a width of 490 mm.

3.4.3. Feeding chute.

The feeding chute is a part of the power thresher through which crop is fed and guided to the threshing cylinder during threshing. The throat dimensions 'C', 'F' and angle 'alpha' and 'beeta' of Fig.8. affect the flow of crop that is feed rate and 'B', 'D' and angle 'beeta' are important from the safety consideration.The other dimensins help in guiding, the crop uniformity, and thus can be selected such that the fabrication is easier and material wastage is minimum during fabrication.

The dimensions of feeding chute as recommended by Indian standard IS:9129-1979 meet the safety requirements but the dimensions which do not affect the safety requirements can be modified to facilitate fabrication and increased material utilization effectively.

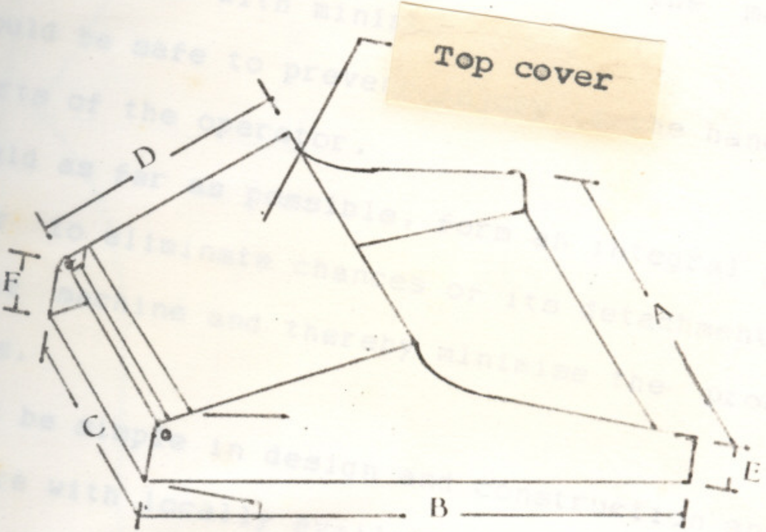

Fig. 8 : An improved feeding chute
(IS: 9129 - 1979)

Design Requirements of a Feeding system.

1. It should be practicable to adopt it on a given type and design of thresher.
2. It should facilitate smooth feeding of the material (whole crop or earheads) with minimum force.
3. It should be safe to prevent injury to the hands and other body parts of the operator.
4. It should as far as possible, form an integral part of the thresher to eliminate chances of its detachment or removal from the machine and thereby minimise the probability of accidents.
5. It should be simple in design and construction and easy to manufacture with locally available materials.
6. It shoul not have any sharp corners or edges to prevent injuries to the operator.
7. Its cost in relation to the cost of thresher should be low.
8. It should not bend, break or deform under the weight of the material being fed.
9. Its size should be adequate to prevent desired feed-rate to achieve the rated out put capacity.
10. It should not lead to backfeeding of the material.

The fabricated feeding chute consists of three portions namely,

i) bottom which receives the crop.
ii) side which guides the crop, and
iii) top cover which restricts the length of arm inside the feeding during threshing.

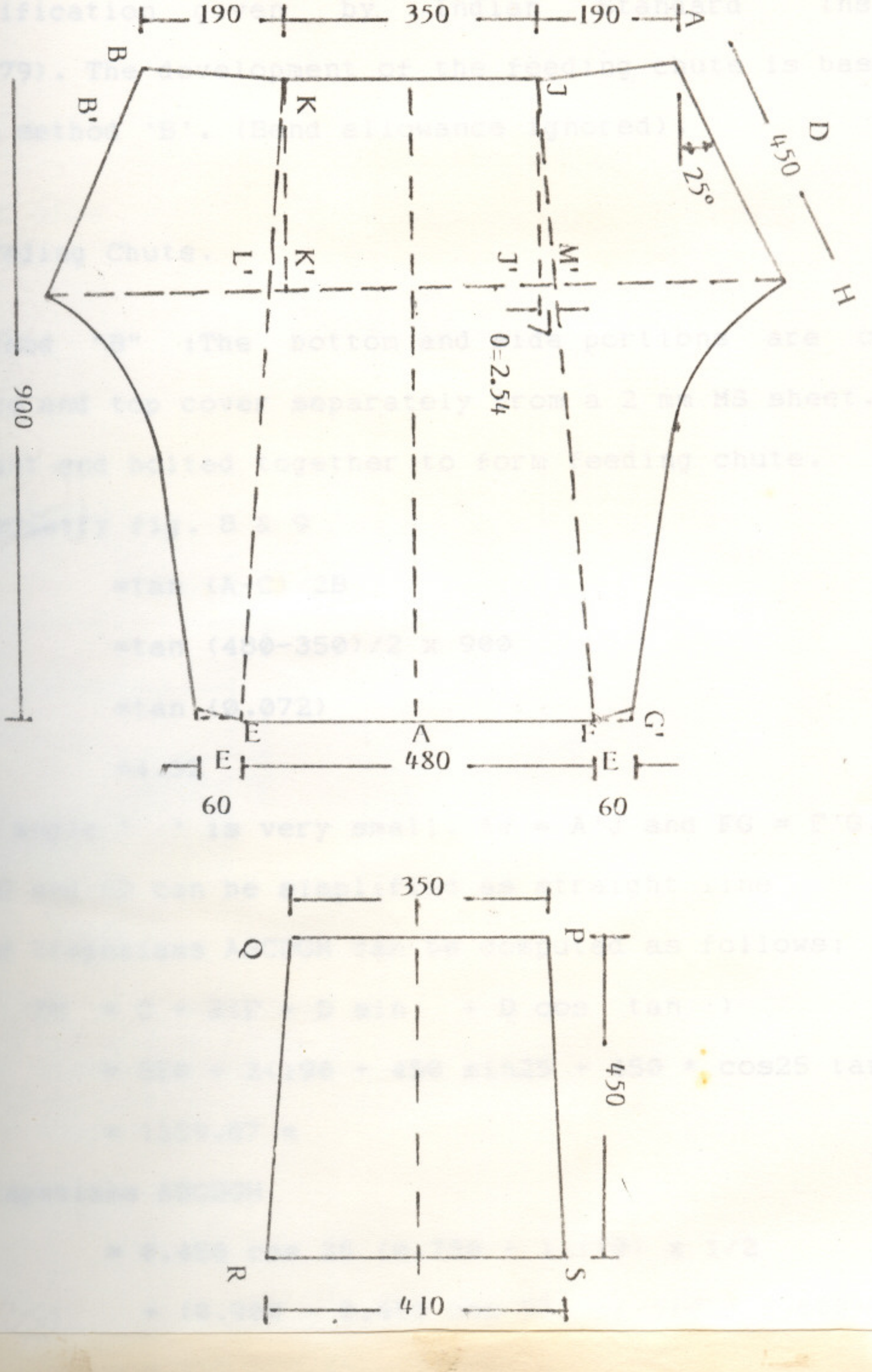

Fig. 9 : Development of feeding chute for spike tooth thresher based on fabrication method 'B'. Dimensions based on IS: 9129 - 1979. (Bend allowance ignored).

The feeding chute was designed and fabricated as per the specification given by Indian Standard Institute (IS:9129-1979). The development of the feeding chute is based on fabrication method 'B'. (Bend allowance ignored).

Design of Feding Chute.

Method "B" :The bottom and side portions are cut in single piece and top cover separately from a 2 mm MS sheet. These are then bent and bolted together to form feeding chute.

From the geometry fig. 8 & 9

=tan (A-C)/2B

=tan (480-350)/2 x 900

=tan (0.072)

=4.32

Since this angle ' ' is very small, AJ = A'J and FG = F'G. Also distance HG and CD can be simplified as straight line

The area of trapeziams ABCDGH can be computed as follows:

FG = C + 2(F + D sin   + D cos tan)

= 350 + 2(190 + 450 sin25 + 450 * cos25 tan4.13)

= 1169.67 m

Area of trapeziams ABCDGH

= 0.450 cos 25 (0.730 + 1.110) x 1/2

+ (0.900 - 0.450 cos 25) (1.110 + 0.600) x 1/2

= 0.375 + 0.421

= 0.796 m

The area of blank from fig(10)

= 1.125

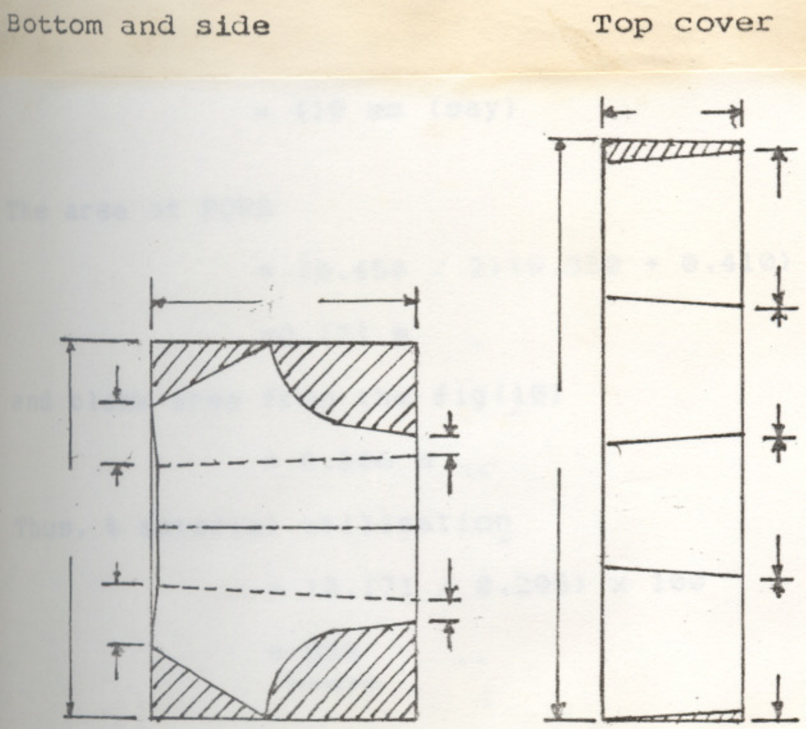

Fig.10 : Blank size cut from the standard size (1800 x 1200) for fabrication of feeding chute based on fabrication method 'B'. (wastage shown by shaded area).

% utilization of material

= (0.796 / 1.125) x 100

= 70.76%

Similarly the area of top cover (fig 9) PQRS can be computed

The length SR = 2 x 450 cos 25 x tan 4.13 + 350

= 408.9 mm

= 410 mm (say)

The area of PQRS

= (0.450 / 2)(0.350 + 0.410)

=0.171 m

and blank area from the fig(10)

= 0.206 m

Thus, % material utilization

= (0.171 / 0.206) x 100

= 83%

The overall material utilization

= [(0.796 + 0.171)/(1.125 + 0.206)] x 100

= 72.65%

The material wastage

= [(1.331 - 0.967) / 0.967] x 100

= 37.6%

In this method of fabrication the length of cut and welding is reduced compared to other methods.

Plate II : Feeding chute.

3.4.4. Blower.

A blower is provided below the cylinder to winnow the grains threshed, and is kept at a distance of 475mm from the cylinder shaft. The blower fan consists of four blades made of MS sheet of 360mm length and 100mm width. The blades are bolted to the angle pieces (125 x 25 x 3mm) and welded around the shaft at right angles. The shaft is made of MS rod of 630mm long and 25 mm diameter. Two ball bearings are provided at the ends of the shaft are provided with bearing cases. Ball bearings of number 6305 are used since it can withstand the load coming on the shaft. The grain drop is fixed as 200mm as per standards.

The blower casing is made of GI sheet of 22 gauge. Two air inlets are provided at the sides of the blower casing. The casing has a diameter of 300mm and has a length of 400mm. The air outlet is extended to the foot of the frame and has a length of 160 mm.

3.4.5. Frame.

The whole frame is made of MS angle of 35 x 35 x 5mm size. The frame is rectangular in shape when viewed from all sides. The overall dimension of the frame is

Height = 870 mm

Width = 480 mm

Length = 560 mm

The threshing cylinder is mounted at the centre on the

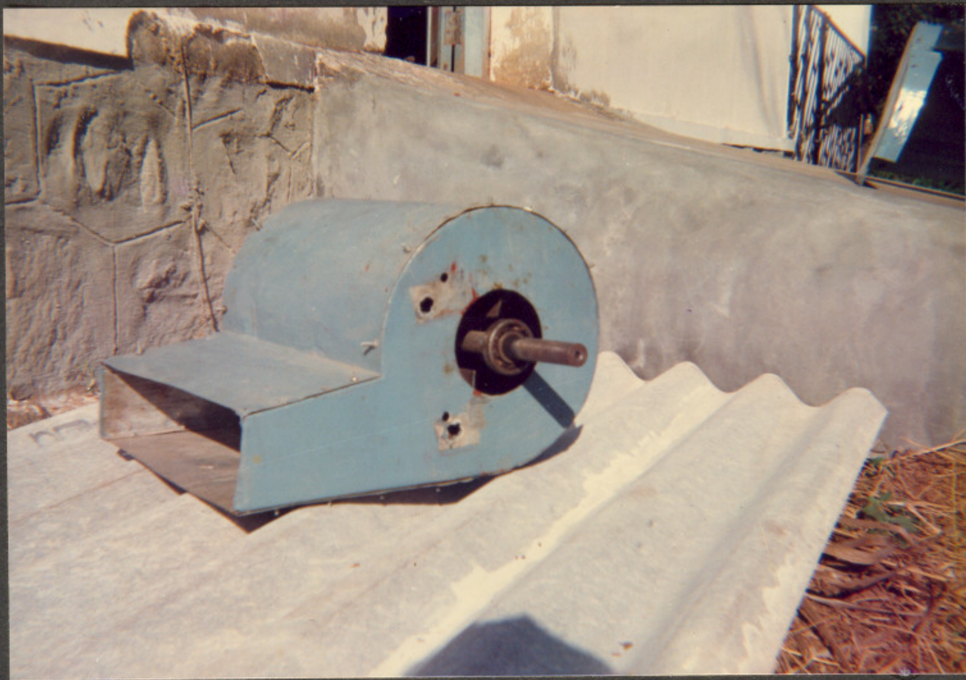

Plate III: Blower & Concave.

top of the frame. The blower is fixed at a distance of 433mm from the top of the frame, and the motor is fixed on the standard made at the bottom of the frame.

3.4.6. Prime mover.

The power required to operate the cylinder and the blower is taken from a single phase 1hp electric motor.

The motor is fixed on a stand made of MS angle 35 by 35 by 5mm size. Grooves are provided on the stand to adjust the tension of the belt whenever necessary. Dimension of the motor stand is

Height = 35 mm.

Width = 220 mm.

Length = 370 mm.

3.4.7. Power transmission system.

The power transmission system consists of V-pulleys and belt of A section. The power is taken from the motor to the cylinder and then to the blower. Dimensions of the pulleys are so selected to get the required rpm. The dimensions are calculated from the following formula.

$N1.D1 = N2.D2.$

where, N1- rpm of the driving shaft.

N2- required rpm of the driven shaft.

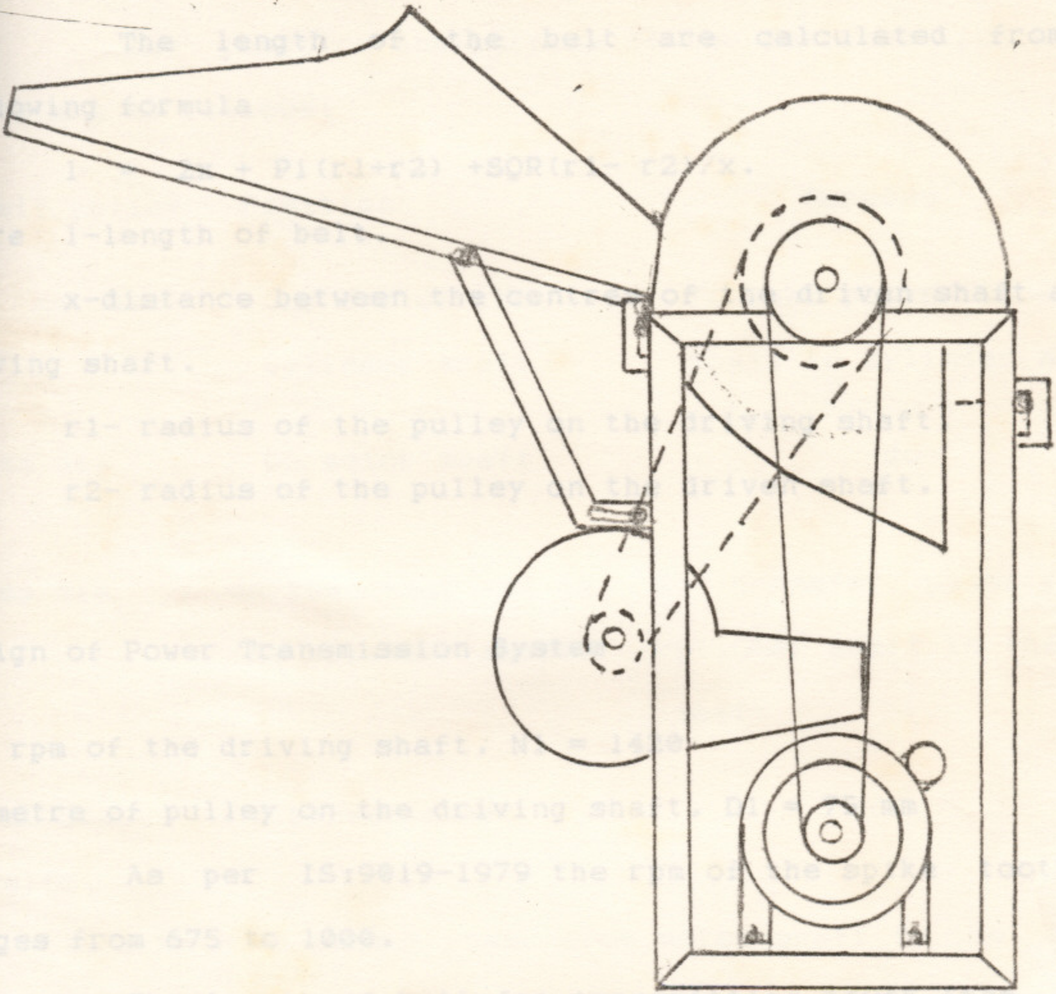

Fig. 11 : Power transmission system of low cost paddy thresher.

D1- diameter of the pulley on driving shaft.

D2- diameter of the pulley on driven shaft.

The length of the belt are calculated from the following formula

$$l = 2x + Pi(r1+r2) + SQR(r1- r2)/x.$$

where l-length of belt.

x-distance between the centres of the driven shaft and the driving shaft.

r1- radius of the pulley on the driving shaft.

r2- radius of the pulley on the driven shaft.

Design of Power Transmission System

The rpm of the driving shaft, N1 = 1420

Diametre of pulley on the driving shaft, D1 = 75 mm

As per IS:9019-1979 the rpm of the spike tooth drum ranges from 675 to 1000.

The length of belt for transmitting power from driving shaft to cylinder shaft,

$$l1 = 2 \times 720 + Pi(75 + 37.5) + (75 - 37.5)/720$$

$$= 1791.48 \text{ mm}$$

$$= 72 \text{ inches (say)}$$

=========

The length of belt for transmitting power from cylinder shaft to blower shaft,

$$l2 = 2 \times 550 + pi(112.5 + 37.5)$$

$$- (112.5 - 37.5)/550$$

= 1561 mm

= 63 inches (say)

The position and purpose of the designed pulleys and belts are as follows:

V-belt pulley	Position	Purpose
150 mm dia	One end of the cylinder shaft	To take power from motor shaft to cylinder shaft
75 mm dia	On motor shaft	-do-
25 mm dia	on the other end of the cylinder shaft	To transfer power from the cylinder shaft to the blower shaft
75 mm dia	On blower shaft	-do-

V-belts.

1800 mm - To convey power from motor shaft to the cylinder shaft.

1575 mm - To convey power from cylinder shaft to the blower shaft

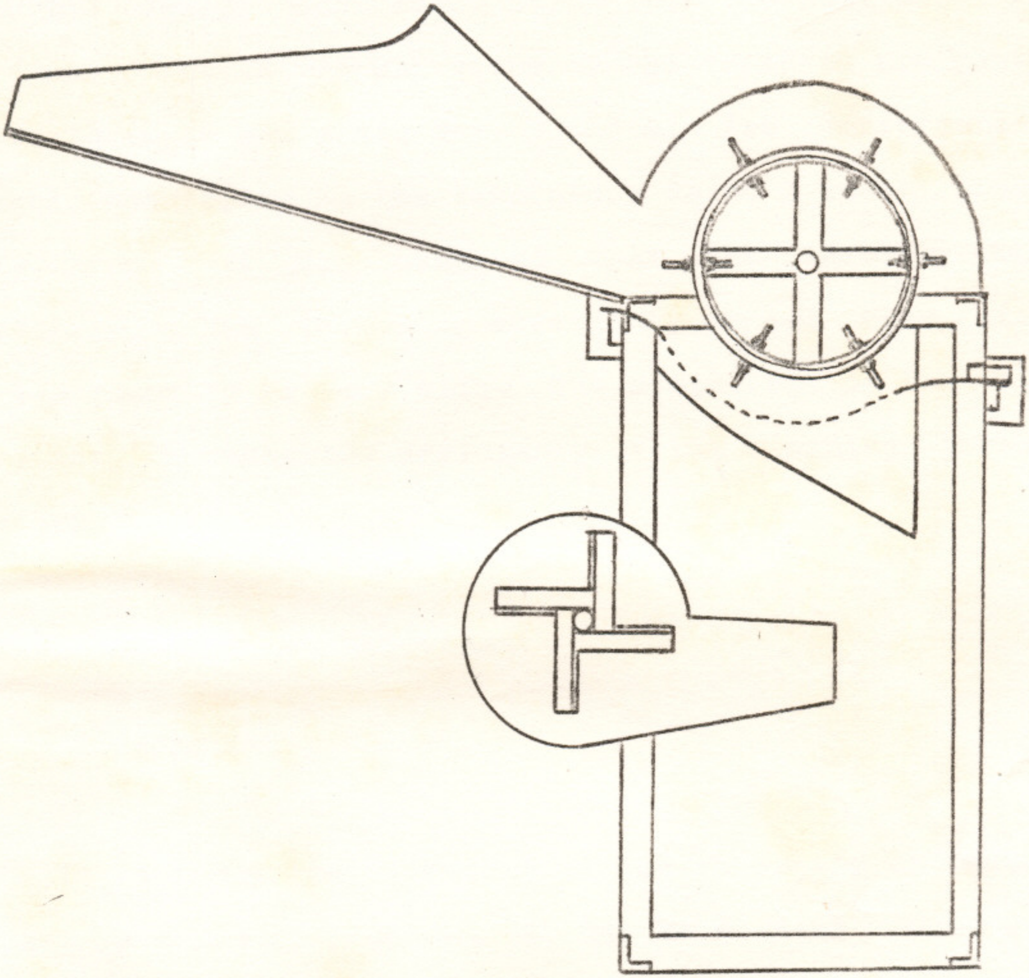

Fig. 12 : Sectional side view of low cost paddy thresher.

RESULTS AND DISCUSSION

The design and fabrication of the"Low Cost Paddy Thresher" was done. Different views of the thresher are given in fig. Nos. 13 to 16 and plate Nos. 5 and 6. The Performance of the thresher was tested in the laboratory using a small quantity of paddy crop. It was observed that the thresher worked satisfactorily. The threshing efficiency during this initial testing was found to be very high. The grain left on the straws were very few. However the efficiency of the cleaning mechanism was very low.

Suggestions for further improvement

1. Drum Modification.

It is found that clogging of the threshing cylinder by the straws is a major problem. It may be studied whether if this is because of uneven feeding or overfeeding. It is also observed that clogging occured at the gap between cover and threshing drum. This happens because we have left a distance between the ends of the threshing drum and the cover. This can be easily rectified. Presently the sides of the drum are open causing clogging problems. This can be avoided by covering the sides of the threshing drum.

2. Blower Modification.

The output of air from the blower is not sufficient to blow away the impurities from the threshed grain. The blower may be modified for getting optimum air velocity and sufficient quantity of air.

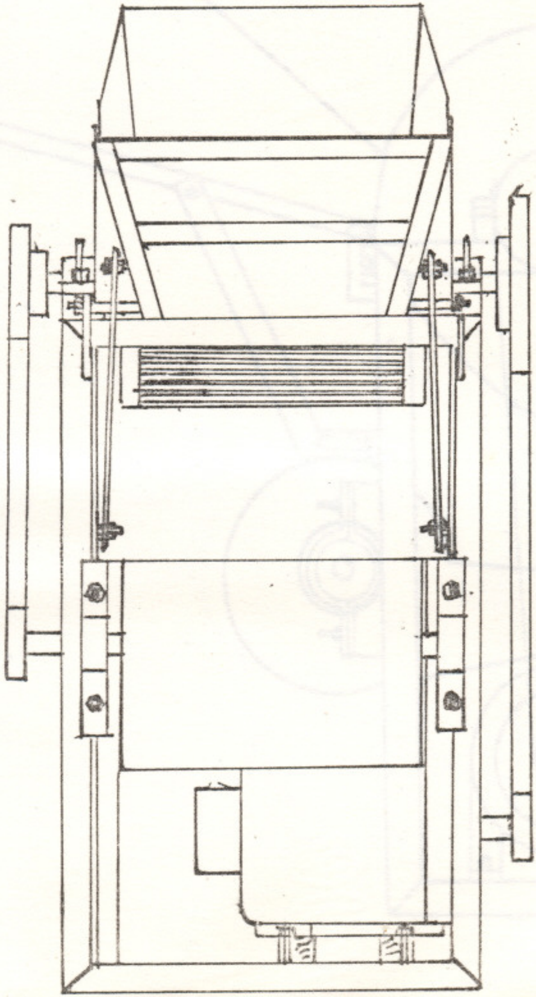

Fig. 13 : Side view of the low cost paddy thresher.

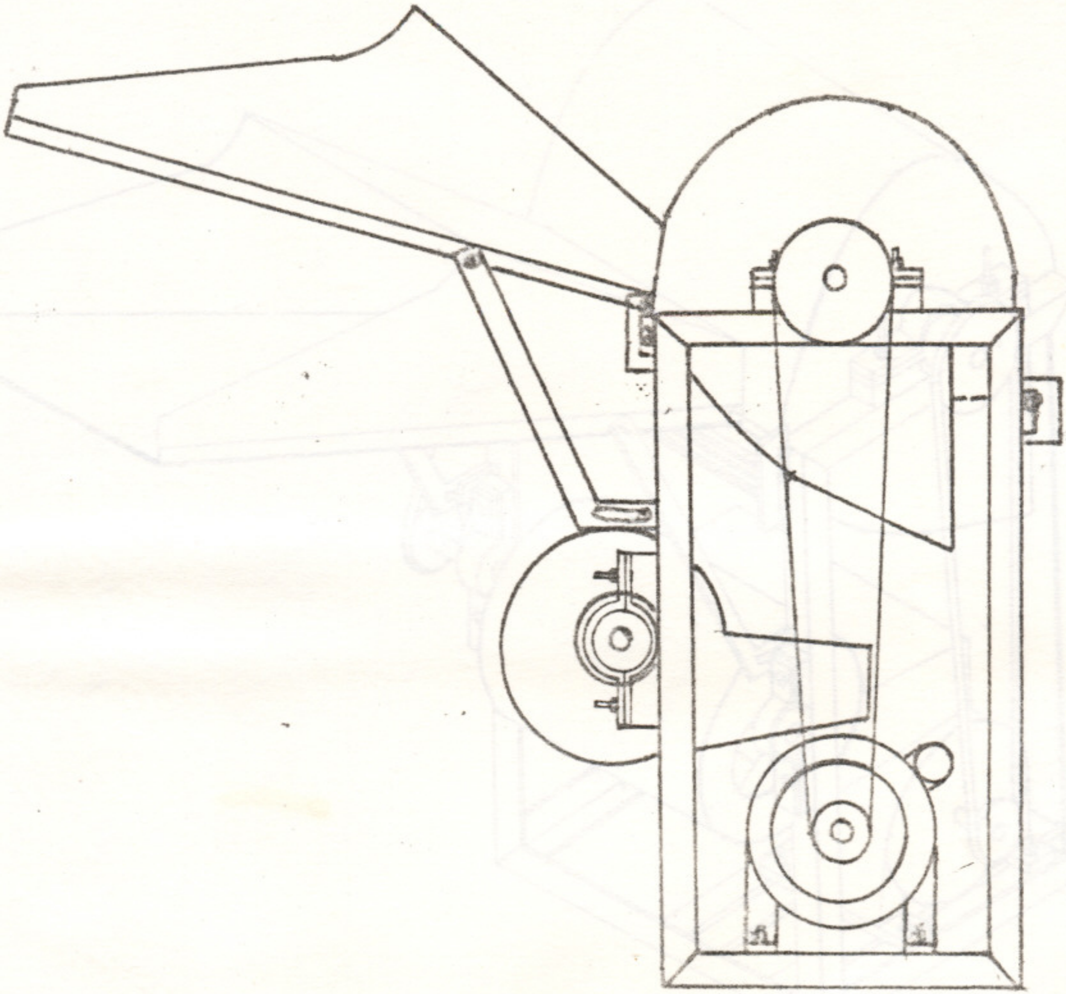

Fig. 14 : Side view of the low cost paddy thresher.

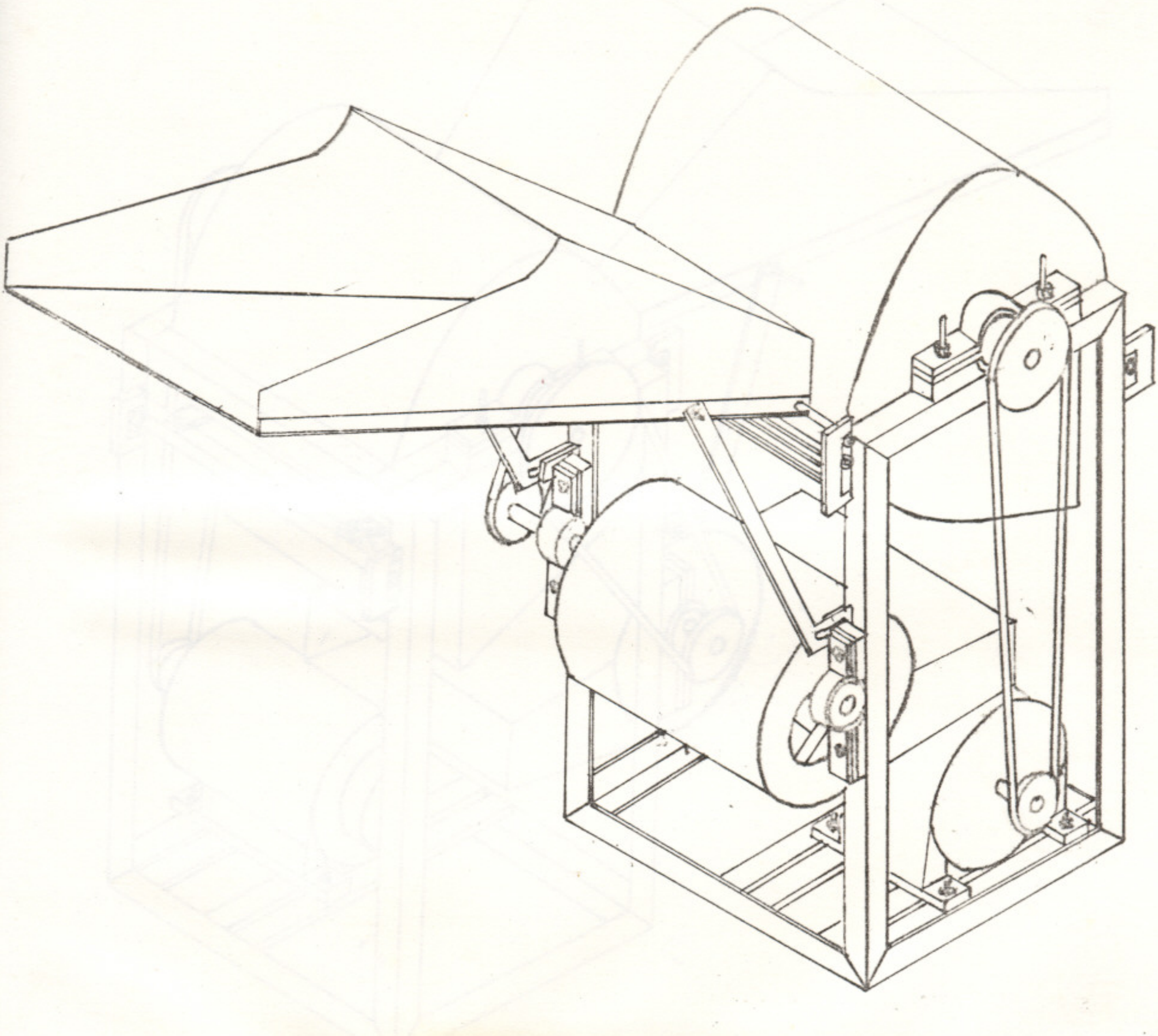

Fig. 15 : Isometric view (front side) of low cost paddy thresher.

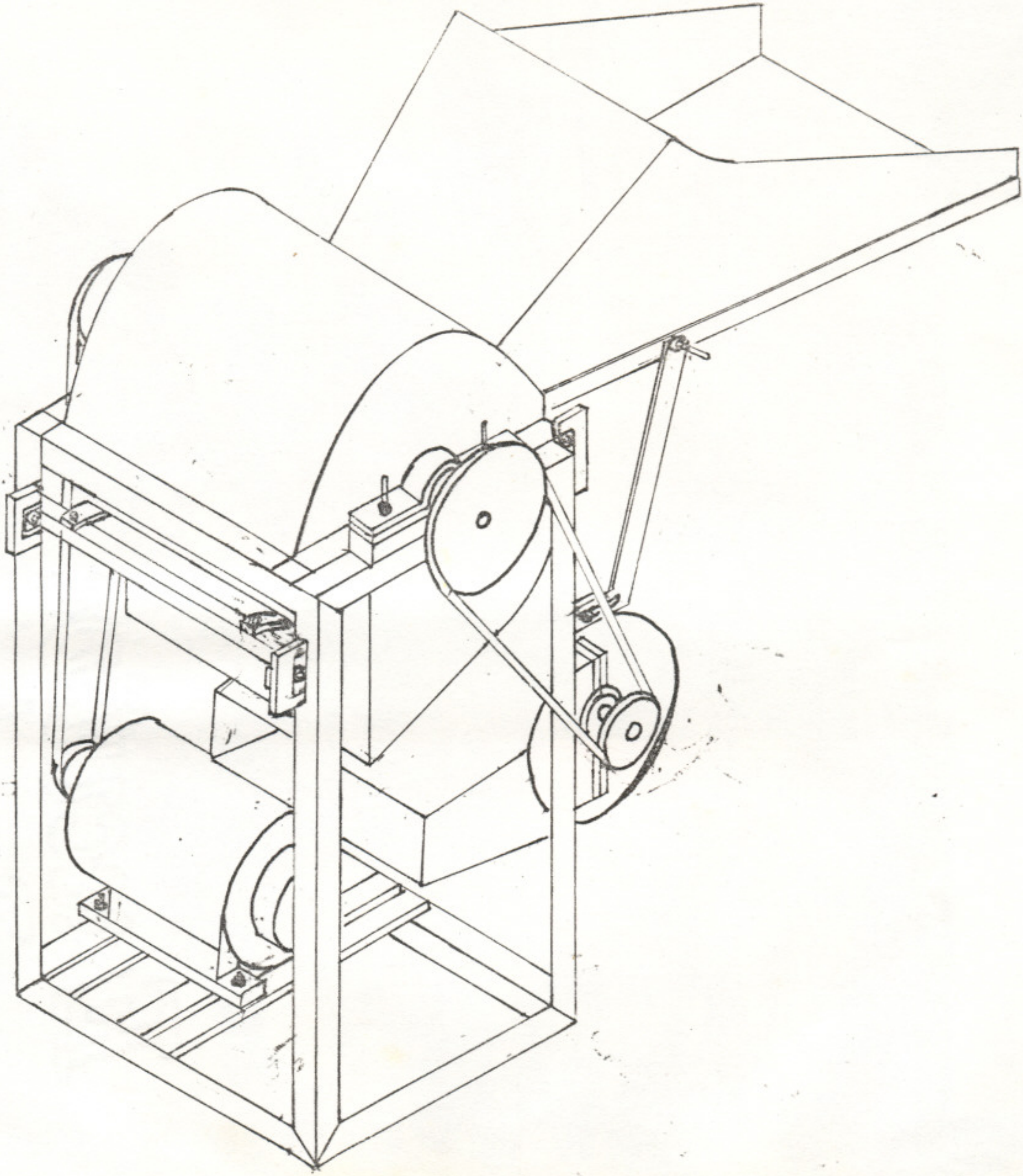

Fig. 16 : Isometric view (rear side) of low cost paddy thresher.

Plate V & VI : Different isometric views of low cost paddy thresher.

SUMMARY

Improved agricultural implements and machines are one of the important inputs in agriculture for increasing production, reducing the cost of operation and maximising the efficiency of other costly inputs.

In India the majority of farmers are in the small and marginal category and their holdings are below two hectares and that too, fragmented in small parcels, posing problems in the use of big machines.

Threshing has been improved by the use of threshers. But these threshers are beyond the reach of small and marginal farmers due to their higher cost. Therefore a Low Cost Paddy Thresher having reasonable capacity and threshing efficiency and that can be operated by an electric motor of about 1 hp whose price comes within the reach of small and marginal farmers has been designed and fabricated at the Kelappaji College of Agrl. Engng. and Tech., Tavanur.

The threshing drum is made of six equally spaced cross bars of 30 mm width 3 mm thickness and 350 mm length welded to the rings provided at the ends. The rings are made of MS flat of 40 x 3 mm and have a diameter of 244 mm. The drum has a diameter of 350 mm at the tip of the pegs and has a length of 350 mm. 3/8" nut and bolt having a length of 100 mm is used as the threshing tooth. The threshing teeth project 50 mm above the

surface of the cross bar.

The cylinder cover is made of GI sheet of 22 gauge. The bottom half of the cover is made at an angle 30 degree to the horizontal.

The feeding chute is made of MS sheet of 2 mm thickness. The dimensions of the feeding chute are as recommended by the Indian Standard, IS: 9129- 1979.

The blower is made of GI sheet of 22 gauge and is provided below the drum at a distance of 475 mm from the cylinder shaft. It has four blades of MS sheet of 360 mm length and 100 mm width. The blower casing has a diameter of 300 mm and a length of 400 mm.

The frame is made of MS angle of 35x35x5 mm size. The frame is 870 mm high, 480 mm wide and 560 mm long.

The power required for the initial testing of the machine is taken from a 1 hp single phase electric motor. V-belts and pulleys are used for the power transmission.

During the initial testing it was observed that the performance of the thresher was satisfactory.

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* originals not seen.

APPENDIX - I

Specifications of the Low Cost Paddy Thresher.

Type	:	power operated
Power requirement	:	1 hp electric motor and 1 person
Length, mm	:	560
Width,mm	:	480
Height,mm	:	870
Weight,kg	:	123
Cylinder type	:	spike type
Cylinder dia., mm	:	350
Cylinder length, mm	:	350
Handling capacity, q/h	:	3.51
Developed at	:	KCAET, Tavanur.

APPENDIX - II

Cost of Operation of the Low Cost Paddy Thresher.

Sl.No.	Material	Quantity	Price(Rs)
1	MS rod of 25 mm diameter	4.80 kg	62.40
2	MS rod of 6 mm diameter	1.32 kg	17.16
3	MS angle of size 35 X 35 X 5 mm	20.00 kg	270.00
4	MS angle of size 25 X 25 X 3 mm	2.10 kg	28.35
5	MS flate of size 30 x 5 mm	2.00 kg	29.00
6	MS flate of size 40 X 3 mm	1.14 kg	16.60
7	MS flate of size 25 X 2 mm	0.30 kg	4.35
8	GI sheet of 22 gauge	1.20 m	194.45
9	MS sheet of thickness 2 mm	1.00 m	166.67
10	3/8" nut and bolt	3.27 kg	128.00
11	Deep grooved ball bearings	4 Nos.	360.00
	(Bearing NO. 6305)		
12	V-belt pulleys		
	75mm diameter	2 Nos.	66.00
	150mm diameter	1 NO.	54.00
	225mm diameter	1 No.	123.75
13	V-belts		
	1575mm long	1 No.	91.00
	1800mm long	1 No.	114.80

14	Welder engaged for welding work 2 Nos. 60.00/each	2 Nos.	120.00
15	Fitter engaged for fitting work 8 NOs. 55.00/each	8 Nos.	440.00
16	Turner-II engaged for lathe work 1 No. 50.00/each	1 NO.	50.00
TOtal			2336.53

APPENDIX - III

Economics:

Economics of the thresher can be calculated considering its initial cost, operating cost and output in terms of the grain. Since the initial costs of the threshers dealt about above varues wuth the year of the manufacture, therefore, the cost of operation can not be compared. However, with the following procedure, the economics can be calculated.

The following appropriate assumptions can be taken.

1. Salvage value of thresher (S) = 10% of initial cost.
2. Life (L) = 5 years
3. Interest (I) = 12% per year of the initial cost.
4. Repair and maintenance = 4% of initial cost per year.
5. Housing = 1% of initial cost per year.

Let,

Fixed cost = Fc per year.

C = Initial cost.

I = Interest Rate

Therefore,

A. Fixed cost (Fc) per year.

(i) Depreciation (Straight line method)

$$= (C-S)/L$$

$$= (C-0.1C)/5$$

$$= 0.9C/5$$

$$= 0.18C.$$

(ii) Interest $= (C + S)I/2$

$$= (C+0.1C)0.12/2$$

$$= 0.066C.$$

(iii) Repair & Maintenance $= 0.04 \times C$

$$= 0.04C.$$

(iv) Housing $= 0.01 \times C$

$$= 0.01C.$$

Total Fc $= (i+ii+iii+iv)$

$$= C(0.18+0.066+0.04+0.01)$$

$$= 0.296C.$$

B. Operation cost per hour (Oc).

(i) Labour charges = No. of persons x Existing labour rates/ Hours of operation

(ii) Power changes = consumption in kW/hr * Rate per kWh.

Total Oc = i + ii

C. Unit cost of thresher per hour(Cu).

Cu = Fc x Oc/Number of hours used in year

D. Cost of threshing per tonne (Ct).

$$Ct = Cu/\text{Grain out put in tons per hour.}$$

Sl. No.	Annual use(hrs)	Fc/hr (Rs)	Oc/hr (Rs)	Cu/hr (Rs)	Cost of threshing per tonne (Rs)

Note:-

The above calculated cost does not include the cost of prime-mover used for the operation of thresher.

DESIGN AND FABRICATION OF LOW COST PADDY THRESHER

By

BABU. V.

SAISUNDAR. S.

SUNILKUMAR PANDEY

ABSTRACT OF THE PROJECT REPORT

Submitted in partial fulfilment of the requirement for the degree

Bachelor of Technology

in

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Department of Agricultural Processing and Structures

Kelappaji College of Agricultural Engineering and Technology

Tavanur - 679 573

Malappuram

1992

ABSTRACT

The various types of threshers available in the country are beyond the reach of small and marginal farmers. Since the farmers will accept only an efficient thresher whose price comes within their reach, a Low Cost Paddy Thresher was designed and fabricated at Kelappaji College of Agrl. Engng. and Tech., Tavanur.

The machine consists of spike type threshing drum, feeding chute, cylinder cover, blower and frame. A single person is required for the whole operation of the machine. The machine is operated by a 1 hp single phase electric motor.

Initial testing of the machine was conducted. The overall efficiency of the machine was satisfactory. The cost of the machine is about Rs. 2500/- excluding the price of the electric motor.