DEVELOPMENT AND PERFORMANCE EVALUATION OF SELF PROPELLED BUSH CUTTER

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PROJECT REPORT

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1997

DECLARATION

We hereby declare that this project report entitled "**DEVELOPMENT AND PERFORMANCE EVALUATION OF SELF-PROPELLED BUSH CUTTER**" is a bonafide record of project work done by us during the course of project and that this report has not previously formed the basis for the award to us of any degree, diploma, associateship, fellowship or other similar title to us, of any other University or Society.

Tavanur
30.5.1997

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CERTIFICATE

Certified that this project report entitled "**DEVELOPMENT AND PERFORMANCE EVALUATION OF SELF-PROPELLED BUSH CUTTER**" is a bonafide record of project work done jointly by **Suresh K.V. Warrier, Venugopal T.S. and Xavier V.V.** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associateship or fellowship to them.

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LIST OF ABBREVIATIONS USED

Agric.	-	Agriculture
Agrl.	-	Agricultural
ASAE	-	American Society of Agricultural Engineers
BSW	-	British Standard Whitworth
c/c	-	Centre to centre
cm	-	centimetre
Dept.	-	Department
dg.	-	degree(s)
dia.	-	diameter
Ed.	-	Edition
Eff.	-	effective
eg.	-	example
Engg.	-	Engineering
et al.	-	and others
etc.	-	etcetra
Fig	-	Figure
ha	-	hectare
HP	-	Horse power
hr	-	hour
KCAET	-	Kelappaji College of Agricultural Engineering and Technology
kg	-	kilogram
km	-	kilometer

KW	-	Kilowatt
lit.	-	litre
m	-	metre
mm	-	millimetre
MS	-	Mild Steel
No.	-	Number(s)
pp.	-	page(s)
PTO	-	Power Take Off
rpm	-	revolution per minute
Rs.	-	Rupees
s	-	second(s)
Trans.	-	Transactions
°	-	degrees
/	-	per
"	-	inches
%	-	percentage
@	-	at the rate of

INTRODUCTION

Bush infestation is a major problem in many parts of our country. Although the nation is hardpressed for finding suitable cropping space, many areas which are cultivable, still lies unutilised due to extensive weed growth. Though, the reason for the problem is multi-faceted, a main reason is the lack of availability of adequate human labour to clear the vast tracts of bushy vegetations. Clearing the land for cultivation, consumes a lot of valuable man-hours. Moreover the process is relatively expensive in this era of high labour charges, especially in a State like Kerala, where cheap agriculture labour is virtually non-existent.

So far no major effort has taken place, to find a mechanical solution to this drudgery in our state. Development of a suitable machinery to clear bushy vegetations, offers interesting engineering challenges. To begin with, there is no uniformity in the size of stem roots encountered unlike the reaper or a lawn-mower. Therefore the selection of cutting mechanism offers innumerable challenges.

The applications of bush-cutter is wide-ranging in character. In addition to its use in land reclamation, it can hold an important place even in recreational and land scaping works. It is found that many institutions and households suffer setbacks in their landscaping programmes due to increasing growth of many types of weeds and bushes. Lawn mowers, which are designed for any specified root diameter are totally inadequate when applied to a heterogeneous mass of bushes. The stress here, is to replace the lawn mowers at areas where they are found to be grossly inefficient and unsuited.

In a nutshell, the present model taken has visions of developing a versatile mechanical implement, which fits various purposes ranging from clearing vast tracts of bush-infested cultivable lands to replacing the lawn-mowers in difficult landscaping works, so as it stands, the major objectives of the work are:

(i) To Develop the self-propelled bush cutter.

(ii) To evaluate the performance of the unit.

REVIEW OF LITERATURE

A brief review of the various methods adopted in cutting shrubs, forage crops etc. are dealt in this chapter.

2.1 Manual methods

Traditionally, the cutting of shrubs were generally done by the use of some hand tools such as sickles. Sickles with serrated edges gave a better efficiency. Sickles with serrated edges were light in weight and required less or no cutting force (Michael and Ojha, 1978). However, manual methods are being outdated mainly because of irritation caused to the human skin while doing the cutting operation.

2.2 Mechanical methods

Harvesting machines are generally equipped with 2 types of cutting mechanism, the reciprocating and rotary type cutter. Cutterbars are mostly used for harvesting cereals, pulses and oil seeds while the rotary type mechanism is mostly used in harvesting forage crops and grasses. The advantage of rotary type mowers lies in its simplicity in construction, sturdiness, less wearing parts and therefore less frictional power loss, high working speed and higher field capacity.

2.2.1 Impact type cutters

Impact cutting principle is applied in 2 types of implements described as rotary cutters and flail shredders. A rotary cutter has knives rotating in a horizontal plane (eg. rotary lawn mower) whereas a flail shredder has knives rotating in vertical planes parallel with direction of travel (Kepner *et al.*, 1978). These were first developed for cutting up stalks, small brush, cover crops, weeds and other similar jobs. In early 1950's stalk cutters and shredders were adopted for chopping forage crops as a low priced for conventional shear bar type field chopper. In the rotary cutters, knives were attached to the support arms through vertical hinge axes so that they could swing back if an obstruction was hit. However, these were hazardous because of the tendency to throw solid objects outward in a violent manner. Flail shredders had free swinging knives attached through a loop or a chain link rather than through pivot axes to provide greater flexibility in rocky condition.

2.2.2 Flail mowers

This employed a horizontal shaft with swinging cutting blades rotating in vertical plane (Culpin, 1978). The knives could be mounted on the cylinder in a variety of ways the most common being a simple pivot mounting which allowed the blades to fold inwards on meeting with an obstruction or an overload.

2.2.3 Orchard mower

Rotary mowers with vertical spindles were widely used. In the first machine with swinging wing which could work right upto tree trunks were used but the guarding required currently safety regulations and interfer with efficient cutting by the wing, so the growers tend to rely increasingly on the use of herbicides (Culpin, 1978). It is difficult to keep orchards really smooth and rotary mowers can keep going in these conditions which are too rough for gang mowers.

2.2.4 Rotary countershear mower

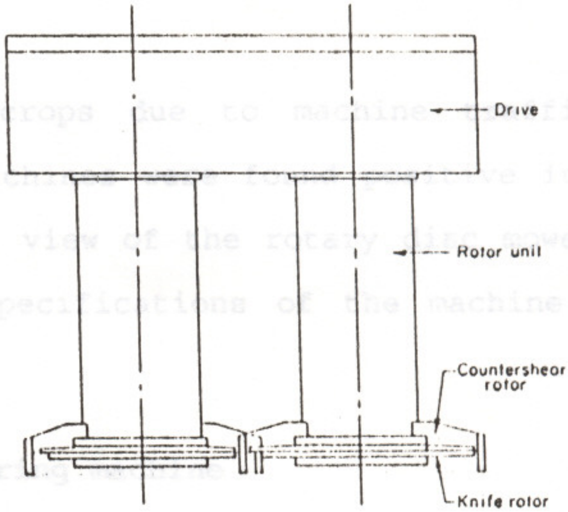
An experimental rotary shear mower was demonstrated in England (Copland and Watchorn, 1987). It had two cutting units each consisting of 2 counter rotating cutting discs with teeth. The average power consumption was 3 KW/m of cutting width and the peripheral speed was 9 m/s. Rotary counter shear mowers for field crops are presently not commercially available.

A rotary countershear mower was analysed, built, tested and evaluated (Persson, 1991). It consisted of sets of two concentric counter rotating discs, one with collecting countershear fingers and one with knives in close contact with the countershears. The shape of the active edges and relative velocities of the rotors were selected as to provide favourable cutting including minimum deflection of the crop. This was operated at forward speeds upto 6.2 km/hr with a power consumption of 1.6 KW/m of cutting width knife velocity was 20 m/s. Figure 2.1 shows the details of the rotary cuntershear mower.

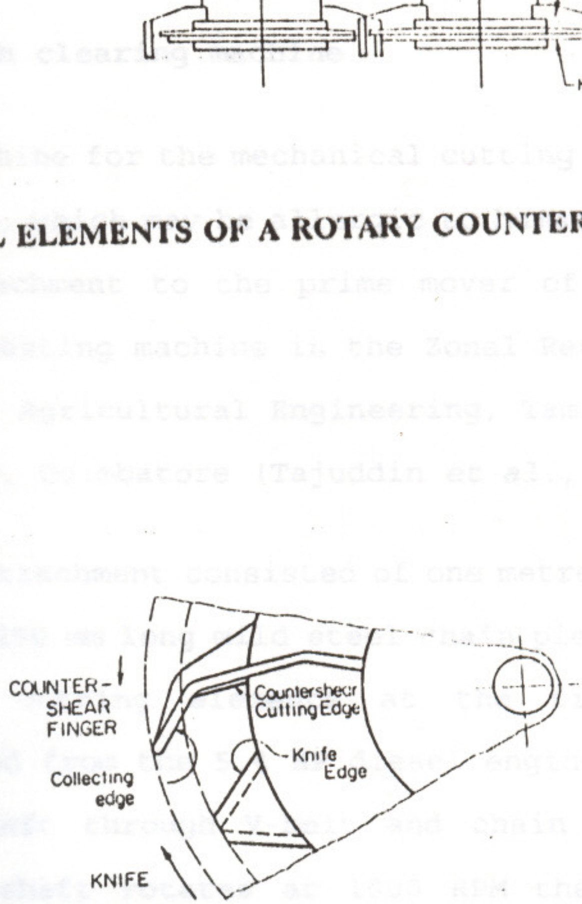
2.2.5 Rotary disc mower

The cutting principle of rotating disc mower is that knife like edge travelling at high speed, cuts through the grass on impact (Hawker and Keenlyside, 1971). In practice this is done by having a series of blades mounted on a disc which rotates at high speed (3000 rpm) parallel to the ground. The number of blades varies from one machine make to another, generally two, three or four. The shape of the blades may be triangular, or rectangular but nearly in all cases they can be removed and replaced to expose another cutting edge.

A tractor operated rotary disc mower was designed developed and tested for harvesting berseem, lucerne and oats (Chattopadhyay and Jai Singh (1982). The effective field capacity was 0.35 ha/hr with 74.4 per cent field efficiency. The cost of harvesting of berseem by the machine including gathering were reduced to Rs.160/ha which is about 50 per cent with reference to the cost of manual harvesting by sickle. There were no adverse effect on regeneration of multicut



PRINCIPAL ELEMENTS OF A ROTARY COUNTERSHEAR MOWER



COUNTERSHEAR FINGER AND KNIFE, TOP VIEW

FIG.2.1 DETAILS OF ROTARY COUNTERSHEAR MOWER

variety forage crops due to machine traffic and impact cutting. The machines were found positive in level fields only. The front view of the rotary disc mower is shown in Fig.2.2. The specifications of the machine are given in Appendix-I.

2.2.6 Bush clearing machine

A machine for the mechanical cutting of bushy plants like Parthenium, which may be allergic to human body, was developed as an attachment to the prime mover of the self propelled paddy harvesting machine in the Zonal Research Centre of the College of Agricultural Engineering, Tamil Nadu Agricultural University, Coimbatore (Tajuddin *et al.*, 1992).

The attachment consisted of one metre long shaft carrying 6 mm size 250 mm long mild steel chain pieces with circular MS flats as cutting elements at the tip. The power is transmitted from the 5.4 HP diesel engine of the prime mower to the shaft through V-belt and chain sprocket mechanism. When the shaft rotates at 1000 RPM the plants are cut by impact. A separate clutch is provided to cut off the shaft rotation irrespective of forward travel of the machine.

The machine can clear 0.2 hectares of land in 1 hr with one operator. The attachment above costs Rs.6300/-. The operational cost of clearing one hectare of land by this machine works out to Rs.102/- as compared to Rs.313/- by conventional method of manual clearing.

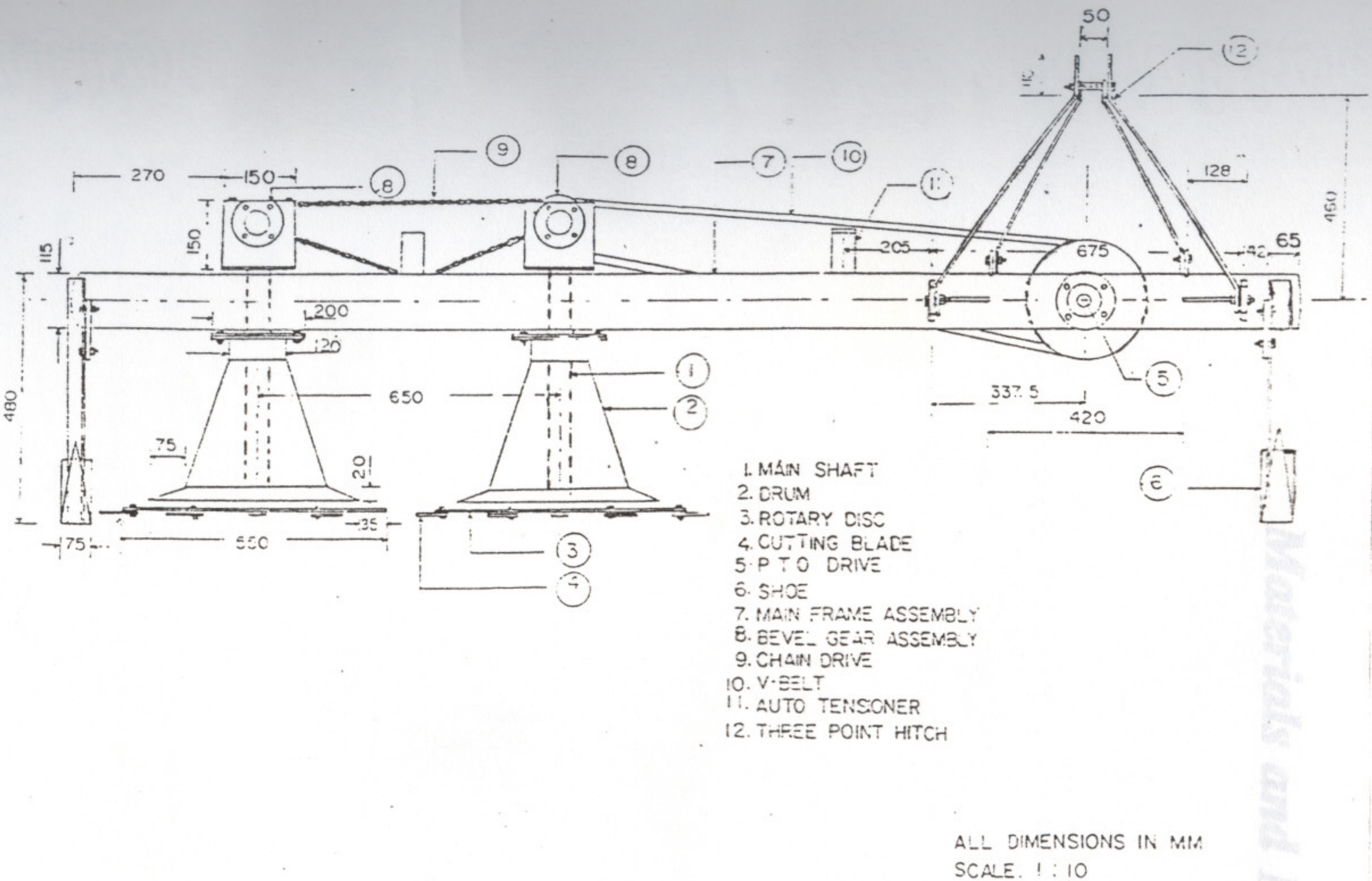


FIG.2.2 ROTARY DISC MOWER

MATERIALS AND METHODS

This chapter describes the procedures adopted for the fabrication of the bush cutter and performance evaluation of the bush cutter assembly.

3.1 Development of the bush cutter assembly

The bush cutter assembly consisted of the following:

1. Frame
2. Cutting unit
3. Power transmission unit
4. Prime mover

3.1.1 Frame

The frame consisted of two parts namely bush cutter frame for mounting the cutting unit and the self propelled reaper frame for mounting the engine.

3.1.1.1 Bush cutter frame

Figure 3.1(a) and 3.1(b) shows the details of the bush cutter frame. A rectangular frame of 350 x 280 mm was made out of 4 MS angles of 35 x 35 x 7 mm by welding them together. Four MS angles of 25 x 25 x 7 mm were welded to each corner of

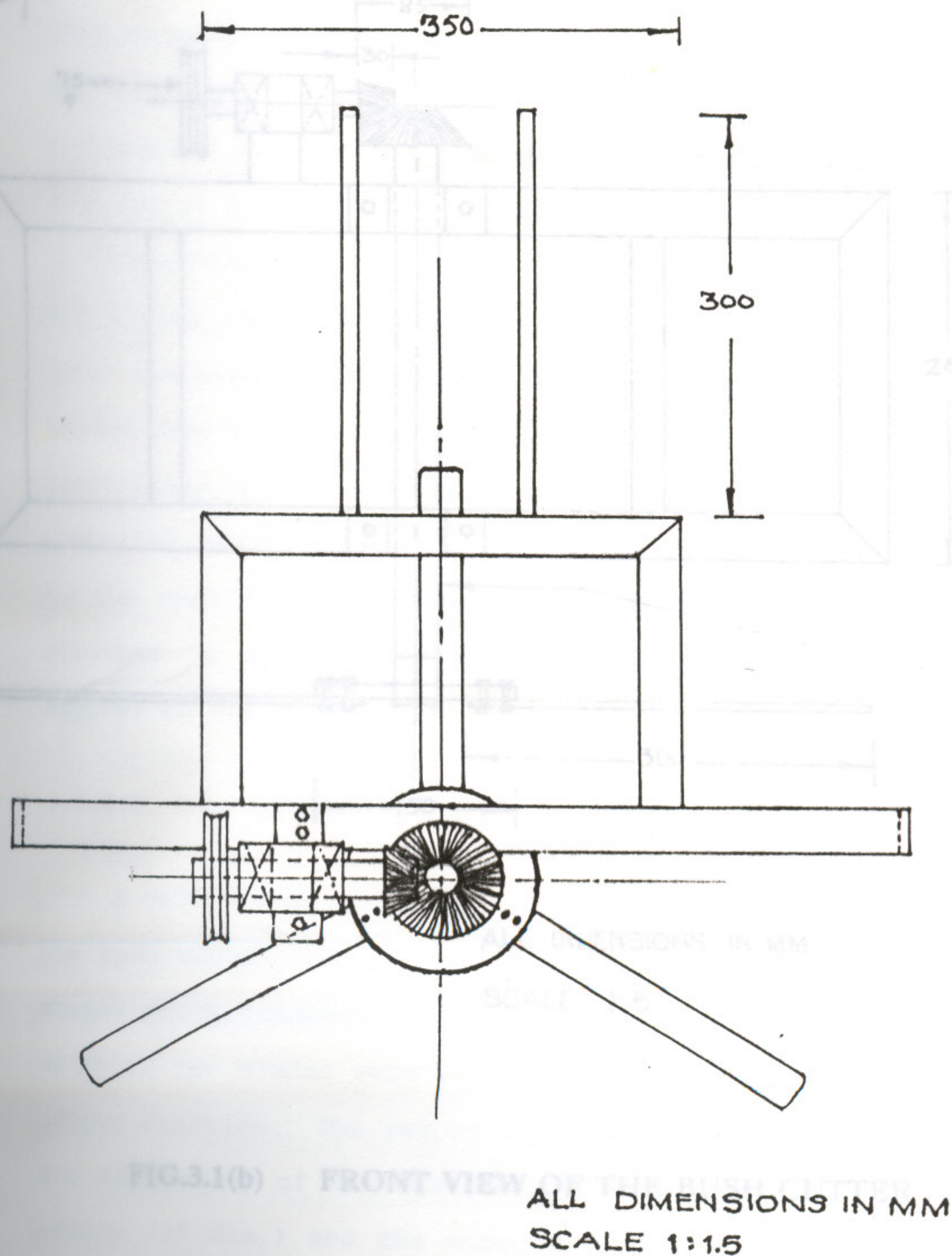


FIG.3.1(a) TOP VIEW OF THE BUSH CUTTER

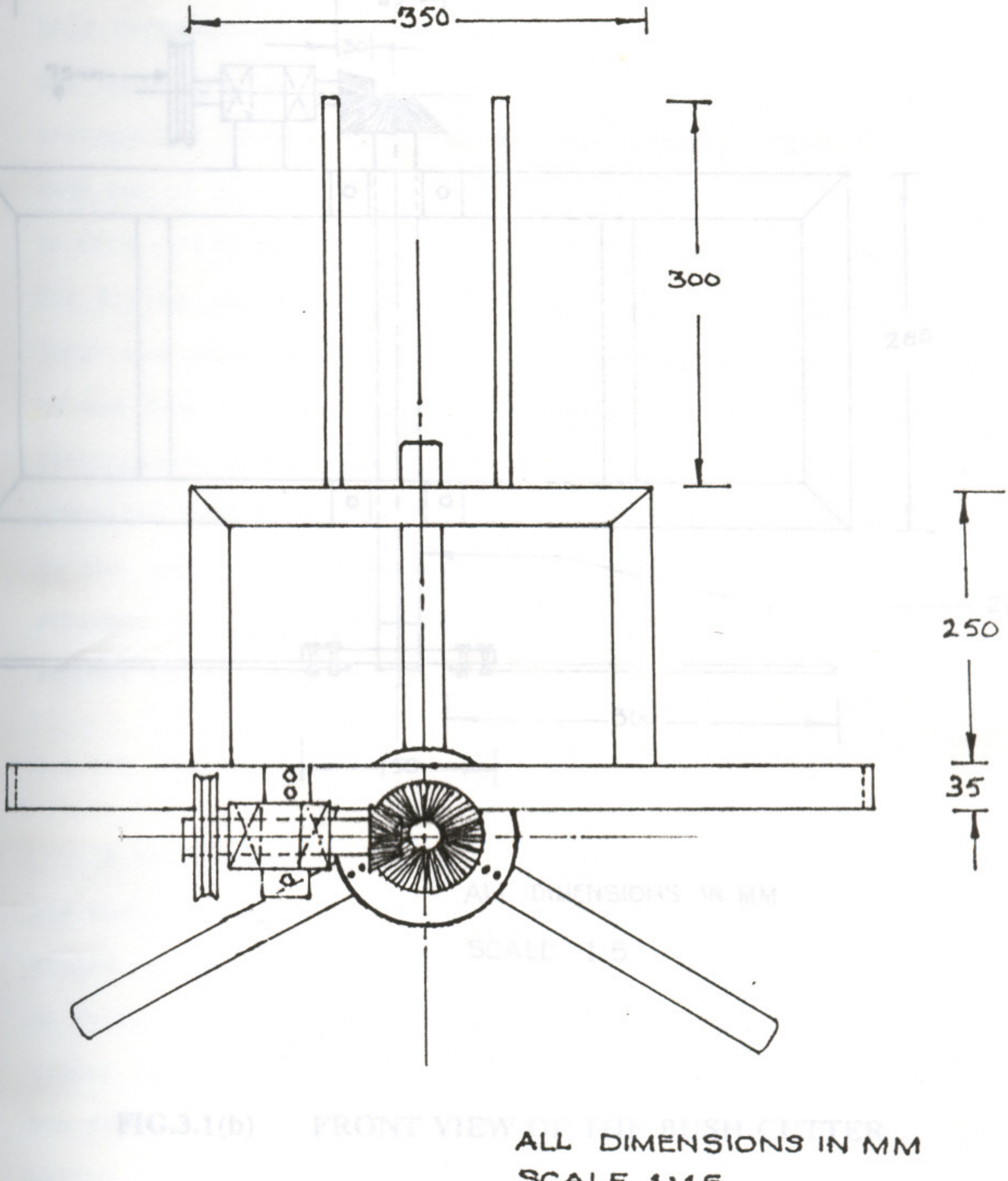
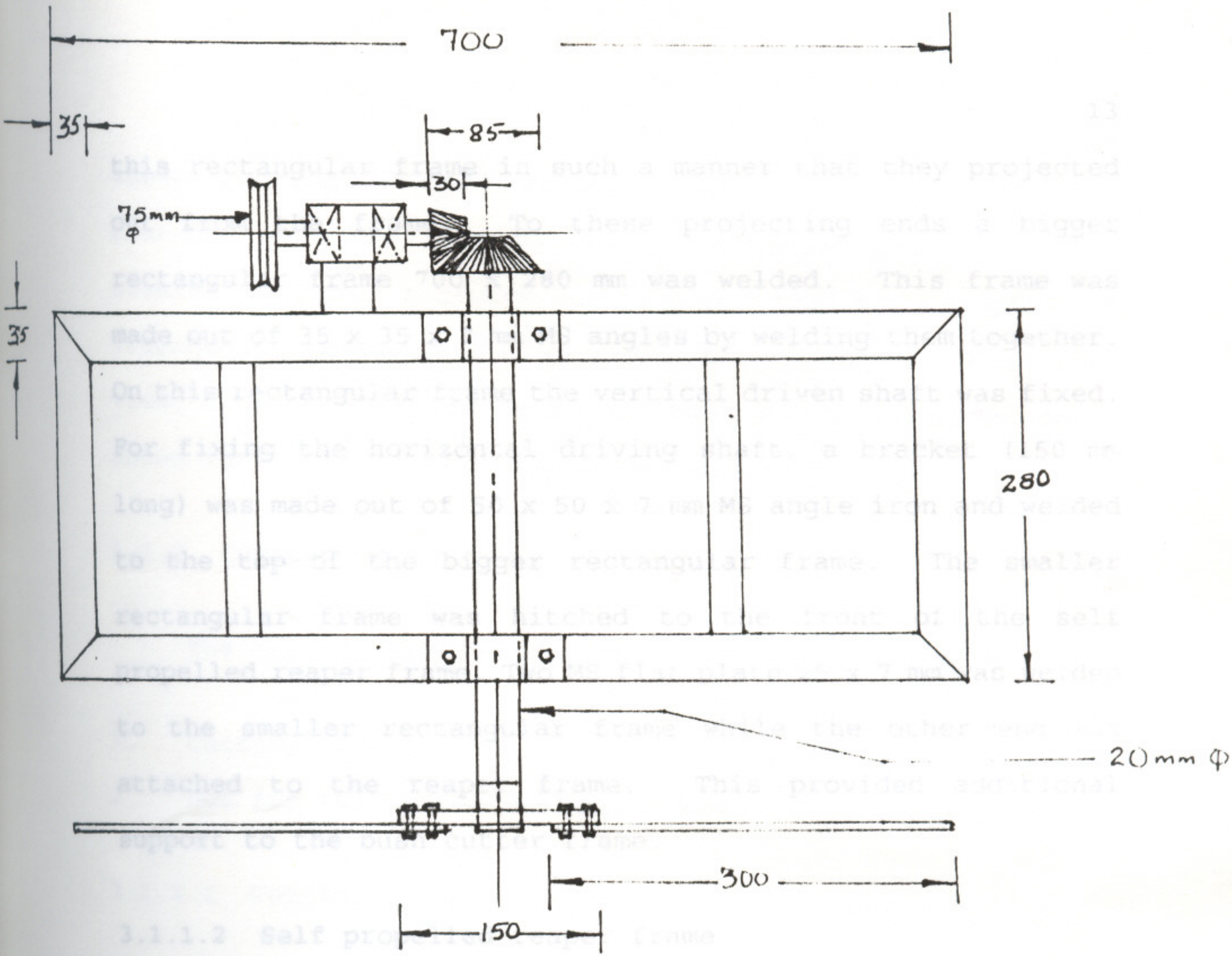


FIG.3.1(a) TOP VIEW OF THE BUSH CUTTER



ALL DIMENSIONS IN MM

SCALE 1:5

FIG.3.1(b) FRONT VIEW OF THE BUSH CUTTER

this rectangular frame in such a manner that they projected out from the frame. To these projecting ends a bigger rectangular frame 700 x 280 mm was welded. This frame was made out of 35 x 35 x 7 mm MS angles by welding them together. On this rectangular frame the vertical driven shaft was fixed. For fixing the horizontal driving shaft, a bracket (150 mm long) was made out of 50 x 50 x 7 mm MS angle iron and welded to the top of the bigger rectangular frame. The smaller rectangular frame was hitched to the front of the self propelled reaper frame. Two MS flat plate 25 x 7 mm was welded to the smaller rectangular frame while the other end was attached to the reaper frame. This provided additional support to the bush cutter frame.

3.1.1.2 Self propelled reaper frame

A self propelled reaper frame was selected for hitching the bush cutter frame. This was fitted with a 5 HP diesel engine which transmitted power to the vertical driven shaft, on which the blades were fixed, as well as to the wheels for proper traction. The reaper frame consisted of two pulleys. One big pulley of 12" dia., which was driven by the engine pulley (3" dia.) and the other a smaller pulley of 5" dia. from which the power was tapped for the cutting unit of the bush cutter. Two cage wheels were used so that this could be used in undulated fields, rocky conditions etc. Usage of cage wheels provided better traction. This was provided with side clutches with the help of which the reaper frame could be steered through. A clutch was also provided for engaging and disengaging power to the vertical driven shaft. The front view, side view and the developed bush cutter in operation is shown in Plates I, II and III respectively.

3.1.2 Cutting unit

The cutting unit consisted of the following parts:

1. Cutting blades
2. Hub for fixing the cutting blades

3.1.2.1 Cutting blades

The pivotal part of the cutting unit was the three cutting blades that were fixed at an angle of 120° between each other. Each blade was 300 mm long, 40 mm wide and 4 mm thick. The edges on the clockwise side of the blades were sharpened methodically to obtain good results. The material used for construction of blade was high quality spring steel. The blades were fixed on the hub by means of six 1½" long 3/8 BSW nuts and bolts.

3.1.2.2 Hub

A 6" dia. circular plate was used as the hub for fixing the blades. The plate was suitably turned and faced to obtain the hub. Six holes of 8 mm dia., two each for holding each blade, was drilled and these holes were tapped using a 3/8 tap for making threads. The blades were then fixed on to the circular hub by means of six 1½" long 3/8 BSW nuts and bolts.

Figure 3.2 shows the details of the cutting unit.

3.1.3 Power transmission unit

The power transmission unit can be divided in different sections for better assimilation. The main parts of the power transmission unit are:

1. Vertical driven shaft
2. Horizontal driving shaft
3. Bevel gear assembly
4. Bearings and bearing blocks
5. V-belt

3.1.3.1 Vertical driven shaft

A MS shaft 470 mm long and 20 mm diameter was chosen and was turned and faced to suit the requirements. At one end of the shaft a bevel gear (85 mm dia., 42 teeth) was fixed. Two

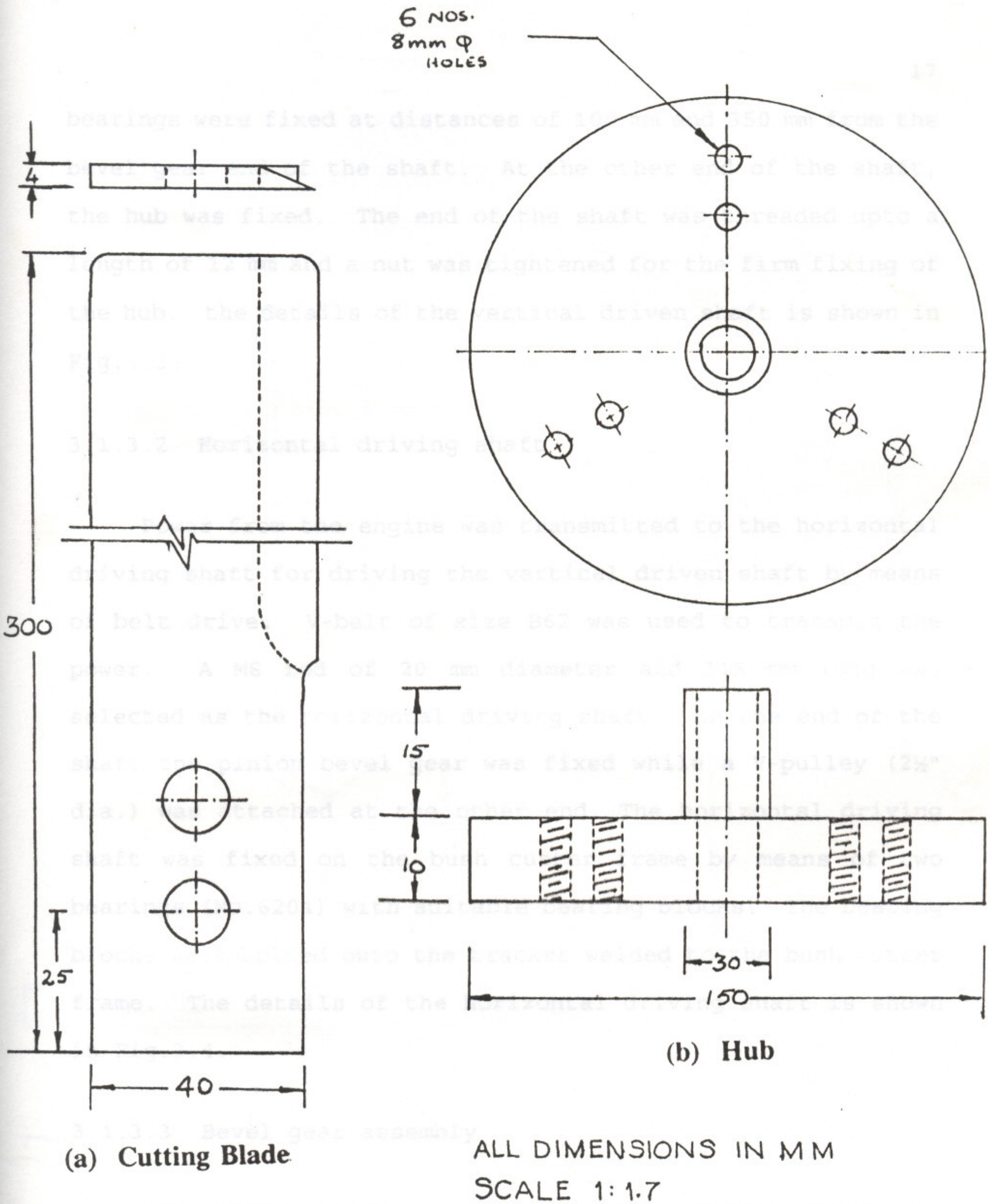


FIG.3.2 CUTTING UNIT OF THE BUSH CUTTER

bearings were fixed at distances of 100 mm and 350 mm from the bevel gear end of the shaft. At the other end of the shaft, the hub was fixed. The end of the shaft was threaded upto a length of 12 mm and a nut was tightened for the firm fixing of the hub. the details of the vertical driven shaft is shown in Fig.3.3.

3.1.3.2 Horizontal driving shaft

Power from the engine was transmitted to the horizontal driving shaft for driving the vertical driven shaft by means of belt drive. V-belt of size B62 was used to transmit the power. A MS rod of 20 mm diameter and 115 mm long was selected as the horizontal driving shaft. On one end of the shaft the pinion bevel gear was fixed while a V-pulley (2½" dia.) was attached at the other end. The horizontal driving shaft was fixed on the bush cutter frame by means of two bearings (No.6204) with suitable bearing blocks. The bearing blocks were bolted onto the bracket welded to the bush cutter frame. The details of the horizontal driving shaft is shown in Fig.3.4.

3.1.3.3 Bevel gear assembly

The rotary motion to the vertical driven shaft was imparted by means of a pair of bevel gears. The pinion bevel gear was fixed onto the horizontal driving shaft which was

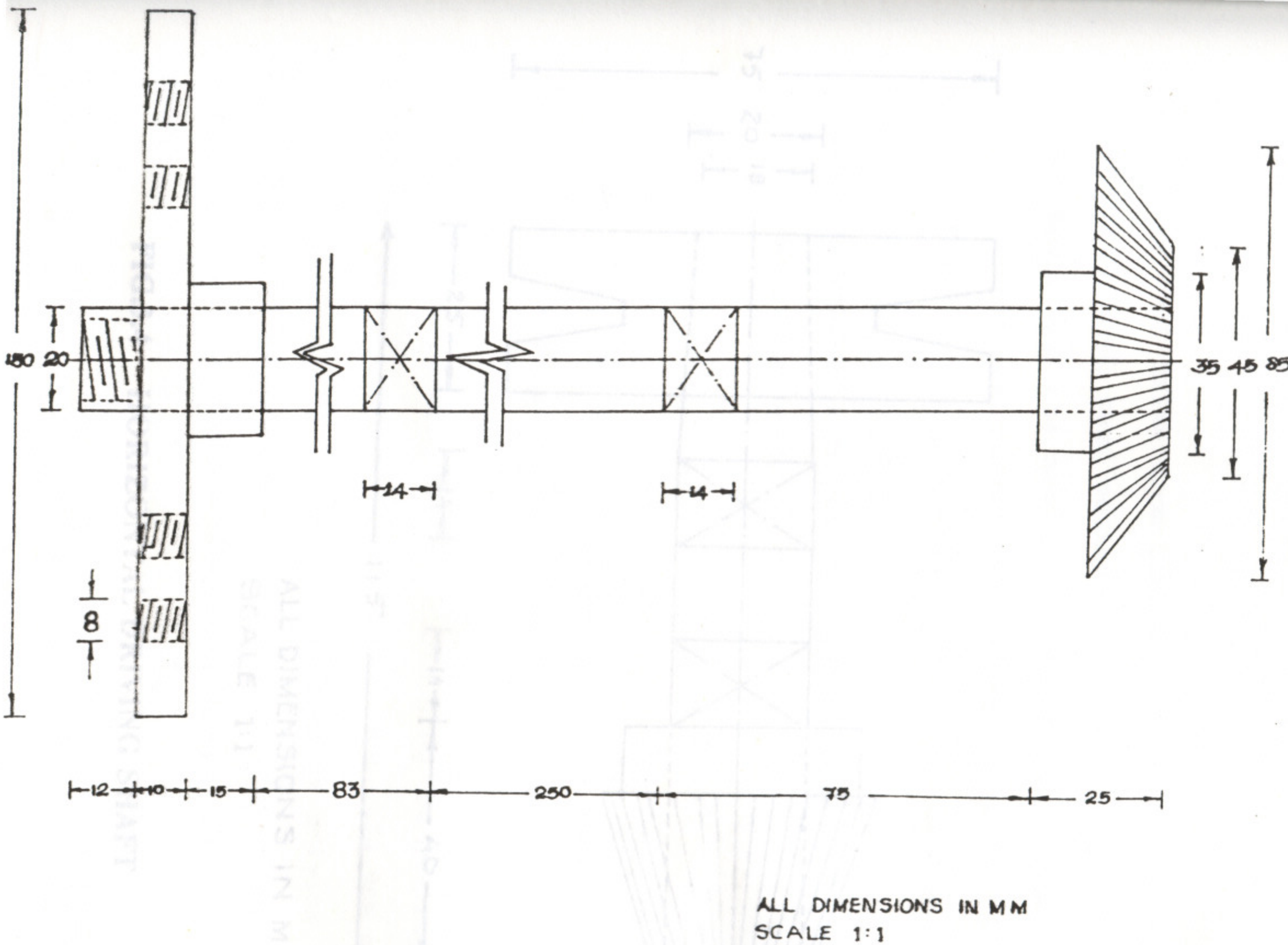
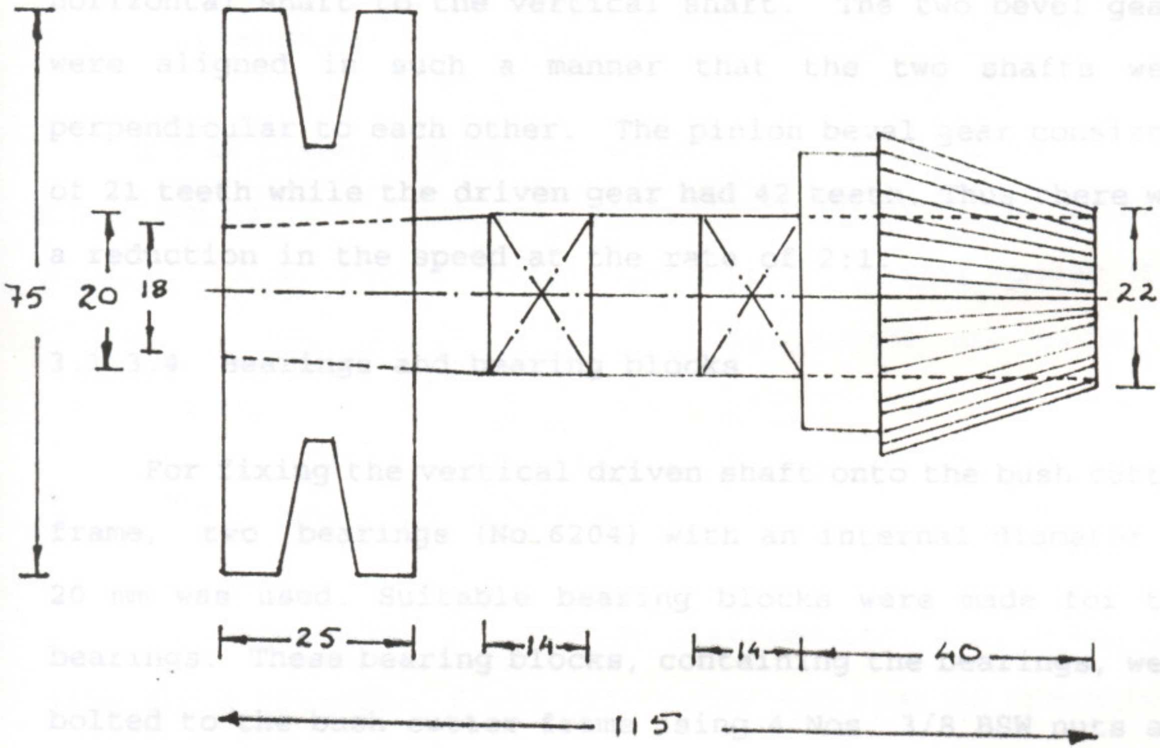


FIG.3.3 VERTICAL DRIVEN SHAFT



ALL DIMENSIONS IN MM
SCALE 1:1

FIG.3.4 HORIZONTAL DRIVING SHAFT

rotated by belt drive from the smaller pulley on the reaper frame. This bevel gear meshed with the one on the vertical driven shaft and the motion was thus transmitted from the horizontal shaft to the vertical shaft. The two bevel gears were aligned in such a manner that the two shafts were perpendicular to each other. The pinion bevel gear consisted of 21 teeth while the driven gear had 42 teeth. Thus there was a reduction in the speed at the rate of 2:1.

3.1.3.4 Bearings and bearing blocks

For fixing the vertical driven shaft onto the bush cutter frame, two bearings (No.6204) with an internal diameter of 20 mm was used. Suitable bearing blocks were made for the bearings. These bearing blocks, containing the bearings, were bolted to the bush cutter frame using 4 Nos. 3/8 BSW nuts and bolts. Similarly for fixing the horizontal driving shaft 2 bearings (No.6204) with suitable bearing blocks were selected and bolted to the bracket extending from the bush cutter frame.

3.1.3.5 V-Belt

The c/c distance of the pulley on the reaper frame to the pulley on the horizontal driving shaft was 690 mm and so a V-belt of B-62 size was selected for the power transmission. For rotating the pulley on the reaper frame, power was obtained from the engine to the bigger pulley mounted on the same shaft as that of the smaller pulley on the reaper frame. V-belt of B-60 size was selected for this purpose.

3.1.4 Prime Mover

A 5 HP diesel engine was selected as the prime mover. It had a RPM of 1800 which was required for rotating the cutting blades. The engine also serves to transmit power for traction. The specifications of the engine are given in appendix II.

3.2 Performance Evaluation

Performance of the unit was analysed for various aspects like field capacity, field efficiency and cost of operation.

3.2.1 Field Capacity

The field capacity of an implement is an important criterion as it gives an exact idea of the rate at which the operation is finished. Knowing the width of cut and the operating speed the theoretical field capacity could be calculated using the formula:

$$\text{T.F.C.} = \frac{W \times S}{10}$$

where,

W = Width of cut in metres

S = Operating speed in km/hr

T.F.C. = Theoretical field capacity in ha/hr

For finding out the effective field capacity a plot of 10m x 6m infested by bushes was selected in a coconut orchard in the college campus. The bush cutter was operated at a speed of 3 km/hr and the time taken to clear off the bushes in the selected plot was noted. From this the effective field capacity was found out.

3.2.2 Field Efficiency

After calculating the theoretical field capacity and effective field capacity the field efficiency was determined by the relation.

$$\text{Field efficiency (\%)} = \frac{\text{Theoretical field capacity}}{\text{Effective field capacity}} \times 100$$

3.2.3 Cost of Operation

A comparison of the cost involved for bush clearing in one hectare of land by means of manual labour and by means of the developed bush cutter was done. The cost for manual labour was taken as Rs.150 per day. Cost analysis for the developed bush cutter taking into consideration the fixed cost and variable cost was done. The cost analysis of the developed bush cutter is given in appendix III.

RESULTS AND DISCUSSION

The result of the work carried out and the evaluation of the performance of the bush cutter assembly to find an amicable settlement to the problem of bush infestation in the State of Kerala and other areas with similar environs, is discussed. The work included, the fabrication of the bush cutter assembly, attaching the unit to a self-propelled reaper frame. Performance of the unit was analysed for various aspects like field capacity, field efficiency and cost of operation. Before going into further details of performance evaluation a general study of performance is mentioned below.

4.1 Cutting Unit

The material selected for the blades, which formed the cutting unit, was spring steel. This has the ability to withstand the forces that may be overcome in cutting thick stems, trashes etc. with least amount of wear. This was found to be very effective for the cutting operation. One edge of the cutting blades were sharpened for efficient cutting. Three blades were selected for the cutting unit and this proved very efficient.

4.2 Main Shaft

Selection of the main shaft with respect to the material and size of the shaft, was an important factor. The entire thrust encountered in cutting the bushes had to be taken up by the main shaft. Keeping this aspect in view, a M.S. rod of 20 mm diameter was selected which was found to be satisfactory.

4.3 Self propelled reaper frame

The bush cutter was mounted on the front of the self propelled reaper frame. The selection of the reaper frame as the mounting unit for the bush cutter was found to be an ideal one as the reaper frame is one with good maneuverability. In case an obstacle had to be overcome such as stones, boulders, rock etc. the implement could be raised or lowered by adjusting the handle to surpass the obstacle and proceed the cutting operation, thus having a control over the height of cut. Also the cage wheels provided gave good traction especially in undulating, trashy surfaces. Clutches provided in the reaper frame enabled the engaging or disengaging of the power to the implement. Side clutches were also provided for efficient steering of the machine in the required direction.

4.4 Selection of prime mover

A 5 HP diesel engine was selected as the prime mover. This gave the required power for rotating the shaft with cutting blades.

Table 1. Performance of the developed bush cutter

Sl. No.	Length (m)	Time taken for cutting (s)	Time lost in turning (s)
1.	10	11	8
2.	10	11	10
3.	10	12	8
4.	10	13	9
5.	10	12	9
6.	10	11	7
7.	10	13	10
8.	10	11	8
9.	10	13	8
10.	10	12	10
		119	87

4.5 Field capacity

The width of cut of the developed bush cutter was 0.60 m and the operating speed was 3 km/hr. Thus the theoretical field capacity was found out to be 0.18 ha/hr.

For determining the effective field capacity, a plot of 10m x 6m was selected and the total time taken for clearing the selected plot of bushes was found out. The time taken for cutting and the time lost in turning for the various passes is shown in Table I. From these datas the effective field capacity was calculated as follows:

Area of the plot	=	60 m^2
Total time taken for cutting	=	119 s
Total time lost in turning	=	87 s
Total time taken for clearing the bush infested plot of 60 m^2 area	=	119 + 87 = 206 s

$$\therefore \text{Effective field capacity} = \frac{60}{206} \times \frac{3600}{10000}$$

$$= 0.105 \text{ ha/hr}$$

4.6 Field Efficiency

It was seen that the theoretical field capacity was 0.18 ha/hr and the effective field capacity was 0.105 ha/hr.

Thus, the field efficiency of the developed bush cutter was computed and was found to be 58.33%.

4.7 Cost of operation

The economy of any agricultural implement is directly related to its cost of operation. In this era of high labour charges and high initial investments, the profitability of any farming operations is directly connected to the economy of the machine. It was observed that the cost of clearing bushes from an area of 1 hectare, manually was Rs.450. Due to this high labour charge it is essential to develop a machine for this purpose which should be economical while substituting for human labour. From the cost analysis of the developed bush cutter it was observed that cost of clearing bushes from 1 hectare land was about Rs.402.44 which is more economical than manual labour.

Thus it was observed that the bush clearing operation by the newly fabricated bush cutter machine was more economical than manual operation. The introduction of the bush cutter machine in Kerala Agricultural scene will solve many problems such as infestation of land by bushes, labour shortage for such operations, etc.

SUMMARY

Bushes and other unwanted weed growth, consume a lot of cultivable land and make then unfit for cultivation. Reclamation of these lands for any sort of cultivation practises is difficult and time consuming. Major hazard is that, the job is highly labour intensive. Reclamation of vast tracts of land requires a lot of manual labour. In this era of heavy labour-scarcity and high wages, the act of clearing of bushes and weeds by manual labour may be uneconomical.

After deciding upon the intricacies of the design, a competitive analysis was done to select a project for bush-cutter assembly. It was found that the self-propelled reaper frame was the most suitable machine for attachment.

The fabrication of bush cutter is summarised below:

A rectangular angle iron frame was made on which four angle irons were mounted. A longer angle iron frame, which holds the driven shaft was mounted on this structure. The whole frame was attached to the reaper frame by means of nuts and bolts.

The drive from the engine pulley, which is conveyed by means of a V-belt, was transmitted to the vertically aligned central shaft by means of bevel gear assembly. A horizontal shaft conveyed the drive from driven pulley to the bevel gear assembly. At the bottom, the blades were mounted on a circular hub of 6" dia. The hub was fixed at the bottom of the shaft by means of adequate nuts and bolts. Holes were drilled on the plate and the blades were fixed at an angle of 120° between each other. The selection of number of blades as 3 was very effective as any increase in numbers would have crowded the cutting area.

Performance evaluation was done for various aspects of the machine like field capacity, field efficiency and comparative cost of operation with manual labour. It was observed that the developed bush cutter had an effective field capacity of 0.105 ha/hr with 58.33% field efficiency. It was also observed that the cost of clearing 1 hectare land infested with bushes was Rs.402.44 as compared to a manual labour charge of Rs.450/ha.

The operation with self prepelled reaper frame mounted bush cutter was effective as it had excellent controls and depth of cut could be adjusted by lowering or hoisting the handle. It can be said that the reaper frame - mounted bush cutter is a very efficient and versatile implement in reducing the drudgery in bush clearing operation in our state.

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APPENDIX-I

Specifications of the tractor operated rotary disc mower

Type of prime mover	:	Tractor
Recommended size of prime mover	:	35 HP
Type of drive	:	PTO
Power transmission system	:	V-belt and chain sprocket drive
No. of discs	:	2
Dia of disc (mm)	:	555
No. of blades in each disc	:	6
Length of each blade (mm)	:	75
Bevel angle of the blade, dg	:	25
Maximum RPM of disc	:	1100
Maximum cutting speed of blade (m/s)	:	40
Eff. cutting width (mm)	:	1300
Cutting height (mm)	:	50-150
Overall dimensions (mm)		
Length	:	2600
Width	:	640
Height	:	630
Weight	:	300

APPENDIX-II

Specifications of the Engine

Make	:	Greaves
Model	:	1523, Diesel engine
Engine number	:	D.C 02751
Fuel	:	Diesel
Output	:	5.18 H.P
Speed	:	1800 RPM

APPENDIX-III

Cost analysis for manual labour

Cost of labour for working 8 hours per day	=	Rs.150
Cost of manual operation	=	Rs.18.75/hr

An average of 3 man days is required for bush clearing operation in 1 hectare.

Thus, cost of the bush clearing operation manually	=	18.75x24
	=	Rs.450/ha

Cost analysis for the developed bush cutter

Self propelled reaper frame

Initial cost (C)	=	Rs.30,000
Fuel consumption	=	1.00 lit/hr
Oil cost	=	1/3rd of fuel cost
Life period (L)	=	10 years
Operating hours per annum (H)	=	1000 hrs
Salvage value (S)	=	10% of initial cost

Fixed cost

Depreciation $= \dfrac{C-S}{L} \times \dfrac{1}{H}$

$$= \frac{30000-3000}{10} \times \frac{1}{1000}$$

= Rs.2.70/hr

Interest @ 12% per annum $= \frac{C+S}{2} \times \frac{I}{100} \times \frac{1}{H}$

$$= \frac{30000+3000}{2} \times \frac{12}{100} \times \frac{1}{1000}$$

= Rs.1.98/hr

Insurance = 1% of initial cost $= \frac{300}{1000}$ = Rs.0.30/hr

Taxes = 1% of initial cost $= \frac{300}{1000}$ = Rs.0.3/hr

Housing = 1% of initial cost $= \frac{300}{1000}$ = Rs.0.30/hr

Total fixed cost = Rs.5.58/hr

Variable cost

Fuel cost @ Rs.10/lit = Rs.10/lit x 1 lit/hr

= Rs.10/hr

Oil cost $= \frac{1}{3} \times 10$ = Rs.3.33/hr

Repair and maintenance = 10% of initial cost

$$= \frac{10}{100} \times \frac{30000}{1000}$$

= Rs.3/hr

Operators wages @ Rs.150/day $= \frac{150}{8}$ = Rs.18.75/hr

Total variable cost = Rs.35.08

∴ Total cost = Fixed cost + variable cost

= 5.58 + 35.08 = Rs.40.66/hr

Bush cutter assembly

Initial cost (C) = Rs.3000

Life period = 10 years

Salvage value (S) = 10% of initial cost

Operating hours per annum (H) = 500

Fixed cost

Depreciation $= \frac{C-S}{L} \times \frac{1}{H}$

$$= \frac{3000-300}{10} \times \frac{1}{500}$$

= Rs.0.54/ha

Interest @ 12% per annum $= \frac{C+S}{2} \times \frac{I}{100} \times \frac{1}{H}$

$$= \frac{(30000+300)\times 12}{2\times 100\times 500}$$

= Rs.0.396/hr

Housing 1% of initial cost $= \frac{1}{100} \times \frac{2000}{500}$

= Rs.0.06 hr

Taxes = Nil

Insurance = Nil

Total fixed cost = Rs.0.996/hr

Variable cost

Repair and maintenance = 10% of initial cost

$$= \frac{1}{100} \times \frac{3000}{500}$$

= Rs.0.6 hr

Total cost = Fixed cost + Variable cost

= Rs.0.996 + 0.6 = Rs.1.596/hr

∴ Total cost of operating the bush cutter = Rs.40.66 + Rs.1.596

= Rs.42.256/hr

Cost of operating in a land of 1 hectare area $= 42.256 \times \frac{1}{0.105}$

= Rs.402.44/ha

DEVELOPMENT AND PERFORMANCE EVALUATION OF SELF PROPELLED BUSH CUTTER

By

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ABSTRACT OF THE PROJECT REPORT

Submitted in partial fulfilment of the requirement for the degree of

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Faculty of Agricultural Engineering and Technology

KERALA AGRICULTURAL UNIVERSITY

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ABSTRACT

Extensive bush infestation, tenders many cultivable lands fallow since the cost of reclaiming such lands by manual operations sometimes may not be cost effective. A solution to alleviate the problem in our state, was sought under the project "Development and Performance Evaluation of Self-Propelled Bush Cutter" conducted at KCAET, Tavanur.

The self-propelled reaper frame was driven by a 5 HP diesel engine and the drive from the engine was conveyed to the vertical shaft mounted on a rectangular angle-iron frame, by means of a V-belt and a bevel gear assembly. Three blades were fixed at an angle of 120° between each other, on a 6" diameter circular plate fixed at the bottom of the vertical shaft.

Performance was evaluated for field capacity, field efficiency and cost of operation. The effective field capacity was 0.105 ha/hr with a field efficiency of 58.33%. The cost of operating the bush cutter was Rs.402.44/ha. It can be said that this machine could very well replace manual labour from the field of bush clearing in our State of Kerala.