A Hand-Operated Bar Mill for Decorticating Sunflower Seed, Rural Technology Guide No. 9

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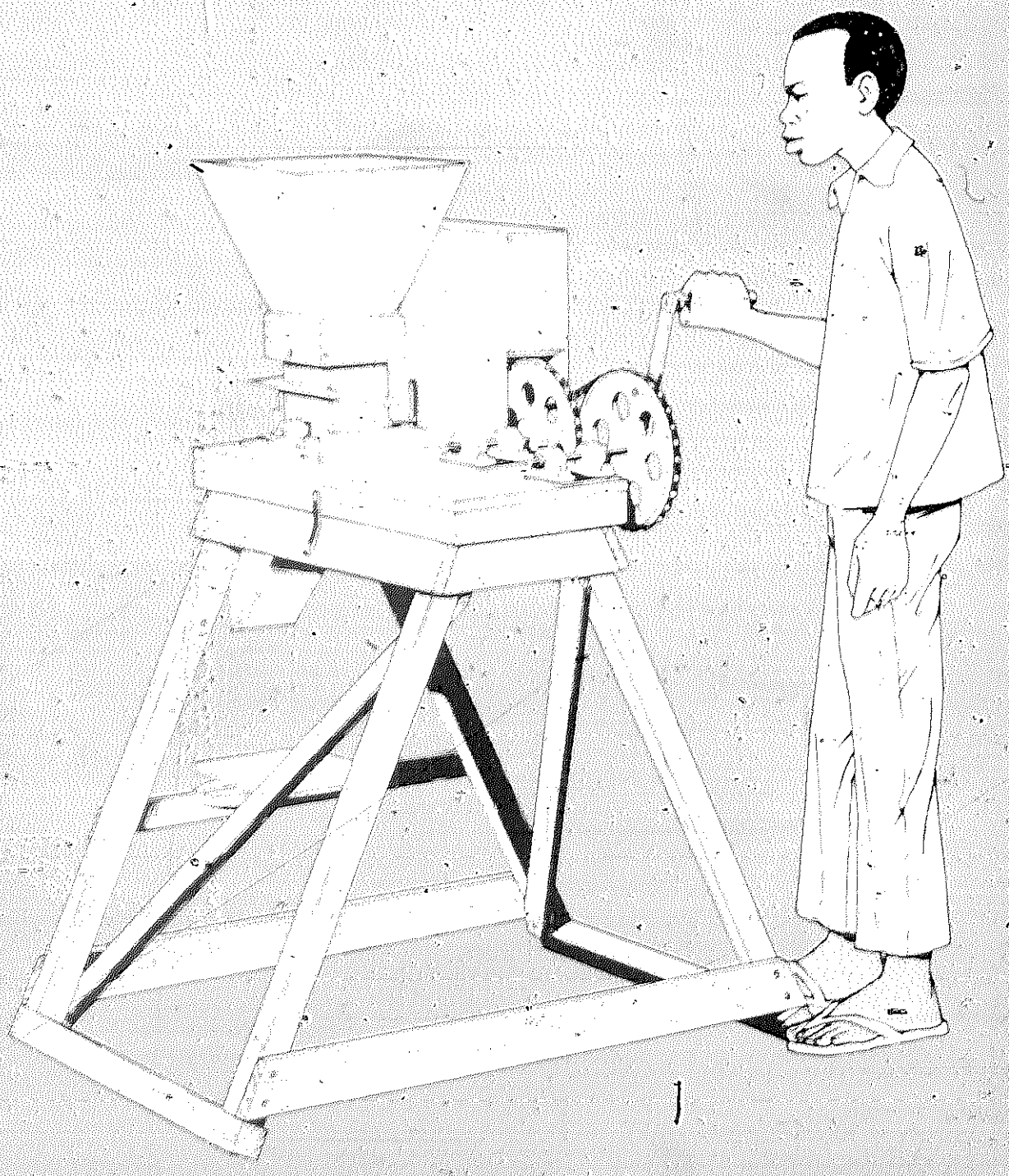

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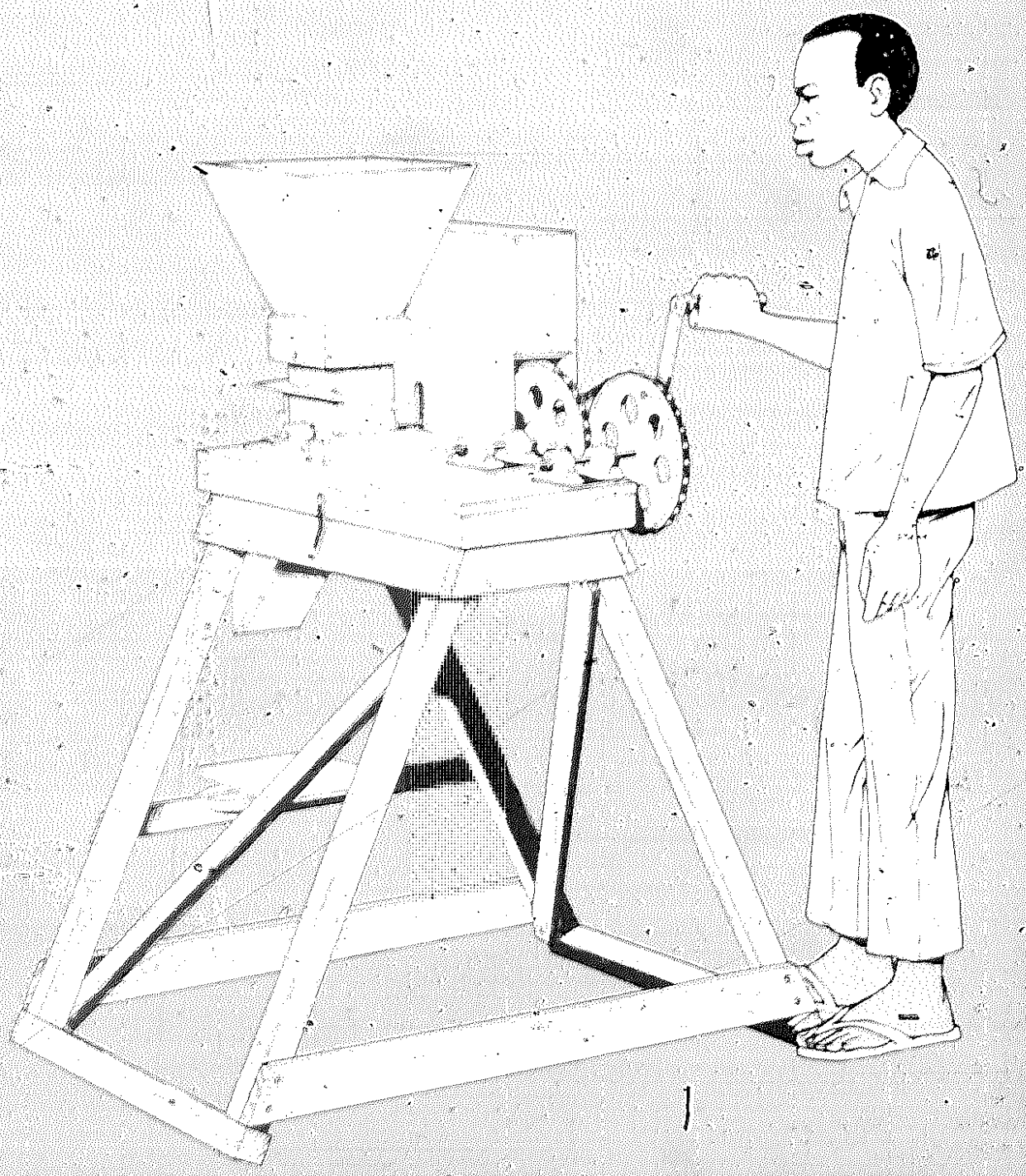
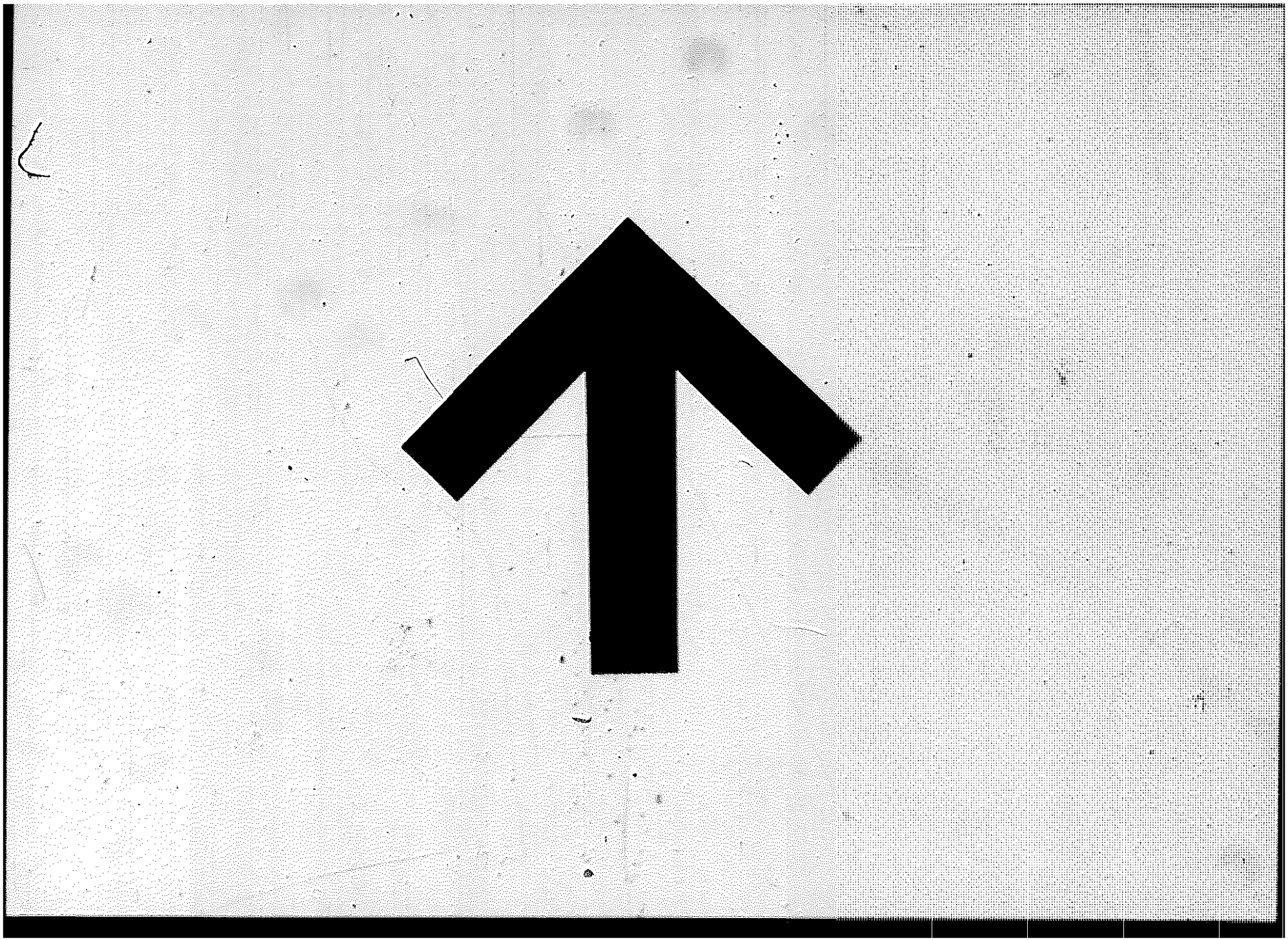




Rural Technology Guide 9 1981

A hand-operated bar mill for decorticating sunflower seed

J H Beaumont

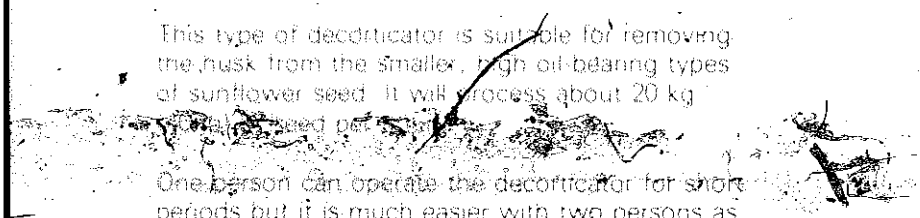
Tropical Products Institute

Contents

Introduction

This guide describes how to make a hand-operated bar mill for decorticating sunflower seed. Most of the parts are made in wood which should be available locally.

This type of decorticator is suitable for removing the husk from the smaller, high oil-bearing types of sunflower seed. It will process about 20 kg [illegible] seed per hour.



One person can operate the decorticator for short periods but it is much easier with two persons as one can take over when the other becomes tired.

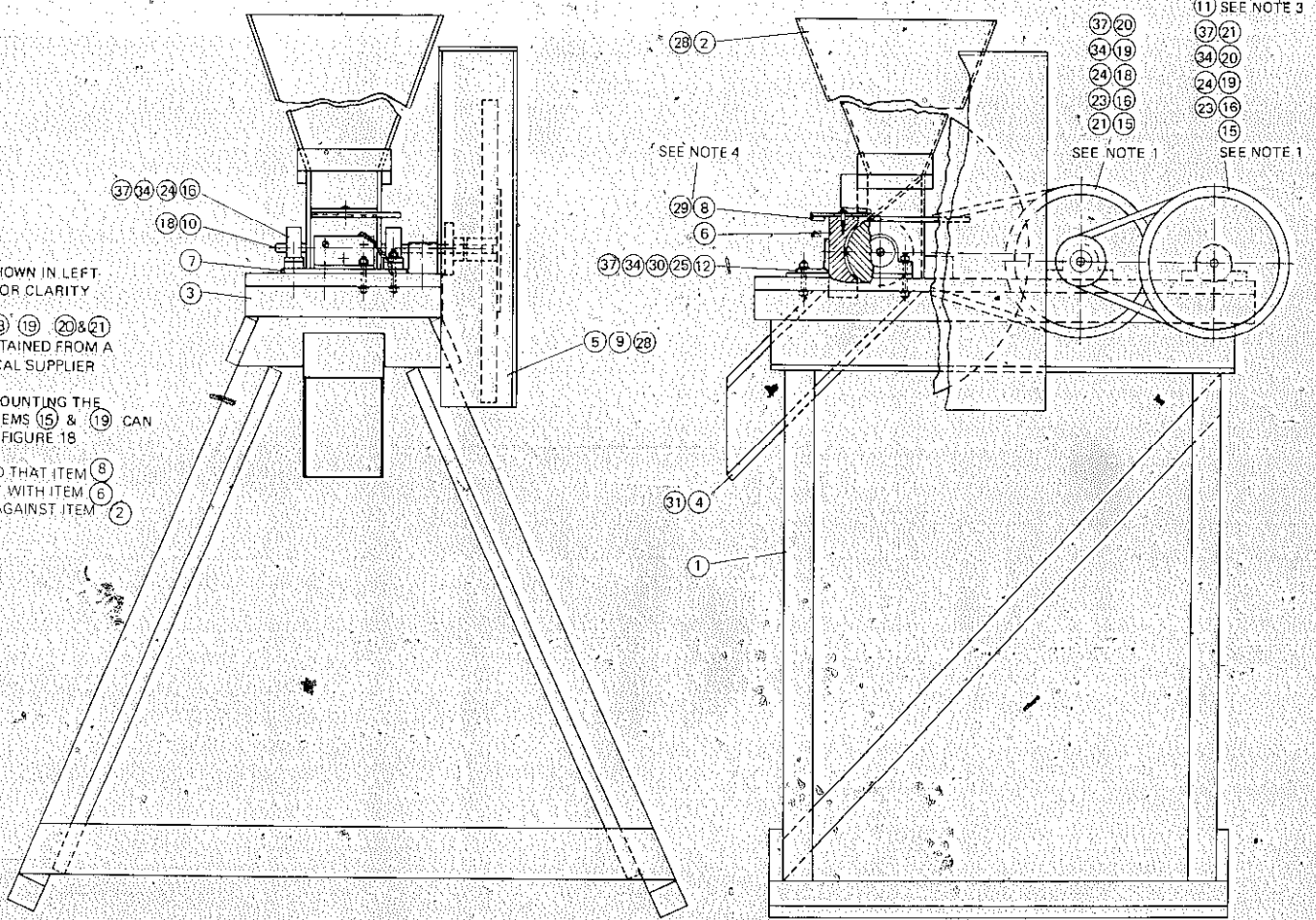
Description

A general arrangement of the decorticator is shown in Figure 1. The unit is made up of three distinct components: a bar mill, a feed hopper, and a mounting frame.

The mill itself consists of (a) a rotating cylinder to which are fixed strips of sheet steel, and (b) a concave stator with a circumference one quarter that of the cylinder, and with metal strips also fixed to its face. The size of the gap between the rotating cylinder and stator can be varied and seed fed from a hopper passes through the gap and is decorticated by the shearing effect of the metal strips.

Most of the parts of the bar mill are made of wood but you may use metal if this is cheaper or easier to obtain. Cylinders and stator quadrants made in both wood and metal have worked equally satisfactorily during field trials.

Figure 1
Bar mill assembly



NOTES

1) ITEMS NOT SHOWN IN LEFT HAND VIEW FOR CLARITY

2) ITEMS (16) (18) (19) (20) & (21) ARE TO BE OBTAINED FROM A SUITABLE LOCAL SUPPLIER

3) DETAILS OF MOUNTING THE HANDLE TO ITEMS (15) & (19) CAN BE FOUND ON FIGURE 18

4) FIT ITEM (29) SO THAT ITEM (8) SLIDES FREELY WITH ITEM (6) AND CLOSES AGAINST ITEM (2)

ITEM No	DESCRIPTION	No. OFF	REMARKS
1	WOOD FRAME	1	FIGURE 2
2	FEED HOPPER	1	FIGURE 12
3	TABLE	1	FIGURE 4
4	SHUTE	1	FIGURE 7
5	FLYWHEEL COVER	1	FIGURE 16
6	QUADRANT	1	FIGURE 6
7	BED PLATE	1	FIGURE 8
8	SHUTTER	1	FIGURE 13
9	FLYWHEEL ASSEMBLY	1	FIGURE 15
10	ROTOR ASSEMBLY	1	FIGURE 5
11	DRIVE HANDLE	1	FIGURE 18
12	ANGLE BRACKET	1	FIGURE 9
13			
14			
15	STEEL SHAFT	2	OD 12mm X 160 LONG
16	PLAIN BEARING PILLOW BLOCK	6	Ø12 BORE
17			
18	PULLEY WHEEL Ø 75	2	Ø 12 BORE SINGLE GROOVE
19	PULLEY WHEEL Ø 230	2	Ø 12 BORE SINGLE GROOVE
20	'V' BELT	2	
21	COLLAR (Ø 12 BORE)	4	STL 25 OD X 12 WIDE
22			
23	M8 SCREWED ROD	5	STL 90 LONG
24	M8 SCREWED ROD	7	STL 70 LONG
25	M8 SCREWED ROD	2	STL 55 LONG
26			
27			
28	WOOD SCREW	6	STL 60 LONG CSK HD
29	WOOD SCREW	1	STL 25 LONG ROUND HD
30	WOOD SCREW	3	STL 20 LONG CSK HD
31	WOOD SCREW	4	STL 15 LONG ROUND HD
32			
33			
34	M8 NUT	26	STL
35			
36			
37	M8 WASHER	28	STL

Manufacture

The decorticator can be manufactured in any well equipped workshop which is also able to call on the services of a carpenter. The following machine tools should be available, as well as competent operators to use them:

a. Small lathe for turning up the rotating cylinder and stator either in metal or wood.

b. Pedestal drilling machine.

c. Metal guillotine (preferably) or a band saw.

d. Welding set.

The following hand tools are required:

e. Bench and vice.

f. Hand held drill, electric if possible and twist drills.

g. Hacksaw.

h. Carpenters tools such as a plane, a wood saw, chisels and mallet.

i. Marking out equipment.

j. Files and general engineering hand tools.

The decorticator can be manufactured mainly from locally available materials but the following special components are also necessary.

k. Six plain bearing pillow blocks (see page 3)

l. Four pulleys (see page 3)

The materials required for the various parts are listed on page 5. All drawings are in 3rd angle projection as in British Standards 308. **All dimensions are in millimetres unless otherwise stated.**

Abbreviations
The following abbreviations have been used on drawings: — ALUM = aluminium; ASSY = assembly; CRS = centres; CSK countersink (*or* countersunk); C/BORE = counterbore; EQUI-SP = equally spaced; M/C = machine; MIN = minimum; OD = outside diameter; RAD = radius; REF = Reference; STL = steel; TRI = triangular; TYP = typical.

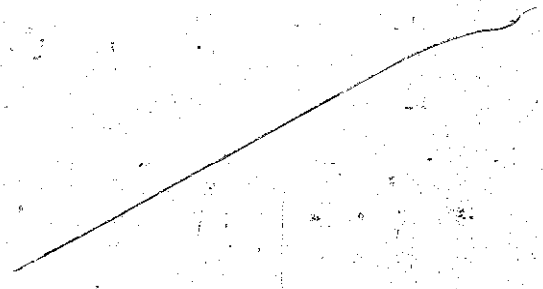
Construction and assembly instructions are given in the following pages. **You are advised to read them through carefully before starting work.**

If further information or explanation is required, please write to Tropical Products Institute, Industrial Development Department, Culham, Oxfordshire.

Parts and materials list

(All dimensions in millimetres)

Part Description	Figure No.	Part Detail	Material	Approximate Amount Required
Frame assembly	2	Frame	Wood	9000 × 44 × 44 planed: 4250 × 75 × 20 planed: 2000 × 44 × 20 planed.
	4	Table top	Wood	2250 × 44 × 44 planed: 750 × 300 × 20 (Blockboard is suitable).
Rotor and stator assembly	5	Rotor	Wood or metal	100 × 100 dia wood or metal. 330 × 12 dia steel rod 6 pieces of 100 × 10 × 1.5 steel sheet. Gauge plate if available.
	6	Quadrant	Wood or metal	125 × 100 × 44 wood or metal, 3 pieces of 100 × 10 × 1.5 steel sheet. Gauge plate if available.
	9	Angle bracket	Metal	90 × 50 × 5 angle iron.
	8	Bed plate	Metal	200 × 190 × 6 steel sheet.
		Bearings (2)		Plain bearing pillow blocks, 12 bore
	7	Chute	Metal	500 × 500 × 1.5 aluminium or other thin metal sheet.
Feed hopper assembly	12	Hopper	Wood	1500 × 300 × 5 plywood: 500 × 32 × 32 planed: 500 × 32 × 20 planed: 150 × 44 × 32 planed
	13	Shutter	Wood	240 × 135 × 8 plywood: 100 × 85 × 5 plywood.
Flywheel assembly	15	Flywheel	Wood	450 × 450 × 25 (Blockboard is suitable).
		Drive plate	Metal	180 × 180 × 6 steel sheet
		Boss	Metal	45 × 30 dia steel rod
	16	Cover	Wood	1120 × 530 × 5 plywood: 530 × 130 × 20 planed: 360 × 44 × 44 planed.
Drive assembly	17	Pulleys (4)		Two off 75 OD × 12 bore. Two off 230 × 12 bore. All single groove.
		Bearings (4)		Plain bearing pillow blocks 12 bore.
		Shafts (2)	Metal	160 × 12 steel rod
		Collars (4)	Metal	25 OD × 12 wide × 12 bore
		Belts		Sufficient to drive assembly
	18	Drive handle	Metal	255 × 25 × 6 steel sheet. Spacer 20 long to fit M10 screw. Collar 25 OD × 12 wide × 12 bore
	19	Handle for drive pulley	Metal	140 × 20 dia steel rod 120 × 22 OD tube 0.8 wall thickness 10 × 25 dia steel rod



The frame

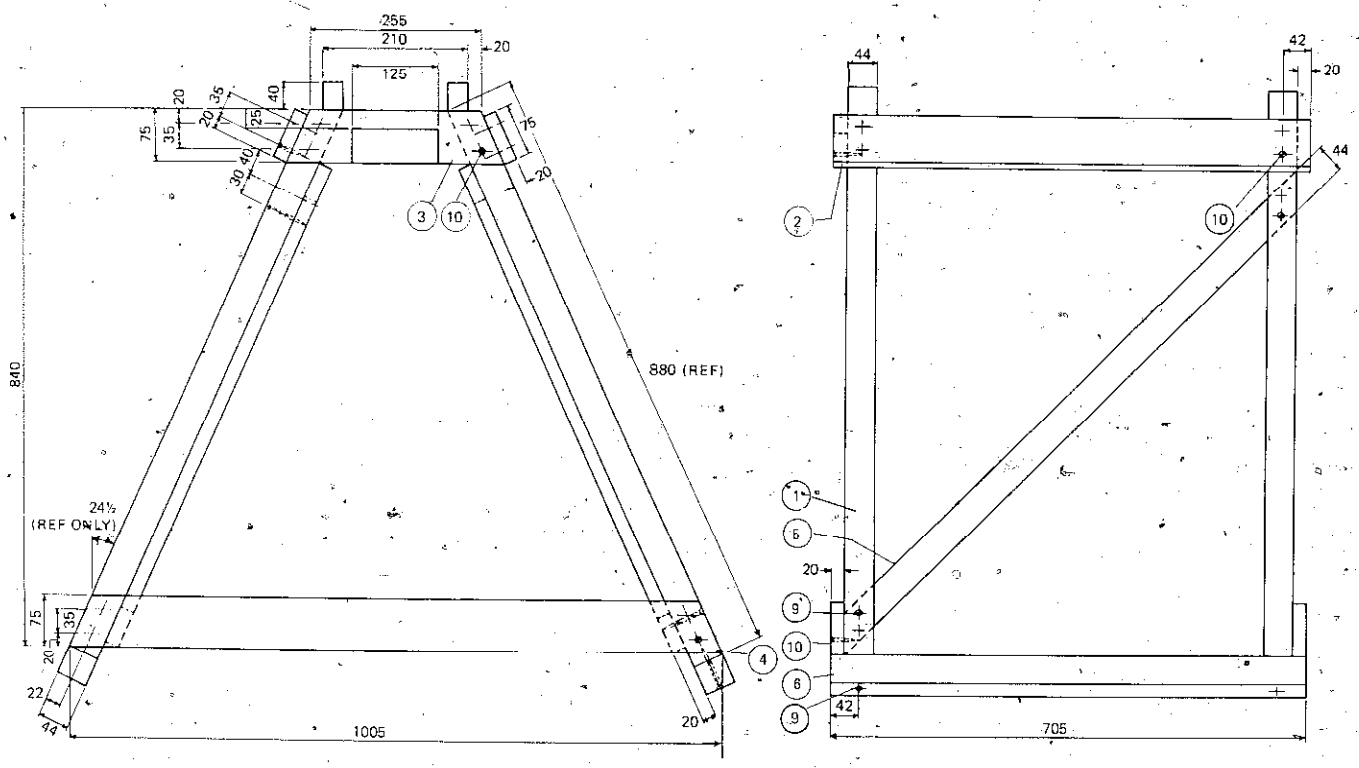
First make the frame (Figs 2 and 3). Cut all the pieces of wood to the correct lengths (see Parts and materials list, page 5) and note that the tops of the four legs are shaped so that the table top will fit squarely on to the frame.

Assemble frame, using wood screws at all joints. In addition, use carpenter's glue on all joints to ensure that the frame and all other wooden parts of the decorticator remain rigid.

Next cut the table top (Fig. 4) to the correct size and cut out the hole for the bar mill in the position shown. Cut the wood for the table top surround to the correct lengths and fix the surround to the table top, using wood screws and glue.

Fit the table top to the frame and secure with wood screws.

Figure 2
Wood frame



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	LEG	4	WOOD
2	TOP CROSS RAIL	2	WOOD
3	TOP SIDE RAIL	2	WOOD
4	BOTTOM SIDE RAIL	2	WOOD
5	DIAGONAL SIDE RAIL	2	WOOD
6	FOOT	2	WOOD
7			
8			
9	WOOD SCREW	12	STL 60 LONG
10	WOOD SCREW	24	STL 40 LONG

NOTE
- GLUE & SCREW ON ASSEMBLY

Figure 3
Wood frame

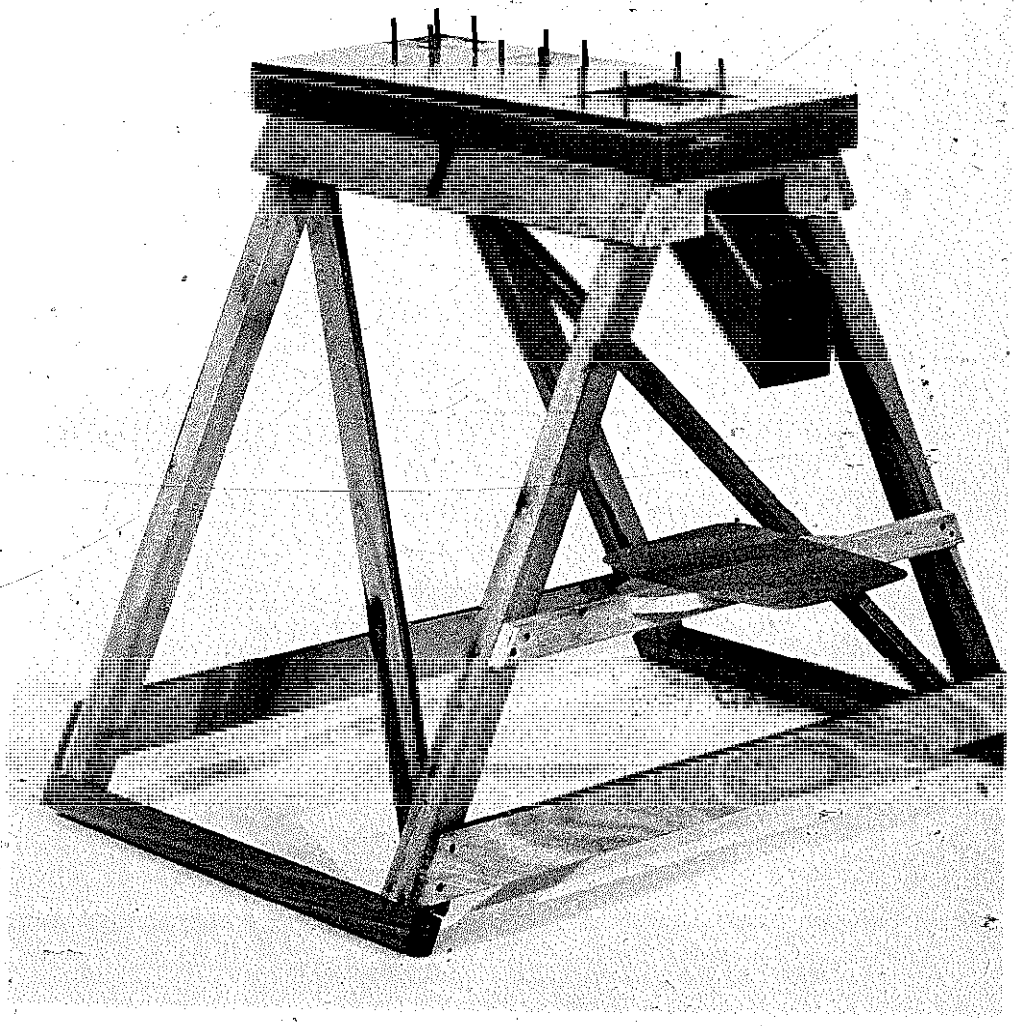
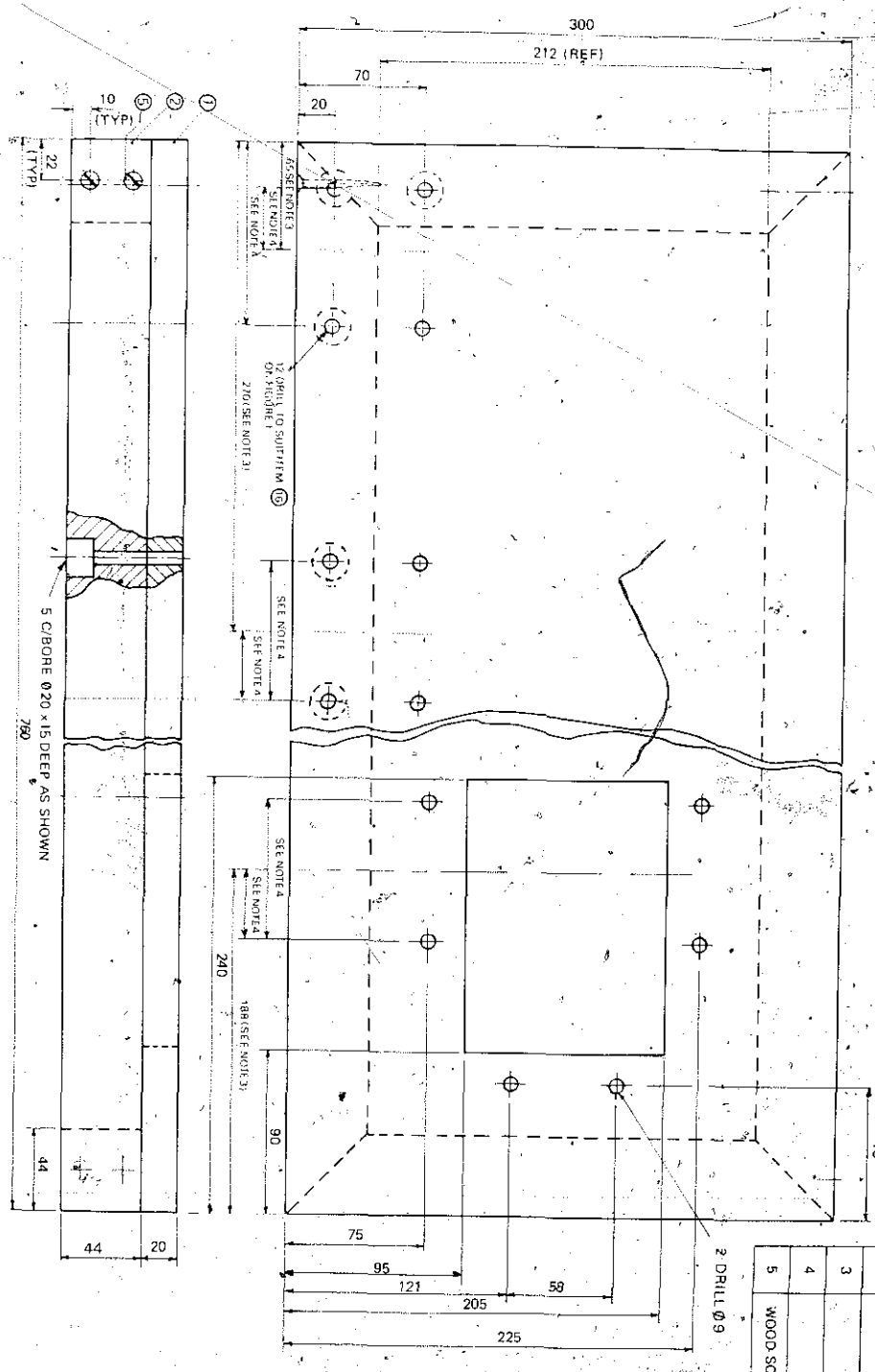


Figure 4
Table



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	TABLE TOP	1	WOOD
2	TABLE SIDES	4	WOOD
3			
4			
5	WOOD SCREWS	8	STL 45 LONG

NOTES
1) GLUE & SCREW ITEMS (2) WITH (5)
2) GLUE & NAIL ITEM (1) TO (2)
3) THE GIVEN CENTRE LINE REFERS TO THE CENTRE LINE OF THE BEARING WHICH IS SHOWN ON FIGURE 1 (ITEM 16)
4) HOLE SPACES TO SUIT THE BEARINGS SHOWN ON FIGURE 1 (ITEM 16)

Rotor and stator

The rotor assembly (Fig. 5) and stator quadrant (Fig. 6) can be made from seasoned hardwood or a metal such as aluminium alloy or mild steel.

Making the rotor assembly (Fig. 5)

First, using the lathe, face the ends of the drum to square them off; drill the hole for the shaft through the centre of the drum. Cut the shaft to length, push it through the hole in the drum and secure it in position. Set the shaft in a lathe and turn the outside diameter of the drum down to the correct size. (See Parts and materials list, page 5).

Cut the blades to the correct size. (Note that gauge plate is preferred to mild steel because it is harder and will retain its cutting edge much longer). Drill and countersink the fixing holes in the blades. Drill and tap the corresponding holes in the drum as in the drawing. If the drum is to be made of wood instead of metal, drill small pilot holes, suitable for appropriate wood screws, instead of tapped holes.

Finally fix the blades to the drum. The rotor assembly is now complete.

Making the stator quadrant (Fig. 6)

Cut the body to size, fix it to a face plate on the lathe, making sure that it is in its correct position, and turn out the 55 mm radius. Cut the blades to the correct size. (Again, note that gauge plate is preferred to mild steel). Drill and countersink the fixing holes in the blades, drill corresponding pilot holes in the body (if this is made of wood) and screw the blades in position as in the drawing. If the body is to be made of steel instead of wood, drill and tap holes, suitable for appropriate steel screws, instead of pilot holes.

Making the chute (Fig. 7)

Make the chute of aluminium if available as this metal is particularly easy to work with, but any suitable thin metal will do. Secure the chute to the top of the table with wood screws.

Making the bed plate (Fig. 8)

Make the bed plate as in the drawing and fix it to the table. Fit the bearings on the rotor assembly and bolt them to the bed plate. Position the stator quadrant against the rotor assembly. The gap between the blades at the top of the stator quadrant must be the same as the gap between the blades at the bottom of the stator quadrant (see Figs 10 and 11).

Make the angle bracket (Fig. 9), lightly fix it to the base plate and slide it up to the stator quadrant. Mark through the existing drilled holes in the angle bracket to indicate the screw positions in the back of the stator quadrant; drill suitable pilot holes in the back of the stator quadrant and, using 20 mm-long wood screws, fix the angle bracket to the stator quadrant.

The slotted holes in the angle bracket make it possible to adjust the clearance between the stator quadrant and the rotor as required. Loosen the clamping screws, reposition the angle bracket and stator quadrant, and then re-clamp.

Figure 5
Rotor assembly

ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	DRUM	1	STL
2	BLADE	6	GAUGE PLATE
3	SHAFT	1	STL
4			
5	M3 SCREW CSK HEAD	12	STL (ZINC PLATE)

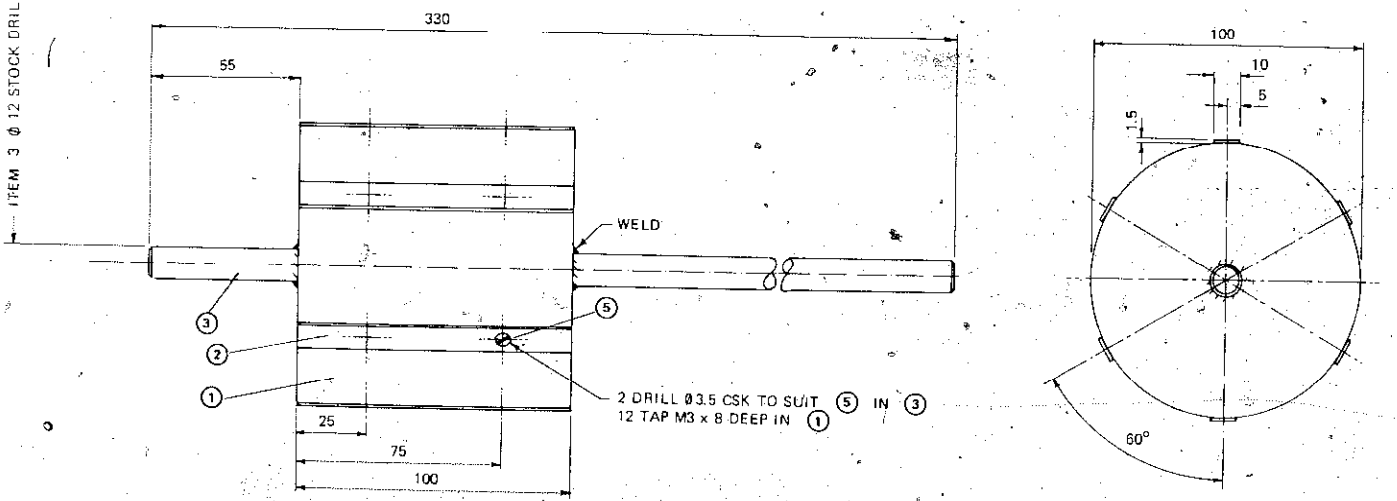


Figure 6
Stator quadrant

ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	BODY	1	WOOD
2	BLADE	3	GAUGE PLATE
3			
4			
5	WOODSCREW	6	STL 12 LONG CSK HEAD

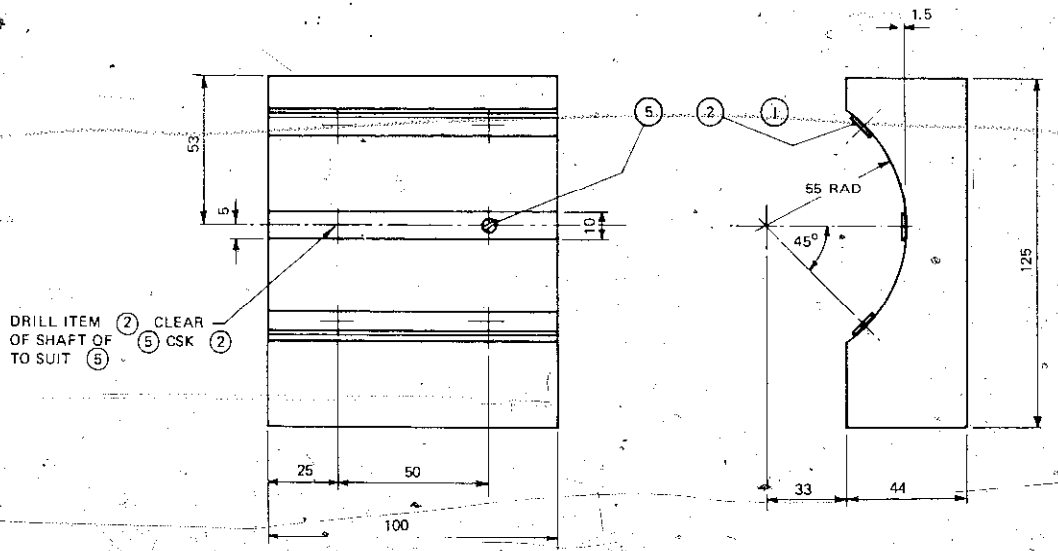
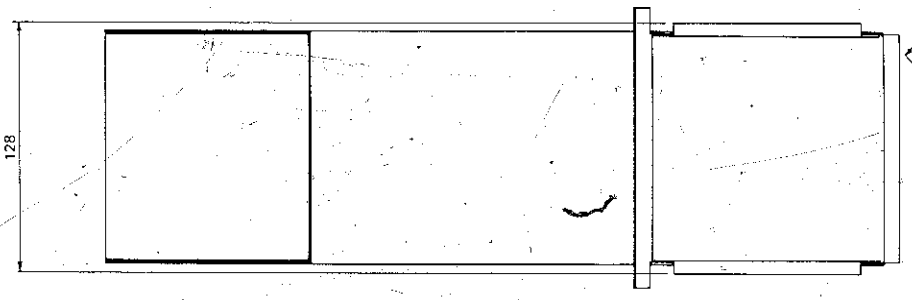
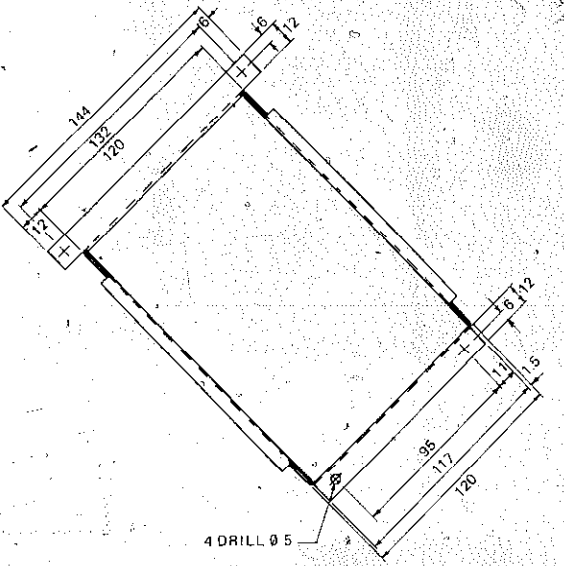
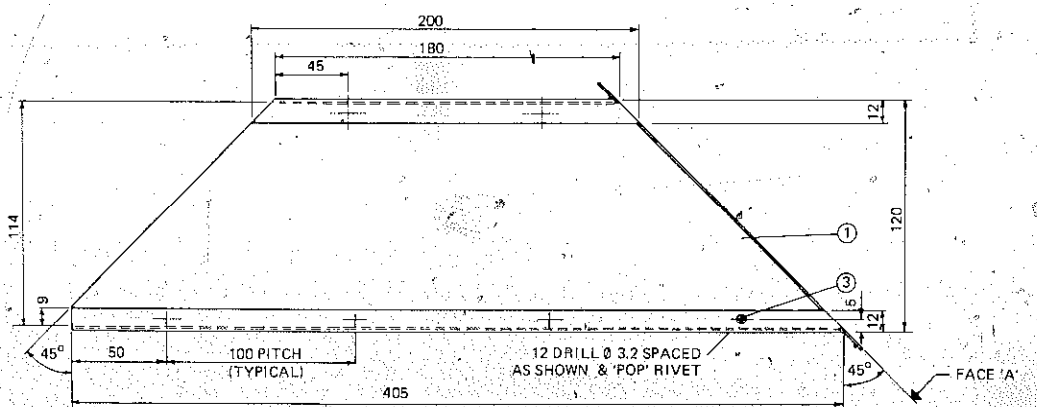


Figure 7
Chute





TRUE VIEW ON FACE 'A'



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	CHUTE	1	1.5mm THICK ALUMINIUM ALLOY
2			
3	Ø3·2 'POP' RIVET	12	8mm LONG

Figure 8
Bed plate

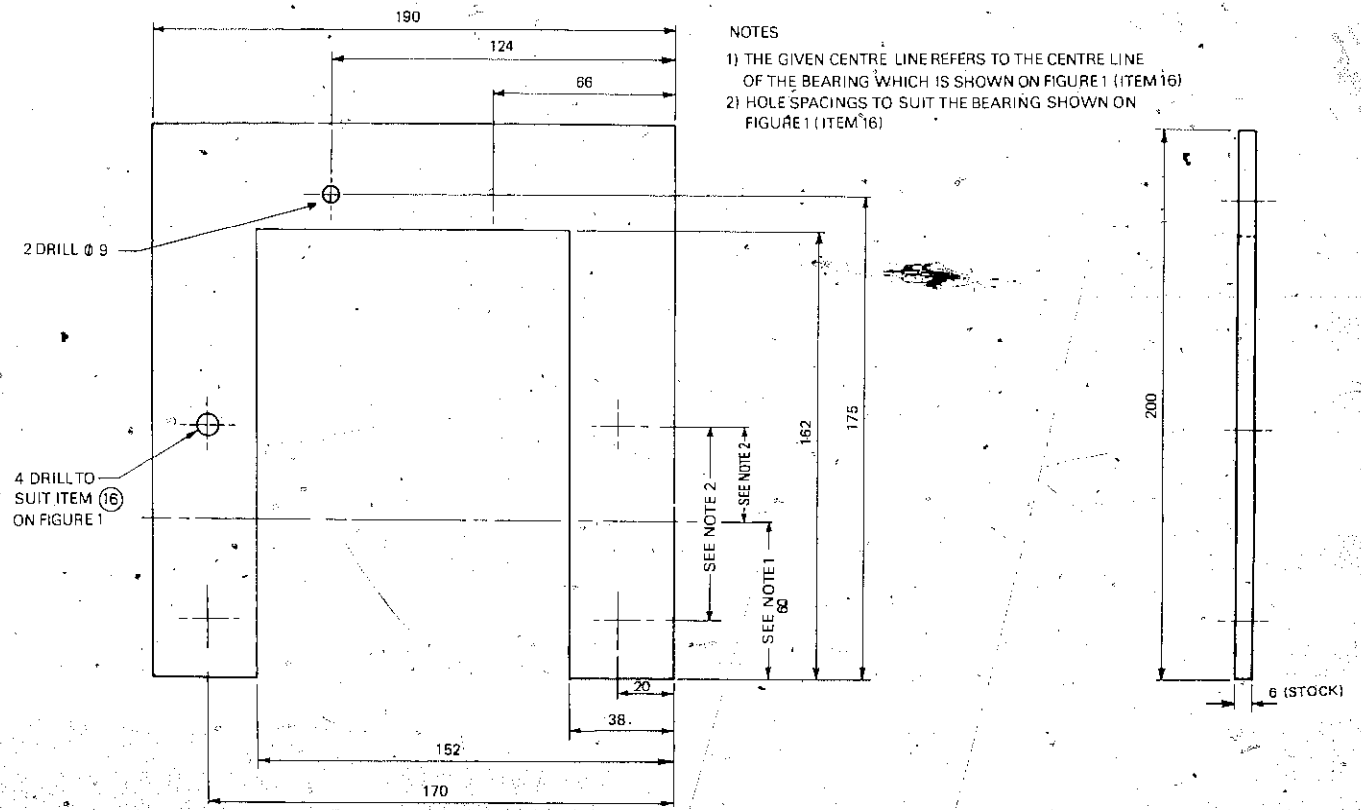


Figure 9
Angle bracket

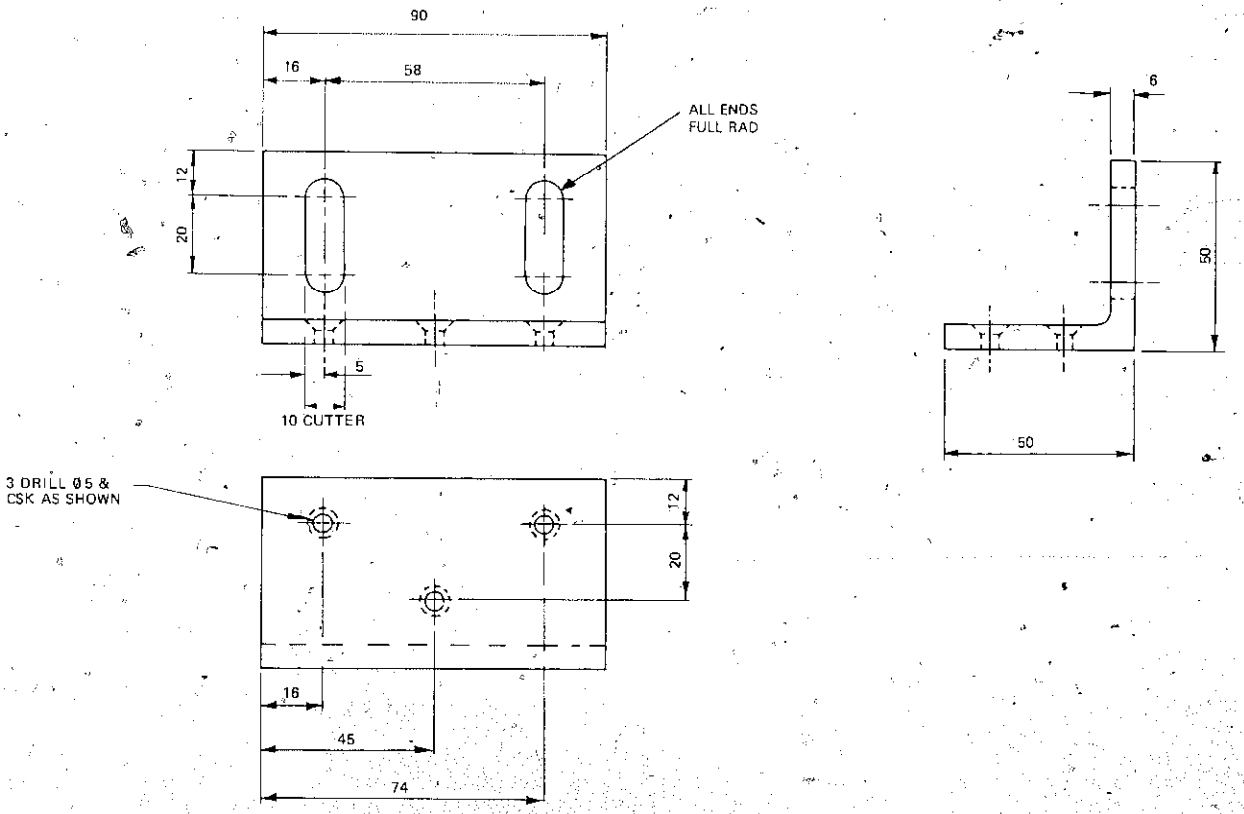


Figure 10
Rotor and stator assembly

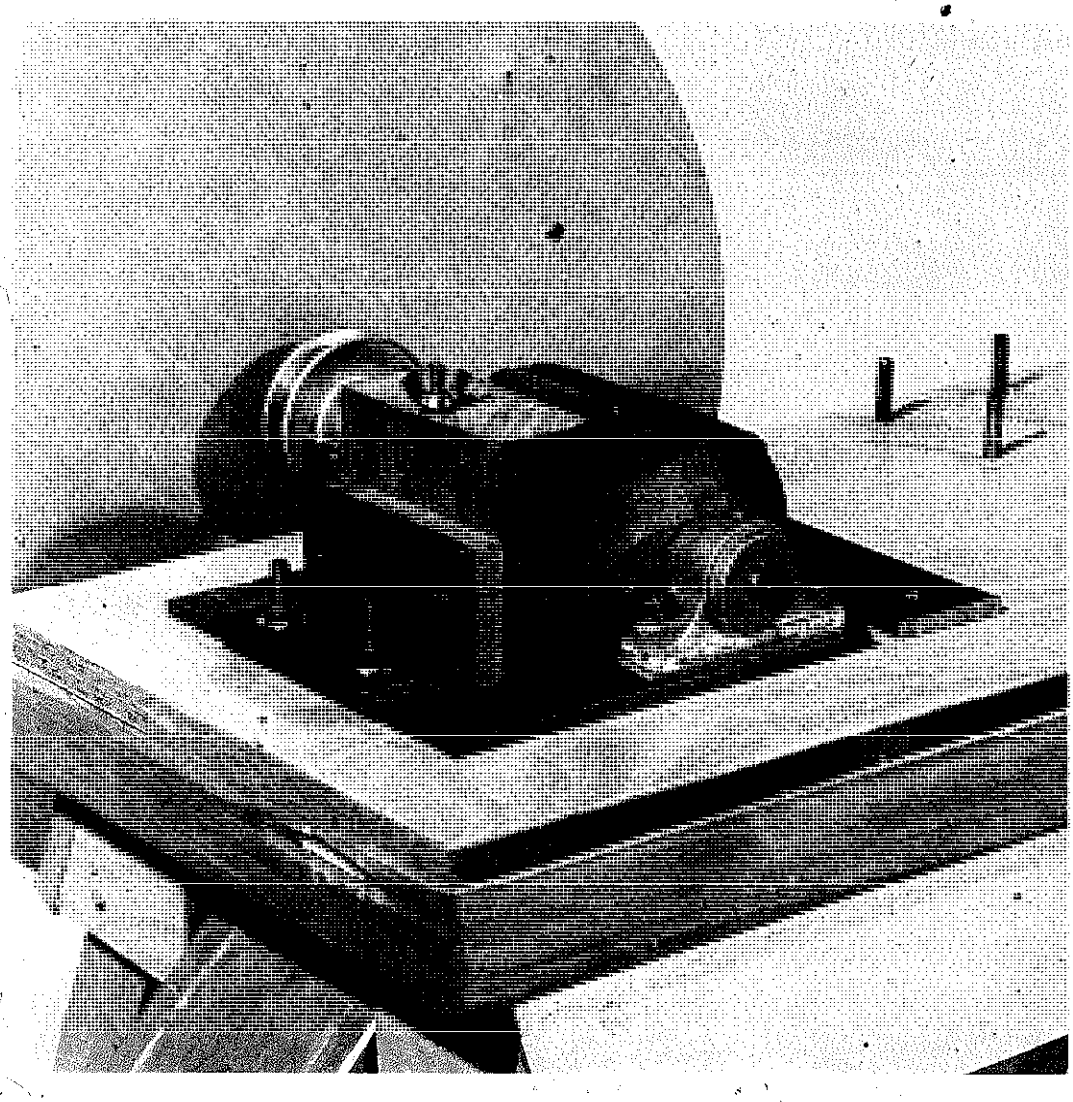
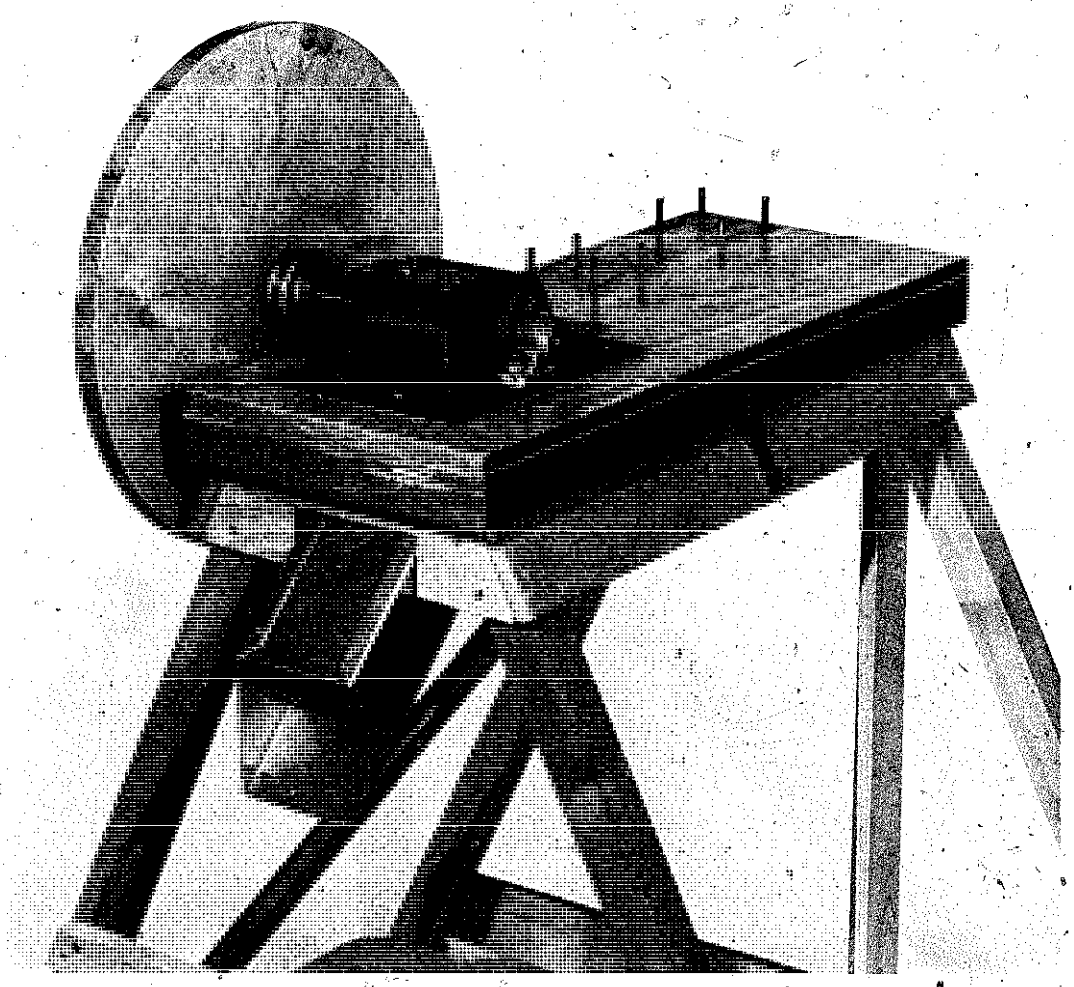


Figure 11
Rotor and stator assembly



Feed hopper

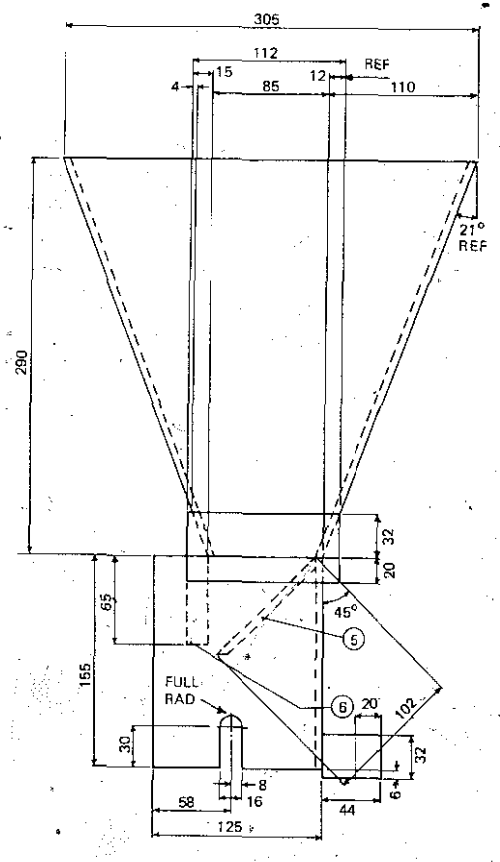
Make the lower part of the hopper first and assemble, using glue on all joints. Mount it over the rotor and position the chute (Fig. 12, item ⑤) so that it just clears the rotor blades.

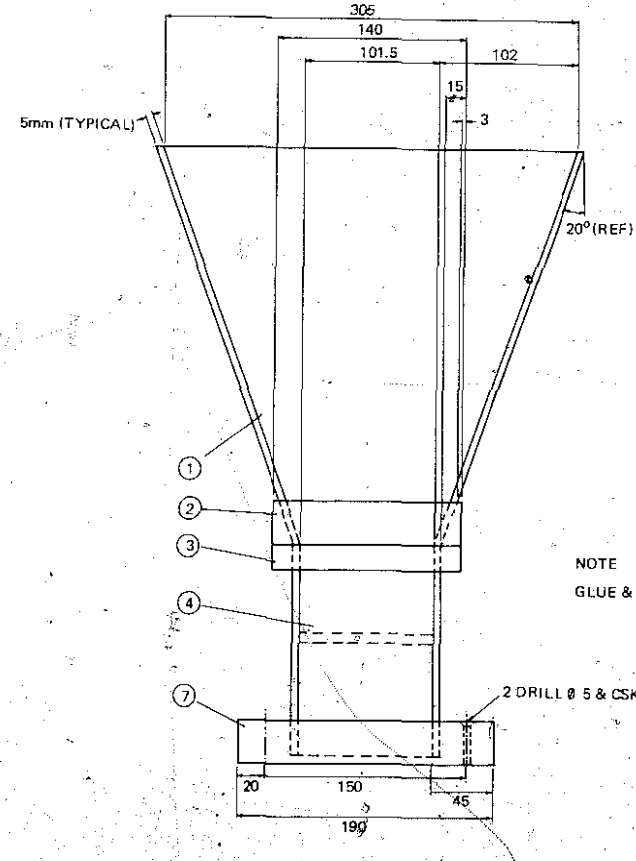
Make and fit the shutter (Fig. 13) and check that it slides freely on the stator quadrant (Fig. 6) and closes against the chute (Fig. 12, item ⑤).

Cut out and assemble the top part of the hopper, again using glue on all joints. Fit it to the lower part of the hopper.

Plywood is recommended in the construction of the hopper (Fig. 14) as it is strong, but any thin planed wood is suitable.

Figure 12
Feed hopper



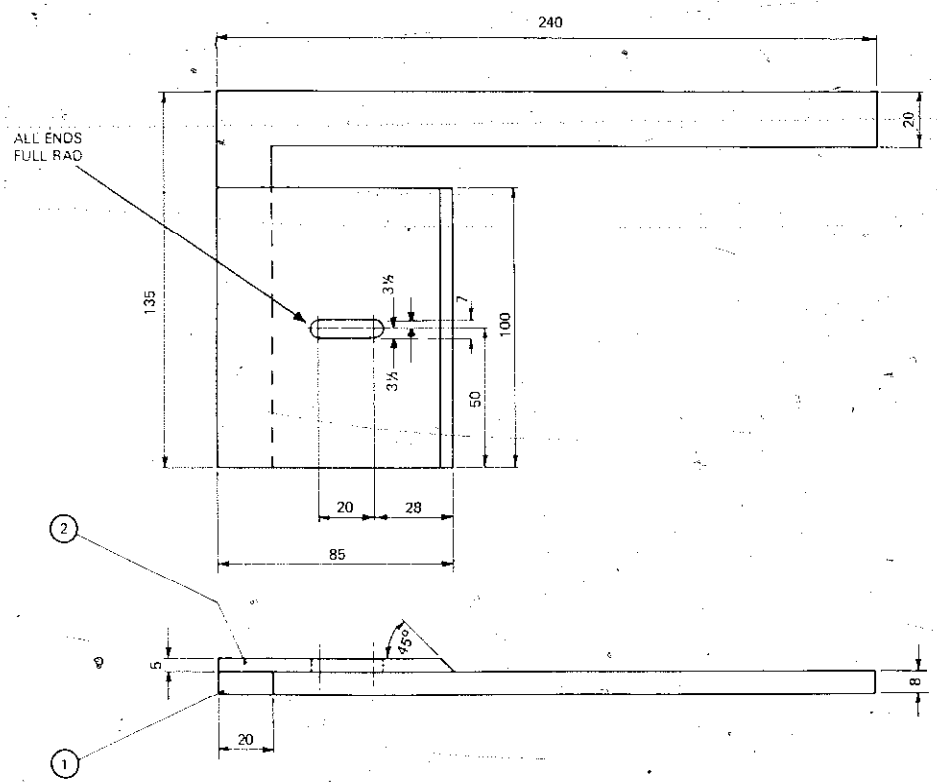


ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	HOPPER	1	WOOD
2	UPPER HOPPER SUPPORT	4	WOOD
3	LOWER HOPPER SUPPORT	3	WOOD
4	CHUTE HOLDER	1	WOOD
5	CHUTE	1	WOOD
6	DEFLECTOR	1	WOOD
7	FOOT	1	WOOD

NOTE

GLUE & NAIL ON ASSEMBLY

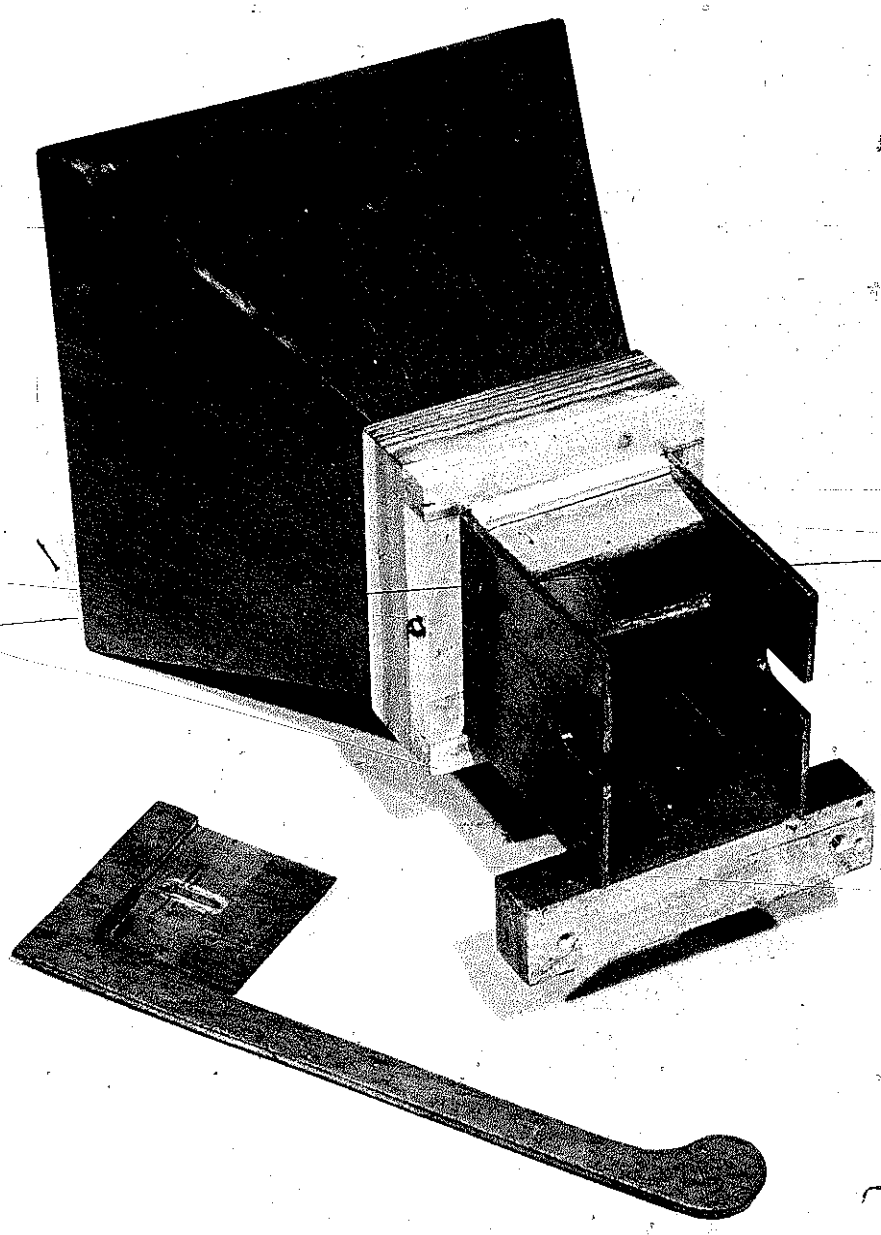
Figure 13
Shutter



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	ARM	1	WOOD
2	SHUTTER	1	WOOD

NOTE
GLUE & NAIL ② TO ①

Figure 14
Feed hopper and shutter



Flywheel

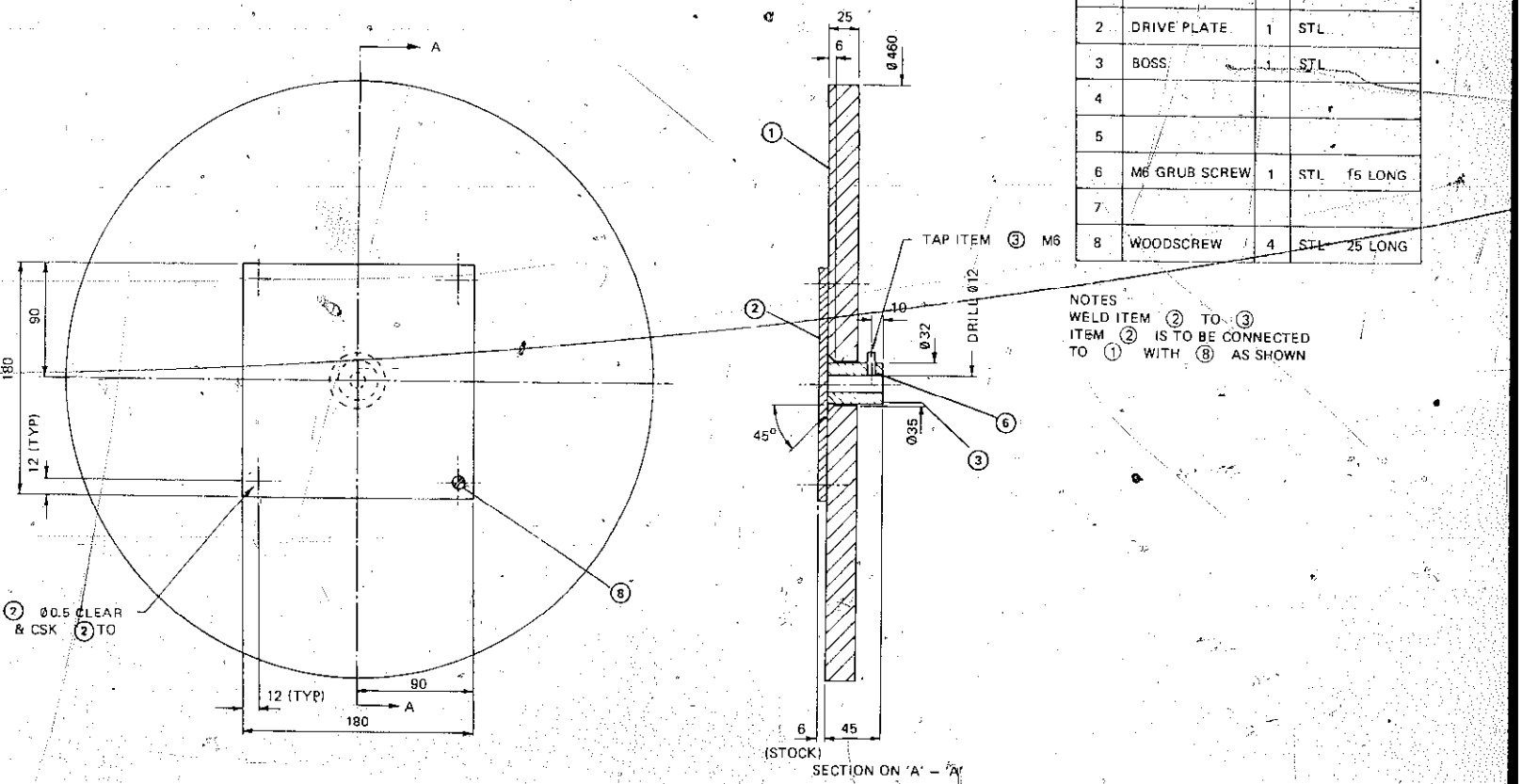
First make the drive plate and boss, then weld the boss to the drive plate (Fig. 15).

Cut the flywheel to size and drill a hole in the centre to take the boss. Secure the drive plate to the flywheel. Blockboard is recommended for the flywheel but any wood of suitable thickness will do. If a single sheet of wood is not available, the flywheel can be made from smaller pieces of wood laminated together. If it is made in this way it is most important to ensure that the flywheel balances properly.

Fit the driving pulley on to the rotor shaft; then fit the flywheel on to the rotor shaft.

Make the flywheel cover (Figs 16 and 17) using plywood if available, but otherwise use any suitably thin wood. Do not fix the cover in position until the drive assembly has been completed and fitted.

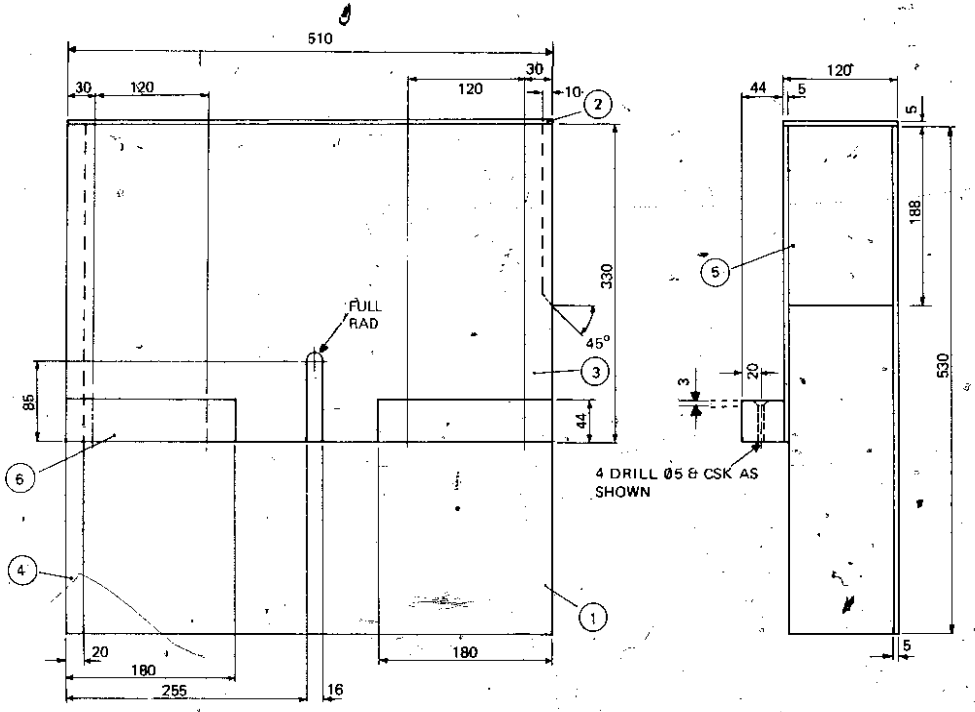
Figure 15
Flywheel



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	FLYWHEEL	1	WOOD
2	DRIVE PLATE	1	STL
3	BOSS	1	STL
4			
5			
6	M6 GRUB SCREW	1	STL f5 LONG
7			
8	WOODSCREW	4	STL 25 LONG

NOTES
WELD ITEM ② TO ③
ITEM ② IS TO BE CONNECTED
TO ① WITH ⑧ AS SHOWN

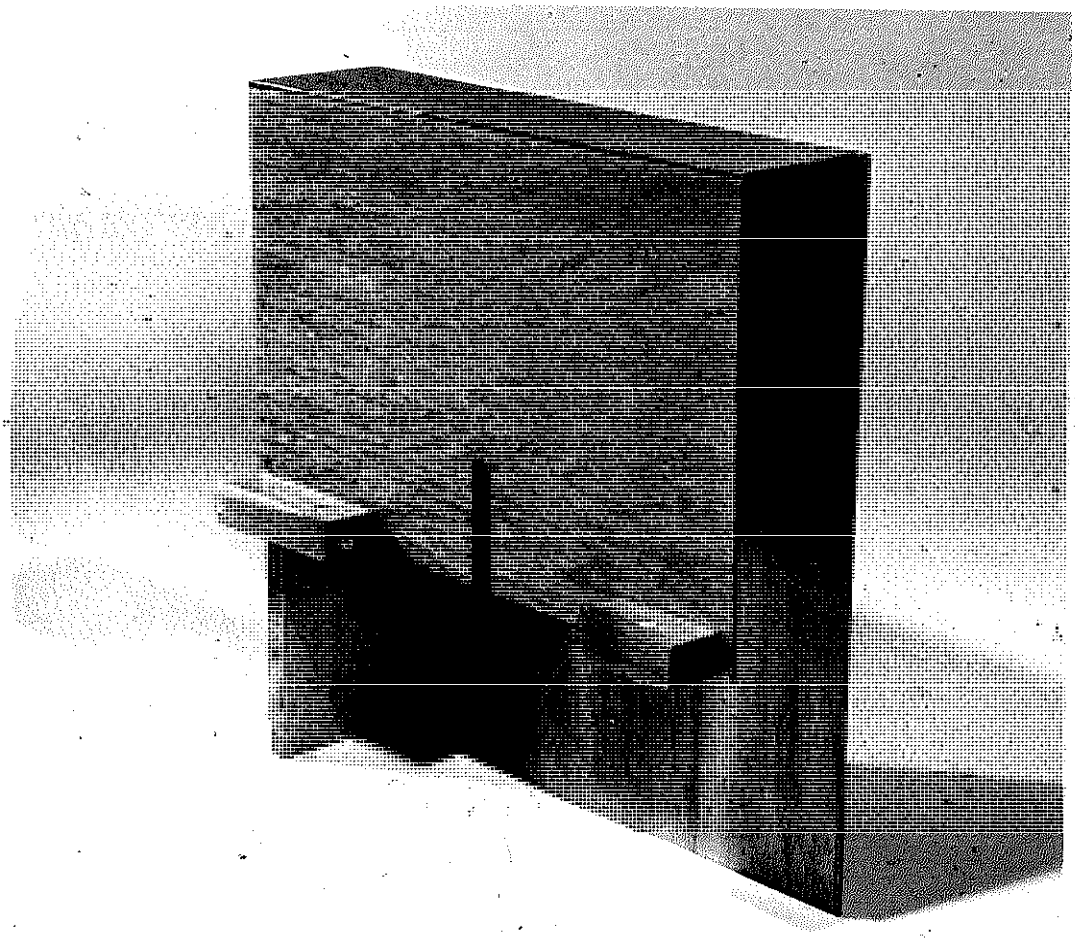
Figure 16
Flywheel cover



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	BACK	1	WOOD
2	TOP	1	WOOD
3	FRONT	1	WOOD
4	L.H. SIDE	1	WOOD
5	R.H. SIDE	1	WOOD
6	BLOCK	2	WOOD

NOTES
GLUE & NAIL ON ASSEMBLY

Figure 17
Flywheel cover



Drive assembly

Cut the shafts to correct lengths and make the collars if these cannot be obtained locally. Fit the shafts to the two plain bearings and secure with the collars in the correct position.

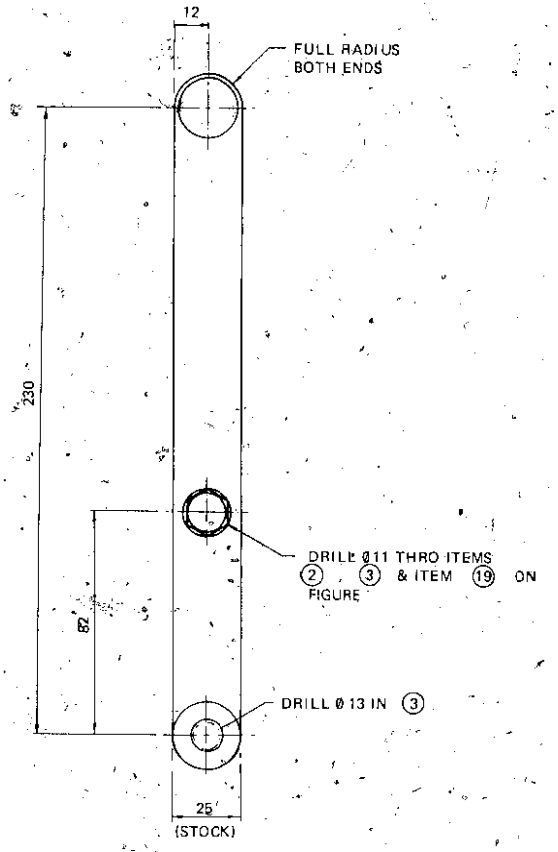
Fit one small pulley to the shaft on the rotor assembly, a small pulley and a large pulley to the intermediate drive shaft, and a large pulley to the first drive shaft.

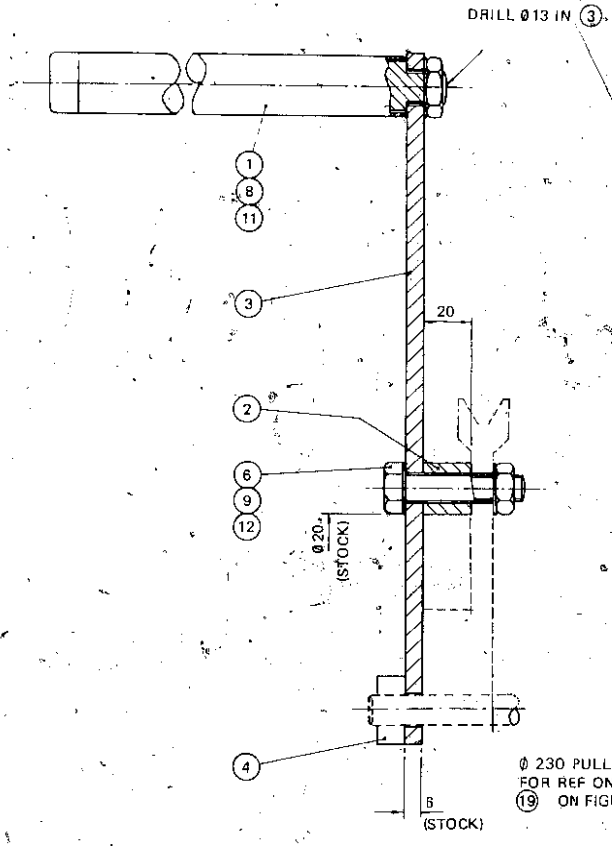
If non-adjustable belts are to be used, select a belt long enough for the intermediate drive shaft to be positioned on the table top about midway between the rotor shaft and the first drive shaft. It may be possible to find old car fan belts of suitable length and section.

With the intermediate drive shaft bearing held in position on the table top, fit the belt over both the rotor pulley and the large pulley on the intermediate drive shaft. Pull until the belt is tight and mark the positions of the bearing holes on the table top. Remove the belt, drill holes for the bearing bolts, and bolt down the bearing.

Make items (1), (2), (3) and (4) on Fig. 18 and assemble them, together with the large pulley (shown dotted on Fig. 18). Fit pulley and handle assembly on to the first drive shaft. Details are shown on Figs 18 and 20. Position and secure the first drive shaft bearing to the table top in the same way as the intermediate drive shaft was secured (see previous paragraph). Put the belts on the pulleys and check that they are tight and that the pulleys are in line (Fig. 20). Fix the flywheel cover in position.

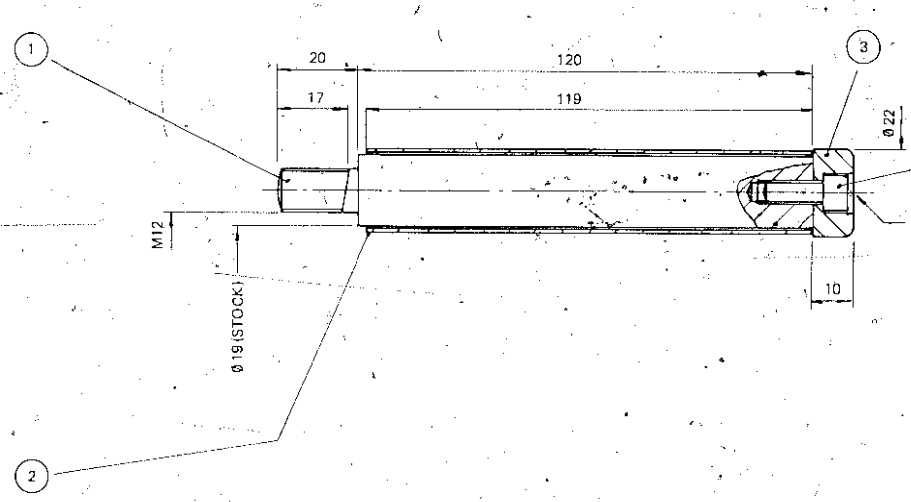
Figure 18
Drive handle





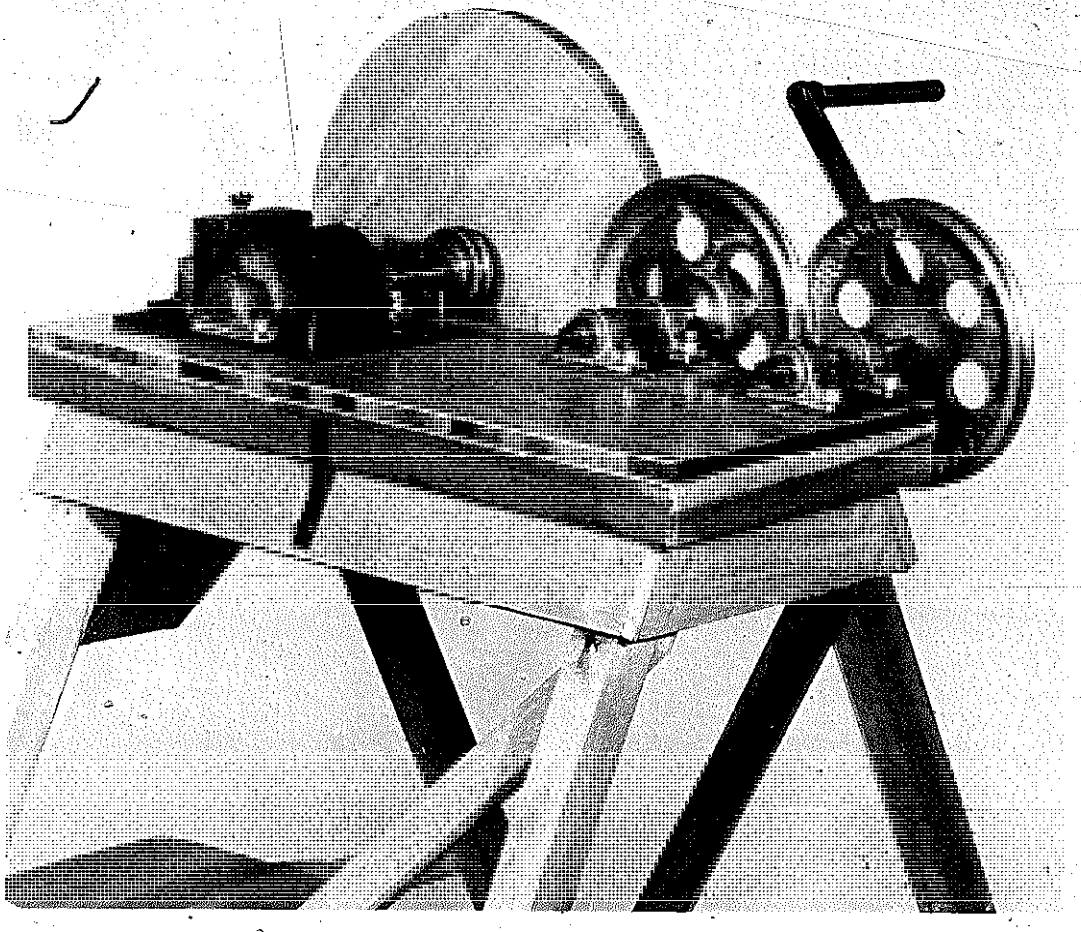
ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	HANDLE	1	FIGURE 19
2	SPACER	1	MILD STEEL
3	ARM	1	MILD STEEL
4	COLLAR (Ø 12 BORE)	1	STL 25 O/D X 12 WIDE
5			
6	M10 SCREW HEXAGON HEAD	1	STEEL 45 LONG.
7			
8	M12 NUT (LOCK)	1	ST_
9	M10 NUT	1	STL
10			
11	M12 WASHER	1	STL
12	M10 WASHER	2	STL
13			

Figure 19
Handle



ITEM No.	DESCRIPTION	No. OFF	REMARKS
1	MAIN SHAFT	1	STL
2	TUBE Ø 22 X 0·8 WALL	1a	STL
3	BACK STOP	1	STL
4			
5	M6 SOCKET HD	1	SCREW —15 Lg

Figure 20
Drive assembly



Adjustment and operation

Set the gap between the rotor and stator quadrant blades to about 1 mm, making sure that the blades are parallel.

With the hopper gate closed, put seed into the hopper.

Turn the drive handle at about 50 rpm. Speed will build up slowly because of the flywheel. At 50 rpm the rotor will rotate at 300 rpm.

Open the hopper gate a little at a time until seed is being decorticated at the optimum rate. If over-fed the rotor will be difficult to turn and the decorticator may jam. If this happens, close the hopper gate, take off the hopper assembly, and remove the seed from between the rotor and stator quadrant.

If you wish to stop decorticating seed while there is seed in the hopper, close the gate and continue turning the drive handle until the rotor is clear; otherwise, it may jam. Also clear the rotor when decortication is finished and the hopper is empty, then close the hopper gate.

Make sure all plain bearings are kept well oiled.

Separation of kernel from shell

Kernel can be separated from shell by traditional hand winnowing methods but some kernel, especially fines, will be lost.

It is advisable first to sieve the decorticated seed on two screens with apertures approximately 3 mm and 1 mm wide. The material remaining on the two screens is then winnowed and the kernel recovered is mixed with the fine kernel which has passed through the 1 mm screen.

A hand operated winnower, constructed mainly of wood, has been developed by TPI and is the subject of Rural Technology Guide 11.

It is not possible to decorticate completely the high oil-bearing types of sunflower seed. The shell left mixed with the kernel fraction after decortication by the bar mill is acceptable, as the presence of about 10 per cent to 12 per cent of shell will help to bind the cake produced when oil is extracted. This is especially so when a screw press oil expeller is used.

Future Guides

The Institute would be glad to receive suggestions for new devices and techniques which might usefully be described in future publications in this series.

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The Tropical Products Institute

The Tropical Products Institute is a British Government organisation which co-operates with developing countries in helping them to derive greater benefit from their plant and animal resources. It specialises in problems which arise after harvest and is ready to provide information and advice on these problems if requests are addressed to:

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Rural Technology Guides

The purpose of this series of Tropical Products Institute publications is to provide working details of devices or techniques suitable for use in rural communities. Each guide is fully illustrated and written in simple, practical language rather than in complex scientific terms, so that the reader can assess its usefulness and then, if he wishes, make the device or carry out the technique described.

The guides are intended principally for extension workers, instructors and other field staff in rural development. However, it is hoped that they will also be useful to anyone who is interested and can follow the pictures and instructions.

The series is being published in English and each publication will, therefore, be useful only in areas where the English language is widely used. For other areas, it is suggested that the text might usefully be translated into the local language and reproduced locally. It may also be possible to prepare visual aids from the pictures in the guide, for the use of instructors and other field staff.

The Institute will be pleased to give advice to anyone intending to reprint this guide or to make visual aids from the illustrations. Requests for such advice should be sent, with full details, to the Head, Publications, Publicity and Public Relations Section, Tropical Products Institute, at the above address.