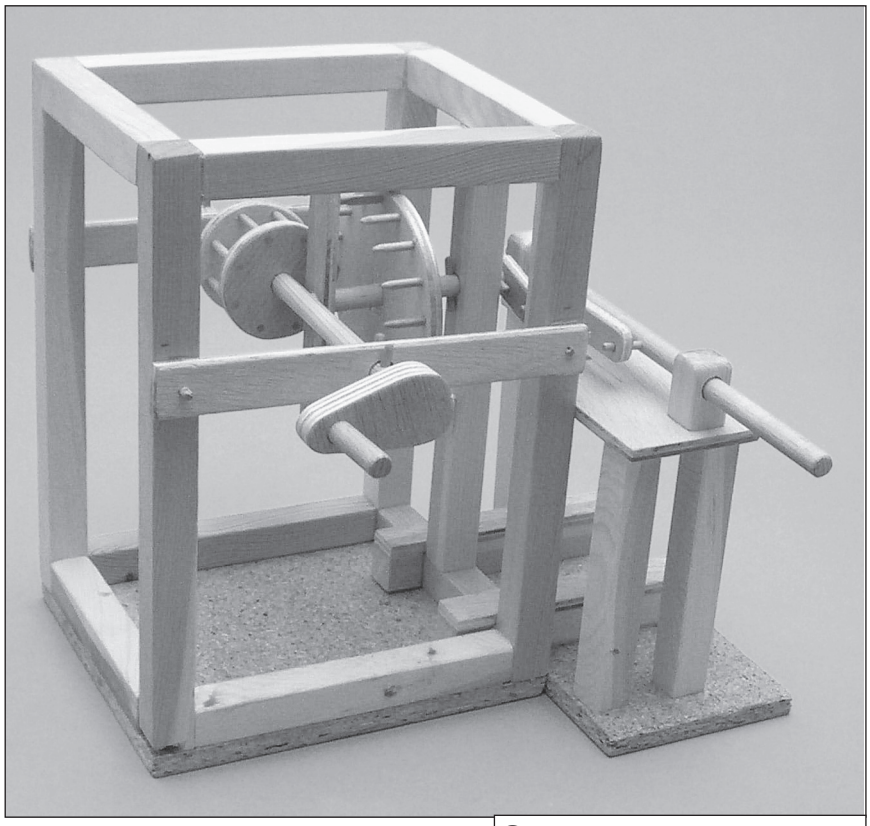
OPITEC

Hobbyfix

100.917

‘Leonardo da Vinci’s gear machine’



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Please Note

The OPITEC range of projects is not intended as play toys for young children.They are teaching aids for young people learning the skills of Craft, Design and Technolo- gy.These projects should only be undertaken and tested with the guidance of a fully qualified adult. The finished projects are not suitable to give to children under 3 years old. Some parts can be swallowed. Dan- ger of suffocation!

1. Project Information:

Article: A wood based model in project pack format.

Use: In Design Technology, Key Stage 3 / 4

2. Material Information:

2.1. Material: Pine wood (Coniferous) softwood
Gabun plywood, multi layered.

Working: All wood parts may have to be sawn, shaped, drilled and planed.
Mark them out according to the patterns, or use the measurements from the plans.

Joining: Use white PVA wood glue.

Finish: Wax (liquid or solid)
Varnish (Undercoat and top coat)
Stain (Coloured, water soluable, finish with clear varnish)
Linseed oil.

2.2. Material: Chipboard
Manufactured from compressed wood chips and glue.

Working: Chipboard can be sawn, shaped and sanded.
Mark our according to size or use patterns

Joining: Use white wood glue

Finish: Wax liquid or solid)
Wood varnish (Undercoat and top coat)
Stain (Coloured, water soluable, finish with clear varnish)
Linseed oil.

3. Tools:

Sawing: Use a **Fret saw** for curves and rounded shapes that cannot be sawn with a straight backed saw. (Tenon / dovetail saw)

Note! Fret saw blades should be inserted with the teeth facing forward.!

Use a Fret saw board and work with slow even strokes turning the work as you go.

Use a **Dovetail saw** or similar for all straight cuts.

Note! Hold the work on a bench hook!

Rasps/ files: Choose the correct grade of rasp or wood file suitable for the work in hand.

Note! Rasps and files only cut on the forward stroke!

Sanding: Use a sanding block and glasspaper on flat surfaces and loose sheet on curves and rounded shapes.

Drilling: Use an electric drill and stand

Note! Adhere to the safety rules: Tie all long hair back, wear safety glasses, remove jewellery and rings. Wear an apron to protect clothes. Hold the work in a machine vice.

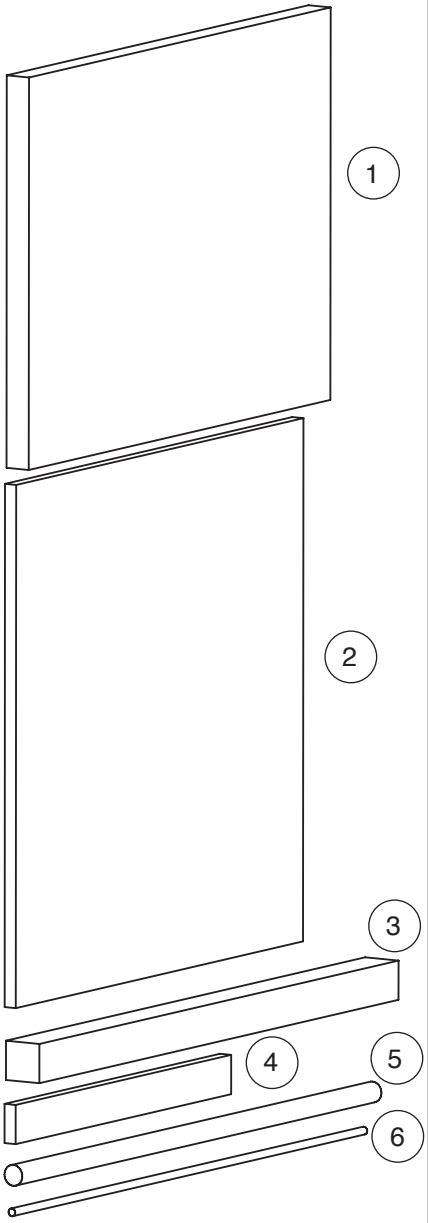
Use the correct size drillbits. Use only shop-drills.

Holding: Clamp the work whilst the glue is drying, do not over tighten the clamps or they will leave marks.

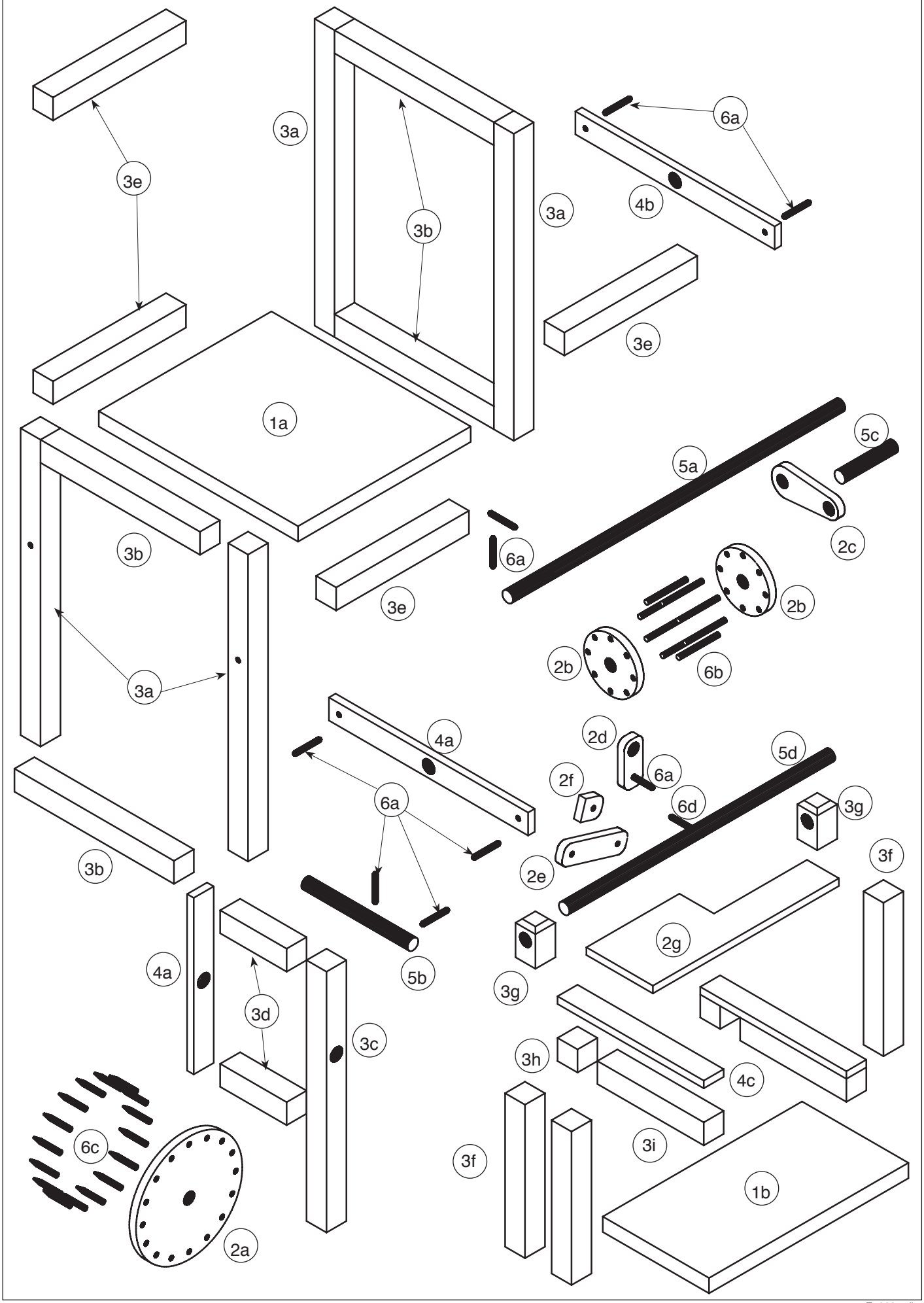
4. Parts list:

Part	Material	Quantity	Size
Base	Chipboard	1	8 or 10 x 150 x 210 mm
Drive gears **Crank handle** **Cover**	Plywood	1	5 x 200 x 200 mm
Frame	Pine strip	12	15 x 15 x 250 mm
Joiners/bearings	Pine strip	5	5 x 15 x 150 mm
Axles	Dowel	3	8 dia x 250 mm
Axles / Pins/Drive	Dowel	4	3 dia x 245 mm

Diagram



5. Exploded diagram



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6. Planning overview

6.1 Designing and making the basic frame

6.2 Making and assembling the gears

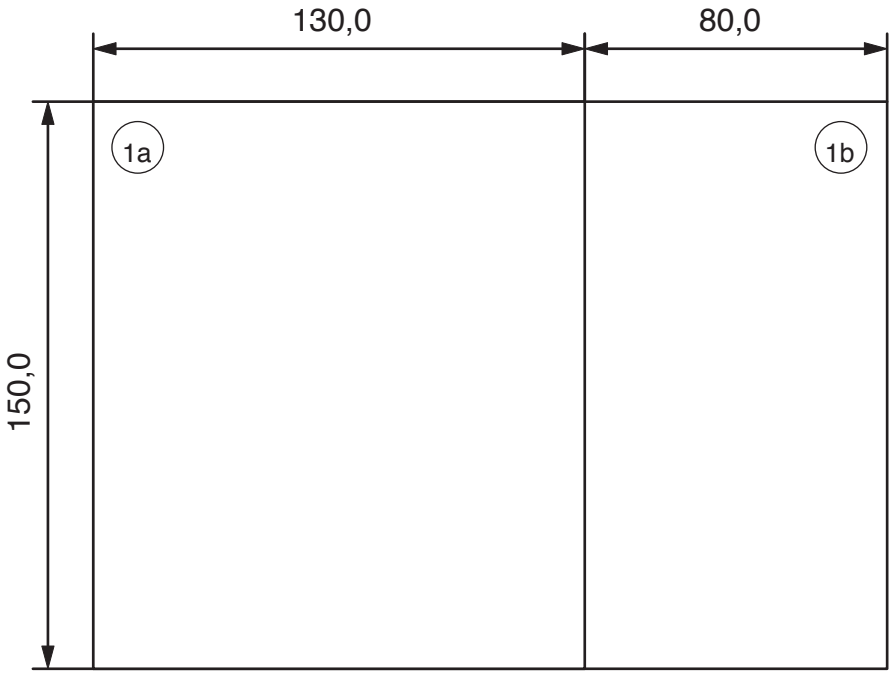
6.3 Making and assembling the crank handle and drive shaft

6.4 Designing and making the slider mechanism

6.5 Final assembly and testing

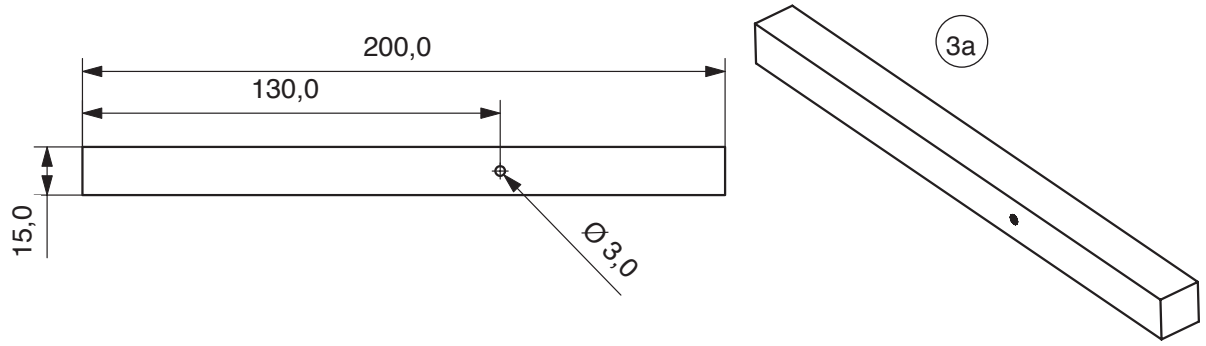
6.1. Designing and making the basic frame

6.1.1 Mark out and saw the base (1) into two pieces as shown. Sand the edges with a block and glasspaper.

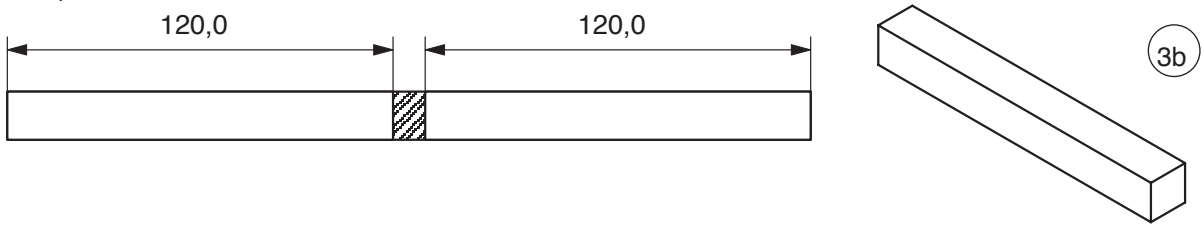


6.1.2 Cut four strips (3a) each 200mm long from the pine strip 15 x 15 x 250mm (3) and drill a 3mm hole x 10mm deep as shown.

Note: This is a blind hole, do not drill all the way through. Keep the (50mm) off cuts as they will be needed later.

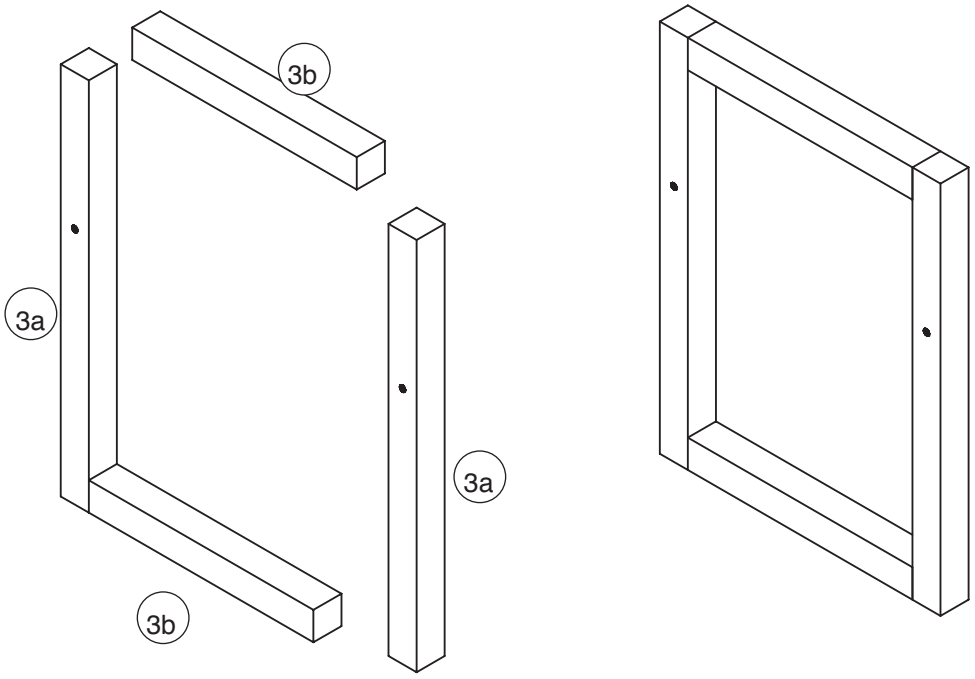


6.1.3 Cut 4 pieces each 120mm long from the pine strip (3) 15 x 15 x 120mm. Square up the ends. (Sanding disc or block)

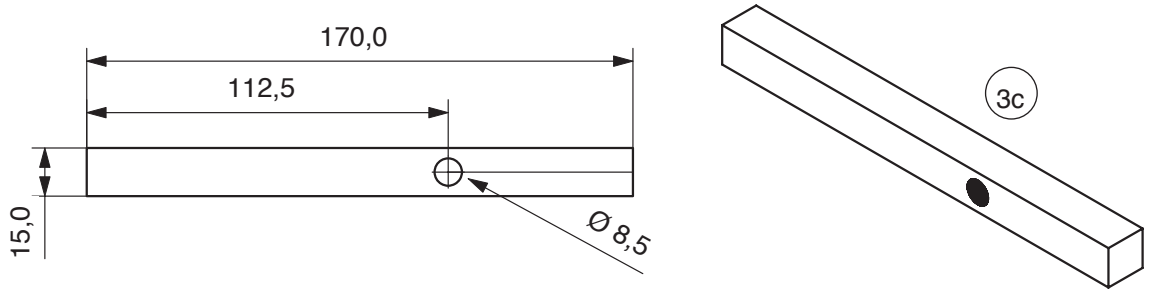


6.1.4 Arrange two of the shorter pine lengths (3a) and two longer lengths (3b) to make a frame as shown.

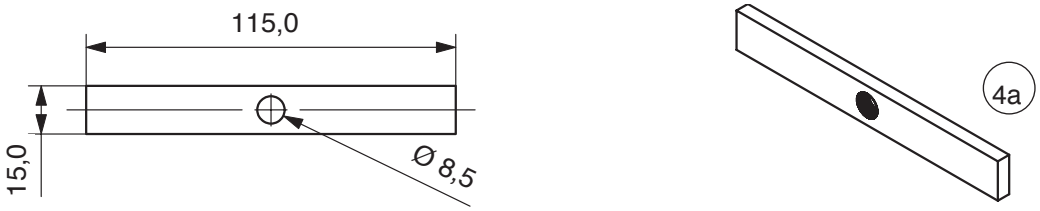
Note: Be careful to ensure all the holes are at the same height and face in the same direction.



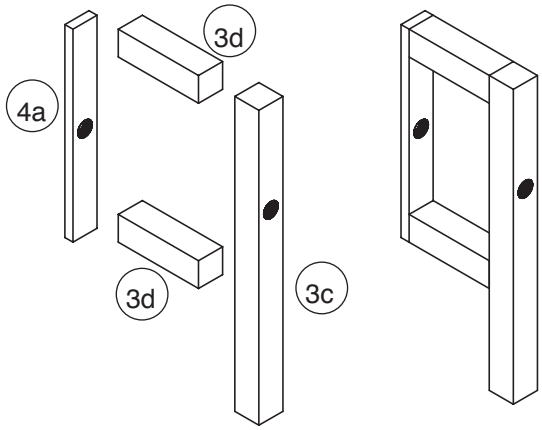
6.1.5 Mark out and saw the pine strip (3) 15 x15 x250mm to 170mm long (3c) and sand the sawn ends. Drill the 8,5mm diameter hole as shown.



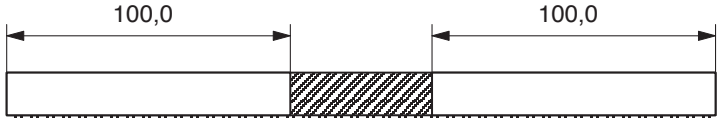
6.1.6 Saw a pine strip (4) 5 x 15 x 150mm to 115mm long (4c) Drill the 8,5mm hole as shown
Sand the sawn ends.

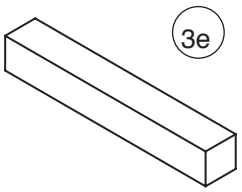


6.1.7 Use the remainder of the pine (3) to make the two 50mm long parts (3d) Sand the sawn ends.
6.1.8 Assemble and glue the parts (3c/3d/4a) to make the bearing frame as shown.

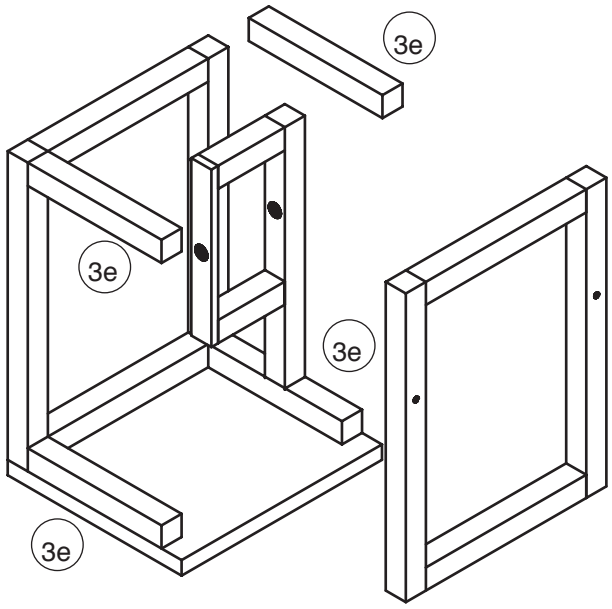


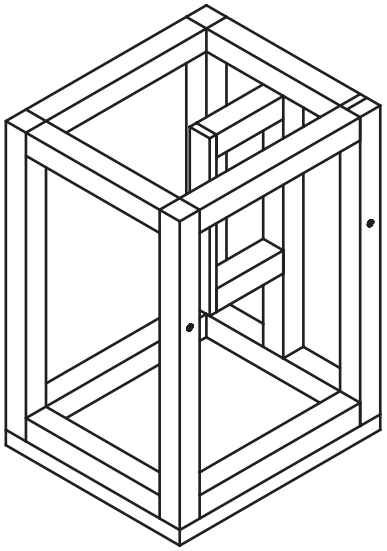
6.1.9 Mark out and saw the cross members from the pine strip (3) four strips each 100mm long (3e). Sand the sawn ends.



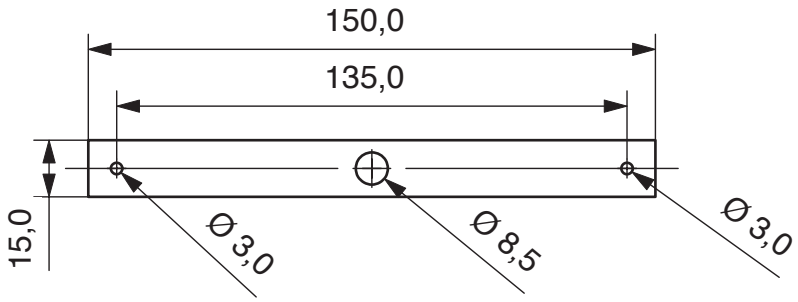


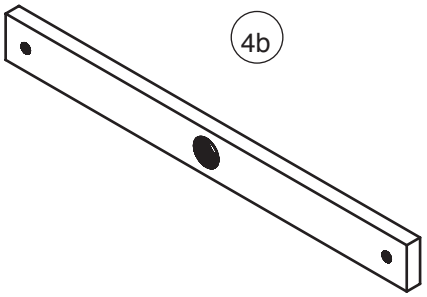
6.1.10 Assemble and glue the cross members (3e) and bearing frame together



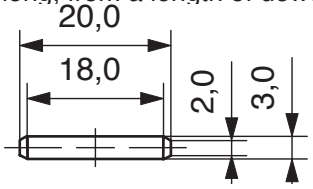


6.1.11 Mark out and drill two of the pine strips (4) 5 x 15 x 150mm. The holes are 3mm diameter and 8.5 mm diameter respectively.

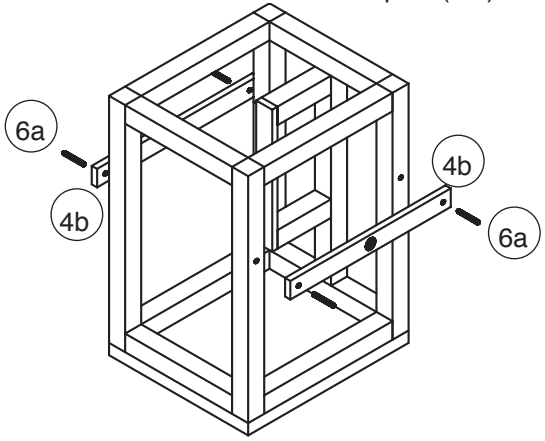


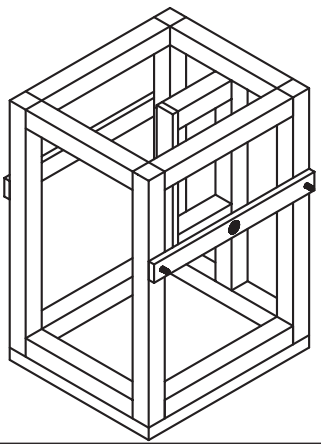


6.1.12 Saw four pins (6a) 20mm long, from a length of dowel (6). Lightly round the ends



6.1.13 Pin the cross members (with bearing holes) (4b) on both sides of the frames so that they line up with the holes in the frame and fix them with two pins (6a).





6.2. Making and assembling the drive gears

6.2.1 Trace the patterns (See page 15) on to the plywood sheet (2).

Note: The plywood sheet supplied is generous enough for making all the gears, however they should still be laid out according to the pattern, any remaining wood can be used for spares.

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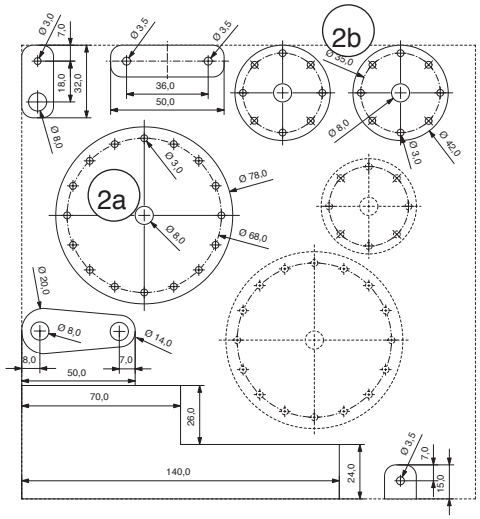
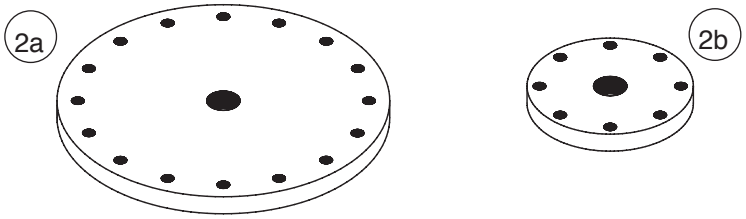


6.2.2 Firstly saw out the larger (2a) and then the smaller discs.(2b) Sand the sawn edges..

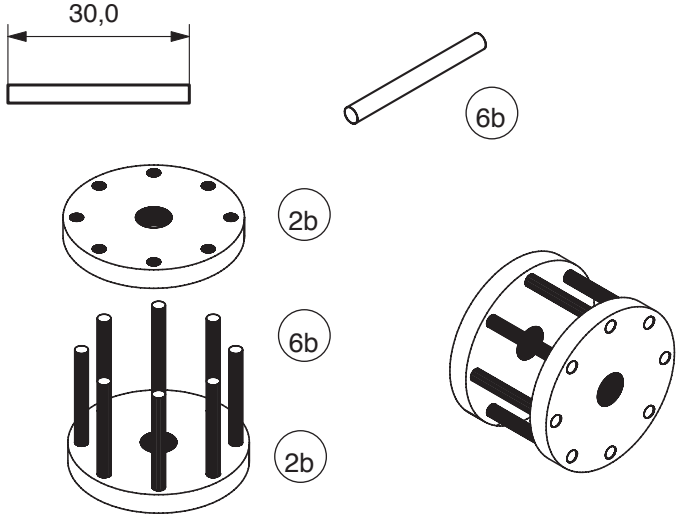
6.2.3 Take the smaller discs and drill the 3mm diameter & 8mm diameter holes. Try to drill both of the same size discs in one action.

Note: Take care to be accurate when drilling !



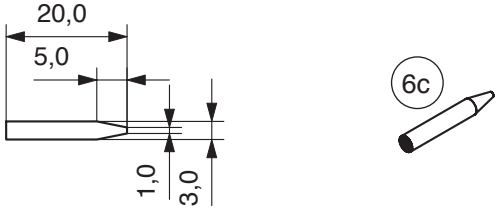
6.2.4 Finally drill the 3mm and 8mm holes in the large disc (2a)

6.2.5 Saw eight 30mm lengths (6b) from the dowel (6). Sand the sawn ends.

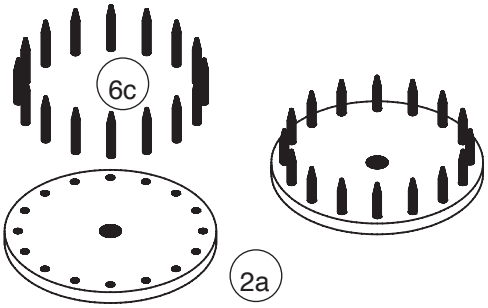


6.2.6 Assemble and glue the discs (2b) and dowels (6b) as shown.

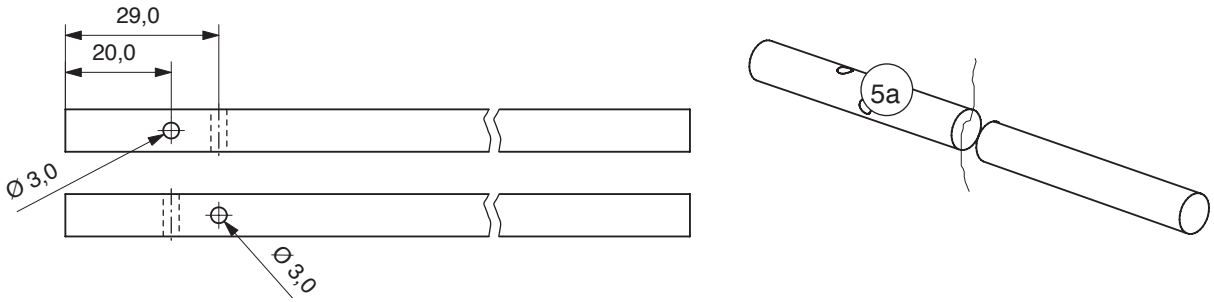
6.2.7 Using two lengths of dowel (6) saw off 16 pieces each 20mm long (6c) . Make one end into a point as shown.



6.2.8 Glue and insert and the dowels (6c) in the holes in one of the large discs (2a) with points uppermost.



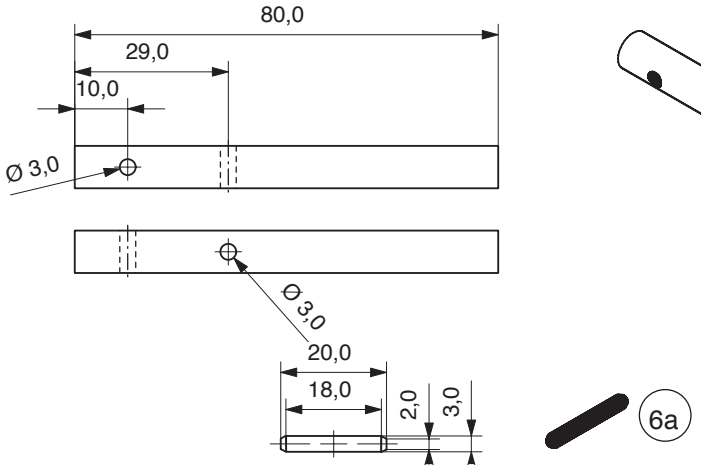
6.2.9 Mark out and drill two 3mmdiameter holes set at 90 degrees in the dowel shaft (5a) 8mm diameter x 250mm.



Note: Hold the work in a machine vice when drilling the holes.

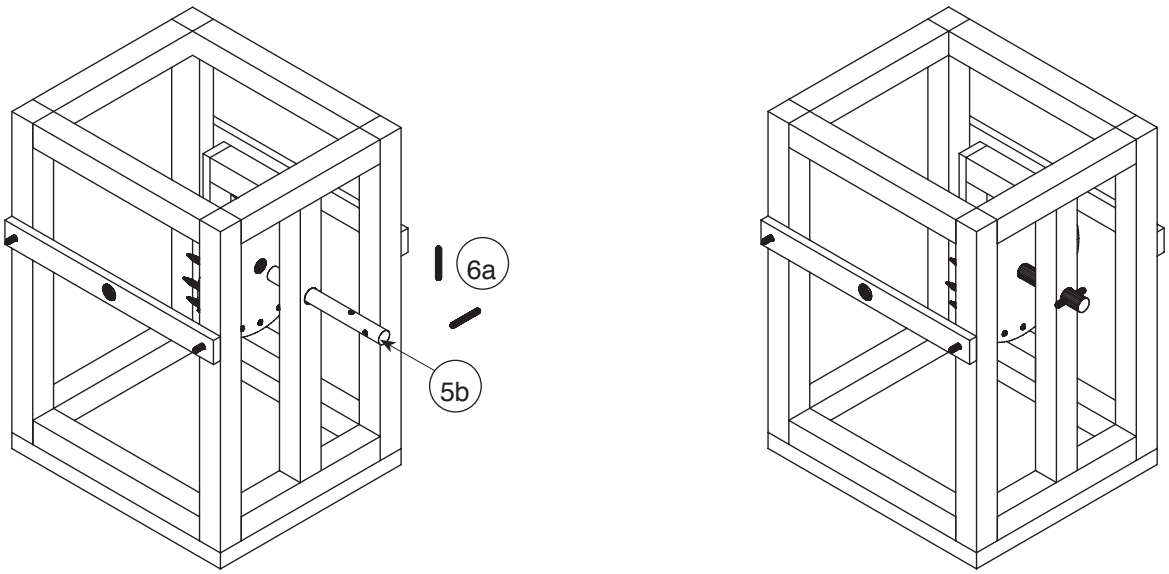
6.2.10 Using the dowel (5) 8mm dia x 250mm saw off a 80mm length to make a shaft. At one end mark out and drill two 3mm diameter holes set at 90 degrees. See diagram for details.

6.2.11 Saw four 20mm long pins (6a) from the dowel (6) and lightly round the ends.



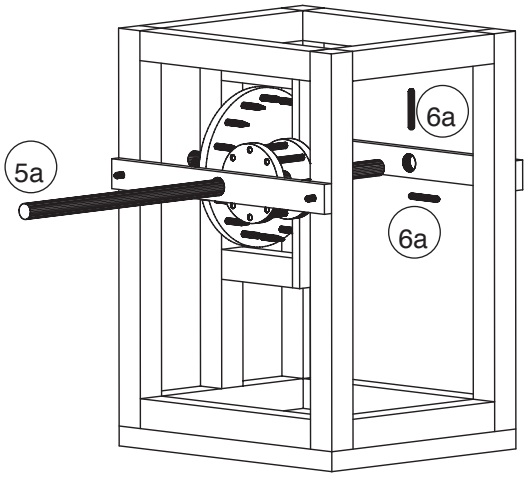
6.2.12 Mount the large drive gear wheel on the shaft (5b) insert it in the bearing block. Use two dowel pins (6a) to hold it in place.

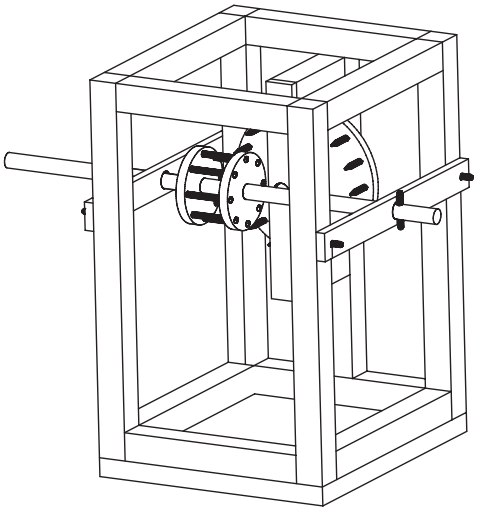
Note: Do not glue these parts!!



6.2.13 Mount the small drive gear wheel on the shaft and assemble it on the cross member. Arrange the gears so that the small drive gear makes contact with the left side of the large drive gear. Once set up secure the shaft with two dowel pins (6a)

Note: Do not glue these parts!

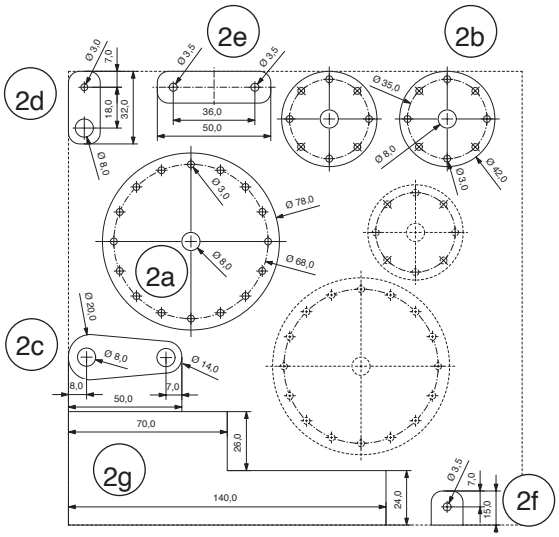




6.2.14 Now adjust the gears, by sliding them on the shafts, so that they engage cleanly and the shafts turn easily.

6.3. Making and assembling the crank handle and drive shaft

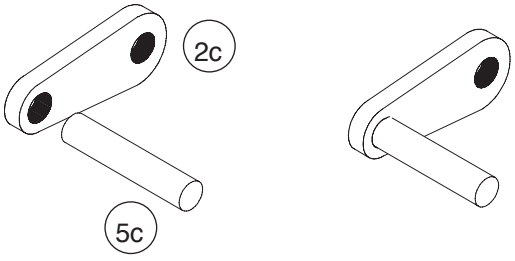
6.3.1 Saw out the crank handle arm (2c) from the plywood sheet 2. Sand the sawn edges and drill the 8mm diameter holes.

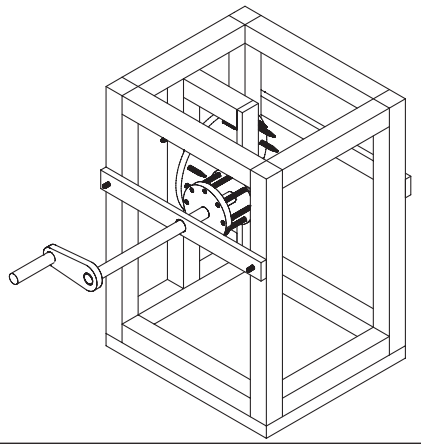


6.3.2 The shaft (5c) is made up from a 40mm length sawn from the dowel remainder (5) Sand the sawn ends.

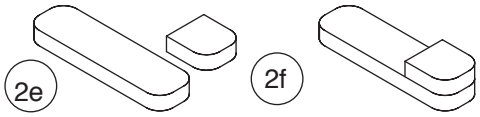
6.3.3 Glue the dowel (5c) into the crank arm (2c)

6.3.4 Glue the crank handle on to the shaft (5a) as shown.

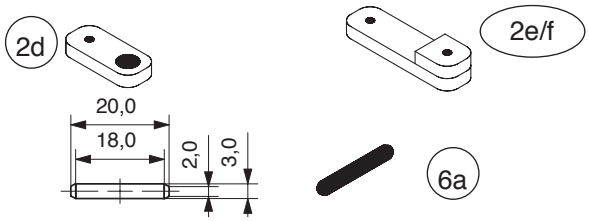




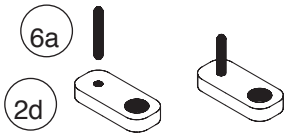
6.3.5 Saw out the drive parts (2d /2e/2f) from the plywood sheet.
6.3.6 Glue parts (2e) and (2f) together as shown in the plan
6.3.7 Drill part (2d) as shown in the pattern (8mm diameter and 3diameter holes)



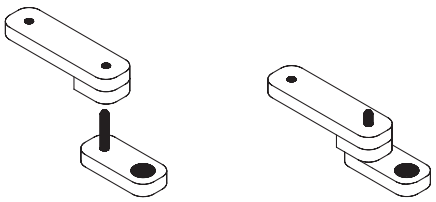
6.3.8 Glue the parts (2e /2f) and drill 3.5mm diameter hole (see pattern)
6. 3.9 Saw a piece from the dowel (6) 20mm long and lightly round the ends.

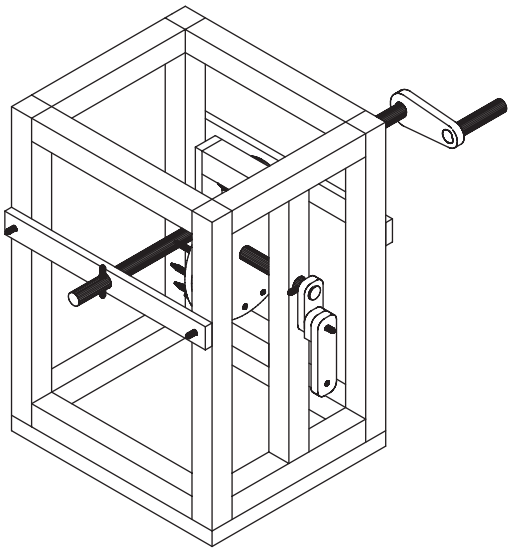


6.3.10 Insert and glue the dowel pin (6a) in part (2d)
6.3.11 Assemble the drive parts on the shaft (5b) as shown.



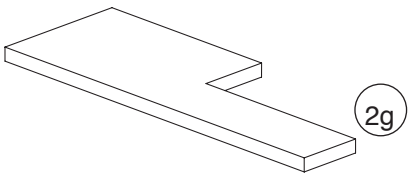
Drive parts



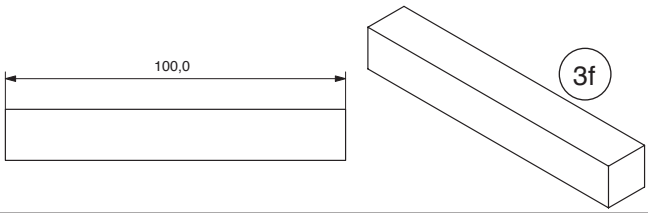


6.4. Designing and making the slider assembly

6.4.1 Trace out and saw the bearing block holder (2g) from the plywood sheet (use pattern)
Sand the sawn edges
6.4.2 Mark out and saw three support strips (3f) each 100mm long from a length of pine (3)
Sand the sawn ends.

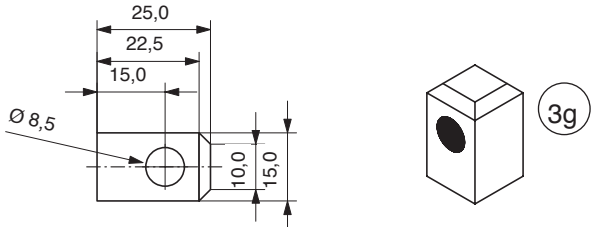


Note: Make sure that all 3 pieces are exactly the same length!

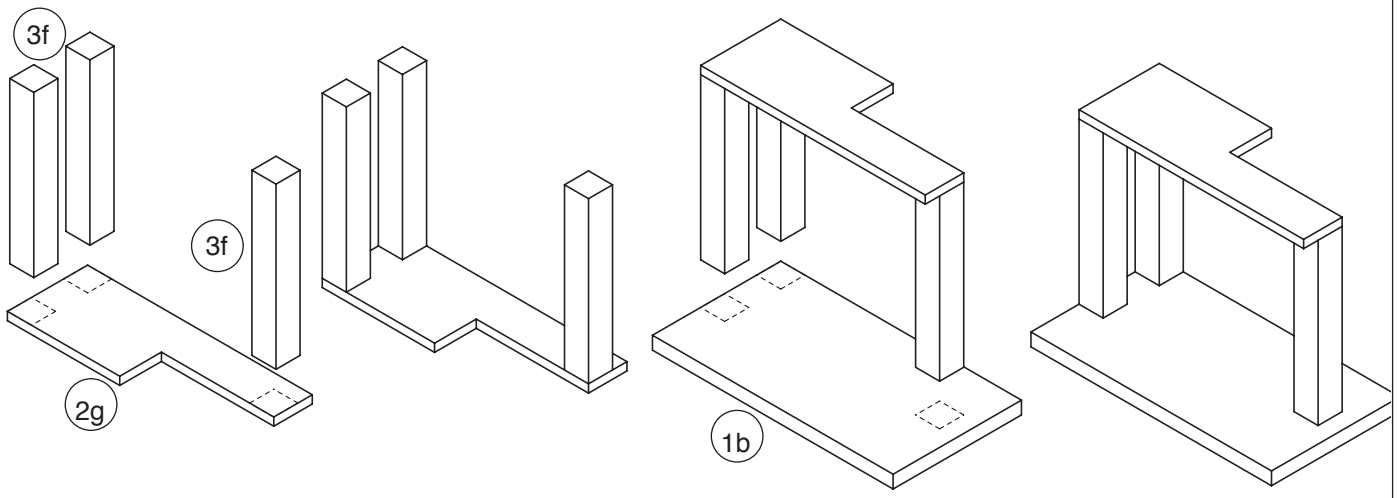


6.4.3 From the remainder of the pine strip (3) saw off two pieces each 25 mm long (3g)
Drill the 8.5mm diameter hole and chamfer the top edges as shown.

Note: The holes must be drilled accurately so that they line up with each other.

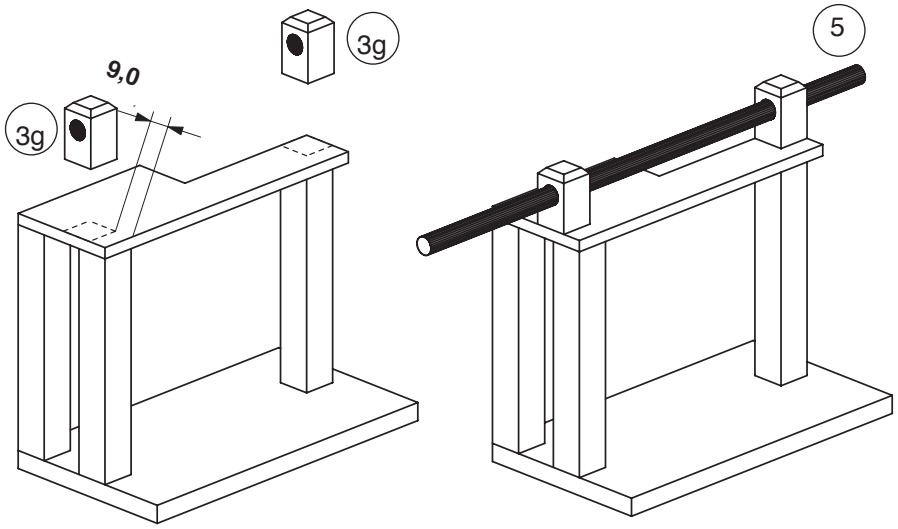


6.4.4 Assemble and glue the supports (3f) to the base (1b) and add the bearing support (2g) as shown.

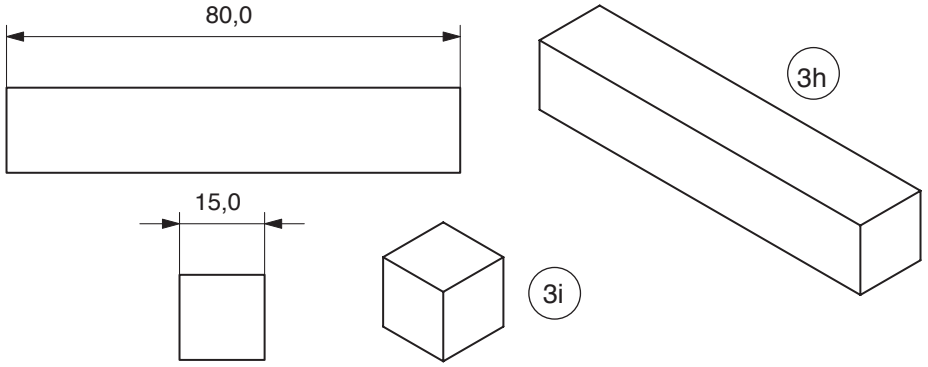


6.4.5 Glue the bearing blocks (3g) on the support (2g)

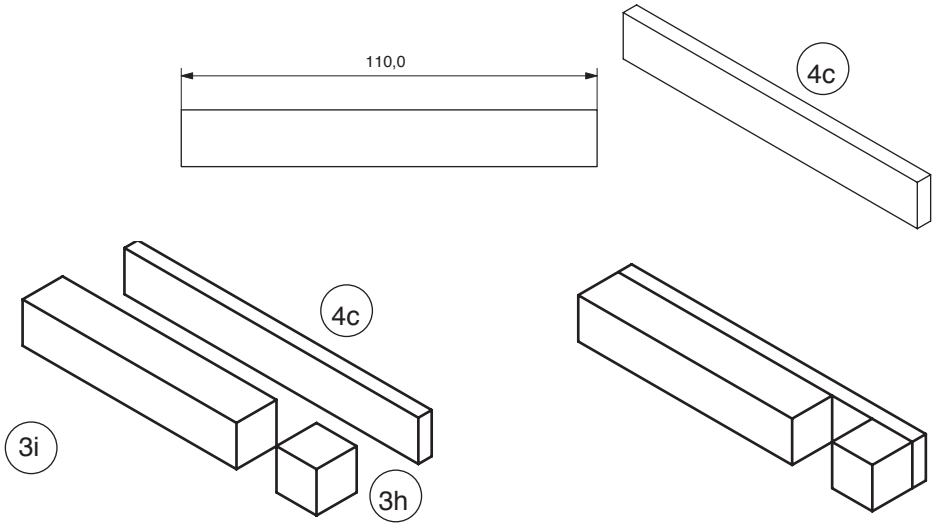
Note: The holes must line up accurately, use the dowel shaft (5) 8mm dia x 250mm to help line them up..



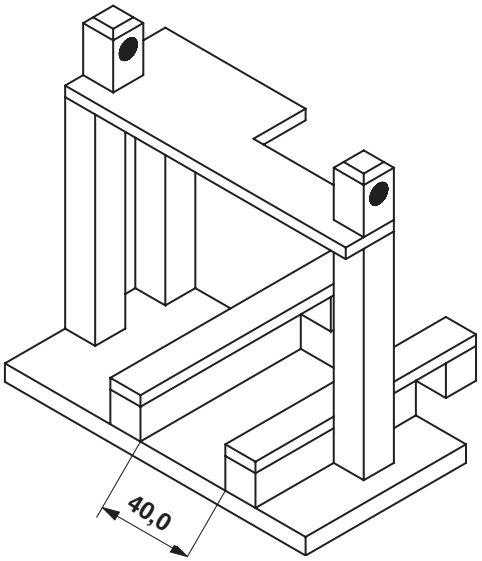
6.4.6 As stops saw two pieces 80mm long (3i) and two 15mm long (h) from the remaining pine strip (3). Sand the sawn ends

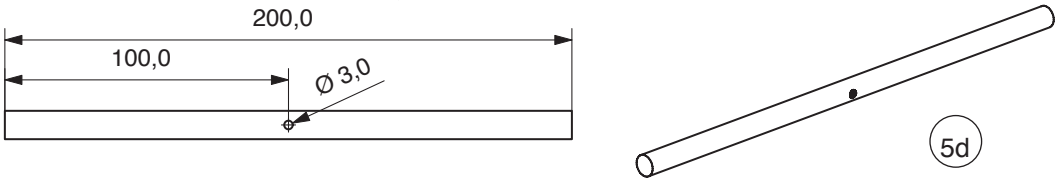


6.4.7 Shorten the pine strip (4) to 110mm long and sand the ends.

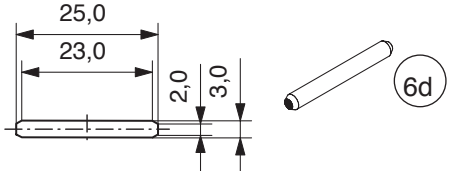


6.4.8 Glue the strips (4c/ 3g/ 3h) together to make the clamp mechanism.
6.4.9 Assemble and glue the clamp mechanism on the base (1b) as shown

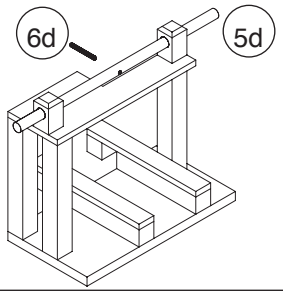




6.4.10 Shorten the dowel (5) to 200mm and drill the 3mm hole in the middle
6.4.10 From remaining dowel (6) saw a pin 25mm long and round the ends.

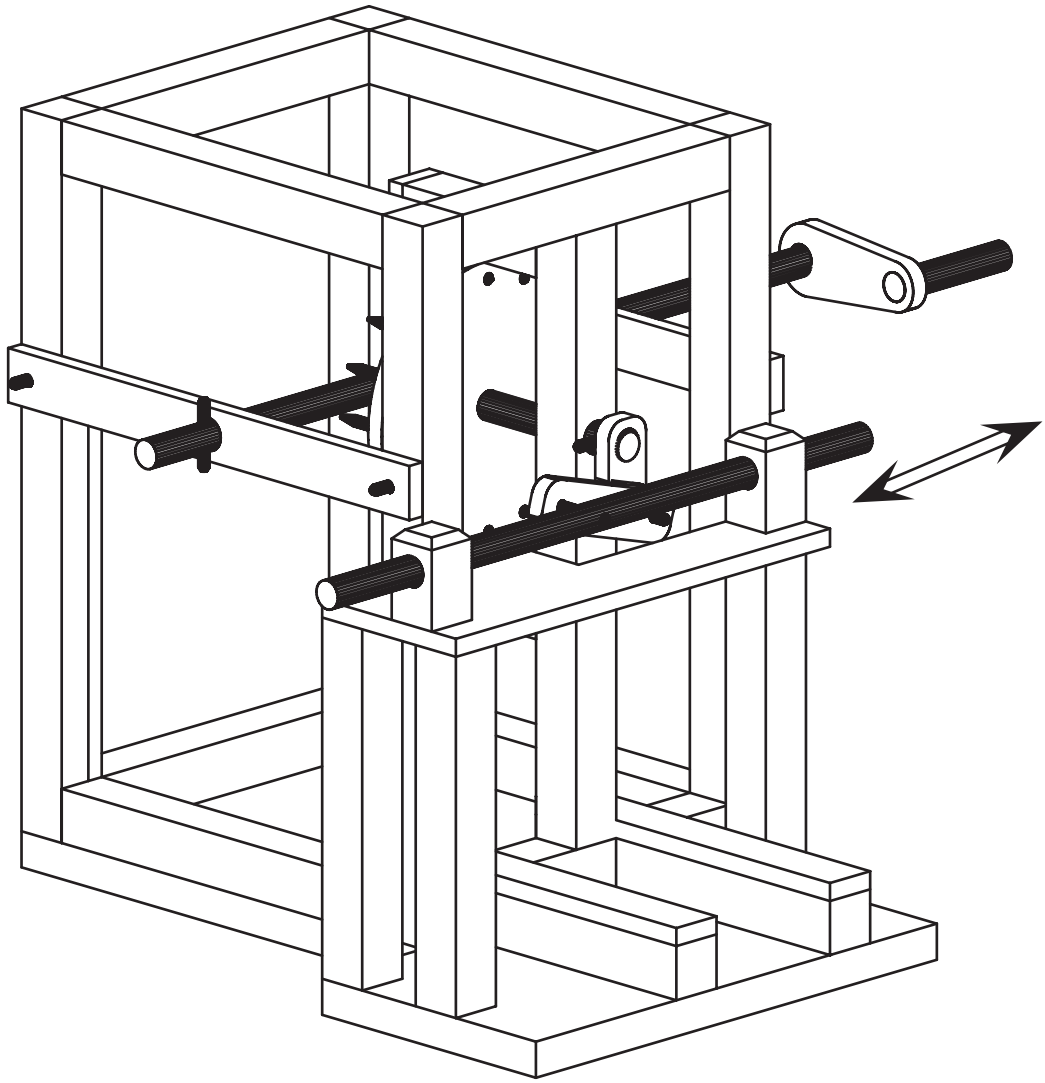


6.4.11 Insert the dowel shaft (5d) in the bearing blocks (3g) and finally insert the Pin (6d) in the centre hole



6.5 Final assembly and testing

6.5.1 Offer up the horizontal drive system to the main gear frame and connect the slider to the pin as shown



6.5.2 **Function test**:

- By rotating the crank handle the slider should travel backwards and forward.

Fault finding:

- If the gears jam their position on the shaft may need to be adjusted.
- If the slider sticks, check that it not to tight in its bearings, also try moving the frame to the left or right.
- If the slider jams- check that the bearing blocks are in line with each other- also try sanding / waxing the slider

6.5.3 Once you have checked the function, glue the gears on the shaft.

7. Patterns for the Plywood sheet (5)

Scale 1 : 1