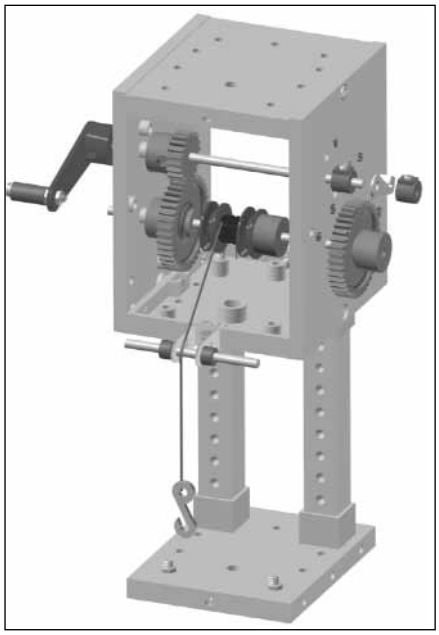
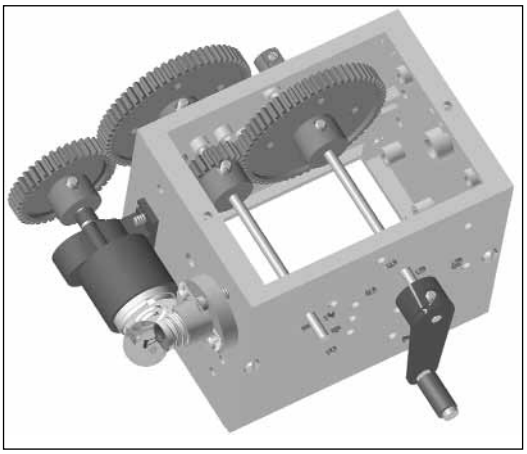
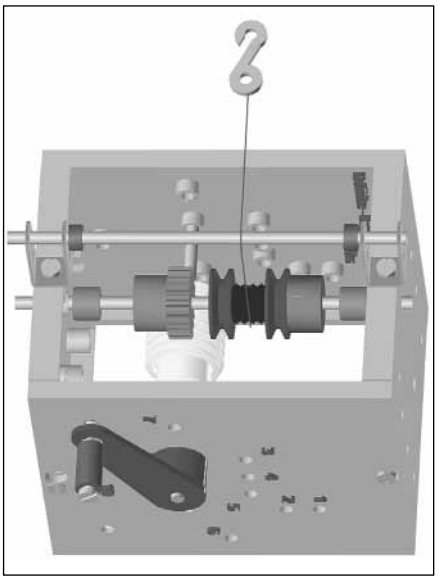
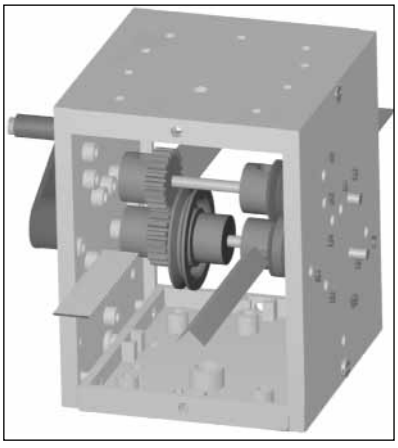
1 1 4 . 0 0 0

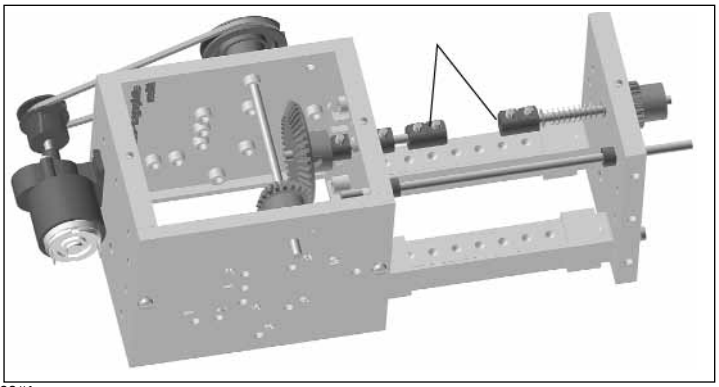
Technical model making

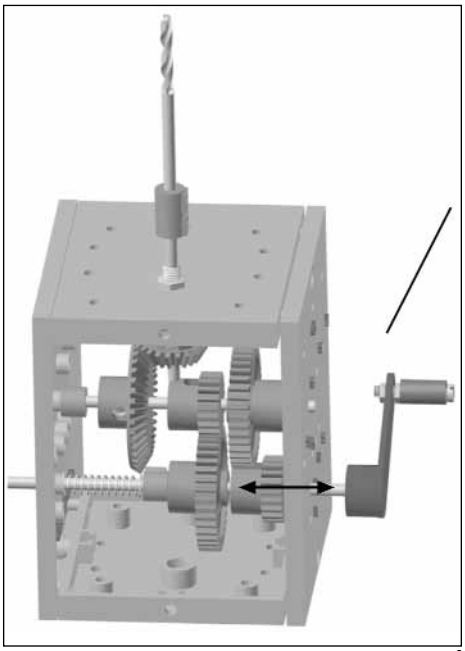






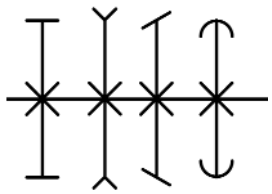




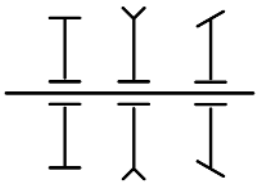


Schematic drawings of the gear systems

The most important parts of this construction system can be shown in symbols. They are known as schematic diagrams and should make the assembly easier.

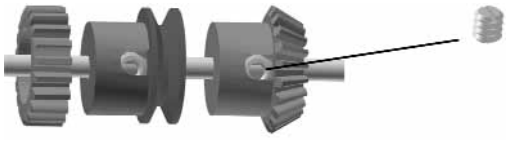


This shows different wheels set on a shaft. They are shown from left to right:
Gear
Pulley
Bevel gear
Friction wheel
Friction disc

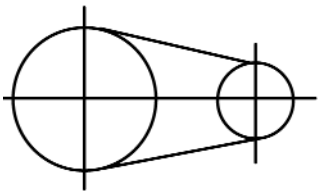


Various gears, with a loose fit on a shaft. The joint is shown by parallel lines

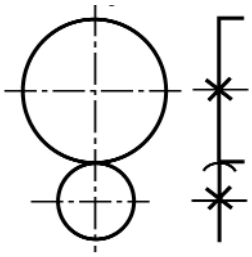
From left to right
Gear
Pulley
Bevel gear



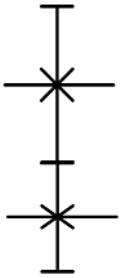
Pully drive



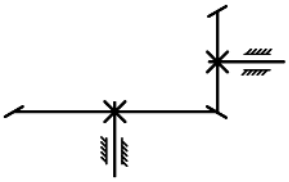
Friction drive



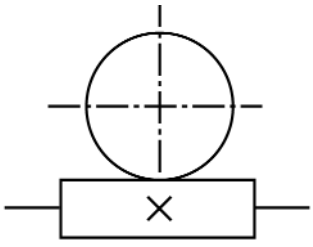
Gear assembly



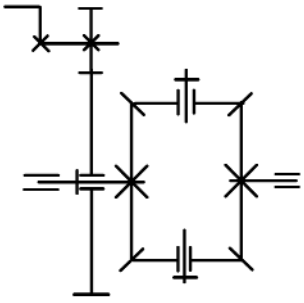
Bevel gears



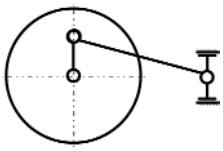
Worm and wheel drive



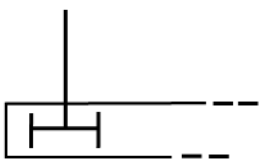
Differential



Crank and slider mechanism



Rack and pinion



1 Forward

This set is designed to help children understand the basics of machines and mechanisms.
By making simple models it is easier see the relationship of the various parts and how they work together. It also helps to develop the co-ordination required in making machines, recognising the various components and how the parts can be arranged to produce different results. The basic models are:

- Pulley drive
- Wheel to wheel drive

- Gear drives
- Bevel gear drive
- Worm and wheel drive

- Horizontal drive system

2 The different parts

This set is made up of the basic elements

- Gear drive housing elements
- With these parts it is possible to make working models quickly and easily. The axles etc. fit easily in the pre-made holes

- Building elements
These are designed to add to the gear drive element etc

Drive systems
There is a battery driven motor for powered models and a crank handle for hand driven machines

Gears, pulley
All the necessary gears , pulleys and drive wheels are included along with specialised parts for different models. The gears have 4mm hole and fit on 4mm dowel

- Dowels, screws and nuts
- These parts are designed joining various parts and are simple enough to re-sort having after having built and tested your model. The simplicity of the system makes it easy to complete one model after another

3. Notes on working

The following pages contain the instruction for making the various models. Along with parts numbers there are diagrams and drawings to make the construction easy

To start with you will find the aim which is designed to illustrate or the problem to be overcome.
The following three points (parts, diagram, assembly) give a set working order. To start , collect and identify all the necessary parts. This is aided by a parts are list with numbers all of which are illustrated. Step 5 suggests the various functions and experiments that can be carried out.
Finally a note should be made of the outcomes

General notes:

1. Do not over tighten the nuts and bolts (No force) Use the correct size screwdriver for the size of machine screw head

2. The gear housing elements are joined with the M8 x 8 (44) machine screws. The joining nuts are already inserted in parts (4,5) Also the frame parts are ready to assemble

3. The bearing (34) is added to the gear base plate as necessary (4)

4. The geared motor will need to be assembled. Instructions are provided . Depending on the required outcome ratios of 6:1 or 3:1 can be made up. When fixing the motor always use the washers (48) under the nuts.

5. The crank (10) will need to be extended with a distance piece (35) to make the handle. For this you will need a M4x 30mm machine screw and two M4 nuts (50) Fit the spacer so that it can rotate freely

6. When using the spring make sure that there is a washer (48) on either end

7. To fix the drive parts on to a shaft use a grub screw (51)

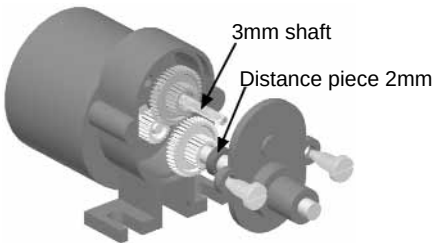
8. The sides of the gear box housing are not shown in the diagram in order to make the drawings clearer. They can be fitted using two machine screws (44)

9. The connection to the motor can be made simply without soldering by using the connector.

Gearbox assembly

Ratio 1:9

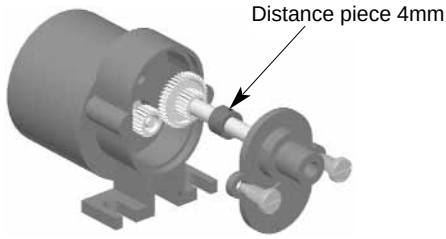
1. Press drive gear 10T on to the motor shaft
2. Insert the 4mm stepped shaft into the double gear (white)
3. Insert motor in the housing
4. Set the 3mm shaft with double gear (green) into the housing
5. Add the cover, complete with axle (2) screw lid in position



Ratio 1:3

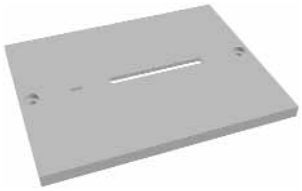
1 Steps 1-3 as above
2 Place distance spacer on the shaft
3 Add the cover and screw in position

4mm Distance spacer

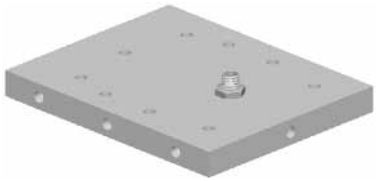


Parts description

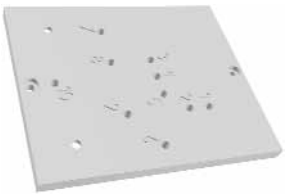
Gearbox housing



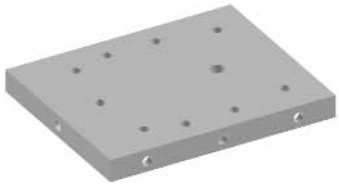
Gear housing plate with slot



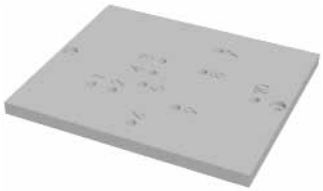
Gear housing base with motor hole and threaded inserts



Gear housing side, right



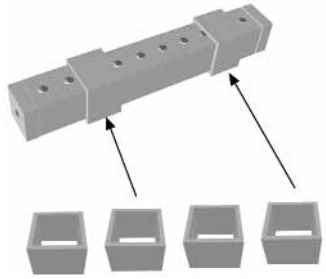
Gear housing base



Gear housing side, left

Construction Parts

U-profile with holed strip



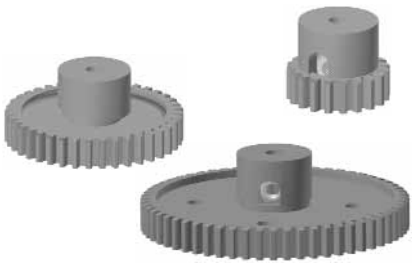
Clips

Drives

Crank handle

Motor and gearbox

Gears and pulleys



Gear 20T, Modul 1

Gear 40T, Modul 1

Gear 60T, Modul 1

Bevel gear 20T, Modul 1

Bevel gear 40T, Modul 1

Drive wheel

Gear,60T, Modul 1
Plain centre

Worm gear

Pulley 20mm

Pulley 36mm

Pulley 60mm

Gears and pulleys

Bevel gear 20T, Modul 1
Plain

Stepped pulleys

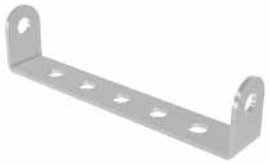
Stepped pulleys

Gear parts

Drive wheel/ Saw blade

Drum

Lever with wedge



U- strip 5 x 1 holes

Locking claw

Drill

U-strip 2 x 1 holes

Gear sundries

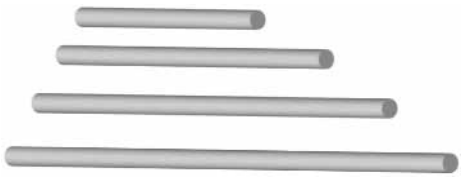
Spacer 15mm

Coupling

Spacing ring 4mm

Locking ring

Rods plain (dowel)



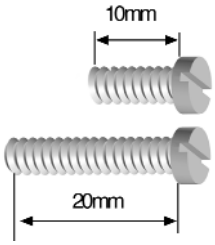
Dowel 60mm long
Dowel 90mm long
Dowel 120mm long
Dowel 150mm long

Screws, Nuts, Washers

Grub screws M4

M4 Nuts

Washer 4.4mm



Machine screw M4 x 10

Machine screw M4 x 20

Tools

Pulley drive — Electric drill

1. Aim

A workshop or factory is full of machines that are designed to make work easier. You will have already seen that machines are made up of various mechanical components. The aim is to construct a model of a drilling machine and observe how power can be transferred using pulleys

2. Parts needed

2x Gear housing sides, right

1x Gear housing side, left

2x Gear housing bases

2x U-profile with holed strip

4x Clips

1x Motor and gearbox

1xDrill

1x Stepped pulley 60/36

1x Stepped pulley 36/60

1x Coupling

1x Dowel (150mm)

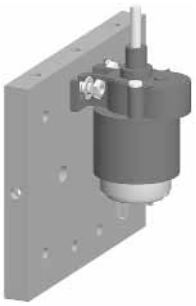
6x M4x10

4x M4x20

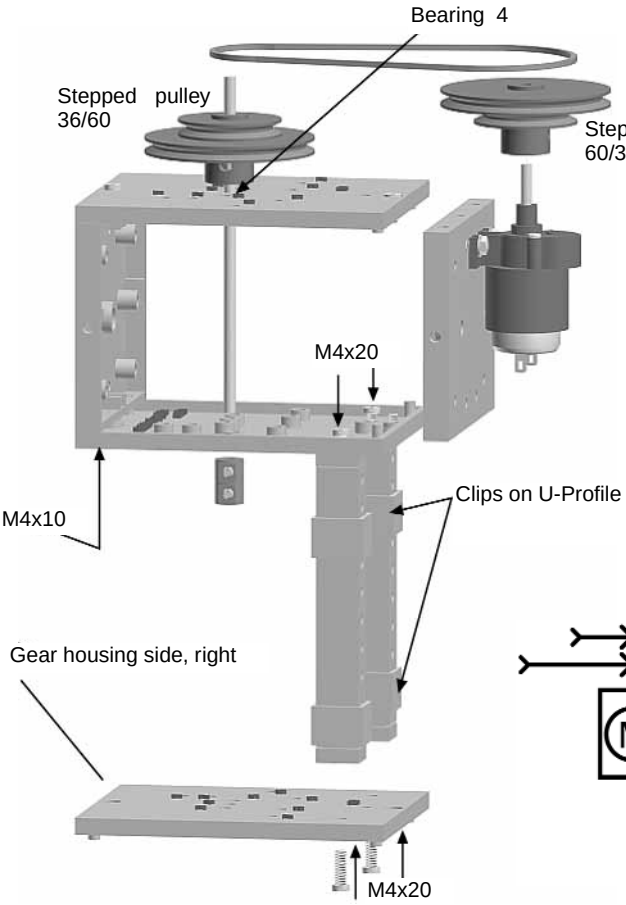
2x M4 Nuts

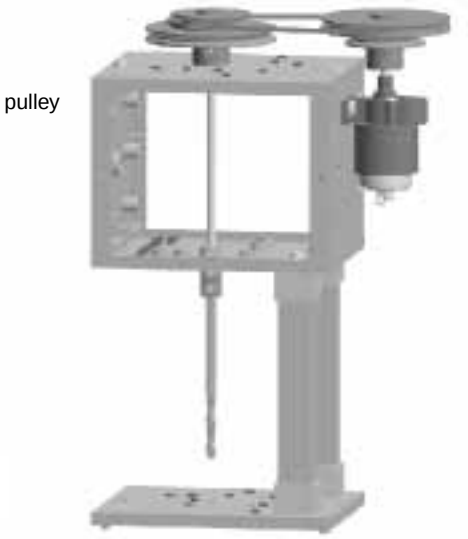
2x Washer 4.4mm

3. Diagram

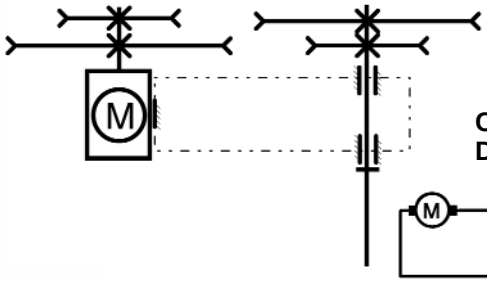


Motor and gearbox, gear housing base, M4x10, M4 Nuts and washers

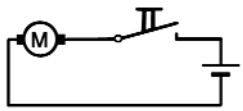




Schematic Diagram



Circuit Diagram



4. Assembly

4.1 Construct the housing as shown

4.2 Mount the motor on its base plate and fit the pulley on the shaft

4.3 Fit the dowel in the bearing hole 4 and mount the pulleys

4.4 Fix the drill bit with the coupling on the shaft and lock

5. Experiments

5.1 Turn the driving pulley and watch what happens to the driven pulley and which direction it turns

5.2 Turn the drive shaft twice (4x/6x) and count how many times the driven pulley turns

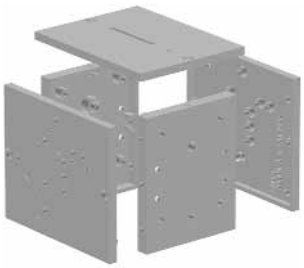
5.3 Connect to battery and try the drill

Pulley drive — Circular Saw

1. Aim

The aim is to construct a working model of a circular saw. These machines are designed to saw wood to length and width. The finished model should help you to understand the most important aspects of a bench mounted circular saw

2. Parts needed



1x Gear housing side, right
1x Gear housing side, left
2x Gear housing bases
1x Gear housing with slot

1x Motor and gearbox

2x Pulley 36mm

1x Drive wheel 36T

1x Locking ring

8x M4x10

2x Nuts M4

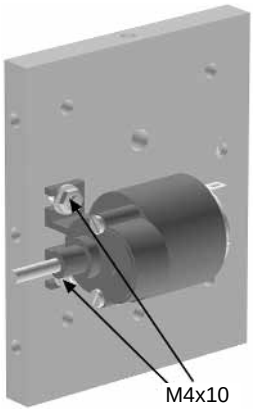
2x Washer 4.4mm

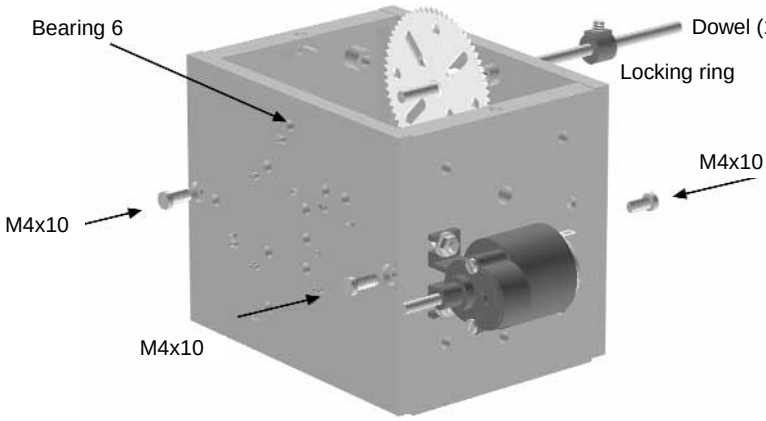
1x Pulley 36mm

1x Dowel (120mm)

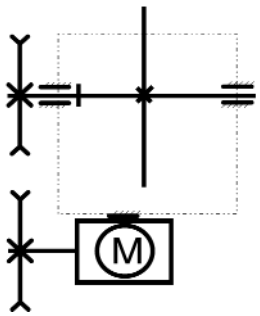
1x Rubber bands

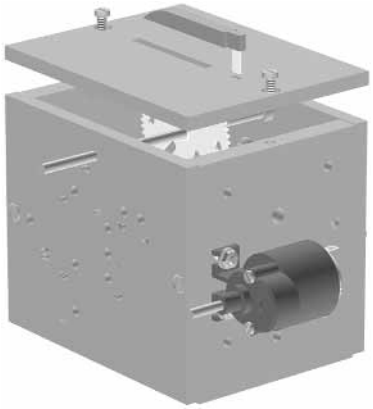
3. Diagram

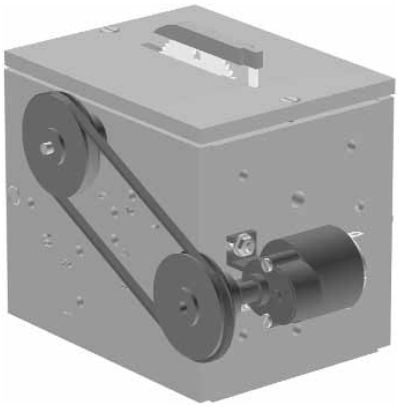




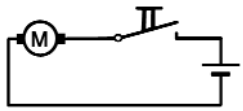
Schematic Diagram







Circuit Diagram



4. Assembly

4.1 Choose the parts and make up the housing
4.2 Place the shaft in the hole 6 and make up the machine as shown.
Firstly place a locking ring and then the saw blade on the shaft
4.3 Add the top of the machine , part 1
4.4 Place the wedge and cover in the small slot on the top
4.5 Fix the E-motor on the side
4.6 Add a drive pulley and drive band

5. Experiments

5.1 Try to work out the ratios of the pulley drive
5.2 Add a different drive pulley so that a ratio of 1:2 is made
5.3 Connect up the motor to the battery
5.4 Switch on and note the direction of the blade
5.5 Try sawing a piece of paper or thin card

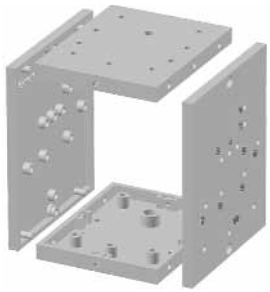
E114000#1

Gear driven Winch

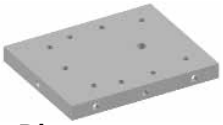
1. Aim

Until now our models have just been interested in the transfer of power from one gear, pulley to another, or changing its direction. This simple winch system will use gears and a locking system to stop the winch from slipping

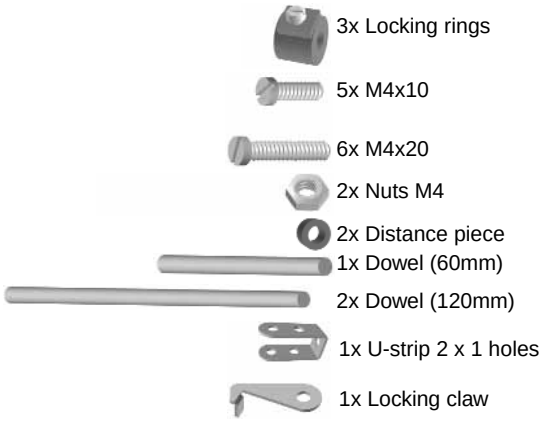
2. Parts needed



1x Gear housing side, right
1x Gear housing side, left
3x Gear housing bases

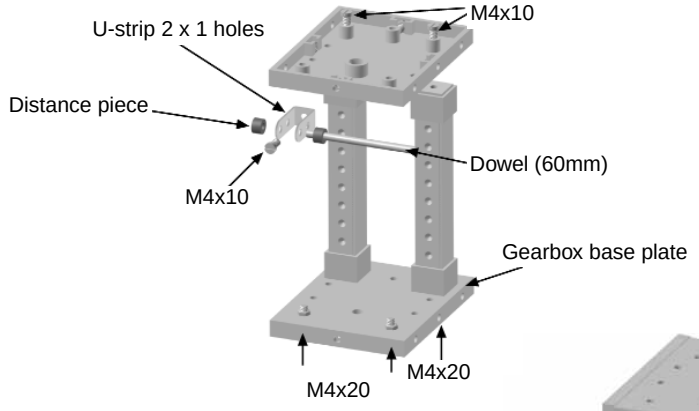


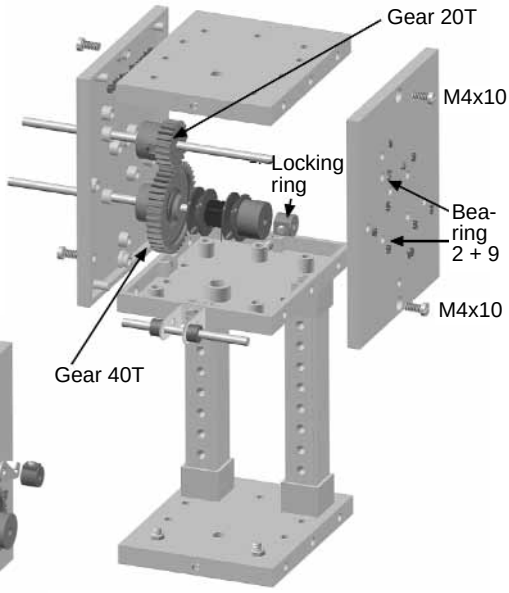
1x Gear 20T
2x Gear 40T
1x Drum
1x Crank handle
2x U-profile with holed strip

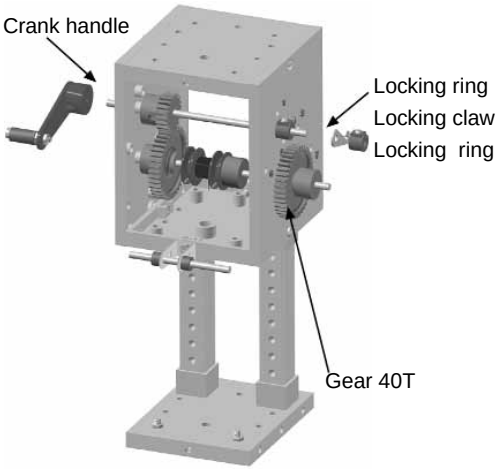


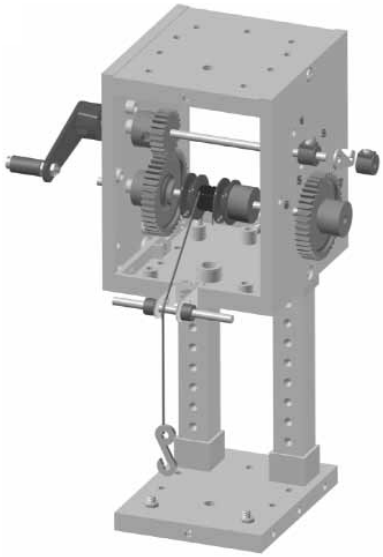
3x Locking rings
5x M4x10
6x M4x20
2x Nuts M4
2x Distance piece
1x Dowel (60mm)
2x Dowel (120mm)
1x U-strip 2 x 1 holes
1x Locking claw

3. Diagram

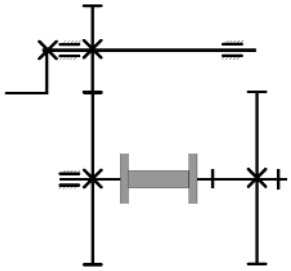








Schematic diagram



4. Assembly

4.1 Choose and construct the housing, mount the drum inside
4.2 Assemble further as shown

Note: One shaft is in hole 2 and the other in 9

5. Experiments

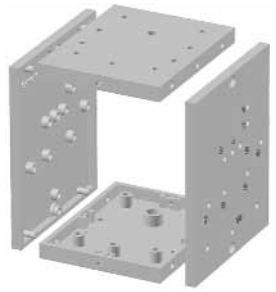
5.1 Turn the crank handle and check the ratio
5.2 Turn the handle and note the direction of the output and input (see drum)
5.3 Try a function test by picking up weight, what happens if you let go of the handle?
5.4 Mount the locking claw and gear so that the drum cannot rotate backwards

Worm wheel drive Winch

1. Aim

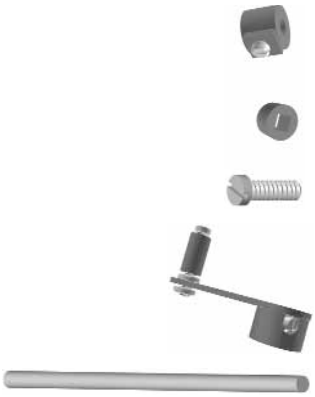
The type of gear assembly is the worm and wheel. By making a simple winch system we can see the most important part of this system

2. Parts needed



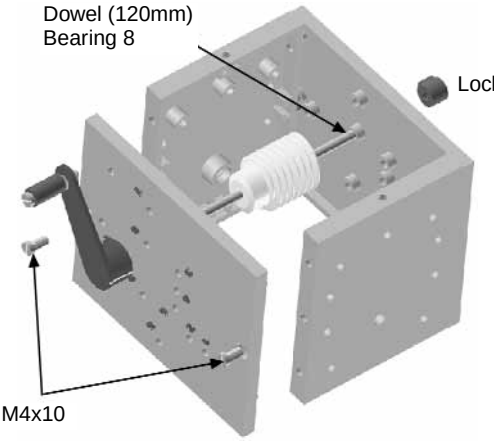
1x Gear housing side, right
1x Gear housing side, left
2x Gear housing bases

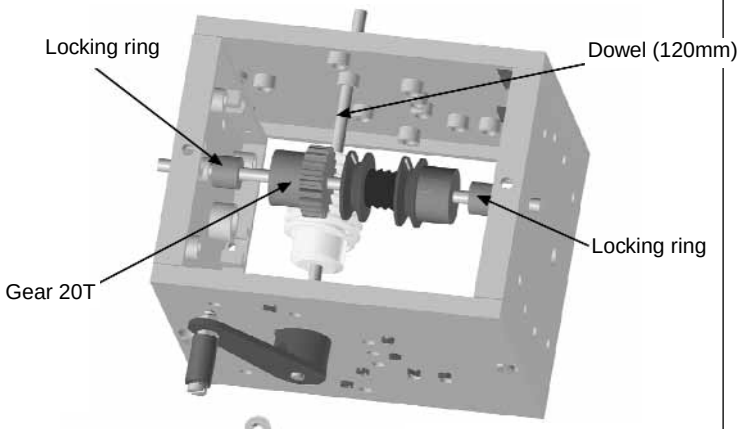
1x Gear 20T
1x Worm gear
1x Drum
2x U-strip 2 x 1 holes

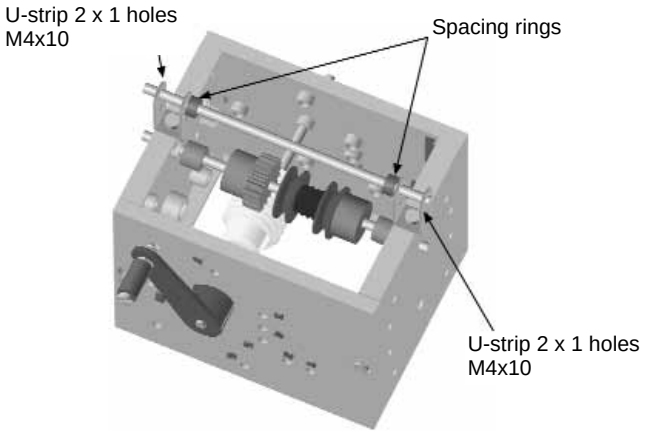


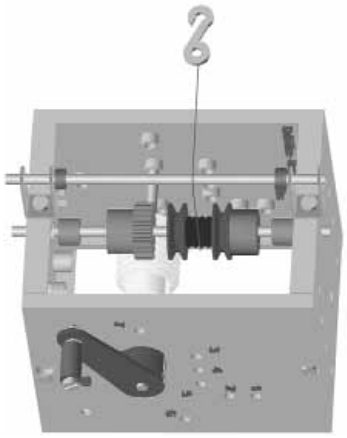
3x Locking rings
2x Spacing rings
6x M4x10
1x Crank handle
3x Dowel (120mm)

3. Diagram

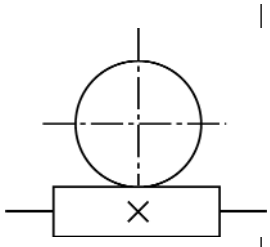








Schematic Diagram



4. Assembly

4.1 Choose are assembled to make the winch

4.2 Seat the drum on the shaft in the bearing and add 2 locking rings gear and drum!

4.3 Place the second shaft in the bearing 3, add a locking ring inside and then the worm gear
Secure the shaft against slipping

5 Experiment

5.1 Turn the handle and try to see which is the actual driving shaft , make note of its direction

5.2 Mount the crank handle on the drive shaft

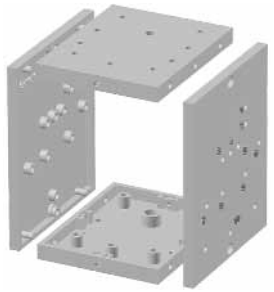
5.3 Does the ratio change?

5.4 Try a function test. Try picking up a weight with the winch, what happens if you let the handle go ?

1. Aim

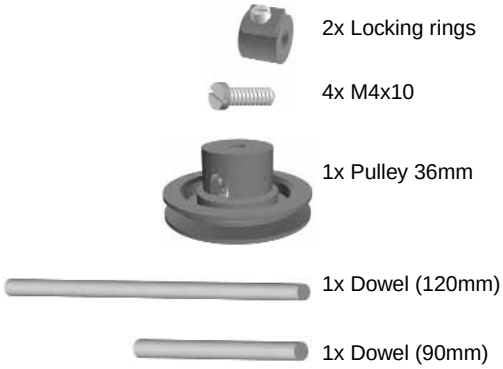
Aim to make model forming press and use our knowledge of gears to build a simple gear drive. The model press will even make a profile in very thin metal sheet It can be operated by hand or can be used with an E-motor

2. Parts needed



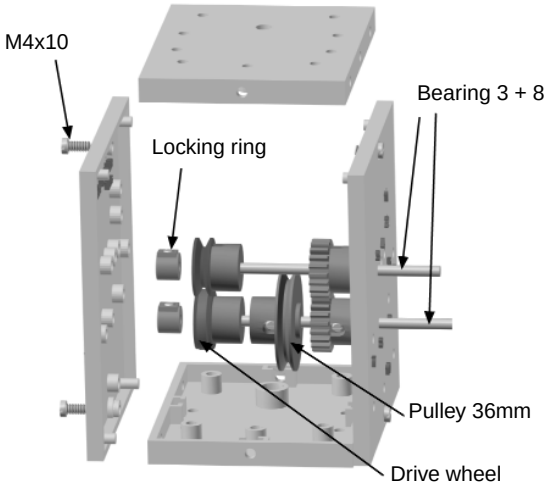
1x Gear housing side, right
1x Gear housing side, left
2x Gear housing bases

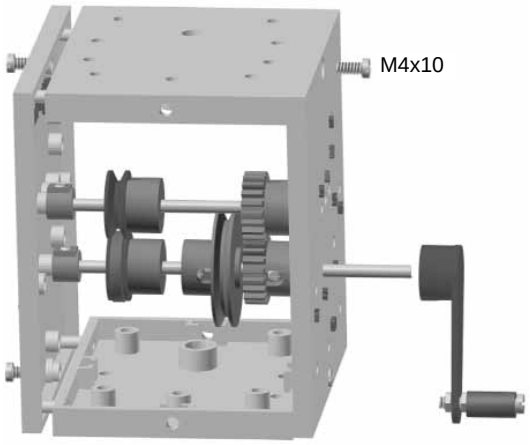
2x Gear 20T
1x Pulley 20mm
1x Drive wheel
1x Crank handle

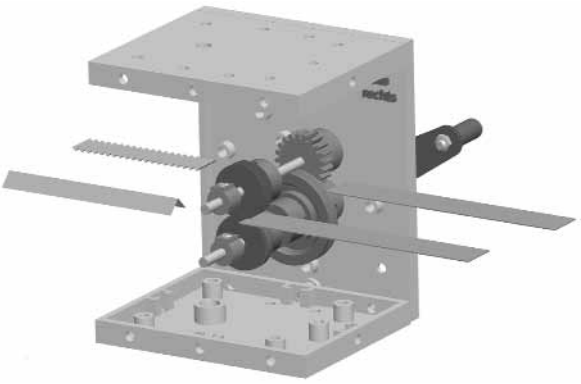


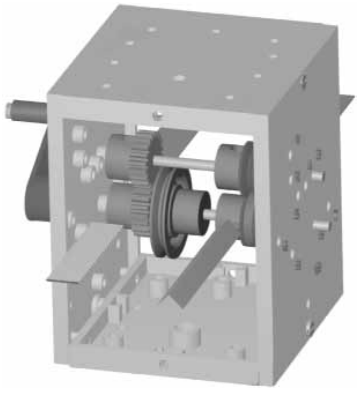
2x Locking rings
4x M4x10
1x Pulley 36mm
1x Dowel (120mm)
1x Dowel (90mm)

3. Diagram

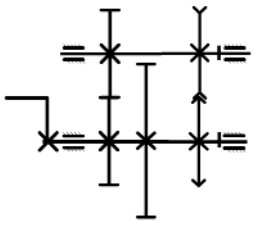








Schematic Diagram



4. Assembly

4.1 Choose the parts to make the machine housing

4.2 Note the following points:

- The ratio is 1:2 the bevel gears should turn in opposite directions
- The drive shaft and bevel gear are inserted in hole 9
- The shaft with the forming wheel and the driven bevel are in bearing 9
- The shaft with the other forming wheel is inserted in bearing 3

5 Experiments

5.1 Check all the gears and wheels

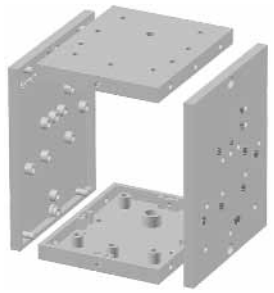
5.2 Try inserting a piece of card into the machine and see if it forms into shape
Check the stiffness of the paper before and after shaping

Gear assembly Hand mixer

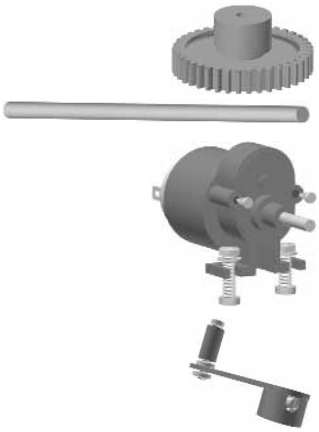
1. Aim

We can use our experience with gears to make a model of a hand mixer. You will find similar machines in every kitchen. This model has two mixing arms and forward / reverse turning movement

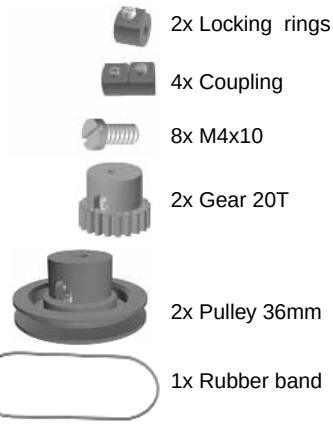
2. Parts needed



1x Gear housing side, right
1x Gear housing side, left
2x Gear housing bases

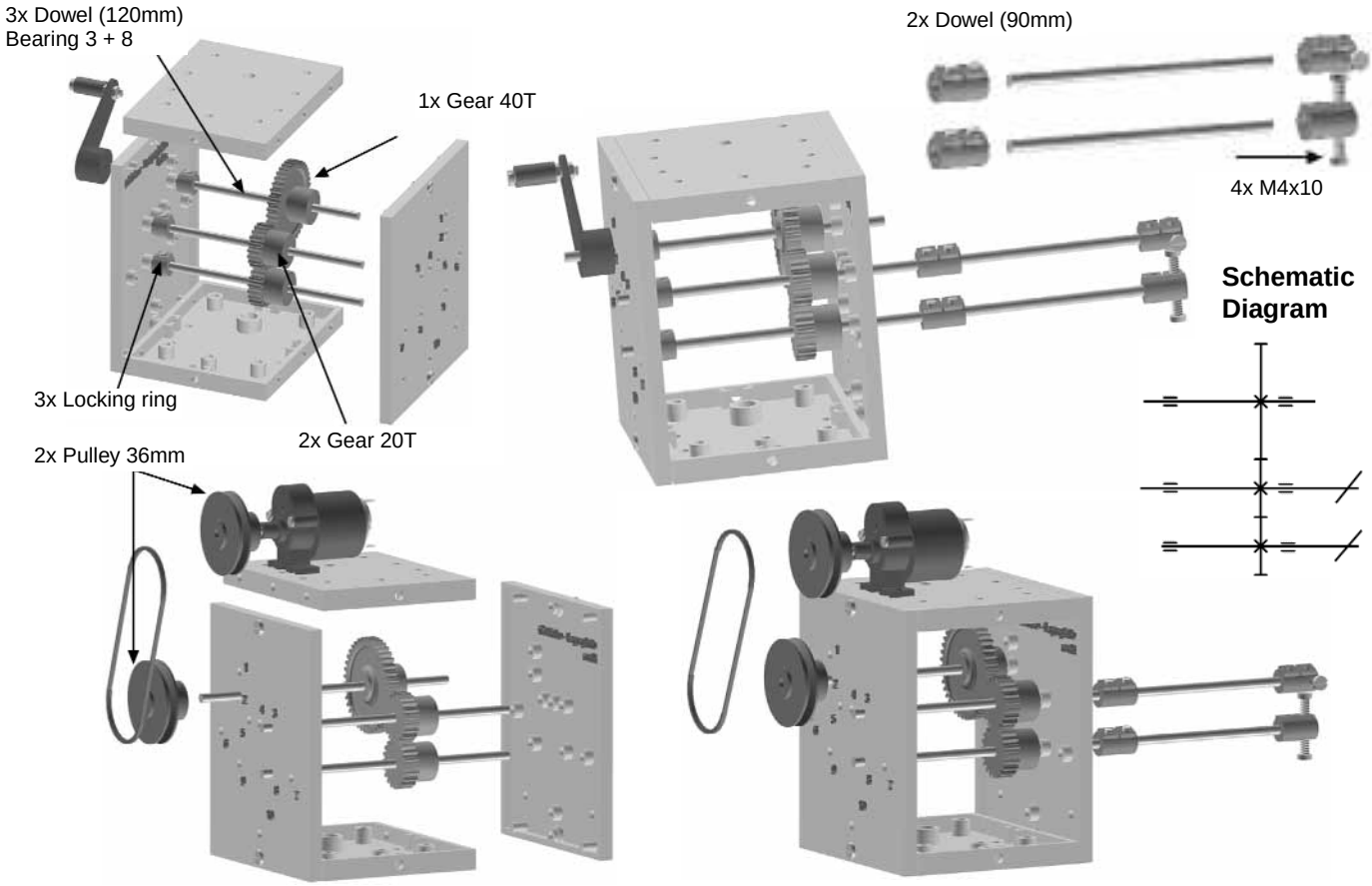


2x Gear 40T
2x Dowel (90mm)
3x Dowel (120mm)
1x Motor and gearbox
1x Crank handle



2x Locking rings
4x Coupling
8x M4x10
2x Gear 20T
2x Pulley 36mm
1x Rubber band

3. Diagram



Schematic Diagram

4. Assembly

4.1 Make up the housing as shown in the diagram

4.2 The drive shaft with hand crank is inserted in bearing hole 1. Note position of locking ring and washer

4.3 Mount the shaft and gears in holes 6and 9. Note locking ring and washer

4.4 Add the coupling and then the mixer arms)

5 Experiments

5.1 Turn the crank and note the direction of the mixer ends

5.2 Turn the crank handle and try to work out the ratio

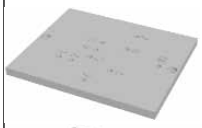
5.3 Try using your model for mixing

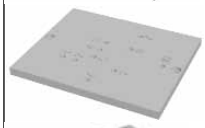
Bevel gear drive Hand-drill

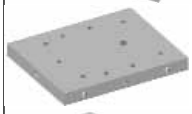
1. Aim

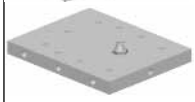
With this project we want to study the mechanism of a hand-drill. Using our knowledge we can construct a working model

2. Parts needed


1x Gear housing side, right


1x Gear housing side, left


1x Gear housing base


1x Gear housing base motor plate hole and threaded inserts


2x Gear 40T


2x Gear 20T


1x Bevel gear 40T


1x Bevel gear 20T


1x Crank handle


2x Locking rings


1x Coupling


4x M4x10


1x Spring

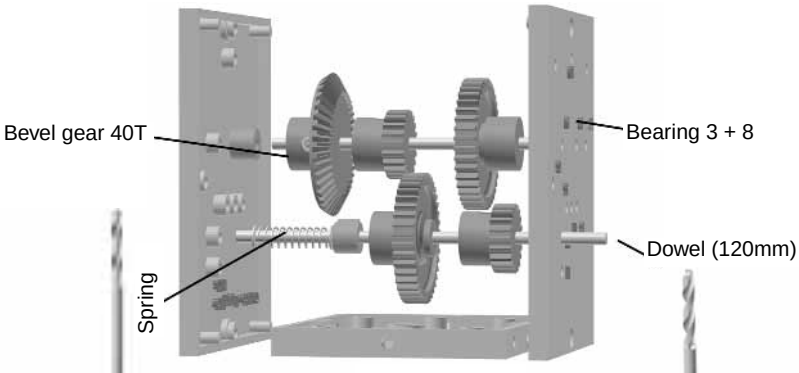

1x Drill

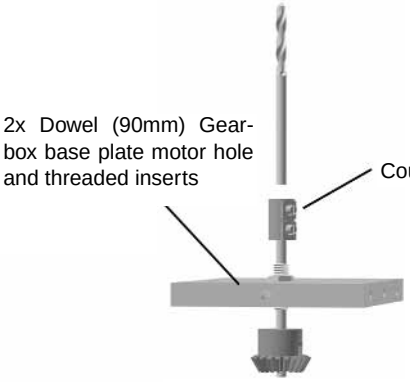

1x Dowel (60mm)

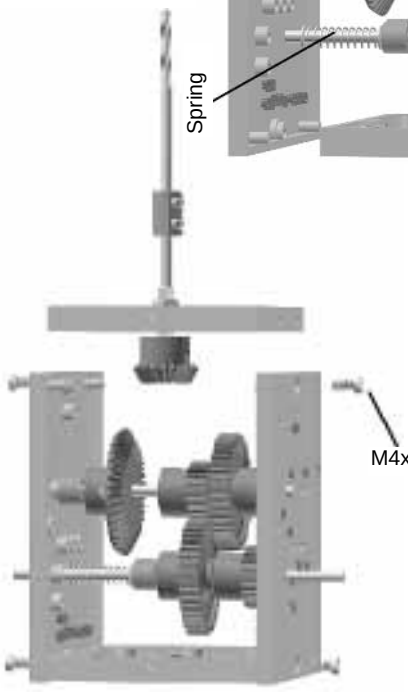

1x Dowel (90mm)

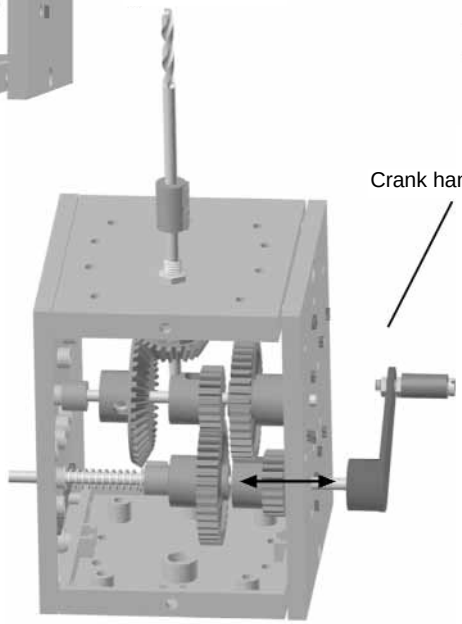

1x Dowel (120mm)

3. Diagram

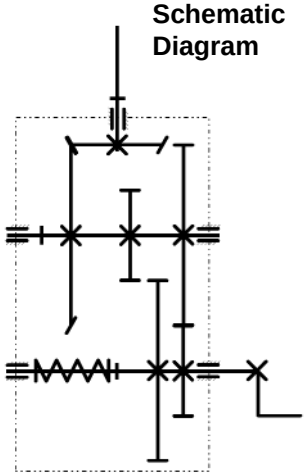








Schematic Diagram



4. Assembly

4.1 Choose the parts to make the housing

4.2 Insert the drill spindle in the bearing and mount the bevel gear
Lock the spindle against movement

4.3 Insert the shaft in hole 9 and mount from the inside, locking ring, bevel gear gear and gear

Note: Try to achieve as little play as possible between the bevel gears and lock the shaft against movement!

4.4 Insert the drive shaft in hole 2 and mount the locking ring, gear and gear plus the spring and washers as shown in the diagram.

4.5 Mount the crank handle

5 Function test

5.1 Turn the crank handle and note the direction in which the spindle turns!

5.2 Turn the crank handle and try to work out the gear ratio

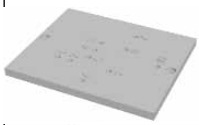
5.3 Push the drive shaft towards the housing and try steps 5.1 and 5.2 again

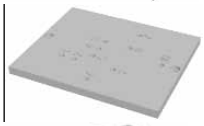
Combined gear and pully drive system Dynamo

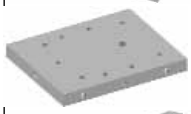
1. Aim

This model is a combination of gears and pulleys. At the same time it uses an electric motor. It demonstrates that an electric motor can not only drive machines but it can itself be used to produce electricity

2. Parts needed


1x Gear housing side, right


1x Gear housing side, left


1x Gear housing base


2x U-profile with holed strip


4x Clips


1x Motor and gearbox


2x Gear 20T


1x Bevel gear 40T


1x Bevel gear 20T


1x Pulley 36 mm


2x Locking rings


2x Distance piece 4mm


1x Coupling


1x Spring


4x M4x20
6x M4x10


2x Nut

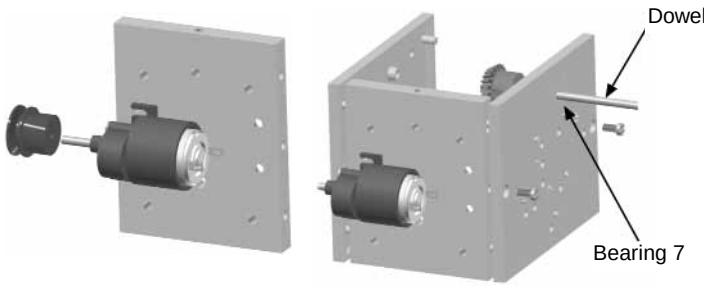

2x Dowel (60mm)

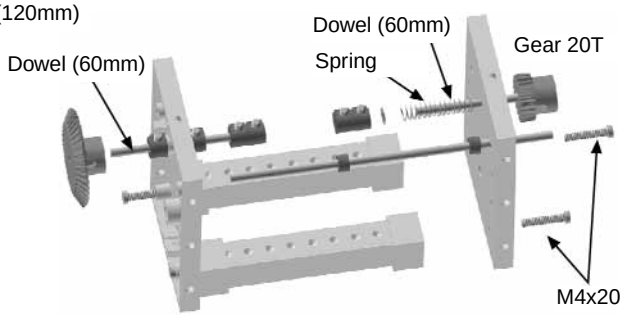

1x Dowel (120mm)

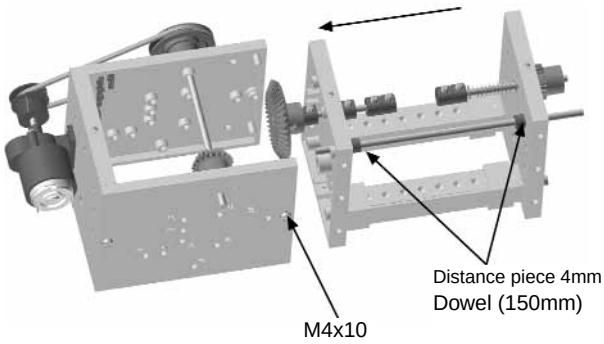

1x Dowel (150mm)

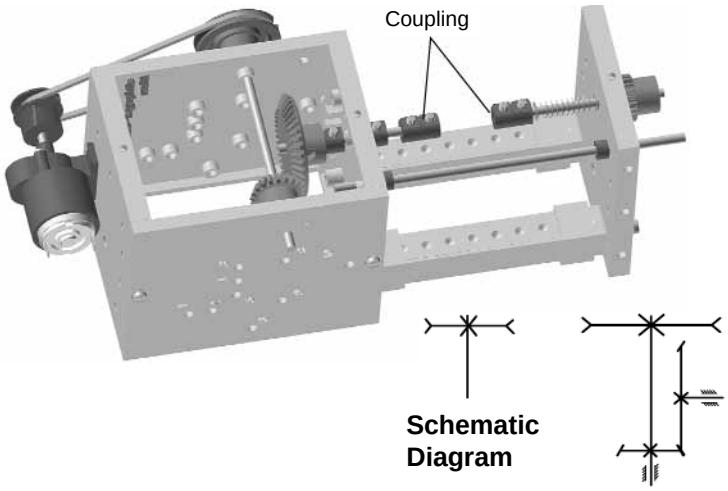

1x Pulley 20mm

3. Diagram









4. Assembly

4.1 Make up the housing from parts
4.2 Insert one metal shaft through hole 9 and mount the gear and locking ring
4.3 Insert the other shaft in hole 1 and mount the gear and pulley
4.4 Mount the generator (E-motor) on the motor housing plate fit the pulley to the generator/motor shaft
4.5 Fit the hand crank
4.6 Make up the electronic circuit as shown

Note: the motor should be assembled with a ratio of 3:1

5 Function test

5.1 Turn the crank handle to test the function
5.2 Turn the crank handle and try to work out the ratio
5.3 Turn the handle at different rates and note the brightness of the bulb

Bevel gears Differential

1. Aim

With the construction of this model we can study a further application of bevel gears. A differential joint is used in many car and lorry designs. The design allows all the power to be transferred in a straight line (both wheels being driven equally) and at the same time allow curves to be negotiated with the wheels turning at different speeds.

2. Parts needed

1x Gear housing side, right

1x Gear housing side, left

1x Gear housing base

2x Gear 60T

2x Gear 20T

1x Bevel gear 40T

1x Bevel gear 20T

1x Pulley 60 mm

1x Crank handle

2x U- strip 5 x 1 holes

2x Locking rings

2x Spacer rings

2x Distance piece 2mm
2x Distance piece 4mm
2x Distance piece 6mm

10x M4x10

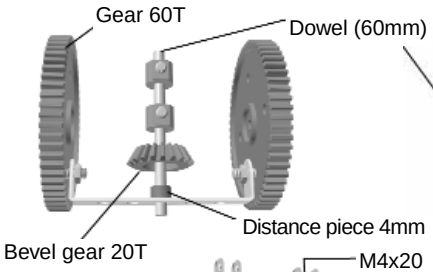
4x Nut

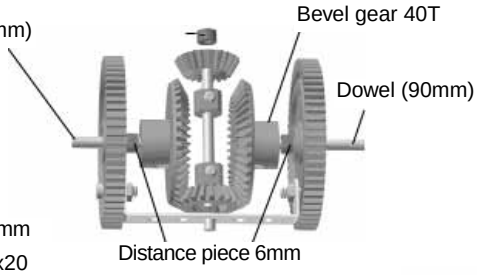
2x Washer

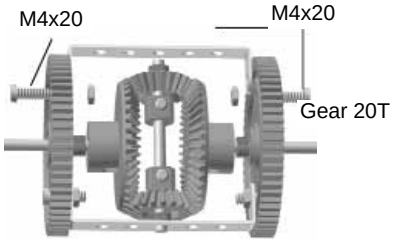
2x Dowel (60mm)
1x Dowel (90mm)
1x Dowel (150mm)

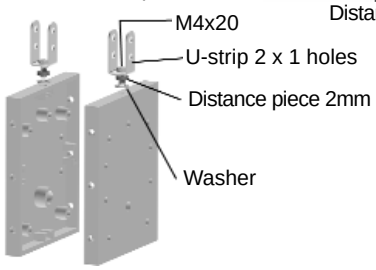
2x U-strip 2 x 1 holes

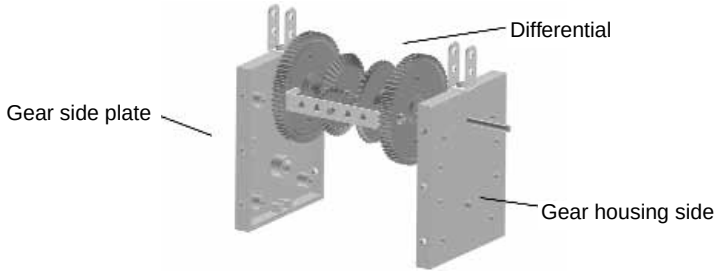
3. Diagram

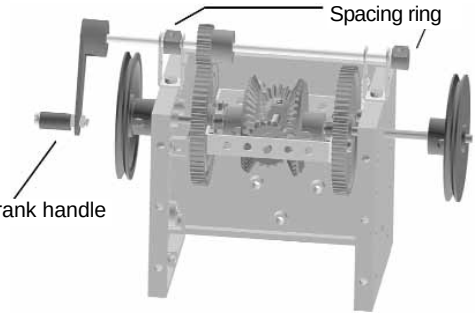


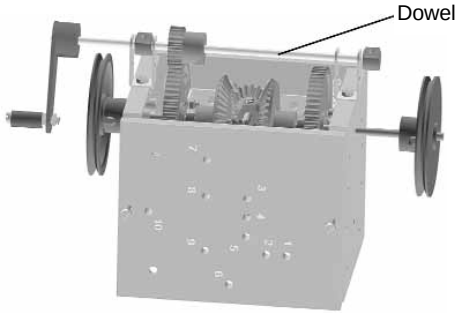




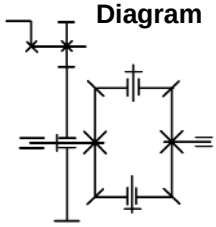








Schematic Diagram



4. Assembly

4.1 Collect the gear housing parts together.
4.2 Make up the gearbox housing. Fit the clip in the middle and lock with nuts. Set up the gears as shown.
4.3 Set the differential housing in the gearbox housing and insert the shaft
4.4 Insert the bevel gears in the housing on the shaft and the bevel gears use part s to ensure the gears engage
4.5 Fit the bearing block on the gearbox. Use a nut as support. Mount the drive with the gears shaft and locking ring plus the hand crank as shown. Mount the two gears on the drive shaft.

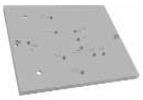
5 Function test

5.1 Check that all the gears engage properly
5.2 Make a note of which parts turn
5.3 Hold one of the outer gears tight in turn and test the function

1. Aim

This model demonstrates changing a rotational movement into a linear movement.
This technique is used practically in many situations.

2. Parts needed


1x Gear housing side, right


1x Gear housing side, left


1x Gear housing side with slot


1x Gear housing base


3x U-strip 2 x 1 holes


1x Kurbelhebel


1x Crank handle


1x Drive wheel


2x Locking rings

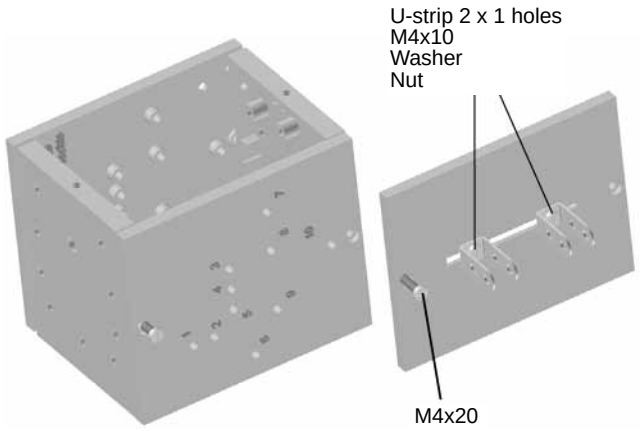

5x M4x10
3x M4x20

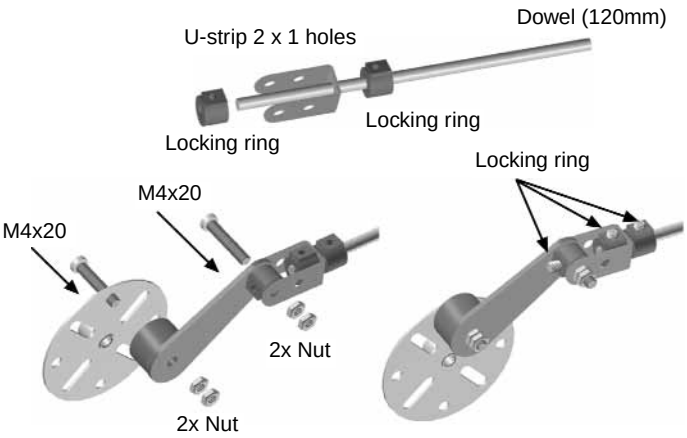

6x Nut

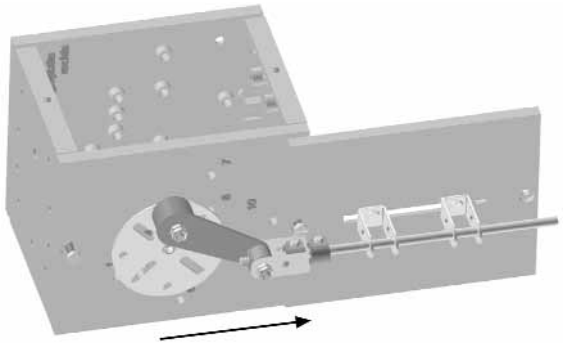

2x Washer

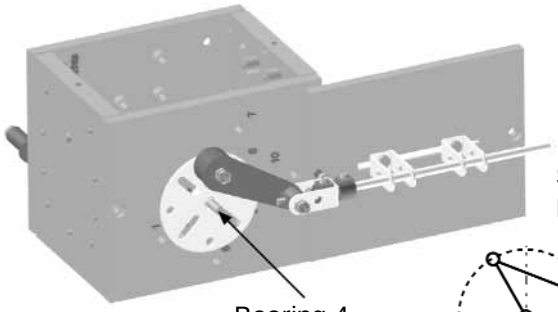

2x Dowel (120mm)

3. Diagram

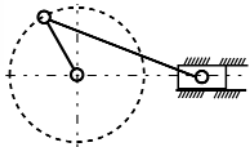








Schematic Diagram



4. Assembly

4.1 Assemble the gear housing as shown
4.2 Fit the gearbox fixing plate on the housing
4.3 Mount the clips on plate
4.4 Sort out parts and make up the slider mechanism
4.5 Mount the hand crank with and join to the slider
4.6 Insert the metal drive shaft in bearing hole 4 and fit the hand crank

5 Function test

5.1 Turn the hand crank and test the system
5.2 Try again and observe the movement of the slider
5.3 Measure the exact movement of the slider
5.4 Try changing the position on the wheel