

# STOMPER

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## SECTION 1: GENERAL AND PLANNING INFORMATION

### DESCRIPTION

The *STOMPER* is a six legged device that is driven by two electric motors through a number of gears. It is controlled by two two-way switches, each controlling the legs on one side.

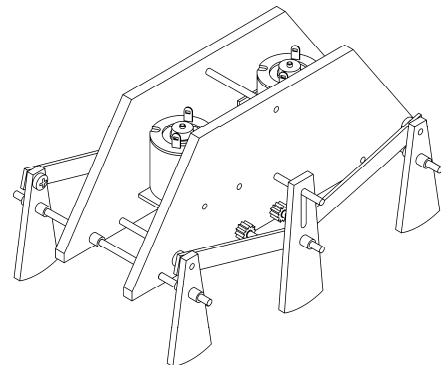
This project requires the student to build a *STOMPER* – a simple robotic device. The student will learn and use a variety of skills – in marking out, cutting materials, drilling, assembling and soldering.

### THE PROJECT

To carry out this project, a student must:

- design the side panels and other parts' shapes and sizes
- mark out and fabricate the components
- cut and drill the component parts
- assemble the robotic device
- connect and solder the wiring, switching and motors

A secondary activity is the design and construction of the Control Unit - a panel or box for the switches and battery compartment.



### DESIGN CONSIDERATIONS.

The design stage allows individualisation of the *STOMPER*'s external shape - depending on the designer's imagination. Note that the component and hole locations as shown in the drawings is important  
Note: the drawings show the size and shape of the prototype device we built.

- there is a fair degree of scope in the size and final shape of the body and legs – the motors are powerful and can drive a larger version of this basic device.
- one or more legs can be extended upwards, for the device to wave a flag or a hand etc. as it “walks”.
- there are other variants of the driving links possible. The driving links shown are standard crank and slot design. Other designs may be possible: eg. the Scotch Yoke system – why not experiment?
- the choice of material plays an important part in the ease of manufacture - some materials are easier to work with, some are more brittle and so on.

## SECTION 2: COMPONENTS & MATERIAL REQUIRED

### 2. COMPONENTS & MATERIAL REQUIRED

**2.1 COMPONENTS SUPPLIED:** The following components are supplied in a plastic bag :

2 x	4.5V electric Motor (round)	2 x	30T x 10T Spur gear (2.4mm hole)
2 x	Motor mounting brackets	2 x	60T x 10T Spur gear (2.4mm hole)
1 x	2AA Battery holder	2 x	Worm gear (1.9mm hole)
2 x	Sliding switch – centre off (large)	6 x	12T Pinion gear (2.4mm dia. hole)
4x	2.6mm dia x4 long self-tapping screw	4x	Steel rod 2.5 dia x120 long
8x	3mm dia x 5 long wood screw	1x	Steel rod 2.5 dia x70 long

100mm Silicon rubber tubing - 2mm ID (for use as retainers)



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## 2.2 ADDITIONAL REQUIREMENTS

The following requirements are in addition to the above components, and can be ordered from us separately: 2.3mm and 2.6mm drill bits. AA batteries.

## 2.3 MATERIAL REQUIREMENTS

For our prototype STOMPER, we used PVC sheeting, of 1.5mm, 3.0mm and 4.5mm thicknesses.

- Suitable materials can be purchased from plastics supplier: in the Yellow pages under "Plastics Fabricators"

# SECTION 3: MAKING *STOMPER'S* BODY PARTS

3.1 For the side panels, the component's locations are shown in the drawings (at the end of this unit). The location of the gear shafts holes, as well as the motor location, relative to the gears is very important. This allows proper meshing of the gears. The shape of the side panels themselves is up to the individual.

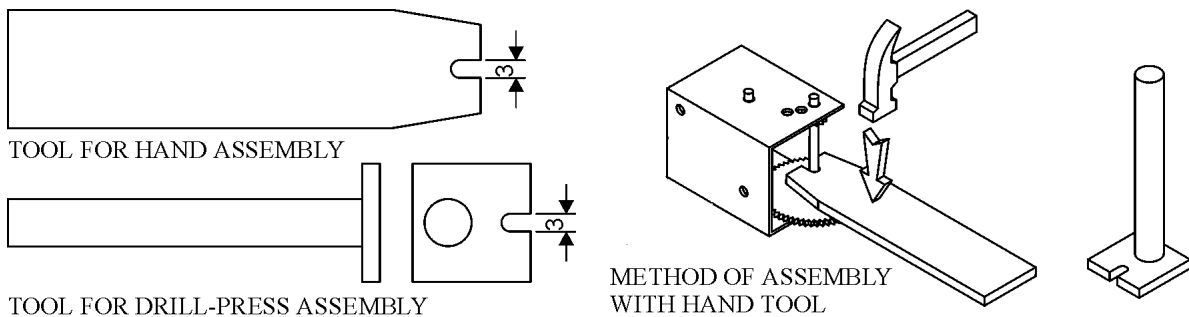
3.2 The other parts, which must be made, are the legs, links and cranks.

# SECTION 4: ASSEMBLING THE *STOMPER*

## 4.1 ASSEMBLY HINTS AND TOOL (FOR GEARS)

The following will aid your assembly work.

- As a jig, a piece of hardwood 40x60x150, with 3.0 dia holes drilled to varying depths is useful.
- Further, when the shaft starts to penetrate through the gear, a 1 mm thick plastic sheet can be placed, temporarily, between the gear and case to prevent damage.
- For pushing the gears and retainers along the shafts, the following tool should be constructed. The tool on the right is used with the drill press. The tool shown on the left is used (gently) with the hammer. It should be made of steel, approximately 1.5 or 2 mm thick.



## 4.2 SIDE PANEL ASSEMBLIES

### 4.2.1 THE TWO SIDE PANEL ASSEMBLIES

The two side panels, and the components assembled on to them, are identical. We suggest you complete one side first, and then review the assembly sequence.

Note: The silicon rubber tubing supplied is for use as retainers on the shafts in various locations. It is suggested that each retainer be cut to approximately 3 mm length.

### 4.2.2 ASSEMBLING THE GEARS AND SHAFTS

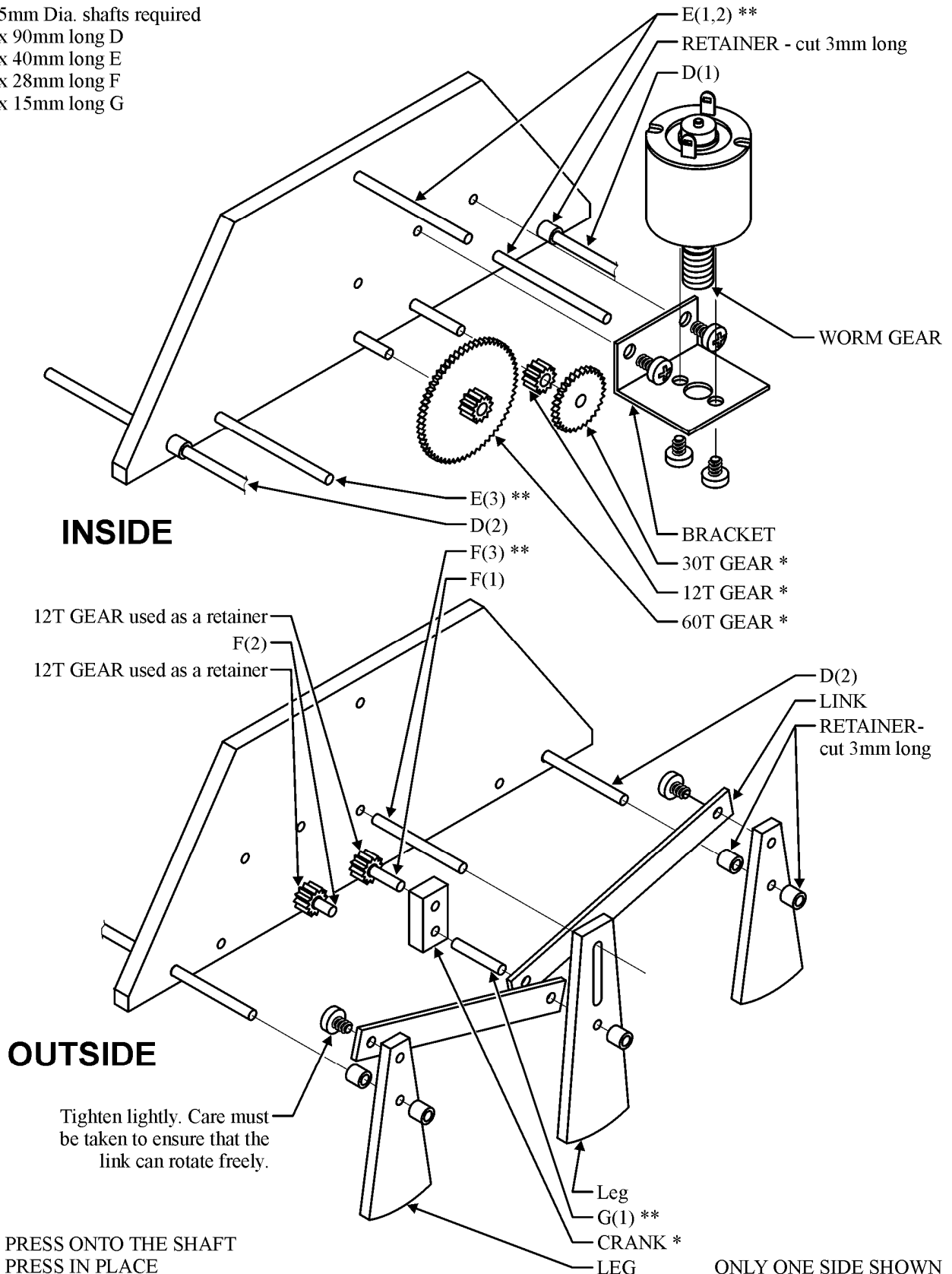
The assembly requires care. **The following sequence is important, to prevent assembly problems later on:**

- Remove the burrs from the ends of the shafts.
- Press 60T gear onto shaft F(1). Insert through the side panel, and press on the 12T gear (as a retainer).
- Press the 30T and 12T gears onto shaft F(2) and insert through the side panel. Press on the 12T gear (as a retainer). Note: the outer face of the 30T gear should be 15 mm from the face of the panel.
- Press shaft G(1) into the hole in the crank. Press the crank and shaft assembly onto shaft F(1).

Note: the outer face of the crank should be 14 mm from the outer face of the side panel.

- Press shafts E(1), E(2) and E(3) into the holes (as shown in the drawing).
- Press shaft F(3) into the hole (as shown in the drawing).
- Assemble the Motor Mounting Bracket to the side panel, using two of the wood screws.
- Check that the 30T gear lines up with the centre of the large hole in the Motor mounting bracket. If not, readjust the gear.
- Assemble the shafts D(1) and D(2), and the retainers as shown. The end of the shafts needs to project approximately 24 mm from the leg side. Note: the shaft needs to project equally from both panels, but will need to be adjusted after the final assembly of both panels.

2.5mm Dia. shafts required  
 2 x 90mm long D  
 3 x 40mm long E  
 6 x 28mm long F  
 2 x 15mm long G



\* PRESS ONTO THE SHAFT  
 \*\* PRESS IN PLACE

ONLY ONE SIDE SHOWN

### 4.2.3 ASSEMBLING AND MOUNTING THE MOTOR

- Press the worm gear onto the motor shaft. Stop when the worm gear is 3mm from the motor's body. **HINT:** Place the gear on the bench, insert the motor shaft into the pinion gear's hole and gently tap the end of the shaft (where it exits the motor) with a small hammer. **WARNING:** Don't just push the motor down by hand, as this can push the motor armature out of its bearings and jam the motor.
- Attach the motor to the Motor mounting bracket using two self-tapping screws. Check that the worm gear and 30T gear mesh properly. If not, adjust the bracket to suit.

### 4.2.4 FINISHING THE FIRST SIDE PANEL

Install the links and legs as shown.

## 4.3 JOINING BOTH SIDE PANELS

Assemble both side panels, by tapping the shafts E(1), E(2) and E(3) into the equivalent holes of the opposite side panel.

## SECTION 5: THE CONTROL UNIT

### 5.1 THE HAND HELD CONTROL UNIT

It is suggested that the two-way switches and battery holder are mounted in a small hand held box, or on a control panel. This control unit is connected by a length of wire to *STOMP*.

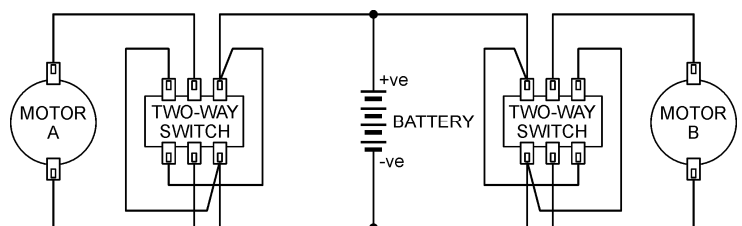
- The suggested length of the wire is 1 to 2 metres.
- A guide "pole" is recommended to keep the control wires away from the legs.
- The platforms design can take whatever shape is preferred. However, the student must design the unit to accommodate the two switches and battery holder.
- The shape, at its most basic, would be either a square or a rectangle. However, you may wish to make it a smaller version of the vehicle itself.
- The control unit can be either fully enclosed (eg. a box) or a panel with side pieces (eg. 12 x 18 mm timber) – to allow the unit to be put down, without damaging the switches.

### 5.2 MAKING THE CONTROL UNIT

- Cut out the designed shape, and as appropriate:
  - Make the box for the unit or
  - Make and attach the side pieces, so the control unit's platform is raised
- Make the two holes for mounting the Forward- off-reverse switches.
- Drill two 3-3.5mm holes in the centre, towards the top, to allow a cable tie to clamp the control wires in place.
- Glue the battery holder in position under the control units platform', or inside the unit (if it will be fully enclosed). Note: the battery compartment's surface may need to be roughened with sandpaper to get the glue to stick to it.
- Fit the two switches.

## SECTION 6: WIRING UP *STOMP*

- Solder a suitable length of wire to each of the motor's terminals. The length will be dictated by the location of the motor and the length selected for the Control unit wires.
- The Two-way switches, battery holder and motors should be wired as shown in "Wiring Schematic". This allows forward and reverse motion of the device.



WIRING SCHEMATIC

## SECTION 6: ELECTRICAL TESTING AND TROUBLE SHOOTING

### 6.1 TESTING

- Make sure that both switches are both in the centre (off) position
- Put two 1.5 Volt AA batteries into the battery holder and put *STOMP* on a smooth flat surface - At this point, *STOMP* should be stationary.
- Turn on the left-hand switch (push it forward), and the left hand legs should go forward.
- Turn on the left-hand switch (push it rearward), and the left hand legs should go in reverse.
- Repeat for the right side.

### 6.2 TROUBLE SHOOTING

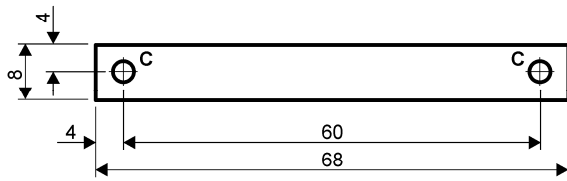
#### 6.2.1 If nothing happened:

- Check that the batteries are properly inserted in the battery holder.
- Check the battery voltage. If low, replace the batteries.
- Check the wiring against the wiring diagram.
- Check that there are no short circuits or solder bridges between wires
- Check that bare wire ends do not touch

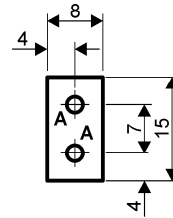
6.2.2 If *STOMP* moves, but not in the correct directions: check the wiring against the wiring diagram, and fix any errors.

*THAT'S IT – STOMP IS NOW READY TO GO WANDERING !!*

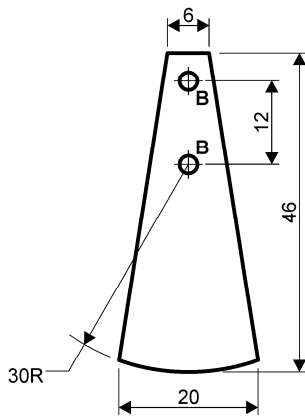
SECTION 3 (CONTD.): *STOMPER's* BODY PARTS



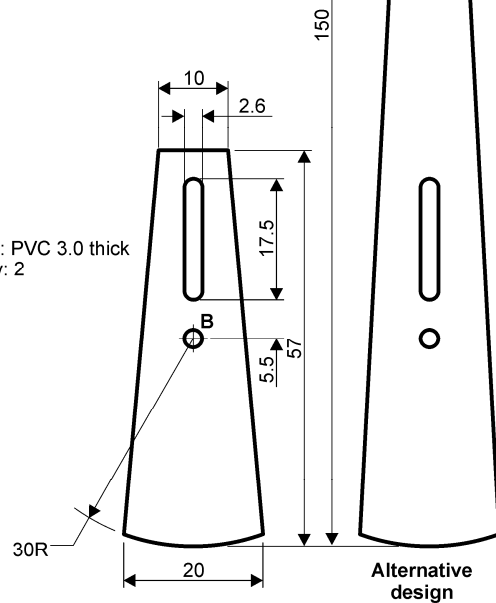
**LINK**  
 Item: 5  
 Material: PVC 1.5 thick  
 Quantity: 4



**CRANK**  
 Item: 4  
 Material: PVC 4.5 thick  
 Quantity: 2



**LEG**  
 Item: 3  
 Material: PVC 3.0 thick  
 Quantity: 4



**LEG**  
 Item: 2  
 Material: PVC 3.0 thick  
 Quantity: 2

Hole Sizes	
A	= 2.3 mm Dia
B	= 2.6 mm Dia
C	= 3.0 mm Dia

**SIDE FRAME**

Item: 1  
 Material: PVC 4.5 thick  
 Quantity: 2

