Check List

1. Check that both upper and lower bodies A1 and A2 are vertical.
2. The small bolts C4 in the lever linkage should have parallel shanks, and be a close fit, inside C1, C2 and B1. Locknuts should be fitted to these bolts.
3. Check as in 2 for the large pivot bolts B3 and C3 inside A1, B1 and C1. The inner nuts on these two bolts must also be welded to the upper body A1.
4. Excess lengths of bolts should be cut off and filed smooth.
5. View the shears from the side, and check that there is a parallel gap of 3 to 4mm. between the lower blade and the upper body. This gap should extend back for 120mm. from the front of the upper body. (See Fig.15, page 19).
6. The lower blade should rest securely on the top edge of the angle iron base.
7. There should be no paint between the upper blade and the upper body.
8. Check that the cutting edges of the two blades are ground at a slight angle only (Fig.8, page 13).
9. There should be a washer between the depth stop and the clamp nut A8.
10. Cut a thin piece of steel sheet with the shears. The cut should be clean, with no bent over edges, for the entire cutting length of the blade. The action of the shears should be quite free and smooth.
11. All moving parts must be lightly oiled.

Introduction

This manual describes in detail how to construct medium-duty shears for cutting sheet metal. The machine is cheap to build and easy to use. It can be built from materials which are generally available in areas where trucks are dismantled or repaired, and can be built using only basic welding and fabrication techniques.

Construction can be modified to suit locally available materials. The machine can be bolted on to a strong bench or mounted on the trolley/stand described.

CAPACITY

The shears described will cut sheet steel up to 3mm thick. The cutting length of the blade is 200mm. Large sheets are cut by the repeated action of the lever, and by moving the sheet forwards each time.

The shears will also crop round bar up to 12mm diameter when cut in the hole provided.

Shears of this type are considered essential for making many articles in sheet metal such as air ducting, water tanks, storage bins and agricultural equipment.

This machine has been found to be a basic tool for metal workshops in the industrialized countries, as well as in the Third World.

Tools Required

Electric welder

Drilling machine

'G' clamps, and basic hand-tools

Oxy-acetylene cutting torch and/or angle grinder/cutting disc

Contents

Important notice to Constructors

The plans and instructions given in this manual *must* be read very carefully at each step of the construction process.

The order described here in which parts are made and assembled is the easiest, and should be followed exactly.

Particular care must be given to the relative positions of parts before they are welded.

Where materials are not available in the sizes specified in the manual, give serious thought as to how your substitution with material of a different size will affect the function of that part of the machine:
— Will the change weaken the finished machine?
— Will it make the machine less durable?
— Will this substitution alter other dimensions given elsewhere in the manual?

Where flat bar or plate of the specified thickness is not available, consider whether you could weld two thinner pieces together around the edges and use this in its place.

It is usually better to use a larger steel section than a smaller one.

Components which slide together or rotate in one another should not be painted on those surfaces, and should be greased or oiled as the machine is assembled. Further oiling from time to time will also prolong the life of the machine.

On page 2 of this manual is a check list. Please read it both before you build the machine and after you have completed the machine. If all the points listed are O.K. you will be well pleased with your machine.

Description

The machine comprises:

THE BODY

This is made from two pieces of heavy steel plate welded together with a spacing piece in between. Angle iron welded along the bottom serves as a rest for the lower blade, strengthens the lower body and provides for fixing down to a bench etc.

THE BLADES

These are made from truck leaf spring and require care in marking out and cutting. The lower blade is bolted to the lower body and is adjustable for correct contact with the upper blade. This pivots on a bolt which is held firmly in a welded nut on the upper body.

THE LEVER MECHANISM

Made from three pieces of flat bar and one piece of steel plate, this allows powerful leverage to be transmitted to the upper blade.

THE DEPTH STOP

This device will be found useful when cutting flat strip, eg 30mm × 3mm. It prevents the strip from tilting upwards and allows both hands to be used on the lever. It is adjustable for different thicknesses of metal.

THE TROLLEY/STAND

Although the shears can be bolted to a bench, it may be found more useful to make them moveable. The wheels on the design of trolley suggested here do not actually touch the floor until the shears are lifted by the handle. Thus the shears are firm whilst in use. They can be wheeled out of the way when not required, or in to a clear space for cutting a large sheet of metal.

Main Assemblies

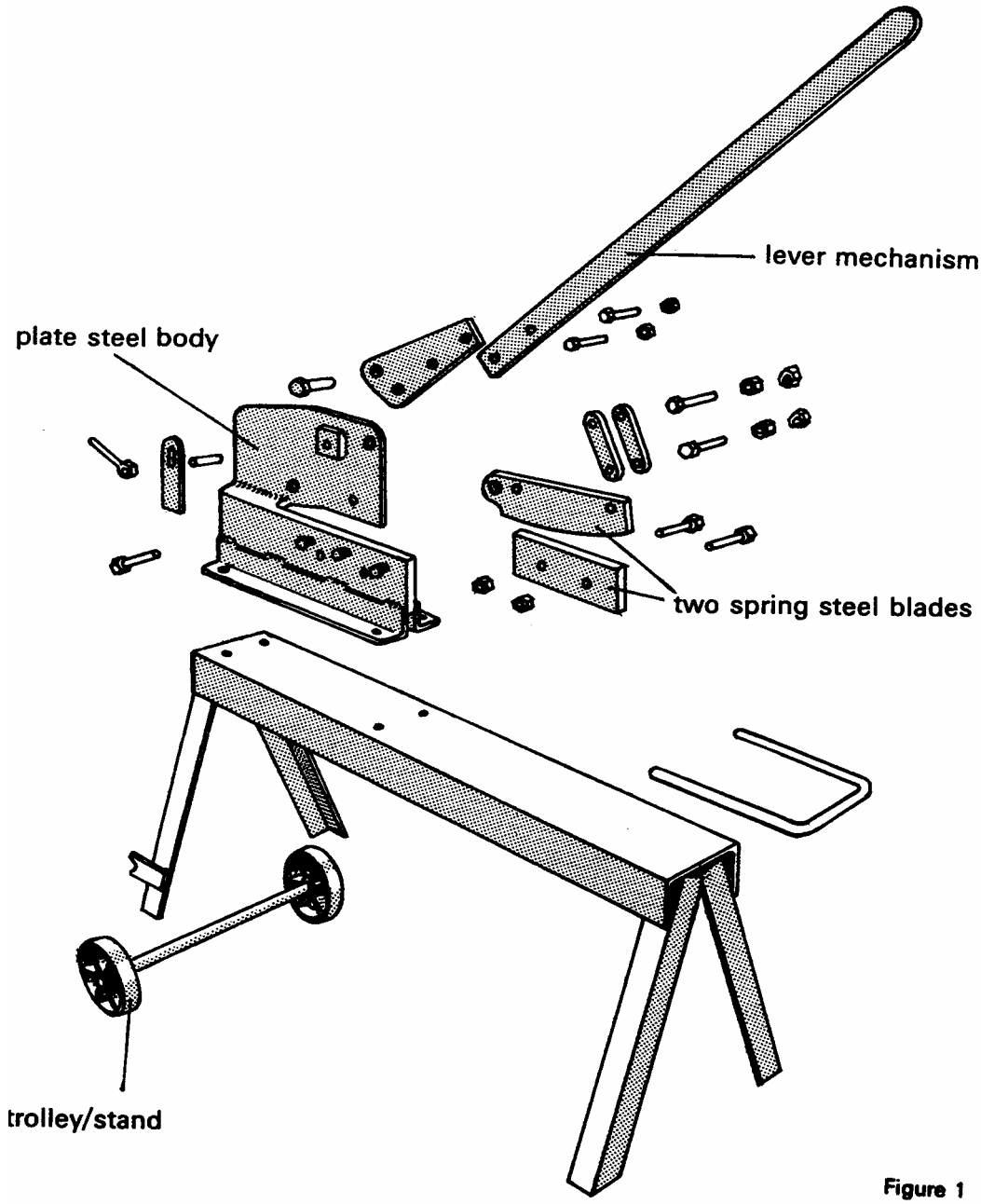
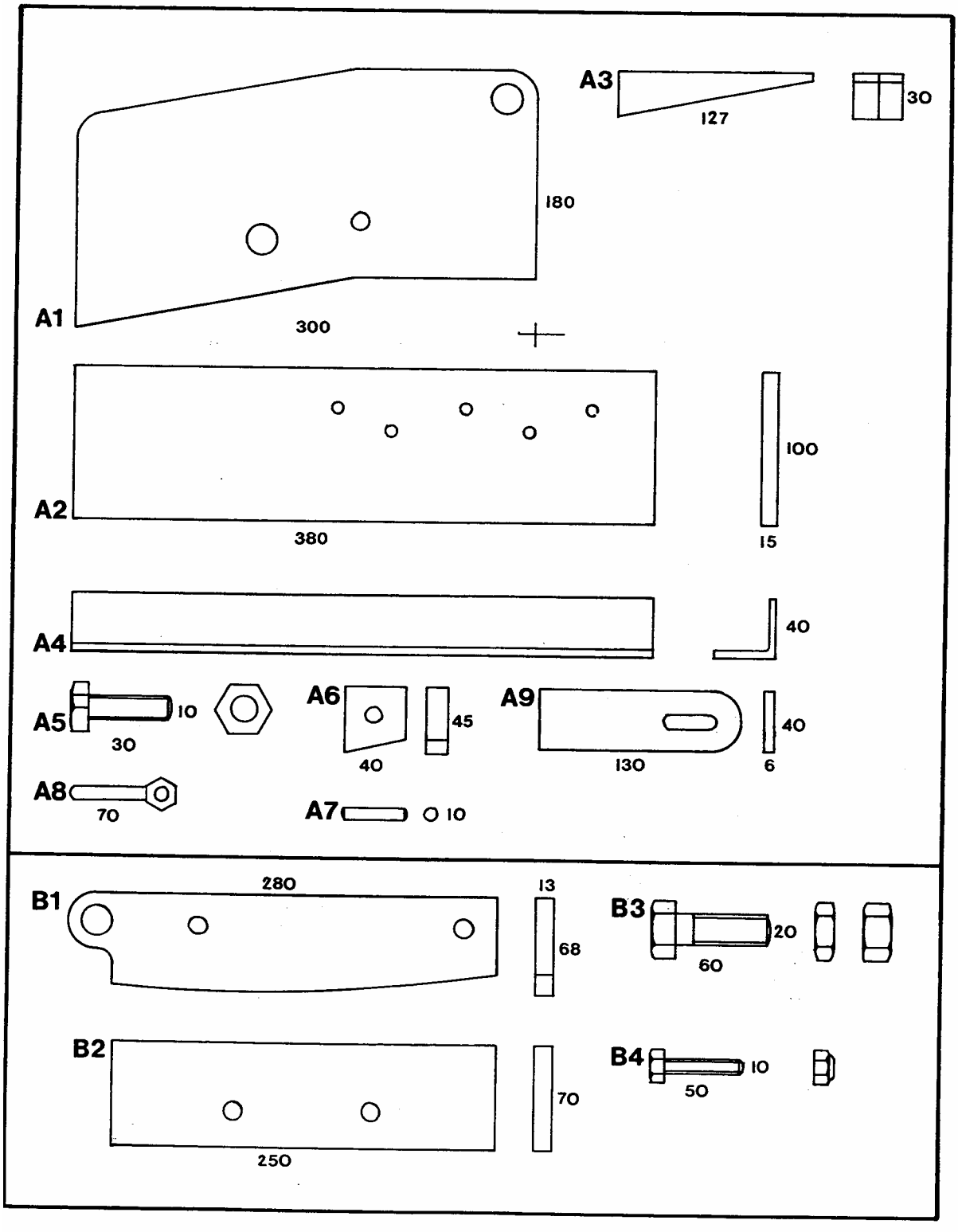
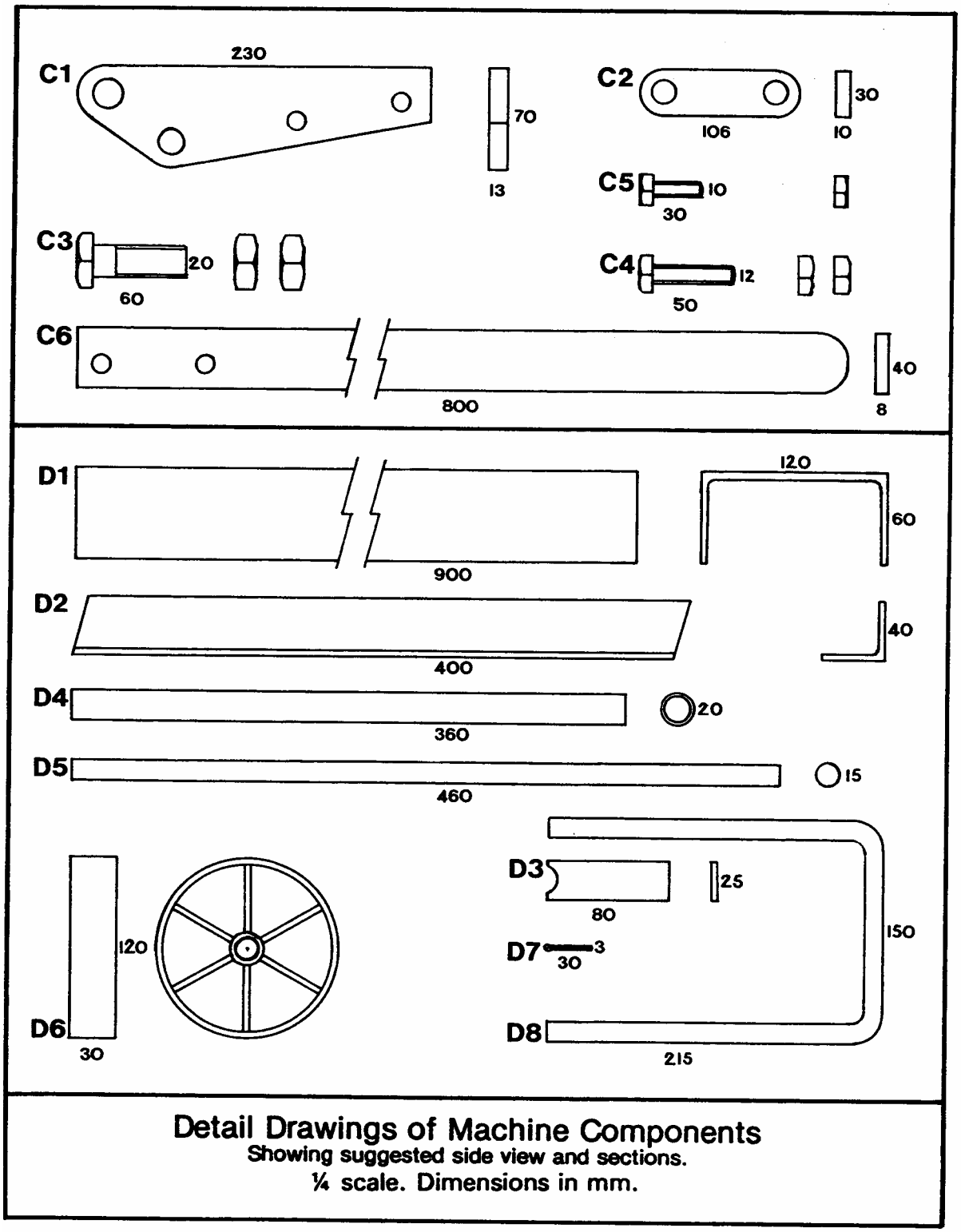


Figure 1


A3
127
30
180
A1
300
A2
380
100
15
A4
40
A5
10
30
A6
45
40
A9
130
40
6
A8
70
A7
10
B1
280
13
68
B3
20
60
B2
250
70
B4
10
50



Detail Drawings of Machine Components

Showing suggested side view and sections.

¼ scale. Dimensions in mm.

Construction

THE BODY ASSEMBLY - PARTS

Part	Name	Quantity	Dimensions (mm)
A1	Upper body	1	300 × 180 × 15 plate
A2	Lower body	1	380 × 100 × 15 plate
A3	Spacing block	1	100 × 30 × 26 (from 15mm plate)
A4	Mounting angle	2	380 × 40 × 40 × 6 angle
A5	Adjustment bolt	3	30 × 10 dia.
A6	Stop spacer	1	35 × 40 × 15 plate
A7	Stud	1	40 × 10 dia.
A8	Clamp nut	1	70 × 8 dia. round + M10 nut
A9	Depth stop	1	130 × 40 × 6 flat
A10	Hardened insert for cropping hole	1	30 x 30 x 15, or bush

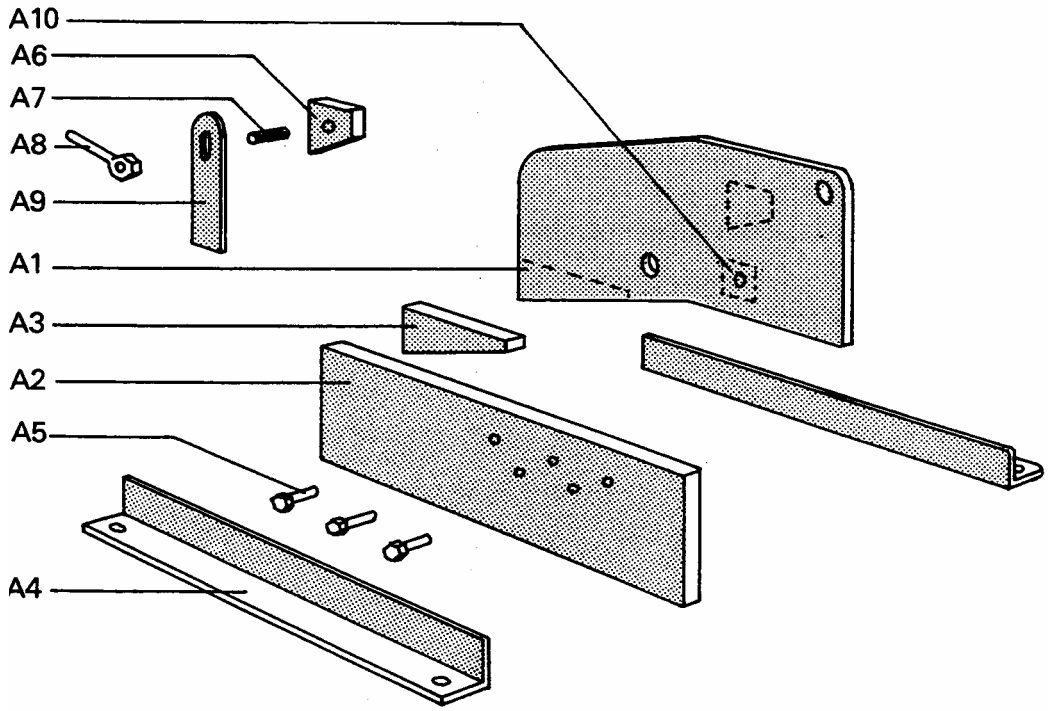


Figure 3

BODY ASSEMBLY -

Using oxy-acetylene or an angle grinder with a cutting disc, cut the plates A1 and A2. Grind all edges and corners neatly and remove any roughness with a file. Mark out and drill holes to suit the bolts being used. The pivot bolts for the upper blade should be as good a fit as possible. The holes for bolts A5 should be drilled to tapping size, and tapped (Figure 4).

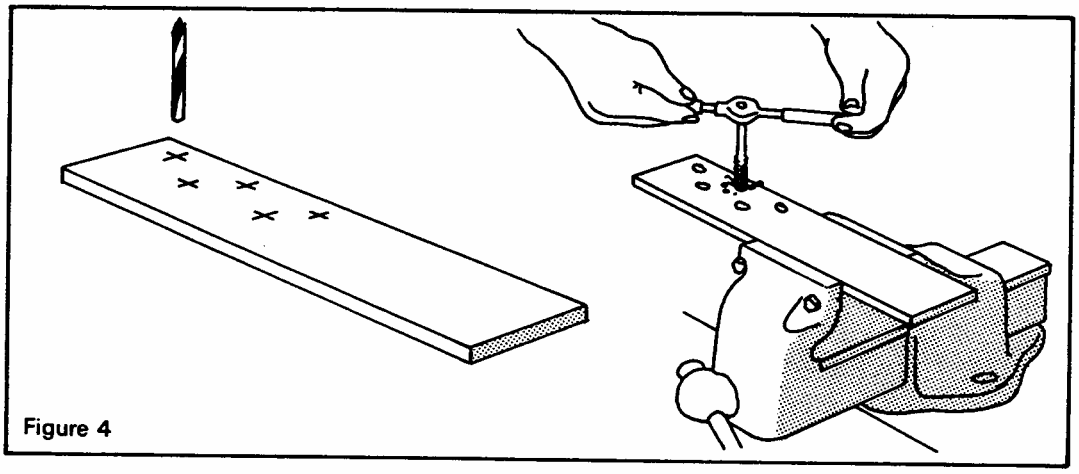


Figure 4

The spacer A3 can be made from one solid block or from two pieces of plate welded together. If this is done, chamfer the edges deeply, and weld strongly (Fig. 5). This spacer A3 should be 1 to 2mm thicker than the two blades B1 and B2, to allow room for adjustment later.

Chamfer the edges of A3 as shown and of the back top edge of A2. Weld the spacer to A2 (Figure 6). DO NOT WELD THE UPPER BODY ON YET.

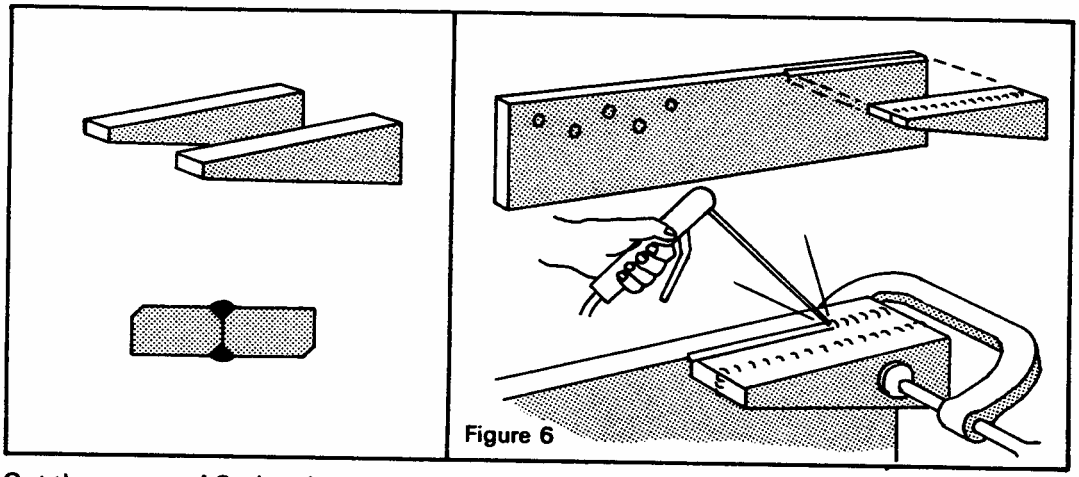


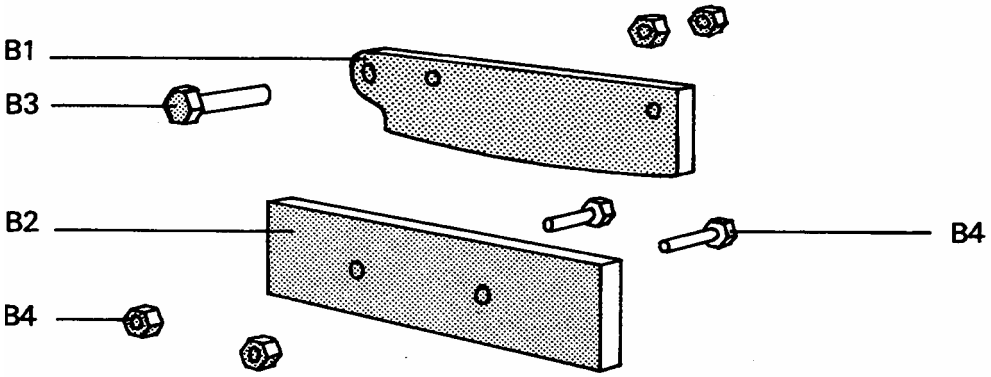
Figure 6

Cut the spacer A6, depth stop A9, and drill and file the slot to suit stud A7. Drill the spacer and weld in the stud. Grind the weld flat, and weld the spacer on to the upper body in the position shown. Screw on nut A8 and weld on a piece of bar for quick release if required.

Cut and drill the mounting angles A4. Do not weld yet.

BLADES ASSEMBLY PARTS

Part	Name	Quantity	Dimensions (mm)
B1	Upper blade	1	280 × 70 × 13 leaf spring
B2	Lower blade	1	250 × 70 × 13 leaf spring
B3	Pivot bolt & nuts	1	60 × 20 dia. (15mm of unthreaded shank)
B4	Bolt & nut	2	50 × 10 dia.



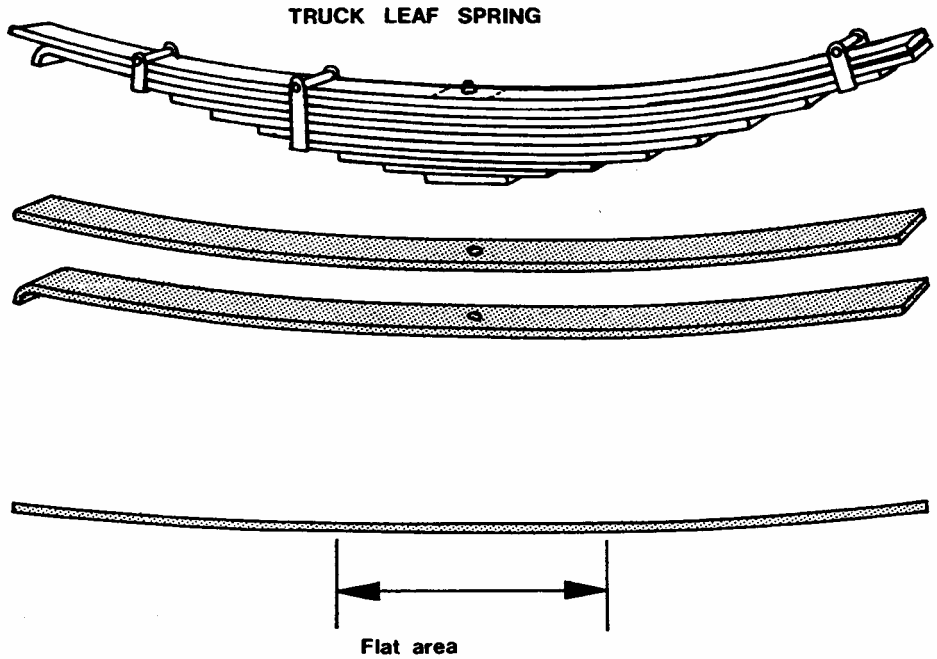


Figure 7

The blades are made from truck leaf springs 12mm × 80mm in section. (See page 20 for alternative method.) One leaf spring, when opened out, was found to have two flat areas in the centre which were cut out to make the blades (Figure 7).

When using a curved leaf spring, proceed as follows:-

Cut out the lengths required using an angle grinder, flame cutter or hacksaw. Heat the two pieces in a fire (forge) until they are dull red all over. Beat them flat on a suitably flat surface (e.g. anvil), using a blacksmiths "Flatter" or a smooth piece of solid steel to protect the hot steel from receiving direct blows from the hammer. Check for straightness using a straight edge. Once they are straight, re-heat the blades to dull red and allow them to cool slowly in dry sand or soil. This will soften the steel. Mark out and drill the holes accurately (page 14). Cut out the curved profile of the upper blade. Re-heat the blades to dull red and quench in water. This will harden the steel.

NOTE: It is important not to overheat the blades as this will cause cracks to appear.

Any rust should be ground off using an angle grinder and the best surface selected for the cutting edges. These should be ground at a slight angle (Figure 8). Use a steel rule as a straight edge to check the surfaces.

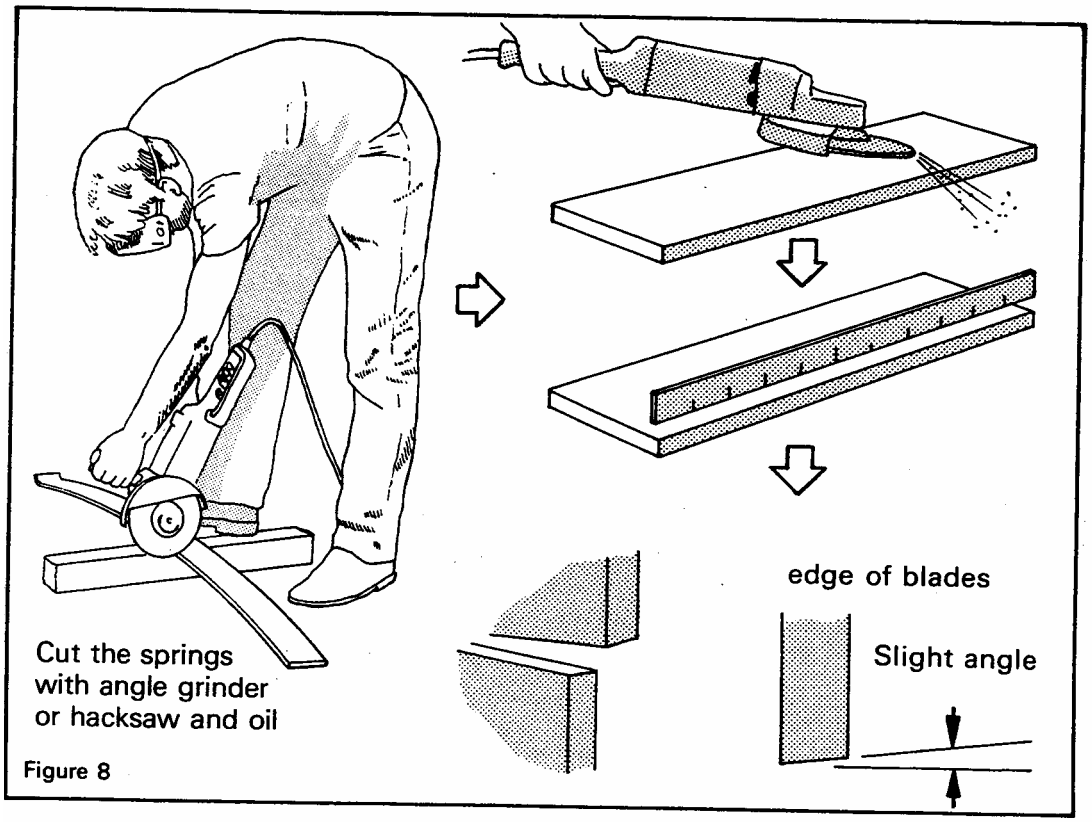


Figure 8

DRILLING:

First drill the holes 3 or 4mm dia. with a very sharp drill bit and oil. Then, if the blades have not been softened, use sharpened masonry drill bits (i.e. tungsten tipped) to drill out the holes to the sizes required. (12. 14 and 20mm). The hole for pivot bolt B3 should be a close fit to the bolt B3, which should have a parallel (unthreaded) shank for at least 25mm. from the head, to provide a good bearing surface. If the blades have been softened, ordinary drill bits should be sufficient. Use a very low drilling speed, e.g. 400rpm. and plenty of oil. Clamp the metal firmly whilst drilling.

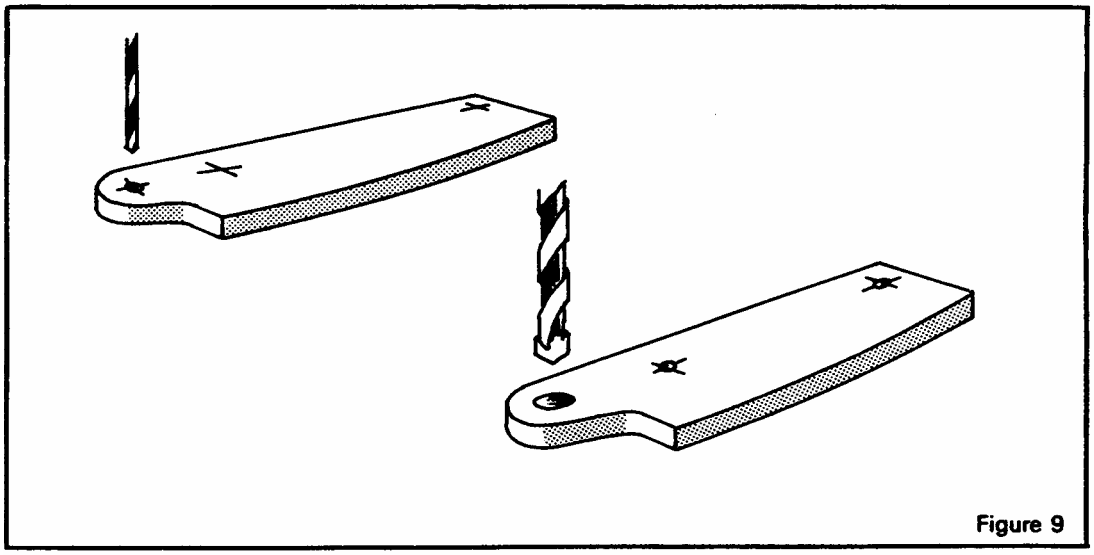


Figure 9

The lower blade should be 2 - 3mm higher than the lower body.

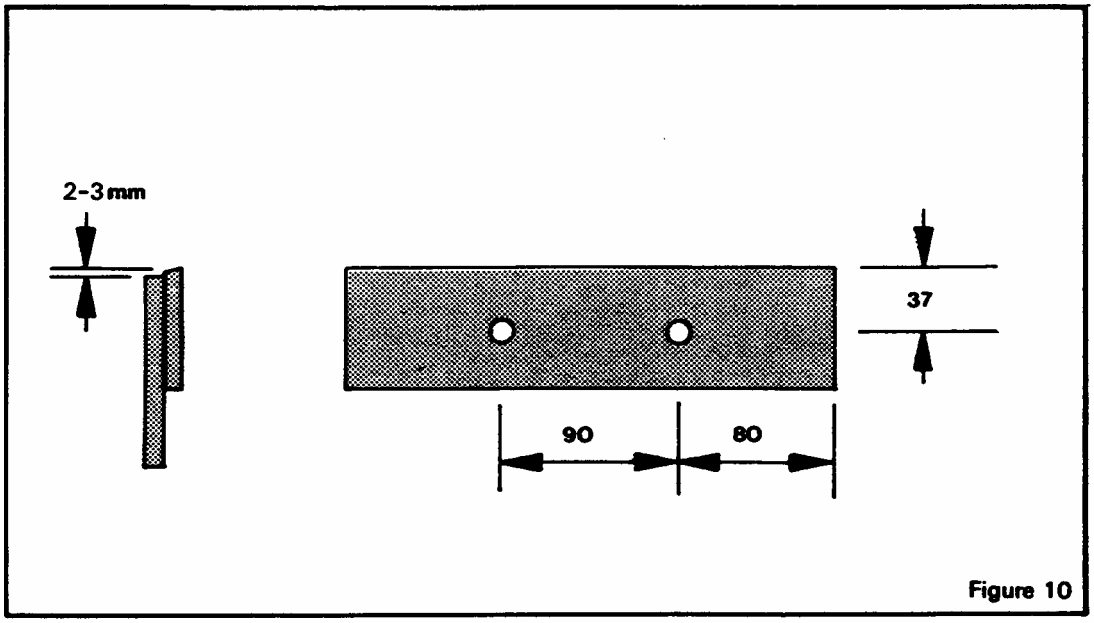


Figure 10

LEVER ASSEMBLY - PARTS

Part	Name	Quantity	Dimensions (mm)
C1	Lever plate	1	230 × 68 × 12 plate
C2	Connecting link	2	105 × 30 × 10 flat
C3	Bolt & 2 nuts	1	60 × 20 dia. (15mm of unthreaded shank)
C4	Bolt & 2 nuts	2	50 × 12 dia. (25mm of unthreaded shank)
C5	Bolt & nut	2	30 × 10 dia.
C6	Lever	1	800 × 40 × 8 flat

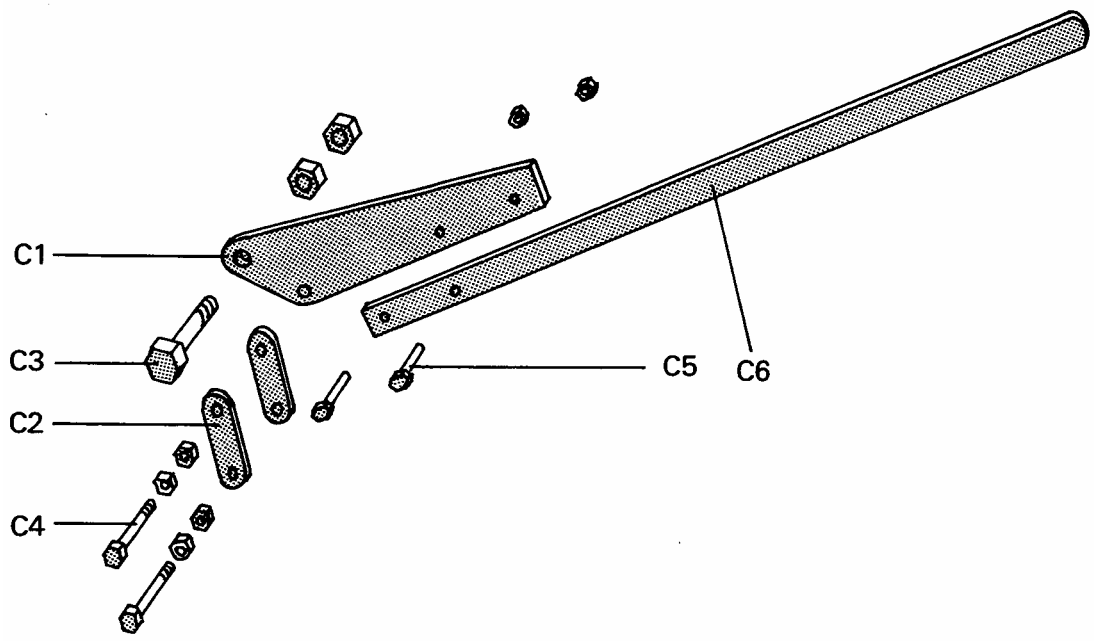


Figure 11

Cut the lever plate C1 from mild steel plate the same thickness as the blades. Mark out carefully. Centre punch the plate and drill the holes. (The larger hole should be a good fit for the bolt used). Cut both links C2, and lever C6, from a suitable strip. Radius the ends of the links, as this is necessary for optimum movement of the top blade. Bolt C3, like bolt B3, is a main pivot; it should have a 25-30mm. length of shank (without threads) which needs to be a close fit inside the holes in upper body A1 and lever plate C1.

TROLLEY/STAND ASSEMBLY - PARTS

Part	Name	Quantity	Dimensions (mm)
D1	Channel	1	900 × 120 × 60 channel
D2	Leg	4	400 × 40 × 40 × 4 angle
D3	Spacer	2	80 × 25 × 5 flat
D4	Axle tube	1	360 × 20 dia. pipe
D5	Axle	1	460 × 16 dia. black round
D6	Wheel	2	30 × 120 dia. (made from black flat)
D7	Split pin	2	30 × 3
D8	Handle	1	550 × 16 dia. black round

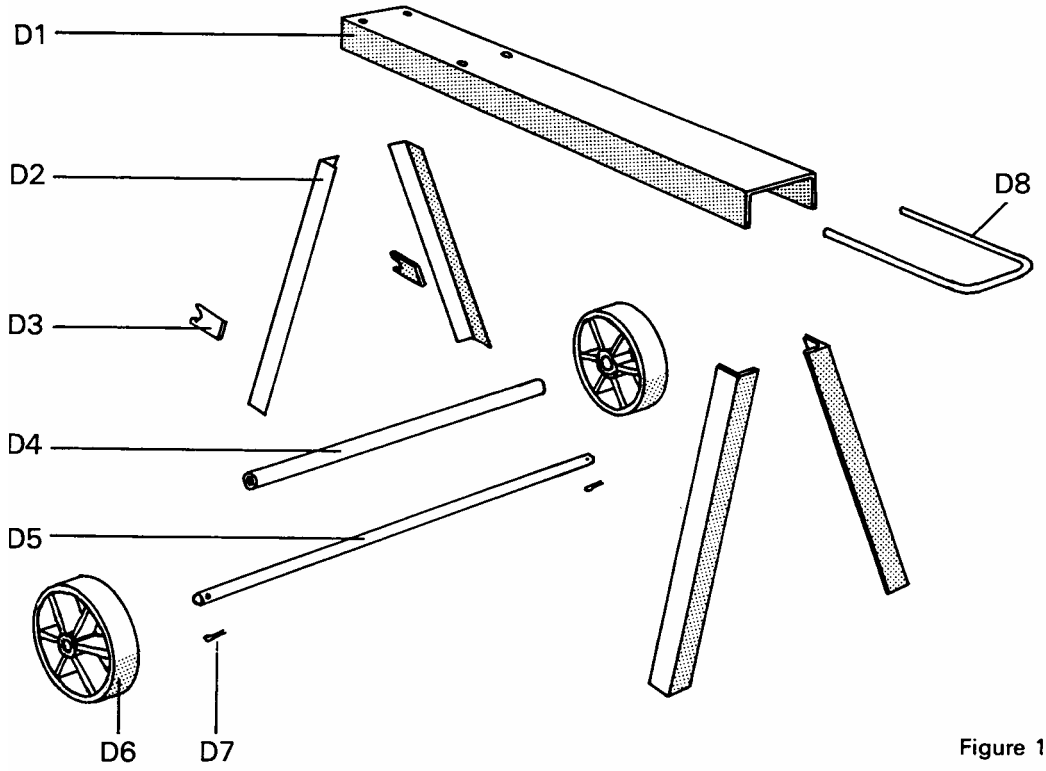


Figure 12

TROLLEY/STAND ASSEMBLY -

Cut channel D1 and legs D2. (Note left and right hand legs). Weld on as shown (Figure 13). Cut the spacers D3 and axle tube D4. Choose or make a suitable pair of wheels. Cut axle to suit and drill for split pins. Assemble the axle and set it up next to the stand. Place some thin tin-plate under the wheels (say 1.5mm). Clamp the spacers D3 in place. Weld the spacers to the legs and to the axle. The spacers hold the axle away from the legs so that the wheels come into contact with the floor only when the handle is lifted.

Cut and bend the handle D8 and weld to channel D1.

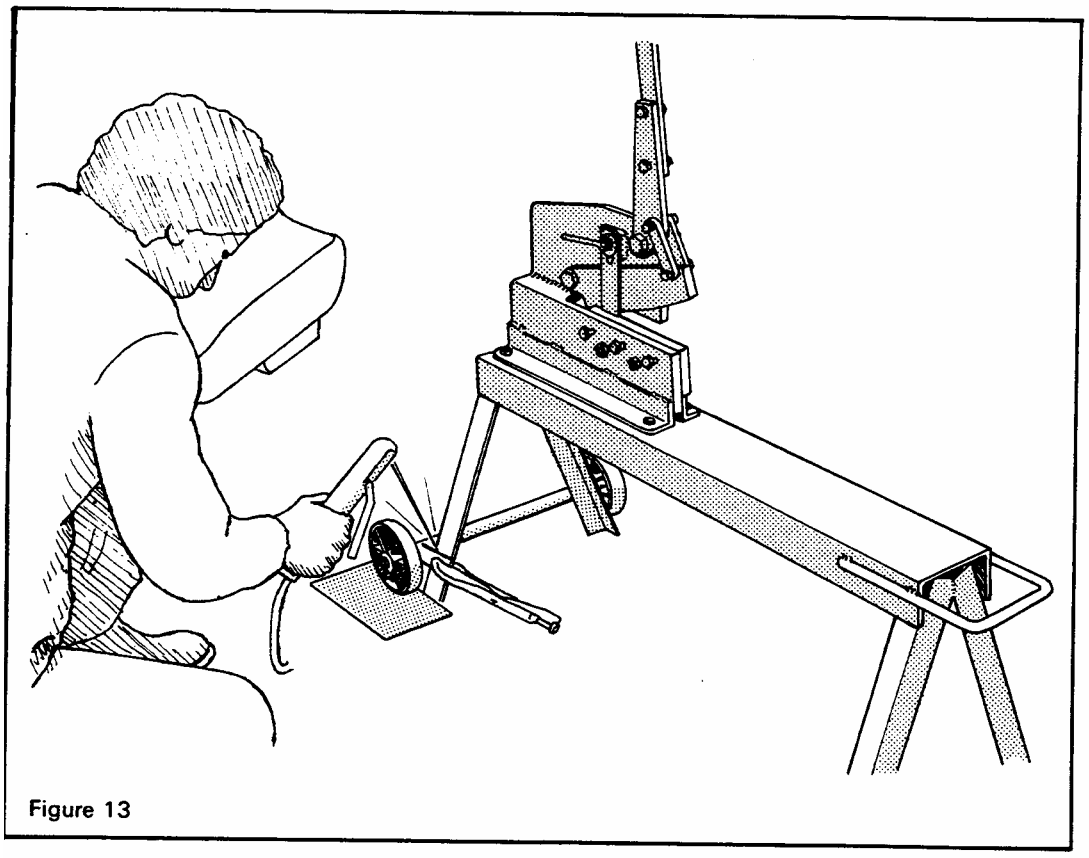


Figure 13

ASSEMBLY

Bolt the upper blade to the upper body using the thinner nut. Weld this nut to the upper body (Fig. 14). Screw on the thicker nut. Assemble the lever mechanism parts C1 - C5 and bolt on to the upper body. Bolt the lower blade on to the lower body, with 2mm protruding above the lower body. Clamp the lower body in a vice and clamp the upper body to the lower body (Figure 14).

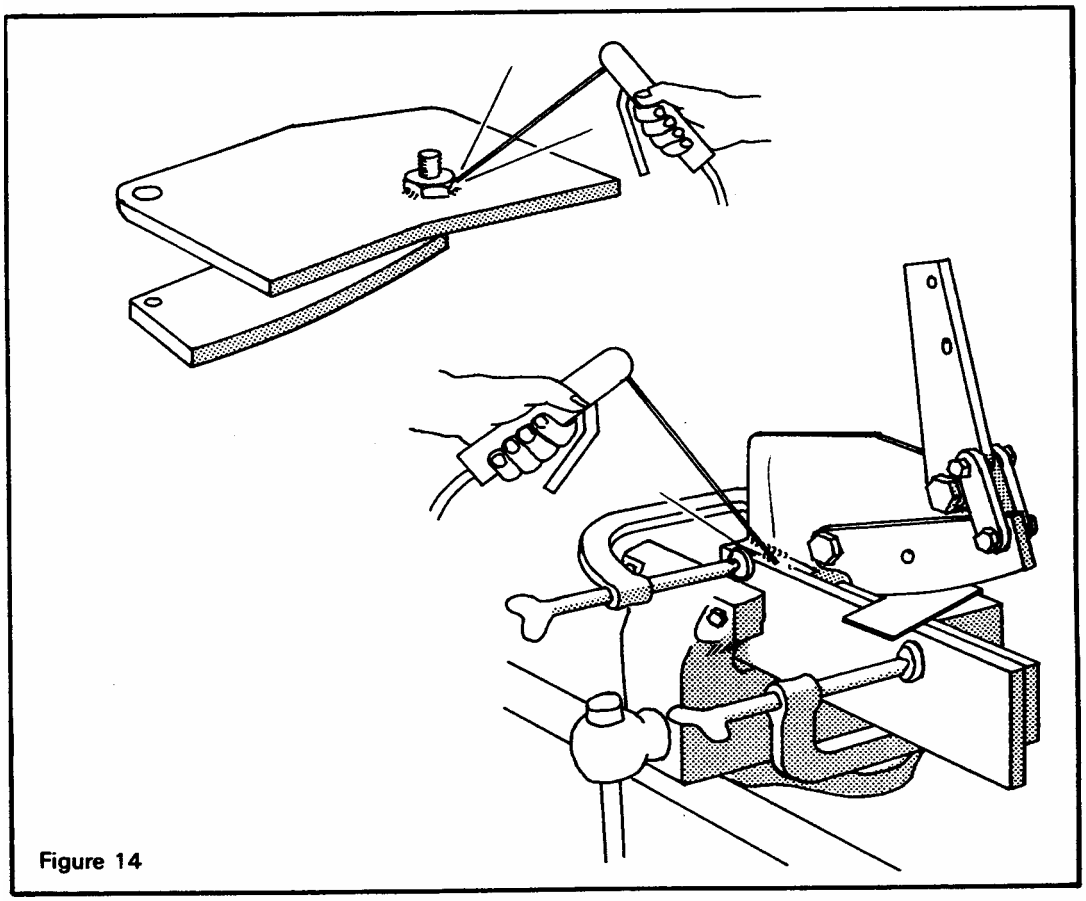


Figure 14

Check for clearance of blades. Make sure that the bottom blade can be adjusted sideways to give 1 to 2mm clearance. Put thin metal sheet in between the spacer and the upper body if necessary. Check for correct overlap of upper body to lower body. There should be a 4 to 5mm parallel gap as shown (Fig. 15). Tack weld the upper body to the spacer, top and bottom. Check everything again, and finish the welds. These welds must penetrate deeply, to make the assembly as strong as possible.

Lower the handle until the connecting link C2 rests against the upper body A1 (Point X, Fig. 17). If the blades overlap, and do not have the gap shown in Fig 16, raise the handle and weld a suitable strip of steel onto the upper body at point X, so that this gap is achieved when the handle is down.

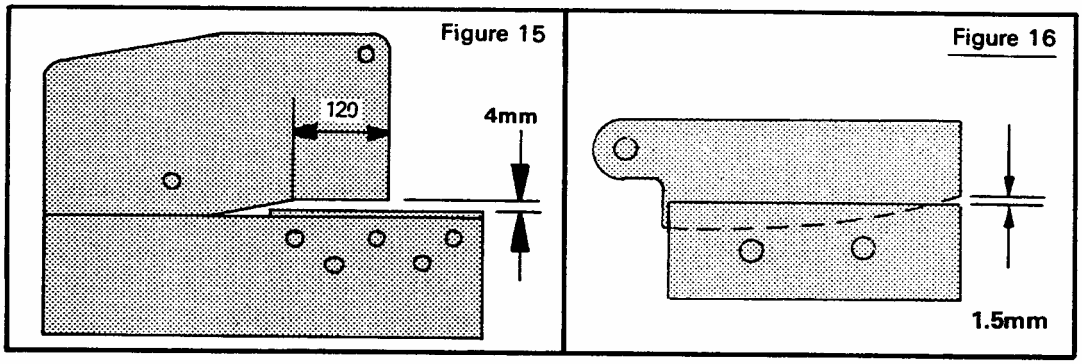


Figure 15

Figure 16

Take one of the mounting angles A4 and grind out the notch for welding. Clamp the mounts on to the lower body with the lower blade resting fully on the notched mount. Remove the lower blade. Weld in the notch and the top edges. Check that the blade still sits down fully, and refit. (Fig. 17).

With the handle fully raised, the position of the 14mm dia cropping hole can be marked in the upper body. Remove the upper blade and handle assembly and fit a hardened steel insert (A10) into the upper body, using one of the two possible methods. One method involves softening a piece of spring steel (see page 13) and cutting out a square 30 × 30mm. Weld this square into a square hole cut in the upper body, so that the 14mm bar-cropping hole can be drilled in the centre of the square. Grind the weld flush and harden the insert by heating to a dull red and quenching with water. Alternatively, if a lathe is available, soften a suitable piece of carbon steel and trim it on the lathe to 14mm internal diameter. Harden it, then drill a hole in the upper body large enough to accept this piece as a tight press fit, and press it in. Replace the blades and handle assembly. Mark the mounting holes through onto the stand channel and bolt the shears on.

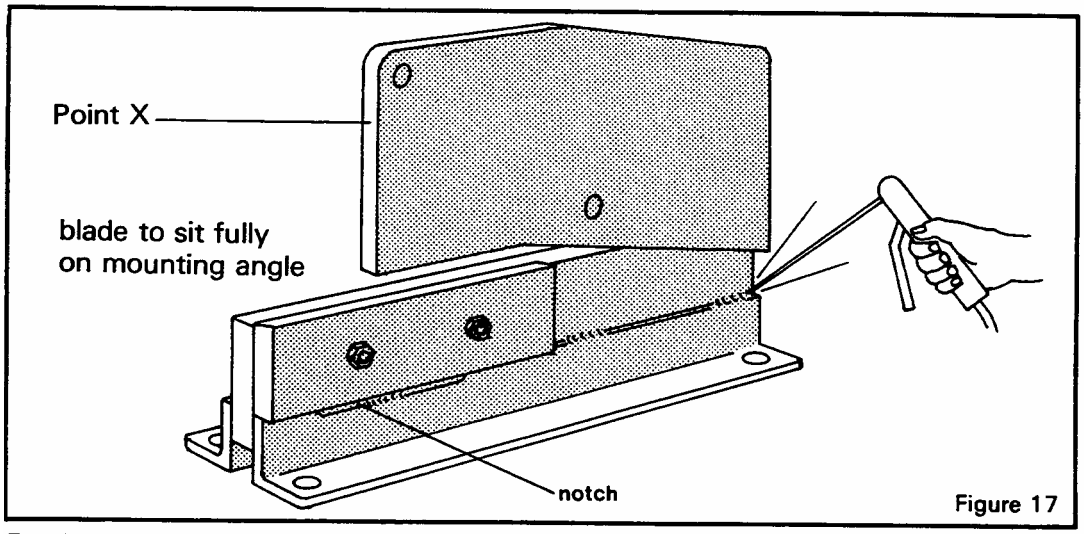


Figure 17

Blade adjustment

Adjust the blades by slackening the two bolts and nuts B4, and tightening the three short bolts A5. The blades should touch with a light pressure for their whole length. Now use the Check List on page 2.

OPERATION

The method of working is obvious to anyone familiar with sheet metal shears, but, for newcomers, you should proceed as follows:

Mark the line to be cut on the sheet metal (straight lines only). Raise the lever. Insert the sheet between the upper blade and the lower blade and line up the line to be cut with the top blade, looking directly from above. Pull the lever but stop before the end of the top blade cuts through the sheet. Raise the lever. Push the metal sheet forward in to the blades. Pull the lever as before.

For cutting large sheets, a suitable box or rest can be used to prop up either side of the shears.

ALTERNATIVE BLADES

If truck leaf springs cannot be found, or if difficulty in drilling the blades is experienced, the following design may be helpful using part hard steel and part mild steel. The thicker the spring steel, the better. Cut it wider than the mild steel plate used, and grind it down carefully after welding (Figure 18).

Note that this design does not allow a bar cropping facility to be included in the shears, unless the hole is case hardened or a hard steel bush insert fitted to the upper blade.

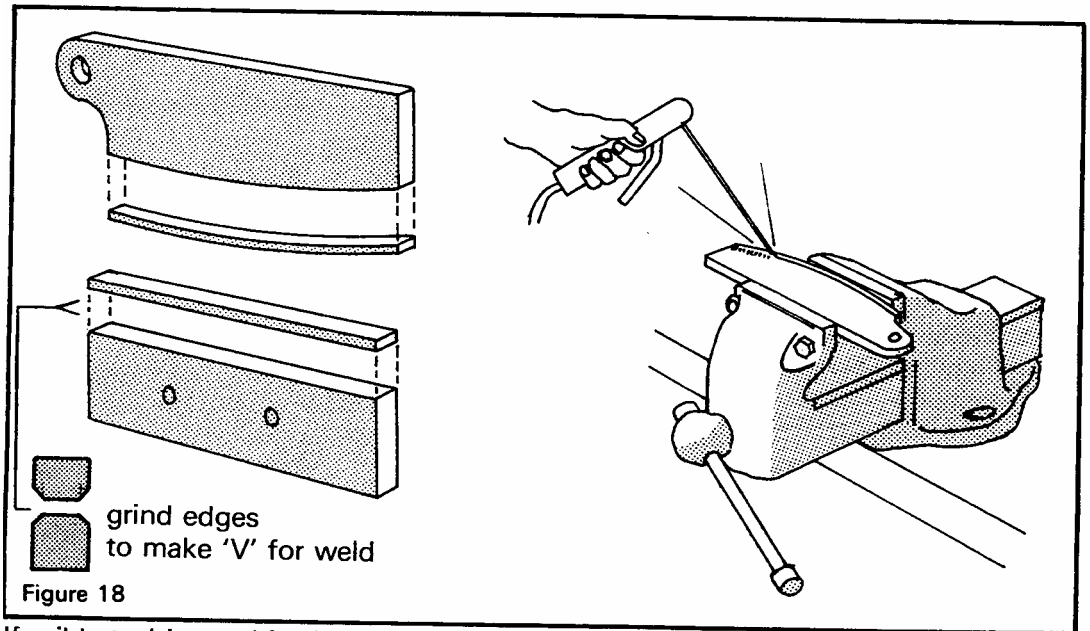


Figure 18

If mild steel is used in the blades, as described above, a hardened steel insert will also be needed for the bar-cropping hole in the upper blade. Fit this by following the procedure described on page 19.