USING THE C.Z. METAL BENDER

A practical review of the ' UNIVERSAL' Metal Bender by G. Read.

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Further information on this unique product may be obtained from the U.K. Distributors
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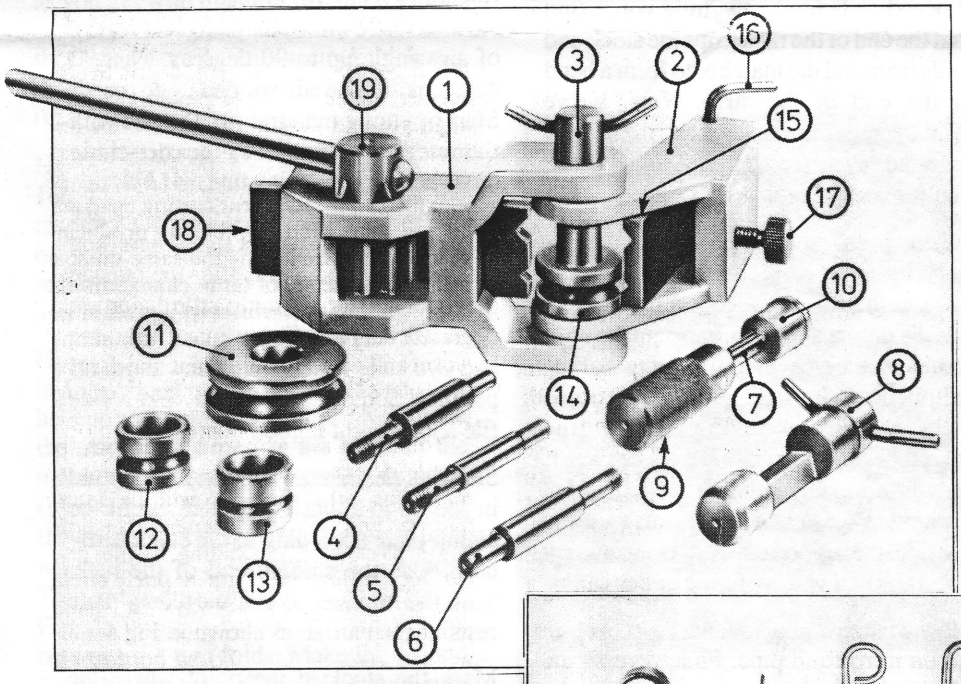
MODEL ENGINEER

The C.Z. Metal Bender is one of the most useful tools to appear for many years. It puts in everyone's hands the ability to accurately fold and curve strip metal and thin rod, and to curve larger rod and tube. It doesn't even take up bench space; you just clamp it in the vice as required. However, the supplied instructions are somewhat less than comprehensive: this isn't really surprising, because the cost of a comprehensive manual would raise the price way above the present one. Supplying comprehensive instructions is what this article is all about, for many operations are anything but obvious.

First, then, what will the tool do? It will put almost any combination of curves and sharp angular bends into strip metal up to about 1½ in. wide and ⅛ in. thick, and the same into rod up to about ⅛ in. thick. It will put almost any combination of curves into rod or tube up to about ⅜ in. diameter. Extra attachments are easily made to greatly extend the scope of the tool.

Next, what is it and how does it work? This bit is best read in conjunction with Fig. 1, in which each part has a reference number which will be used in the text.

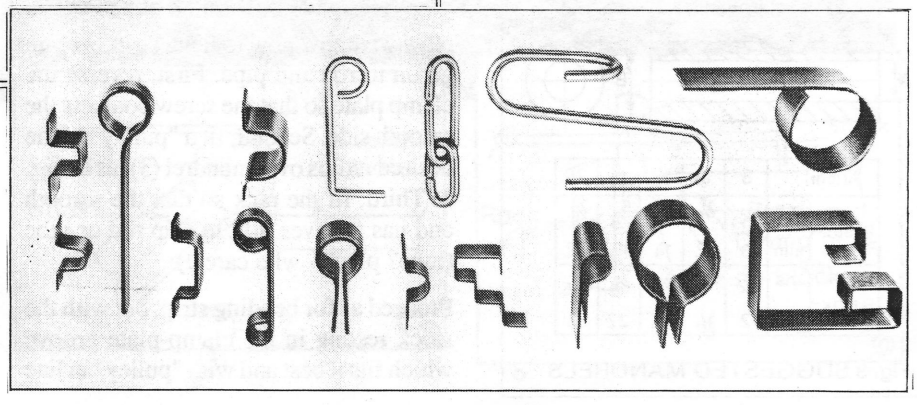


Parts of the Bender

Two aluminium alloy castings (1 and 2) are pivoted together by one of a selection of bending mandrels (3 to 8). Two of the mandrels (3 and 8) fit directly into the castings. The others, being smaller, are used with screw-on end pieces (9 and 10). For bending rod and tube, "pulleys" (11, 12, 13 and 14) are used; theses slip over mandrel (3).

One casting(2) has a lug on the underside, which is used to clamp the bender in a vice. This casting houses clamp plate (15), which is pivoted to the casting pin (16). The clamp plate has two holes for the pin. The one nearest the end of the clamp plate is positioned so that the other end of the clamp plate rests against the mandrel. The other hole allows the clamp plate to swing past the mandrel. Why? I'll tell you in due course!

The amount the clamp plate can swing is set by screw (17) The clamp plate is reversible; one side is smooth, for strip stock, and the other is grooved for rod and tube.The second casting (1) embodies grooves in which rack (18) slides. The rack is reversible; one end has teeth which grip the stock so as to pull it round the mandrel. The other end is smooth, to allow "stroking" the stock round the mandrel. The rack is moved in the casting by tommy-bar and pinion (19).



Using the Bender

The principle of operation is simple. Take the production of a 180 deg. bend in a 1 in. wide 16 s.w.g. strip as an example. From here on, we're going to use "step-by-step" instructions for a while. I know M.E. doesn't usually give them, but for this purpose they're the best way of avoiding confusion. So, here goes!

1. Clamp casting (2) in the vice, with the mandrel hole to the left. Pivot casting (1) on to it with mandrel (3).
2. Ensure pin (16) is in the end hole of the clamp plate, the other end of the clamp plate is in front of the mandrel, and the grooved side of the clamp plate contacts screw (17).
3. Ensure that rack (18) has its smooth end facing the mandrel.
4. Mark the strip to be bent, at the point where the bend is to start.
5. Swing casting (1) forward (i.e., towards you) so as to be at 90 deg. to casting (2).
6. Slack off screw (17) just enough to insert the strip stock in front of the mandrel and behind the clamp plate. Tighten the screw so that it lightly grips the stock. Adjust the position of the stock so that the mark (step 4) just appears at the end of the clamp plate touching the mandrel. Turn screw (17) until finger-tight.
7. Rotate the tommy-bar so as to bring the end of the rack on to the stock.

Using the tommy-bar, rotate casting (1) through 180 deg., keeping the end of the rack firmly against the stock. This will produce a 180 deg. bend in the stock, of the same diameter as the mandrel.

8. Rotate the tommy-bar anti-clockwise, and swing casting (1) back to its original position (as in step 5). Slack off screw (17), and remove the bent strip.

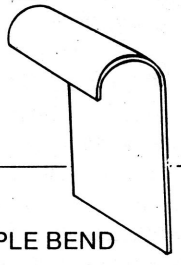
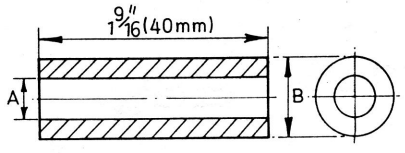


Fig. 2 A SIMPLE BEND



A(mm)		8	10	12	14	20
B min	ins.	13/32	1/2	9/16	5/8	7/8
	mm	10	12	14	16	22
B max	ins	1/2	9/16	5/8	7/8	2 5/16
	mm	12	14	16	22	58

Fig. 3 SUGGESTED MANDRELS ©

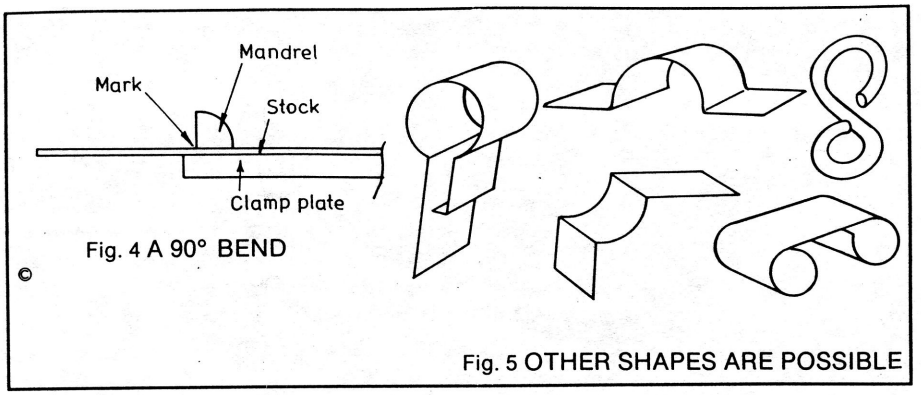


Fig. 4 A 90° BEND ©

Fig. 5 OTHER SHAPES ARE POSSIBLE

Now for More Difficult Work

That's got the first part out of the way! So, now for variations. The first is when you want the bend right at the end of the strip, as in Fig. 2. The bend doesn't have to be 180 deg.; it can be any amount from a few degrees up to almost 360 degrees. But, if it's more than 180 deg. you have to remove the mandrel to release the workpiece.

To make a bend on the end of a strip, reverse the rack so that the toothed end faces the mandrel. Insert the stock as before, but this time have only about 3/16 in. of it showing beyond the end of the clamp plate. Also, don't tighten the screw hard; this time the rack pulls the stock along the clamp plate.

Proceed as before. This time you'll find that the end of the rack grips the stock and pulls it around the mandrel to form a bend at the end of the strip. Now, we've established a rule: smooth end of the rack for bends away from the end, and toothed end for bends at the end of the stock.

At this point you'll have spotted that it's only possible to produce bends of the same radii as the supplied mandrels. True, but it's only a simple turning job in mild steel to make sleeves to fit over one of the supplied mandrels. Examples with sample sizes are shown in Fig. 3. No fine tolerances are needed for these sleeves. If they are a goood running fit on the mandrel an have a reasonable tool finish on the outside, that's good enough. Unnecessary accuracy is a waste of time and effort!

Now we know how to bend strip, we can go on to rod and pipe. First, reverse the clamp plate so that the screw contacts the smooth side. Second, fit a "pulley" of the desired radius over mandrel (3), as in Fig. 1. Third, fit the rack so that the smooth end has grooves in it to grip rod or tube (tube? pipe? - who cares!)

Proceed as for bending strip, but with the stock resting in the clamp-plate groove which fits it best and with "pulley" in line with it. The rack forms the stock around the groove in the "pulley". There is, of course, a minimum radius around which tubes will bend without flattening. As an example, copper tube of about 3/8 in. dia. can only be bent around the largest "pulley". Again, for different radii it's only a matter of turning more "pulleys" of different diameters.

If the bend is at the end of the stock, don't have the screw too tight, and put enough force on the tommy-bar to ensure grip on the stock. If the bend is away from the end of the stock, tighten the screw hard, and only use enough force on the tommy-bar to bend the stock. Here, in fact, we've broken the rule stated earlier; it's about the only exception, so that should "prove the rule"!

Now to move on to sharp angular bends, of any angle up to 90 degrees. That 90 deg. is a hard limit we can't get round. Start by fitting mandrel (8), the one with the middle cut away to a quarter-circle cross-section. You may find, as I did, that this mandrel will not easily enter the holes in the castings. I suspect that the milling was done in production after the outside diameter was turned, and a little distortion occurred. Anyway, exception or not, mine had two ends which were a few thou. off parallel. Some marking blue and a fine file soon taught it good manners!

Sharp angles can only be done in strip and in rod up to about 1/8 in. dia., so fit the clamp plate according to the stock being used. Use the smooth end of the rack. Turn the mandrel so that the clamp plate rests against a flat, as shown in Fig 4.

Mark the stock at the point where the angle is to come, and insert it so that the mark is on the "corner" of the mandrel (Fig. 4.). Tighten the screw hard. Then, proceed as for bending. Rotate casting (1) through whatever angle is required. The "fold" need not be at right angles to the edges of the clamp plate, the fold will be at a corresponding angle to the edges of the strip.

Now, we are going to deal with combinations of bends and folds. When dealing with these, two new techniques are often used. They are usually required when a curve starts or finishes in a fold. So, we'll start with a half-round pipe clip, (Fig. 6A). This first technique consists of using the rack to push things in the opposite direction to normal. The second is the use of the second hole in the clamp plate.

First, then, the shape of Fig. 6A. It started with making a 180 deg. bend away from the end of a piece of strip stock, around a mandrel of whatever diameter is suitable - simple. The bent stock is now reversed on the mandrel as in Fig. 7, with the smooth end of the rack between the two projecting ends. The end of the stock towards the front may have to be bent slightly to get the track into position. Tighten the clamp screw.

Now, using the tommy-bar to push the end of the rack hard against the stock, rotate casting (1) (part numbers in brackets refer to the numbered photo in Part 1 - Ed) anticlockwise. This , at first sight, looks like two opposing motions which are going to fight each other. Amazingly, with the tommy-bar at right-angles to casting (1) and pointing away from you, it's not difficult. The result is to make a fold between the end of the rack and the end of the clamp plate; it's not such a sharp fold as you get with mandrel (8), but it's quite adequate. However, it has to be admitted that it gets more difficult as stock thickness increases: best restrict it to stock no thicker than 3/32 in.

Having made the fold at one end of the 180 deg. bend, reverse the stock on the mandrel and do the same at the other end of bend. Remove the stock from the mandrel, cut the ends to length, drill them, and there's your pipe clip!

Now we'll make the familiar shape shown in Fig. 6B; your car exhaust is probably held up with something similar. We attack the stock four times, in the order of the numbers in Fig. 6B.First, using mandrel (8), we put a 90 deg. fold near one end of the stock. Next we put another in it, a little way along and in the opposite direction. This needs a packing block, as shown in Fig. 8, or we'll finish up with a bend between the two folds. Make the second fold a bit less than 90 deg. Now for theuse of that second hole in the clamp plate! Pivot the clamp plate in the second hole (the one away from the end) and fit mandrel (3). Mandrel (3) is used for this trial piece, but you can use any diameter the job requires. There is, however, a limit. The clamp plate must be able to swing past whatever mandrel is used. For large diameters, where a sleeve is used

1: One of the many jobs that the machine is capable of undertaking, bending tube, in this case 3/8 in. diameter copper.

2: Making the second fold in the pipe clip shown in Fig.6B, using a packing block.

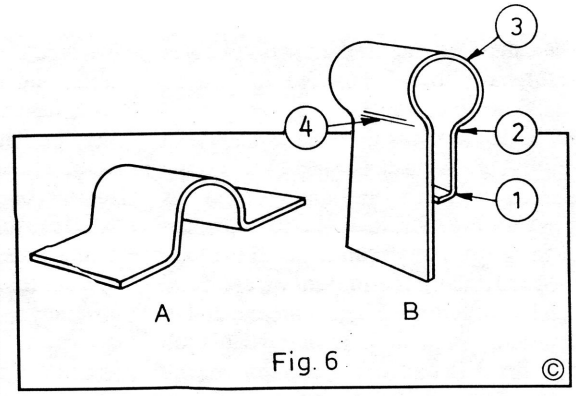
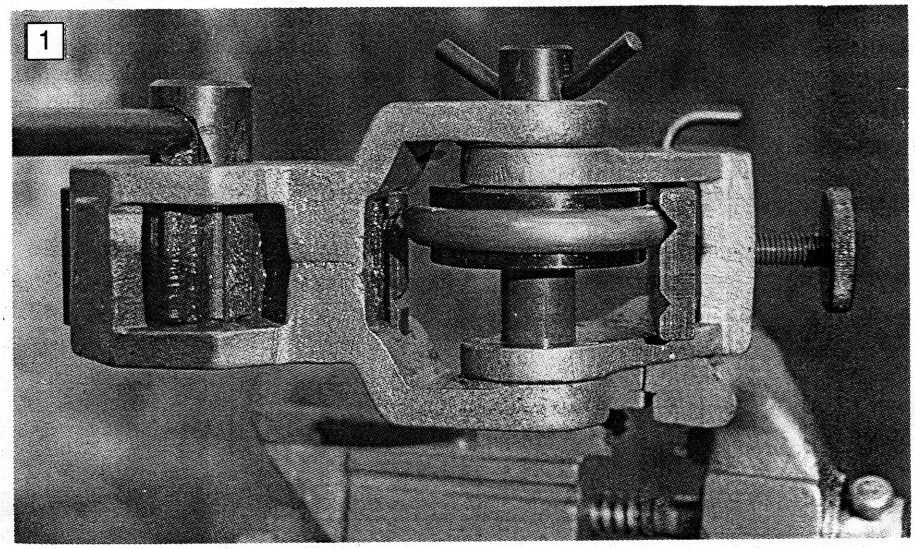
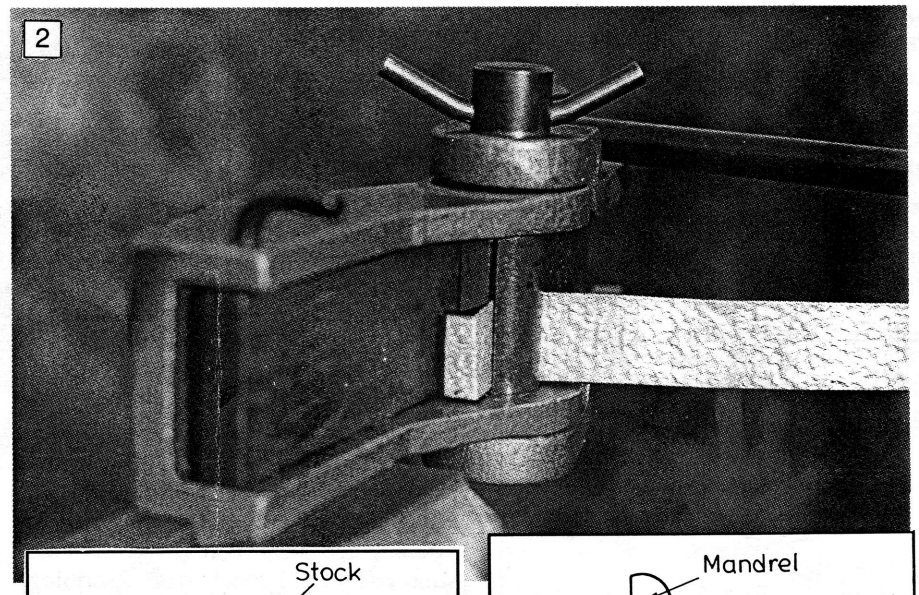


Fig. 6 ©





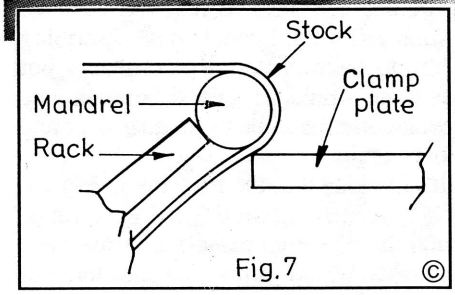


Fig. 7 ©

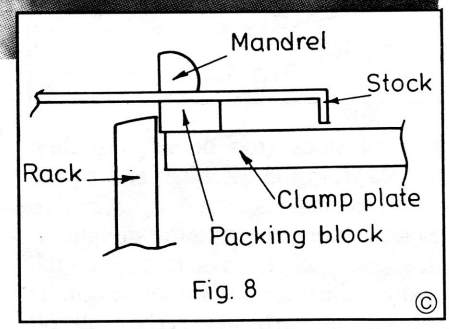


Fig. 8 ©

over a standard mandrel, new pivot holes would have to be provided in bolt-on extensions to casting(2).

The folded stock is inserted as shown in Fig. 9. Adjust screw (17) so as to set the stock in relation to the mandrel axis as shown in Fig. 9. Now, the clamp plate doesn't grip the stock, and a packing block is needed to limit the amount we can bend round the mandrel. Fingers are needed to keep things in position at first, so this job calls for left-handed operation of the tommy-bar. The packing block is best made of metal, but wood will do at a pinch; a useful tip is to stick it onto the stock with a spot of Evostick or the like. I've used Blutak before now!

Using the tommy-bar with left hand, push the rack (smooth end) inward as far as possible and rotate casting (1) clockwise as far as possible. This will form the stock as shown by the chain-dot line in Fig. 9. Because the stock has to fold against the

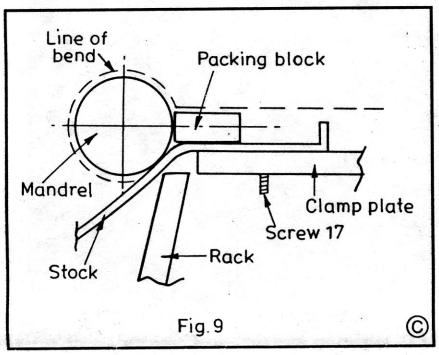


Fig. 9 ©

packing block, a somewhat sharper fold is obtained with a metal block than with a wooden one.

The two techniques illustrated by the shapes shown in Fig. 6 cover almost every case where a fold and a bend are adjacent. There is one more to come, used where two adjacent curves are required in opposite directions, as shown in Fig. 10. Referring to Fig. 10, the curve (A) is formed in the usual way on the end of the stock by use of the toothed end of the rack.

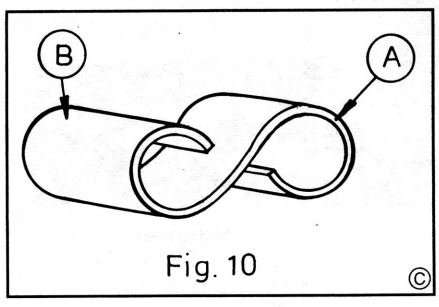


Fig. 10 ©

The bent stock (rod or strip) is then removed from the machine, and a plug (wood or metal, it doesn't matter) fitted to the curved portion. Next, the straight bit of the stock is cut to about three times the mandrel diameter; no more length is needed as the next bend won't be a full 360 deg.

With the clamp plate pivoted in the second hole, and using the smooth end of the rack, insert the plugged stock as shown in Fig. 11. The next step appears obvious - bend the stock round the mandrel. But there is one thing to know before you do so! If the stock is thin (like heavy tinplate), undue pressure from the rack will unwind it from the plug; this causes incantations to strange gods! So, if the stock is thin, use no more pressure than is absolutely necessary to form it round the mandrel. With larger diameters, it's sometimes possible to grip the plugged but with a small Mole wrench to stop it unwinding. The three examples described use all the techniques I know of. Someone will of course know another one; I invite him to tell the editor about it, because we'd all like to know it! However, the techniques described enable a very wide variety of

3: Making curve number 3 in the pipe clip shown in Fig. 6B.

4: This is the pipe clip shown in Fig. 9, showing the bend being made against the packing block.

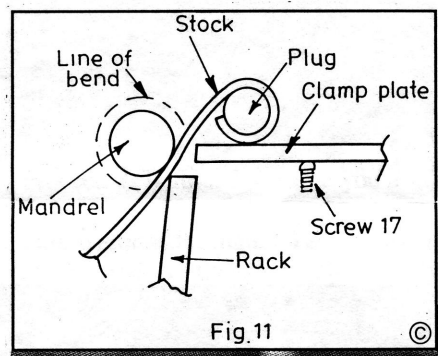
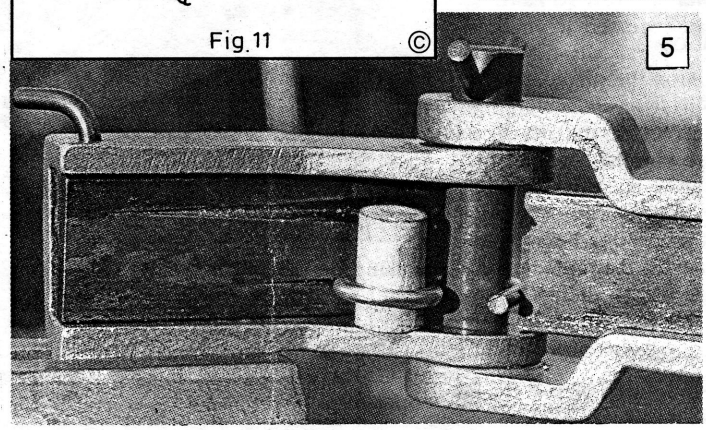


Fig. 11 ©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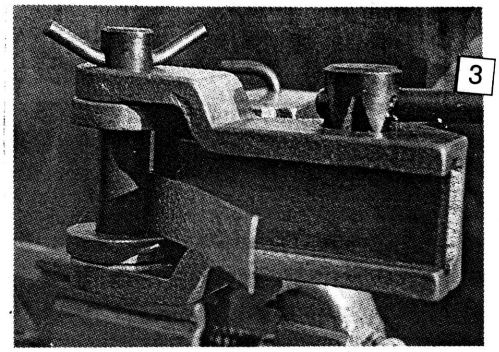
5: Making the link shown in Fig. 11. Here we see the second bend being made, the first is protected by a plug to prevent deformation.

shapes to be produced. The important thing is to become familiar with them, so you can use them as required to make what you want. I could go on describing how to make all sorts of other shapes, but nothing would be gained because they would use the same techniques over and over again.

It's obvious that the machine is just the thing for making circlips, hairpin springs, and the like from piano-wire. However, as when winding springs, bends turn out to be of larger diameter than the mandrel: make allowances accordingly. Also, any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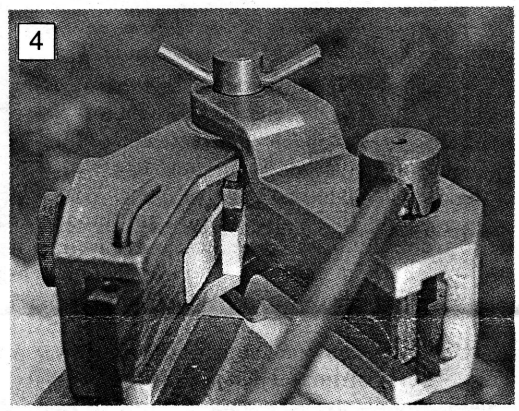
projecting end of a bit piano-wire will be sharp. If anything slips, it can bite hard: to quote LBSC, "nuff sed!"

With a C.Z. Bender, especially if it's backed up by a set of bending rolls and a small electric welder, it's amazing what can be easily made. The model engineering uses are almost infinte: chain, screw couplings, locomotive steps, all sorts of brackets, "dog-leg" rods, and so on. On top of that, car things like exhaust brackets can be made when the need is vital after the shops have closed! Finally, ornamental metalwork,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to please the "domestic authorities" can be made to a "where did you buy that? " standard. I've even used mine to make attachments for a big rotary cultivator (I've half an acre of garden!)

This article doesn't pretend to cover every possibility. Somewhere, someone else knows something else this machine can do; of that I'm sure. Whoever designed the thing is really brilliant. I applaud the clever thinking behind the machine each time I use it.

G. READ