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THE R.T. BLANKING SYSTEM

BY

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THE WORSHIPFUL COMPANY OF GOLDSMITHS

The R.T. Blanking System

ABSTRACT

A technique of making blanking tools for sheet metal and other materials is described in detail. The technique requires only the normal tools and skills of the jewellery or silversmithing craftsman to produce tools for the blanking of large or small quantities of simple or complex forms.

The tools produced are suitable for use in conventional hand or foot presses or can even be used in a bench vice or with simple hammer blows.

Special equipment developed to facilitate production and usage of the tools is also mentioned.

PUBLISHERS NOTE

This report is a detailed description of a very low-cost method of making blanking tools for sheet metal and other materials using the normal skills and tools of the jewellery or silversmithing craftsman.

The process was invented by Roger Taylor and is subject to British Patent No. 1594396. In the interests of the making of this information available to all craftsmen, the Goldsmiths' Research Foundation has come to an arrangement with Roger Taylor for the production and distribution of this report.

The proceeds of the sale of the report are to be used to defray the costs of the development of the process and its dissemination, and purchasers receive the right to operate the process for their benefit only.

Peter Gainsbury, Director of Research

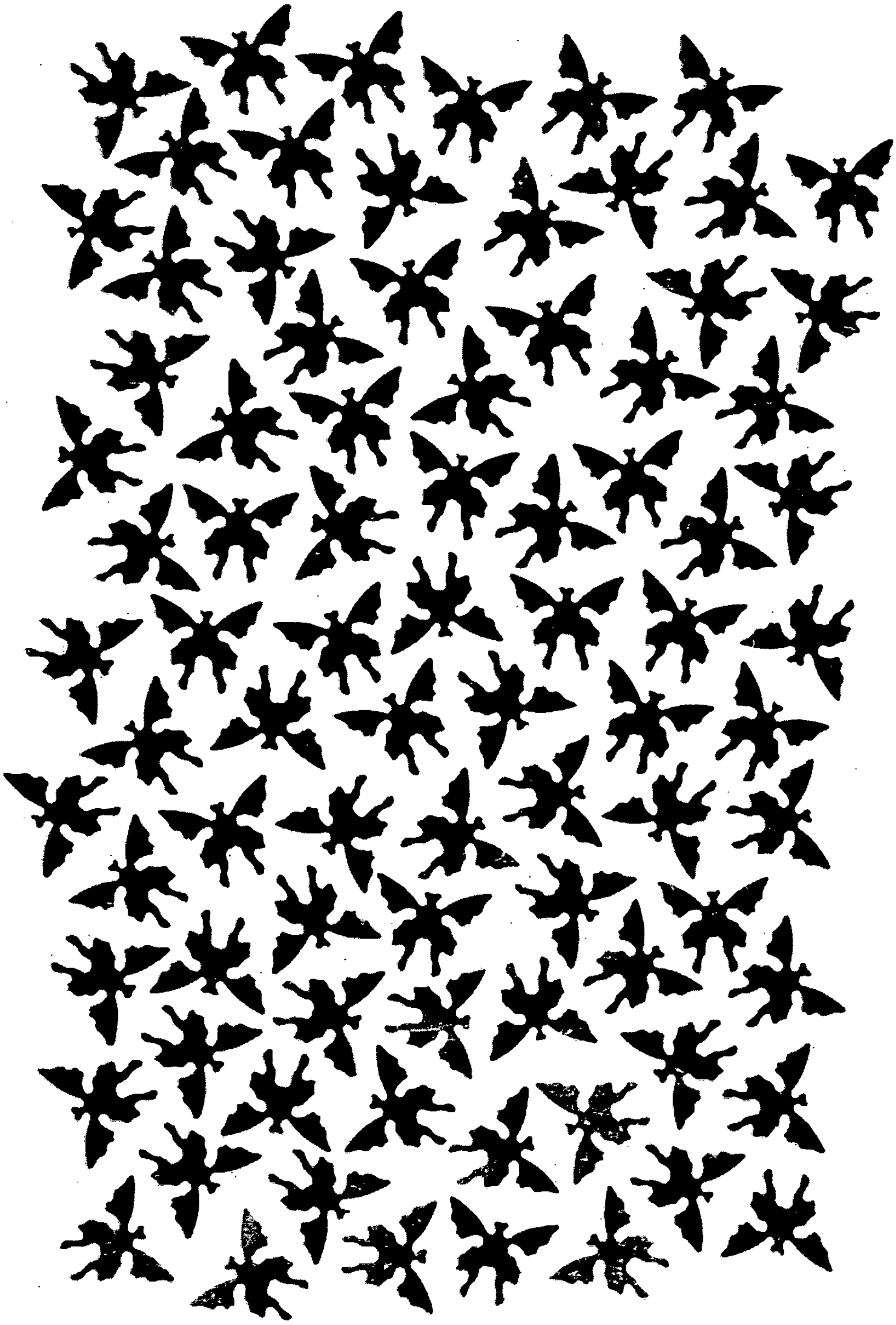

Figure 1: Silver blanks produced in quantity by the R.T. system.

INTRODUCTION

Every metal craftsman at some time or other has to face the problem of reproducing identical flat shapes whether just 2 or 200 off, there has always been this basic need for making copies. This report explains a simple blanking tool process invented by the author, a practising designer and craftsman in jewellery and engineering. Tools are described which can be made with a minimum of cost, skill and technical knowledge, and yet gives the craftsman all the freedom of an inhouse, self-controlled process which is capable of successfully competing with all other methods of flat material blanking.

Blanking is a technical term referring to the cutting of flat shapes by means of a close fitting two-piece positive punch and negative die tool. The punch being able to pass through the die under force and thereby cut its shape out of a flat sheet of material placed between the two parts of the tool. The shape being cut will pass through the die while the waste will pass over the punch.

By traditional tool-making methods the punch and die are made separately and for use, accurately located within the press. With this arrangement the die has to be designed to allow access to the blank after it has passed through it, and a manual or mechanical device is required to strip the waste material from the punch. This represents blanking in its simplest form but even so does require a press, skilled setting up and specialised skills and knowledge for the design and manufacture of the tools. Although T.A.C. Project Report No. 12c/1, published by the Goldsmith's Company in 1969, describing low-cost blanking and piercing tools, went some way towards simplifying the process, it still relied on the basic principle of making a punch and then the die to fit it along with the hardware required for guiding the punch into the die. Most designer-craftsmen do not have the special skill and knowledge or money for capital equipment needed for this type of tooling.

There are, of course, other methods of reproducing flat shapes in quantity, these include photo-etching, spark erosion, routing, etc. However, these processes are unlikely to be immediately available to small craftsmen or under their direct control, and when working in precious metals there may be difficulty in recovering scrap. Apart from cost, the greatest disadvantage with all these processes is the lack of freedom for the designer, for once the commitment has been made to the method of manufacture there is little room for error, change of design or pure experiment.

PRINCIPLES OF THE R.T. BLANKING SYSTEM

Flat simple or complex shapes can be produced by hand saw piercing, after piercing out the first one the production of further identical shapes becomes more and more tedious and the results less and less like the original.

As the method of saw piercing enables complex and precise shapes to be cut, albeit only one at a time, it therefore follows that if this method of cutting could be employed to produce blanking tools then the tool in turn could reproduce the shape required time and time again. This is the first principle of the R.T. Blanking System, and with a saw, tools can be cut capable of blanking out shapes ranging in size and complexity from tiny butterflies to picture frames, from materials including silver, gold, platinum, steel, copper, brass, aluminium, titanium, tantalum, niobium, plastic, leather, and paper up to a thickness of 1.4mm.

Fig. 1 shows 100 butterflies produced by the R.T. System by blanking from 0.6mm silver sheet. A total time of only 40 minutes was required to produce both the 100 blanks and the tool to cut them.

It is clear that a close-fitting punch and die is necessary for blanking out shapes, thus if a circular shape is required to be blanked out then the punch is made to the size of the circle and the hole is machined in a suitable plate to a size, so that the punch fits into it with a minimum clearance. The

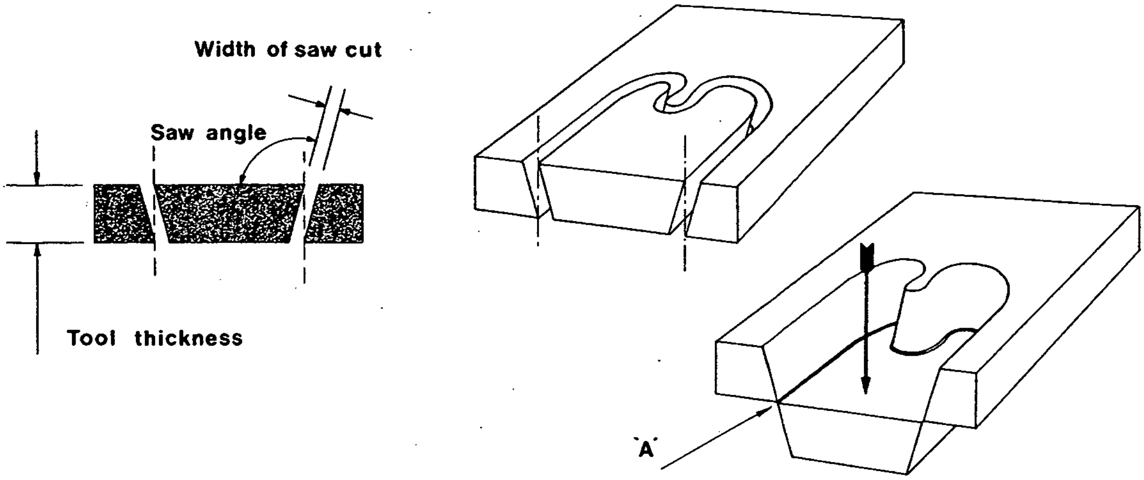

Figure 2: Diagram illustrating the principle of angle cutting to obtain punch and die fitting.

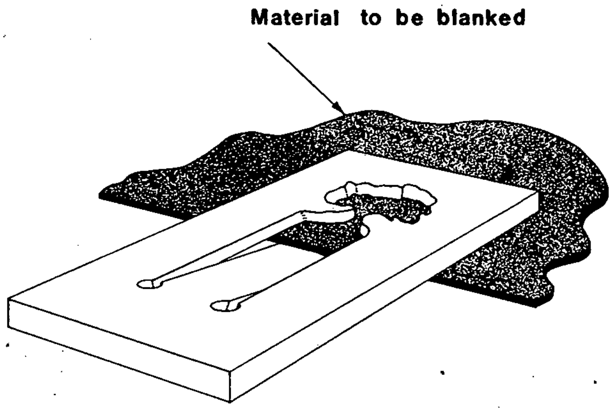

Figure 3: Diagram illustrating the principle of punch and die retention.

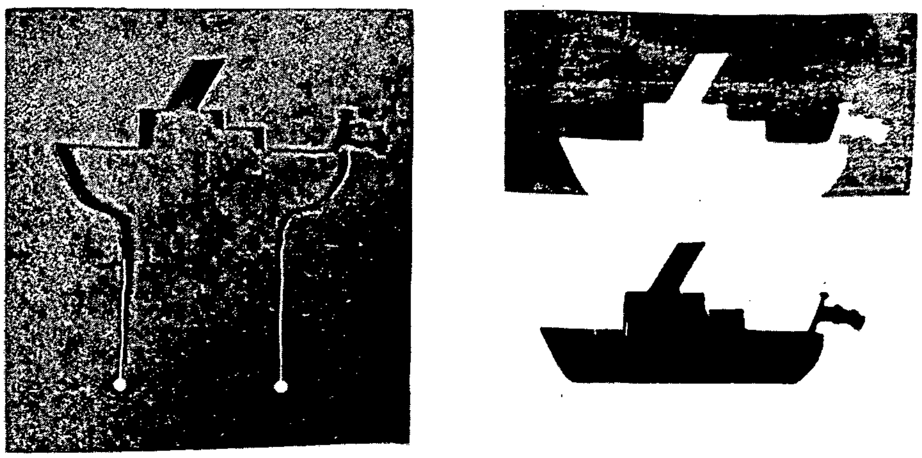

Figure 4: Simple tool with blank incorporating material edge.

clearance required is similar to that of the cutting edges of a pair of scissors or metal shears. If the edges do not meet correctly then one merely creases the metal between the blades instead of cutting. From this it is possible to appreciate the difficulty of making a punch and die by conventional means to fit each other to produce a blank of the complexity of that shown in Fig. 1.

In the R.T. Blanking System the tool is cut from a single steel sheet with the use of a conventional piercing saw, so that both punch and die are produced simultanteously one from the other. An essential feature of this process is that the saw cut is made at a controlled angle to the steel surface. This enables the problem of the gap made by the saw to be overcome and is the second principle of the system.

With reference to the drawing, Fig. 2, it can be seen that by knowing the thickness of steel and width of saw cut, the angle can be adjusted to produce a perfectly fitting tool at the point 'A'. In addition, the sloping angle of the cutting edges of the tool allows the cut material to leave the two parts of the tool freely without binding, eliminating the need for stripper plates.

With conventional tools the punch has to be guided so as to enter the die accurately. In the R.T. System, as shown in Fig. 3, the punch and die are permanently retained within the original sheet from which they were cut, allowing the material itself to act as a hinge ensuring perfect alignment and eliminating the need for tool setting and guiding. However, the hingeing method of tool alignment requires some thought regarding the shape being cut, for in single tools, as in Fig. 4, one straight edge of the material being cut normally becomes part of the finished blank.

BLANKING TOOL MATERIALS

Tools can be made from mild steel, tool steel, brass or even acrylic resin sheet, depending on what materials are to be cut and the required tool life. If one works on the analogy that the cutting tool material must be stronger than the material being cut, then a tool made from plastic will cut paper or card, mild steel will cut silver, and tool steel, perhaps hardened, will cut 9 ct. gold and mild steel. Experience has shown that for general purposes 16swg (1.62mm) thick mild steel sheet is quite adequate for blanking out shapes from material with shear strengths up to that of silver. These include aluminium, brass, copper, 22ct. gold etc. Nevertheless, it is possible to punch out steel blanks with a mild steel tool but the thickness of stock which can be cut, and the life of the tool, are limited. Tool steel is perhaps the best to use for general purposes, it is readily available in a form known as ground flat stock or gauge plate. This is produced in various thicknesses pre-ground and is far tougher than mild steel and far better for cutting 9 ct. gold, platinum, titanium, and steel etc., and for greater tool life it can also be hardened. Two thicknesses of tool steel are recommended, they are 1.6mm (1/16") and 0.8mm (1.32"). The 0.8mm thickness for blanking out materials up to .7mm and 1.6mm for up to 1.4mm.

Fig. 5 shows an example of a mild steel tool from which blanks were cut, in order, from various materials. The results of this test show that a variety of materials can be blanked out using mild steel. Paper was cut to start and finish to demonstrate that the cutting edge of the tool was maintained.

a) Paper
b) Silver .5mm thick
c) Brass .75mm thick
d) Aluminium 1.0mm thick
e) Mild steel .2mm thick
f) Paper

BLANKING TOOL DESIGN

Figures 6 to 9 show various tool configurations with blanks produced from them and in some cases assembled into products. The first, Fig. 6, links for a bracelet in silver, makes use of one edge of the silver strip, to cut not only the outer shape but also the inner. Note also two notches cut into the tool edge to act as guides for the material strip when fed through the tool. The tool was made from 1.6mm tool steel and the silver sheet was 0.65mm thick.

In the next two examples, Figs. 7 and 8, two sections of the tool are hinged from opposite sides, effectivly giving two punches and dies within the same tool. Fig. 7 blanks out small sections from each side of a continuous strip to manufacture gallery for stone settings, whereas the tool in Fig. 8 produces an abstract shape. This tool also shows that by using this method the design of the finished blank does not have to rely on retaining a straight edge of the material, the blank, however, does require cutting from its neighbour after each operation. In both these examples the tool was made from 0.8mm tool steel and the product was in 0.4mm silver sheet.

The camel in Fig. 9 shows how small and complex tools and products can be produced by the R.T. System. The tool was made from 0.8mm thick tool steel and the camels blanked from 0.4mm silver sheet.

Referring back to Fig. 1, it will be noted that the butterflies retain no straight edges and therefore apparently were not produced from a hinged-type tool. Furthermore, a precise symmetrical shape has been achieved and to do this by hand, cutting each side of a centre line identically, would be extremely difficult, if not impossible. In this case the apparently impossible has been achieved by the same hinge tool method as illustrated in Fig. 10, which shows the butterfly tool and stages 'A' and 'B' blanks. It can be seen that the tool was designed to cut one half of the form leaving sufficient material on the opposite half so that portion in turn can be placed under the tool and cut to complete a perfectly symmetrical shape. From this example it is also evident that with two tools it is possible to blank out in two stages a non-symmetrical shape without retaining any of the original material edge.

The occasion may arise in a design where a shape that is blanked out is required to fit back into the portion it came from, for example it may be required to cut a negative shape from white gold and a positive from yellow gold, fitting them one into the other. If this were tried it would be found that the fit is so tight the two forms could only be forced together with distortion. With the R.T. Blanking System, however, it is possible to cut two tools together, one slightly larger than the other, due to the cutting angle, overcoming this problem. Figure 11 shows two steel plates from which tools are to be cut with a drawing of the required shape on the top plate and illustrates that when the two plates are cut at the required angle the lower plate 'B' produces a smaller image than the top 'A'. By this method two complete tools are cut at the same time and tool 'A' can be used to blank out the negative shape and 'B' the positive allowing the forms to fit exactly into each other without force and distortion.

BLANKING TOOL MANUFACTURE

It has been explained that the tools are cut with a piercing saw at a set angle to the metal surface. In determining the correct angle to cut the tool, two factors have to be established. The first is the width of cut produced by the saw blade, and experience has shown that to achieve the best compromise between a constant cut width, material removal and sharpness of turn, size 4/0 high quality bright wire blades, such as Barrel Brand or Herkules are best. All the angles and data given are based upon this blade size.

The second factor is the tool material thickness, although 0.8mm and 1.6mm have been mentioned other thicknesses can be used, and with reference to the diagram, Fig. 12, angles can be determined for tool material thicknesses from 0.5 to 2.5mm (0.10").

Early trials showed that cutting with the saw blade kept vertical, with the tool plate set at the required angle, is the most satisfactory way and to achieve this a wooden peg with a 'V' slot should be constructed, with a block fitted to its underside enabling it to be held in a bench vice at varying angles, see Fig.13. The user sits facing this working surface so that it angles down to the left (this is for right-handed users). The saw frame must be kept in the vertical plane at all times without turn-

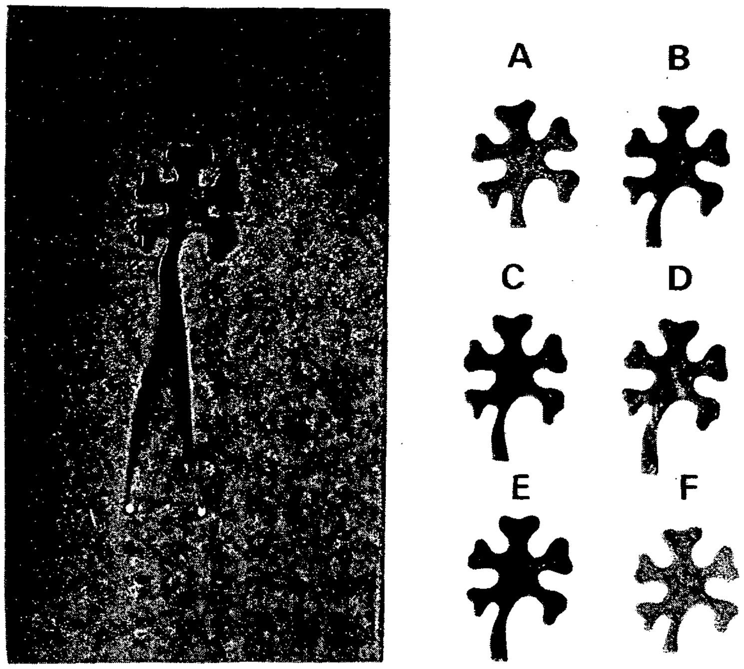

Figure 5: Mild steel tool with blanks cut in turn from A paper, B silver, C brass, D aluminium, E mild steel and F paper.

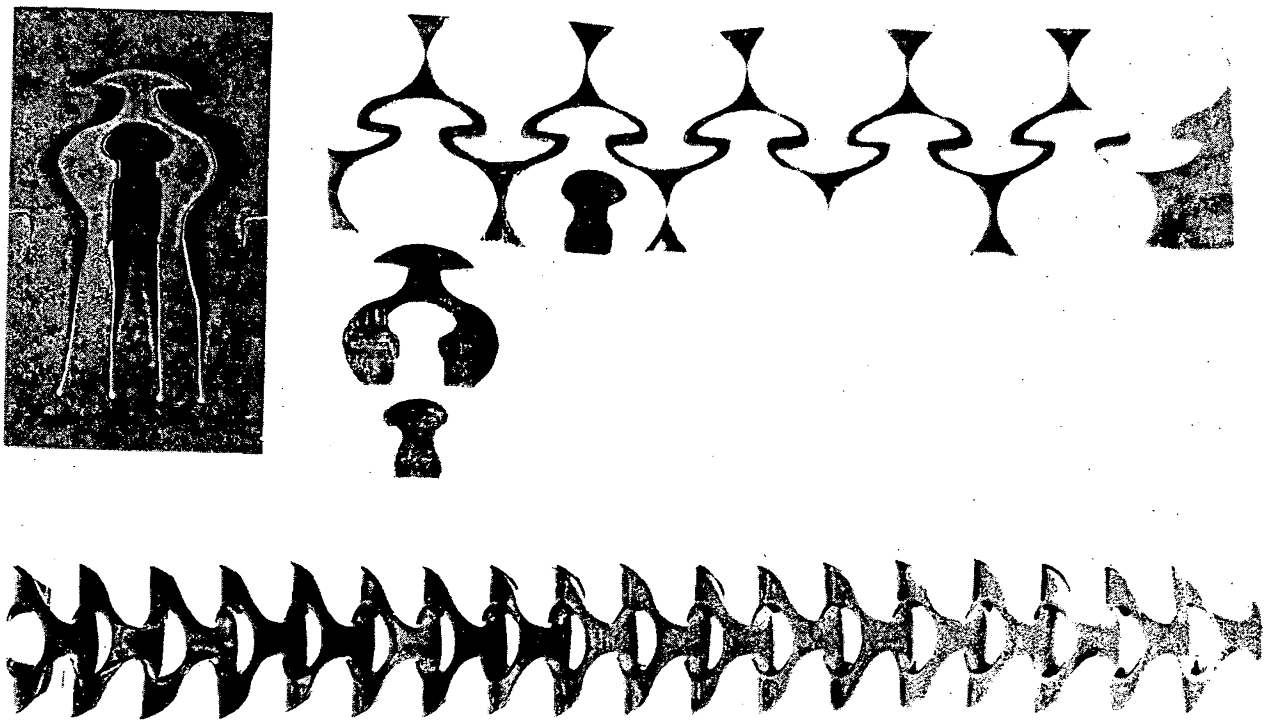

Figure 6: Double tool with guide notches to cut inner and outer shapes for the bracelet illustrated.

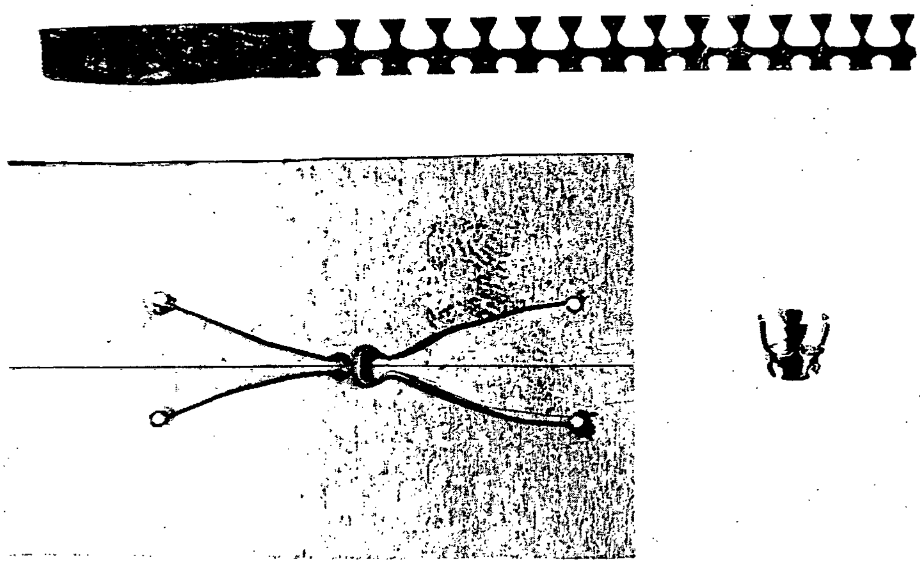

Figure 7: Double tool for gallery strip.

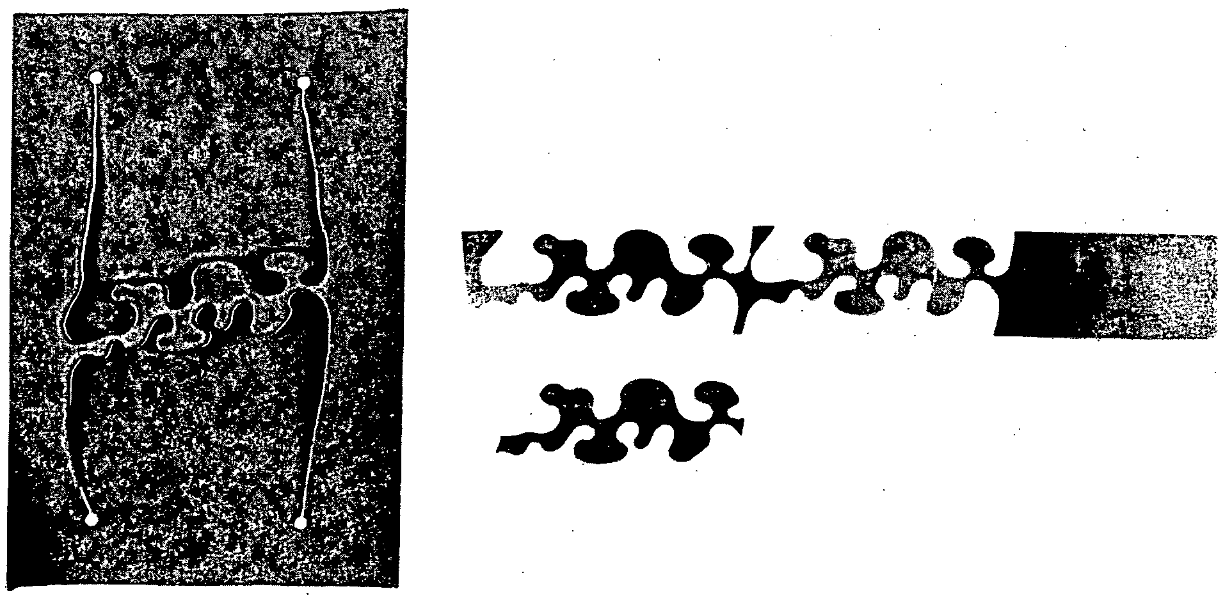

Figure 8: Double tool to eliminate straight edges.

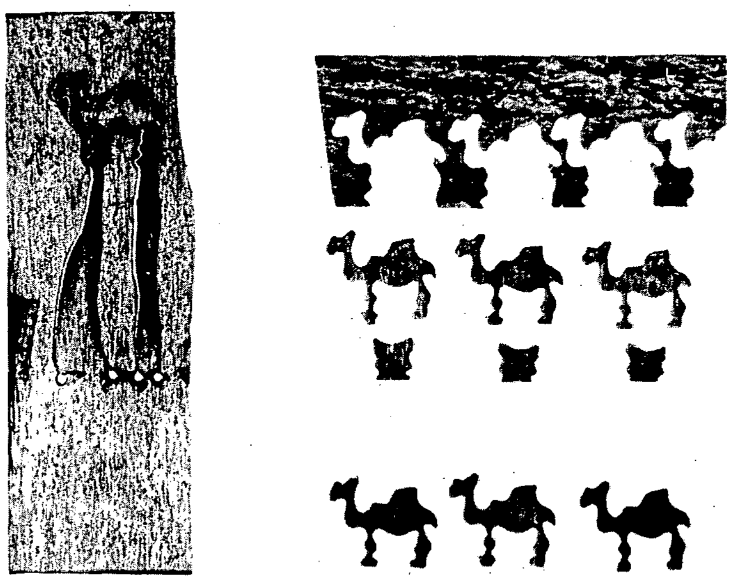

Figure 9: Small tool with double hinge.

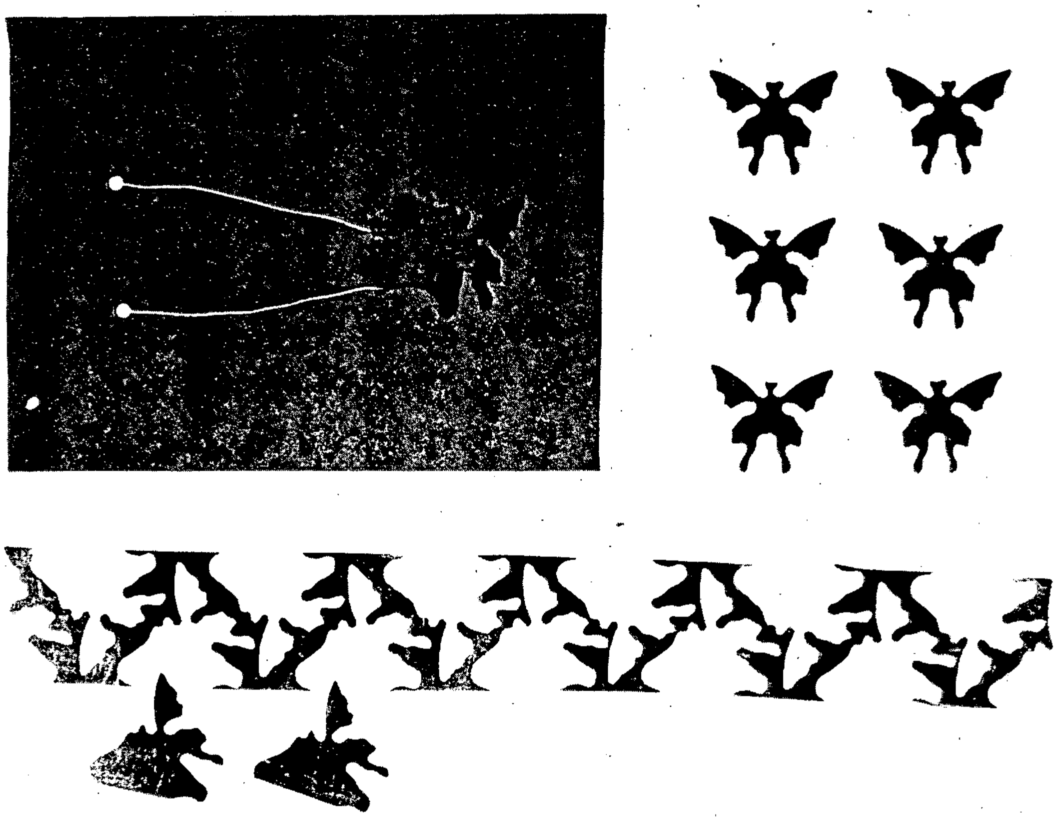

Figure 10: Two stage blanking tool.

ing while cutting. The tool plate is rotated to follow the desired cut line when sawing. It is most important that the correct cutting angle is maintained while sawing.

In preparing the tool for cutting, the true size and shape of the blank should be drawn on the top surface with two extended lines approximately 40mm long, to form the hinge section, see Fig. 14. At the ends of these lines a small hole is drilled to enable the saw blade to be entered at hole 'A' and removed at hole 'B' after cutting the shape. This means that with right-handed working the tool rotates in a clockwise direction while being cut, if not then the true blank size will not be produced on the top surface. The punch shape which was drawn and cut from the top surface has now to be pushed carefully through the die by hand, bending the metal between the two drilled holes so as to stand off the die face to enable the sheet material to be blanked to pass between the punch and die ready for pressing.

Difficulty may at first be experienced in maintaining the true saw cut angle, therefore it is wise to cut a test piece enabling adjustments to be made to the angle before commencing the actual tool. This test can be done by cutting a small circular piece about 4mm diameter out of the edge of the tool. This small piece will be conical in shape, having a smaller diameter on the underside. If after being cut it will pass through the hole with the minimum of clearance, then the angle is correct. If not then the angle must be altered and further tests done until success is achieved.

Angle of cutting requires more saw piercing skill than cutting on the flat and also there is a greater tendency to break blades, nevertheless most of the blanks shown in Fig. 15 were produced by cutting tools in this way.

To facilitate and increase the accuracy of cutting tools, special sawing equipment has been designed and is being manufactured for sale specifically for the R.T. System. This equipment illustrated in Fig. 16 consists of a special saw frame mounted to be operated by hand in a fixed vertical plane. A sawing table is provided which can be readily adjusted to angle, and can be set precisely using a detachable direct read-off scale capable of setting angles to minutes of a degree. To set the table to the correct angle one sets the scale, when mounted in the saw frame to the thickness of the tool being cut, and then locks the table into position against it by means of a hand nut. By this means the correct angle can be obtained and maintained throughout the cut for any thickness of tool up to 2.5mm. Because the saw frame is held in the vertical plane a conventional handle is no longer required, and instead a small plate is fitted to the frame which is held between the thumb and forefinger enabling precise and delicate stroking operations of the saw to be performed. Due to the fineness and greater accuracy of sawing which can be achieved far better results are possible with this equipment.

Power piercing saws such as those available from some Continental manufacturers would also be very suitable for tool production as long as the saw table can be precisely set at the required range of angles.

BLANKING TECHNIQUE

In use, force is applied to the tool to blank out the shape in the required material but unlike conventional tools the R.T. System tools must be supported on both sides over their complete surfaces. One way to achieve this is to provide a pair of steel plates, preferably hardened and not less than 12mm thick, to sandwich the tool. Force can be applied by hammer blow or squeezing in a vice, though some form of press is much to be preferred. When a press such as a fly or kick press is to be regularly used, then suitably sized plates could be permanently mounted on the press bolster and ram, ensuring that they are fitted parallel to each other.

The force required for blanking varies considerably depending on the size of punch and the nature and thickness of material being blanked. With some materials it is possible to make do with a vice or hammer to impart force but is far better to use a fly or mechanical press. Whatever the method, steel support plates each side of the tool will always be required.

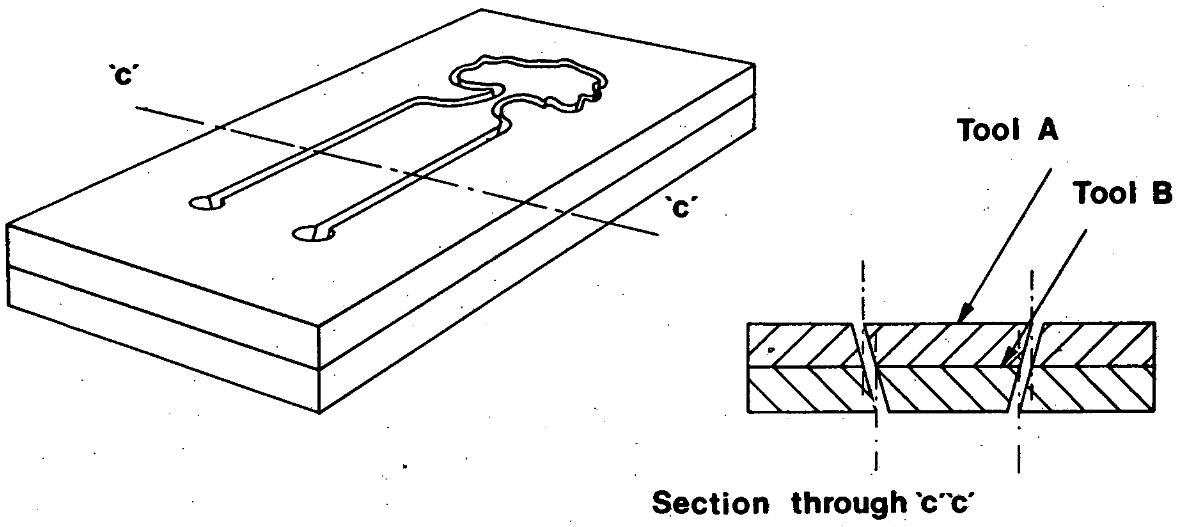

Figure 11: Production of paired tools for fitting-components.

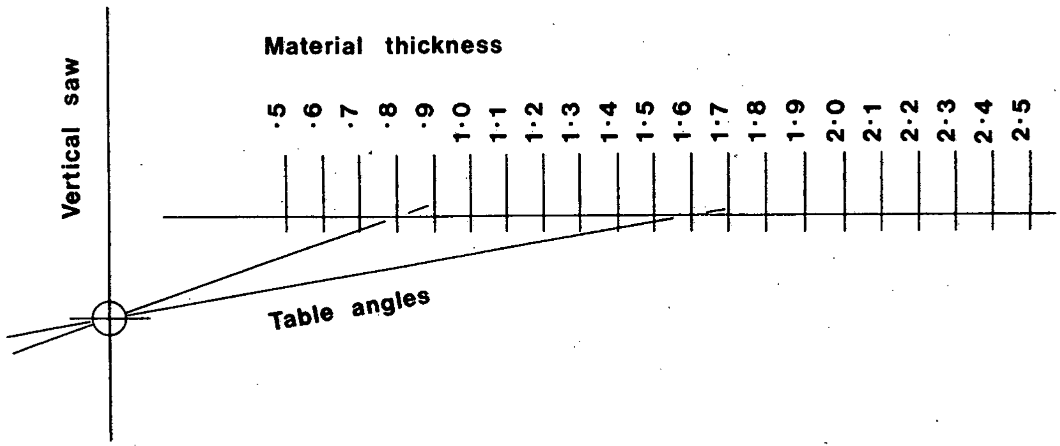

Figure 12: Saw table angle against tool material thickness for size 4/0 piercing saw blades.

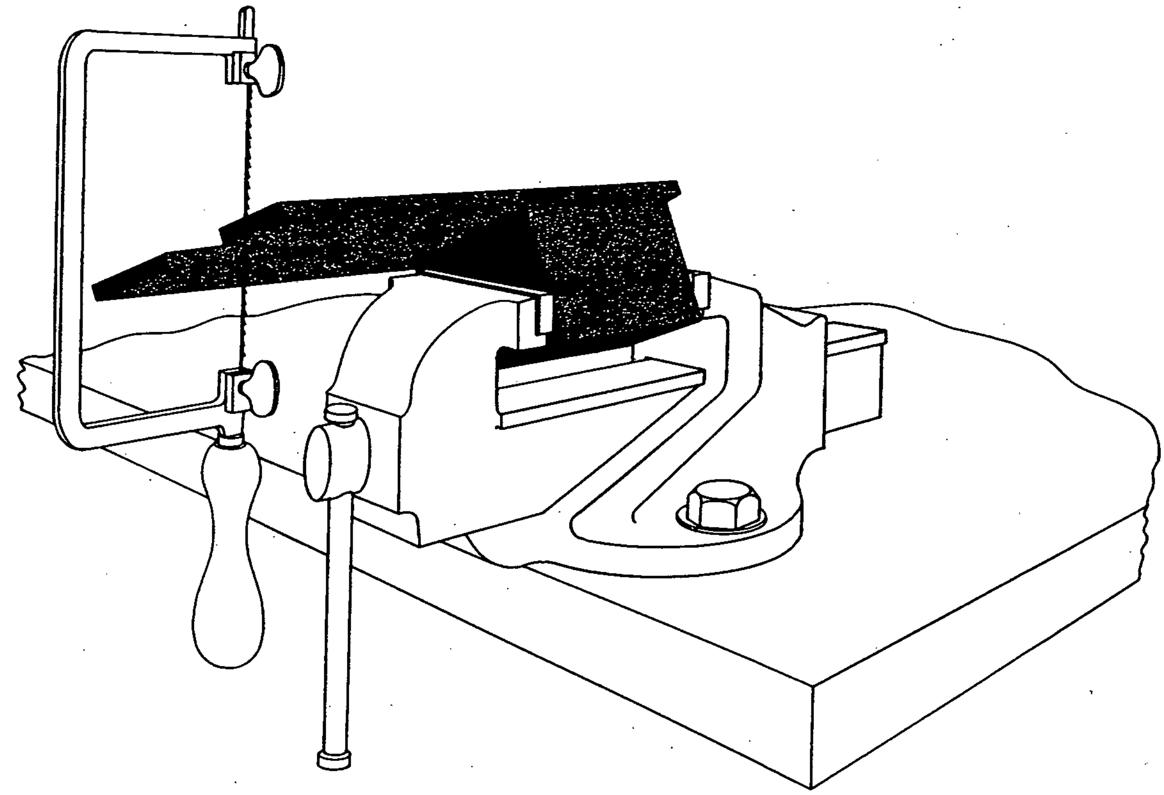

Figure 13: Simple angle sawing table.

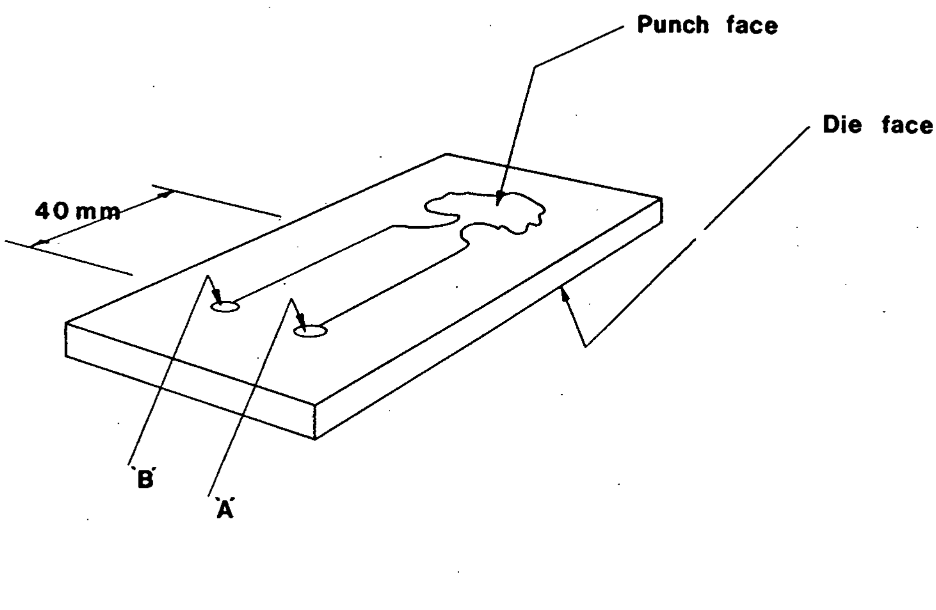

Figure 14: Diagram of tool layout ready for sawing.

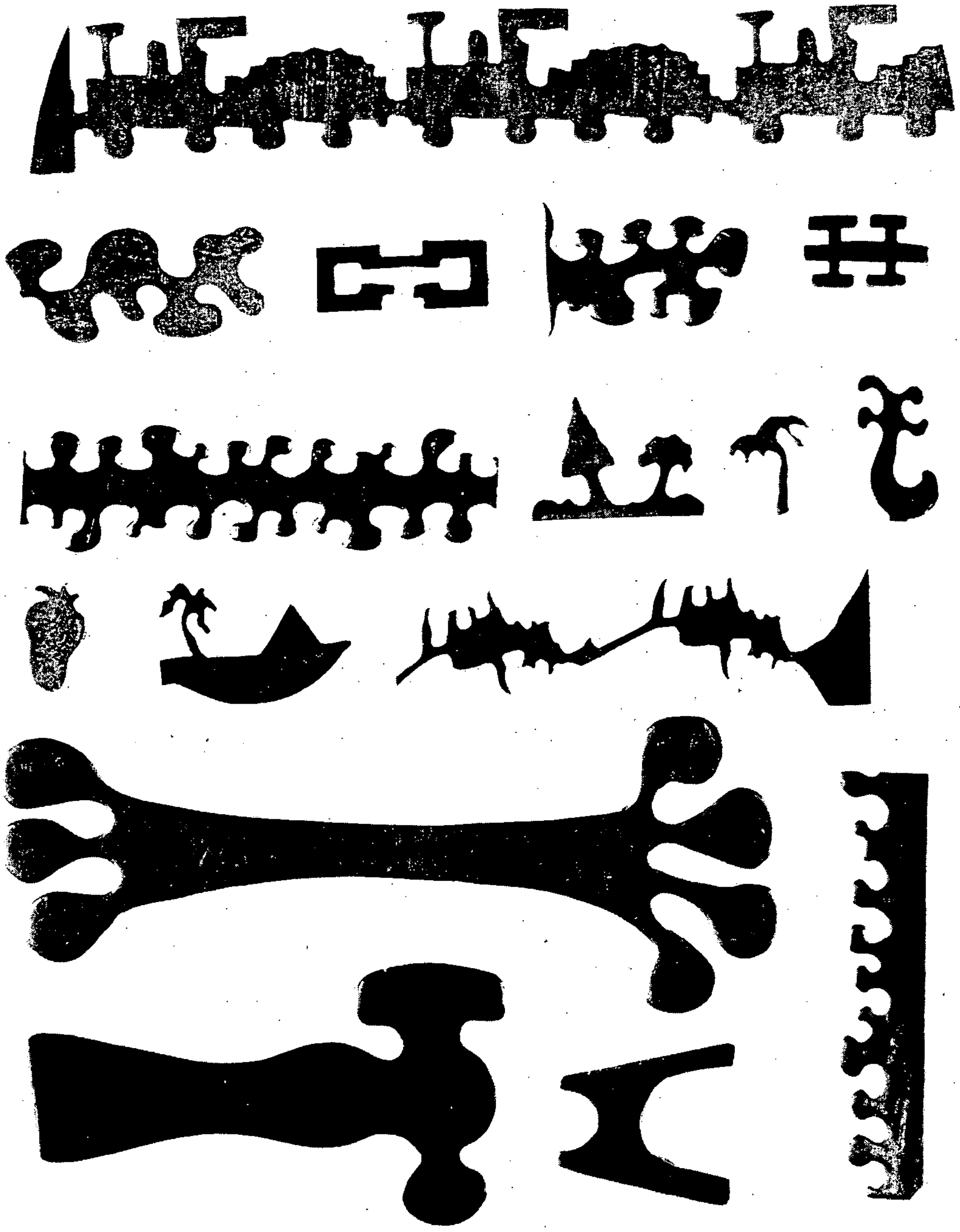

Figure 15: Miscellaneous metal blanks produced by the R.T. system.

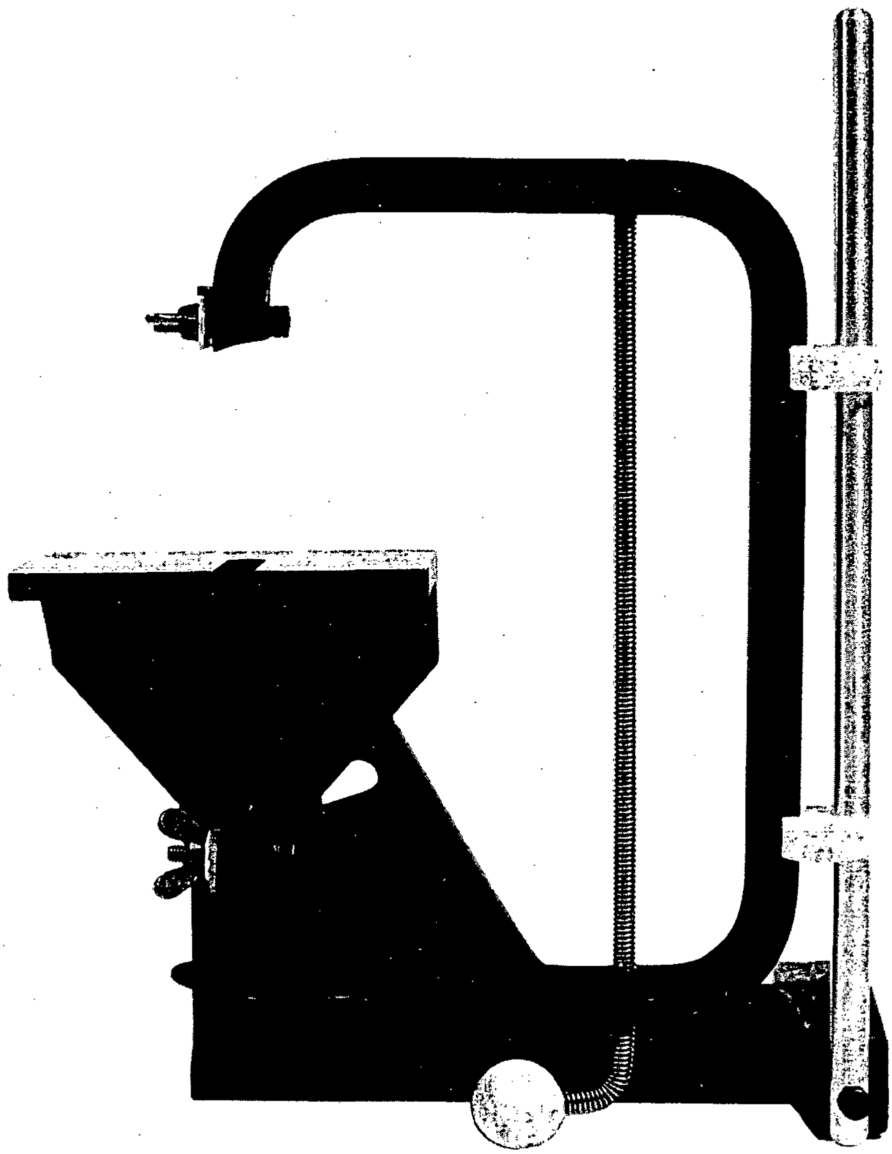

Figure 16: R.T. system piercing saw.

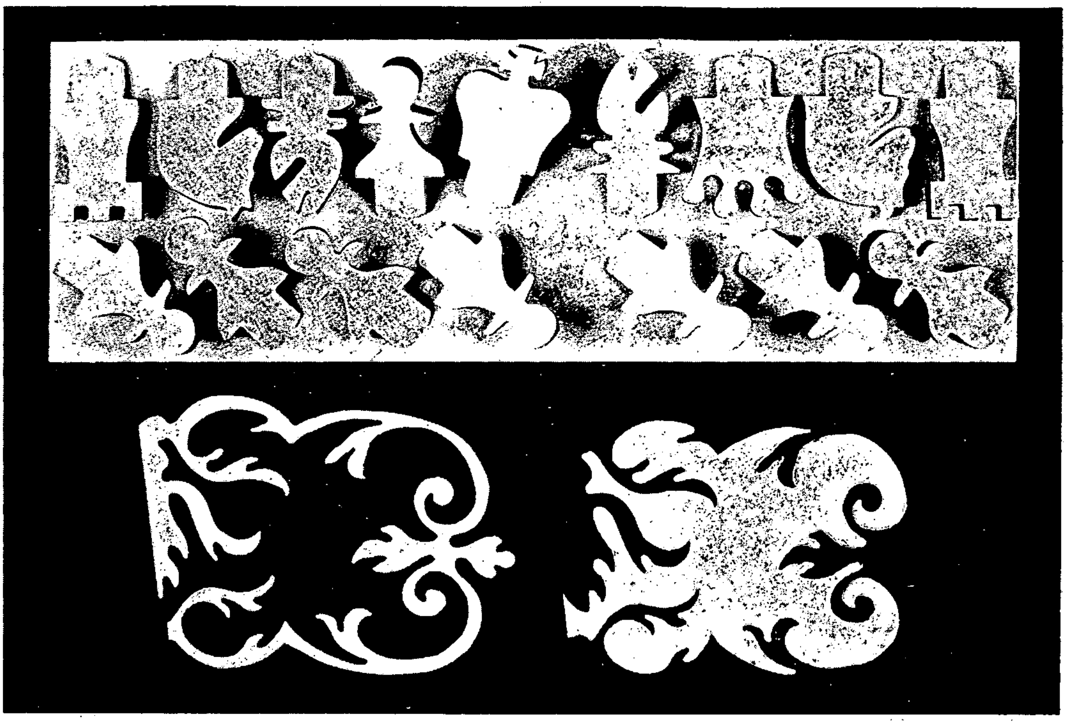

Figure 17: Paper and plastics sheet forms cut by the R.T. system.

Figure 18: The smallest piece blanked by the R.T. system.

It is possible to calculate the force required to blank out a given shape, to do this the shear strength of the material is multiplied by its thickness and then by the total length of the blank perimeter. Alternatively, multiply the cut length by the material thickness, both measured in millimetres, and divide by 24 for steel and 30 for brass to given a approximate value of the force required in tons. This information is quite meaningless, however, if the force of a press or hammer blow is not known. Therefore as a guide a No. 6 fly press will blank out approximately 380mm of cut length in 0.9mm brass sheet, the thinner or softer the material the greater the cut length, and the reverse for harder and thicker material.

DISCUSSION

It has been shown that with a very simple idea the possibility of multiple production by the individual craftsman has been substantially increased. Like any new idea, however, thought and experience are required before the full advantages of the technique can be appreciated. The R.T. Blanking System at worst may only help the craftsman by facilitating present production, but alternatively could open up new horizons for design far beyond the increased productivity of components currently being made by hand.

This report has dealt with the basic development of the process to date, but there are still many new ways of using and developing this blanking system, for although some types of basic tool design have been explained, no consideration has been given to multiple or progression tools which will soon suggest themselves to users and perhaps there is scope for tool construction that is not reliant on the hinge principle. Furthermore, there is the possibility of using this principle for metal forming instead of blanking by merely bending the punch so as to enter the die from the opposite face. This may have applications for recessing for enamels or forming up hollow shapes such as for lockets. Yet another area for development is in the use of stops and guides that can be incorporated into the tool which could be hinged so as to retract in the same way as the punch.

It is obvious that the possibilities for the use of this system for metal work are enormous, but it may not be immediately evident that the tooling can be employed for producing such things as contoured business cards, name or price tags, cut leather pouches or plastic ring boxes sticky labels, buttons and Christmas cards. In fact, anything which can be cut and formed from the flat sheet.

There is a general rule that it is not possible to blank out a section narrower than 1½ times the thickness of the metal from which it is blanked. However, this is not always so, for shown in Fig. 19 is a tiny tree blanked from 0.45mm thick 9 ct. gold with its narrowest point of 0.45mm wide. This respresents the smallest piece that has been blanked out to date using the R.T. System, which retains the character of what is portraying. If anyone can do better we would like to hear from them.

APPENDIX

Suppliers

Supply of R.T. System piercing saw and platen press:
Taylor Designs, 132 Abbotts Drive, North Wembley, Middlesex.
Tel: 341 9287

Ground Flat Stock:
Robert Samuel & Co., 7 Court Parade, East Lane, North Wembley, Middlesex.

Piercing Saw Blades (Barrel Brand):
Charles Cooper Ltd., Knights House, 23-27 Hatton Wall, Hatton Garden, London EC1.