Decorative Ironwork

Other publications available:

The blacksmith's craft
ISBN 1 869964 14 4

Blacksmith's manual illustrated
ISBN 1 869964 21 7

Metals for engineering craftsmen
ISBN 0 854070 27 3

Wrought ironwork
ISBN 0 854070 07 9

Catalogue of drawings for wrought ironwork
ISBN 0 854070 28 1

Catalogue of drawings – wrought ironwork gates
ISBN 1 869964 22 5

Catalogue of drawings – weathervanes
ISBN 1 869964 28 4

For publications please contact:
Countryside Agency Publications
PO Box 125, Wetherby, West Yorkshire LS23 7EP.
Tel: 0870 1206446
Fax: 0870 1206467
Website: www.countryside.gov.uk
Minicom: 0870 1207405 (for the hard of hearing)

Decorative Ironwork

some aspects of design and technique

First published 1962
Reprinted twice 1966
Reprinted 1969
Reprinted 1973
Reprinted 1978
Reprinted 1987

© Council for Small Industries in Rural Areas
ISBN 0 85407 012 5

Reprinted 2000

© The Countryside Agency
ISBN 0 86170 632 3
CA32

British Library CIP Data.
A catalogue record for this book is available from the British Library.

Cover photos © J. Stone/Countryside Agency

Published by the Countryside Agency, John Dower House, Crescent Place, Cheltenham, Gloucestershire GL50 3RA

Printed by Henry Ling Ltd, The Dorset Press, Dorchester
on recycled paper

04/00/tk

£12.00

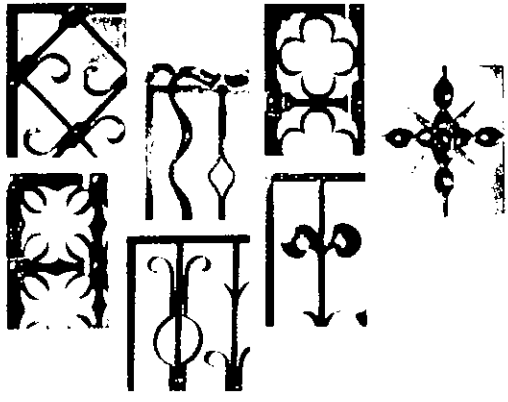
Contents

Decorative Ironwork - some aspects of design and technique

This is the third technical book on the subject of blacksmithing to be published by the Countryside Agency and its predecessor bodies. It has been carefully reproduced in its original format to retain the appeal of the original text, photographs and drawings that have for so long proved to be a valuable source of reference.

The information contained in this book is aimed at the specialist ironworker and will assist trainees to gain a better understanding of their craft.

The Countryside Agency offers a wide range of courses and related publications as part of its responsibility to develop rural skills that can enhance the environment and preserve the character and cultural heritage of the countryside. We run a rural forgework apprenticeship and short course programme covering more specific techniques. Courses are offered at different levels and include general smithing, scroll work, fitting and framework, power hammer work and tool making, lead block repoussé, gilding and decorative effects.



INTRODUCTION

This is the third manual on the subject of blacksmithing to be published by the Council for Small Industries in Rural Areas.

The first, *The Blacksmith's Craft*, dealing with basic and general smithing, was followed by *Wrought Ironwork*, a technical work in which the basic elements of the decorative side of the smith's craft were described.

In both these works great attention was paid to technical detail throughout the profusely illustrated texts. To a large degree they were complementary and were addressed to the novice as well as the more advanced smith.

This third volume has, however, been compiled more with the specialist ironworker in mind. Consequently, a number of operations included under the heading of standard practice have not been described in detail, as this would have proved unnecessarily tedious to the skilled smith, and would also have tended to divert the aim of the book.

The purpose of the authors was, broadly speaking, threefold.

First to introduce a number of methods of working iron not normally found in association with scroll work; methods in fact dissimilar to those commonly employed in this country since the early 18th century, but lending themselves more readily to designs akin in character to work executed prior to that period.

Secondly, to suggest to craftsmen by means of certain of these methods or techniques, that a return to a form of design in which

flat metal surfaces, rather than narrow edges, are more prominently displayed, might tend to produce ironwork better suited to some styles of modern architecture.

In relation to the latter point, it was felt that the style of modern continental Ironwork, in which similar technical methods have been exploited for some considerable time, would eventually be bound to influence patrons of the craft in this country. Until recently, designs copied or derived from the 18th century manner have been generally acceptable in Britain, but with the upsurge of continental travel the need for greater flexibility in ideas might arise.

This possibility materially affected the selection of techniques dealt with in this volume. They were chosen with the object of demonstrating to the craftsman and designer that quite a small number of 'moves' can yield a wider range of possibilities in design than might be expected. In this connection grilles Nos. 3 and 4 afforded an interesting example of identical methods producing, simply by the change in direction of a chisel cut, two designs similar in structural form but differing widely in ornamental effect. The inclusion of more examples of this kind was considered undesirable if the third aim of the book was to be achieved.

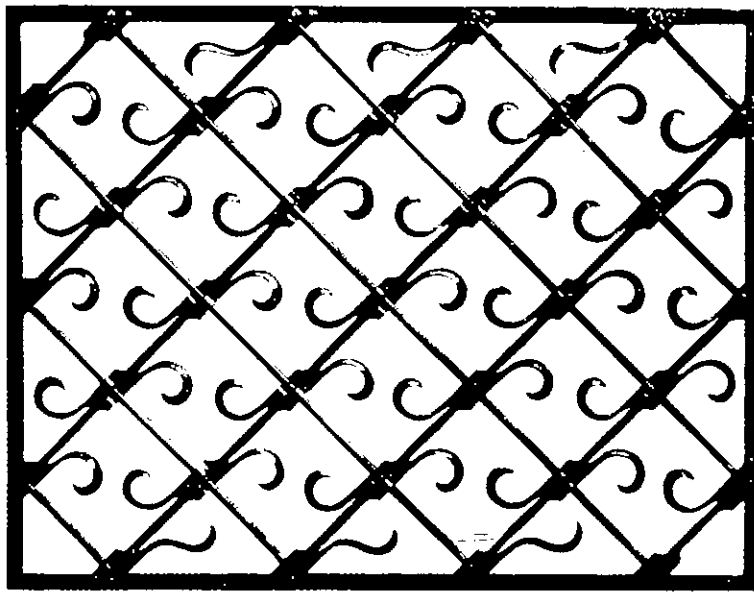
Thus, thirdly, it was hoped that the manner in which the technical material was presented would prompt those receptive of new ideas to enter the experimental field through the medium of design, and create for themselves.

The exploitation of a technique for its own sake alone is liable to give rise to departures from established practice merely to achieve novel or ingenious effects: such results are without merit and it is for the avoidance of this fatal error that the design factor is stressed here and at intervals throughout the text.

Though working drawings of each grille have been produced and are available to rural smiths, the grilles should not be regarded simply as catalogue designs, but rather as examples to be studied one in conjunction with another.

Before any attempt is made to use an individual text as a working recipe, the volume should be read, as Initially intended, from cover to cover. For good reasons certain details were dealt with at the ends of the chapters, while other material points mentioned in the text applying to one example may throw additional light on processes applicable to one or more of the other designs. Thus it was hoped that the reader would, by following the text consecutively, develop a mental picture of the subject as a whole, before becoming preoccupied with specific details.

The examples have been called 'grilles' for convenience and not because the repeating designs employed are suitable for the making of grilles only, or to suggest that the decorative features must necessarily fill any given framework. Several of the devices might well be used sparingly in large gates, for example, in the form of borders or panels, so long as the overall character of the work is maintained; in fact the techniques dealt with in this book can be applied over the whole field of decorative ironwork.



Design 1

A feature of this design Is the exploitation of contrasting bar sections. The use of rectangular section for one series of bars, and a round section for the other series, not only appeals to the eye, but also simplifies the making of the apertures in the flat bars through which the round bars pass.

The method employed eliminates the hot punching, drifting and dressing associated with intersecting bar work, and consequently saves time.

The lack of ability to fire weld is no handicap in the construction of this particular grille as the simple leaf forms are not made separately and attached, but are developed from the parent bar by methods which have, particularly since the 18th century, largely fallen into disuse in this country.

It will be appreciated that this design may be carried out in a wide range of bar.sizes. Because the use of the chisel gives rise to a limited amount of drawing of the metal, and since the length of slit required to form an eye of given size must be determined, definite bar sizes are quoted and dimensions given. These figures are used solely for the purpose of rendering technical principles clear, and apply to $1\frac{1}{2}'' \times \frac{1}{4}''$ and $\frac{1}{2}''$ round bar.

The frame size of this particular example is $3'\ 9'' \times 2'\ 10\frac{1}{2}''$ and is made from $1'' \times \frac{1}{2}''$ bar.

DESIGN 1

Fig 1 The flat bar is marked out with chisel and centre punch. The drawing, Fig. 16 on page 16, gives the measurements for setting out when using $1\frac{1}{2}'' \times \frac{1}{4}''$ bar.

This marking, besides being accurate must be sufficiently indented to be seen clearly when the metal has been heated for slitting and cutting operation.

Fig 2 A slit is cut in the hot metal with a chisel $\frac{13}{16}''$ wide, this being the slit necessary for the formation of an eye through which $\frac{1}{2}''$ round bar will pass.

A cutting plate, preferably of copper, is used to protect the chisel edge from the hardened anvil face.

Fig 3 Using a $\frac{1}{2}''$ top fuller in conjunction with 1" bottom swage, one half of the eye is formed.

A bottom swage of ample depth must be used if pinching-in the bottom of the tool and consequent malformation of the shape is to be avoided.

The bar is turned over and the other half eye is formed.

Assuming that no unnecessary violence has been used, it will be found in practice that no appreciable alteration occurs in the distance between centres, which in the present case is $7\frac{1}{2}''$, as shown in the diagram on page 16.

It is important to use a hand length of $\frac{1}{2}''$ round bar to check that eyes have been opened sufficiently to enable the longer round bars to pass through a series of eyes easily when the work is assembled.

Note: The setting of the eyes alternates. A scrutiny of the illustration of the finished grille will make this point clear.

Fig 4 A curved chisel is used to release the tip of the spur, and the straight cut is continued with a sharp hot-set.

It is here, in this operation, that a slight lengthening can occur. To minimise this effect, the hot-set must be thin and a good edge must be maintained.

From tip to butt the spur must be released progressively with well-controlled blows of a moderate weight.

In order that the natural chamfer made by the hot-set may appear

uniformly on the face side of the work, all cutting must be done from one side only.

From time to time work must be checked to ensure that the measurements between the centres of the eyes is uniform.

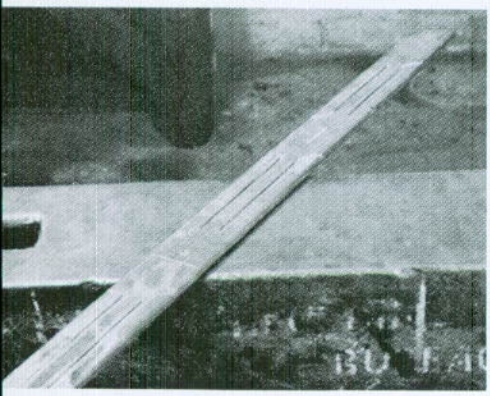


Fig. 1

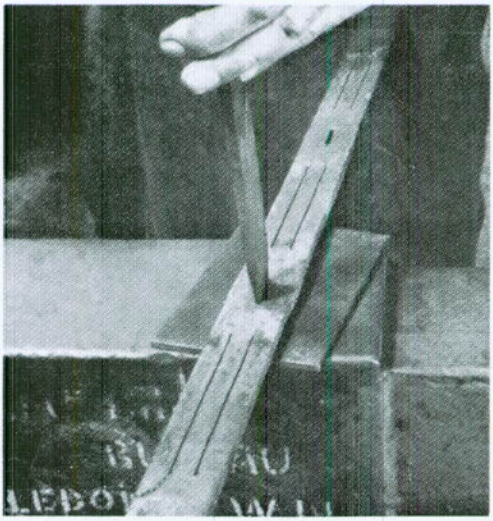


Fig. 2

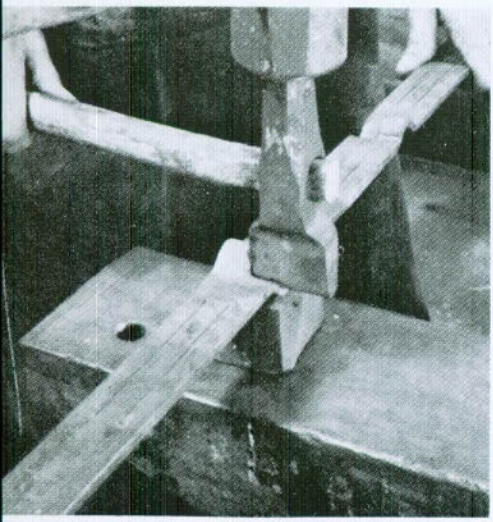


Fig. 3

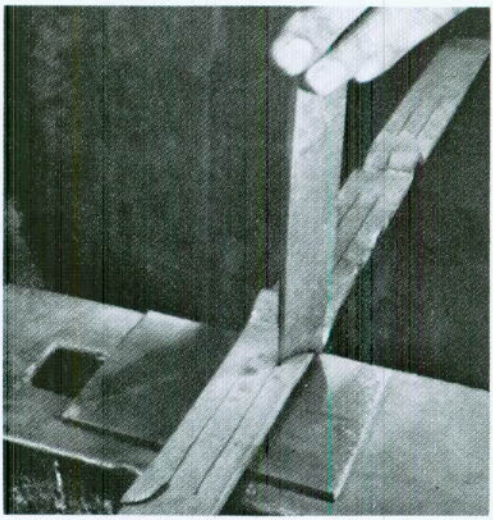


Fig. 4

DESIGN 1

Fig 5 The reason for the next step may not be obvious at this stage. It will suffice to state here that on it depends the correct formation and setting of the spurs. By carefully following the instructions for the succeeding operations the reason for this first step will become apparent.

The spur is given a short 90° twist bringing its outside edge uppermost in relation to the face side of the bar. In order to facilitate this operation the spur is first pulled out at a convenient angle.

Fig 6 The 90° short twist is made and this brings the curve of the spur tip into a position which assists when further curving the feature as forging proceeds.

The bar is gripped in the vice with the eye inserted a short distance within the jaws. This ensures stability and prevents distortion.

Fig 7 Using a curved faced hammer the twist is dressed to blend with an even flow into the main bar. If necessary the heat should be localised by controlled quenching to avoid distortion occurring either in the eye or the centre stem.

Fig 8 The twisted root of the spur is dressed on two sides roughly at right angles to one another in order to produce a uniform section. As it is clearly impossible to continue on the anvil bick, a stake with an acute angled flat is brought into use.

Fig 9 The spur is now curved over the bick, care being taken to avoid continuing this operation too far, as further curving takes place naturally during the stages to follow.

It is also convenient at this point to refine the shape of the spur tip a little, bearing in mind that a few light blows will suffice, as any tendency to depart from the leaf form is out of place in this design.

Fig 10 With the spur resting flat on the anvil both edges are hammer chamfered. A curved faced hammer is used for treating the inner

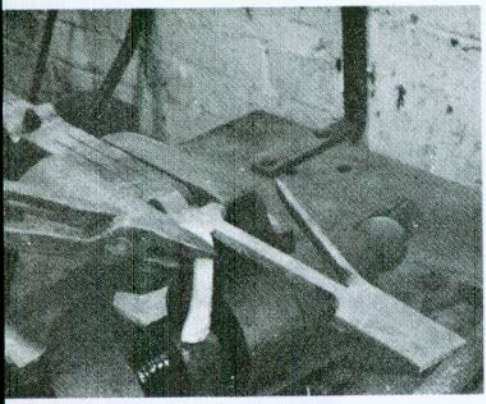


Fig. 5

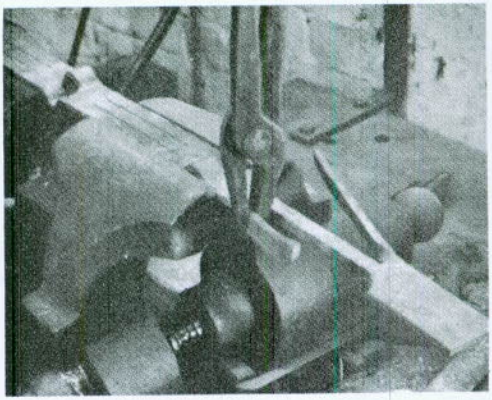


Fig. 6

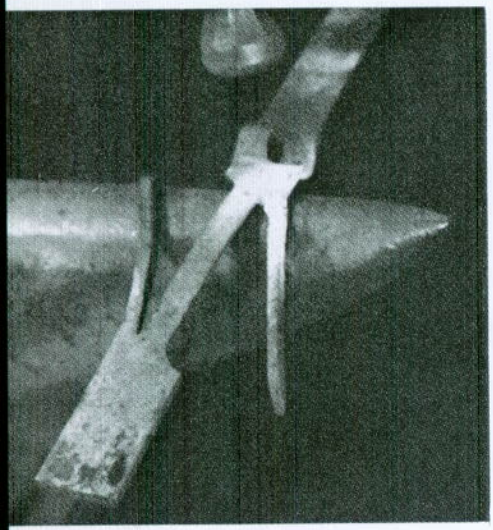


Fig. 7

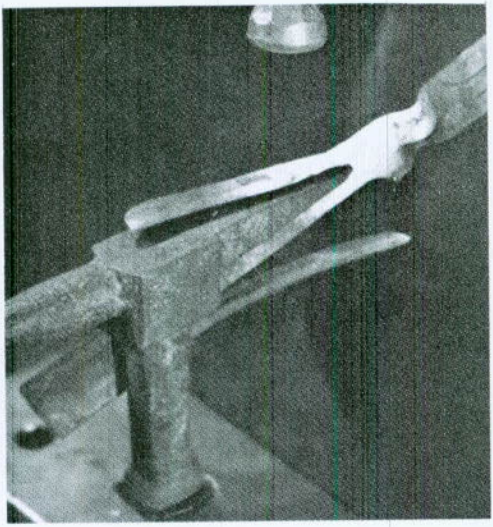


Fig. 8

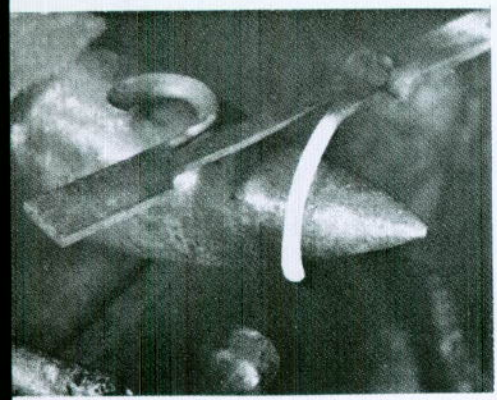


Fig. 9

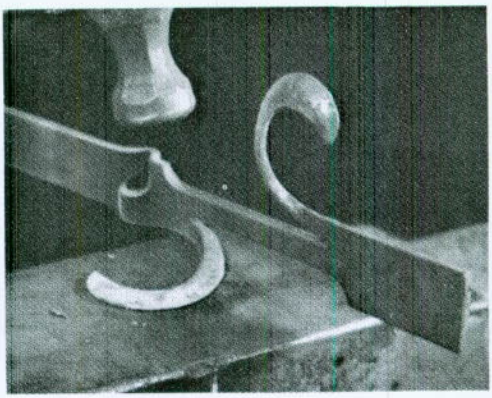


Fig. 10

DESIGN 1

edge and a flat faced hammer for the outer, and the transformation from the spur into the leaf form develops.

Fig 11 The leaf form is still lying in a place at right angles to the face of the bar.

At this stage, however, the axis of the leaf is canted by resting the inside edge on the bick. The outside edge is therefore raised a little and is hammered down on to the bick with light coaxing blows, great care being exercised to avoid solid blows which would thin the metal and tend to distort the emerging shape.

This action is used progressively from tip to butt, the work being moved round the bick as shaping proceeds.

During this operation the leaf begins to revert to its original plane, moving back through the 90° setting described in Fig 5.

Fig 12 Additional work is still required to bring the leaf right back into a plane true with the parent bar.

This is done by gripping the top edge of the leaf with the round-nosed pliers at a point where leverage applied in a downward direction will bring the leaf into its correct setting.

This motion achieves two objects. First the leaf is set in its correct plane, and, secondly, the top edge is correctly canted and blended with a smooth sweep into the parent bar to complete the flow of the whole form.

Fig 13 After a pair of leaves has been forged they are given the customary inspection and any small adjustment is made. Nothing more than a light tap here and there with the hand hammer will usually be necessary.

Figs 14 and 15 Assuming that the frame has been made to the required dimensions, and all the decorative bars have been forged, work preparatory to assembly begins.

Using the full size working drawing for guidance, the forged bars are placed accurately on the frame and round bars are temporarily passed through the eyes to check alignment. The cutting-off points are marked at the correct angles on the flat bars where junction is made with the frame.

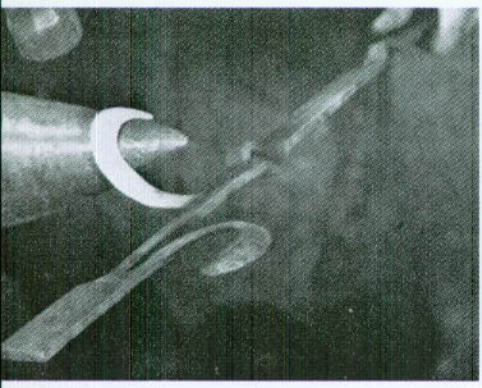


Fig. 11

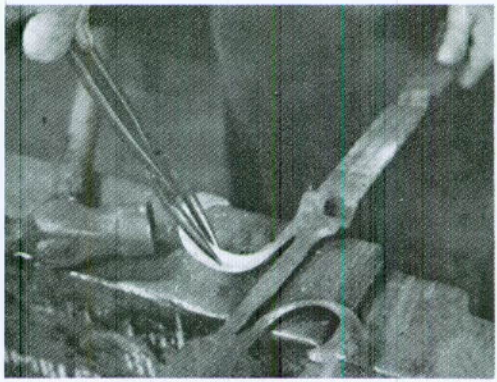


Fig. 12

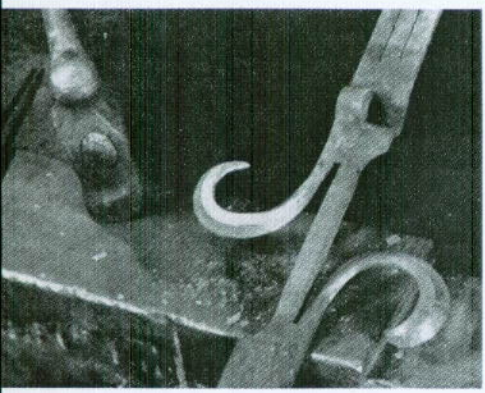


Fig. 13

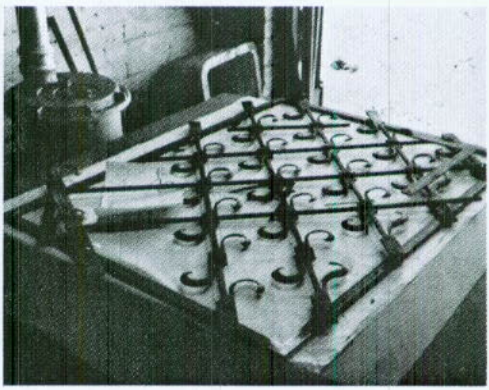


Fig. 14

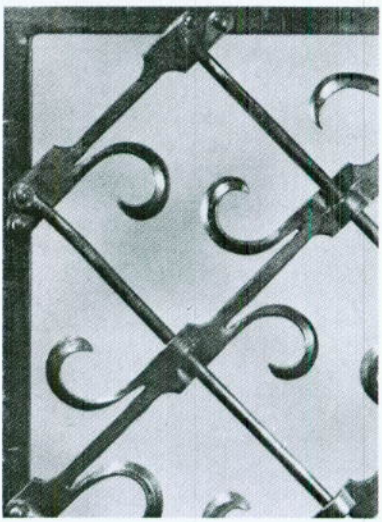


Fig. 15

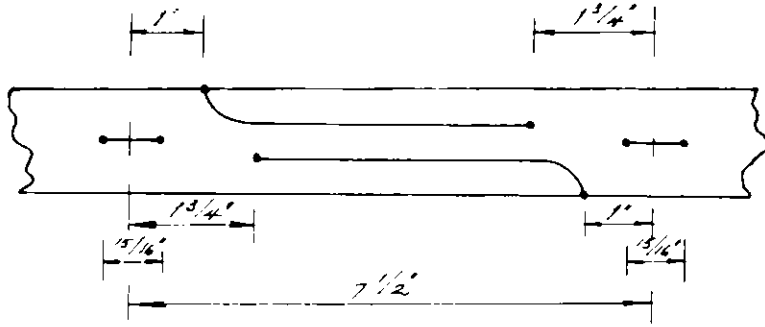


Fig. 16 Marking out diagram

After cutting to length the ends are shaped and hammer chamfered.

The positions of rivet holes are now marked and clearance holes drilled.

The bars are reassembled on the frame over the working drawing, and the rivet holes are scribered through on to the frame. These holes are now drilled and slightly countersunk at the back.

The bars are fixed into position temporarily with bolts and nuts which are replaced eventually by rivets.

For ease of working, the round bars which have forged bosses drilled for riveting at either end, are each made in two sections and oxy-acetylene welded together when in place. The butt joints must be arranged to fall in convenient positions between the decorative bars.

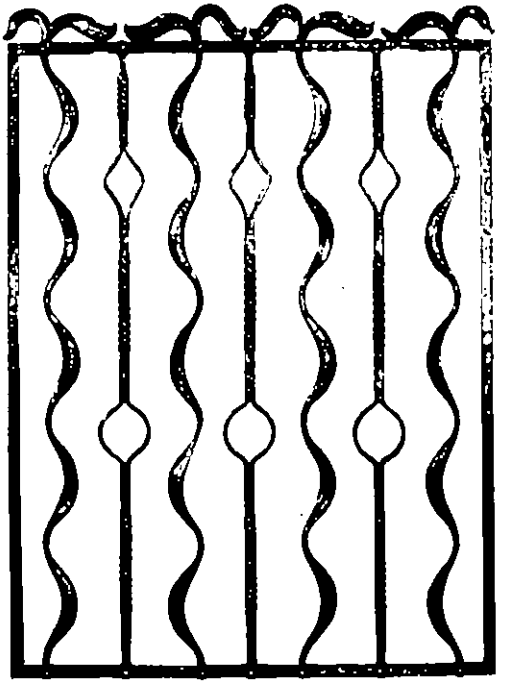
Where the bars of the grille abut the frame, a number of half squares occur naturally. They do not afford sufficient space to accommodate the leaf motif in the form used in the complete squares. Consequently a leaf of a different shape was designed to fill these triangular spaces. These leaf forms were produced from spurs released from the bar in the same manner as the main leaf motif, and were worked in a similar way, but were shaped to suit the proportions of the space to be filled.

To ensure the full effect of this design reasonably precise adherence to the full size working drawing must be maintained: nevertheless work should be freely forged and the direct character of the hammer work should not be spoiled by unnecessary fettling.

When assembling it may be found helpful to use a round file for easing the sides of the eyes through which the straight ½" round bars pass, should adjustment of alignment be necessary.

As one of the fixing holes in each of the flat bar-ends is also used for the fixing point of a round bar, the ends of the latter are set and cranked so that their rivet holes, when drilled, will be central in the bosses and coincide with the appropriate holes.

If it is desired to use this design for a gate, the complete grille could be housed within another frame made in the usual manner for gates, carrying the appropriate fittings. This would become a shadow surround, the grille being secured by countersunk screws.



Design 2

The design of this example deviates from the orthodox in the way that the decorative features are evolved from the structural bars of the grille and are not additions in the form of branch welded or collared scrollwork.

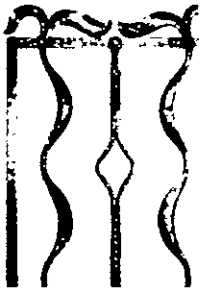
Such scrollwork and other applied ornamental devices have been used for generations to form panels and borders within vertical and horizontal straight bars. In earlier times, however, the splitting of sections of metal was employed to a greater extent than has been practised since the 18th century, to relieve, or partially release from parent bars, portions which were fashioned into decorative features or points of attachment.

In the present example this technique has been employed in the fashioning of the intermediate bars to achieve a decorative effect without resorting to the use of applied embellishments.

Splitting is also exploited in the branching leaves of the freely forged cresting.

The wavy bars, built up from forged shapes fire welded together, also embody their own decorative elements within the bar without recourse to the addition of supplementary motifs.

To achieve the strongest visual effect the frame is constructed with the broad faces of the bars outwards and the internal bars are secured by means of rivets, which, in themselves, contribute something of value to the general effect of the design.



DESIGN 2

The split-forms in the alternate bars are not equally spaced. The intervals between them are carefully proportioned to give life to the design and avoid a feeling of heaviness.

To give a play of light and shade the concave curved sections of the wavy bars alternate both horizontally and vertically.

Where dimensions occur in the text they refer specifically to the example illustrated, the frame of which is made of $\frac{3}{4}'' \times \frac{1}{2}''$ bar and measures 3′ 3″ × 2′ 7″. These dimensions would, however, be adequate for larger areas, though enlargement would tend to lighten the general effect. This would not necessarily be a disadvantage.

A scale drawing should always be made to confirm the suitability of the proportions of the proposed design for any given site.

Fig 17 Assuming that a start is made on the split features, a bar, in this instance $\frac{5}{8}''$ square and long enough for making a complete upright to the dimensions given in the working drawing, is cut off.

After marking out the bar is cut with a hot-set almost right through to its other side to the required length.

The work is turned over and the split is completed. It is advisable to radius very slightly the corners of the hot-set blade.

Fig 18 The split is opened a little with the hot-set to allow an elongated drift to be inserted. A bolster is used to avoid damaging the edge of the hot-set on the anvil face.

Fig 19 The split is now ready to accept an elongated drift.

Fig 20 The drift and deep bolster with which the next stage of the work is done. See drawings, Figs 46 and 47, page 29.

Fig 21 The work is reheated and the drift is driven into the split but not to its full extent.

Fig 22 Both faces of the bar are trued with the hand hammer. After dressing one face the work is turned over and the other face is treated.

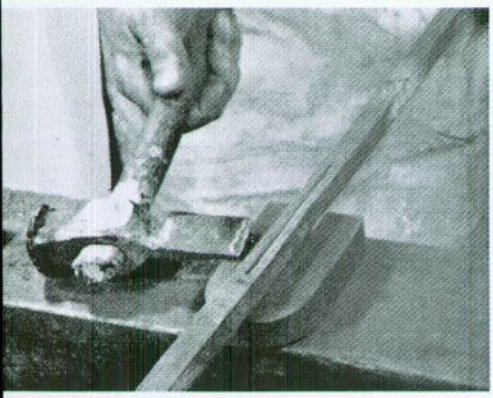


Fig. 17

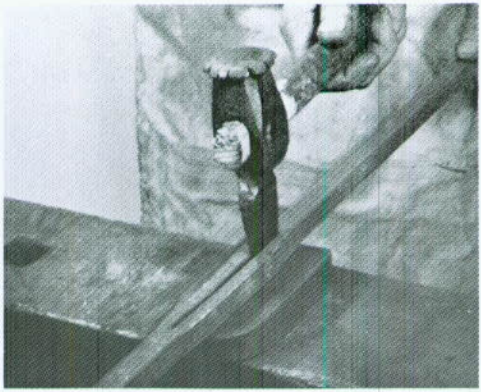


Fig. 18

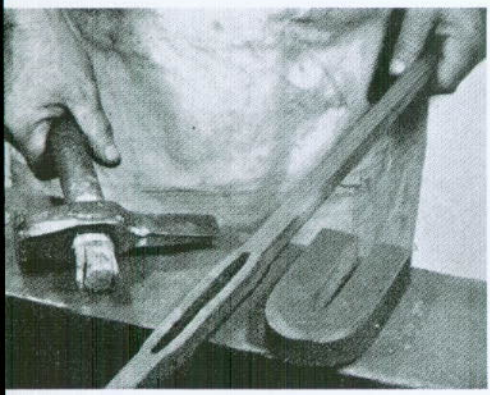


Fig. 19

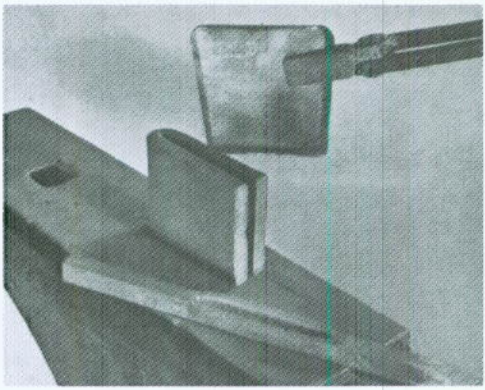


Fig. 20

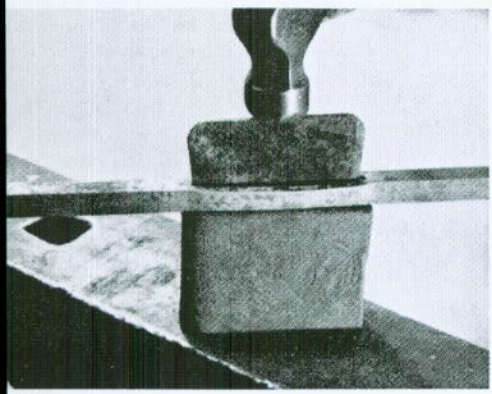


Fig. 21

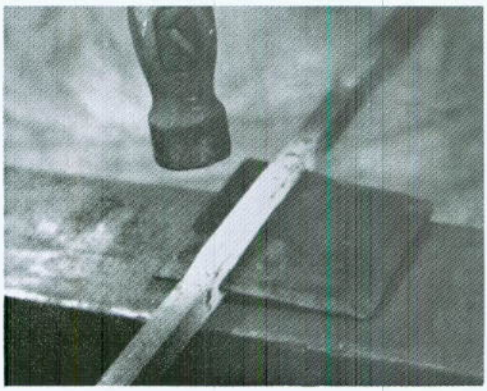
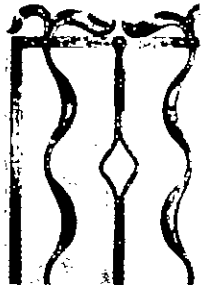


Fig. 22



DESIGN 2

Fig 23 The drift is now driven home to its full extent and the truing process is completed.

Fig 24 To make the diamond shape the split is opened in the middle as a lead-in to the next operation.

Fig 25 Another heat is taken and the bar is hammered up from one end to widen out the naturally formed diamond shape to the required extent. The effect of the blows should be controlled by turning the work over occasionally. If this point is neglected serious distortion may develop and the freshness of the work may be lost in course of adjustment.

Fig 26 The shape of the diamond feature is now finished on the anvil bick to conform with the contours of the full size working drawing. A delicate touch with the hammer is called for here.

Fig 27 To make the circular opening, the initial splitting and dressing is carried out as before; but the first stage in the actual opening of the feature differs.

In this case both ends and the centre of the split are widened by the insertion of the hot-set. This operation predisposes the split to assume its final ring-out form.

Fig 28 After reheating, the bar is hammered-up from one end and the process started in the previous operation is further developed and the split nears its final form.

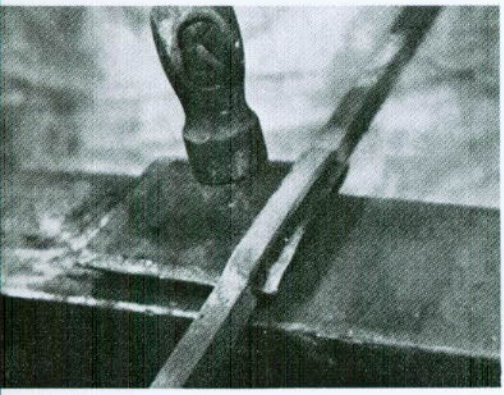


Fig. 23

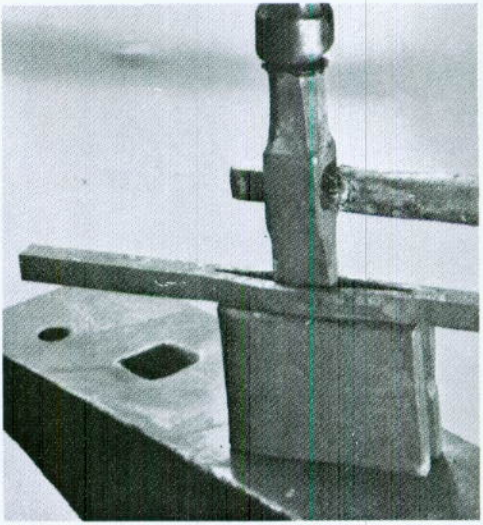


Fig. 24

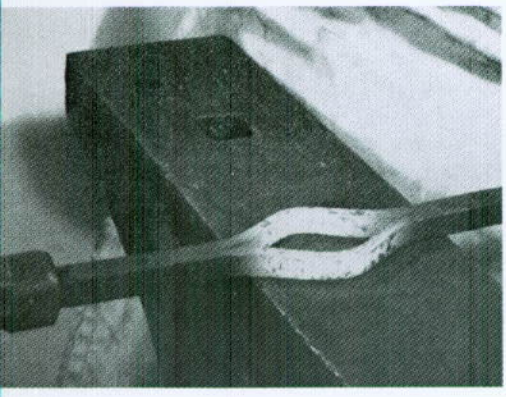


Fig. 25

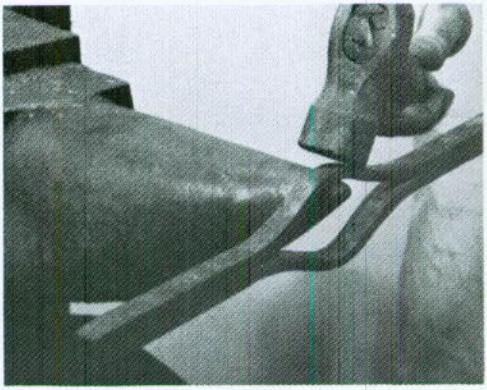


Fig. 26

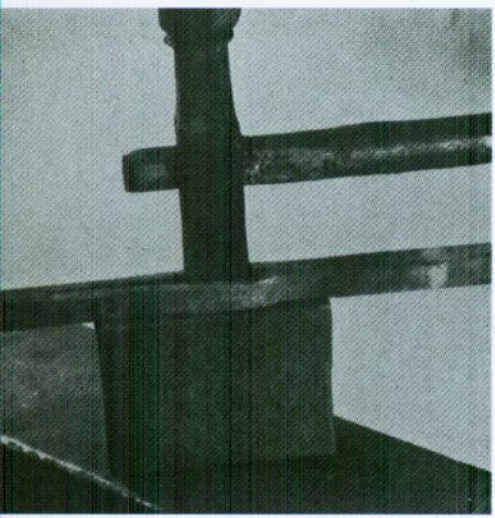


Fig. 27

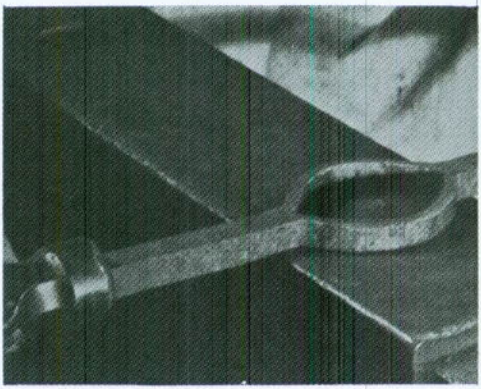
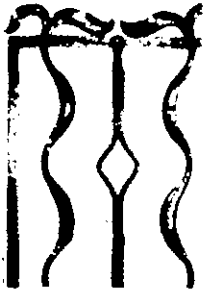


Fig. 28



DESIGN 2

Fig 29 The ring feature is now fully opened across the anvil bick by hammering on each end in turn after heating and reheating.

The shape is finally adjusted to conform with the working drawing.

Fig 30 The twisted sections forming part of the embellishment of these bars are now prepared.

The length of the section to be twisted is marked with centre dots.

Top and bottom $\frac{3}{8}$″ rope tools are used to indent and round the bar in such a manner as to convert the square section into a quatrefoil section; thus an assembly of four $\frac{5}{16}$″ round rods is simulated.

Fig 31 An increase in length occurs during the operation described in Fig 30, owing to the drawing effect of what is virtually a swaging action.

The prepared section is twisted at a moderate, even, red heat (see page 46, Fig K of *Wrought Ironwork**) and this process restores it to approximately the original length.

Fig 32 **Care is taken throughout to ensure that the twist ends precisely** at its junction with the plain square section of the bar.

Fig 33 The successful forging of the wavy bars calls for a dishing block, a special tool in the form of a simple die (see drawing, Fig 48, on page 30). The shape of the die is obtained from the working drawing, but to furnish a better idea of what is required a full-scale plasticine model of one of the dished and curved shapes is useful. The impression in the tool is sunk by means of suitable fullers with the mild steel block at a bright heat. A forging is made from $\frac{3}{4}$″ × $\frac{3}{8}$″ bar, the ends of which have been reduced and rounded leaving a centre swelling. This is the opening move in the production of one of the component shapes and it is here that the smith's judgement, as well as measurements, must play an essential part. The forging is left at this stage and retained

* CoSIRA Publication No. 55.

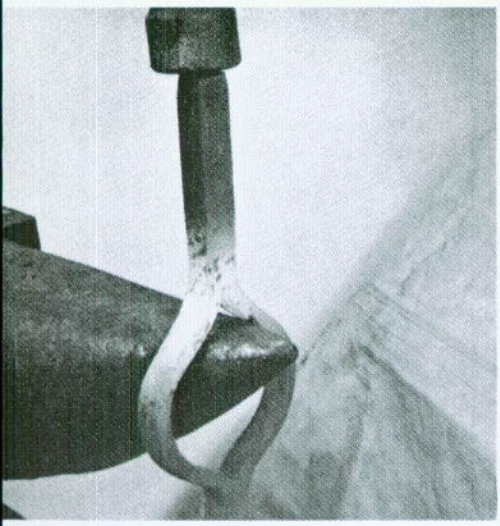


Fig. 29

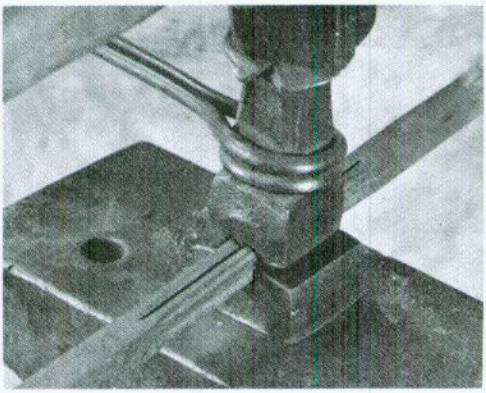


Fig. 30

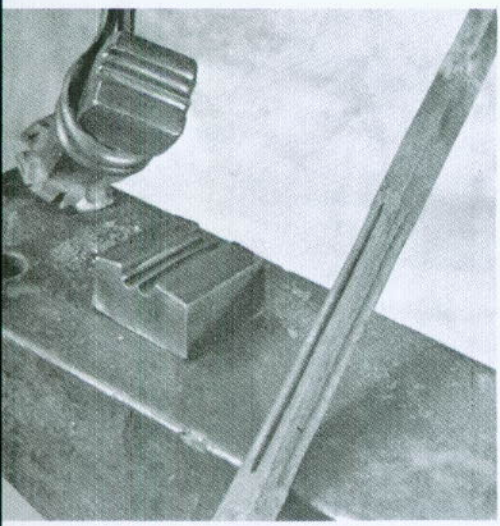


Fig. 31

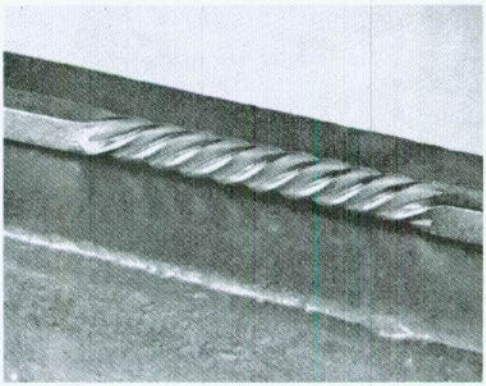
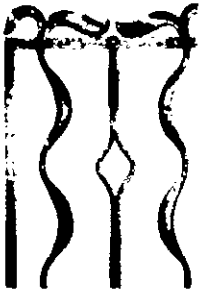


Fig. 32

Fig. 33



DESIGN 2

as a guide. Its value as a final pattern will be checked by the operations which follow in Figs 34 to 39, and in any of these succeeding stages the need for adjustment may be revealed. A handling length of $\frac{3}{4}$" :. $\frac{3}{8}$" bar is taken and, working to this trial pattern, the first stage is forged: it is, however, not severed from the stock bar.

Fig 34 Using anvil horns and scroll wrench the curve is now put in to conform with the impression in the tool.

Figs 35 and 36 The rectangular section of the blank is transformed into a shallow half-rounded section, first by shaping the outer edge with the normal hand hammer, followed by similar shaping on the inner edge, but this time with the curved faced hammer.

Fig 37 With the flat side uppermost the work is now dished in the tool. Suitable fullers are applied progressively round the curve, the smith's mate striking with moderate blows to avoid undesirable thinning occurring as the form is worked into the cavity.

Fig 38 **The plane of the forging is trued. The outer edge will make contact with the anvil face leaving the inner edge raised naturally.**

Fig 39 A chalk tracing of the appropriate portion of the working drawing is prepared on a steel sheet (see *Wrought Ironwork*, pages 12 and 13, Figs 12 to 15*) and the work is now set to follow the lines of this drawing.

The freshly forged piece is cut from the bar and work continues on the making of the requisite number for welding up into a decorative bar.

* CoSIRA Publication No. 55.

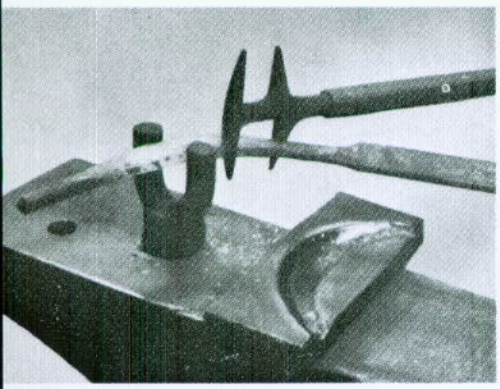


Fig. 34

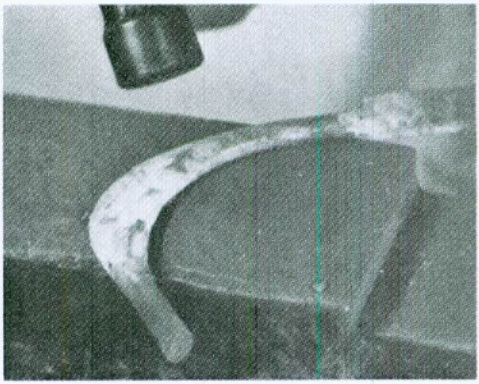


Fig. 35

Fig. 36

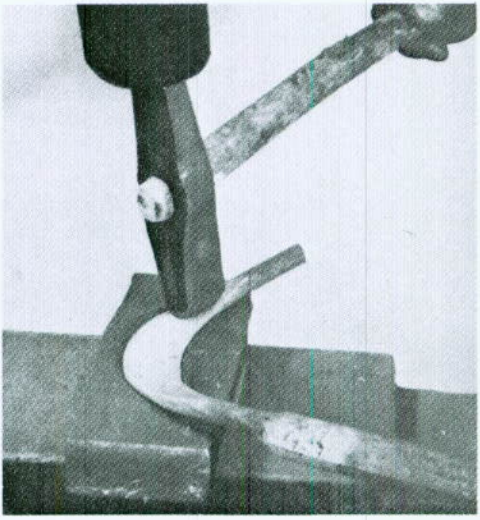


Fig. 37

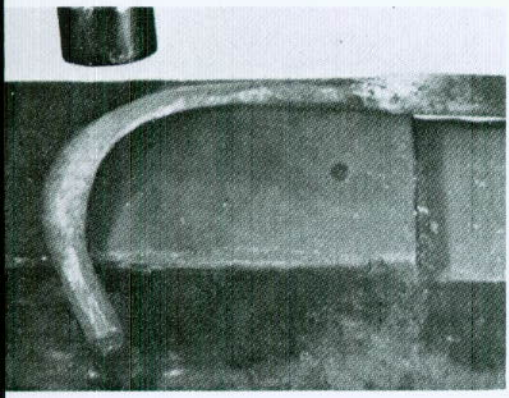


Fig. 38

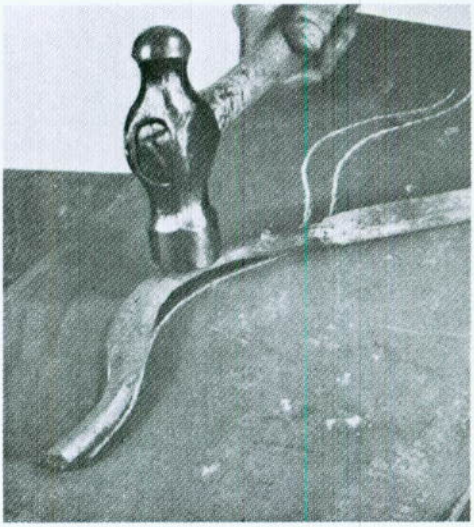
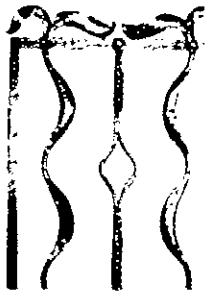


Fig. 39



DESIGN 2

Fig 40 The forged shapes are fire-welded together with convex and concave sides alternating. In the example shown the welding process was arrested in order to show the position of the scarfs. Normally this weld is completed in one heat and dressed to the correct round section.

As each weld is finished the work is checked against the chalk tracing and set as required.

Fig 41 The pairs of branching leaves forming the cresting are forged, in the present instance, from 1¼" × $\frac{5}{16}$" bar.

A heating length of the bar is split to the required depth. The cut is made off centre to produce lobes of unequal size, to conform with the design.

Fig 42 Immediately in wake of the split the bar is reduced by the use of a cheese fuller with the work positioned on the anvil bick.

Fig 43 The leaf forms are fashioned by short pointing the lobes and curving the points on the tip of the anvil bick.

Fig 44 The leaves are hammer-chamfered on all face side edges. This process, besides providing the desired surface texture, also spreads and shapes the leaves to conform with the design.

Too great an insistence on precision should be avoided here, as the leaves are freely forged and undue dressing or smoothing of the surfaces will destroy their character. A rivet hole is punched in readiness for fixing the bar on to the frame. The branching leaves are severed from the handling length leaving a shank long enough to fire-weld on to the top end of a wavy bar.

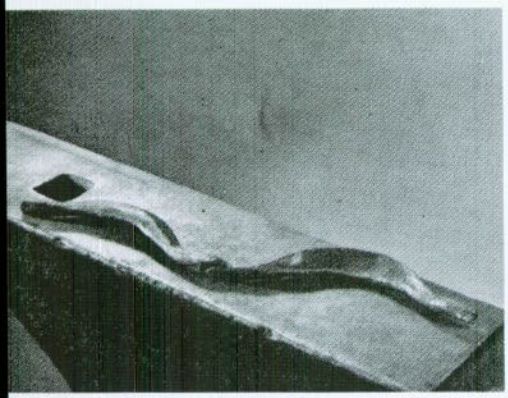


Fig. 40

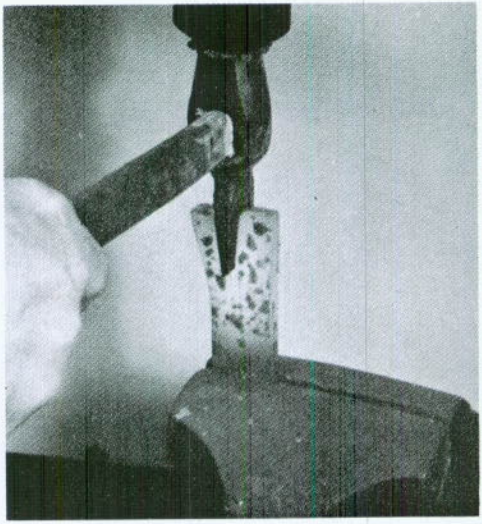


Fig. 41

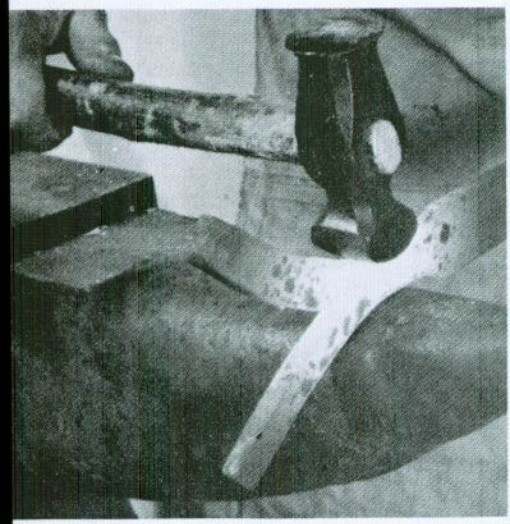


Fig. 42

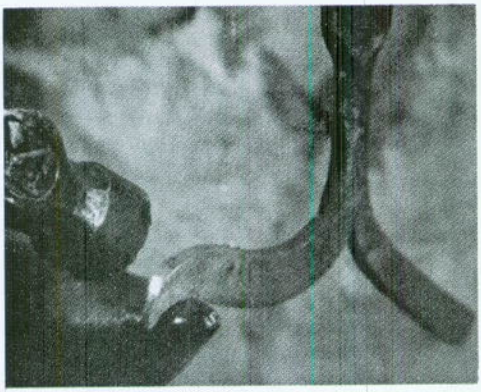


Fig. 43

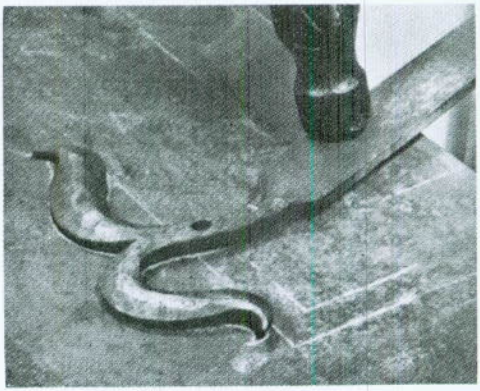
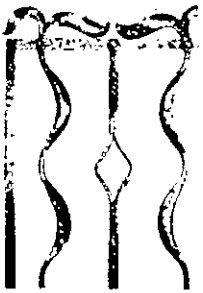


Fig. 44



DESIGN 2

Fig 45

All decorative bars are riveted to the frame. The top rivet holes of the wavy bars have been mentioned, leaving the bottom holes and both rivet holes in the other type of bar to be dealt with.

In the case of the lower holes in the wavy bars, a swelled eye was produced at the end of the bar by slot punching and drifting to the appropriate size. The holes in the other bars are made differently. First the ends of the bars are rounded laterally. After the bar end is heated, a round punch with a $\frac{7}{8}''$ diameter flat face is positioned on the end of it. The punch is dealt a heavy blow by the smith's mate using a sledge hammer, and produces a flat round boss stepped-in from the face side of the bar, with an area and section of sufficient strength to permit the drilling of a rivet hole. If it is desired, distinction may be added to the riveting boss by a slight and graceful reduction of the square bar immediately adjacent to the boss. This refinement should, of course, be made over the anvil bick with the curved faced hammer before the boss is formed. Both operations described cause the bar to lengthen a little, consequently a reduction must be made prior to cutting away surplus bar at each end.

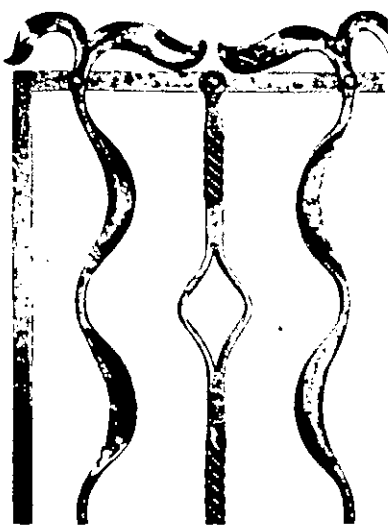


Fig. 45

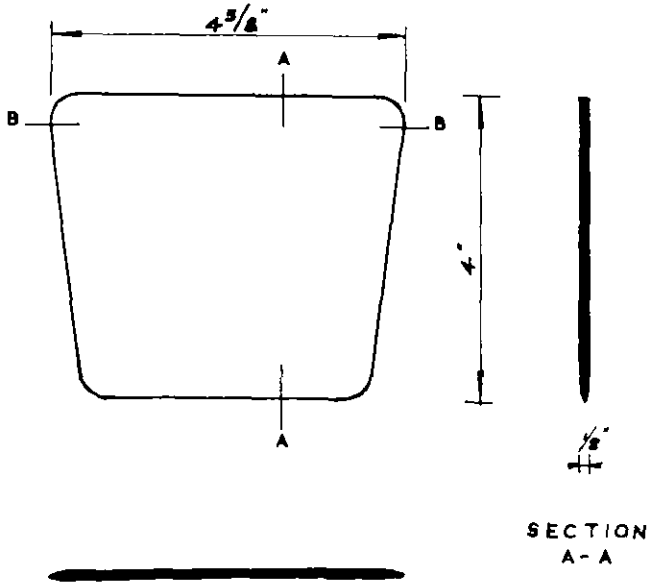


Fig. 46 Elongated drift

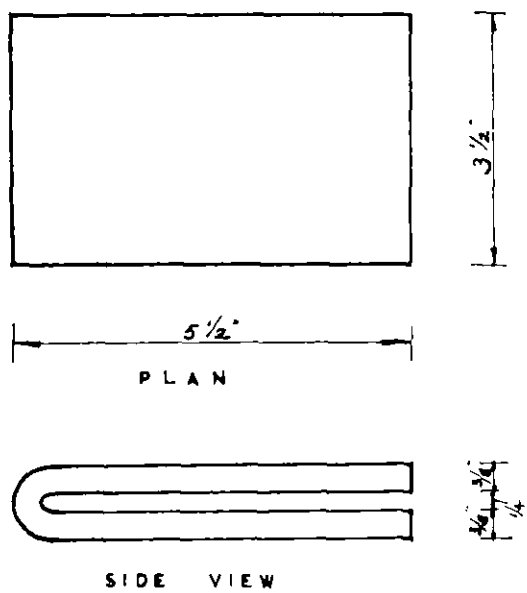


Fig. 47 Deep bolster

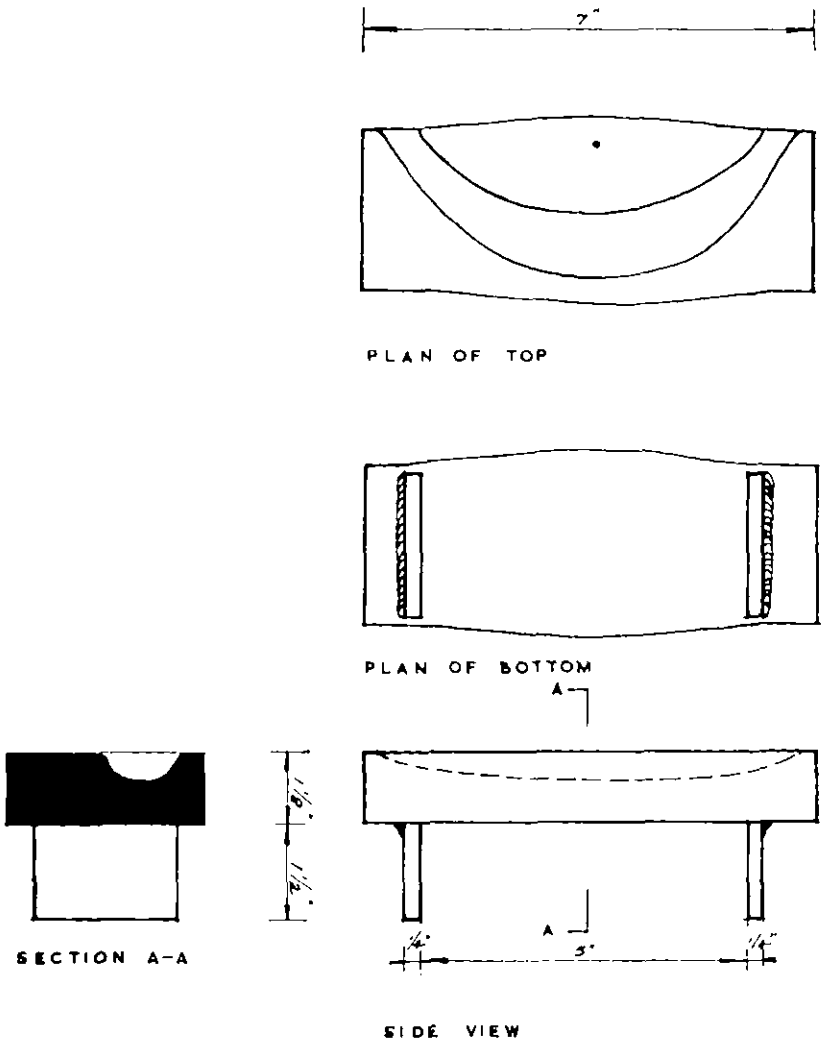
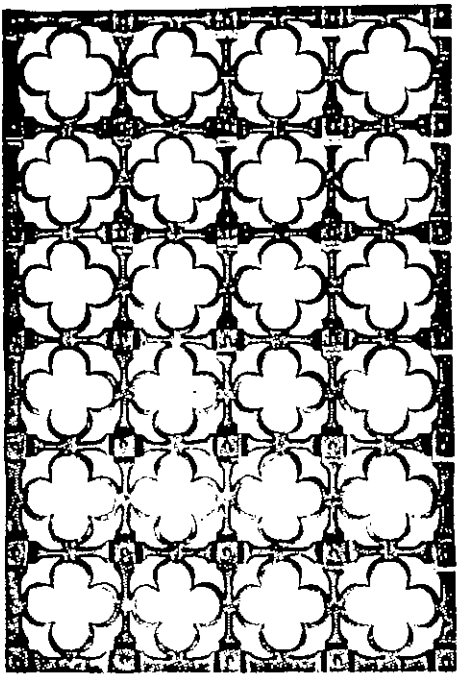


Fig. 48 Dishing block



Design 3

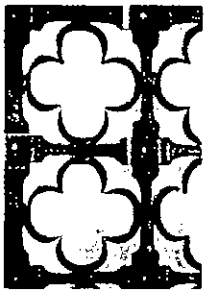
This is an example of the time-honoured quatrefoil theme but one in which the decorative elements are formed almost entirely by means of a splitting technique.

Curved spurs, relieved from the bars by chiselling, form sections of each quatrefoil, leaving the parent bars with modified contours which play a part in the decorative whole at the points of intersection.

The outer frame is of interest because it contributes to the completion of the pattern and thus performs rather more than the usual structural function.

Ironwork in which this type of construction has been used does not entirely rely for its appeal on flow of line, and a silhouette effect. The surface of the metal acquires an attractive textural quality during forging, while chamfered edges, offset sections and rivet heads break up the play of light over the surface of the work and enhance the general effect.

The dimensions of this grille are 2′ 4½″ × 1′ 7½″.



DESIGN 3

Fig 49 The pair of tools illustrated are used for offsetting the 1″ × ¼″ bars at the intersecting points and junctions with the frame.

The guide pegs of the tool have been set at a distance which will just allow the bar to be moved freely through the tool without binding.

The bars are marked out in this instance at 4½″ centres and accurate positioning in the tool is ensured by aligning each centre as work proceeds with punch marks indicating the centre line of the bottom tool.

Fig 50 At a bright red heat the bar is positioned between the top and bottom tools and two or three light blows are sufficient to seat the heated metal in the bed of the bottom tool.

Excessive hammering must be avoided as this will lengthen the distance between centres, whereas these distances will remain unchanged if moderate controlled blows are used.

Fig 51 When marking out the section of bar from which the spurs are released it is essential to remember that all the natural chamfering left by the chisel cuts must be seen on one side of the work only, the face side.

It follows that the horizontal and vertical bars are not marked out on the same side, since the offsets are somewhat akin to halvings. Assuming that the horizontal bars are marked out with the impressed offset sections in a downward position, the vertical bars must then be marked out on the opposite side, that is, with the impressed offsets in a raised position. (See this figure and *Design*, 4, Fig 67, page 44.)

The scheme of marking out is dictated by the fact that adequate sections of metal must be relieved from the bar in order to form the tapered quatrefoil sections but yet, at the same time, sufficient substance must be left in the parent bar to satisfy both structural and visual requirements.

The width of the bar is divided equally into three and the marking completed as shown in Fig 60 preparatory to hot chiselling. The essential points which determine the chiselling positions are marked with a centre punch. Two specially forged chisels are needed, one of each hand. (See drawing, Fig 62, page 39.)

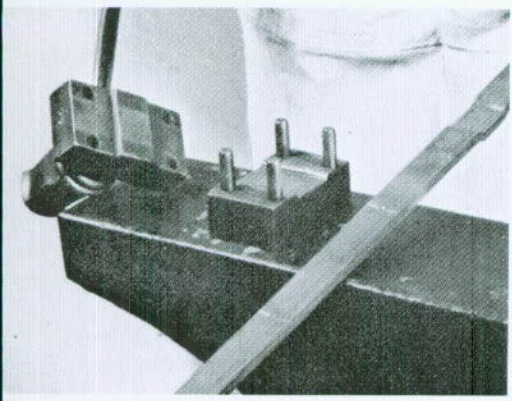


Fig. 49

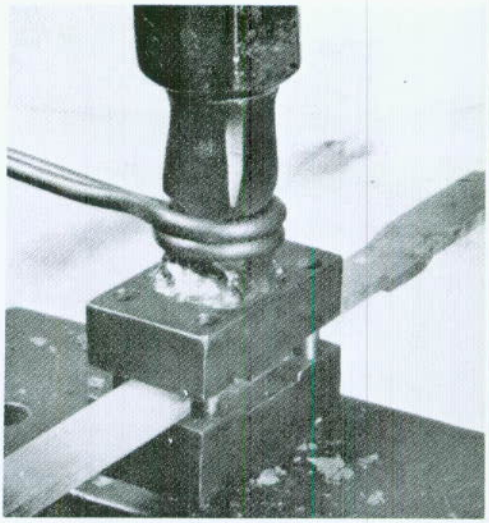


Fig. 50

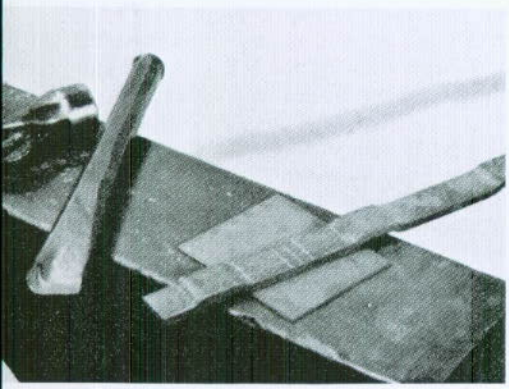


Fig. 51

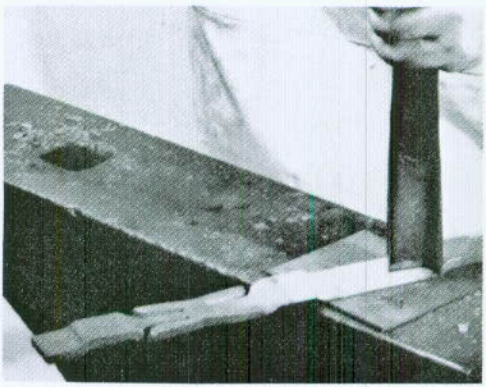


Fig. 52

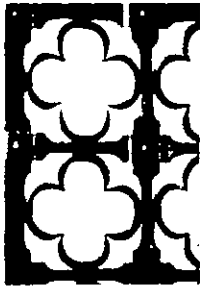
Fig 52 The cut is made right through the hot metal from the face side only.

The cutting edge of the chisel is of the precise length and of the correct shape for the cut required. It must therefore be placed accurately and struck decisively. There is no room for fumbling.

A vessel containing water, in which the chisel may be cooled at intervals, must be within convenient reach.

A copper or soft iron plate must be used under the work to protect the edge of the tool from the anvil face.

A very slight lengthening of the parent bar takes place during this hot splitting process, which collectively affects the overall length of any given bar. The amount of lengthening can only be determined by making a short trial section.



DESIGN 3

Fig 53 At a red heat the work is engaged between anvil horns of the correct size (see drawing, Fig 63, page 39), and with the round-nosed pliers the spurs are moved away from the parent bar.

Fig 54 Using a stake (see drawing, Fig 64, page 40) specially designed to enable a number of operations to be done within a small compass, and a 'fuller' ended hammer (see drawing, Fig 65, page 41), a spur is drawn out to form part of the crescent shape which, with its pair, makes one quarter of a quatrefoil. When the smith's hand is lower than the part being forged, an old woollen glove is worn to ward off hot scale.

Since the section of the spur is not, at this juncture, square, and since the bevel left by the chisel must coincide with the face of the special stake during forging, distortion of the spur is inevitable.

Fig 55 If the work is viewed edgeways any distortion is readily seen and it must be dealt with in the course of forging.

Fig 56 The first stage in correcting distortion is carried out on the mandrel section of the special stake using the same hammer, the other end of which has been forged and ground to a flat square face.

The work is tilted at an angle and with well controlled blows the high edge of the spur, thrown into prominence in this position, is forged down from tip to root. By this means the spur is given the desired square section.

Fig 57 The spur—one only is dealt with at a time—is brought back into a plane true with the parent bar and its surface is levelled in one and the same operation. This work is done on the anvil-like surface of the multiple tool and, as in the three preceding operations, the length of the spur is increased.

When the forging of a pair of spurs has reached this point, a full quarter of a quatrefoil has been formed, and the tips should be long enough to connect with their neighbours when the grille is assembled.

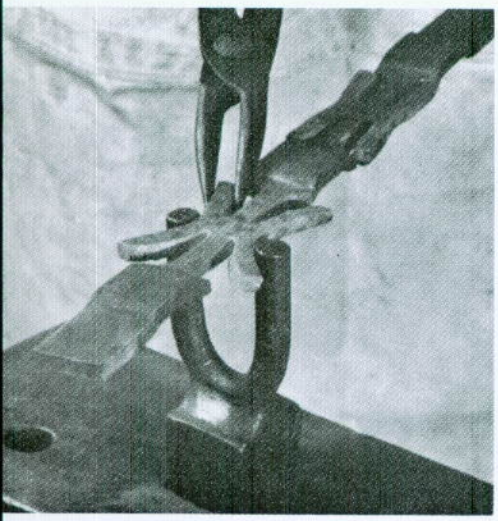


Fig. 53

Fig. 54

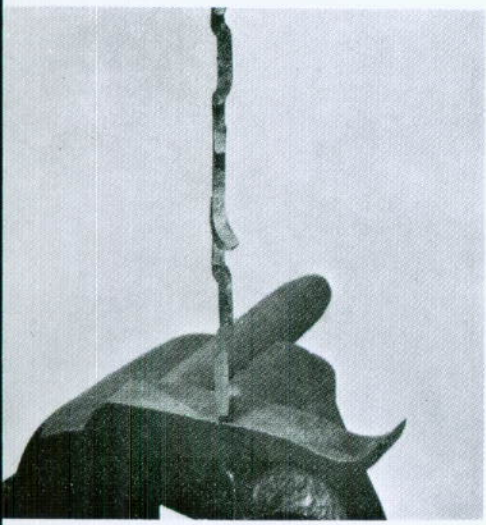


Fig. 55

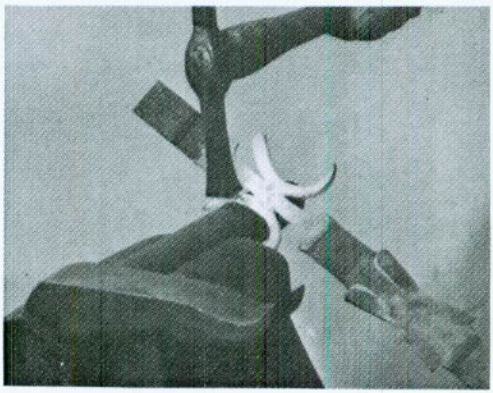


Fig. 56

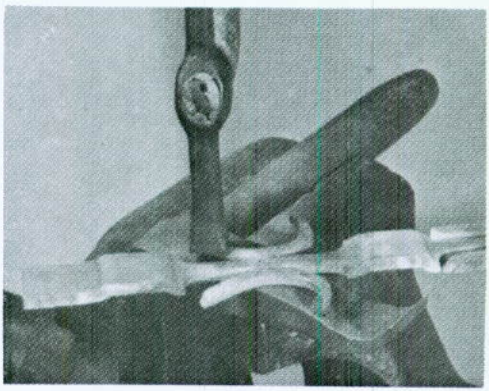
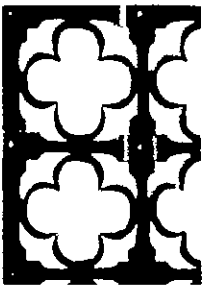


Fig. 57



DESIGN 3

Fig 58 In the final setting operation another special tool is brought into play (drawing, Fig 66, page 42).

This tool comprises a crescent-shaped former and four guide pegs spaced to accept the cut-away stem bearing the quatrefoil sections.

With the work at a red heat, and using a pair of round-nosed pliers in each hand, the horns of the crescents are squeezed into shape against the former.

Fig 59 Providing that the offsets have been accurately positioned and that the correct reductions have been made between centres to allow for the slight lengthening which occurs during hot splitting, the assembly of the grille is straightforward.

As the frame bars bear crescent shapes on their inner edges only, they will not tend to lengthen as much as the internal bars, and therefore it is advisable to mark off the centres of their offset sections at the finishing intervals, i.e., the interval given by the working drawing.

Small, unpredictable variations can occur occasionally between centres in forgings of this kind, which must be adjusted prior to final assembly. Such adjustments may be effected by lengthening by the drawing process or shortening by upsetting, whichever is appropriate for the correction of the faulty sections.

The bars are straightened and any twists are removed, after which the rivet holes are drilled in the bars forming the outer frame.

The frame is temporarily bolted together at the four corners and tested for squareness.

The horizontal and vertical bars are now laid one at a time on the frame and the positions of their end holes are scribered off and drilled.

One set of bars, either vertical or horizontal, are now drilled at the points of intersection.

The grille is temporarily bolted together and the positions of the holes in the set of undrilled bars are scribered through, drilled and replaced in position.

At this stage, with frame and bars bolted together and again

tested for squareness, any overlapping of the quatrefoil segments is corrected with a small scroll wrench.

Small, final adjustments to the tips of the segments are made after the temporary bolts have been withdrawn singly and replaced with rivets.

If it is found necessary to resort to the use of heat the oxy-acetylene torch is employed.

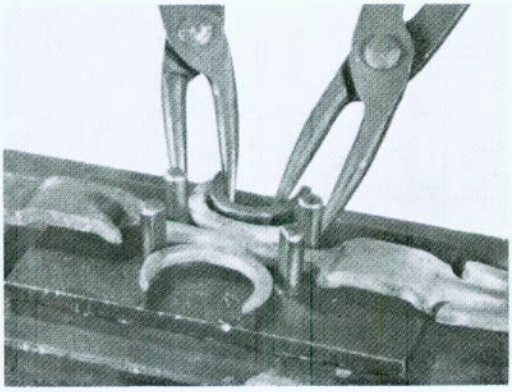


Fig. 58

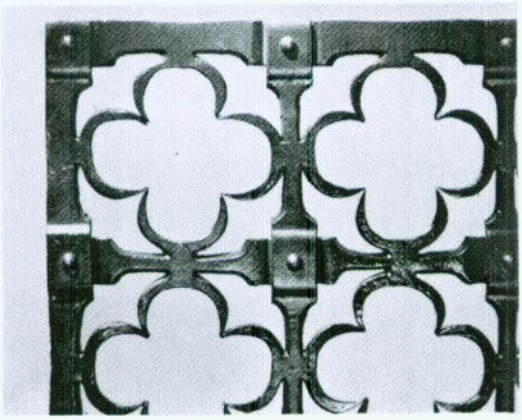


Fig. 59

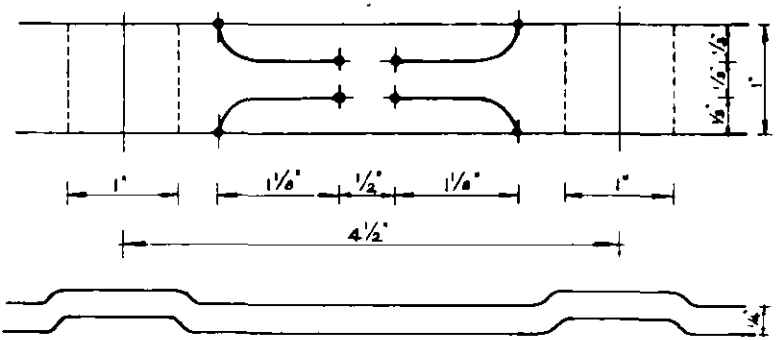


Fig. 60 Marking out diagram

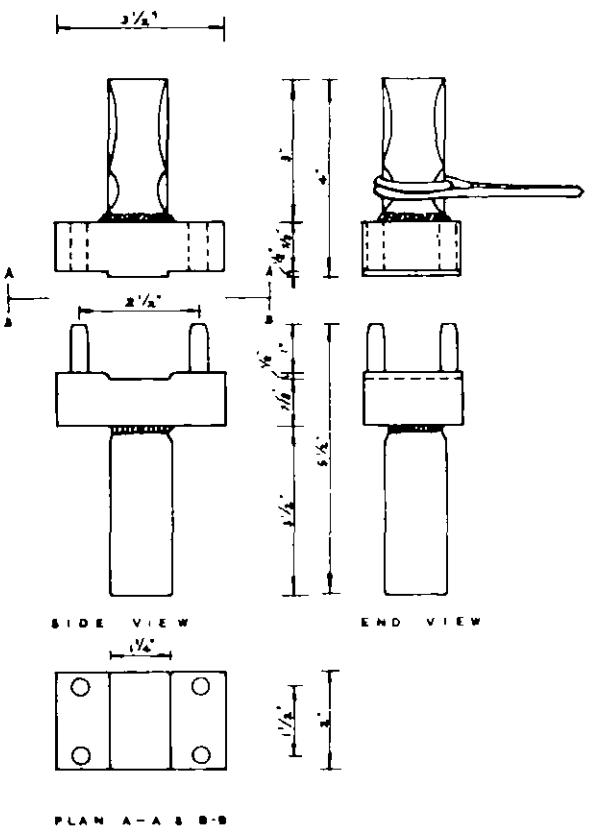


Fig. 61
Offsetting tools

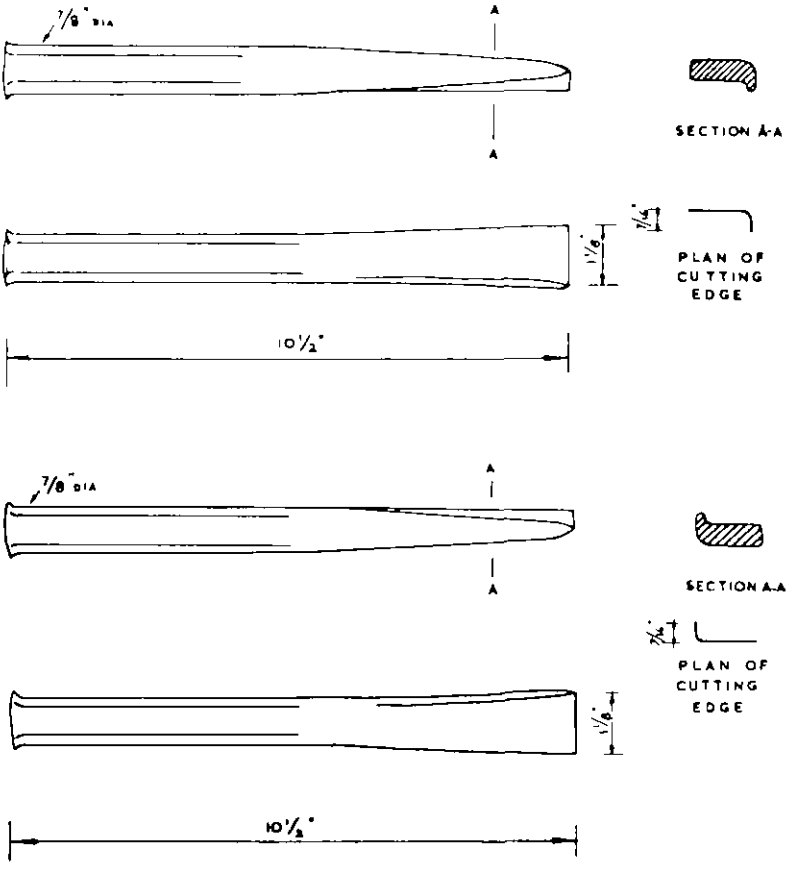
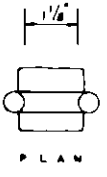


Fig. 62 Special chisels—one of each hand



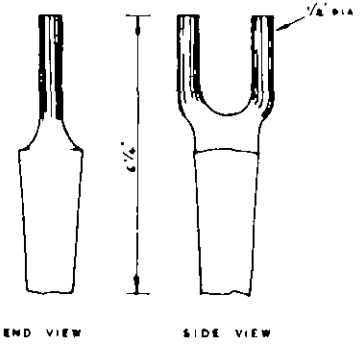


Fig. 63
Anvil horns

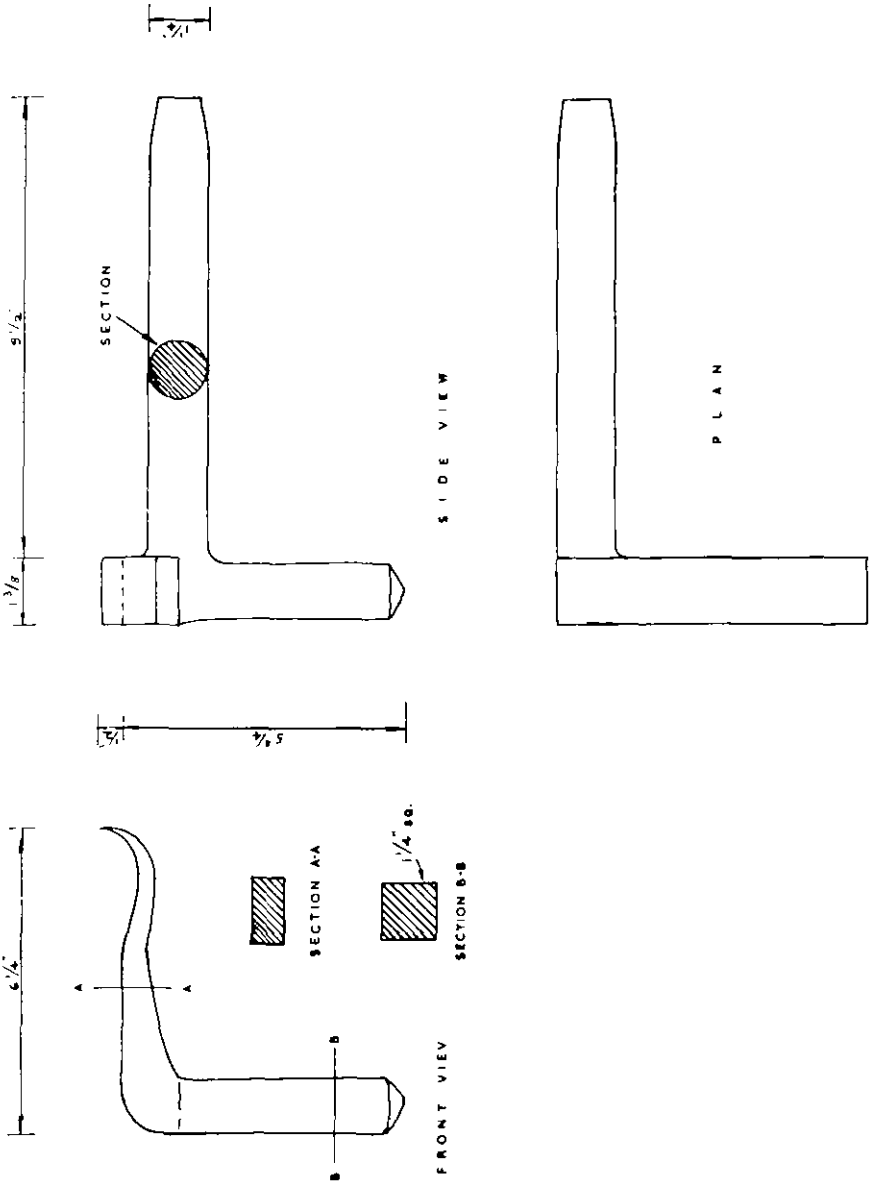


Fig. 64 Multi-purpose stake

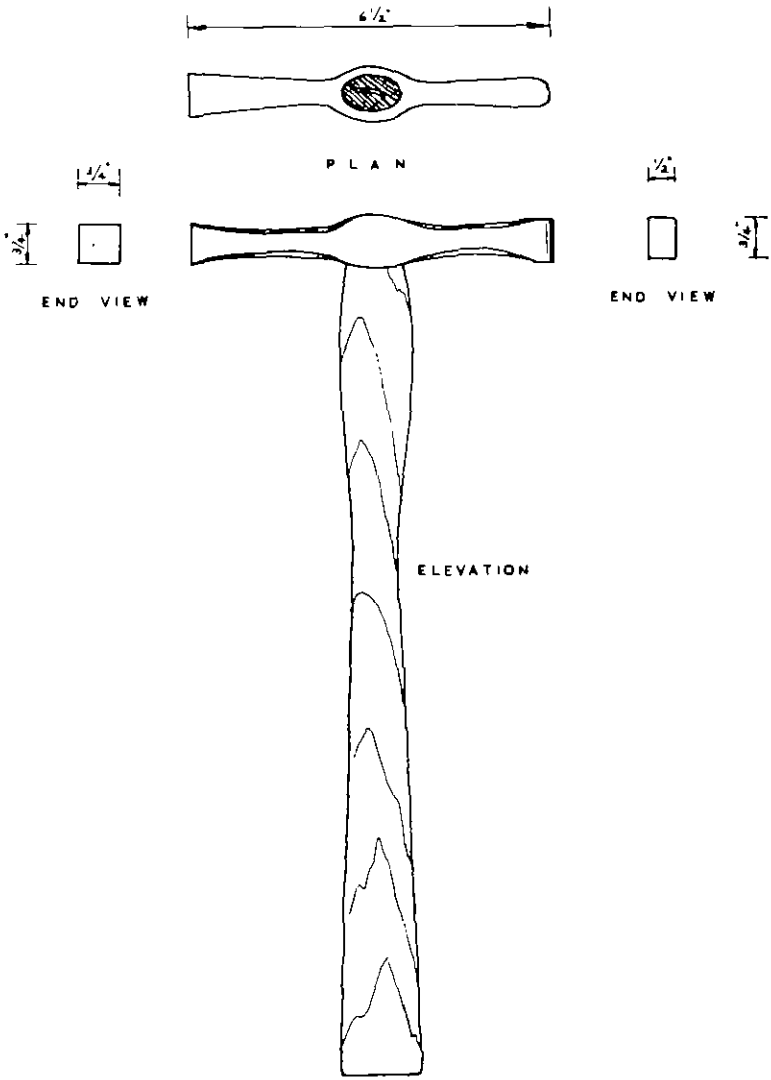
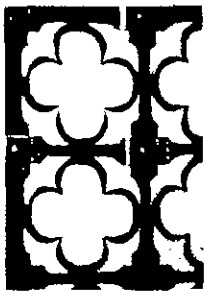
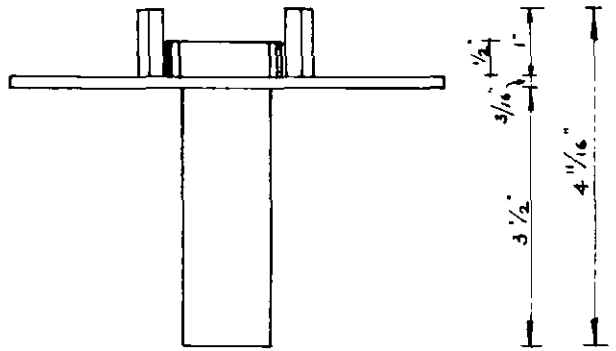


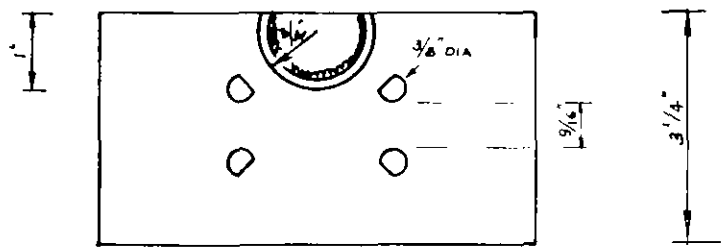
Fig. 65 Double-ended hammer



DESIGN 3



SIDE VIEW



PLAN

Fig. 66 Jig for setting spurs