

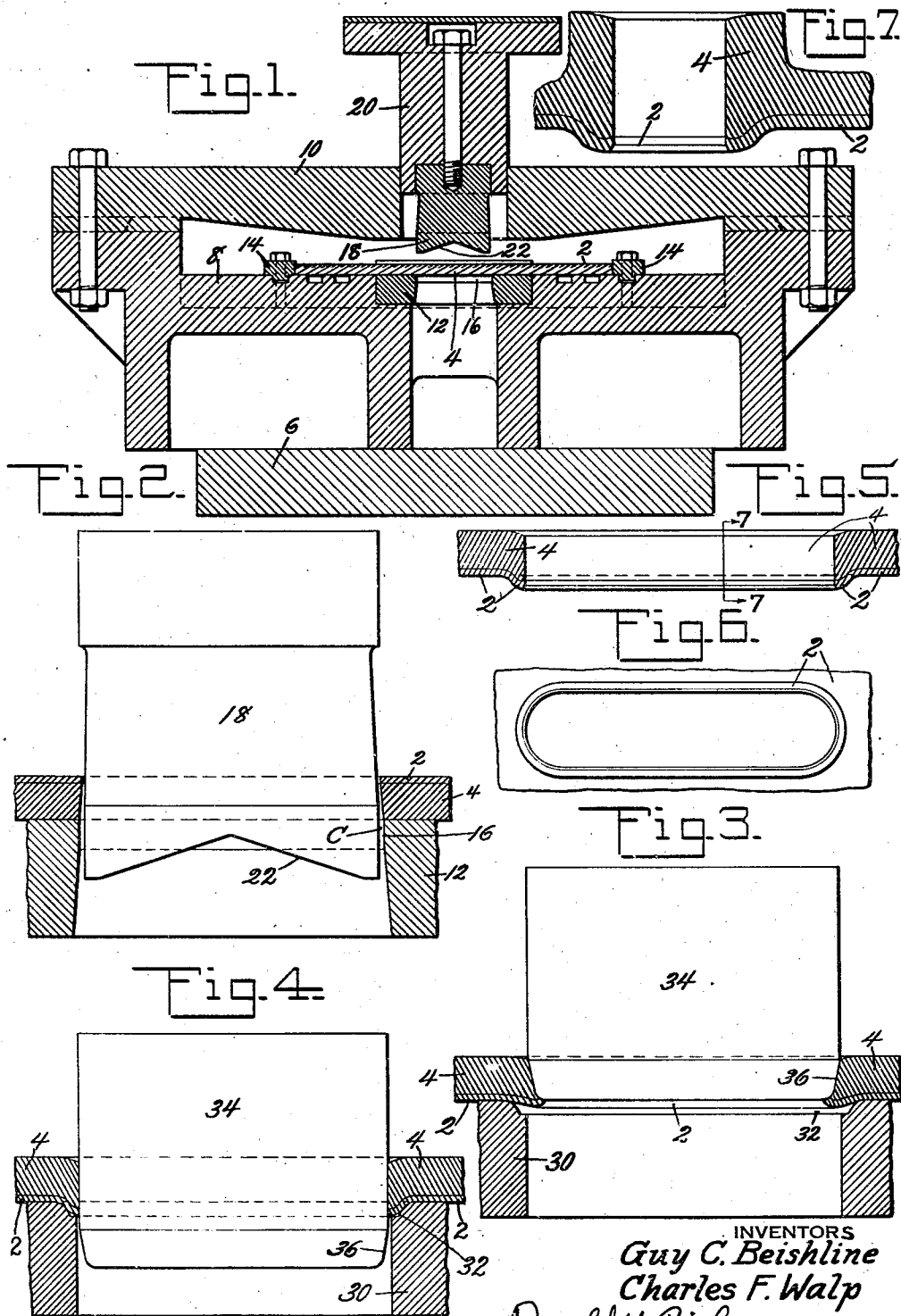
Aug. 28, 1945.

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2,383,584

METHOD OF FLANGING BIMETALLIC PLATES

Filed Jan. 21, 1941



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UNITED STATES PATENT OFFICE

2,383,584

METHOD OF FLANGING BIMETALLIC PLATE

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Application January 21, 1941, Serial No. 375,282

5 Claims. (Cl. 29—148)

This invention relates to the flanging of plate in general and in particular to the flanging of bimetallic plate such as used in armoring of mobile or stationary structures.

In the past flanges have been placed around openings in armor or other plates to provide deflectors preventing splash from bullets entering the gun ports or observation holes. In cases of heavy armor these flanges have been cast in place. In recent years where mobile structures were armored the use of cast metal became impossible due to weight and it was necessary to resort to high strength alloy steels properly treated to give maximum resistance against penetration. With such high alloy steels properly treated a proper flange could not be obtained and the flange was provided by means of welding a bead around the openings and grinding this bead to proper contour but such operation on the plate damaged the plate structure and gave an extremely weak condition at a very vital point in the armor. It is obvious that without a proper flange or splash protection at the gun ports and peep holes the casualties as a result of head injuries would become enormous. It has been discovered that by proper handling and by following the method later to be set forth an integral splash bead or flange may be provided in high alloy bimetallic plate without weakening the metal either in the flange or in backing up the flange, thus producing an opening surrounded by plate having a maximum strength up to the very edge of the opening. One of the objects, accordingly, of the invention is the production of the flanged bimetallic plate having uniform structure in the plate and flange.

A further object of the invention is the production of a bimetallic plate having openings surrounded by flanges projecting from the hard side of the plate and with a substantially uniform depth of hardness in the plate and flange.

A still further object of the invention is the production of a bimetallic plate having openings therein surrounded by flanges projecting from the hardened side of the plate and formed by a compression of the hard surface and backing metal.

These and other objects of the invention will be apparent to persons skilled in the art from a study of the following description and accompanying drawing in which:

Figure 1 is a sectional view through a machine adapted to operate on the bimetallic plate which is shown in position on the machine bed;

Fig. 2 is an enlarged sectional view showing the position of tool parts after the opening has been punched through the bimetallic plate;

Fig. 3 is an enlarged sectional view showing the position of bimetallic plate and swaging dies at the beginning of the swaging or compressing operation;

Fig. 4 is an enlarged sectional view similar to Fig. 3 but showing the tool parts and plate condition upon the completion of the swaging or compressing operation;

Fig. 5 is a sectional view through the opening in the completed plate;

Fig. 6 is a front view of the flanged opening in the bimetallic plate, and

Fig. 7 is an enlarged sectional view taken substantially on line 7—7 of Fig. 5 and better disclosing the condition of the metal at the opening.

The high strength alloy steel plates may be received from the rolling mills in final condition to be worked but in most instances will be received in a plain rolled condition and must be carburized to produce the hard skin on one surface backed up by softer metal, all of which is so necessary to production of a proper plate capable of resisting penetration by modern arms. The plates may be carburized in any well known manner and after carburizing they must be annealed to produce the proper structure and to soften the plates sufficiently for drilling, punching or other operations. After the plates are annealed they are heated locally and brought to a punching machine such as shown in Fig. 1 with the locally heated area in position beneath the male punch die. The plate will be in the condition indicated by the drawing, namely, with a hard surface 2 backed up by a relatively softer metal 4 and it should be noted that when in position for punching the hard surface is uppermost and is the first to be contacted by the male die.

The machine may be of any form but in the instance shown comprises a heavy base 6 supporting the bed 8 to which is clamped a heavy stripper plate 10. The female die 12 having the desired opening therein is supported in any suitable manner upon the bed plate of the machine, while work positioning guides 14 are clamped or held on the bed in proper position so that the plate to be punched may be readily brought to its correct position between the dies. The female die 12 is formed, as clearly shown in Fig. 2, with a considerable taper in order to permit passage of the punched slug, while the throat 16 has considerable clearance C between it and the male die in order that the punched plate will have an opening with tapering sides converging toward the hard side of the plate, as clearly shown in Fig. 2. The clearance C between the throat of the female

die and the male die is carefully calculated and proportioned in accordance with the thickness of the bimetallic plate in order that the proper amount of taper will be obtained to give the necessary volume of metal for the subsequent swaging operation. The male die 18 is fastened to the ram 20 of the machine and passes through the opening in the heavy stripper plate and at the bottom of the stroke has entered the female die, as clearly shown in Fig. 2. The male die may be of any desired contour on its punched face, but in the instance shown has been tapered as at 22 in order to act more as a shear and reduce the power necessary to punch the high strength bimetallic plate.

After the bimetallic plate has been punched as shown in Fig. 2 it may be immediately removed to the swaging machine, provided enough heat still remains in the plate, otherwise it must be reheated locally at the opening, after which it is taken to the swaging machine. The swaging machine may be identical with the punching machine described with the exception that different tools are carried by the bed and ram. The tools carried by the swaging machine, as shown in Figs. 3 and 4, are a female die 30 having a straight walled opening therethrough, with the upper edge surrounded by a cavity 32 of the contour desired for the final flange on the plate. The male swaging tool 34 likewise has straight sides throughout the major portion of its length, while the nose is tapered as at 36 to cause an upsetting and compression of the metal in the bimetallic plate. The properly heated bimetallic plate will be placed on the female swaging die with the hard side downward, thereby causing the male swaging tool to first contact the relatively soft metal forming the tapered sides of the opening, as clearly shown in Fig. 3 which indicates the contact of the male swaging tool with the bimetallic plate and after a slight distorting pressure has been applied. Application of further pressure will cause the male swaging tool to move downwardly compressing the hard part 2 of the bimetallic plate and causing it to flow into the recess in the female die, while at the same time the relatively softer metal is compressed and made more dense adjacent the opening and the plate and tool then assume the position and condition shown in Fig. 4. Upward movement of the male die will, of course, lift the bimetallic plate from its bed on the machine, but it will be stripped from the tool by means of the heavier stripper plate 10 and may then be removed from the machine and the bead or flanged opening will appear as shown in Figs. 5, 6 and 7. After the plate has been removed from the swaging machine and provided no further operations are to be performed on the plate, it may be given its final heat treatment placing it in condition for application to the armored structure. As clearly shown in Figs. 4, 5 and 7 the hard surface of the plate is of substantially uniform depth up to the very edge of the opening and will retain its full strength since only compressive forces have been applied during its distortion, such compressive forces being applied not only by the swaging tool, but by the movement of the softer metal forced toward the hard surface due to the shape of the swaging tool and the taper in the punched opening. It is, of course, necessary that the volume of metal remaining in the opening, due to the tapered punching, be properly proportioned so as to as nearly as possible exactly supply the metal necessary in the compression or swaging operation.

Once this volume has been carefully calculated the flanges will appear as shown in Figs. 4, 5 and 7 which follow almost exactly the etched samples taken from actual flanged plates.

Although the invention has been shown and described in considerable detail, it will be obvious that slight modifications in procedure as well as considerable variation in the machinery used will suggest themselves to persons skilled in the art but all such modifications and procedure and variation in machinery are contemplated as will fall within the scope of the following claims defining our invention.

What is claimed is:

1. The method of providing a hard surfaced integral flange on a bimetallic plate having a hard surface backed up by a relatively softer metal, which consists in punching an opening in the plate by moving a slug of metal from the hard surface through the softer backing metal, and then forming the flange by forcing a swaging tool through the opening toward the hard surface simultaneously compressing the softer metal forming the sides of the opening and moving the same toward the hard surface to bend the latter outwardly and form the flange.

2. The method of providing a hard surfaced integral flange on a bimetallic plate having a hard surface backed up by a relatively softer metal, which consists in forcing an undersize punch from the hard surface through the softer metal to form an opening with sides having a predetermined taper, and then sizing the opening and forming the hard surfaced flange by forcing a swaging tool through the opening toward the hard surface simultaneously compressing the softer metal forming the tapering sides of the opening and moving the same toward the hard surface to bend the latter outwardly forming the flange.

3. The method of providing a bimetallic integral flange on a bimetallic plate each having a hard outer surface backed up by a relatively softer metal, which consists in forming an opening in the plate and then forming the flange by forcing a swaging tool through the opening toward the hard surface simultaneously compressing the softer metal forming the sides of the opening and moving the same toward the hard surface to bend the latter outwardly thereby forming the bimetallic flange.

4. The method of providing a bimetallic integral flange on a bimetallic plate each having a hard outer surface backed up by relatively softer metal, which consists in punching in the plate an opening having sides of a predetermined taper converging toward the hard surface and containing sufficient metal to form the flange, and then forming the bimetallic flange and simultaneously straightening the sides of the opening by forcing a swaging tool through the opening toward the hard surface.

5. The method of providing a bimetallic integral flange on a bimetallic plate each having a hard outer surface backed up by a relatively softer metal, which consists in forming in the plate an opening having tapering sides converging toward the hard surface of the plate, and then straightening the sides of the opening and simultaneously forming the bimetallic flange by forcing the softer metal of the tapering sides toward the hard surface thereby bending the hard surface outwardly and forming the bimetallic flange.

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