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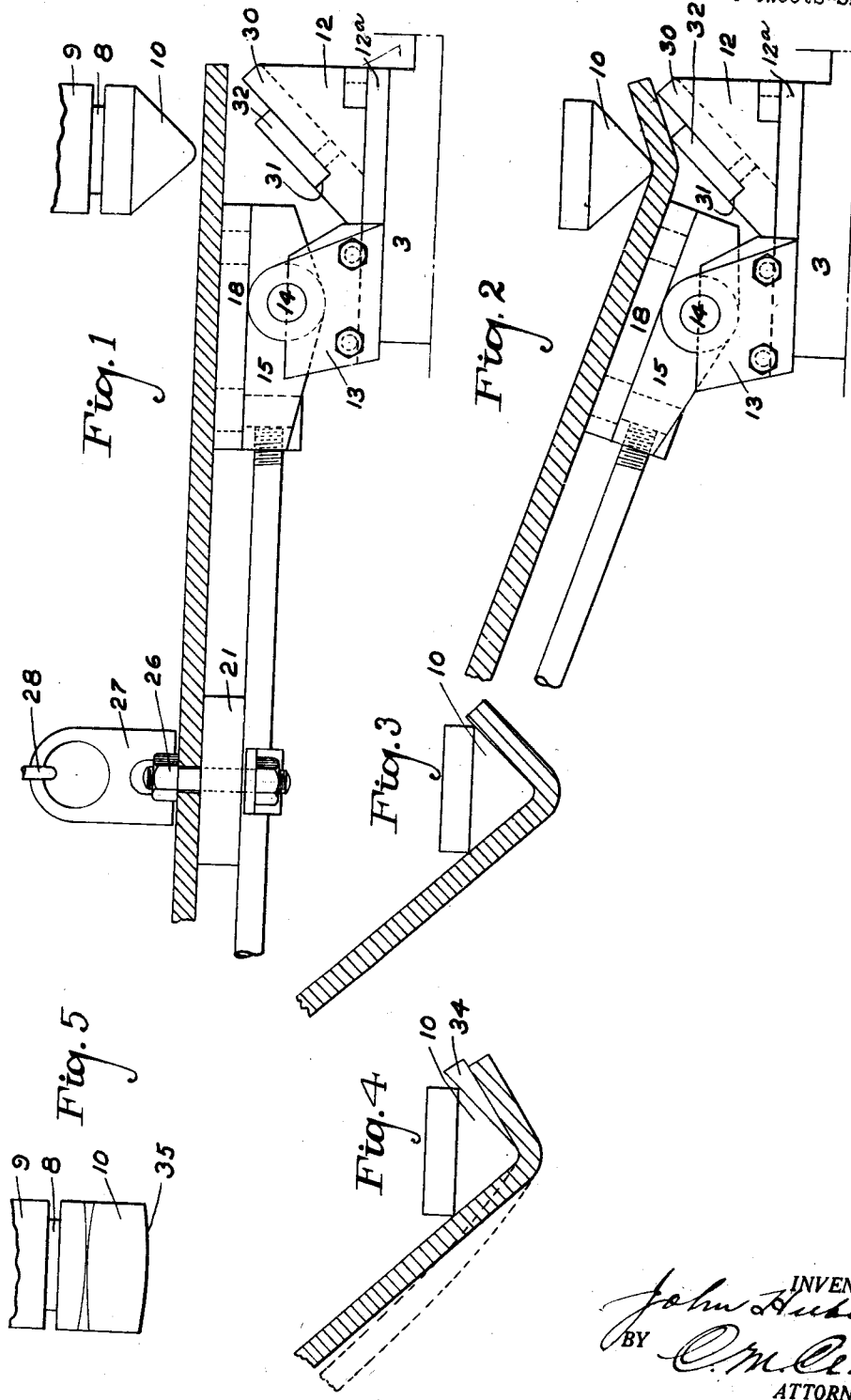
J. HUBER

1,754,428

METHOD AND MACHINE FOR FLANGING PLATES

Filed Feb. 3, 1926

4 Sheets-Sheet 1



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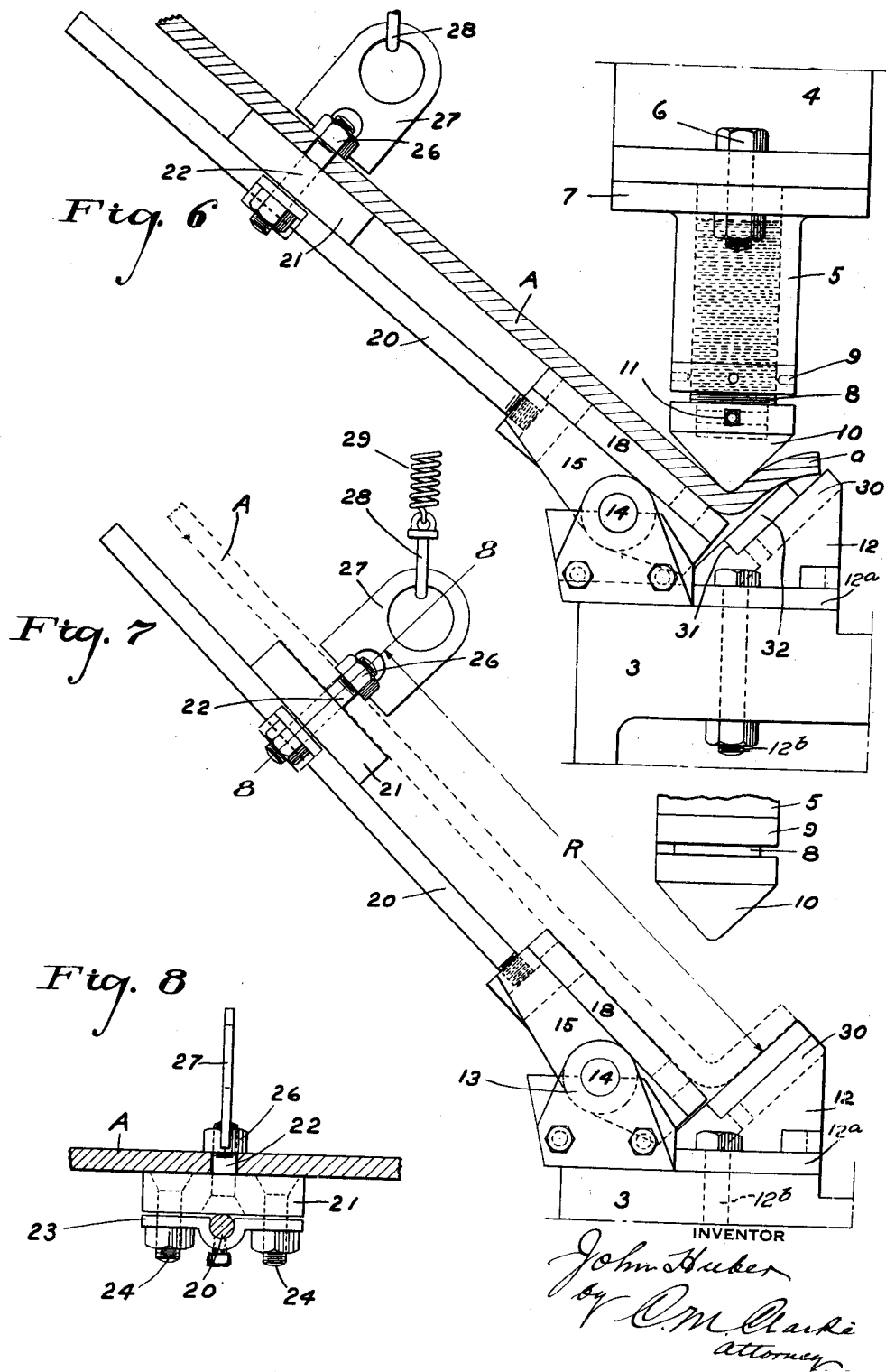
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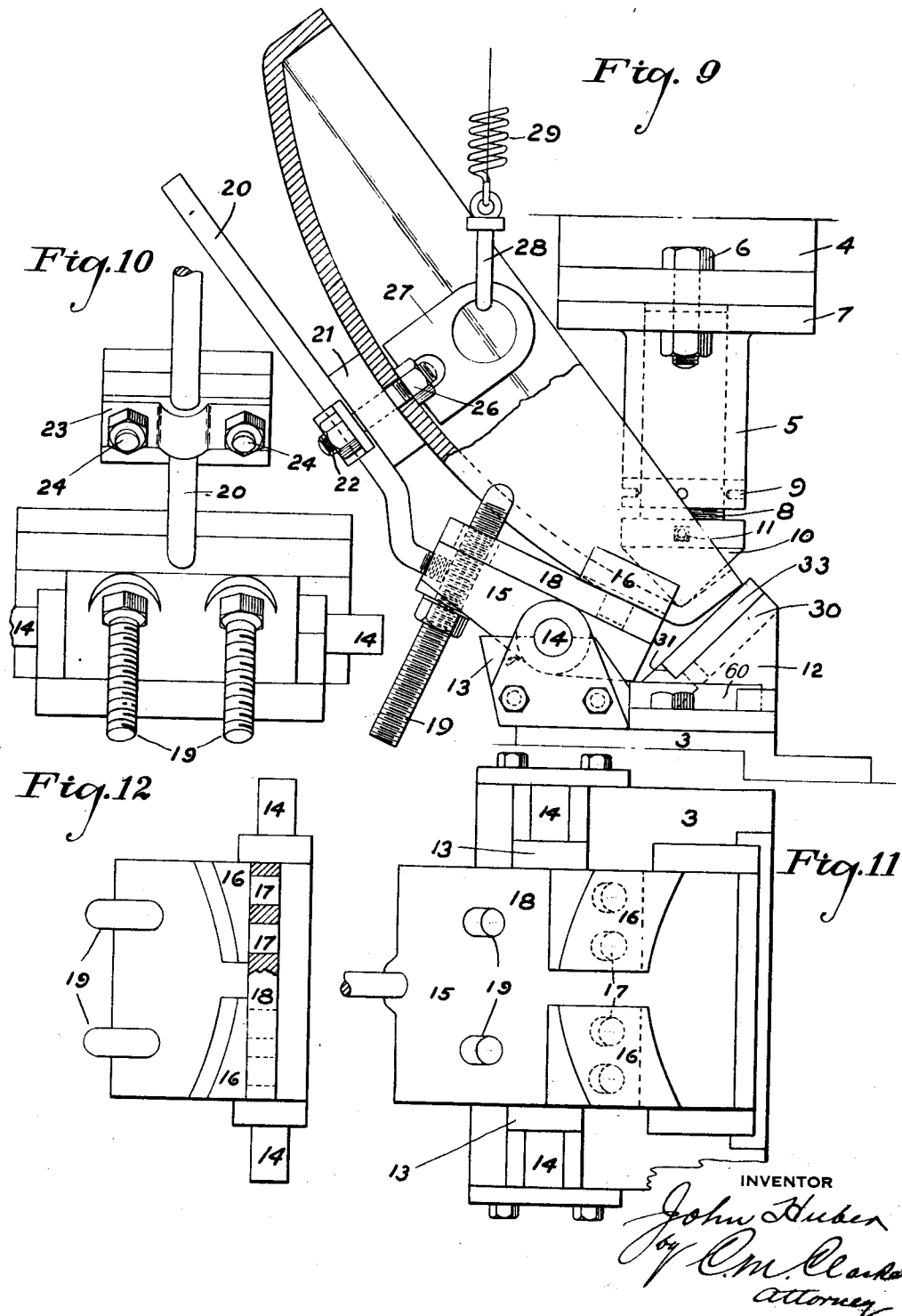
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METHOD AND MACHINE FOR FLANGING PLATES

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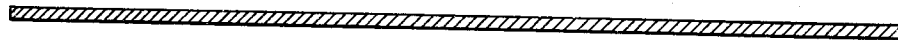
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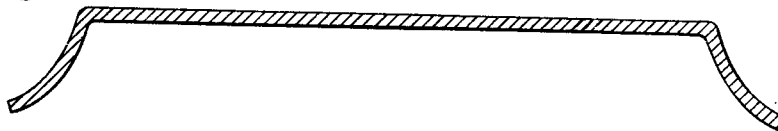
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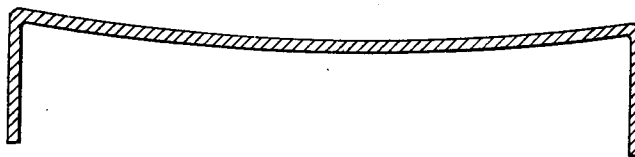
— *Fig. 13.*



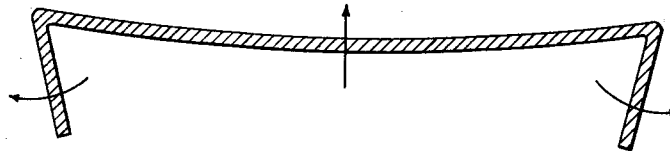
— *Fig. 14.*



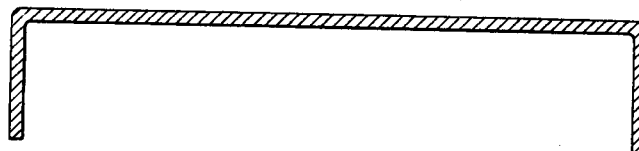
— *Fig. 15.*



— *Fig. 16.*



— *Fig. 17.*



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## UNITED STATES PATENT OFFICE

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## METHOD AND MACHINE FOR FLANGING PLATES

Application filed February 3, 1926. Serial No. 85,700.

This invention has to do with a method and apparatus for flanging metal, for instance plate or sheet metal, and it is an object of the invention to provide a method and apparatus whereby metal can be flanged effectively and economically.

In the ordinary practice of flanging metal, for instance circular or curved heads for boilers, and the like, it is customary to form the flange by bending it downwardly over a resisting anvil or abutment. With this method strains are set up in the flange which cause buckling or distortion of the plate or head. The reduction in diameter of the peripheral portion of the plate crowds or sets up strains in the flange, which strains are within the elastic limits of the metal and tend to return the flange to the original shape. These strains are communicated through the knuckle or bend and act on the main body of the plate deflecting it from the true flat condition. To overcome this distortion or buckling of the plate a method has been employed which includes initially distorting the plate so that the distortion caused by the flanging returns the plate to about its original shape. This method necessarily requires the distinct operations of distorting the plate preliminary to the formation of the flange and requires considerable skill and care on the part of the operator. Further the method ordinarily employed for flanging metal plates requires heavy expensive apparatus, usually apparatus designed entirely and exclusively for this work.

It is an object of my invention to provide a method of flanging a plate, for instance a circular head, so that the finished plate is undistorted, and which does not require initial distortion of the plate such as I have referred to above. By the present invention the flange is initially formed or bent beyond its finished position and is then bent back to the finished position. As the flange is bent back to the finished position the

crowding or strain within the metal of the flange is relieved so that undesirable strains are not present to be communicated to the body of the plate.

Another object of my invention is to provide a method of forming a flange on a head, or the like, whereby the operations performed on the flange alone result in the finished head being without distortion.

It is another object of my invention to provide apparatus for effectively and economically carrying out the process or method that I have provided.

Another object of my invention is to provide metal flanging apparatus which is particularly simple and inexpensive.

A further object of my invention is to provide flanging apparatus which may be employed in or as an attachment to, a punch press or the like.

A further object of my invention to provide flanging apparatus involving novel features of arrangement and construction.

The various objects and features of my invention will be best and more fully understood from the following detailed description of a typical form and application of the invention throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of the working portions of the mechanism provided by this invention showing a circular plate in position to be operated upon;

Fig. 2 is a partial view similar to Fig. 1, showing a condition of the plate during the flanging operation;

Figs. 3 and 4 are views illustrating other stages or phases of the formation of the flange;

Fig. 5 is a detailed side elevation of the hammer die provided by my invention;

Fig. 6 is a view similar to Fig. 1 showing the mechanism in operating position with the flange partially formed;

Fig. 7 is a view similar to Figs. 1 and 6 illustrating the manner in which the mechanism may be adjusted;

Fig. 8 is a cross sectional view taken as indicated by line 8—8 on Fig. 7 showing the plate in position;

Fig. 9 is a view of the apparatus showing a crowned head in place therein, the head being shown in finished form;

Fig. 10 is a rear elevation of the parts shown in Fig. 9;

Fig. 11 is a plan view of the parts shown in Fig. 10;

Fig. 12 is a view of a portion of the mechanism shown in Fig. 10 with parts broken away; and

Figs. 13 to 17 illustrate diagrammatically successive stages in the formation of a flange in accordance with the method provided by my invention and as accomplished by the apparatus provided by my invention.

The method which is the subject of this invention is particularly useful and of commercial value in the flanging of plate or sheet metal in the formation of curved or circular heads for boilers, and the like. I will therefore proceed to set forth the principles of my invention by describing the method as employed in the formation of a typical circular flanged head, it being understood that the broader principles of the invention are not to be considered limited by the specific examples or details herein set forth, and that when I use the term circular I mean to include curved formation in general.

My method includes, generally, the bending or forming of an initially undistorted plate to such a degree or extent that the flange is bent past or beyond the finished position, causing an over strained condition to exist in the flange and a distorted condition of the plate which naturally occurs as the result of such condition in the flange, and then relieving the strained condition of the flange by bending it in a reverse direction, or outwardly to the finished position, relieving or neutralizing the strain and allowing the plate to return to its natural or normal condition. In Figs. 13 to 17 I illustrate diagrammatically the several steps or stages in the formation of a flanged head in the manner provided by my invention. In Fig. 13 I illustrate the original flat undistorted plate out of which the head is to be formed. In Fig. 14 I show the edge portion of the plate bent or turned to form the flange, and have shown in this figure the flange outwardly curved. In the preferred manner of carrying out my method the flange is, during the first stages of formation, shaped as shown in Fig. 14, so that its outer diameter is larger than its inner diameter, that is so that its outer edge is larger in diameter than the part which joins the plate. From the outwardly curved condition shown in Fig. 14,

the flange is further bent or formed inwardly until it is substantially straight and in finished position as shown in Fig. 15. By outwardly curving the flange during the first stages of the formation it is comparatively easy to thereafter form it into the straight condition shown in Fig. 15. With the flange thus formed it will be under considerable strain and will usually result in the flat part of the plate being distorted in a manner such as is shown in Fig. 15. I proceed with the bending of the flange from the position shown in Fig. 15, to a position such as is shown in Fig. 16 where it is bent inward of the finished position. With the flange thus bent beyond its finished position it is in a strained condition and the flat part of the plate is usually distorted, possibly slightly more than it was with the flange in the position shown in Fig. 15. I then reverse the bend of the flange, that is I bend the flange outwardly from the position shown in Fig. 16, in the manner indicated by the arrow in Fig. 16, to the finished position. This outward bending of the flange I have found relieves the excessive strain formerly set up in the flange with the result that the flat part of the plate is allowed to return to its normal flat condition so that the finished head is in the form indicated in Fig. 17. The finished head thus produced not only lacks distortion, but is substantially free of strains which are undesirable. Although I have referred to the plate as being flat and as being distorted from and returned to a flat condition, it will be obvious that the plate might be crowned and that the distortion and return might be from and to the crowned condition.

The apparatus or mechanism provided by my present invention for carrying out the method which I have described may be built into a unitary machine which will operate the various parts in the manner hereinafter described, or may be in the form of an attachment applicable to standard punch presses, or the like. I have in this application, set forth the invention in a form applicable to a standard form of punch press, shear, or the like, and in the drawings I have shown certain parts of a standard punch press. Throughout the drawings numeral 3 designates the anvil block of a punch press, and numeral 4 designates the head of the press which reciprocates vertically above the anvil block.

The mechanism provided by this invention includes, generally, a hammer die 10, base dies 12 and 15, and means for supporting work in proper position with reference to the dies. The hammer die 10 is adapted to be mounted on and operated by the reciprocating head of the punch press, it being preferred in practice to mount the die 10 so that it is adjustable with reference to the head 4. In the form of construction shown in the

drawings the hammer die 10 is mounted on the lower end of a screw 8 which screw threads into a carrier 5 mounted on the head 4 by means of a flange 7 and bolts 6. The die 10 is retained on the lower end of the screw 8 by means of a set screw 11, and the screw is adapted to be set in adjusted position in the carrier by means of a lock nut 9 carried on the screw to engage the lower end of the carrier. The lower or working end of the die 10 is wedge shaped and is sufficiently wide to engage a suitable section of the work or plate A.

The base dies 12 and 15 are relatively movable to support the edge part of the plate A in the various forms that it takes during the formation of the flange. In the preferred form of the invention shown in the drawings the dies 12 and 15 are mounted on a common base plate 12<sup>a</sup> adapted to be secured to the anvil block of the press as by bolts 12<sup>b</sup>. In this form of the invention one of the base dies, for instance the die 15, is movable with reference to the base plate, and therefore with reference to the die 12. The base die 12 has an angularly disposed body part 30 at the lower end or edge of which there is an upwardly facing shoulder 31. The body is disposed at an angle of about 45 degrees as shown throughout the drawings. Face plates 32 are adapted to be applied to the front of the body 30 so that they are supported by the shoulder 31 and in carrying out my method it is preferred to employ face plates of different heights or sizes during different stages of the flanging operation. For instance, in Figs. 1, 2 and 6 I show small or narrow face plates 32 on the die 12, while in Figs. 7 and 9 I show large or wide face plates on the die.

The base die 15 is preferably provided with a pivotal mounting so that it can tilt with reference to the base plate 12<sup>a</sup> and die 12, and therefore will be termed the tilting base die. The die 15 may be provided at its ends with trunnions 14 which are carried in bearings 13 on the base plate 12<sup>a</sup>. The tilting die 15 is provided with a face plate 18 which is of considerable length and in the form of the invention shown in the drawings the plate 18 overhangs the bearings and trunnions. With the construction just described the tilting die is operable between a position where its face plate 18 is horizontal as shown in Fig. 1, and a tilted position such as is shown in Fig. 7. In the operation of the mechanism the face plate 18 assumes various angular positions during the various stages of formation of the flange.

The means provided for supporting the work or plate A in proper position with reference to the dies is connected with the tilting die 15 to be movable therewith so that the plate A moves or tilts bodily with the tilting die during the formation of the flange. In accordance with the broader phases of my in-

vention the mounting means may vary widely in arrangement and construction. In its preferred form the mounting means includes a pin 22 supported at a suitable distance from the die 15 and adapted to carry the plate A. In the particular construction shown in the drawings the pin 22 extends from a block 21 adjustably carried on a part projecting from the die 15. The part which projects from the die is in the form of a rod 20. The block 21 is adapted to be set in various positions with reference to the die 15 by means of clamp bolts 24. In working on a circular plate A a hole is formed at the center of the plate so that the plate can be mounted for rotation on the pin 22. A retaining nut 26 may be screw threaded on the pin to hold the plate in position on the pin. During operation the plate is preferably supported by a hoist or the like, in the desired angular positions. For this purpose the nut 26 may be provided with an eye 27 to receive a hook 28 depending from the usual chain block or other lifting apparatus. The suspension means preferably includes a resilient element such as a spring 29. Auxiliary supporting means may be provided in the form of screws 19 carried by the die 15, to be adjusted into engagement with the lower side of the plate A. These supplemental adjusting screws are clearly shown in Figs. 9, 10 and 11 of the drawings.

In operating the mechanism above described the plate A is properly mounted on the pin 22 and the pin is adjusted to the desired position with reference to the dies. The adjusted position of the pin may be determined in various manners. For instance, the die 15 may be tilted to position such as is shown in Fig. 7, and the pin set a distance R from the face plate of the stationary die 12 corresponding to the outside radius to be obtained in the finished flange. The plate properly mounted with reference to the dies and with a narrow or small face plate 32 on the stationary die 12, operation is started. The parts start from about the positioning shown in Fig. 1. The hammer die 10 is forced into engagement with the plate with the result that the die 15 tilts and the plate moves upwardly from the horizontal position, for instance, to a position such as is shown in Fig. 2. This operation is carried completely around the plate A by suitably advancing or rotating the plate between successive operations of the die 10 to bring successive sections of the edge portion of the plate into position at the dies. The narrow face plate 32 causes the flange, formed during the operations above mentioned, to be outwardly curved or concave at its outer side as shown in Fig. 6. When the operation has been continued until the flange A is formed to about the shape shown in Fig. 6, the narrow face plate 32 is removed and a wide one substituted for it, so that further operation causes

the flange to be straightened or flattened out. By forming the flange in this manner the metal at the corner formed by the flange is worked or stretched so that strains that might otherwise pass to the plate to distort it are checked or counteracted with the result that the tendency for the plate to become distorted is minimized. In some cases there is practically no distortion of the plate. In further carrying out the method provided by my invention distortion of the plate is removed by continuing the flanging operation until the flange has been flattened as just mentioned and until it has been bent inwardly past or beyond its finished position. Thus excessive inward bending of the flange will occur. The desired amount of inward bending of the flange may be obtained by proper operation of the mechanism and by shaping the operating end of the hammer die 10 so that it causes the flange to be bent inwardly beyond the finished position. To restore the plate to its normal position and to relieve the internal strain in the flange I operate the mechanism to bend the flange back or outward to bring it to the finished position. This may be done by substituting a hammer die 10 of the proper shape or by applying a wedge shaped member 34 between the hammer die and flange as indicated in Fig. 4 of the drawings. When the mechanism is being used to flange a crowned plate as shown in Fig. 9, supplemental face plates 16 shaped to fit more or less closely the outer contour of the plate A, may be mounted on the face plate 18 of the tilting die. These supplemental face plates may be conveniently mounted on the plate 18 by means of dowel pins 17, or the like. Further, in practice it is desirable to, in some cases, limit the tilting movement of the die 15 so that it forms a fixed abutment against which this hammer die can act. This may be accomplished in various manners. For instance, a suitable stop block 60 may be inserted between the lower or inner end of the die 15 and the base plate 12<sup>a</sup>, as shown in Fig. 9, to positively stop further upward tilting of the die, thus transmitting the full pressure of the press for the plate under operation.

Having described only a typical preferred form of my invention I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. The method of flanging a metal plate including bending the flange part with its side away from the direction of bend concave and then flattening the flange to finished form.

2. The method of flanging a circular metal plate including bending the flange part with

its side away from the direction of bend concave, flattening the flange and bending it past its finished position and then bending the flange back to its finished position.

3. A plate flanging mechanism including a hammer die, a base plate, a base die stationary on the plate to engage the flange forming portion of the plate, and a second base die mounted on the base plate for movement relative to the stationary die to support the plate adjacent the flange forming portion.

4. A plate flanging mechanism including a hammer die, and two base dies, one stationary and the other movable, the stationary die having an angularly disposed part adapted to support a face plate to engage the flange forming portion of the plate.

5. A flanging mechanism including a hammer die, a base plate, a stationary base die on the base plate, a second base die, and bearings pivotally supporting the second base die on the base plate, the second base die having a face plate overhanging the bearings.

6. A flanging mechanism including a hammer die, two base dies, one stationary and the other mounted for pivotal movement, and means in connection with the movable die for supporting work in position to be operated on by the dies, said means including a member for connection with the work and means adjustably supporting said member from the movable die.

7. A flanging mechanism including a hammer die, two base dies, one stationary and the other mounted for pivotal movement, and means in connection with the movable die for supporting work in position to be operated on by the dies, said means including a pin for carrying the work, and an adjustable mounting for the pin.

8. A flanging mechanism including a hammer die, two base dies, one stationary and the other mounted for pivotal movement, and means in connection with the movable die for supporting work in position to be operated on by the dies, said means including a pin for carrying the work, a rod extending from the die, and a carrier for the pin adjustably mounted on the rod.

9. A flanging mechanism including a hammer die, two base dies, one stationary and the other movable, and means in connection with the movable die for supporting work in position to be operated on by the dies, said means including a pin for supporting the work and an auxiliary supporting screw for engaging the work.

10. A flanging mechanism including a wedge shaped hammer die, a base plate, a stationary base die on the plate having an angularly disposed part, a detachable face plate for said part, a second base die, bearings mounting the second base die on the plate for tilting movement, a face plate on the second base die overhanging the bear-



ings, stop means for limiting tilting movement of the second base die, a rod extending from the second base die, and a pin adjustably mounted on the rod to carry work in position  
5 to be operated upon by the dies.

11. The method of straightening the warped condition of a flanged round plate comprising stretching the outer edge of the flange.

10 In witness that I claim the foregoing I have hereunto subscribed my name this 16th day of January, 1926.

JOHN HUBER.

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