

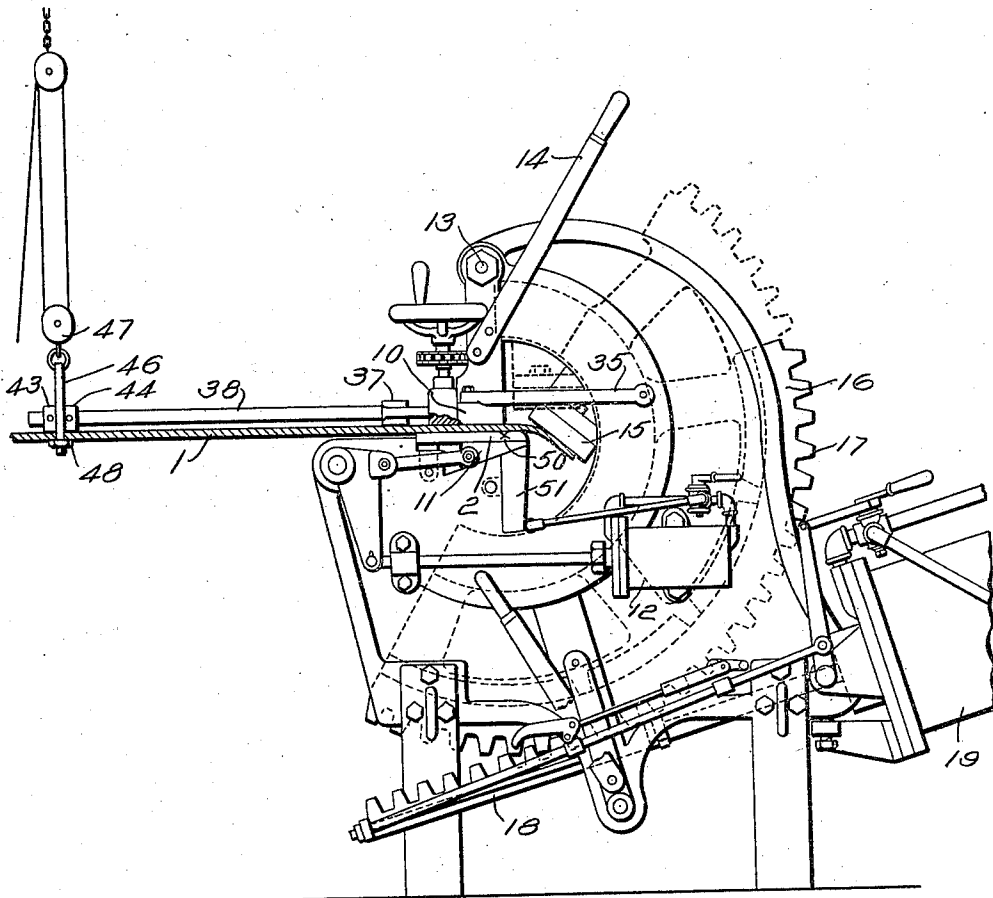
H. McCABE.
METHOD OF FLANGING.
APPLICATION FILED APR. 9, 1913.

1,065,824.

Patented June 24, 1913.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses,
Roswell F. Hatch
Alice Ackroyd

Inventor,
Hugh McCabe
By His Attorney
Phillips Van Curen & Co.

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3 SHEETS—SHEET 2.

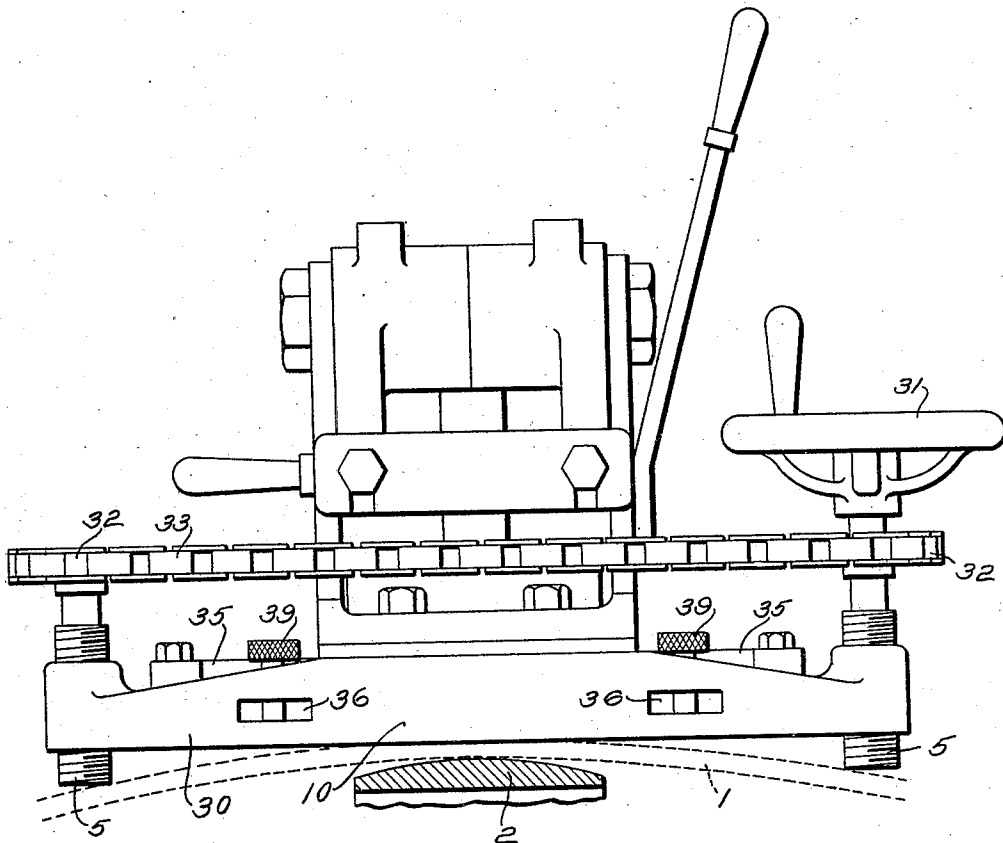


Fig. 2.

Witnesses,
Rowell F. Hatch
Alice Ackroyd

Inventor,
Hugh McCabe
by his Attorney
Phillips Van Duren & Fitch

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3 SHEETS-SHEET 3.

Fig. 3.

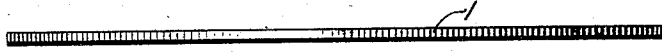


Fig. 4.

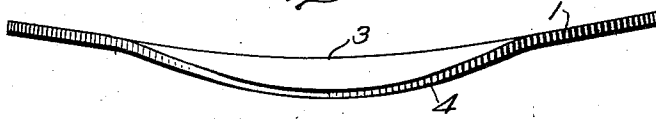


Fig. 5.



Fig. 6.

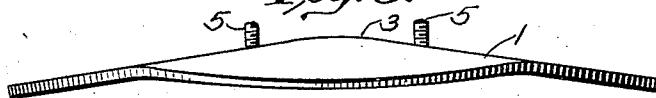
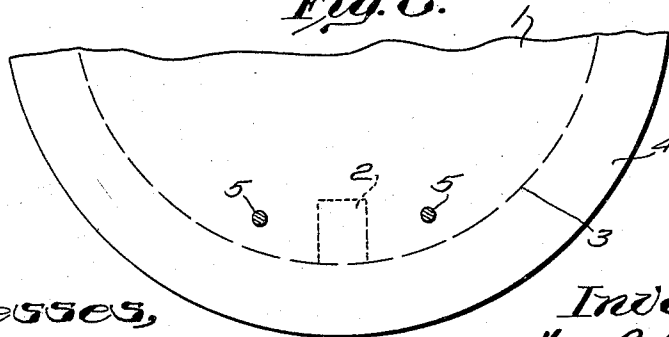


Fig. 7.



Fig. 8.



Witnesses,
Rexell F. Hatch.
Alice Ackerayd

Inventor,
Hugh McCabe
by his Attorney
Phillips Van Emden

UNITED STATES PATENT OFFICE.

HUGH McCABE, OF LAWRENCE, MASSACHUSETTS.

METHOD OF FLANGING.

1,065,824.

Specification of Letters Patent.

Patented June 24, 1913.

Original application filed October 29, 1912, Serial No. 728,355. Divided and this application filed April 9, 1913. Serial No. 759,908.

To all whom it may concern:

Be it known that I, HUGH McCABE, a citizen of the United States, residing at Lawrence, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Methods of Flanging; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to a method of flanging and more particularly to a method of flanging the curved edges of plates.

This is a division of my co-pending application, Serial No. 728,355, filed October 29, 1912.

The object of the present invention is to produce a method of flanging the curved edges of plates without causing the plates to become buckled.

With the above object in view, the present invention consists in the method of flanging hereinafter described and particularly pointed out in the claims.

In the drawings, which illustrate the preferred embodiment of the machine for carrying out the method of the present invention, Figure 1 is a side elevation of the machine; Fig. 2 is a front elevation of part of the machine head; and Figs. 3-8 inclusive illustrate diagrammatically the flanging of a plate according to the method of the present invention.

The machine with which it is preferred to carry out the method of the present invention is an improvement upon the flanging machine disclosed in the patents to Hugh McCabe, No. 1,006,861 dated October 24, 1911 and No. 1,030,416, dated June 25, 1912.

The method of the present invention will first be explained and then the machine will be described.

It is very often desirable to flange a plate consumed in heating the edge of the plate before it is operated upon by the flanging machine. A machine of the type disclosed in my two prior patents above mentioned will operate satisfactorily to bend a flange on the straight edge of a cold plate, but if a plate having a curved edge such as a circular plate is flanged cold, the plate will be buckled. For example, if a round plate has its entire edge flanged cold, the middle por-

tion of the plate will be buckled, or dished, concave on the side of the plate which is opposite the direction in which the flange extends. Referring particularly to Figs. 3, 4 and 8 of the drawings, the reason for this will be apparent. Figs. 3 and 8 show the side and top view respectively of a flat, round metal plate. In Fig. 4 is illustrated the same plate after it has received a single flange bending stroke through an angle of about 30 degrees, such as would be given it by either of the machines shown in my two patents, if the plate was cold. It will be noticed in Fig. 4, that while the edge of the plate is turned downward to partially form the flange, the plate is bent transversely being concaved upward so that it presents a sort of flattened saddle-shaped surface. The reason why the bending of the plate downward longitudinally of the edge to form the flange causes the plate to be transversely bent or buckled concave upon its upper side can best be explained with particular reference to Figs. 4 and 8. The plate 1 is bent longitudinally of its edge over the edge of a clamping block or anvil 2 about an axis which is tangent to the broken line 3 which indicates the base of the flange which is to be bent around the entire circumference of the plate. The circumference of the plate around its extreme outer edge 4 is considerably greater than the circumference of the circle indicated at 3. Now, if a flange is turned at right angles to the plate, the entire distance around its edge, it will be obvious that the extreme edge 4 will have to have the same circumference as the base 3 of the flange. To accomplish this, the metal at the extreme outer edge 4 must necessarily be longitudinally compressed and so flow that the outer edge 4 becomes thickened with respect to the base 3 of the flange, because the surplus metal due to the greater initial circumference of the edge 4 must be taken care of. The metal at the edge 4 of the plate, however, resists the longitudinal compression, so that, as shown in Fig. 4, instead of the plate remaining flat and the edge 4 becoming longitudinally compressed when it is flanged, the resistance of the edge 4 to longitudinal compression causes it to push out sidewise and bow or buckle the plate transversely and concavely upward. Since the plate is held clamped only by the work clamp in the machines illustrated

in the above mentioned patents, the edge 4 retains substantially the same length as in the flat plate, the edge 4 at the bent over portion keeping its original thickness and being pushed out sidewise to warp or buckle the plate transversely. If the bending operation on a cold plate, the first step of which is shown in Fig. 4, is carried on as described in my prior patents, until the entire circumference of the round plate 1 is flanged, each time the flange is bent, the resistance of the edge 4 to longitudinal compression will cause the plate to be buckled or made concave on its upper side, so although after the complete flange is bent, the edge 4 is thickened by the flow of metal which compensates for the greater initial circumference of the edge, nevertheless, the plate will present a buckled appearance, the middle portion being dished or made concave on its upper side due to the transverse bending of the plate every time the edge is turned down, as shown in Fig. 4.

If the edge of the plate 1 is heated and the flange is bent, the hot metal readily flows so that the extreme edge 4 thickens instead of being pushed out sidewise, as shown in Fig. 4, so that although a curved cold iron or steel plate cannot satisfactorily be flanged in the machines illustrated in the above mentioned patents, nevertheless, if the edges are heated, the plates can be satisfactorily flanged without buckling. However, as it is cheaper to flange a plate without having to heat it, one of the objects of the present invention is to devise a method by means of which a metal plate having a curved edge can be flanged cold. According to the present invention, the transverse buckling of the plate, shown in Fig. 4, is prevented by clamping the plate in such a position that when its edge is bent over longitudinally to form the flange, the extreme edge 4 cannot move out sidewise to buckle the plate, but the metal must flow so that the edge 4 is longitudinally compressed and is thickened. Suppose the plate to be clamped transversely flat while the edge is flanged. Under these circumstances even though the edge 4 is longitudinally compressed, the cold metal of the edge 4 is elastic enough so that when the plate is released the edge 4 will expand longitudinally to some extent and cause the plate to be buckled somewhat, as shown in Fig. 4, only less so. Therefore, in order that the metal at the extreme edge 4 of the plate shall be thickened sufficiently, so that after the plate is unclamped the plate will not be buckled, but will be substantially flat, it is necessary to bend the plate transversely so that the plate is concave on the side which faces the direction in which the flange projects. As above pointed out, if the plate is free to buckle, or if it is merely held flat, the bend-

ing of the flange will cause a transverse strain in the plate. The term strain, as here used, is to be understood as used in scientific language, meaning the deformation which results from a stress. According to the method of the present invention, the undesirable transverse strain which results in buckling the plate is obviated, or as might be said anticipated, by reversely straining the plate by an amount approximately the same as the plate would be transversely strained as a result of bending the edge longitudinally to flange it.

Referring particularly to Figs. 5, 6, 7 and 8, the plate 1, according to the preferred manner of carrying out the method of the present invention, is first given a reverse strain transversely to the edge by means of two members 5 which engage the plate on the side opposite the clamping block or anvil 2 and bend the plate transversely over it, so that the plate assumes the shape shown in Fig. 5. Then, while the plate is held thus reversely and transversely strained, the edge of the plate is bent longitudinally of the edge downward through an angle of about 30 degrees about an axis which is tangent to the base line 3 of the completed flange, so that the flange extends from the lower or concave side of the transversely bent plate. The members 5 hold the plate so that it cannot buckle and, therefore, the metal at the extreme edge 4 is longitudinally compressed and is forced to flow so that the surplus metal is taken care of by the thickening of the edge. The plate now has the form shown in Fig. 6. Then, the plate is freed from the stress exerted upon it by the members 5 and the anvil 2. The resiliency, which the cold metal at the edge 4 possesses, causes the edge 4 at the turned down portion to tend to resume its original length, so that when the plate is free, the plate springs back substantially flat, as shown in Fig. 7. After the first flange bending operation, illustrated diagrammatically in Figs. 5, 6 and 7, has taken place, the plate is turned to present another portion of its circumference to the clamping block 2, the members 5 and the bender, and the operation is repeated until the entire circumference of the plate is flanged, as will be readily understood by one skilled in the art from a perusal of my two prior patents above mentioned.

Of course, it is to be understood that the amount which an unclamped plate will be transversely strained by flanging, as shown in Fig. 4, and the amount of reverse strain applied to the plate, as shown in Figs. 5 and 6, are exaggerated for the purpose of better presenting to the eye the method of the present invention. It is evident that, as the reverse, transverse strain is applied to compensate for the resiliency of the metal,

it is within the elastic limit of the metal, whereas the bend which is imparted to set the flange is beyond the elastic limit of the metal.

5 While in the preferred manner of practicing the present invention, the plate is first transversely bent and then the flange is bent while the plate is held transversely bent, nevertheless, it is within the purview of the
10 present invention, viewed in its broader aspects, to simultaneously transversely bend the plate and bend the flange so that the extreme edge of the plate is longitudinally compressed at the same time the flange is set, or to first bend the flange on the plate
15 and to subsequently transversely bend the plate while the flange is held bent to longitudinally compress the metal at the extreme edge of the plate. The invention, viewed in
20 one of its broader aspects, consists in counter-acting the tendency of the plate to warp when the flange is bent by reversely and transversely bending or straining the plate whether the reverse bending or straining
25 takes place before or after the bending of the flange or simultaneously with it.

The illustrated embodiment of the machine for carrying out the present invention is described as follows:—The plate 1,
30 which is to be flanged, is held in a work clamp which comprises an anvil 2 and a clamping block 10. The anvil 2 is lifted by means of a wedge 11 operated from a compressed air cylinder 12 to firmly clamp the
35 work in place. The upper clamp block or member 10 can be swung up about a hinge 13 by means of a handle 14 so that the work can be readily removed after it is flanged. The flange is bent upon the edge of the
40 plate by means of a bender which comprises a work engaging plate 15 which is mounted upon a segmental bender carrier 16 which is provided with a segmental gear 17. The segmental gear 17 meshes with a rack 18
45 which is reciprocated by means of compressed air in the cylinder 19 to impart an angular movement to the bender. The bender is repeatedly oscillated through an angle somewhat more than 30 degrees and
50 the work is fed and clamped until a flange of about 30 degrees is turned around the entire periphery of the plate. Then the bender is shifted forwardly so that the completed flange is bent in a plurality of steps,
55 as clearly described in the McCabe Patent No. 1,030,416. The above mentioned parts with the exceptions hereinafter noted have substantially the same construction and mode of operation as the corresponding
60 parts in the McCabe Patent No. 1,030,416, and further detailed description thereof is unnecessary.

The anvil 2 about which the flange is bent, instead of having a flat top, as in the
65 machine shown in the McCabe patent, has

its top transversely rounded, as clearly shown in Fig. 2 of the drawings. The upper clamping block 10 has a flat, work engaging surface and is provided with two laterally extending arms 30 in which are
70 screw-threaded two work engaging members or studs 5. One of the studs is provided with a hand wheel 31 and is connected to the other stud by means of sprockets 32 and a chain 33 so that both
75 studs can be turned simultaneously. After the first flange bending movement of the bender 15, the plate is turned to bring an unflanged portion into the work clamp, the flanged portion being moved to one side of
80 the clamp. The dissymmetry between the flanged portion on one side of the clamp and the unflanged portion on the other, causes the plate to move forward on one side and backward on the other side be-
85 neath the studs 5 so that the arms 30 experience a couple tending to twist the block 10 about a vertical axis. To brace the arms 30 against twisting, a removable tie rod 35 extends from each arm 30 to the frame of
90 the machine.

In the front of the arms 30 are formed recesses 36 in which are received the forked legs 37 of a spacing rod 38. The legs 37
95 have holes at their ends to receive locking pins 39 to hold them in the recesses 36. On the other end of the spacing rod 38 are adjustably mounted two collars 43 and 44, between which is mounted a screw-threaded
100 pin 46 which has an eye in its shaft so that it can be longitudinally adjusted on the rod 38 by means of the collars. The upper end of the pin 46 also has an eye by means of which it is connected to a block and tackle 47 hung from overhead in the shop-
105 building. The lower end of the pin 46 is screw-threaded to receive a nut 48. When a circular plate is to be flanged, a small hole is drilled through the center of the plate. Then, the threaded end of the pin 46 is
110 passed through it and the nut 48 screwed into place. The plate 1 can then be lifted by the block and tackle 47 and swung up to the machine where it is positioned with
115 relation to the work clamp by means of the collars 43 and 44 on the spacing rod 38. The edge of the plate 1 is thus accurately positioned in the flanging machine, while the plate is free to turn about its center to present successive portions of the periphery
120 to be flanged.

In order to bend the flange with a wiping stroke of the bender plate 15, the anvil 2 and bender plate 15 are arranged somewhat
125 differently than they are in the McCabe patents above mentioned. In the machine illustrated in the drawings, the axis about which the bender oscillates is indicated by the X 50 (see Fig. 1). This axis is located inwardly
130 from the edge of the anvil 2. As shown in

Fig. 1, the bender plate 15 is farther above the anvil in its initial position than in the machine of the McCabe patents. This is necessary because the anvil projects some distance to the right, as viewed in Fig. 1, of the axis of oscillation 50 of the bender plate. The side of the anvil, as indicated at 51, is undercut somewhat so that the flange is bent a little bit beyond a right angle to compensate for the elastic springing back of the flange, which as described in the McCabe Patent, No. 1,030,416 must be allowed for. The face 51 of the anvil extends thus at about right angles to the upper face of the anvil against which the work is clamped and forms with it the corner about which the flange is bent. The axis 50 is removed from the corner of the anvil and is nearer the face of the anvil against which the work is clamped than it is to the face 51. As shown in Fig. 1, the bender plate 15 moves laterally toward the corner of the anvil simultaneously with its angular movement about the corner, so that these two movements combine to give the bender plate an angular wiping stroke against the work. The bender plate 15 moves from the dotted line position into the full line position shown in Fig. 1 for the first step in bending the flange. Afterward, the segment is twice shifted forwardly so that when the flange bending operation is completed, the bender plate 15 carries the edge of the plate 1 against the undercut face or side 51 of the anvil. As will be readily understood from an inspection of Fig. 1, the bender plate 15 will first engage the extreme outer edge of the plate, and since it is oscillating about an axis which is located inward from the edge of the anvil about which the flange is bent, the bender plate 15 will slide downwardly on the plate as it bends its edge, thus bending the flange with a downward angular wiping stroke. This wiping stroke is much more effective in setting the flange than an angular movement of the bender plate without the wiping movement.

The operation of the machine illustrated in the drawings is as follows:—The round plate 1, which is to be flanged cold, is hung upon the pin 46 and properly spaced from the clamping machine by means of the spacing rod 38 so that the line 3 which marks the base of the flange lies at the corner of the anvil about which the flange is to be turned. The hand wheel 31 is turned until the studs 5 project the proper distance below the face of the upper clamping member 10. The amount that the studs 5 are to project varies with the size of the plate to be flanged, with its thickness and with the resiliency of the metal. With a circular plate of boiler iron about one-half an inch thick and about four feet in diameter, I find that the studs 5 should be set to project

about five-eighths of an inch. Then, the compressed air is admitted into the cylinder 12 and the wedge 11 forced into place to clamp the plate as will be readily understood from my two patents above mentioned. As the top plate of the anvil 2 is lifted by the wedge 11, the plate 1 is reversely strained or bent so that its upper side is convex, as shown in Figs. 2 and 5. Then, while the plate is held thus clamped and reversely strained, the compressed air is admitted to the cylinder 19 moving the bender from the dotted line position to the full line position, illustrated in Fig. 1, to bend the edge of the flange through an angle of a little over 30 degrees. The plate now is in the shape illustrated in Fig. 6. Then, the compressed air is admitted into the other end of the cylinder 19 to move the bender from the full line into the dotted line position and the compressed air is admitted into the cylinder 12 to unclamp the plate. The plate which is relieved of the bending stress caused by the anvil 2 and the studs 5 springs into shape substantially like the illustration in Fig. 7. Then, the plate is swung about the bolt 46 as an axis to present an unflanged adjacent portion on the edge to the machine and the flanging operation is repeated again and again until the entire edge of the plate is flanged through an angle of about 30 degrees. While the plate, as illustrated in Figs. 5, 6 and 7, is shown as having been transversely bent only enough so that when the plate is unclamped it will be flat, it is, however, found preferable to transversely bend the plate by means of the studs 5 so that when the plate is unclamped it will not be exactly flat, but will be slightly bent convexly upwardly so that after the plate is flanged all the way around through an angle of about 30 degrees, the center of the plate will be slightly crowned. After the flange is set through an angle of about 30 degrees, the rack 18 is shifted on the segmental gear 17 and the flange is bent until it stands at about 60 degrees to the plate. Then, the rack and segmental gear are shifted again and the bender 15 is moved against the face 51 of the anvil to set the flange at right angles to the plate. The manipulation of the valves and levers for admitting the compressed air and for shifting the rack and gear will be readily understood from my two prior patents above mentioned. During the operation of bending the flange from a 30 to 60 degree angle, the studs 5 are set about three-eighths of an inch below the face of the clamping block 10, and during the last bending operation in which the flange is finally set at right angles to the plate, the studs 5 are set about three-sixteenths of an inch below the face of the clamping block 10. It is to be understood that these measurements are only

approximate and are such as I have found to give about the right results with a boiler-iron plate about four feet in diameter and one-half inch in thickness when it is flanged cold. The studs 5 are preferably set so that after the flange is set through an angle of 60 degrees the plate is still slightly crowned. During the bending of the flange from a 60 degree to a 90 degree angle, the studs 5 are preferably set to hold the plate transversely bent to such an amount that when it is unclamped it will spring back to leave the plate substantially flat. It will be noticed that during the three successive bending operations, from 0 to 30 degrees, from 30 degrees to 60 degrees and from 60 to 90 degrees respectively, the distance that the studs 5 are set below the face of the clamp plate 10 is successively reduced. This is because as the flange is bent more and more it stiffens the edge of the plate and renders it less resilient to a transverse strain so that after the plate is released it cannot spring back as much. After the flange is set through 90 degrees, or the desired angle, the tie rods 35 are loosened, the pins 39 are removed to free the spacing rod 38 and the upper clamping block is swung up by means of the lever 14 so that the flanged plate can be removed from the machine. The work engaging face of the bender plate 15 and the face 51 of the anvil 2 are substantially flat or slightly curved for operating upon the curved edges of plates. The bender and anvil are removably mounted upon the machine so that they may be replaced by bender plates and anvils of different shapes.

While the preferred manner of carrying out the method of the present invention has been explained and described in detail, it is to be understood that the method is not limited to the details set forth in the description, but may be embodied in other methods within the scope of the invention as defined in the following claims.

I claim:

1. The method of flanging the curved edge of a plate which consists in subjecting the edge of the plate to a transverse strain reverse to the direction in which the bending of the flange tends to transversely bend the edge and of such an amount that when the plate is released after the flange is bent, the plate near the edge will be substantially

flat, and in flanging the edge of the plate while it is held thus strained.

2. The method of flanging the curved edge of a plate which consists in bending the plate in two opposite directions which are substantially at right angles to each other, one bend being longitudinal of the edge and exceeding the elastic limit of the material, and the other bend being concave on the same side of the plate as the first bend and being transverse to the edge of the plate and not exceeding the elastic limit of the material.

3. The method of flanging the curved edge of a plate which consists in flanging the edge of the plate and counteracting, by transversely bending the edge, the tendency of the plate to become warped, the flange and the transverse bend both being concave on the same side of the plate.

4. The method of flanging a curved edge of a plate which consists in bending the edge longitudinally to form the flange and counteracting the tendency of the plate to become warped by transversely bending the edge in a direction opposite to the direction in which the bending of the flange tends to transversely bend the edge.

5. The method of flanging a curved edge of a plate which consists in bending the edge of the plate longitudinally to form the flange and counteracting the tendency of the plate to become warped by transversely bending the edge in a direction opposite to the direction in which the flanging of the plate tends to transversely bend the edge and holding the plate thus transversely bent while it is flanged.

6. The method of flanging the curved edge of a plate which consists in flanging successive portions of the edge of the plate to bend a continuous flange in a plurality of steps, and in counteracting the tendency of the plate to become warped by transversely bending the edge of the plate at each flange bending step, the transverse bend being in the direction opposite to that which the flanging of the plate tends to transversely bend the edge.

HUGH McCABE.

Witnesses:

JAMES A. McCABE,
MONICA I. BUTLER.

Correction in Letters Patent No. 1,065,824.

It is hereby certified that in Letters Patent No. 1,065,824, granted June 24, 1913, upon the application of Hugh McCabe, of Lawrence, Massachusetts, for an improvement in "Methods of Flanging," an error appears in the printed specification requiring correction as follows: Page 1, line 45, after the word "plate" insert the words *could because of the increased labor and time*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of August, A. D., 1913.

[SEAL.]

E. B. MOORE,
Commissioner of Patents.