Sept. 27, 1932. C. CARLSEN 1,879,077

METHOD OF AND MEANS FOR FORMING PIPE BLANKS

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Fig. 1.

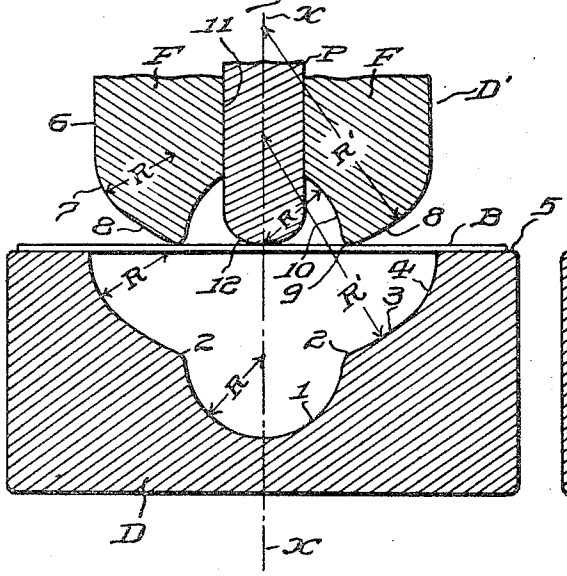


Fig. 2.

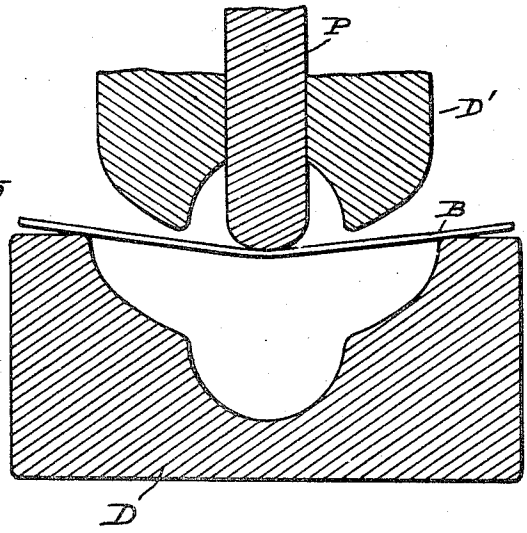


Fig. 3.

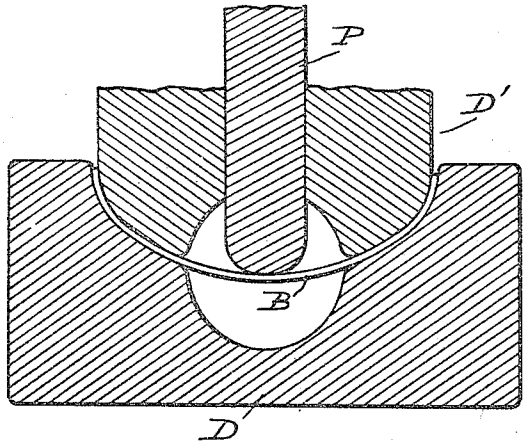
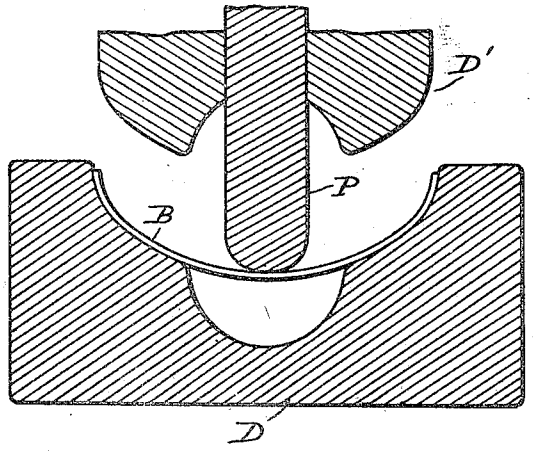


Fig. 4.



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METHOD OF AND MEANS FOR FORMING PIPE BLANKS

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Fig. 5.

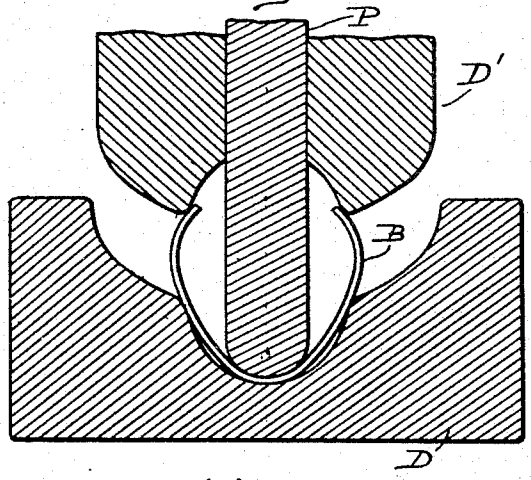


Fig. 6.

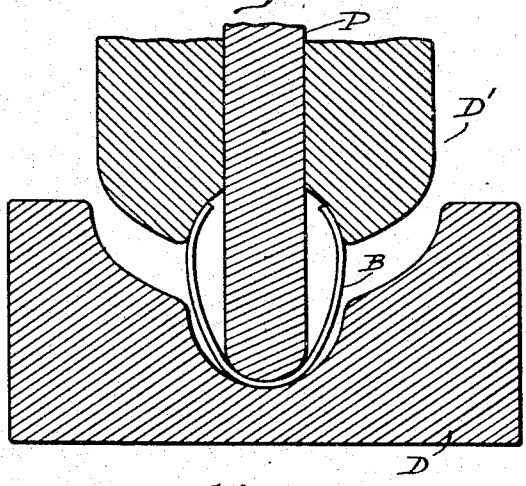


Fig. 7.

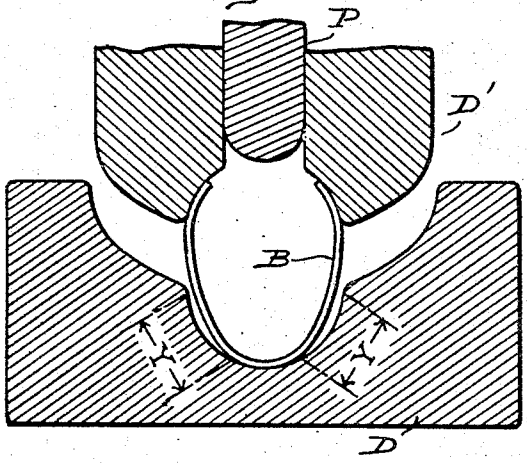


Fig. 8.

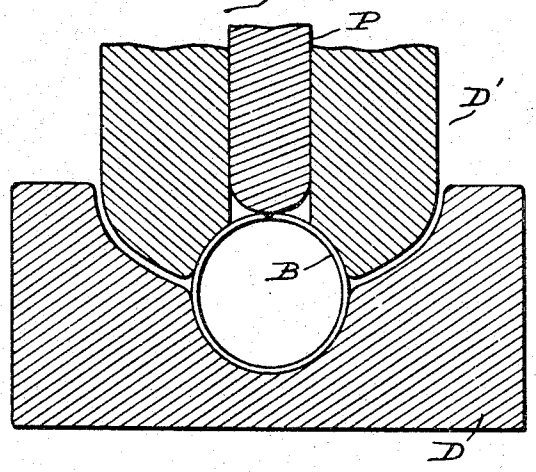


Fig. 9.

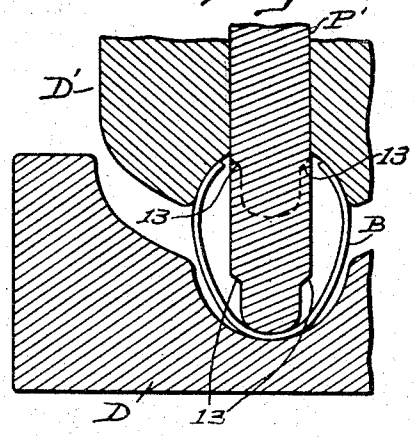


Fig. 10.

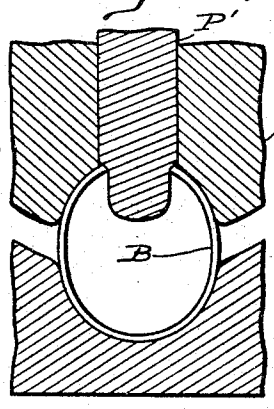
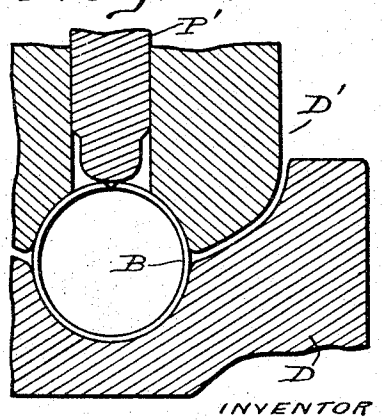


Fig. 11.



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METHOD OF AND MEANS FOR FORMING PIPE BLANKS

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Fig. 12.

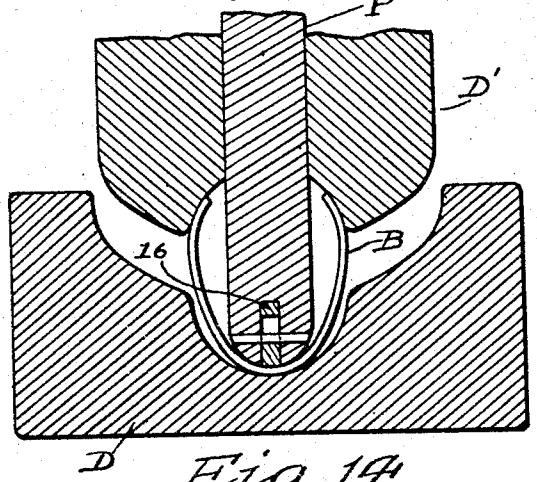


Fig. 13.

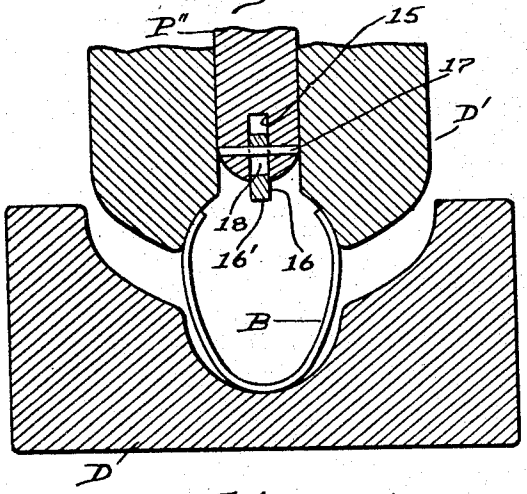


Fig. 14.

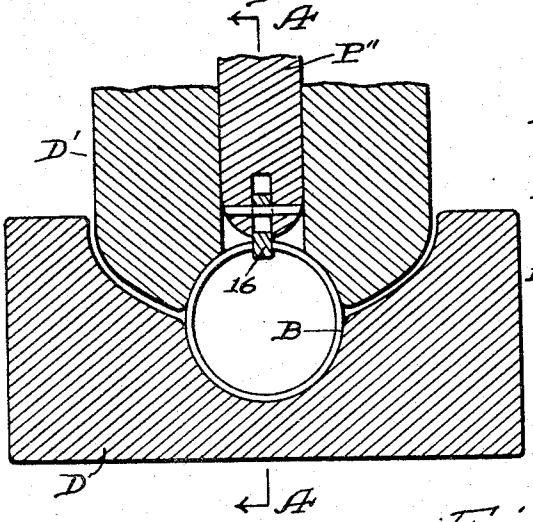


Fig. 15.

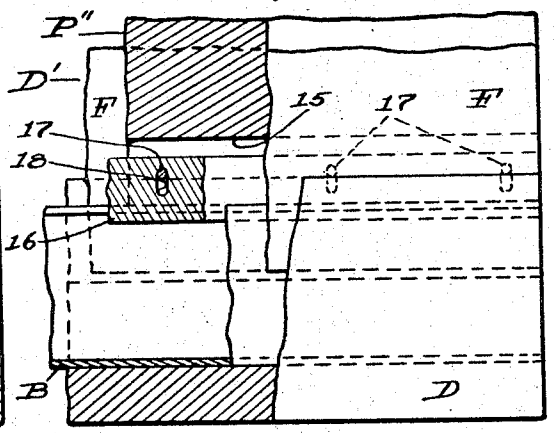
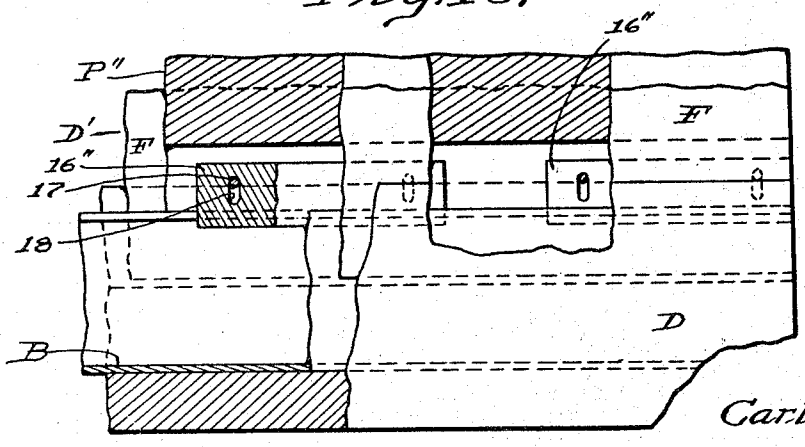


Fig. 16.



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UNITED STATES PATENT OFFICE

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METHOD OF AND MEANS FOR FORMING PIPE BLANKS

Application filed March 7, 1929. Serial No. 344,979.

One method commonly employed in the manufacture of steel or other forms of metallic pipe is to reduce a flat, elongated rectangular blank to cylindrical cross-section by forming up the blank in a series of dies and to then weld the longitudinal seam between the adjacent side edges of the blank. In the practice of this method it has heretofore been necessary to utilize a series of separate dies, each designed to effect only a partial shaping of the blank so that the latter, as it is consecutively operated on by the various dies through which it is progressively passed, is ultimately brought to the desired cylindrical or substantially cylindrical shape. It is obvious that this method is open to numerous disadvantages, among which may be mentioned the relatively heavy cost of the series of dies, the necessity of providing a plurality of separate presses for the different dies or, when but one press is used, the necessity for inserting and removing the different dies therefrom as the work progresses, the large amount of capital continuously tied up in the presses when a press is provided for each set of dies as is the usual practice, the large amount of floor space required for the presses, and the necessity of transferring each blank from one set of dies to the next as it is progressively formed up and of properly locating the blank therein with consequent loss of time and enhancement of labor costs with resultant increase in manufacturing expense.

The principal object of my invention, therefore, is to provide a novel method of reducing a flat, rectangular blank, and more particularly one of elongated shape, to cylindrical cross-sectional form by a series of successive operations in a single set of dies, as well as to provide a set of dies of novel form adapted for the performance of the said method and which are so constructed and arranged that after the blank has been initially inserted therein it may be brought to cylindrical form by suitable manipulation of the dies without removing the blank from the dies or adjusting its position with respect thereto.

My invention further includes other objects, advantages and novel features of operation and of design, construction and arrangement hereinafter more particularly pointed out or which will be apparent to those skilled in the art from the following description of certain manners of performing the invention through the use of my improved dies.

As hitherto stated the invention may be advantageously employed for forming cylindrical pipe blanks designed to be welded along the longitudinal seam formed at the abutting or substantially abutting side edges of the blank to thereby form the completed pipe, and for convenience of description I will therefore refer to the use of the invention for that purpose, it being understood however that it may be employed with equal facility for the formation of hollow cylindrical articles other than pipe blanks from rectangular flat sheets or plates.

In the performance of the invention I provide, but a single set of dies comprising a single female member and a compound male member embodying relatively movable parts or elements, both the female and the male members of the set being of sufficient length to receive the blank which, of course, usually substantially corresponds in length to the pipe which is to be formed. Thus if the latter is to be ten feet in length the dies should have a length at least as great, although it will of course be obvious that the dies may be longer than the blank on which they are to operate or, in other words, than the pipe blank or the pipe to be formed therefrom.

In the accompanying drawings, Figs. 1 to 8 inclusive consecutively illustrate the series of operations requisite for reducing the blank to the desired cylindrical shape when employing a set of dies constructed in accordance with one embodiment of my invention and as shown in the said figures, while Figs. 9 to 11 inclusive, respectively substantially corresponding to Figs. 6, 7 and 8, consecutively illustrate the final operations corresponding to those illustrated respectively by Figs. 6, 7 and 8 when using a slightly modified form of male die which, under certain conditions and for certain classes of work, may be found preferable to the form shown

in the preceding figures: In Figs. 12 to 15 inclusive I have illustrated a further slightly modified form of male die which may be employed when it is desired to leave a space or gap between the juxtaposed edges of the formed-up blank. Of these figures, Figs. 12, 13 and 14 respectively correspond to Figs. 6, 7 and 8 and illustrate the final operations incident to the use of this form of die while Fig. 15 is a fragmentary side elevation of the dies shown in Fig. 14 and partially in central vertical section on line A—A of said figure. Fig. 16, generally corresponding to Fig. 15, illustrates a further slight modification of the male die. As the dies exhibit at all points throughout their length the same cross-sectional profile all of the said figures save Figs. 15 and 16 may therefore be considered as cross-sectional views of the dies and of the blank at any point throughout their respective lengths.

I shall first refer more particularly to the conformation and construction of the dies shown in Figs. 1 to 8 inclusive and then to the series of operations incident to their use in forming up the blank and for this purpose reference may first be had to Fig. 1. Thus in the said figure I have shown the female die D which is in the form of a longitudinally extending block of suitable length hollowed out so as to provide a central, substantially semi-cylindrical channel 1 having a radius R corresponding to the radius of the exterior of the pipe to be formed, the channel being symmetrically disposed with respect to the central, vertical longitudinal plane X—X of the die. This channel terminates on opposite sides of the plane X—X in a shoulder 2 which is slightly rounded off and lies substantially in the same horizontal plane as the center of curvature of the channel; from each of these shoulders the die is cut back outwardly to form a surface 3 of radius R′ which merges into a succeeding surface 4 of radius R and terminates at the upper face 5 of the die. Thus the opening in or mouth of the die is of materially greater width than the channel 1 though of less width than the blank B which is to be formed-up and which therefore, when symmetrically positioned across the mouth of the die at the beginning of the forming-up operation, extends considerably beyond the same in either direction as shown in Fig. 1.

The male member of the die, generally designated as D′, comprises a plurality of parts, namely, a central plunger P disposed between side formers F—F between which the plunger is vertically movable. The formers F—F may be either integral with each other or else constructed separately but in any case are arranged to move unitarily throughout the series of operations incident to forming-up the blank. The profiles of both side formers F—F are similar though, of course, the formers are oppositely disposed. Thus, and beginning at the lower end of the outer vertical side face 6 of either former, the surface thereof is carried inwardly on a radius R to form a surface 7 which merges into a surface 8 having a radius R′ conformable to the surface 3 of the female die and terminates substantially above the subjacent shoulder 2 of the latter; from thence the lower corner of the former is upwardly rounded off as at 9 and its profile then carried upwardly and inwardly to form a surface 10, also having a radius R, terminating at the slot 11 between the formers in which the plunger P is disposed. This latter, in the form of the invention now being described, has vertical side faces engaging the sides of the slot 11 and a transversely rounded lower extremity 12 the central part of which desirably approximates the radius of curvature R′.

It will of course be understood that in use the dies are firmly secured in a suitable press of such construction that relative motion can be accorded the plunger and formers of the male die so that as required the plunger may be moved up and down relatively to the formers and the die D, or the formers similarly moved relative to that die and to the plunger, or both the plunger and formers moved together as a unit relatively to the die D.

The series of operations incident to the reduction of the blank B to cylindrical form and as illustrated in Figures 1 to 8 will now be described: With the formers and plunger elevated above the die D, the blank is first laid on the upper surface of the latter so as to extend symmetrically across the opening therein as shown in Fig. 1. The plunger P is then lowered to the position shown in Fig. 2 in which its end is substantially tangent to an arc of the radius R′, that is, an arc coincident to the surfaces 8, 8 thus bending the blank slightly downward to substantially the position shown in said figure. Both the side formers F—F and the plunger P are then moved downward as a unit while occupying the relative position just described, to thereby force the blank into the die D until the parts assume the position shown in Fig. 3 in which it will be noted the blank snugly conforms to the surfaces 3 and 4 of the die D and corresponding surfaces of the formers. For the next operation the side formers of the die D′ are retracted upward until their lower corners are above the lower die D in which the blank is retained by the plunger during this movement of the formers thereby bringing the parts to the position as shown in Fig. 4 with the sides of the blank snugly conforming to the surfaces 3 and 4 of the female die and its central portion extending over the channel 1 therein and being slightly bowed downward. With the formers still raised, the plunger is then forced downward to the limit of its posible movement thus

bringing the central part of the blank against the central part of the channel 1 and causing the side portions of the blank to move oppositely inward as they fulcrum on the shoulders 2, 2; the side edges of the blank are, by this operation, moved inwardly beneath the points 9, 9 of the formers so that as the latter are thereafter moved down they will engage and overlap the blank adjacent its edges substantially as shown in Fig. 5 whereby, as the downward movement of the formers is continued, the blank is oppositely and inwardly compressed and the portions thereof adjacent its side edges caused to conform to the surfaces 10, 10 of the formers substantially as indicated in Fig. 6, the blank during this operation bending oppositely inwardly about the curved lower end of the plunger and away from the shoulders 2, 2. When the formers have been lowered sufficiently to bring the edges of the blank into proximity with the plunger, the latter is then raised as shown in Fig. 7 to a position in which when the die D' is subsequently lowered to final position, the lower end of the plunger will be substantially tangent to the then cylindrical blank; the plunger and formers while occupying the relative positions just described are now moved down as a unit to final position as shown in Fig. 8 thus bringing the blank to the desired cylindrical form.

It will be observed that when the blank has assumed the position shown in Fig. 7, the portions thereof lying adjacent its side edges have been brought by the formers to the desired curvature and that the central part of the blank lying at the bottom of the channel 1 has also been brought thereto but that those portions of the blank lying between its properly curved central part and its properly curved lateral portions have yet to be brought to the desired final curvature. Under most conditions this final shaping of these portions of the blank is satisfactorily effected by the movement of the male die from the position shown in Fig. 7 to that shown in Fig. 8 as owing to the peculiar conformation of the dies pressure is exerted on the blank during this movement in such a way as to cause the blank to properly conform to the sides of the channel 1 throughout the areas designted as Y, Y in Fig. 7.

However, under certain circumstances and with certain classes of material difficulty is sometimes encountered in effecting this result with dies of the character of those to which I have hitherto referred, and under these conditions it may be preferred to use a plunger of the form shown in Figs. 9 to 11 inclusive. This plunger P', similarly to the plunger P, has its lower end suitably rounded but is inwardly offset on each side above that end and parallel to its side faces and provided at the upper extremity of the inwardly offset portions with outwardly oppositely inclined shoulders 13 against which the edges of the blank can abut when forced thereagainst by suitable movement of the formers F—F which, as well as the die D, are of the same construction as that heretofore described and thus capable of use with either form of plunger.

When employing a plunger P' of the type to which reference has just been made, the operations incident to the forming of the blank as illustrated in Figs. 1 to 5 inclusive are identical to those heretofore described and thus require no further explanation. However after the formers have been lowered sufficiently to receive and slightly overlap the edges of the blank as in Fig. 9 the plunger P' is raised to approximately the dotted line position in said figure thereby bringing the inclined shoulders 13 opposite the edges of the blank and both the formers and plunger are then moved toward the die D in unison thus causing the edges of the blank to engage the shoulders 13 whereby, as the upper die approaches the lower, the blank is bulged outwardly into the areas Y, Y so as to closely conform thereto. When the die, plunger and formers as a unit have been lowered sufficiently to accomplish this result as shown in Fig. 10, the plunger is retracted to a point at which its lower end will be tangent to the surface of the blank at the completion of the final operation and the plunger and formers then moved again toward the lower dies in unison until the blank is finally brought to cylindrical shape as shown in Fig. 11.

It is thus apparent that in accordance with my invention but a single set of dies are required for reducing the flat blank to cylindrical form and, further, that once the blank has been introduced to the dies no repositioning or adjustment of the blank therein is required throughout the ensuing series of operations so that the latter can be carried on rapidly by the use of but a single press and without requiring the services of operatives for adjusting the position of the blank in the dies or moving it from one set of dies to another. An additional and extremely important advantage of my invention resides in the fact that the cylindrical blanks formed in accordance therewith have little or no tendency to spring apart after removal from the dies with consequent separation at the longitudinal edges of the blank at the point where the seam is to be formed by welding. This tendency to spring apart and thus separate the edges of the blank adjacent the seam line is inherent in cylindrical pipe blanks formed by the methods heretofore in use and enhances the difficulty of properly welding the seam as well as increases the cost of manufacture through the necessity of bringing the blank back to proper shape with its edges in contact, or substantially in contact, before

the weld can be made. Steel pipe blanks formed in accordance with the present invention, however, are free from this difficulty and are thus particularly suitable for satisfactory welding at a minimum of expense.

I have heretofore referred more particularly to the forming-up of a flat blank in such manner that its juxtaposed edges after the forming-up operation is completed will be in abutting or substantially abutting relation, but under certain conditions of pipe and tube manufacture it is sometimes desirable to have the completed blank exhibit a space or gap of predetermined width between said edges, blanks of this character being frequently employed when the edges are to be united by resistance welding or for other purposes. This result can be readily effected in accordance with my invention by using a plunger P″ such as is shown in Figs. 12 to 15 inclusive and to which reference will now be made. This plunger which, save in the respects now to be mentioned, may be similar to the plunger P or to the plunger P′ hitherto described, is provided with a central longitudinally extending slot 15 extending the full length of the plunger and upwardly and inwardly directed from its lowest point and spaced equidistantly from its side faces. Within this slot is disposed a tongue 16 so arranged as to be vertically slidable in the slot and of such height that when pushed upwardly into the slot it will be completely housed therein with its upper edge abutting or substantially abutting the bottom of the slot and its lower edge 16′ lying coincident with the lower end surface of the plunger to which the lower edge of the tongue desirably conforms. For supporting the tongue in the plunger in such manner that it can move freely in the slot, a plurality of pins 17 are extended transversely through the plunger at longitudinally spaced intervals and through correspondingly spaced vertical slots 18 formed in the tongue and of such length that the tongue can drop by gravity to a position, as shown in Figs. 13 and 14, in which it projects for a short distance below the curved end of the plunger.

The operations incident to the forming-up of the blank when using a plunger P″ of the character of that just described are exactly similar to those to which reference has heretofore been made and thus require only a brief mention. From an inspection of Fig. 12 it will be apparent that throughout the series of operations whenever the plunger is forced down against the blank, the tongue 16 will be correspondingly forced up into the slot and the lower end of the plunger will therefore operate on the blank in the same way as if the plunger were of either of the type P or P′. When the plunger is retracted relatively to the side formers, however, or otherwise moved upwardly away from the blank, the tongue will drop down so as to project below the end of the plunger as shown in Figs. 13 and 14 with the result that in the final forming operations, as illustrated by said figures, the edges of the blank are brought into abutting engagement with the sides of the tongue and thus kept apart for a distance equal to the thickness of the tongue instead of being allowed to come together as when a plunger devoid of the tongue is utilized. Thus at the conclusion of the forming-up process the completed blank exhibits a space or gap between its juxtaposed edges corresponding or substantially corresponding to the thickness of the tongue and as blanks formed with this gap in accordance with my invention have little or no tendency to spring apart after being removed from the dies the width of the gap remains substantially constant indefinitely, just as the edges of the blank remain in engagement or substantially in engagement after the blank is removed from the dies when a plunger unprovided with the gap forming tongue is employed.

The tongue 16 may be either continuous throughout the length of the plunger, as shown in Fig. 15, or it may be made in a plurality of short longitudinally separated sections 16″ as shown in Fig. 16 in which case each section is supported by the pins 17 or other convenient means so it can move up and down in the plunger as required. Of course under these conditions all of the tongue sections move simultaneously relative to the plunger when the latter is raised or lowered.

It will thus be understood that the present invention contemplates both the formation of tubular blanks in which the juxtaposed edges are in abutting or substantially abutting engagement as well as blanks in which the said edges are separated by a gap or space and, consequently, that terms such as cylindrical, substantially cylindrical, or the like as herein employed for convenience of description are to be understood as including both of said forms.

While I have herein described with considerable particularity both the specific shape of the dies and the series of operations therewith which I prefer to employ in the practical performance of my invention, I do not thereby desire or intend to confine myself solely thereto as slight variations may be made, if desired, in the conformation of the dies as well as modifications in the series of operations incident to their use without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:—

1. The method of reducing a flat blank to hollow cylindrical cross-section by means of a die having relatively movable members,

which comprises the steps of first positioning the blank in the die and then, by manipulation of the members of the die, curving the blank transversely from one side edge to the other, then drawing the side edges of the blank inwardly toward each other, then bulging the blank outwardly in opposite directions to bring a portion of the blank to substantially semi-cylindrical cross-section and finally forming the rest of the blank to substantially similar cross-section.

2. The method of reducing a flat blank to hollow cylindrical cross-section by means of a die having relatively movable members, which comprises the steps of first positioning the blank in the die and then, by progressive manipulation of the members of the die, symmetrically curving the blank transversely from one side edge to the other, then drawing the side edges of the blank symmetrically inwardly toward each other, then symmetrically bulging the blank outwardly in opposite directions to bring a portion of the blank to substantially semi-cylindrical cross-section and finally forming the rest of the blank to substantially similar cross-section.

3. The method of reducing an elongated flat blank to hollow cylindrical cross-section by progressive operations in a die having relatively movable members and without removing the blank therefrom, which comprises the steps of first positioning the blank in the die, then by relative movement of the members of the die first slightly dishing the blank at its center, then curving the blank transversely from one side edge to the other, then drawing the side edges of the blank inwardly toward each other, then bulging the blank outwardly in opposite directions to bring a portion of the blank to substantially semi-cylindrical cross-section and finally forming the rest of the blank to substantially similar cross-section.

4. The method of reducing a blank to hollow cross section which comprises the steps of positioning the blank in a die having relatively movable members and then, without removing the blank from the die, by manipulation of said members bending the edges of the blank, then by further manipulation forcing a member of the die into the blank, withdrawing it therefrom and finally forming the blank to the desired cross section.

5. The method of die forming a cylindrical pipe which comprises the steps of positioning a flat blank in a die comprising relatively movable members, then by manipulation of said members bending said blank to a form in which said blank embraces a portion of one of the members, removing said portion from the blank, then, by further manipulation of the members, reducing the blank to substantially cylindrical form and thereafter removing the pipe from the die.

6. The method of reducing a flat blank to hollow cylindrical cross section, which comprises the steps of positioning the blank in a die having relatively movable members, and then by manipulation of said members while in engagement respectively with opposite faces of the blank first bending the blank transversely and symmetrically with respect to its longitudinal center line and thereafter, without removing the blank from the die, reducing the blank to desired cylindrical form while said members are engaged with one of said faces, the interior of the blank upon completion of said reduction being unoccupied by any of said members.

7. The method of reducing a flat blank to hollow cylindrical cross section, which comprises the steps of positioning the blank in a die having relatively movable members, then moving certain of said members while in engagement with one face of the blank relatively to another of said members while in engagement with the opposite face thereof to curve the blank transversely from one side edge to the other and symmetrically with respect to its longitudinal center line, then disengaging said first mentioned members from said first mentioned face and successively effecting engagement thereof with said opposite face without removing the blank from the die and progressively moving said members to transform the shape of the blank until it is reduced to the desired cylindrical form, the interior of the blank being unoccupied by any of said members upon completion of said reduction.

8. The method of forming a cylindrical pipe blank which comprises the steps of positioning a flat blank in a die having relatively movable members, effecting relative reciprocation between the members of the die in a plane substantially normal to the plane of the blank to thereby initially curve the blank transversely, then bend the blank simultaneously adjacent its longitudinal edges and thereafter adjacent its longitudinal center line and finally reduce the blank to desired cylindrical form without removing the blank from the die.

9. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges of said channel to the upper face of the die, and a male member comprising separate elements, one of said elements having curved surfaces substantially conforming to said curved surfaces of the female member and the other element being adapted to enter the channel in said female member and operatively relatively movable with respect to the first element.

10. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a

female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising side formers having curved surfaces substantially conforming to said curved surfaces of the female member and a central plunger relatively movable with respect to the side formers and adapted to enter the central channel of the female member.

11. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising side formers having oppositely curved surfaces respectively adapted to cooperate with said curved surfaces of the female member and other curved surfaces respectively extending oppositely inwardly from said first mentioned curved surfaces and a central plunger disposed between said last mentioned curved surfaces and relatively movable with respect to the side formers.

12. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising a central plunger adapted to enter the channel in the female die and members disposed on opposite sides of said plunger and each provided with a curved surface substantially conforming to the adjacent curved surfaces of the female die and an inwardly curved surface of a radius conforming to that of the channel extending from each first mentioned curved surface to the adjacent side of the plunger.

13. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member adapted to enter the female member and comprising relatively movable elements respectively provided with curved surfaces adapted to cooperate with the corresponding subjacent curved surfaces of the female die during the operation of forming the blank.

14. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising a central plunger aligned with the channel in the female die and adapted to enter thereinto, and side formers disposed on opposite sides of the plunger each provided with a curved surface substantially conforming to the curved surface of the female die aligned therewith and an inwardly curved surface of radius corresponding to that of said channel substantially extending from the extremity of the adjacent first-mentioned curved surface to the adjacent face of the plunger, the plunger being relatively movable with respect to the side formers and both side formers and plunger being operatively relatively movable with respect to the female die.

15. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising side formers and a plunger disposed therebetween and relatively movable with respect thereto, the side faces of the plunger adjacent its operating end being oppositely inwardly offset.

16. A die for reducing a flat blank to hollow cylindrical cross-section, comprising a female member having a central longitudinally extending channel of substantially semi-circular cross-section and curved surfaces extending oppositely outward from the edges thereof to the upper face of the die, and a male member comprising side formers adapted to cooperate with the curved surfaces of the female die and a central plunger relatively movable with respect thereto and having parallel side faces in slidable engagement with the formers; the sides of the plunger adjacent its operative end being inwardly offset, and oppositely outwardly inclined shoulders respectively extending between said offset portions and the side faces of the plunger.

17. A die comprising a female member having a central longitudinally extending channel and a male member comprising relatively movable elements arranged for relative reciprocation to and fro while forming the blank one within the other and cooperable with the female member to progressively reduce to hollow substantially cylindrical form a flat blank disposed thereon.

18. A die for forming a pipe blank, comprising a female member provided with a substantially semi-cylindrical channel and curved surfaces extending oppositely outward from the edges thereof and a male member adapted to enter the female member to thereby bend the edges of a blank disposed thereon and comprising side formers and a plunger disposed centrally thereof and rela-

tively movable with respect thereto, said plunger being operative when in one position to space the edges of the blank while the blank is being acted on by the side formers and operative when moved with the side formers towards another position to effect intimate engagement between said edges.

In witness whereof I have hereunto set my hand this 4th day of March, 1929.

CARL CARLSEN.