

C. P. HIGGINS.
 MULTIPLE DIE PRESS.
 APPLICATION FILED APR. 9, 1912.

1,043,520.

Patented Nov. 5, 1912.

2 SHEETS—SHEET 1.

Fig. 1

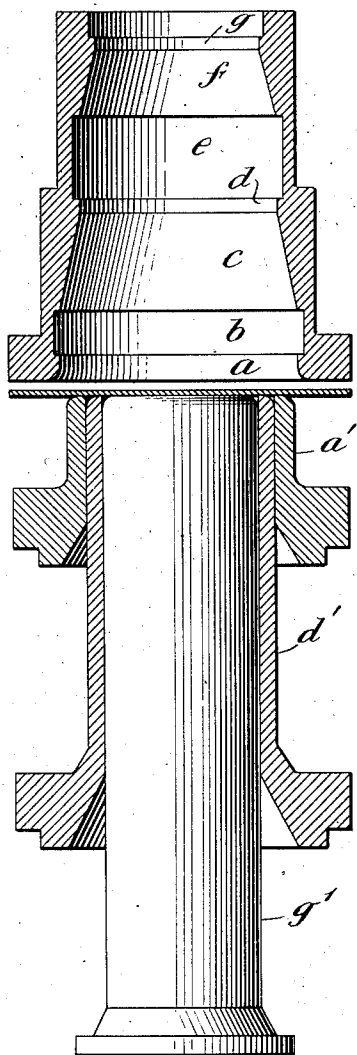
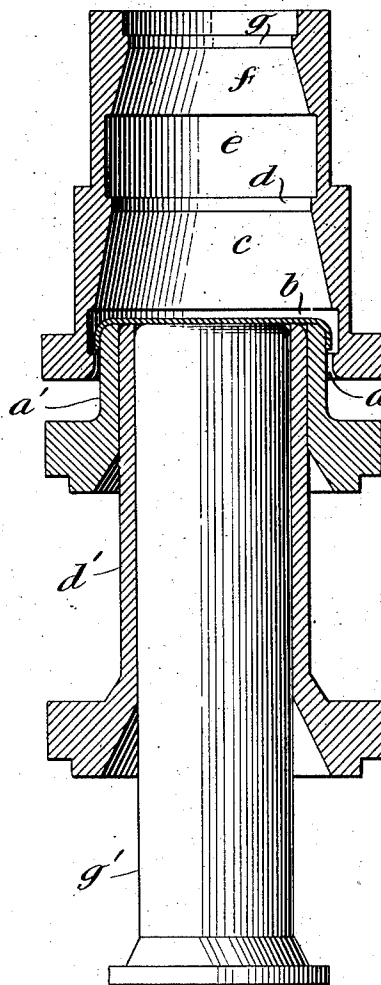


Fig. 2



Witnesses:
Charles A. Jones

Inventor
Campbell P. Higgins
 By *Sifford Bull* Attorneys

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2 SHEETS—SHEET 2.

Fig. 3.

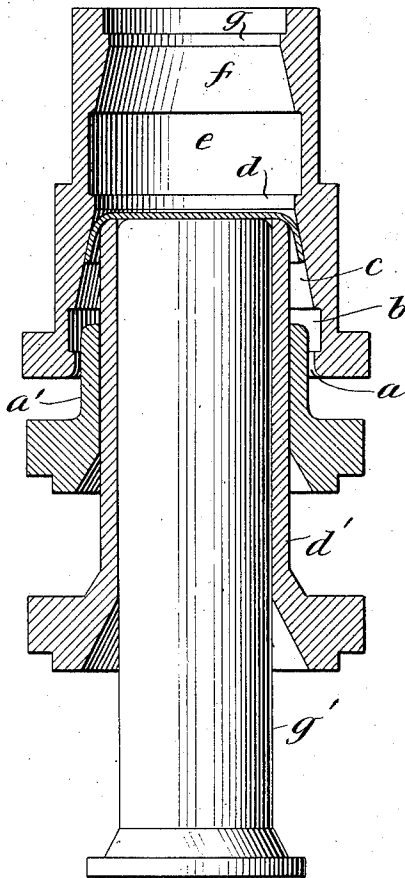
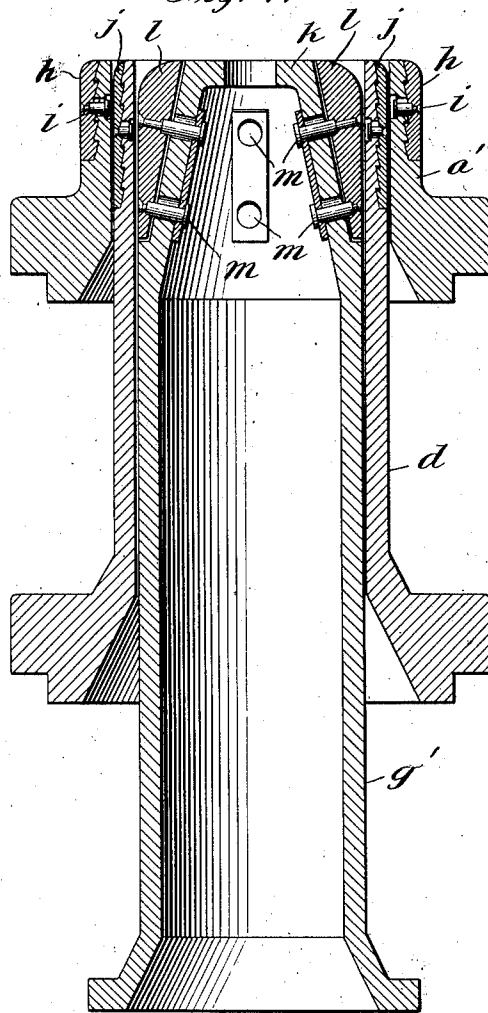


Fig. 4.



Witnesses:
Charles D. Jones.

Inventor
Campbell P. Higgins
 By *L. H. Bull*
 Attorney

UNITED STATES PATENT OFFICE.

CAMPBELL P. HIGGINS, OF ROSELLE, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MULTIPLE-DIE PRESS.

1,043,520.

Specification of Letters Patent.

Patented Nov. 5, 1912.

Original application filed March 23, 1908, Serial No. 422,595. Divided and this application filed April 9, 1912. Serial No. 689,542.

To all whom it may concern:

Be it known that I, CAMPBELL P. HIGGINS, a citizen of the United States, residing at Roselle, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Multiple-Die Presses, of which the following is a specification.

The present application is a division of an application filed by me, Serial No. 422,595, filed March 23, 1908, for header for water tube boiler and the process for manufacturing the same. In that application I have described and claimed, as an article of manufacture, a header for water tube boiler which I have succeeded in manufacturing by the use of a press described in the present application, and under conditions herein-after described. In my prior application I have also claimed the process involved in such manufacture. In the method of manufacture which has survived for many years past, headers of this class have been welded; that is to say, have contained a welded seam extending longitudinally from end to end of the header and each end of the header has contained a welded closure; three separate pieces being employed in the make up of the header. The preferred process of manufacture has heretofore been to fold a blank around a mandrel until its edges lap; then to weld the lapped edges together into a welded seam extending from end to end; then after it has been staggered, to insert a piece in each end and weld it so as to produce the welded closure at each end.

In my new article of manufacture, the side walls and ends are weldless and, at the same time, the metal is in that condition which results from forming without such substantial thinning, as occurs in tube drawing.

In the accompanying drawings Figures 1, 2 and 3 are longitudinal sections of my improved multiple die press showing the progress of the article through successive matrices and the intervening space, the details of construction of the male dies being omitted; and Fig. 4, a longitudinal section of the multiple plunger or male dies showing details of their construction.

Similar reference numerals indicate similar parts in the several views.

My process may be described as follows: I start with a circular steel disk one half of an inch in thickness and fifty-four inches in diameter, or other diameter according to the length of the header desired, and throughout all the changes of form this thickness remains substantially constant. This disk is composed of what is known commercially as a flanging quality of open hearth steel plate. This disk is first heated in a gas furnace to a uniform temperature of about twenty-two hundred degrees Fahrenheit at which temperature it is introduced into and passed through the multiple dies shown in Figs. 1, 2 and 3, occupying about eighty seconds in its passage. It is then reheated to a uniform temperature of about twenty-two hundred degrees Fahrenheit in the gas furnace and introduced into and passed through a second press having two dies, occupying about forty-five seconds in its passage. It is then reheated in the gas furnace to a uniform temperature of about twenty-two hundred degrees Fahrenheit and introduced into and passed through a third press having two dies, occupying about thirty-five seconds in its passage. It is then reheated to about twenty-two hundred degrees Fahrenheit and passed through a press having one die, occupying about twenty seconds in its passage.

The dies are all set in vertical position and the article passes upward through them and during its passage through each set of the dies a stream of cold water is kept playing onto the closed end of the article to prevent the end being punched out by the pressure of the plunger. As the article is forced through each matrix of the dies it has passed substantially out of control of the preceding matrix. The action in each matrix is essentially a transforming action as distinguished from a thinning action and the intention is that the space between matrix and plunger shall be adapted to produce the reduction in diameter without any such thinning of the metal as occurs in drawing operations where the thinning of the metal is depended on for producing the transformation. If the thrust of the plunger acts to thin the closed end at all, it is so slight as to be immaterial.

The reduction in diameter and elonga-

tion throughout the series of passes is so gradual that, at the heat specified, the transformation is accomplished without substantial fluting or other deformation of the cylindrical form of the side walls of the article.

The article as it leaves the last press is reheated to about twenty-two hundred degrees Fahrenheit, and by rolls its side walls are pressed into parallelogram form while containing a mandrel. While still hot, the side walls are pressed in a suitable press into sinuous form while containing a sectional mandrel. It is then cooled and the side walls are bored. It is then heated to about twenty-two hundred degrees Fahrenheit and the hand-holes are flanged by a machine known in the art. The open end of the article is next reheated to about twenty hundred degrees Fahrenheit and contracted by pressure to provide an opening for the reception of a nipple. The article is now complete and constitutes, as a new article of manufacture a water tube boiler header, the side walls of which are substantially non-thinned and weldless, the ends being also weldless.

The multiple die press through which the article is passed and transformed is shown in the accompanying drawings in which *a* is the matrix which first acts upon the disk, its mouth is tapering and its body is cylindrical as shown.

a' is the plunger by which the disk is forced through and beyond it.

b is a clearance space slightly larger in diameter than the matrix *a* and longer than the article formed by the matrix *a*.

c is a space in the form of the frustum of a cone, the sides of which taper inwardly at an angle of approximately fifteen degrees to the vertical.

d is the second matrix which is cylindrical and approximately three-quarters the diameter of the matrix *a*.

e is the second clearance space somewhat larger in diameter than the matrix *d* and longer than the length of article produced by matrix *d*.

d' is a plunger cooperating with the matrix *d*.

The disk being placed on the plunger *a'*, as shown in Fig. 1, is forced by that plunger through the matrix *a* into the position shown in Fig. 2 where the article is entirely within the clearance space *b*. Plunger *a'* now stops and plunger *d'* advances and by pressure upon the head of the article carries it off of the plunger *a'* and into the conical space *c* wherein the article assumes the conical form shown in Fig. 3, and wherein a clearance space still exists between the side wall or flange of the article and the plunger *d'*. I have discovered that under these conditions and at the heat prescribed

and with an angle not exceeding about fifteen degrees, the diameter of the article may be reduced without substantially fluting the side wall or flange thereof. It is then forced by the plunger *d'* through the matrix *d* into the clearance space *e* and in doing so is made cylindrical. It next receives its third reduction in diameter in the tapering space *f* and matrix *g* through which it is forced by the plunger *g'*; the plunger *d'* having come to rest in the clearance space *e*. The presses after the first, require modification of the male plungers or dies because of the length that the article has attained, but the matrices or female dies are substantially as shown in Figs. 1, 2 and 3 except that the second and third presses have two matrices each and the fourth press one matrix.

The acting surface of each plunger, in the press shown, is made as shown in Fig. 4 so as to be collapsed by the withdrawal of the article from it and these withdrawals are accomplished in the clearance spaces wherein each succeeding plunger, shoving against the head of the article, shoves the article off of the plunger previously in action. As illustrated in Fig. 4 the outer surface of the operating end of the plunger *a'* is constructed with serrations having inclined bearing surfaces which engage with cooperating serrations upon the inner surface of segmental sections *h*, which are loosely mounted on the pressure end of the plunger and held in operative contact by means of cross-pins *i*, extending through the wall of the plunger and rigidly fixed in the segmental sections *h*. The plunger *a'* is provided with guide slots to fit the cross-pins, and with recesses to accommodate the heads. A shoulder is formed at the end of the serrations on the plunger *a'* and limits the longitudinal and expansion movement of the sections *h*, the ends of said sections resting against the shoulder when they have expanded to their full diameter.

Plunger *d'* is similarly constructed to plunger *a'*, except the segmental sections are made longer than sections *h*, to correspond to the increased length of the flanged plate formed by the plunger *d'*. The sections *j* are held in operative contact by means of cross-pins extending through guide slots in the wall of the plunger *d'*, similar to the sections *h* on the plunger *a'*. Plunger *d'* is operatively telescoped into plunger *a'*, after it has acted upon the blank. The serrations on the sections and the plungers are made sufficiently large to allow for sufficient movement to expand and retract the sections, and strong enough to stand the strain of the flanging operation.

Plunger *g'* consists of a hollow cylindrical body having a flange on one end. The pressure end *k* is integral and an aperture in the

center is made for the convenience of assembling the attached parts during its construction. The end of this plunger is coneshaped and the segmental sections *l* are also coned to co-act with the conical surfaces of the pressure end. These sections are held in operative contact with the conical surface of the pressure end by means of cross-pins *m* extending through guide slots in the walls of the plunger, and are rigidly secured in the sections.

The differences essential to success between the press above described and prior presses known to me, may be stated as follows:

1. Matrix *a* starts the flange in cylindrical form.

2. Cylindrical clearing space *b* loosely encircles the cylindrical flange while it is removed from plunger *a'* without strain.

3. Conical clearance and reduction space *c*, of approximately fifteen degrees, loosely incloses the flange and at the same time, very gradually reduces the head and lengthens the flange. It is at the same time a reduction space for the reduction of the head and a clearance space for the flange. It is the clearance and angle in this reduction space that afford the freedom and graduation whereby the enormous flow, backward and inward, of the thick refractory metal is attained without undue violence or strain.

4. Matrix *d* reduces the flange to cylindrical form.

5. Cylindrical clearance space *e* loosely encircles the cylindrical flange while it is removed from plunger *d'* without strain.

6. Conical clearance and reduction space *f*, of approximately fifteen degrees, loosely incloses the flange and at the same time very gradually reduces the head and lengthens the flange in a manner similar to the preceding space *c*.

7. Matrix *g* reduces the flange to cylindrical form.

8. These operations are performed on the wrought steel disk uniformly heated to about twenty-two hundred degrees Fahrenheit, or in other words at a red heat considerably below the welding temperature.

9. The collapsible plungers permit removal at the end of each transformation.

The less than twenty-five degrees angularity of the clearance and reduction spaces *c* and *f* interposed between the successive matrices, and the limitation of the temperature to a red heat below welding produces the conditions whereby the metal is given adequate freedom of flow to permit of its transformation without rupture or fatal fluting. Insufficient temperature, or excessive angularity, or absence of clearance space, will prevent sufficient freedom of flow.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A press comprising a female die having a matrix, a clearance space of greater diameter than the diameter of the matrix, a conical clearance and reduction space, and a male die or plunger adapted for coöperation with said matrix.

2. A press comprising a female die having a matrix, a clearance space of greater diameter than the diameter of the matrix, and a conical clearance and reduction space of less than 25° angularity, and a male die or plunger adapted for coöperation with said matrix.

3. A press comprising a female die having a plurality of matrices and between successive matrices a cylindrical clearance space of greater diameter than the diameter of the preceding matrix, a conical clearance and reduction space between each cylindrical clearance space and the succeeding matrix, and a plurality of male dies or plungers adapted for coöperation with said matrices.

4. A press comprising a female die having a plurality of matrices of gradually decreasing diameter, and between each matrix a clearance space, each of greater diameter than the matrix preceding it, and a plurality of male dies or plungers of corresponding decreasing diameters adapted for coöperation with said matrices.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

CAMPBELL P. HIGGINS.

Witnesses:

M. E. McNinch,
Charles S. Jones.