APPARATUS FOR FORMING A BOILER HEAD
OR THE LIKE

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1. Claim. (Cl. 78—61)

This invention relates to apparatus for forming a boiler head or the like. This application is a division of my copending application Serial No. 522,276, filed July 15, 1955, now Patent No. 2,859,510, issued November 11, 1958, which is in turn a division of my copending application Serial No. 481,616, filed January 13, 1955, now abandoned.

The invention has to do with the forming of articles such as boiler heads having an opening therethrough and a tubular projection integral with the article coaxial with the opening for receiving a closure means. The closure means may be a threaded plug and the tubular projection may be threaded to receive the plug. For purposes of explanation and illustration the invention will be described as embodied in apparatus for forming a boiler head.

The tubular projection may be subjected to heavy stress, especially when the boiler of which the head is a part contains fluid under pressure. It has heretofore been recognized that the wall thickness of the tubular projection should be as great as the specified wall thickness of the boiler head surrounding the tubular projection. To obtain that result separate spuds have been utilized but the cost incident to the provision and attachment of separate spuds is substantial. To avoid this cost it has been proposed to form the tubular projection integral with the material of the head. This has been done by hot and cold forming but the result produced to the present invention has been a tubular projection of less wall thickness than the head at least a substantial portion of the tubular projection. Since the wall thickness of the tubular projection should be as great as the wall thickness of the head itself which is required to withstand the pressure within the boiler those skilled in the art have been utilizing metal of unnecessarily great thickness for the heads of boilers in order to form integral tubular projections having the necessary wall thickness to withstand the imposed stresses. This has entailed undesirable expense through the utilization of heads which are heavier than required not only in the cost of the material of the head but also in increased shipping charges because of the increased weight of the boiler.

I have solved the problem by producing a boiler head or the like having a tubular projection integral with the metal of the head and whose wall thickness is at least as great as the thickness of the material of the head. Specifically, I provide a boiler head or the like comprising a plate-like metal member having an opening therethrough and a tubular projection integral with the plate-like metal member and projecting generally normal thereto, the inner surface of the tubular projection being continuous with the periphery of the opening, the thickness of the metal forming the tubular projection being at least as great as the thickness of the metal of the plate-like metal member surrounding the tubular projection. Desirably the tubular projection gradually increases in transverse dimension from one end to the other thereof to adapt it to receive a tapered plug. Normally the tubular projection is threaded. If it is to receive a tapered externally threaded closure plug the tubular projection should be of greater transverse dimension at its outer extremity than at its inner extremity and should be internally threaded to receive the tapered plug. If the tubular projection is to receive an internally threaded closure cap it should be externally threaded. The most common type of closure is a tapered externally threaded closure plug so that normally the tubular projection will be shaped to receive such a plug and internally threaded. The tubular projection may project in either direction from the boiler head.

I preferably form a boiler head or the like by hot deforming a plate-like metal member having an opening therethrough to enlarge the opening and form a tubular projection integral with the plate-like metal member and projecting generally normal thereto whose inner surface is continuous with the periphery of the opening but with the thickness of the metal of the tubular projection being at least a portion of the tubular projection less than the thickness of the metal of the plate-like metal member surrounding the tubular projection and upsetting the metal of the tubular projection to increase the thickness of the metal thereof at said portion thereof to a thickness at least as great as the thickness of the metal of the plate-like metal member surrounding the tubular projection. I preferably shape the tubular projection so that it gradually increases in transverse dimension from one end to the other thereof, and I preferably thread the tubular projection.

I provide apparatus for forming a boiler head or the like comprising a die member having a cavity therein adapted to support a blank having an opening therethrough with the opening in alignment with the cavity with the material of the blank at the periphery of the opening projecting radially inwardly of the periphery of the cavity, a punch movable into the cavity to form said radially projecting material into a tubular projection on the blank within the cavity and surrounding the punch and an annular upsetting die movable into the cavity in a direction opposite to the direction of movement of the punch into the cavity to surround the punch and upset the material of the tubular projection between the punch and the wall of the cavity. The apparatus may embody further features contributing to increased utility and efficiency of operation as will be described below.

Other details, objects and advantages of the invention will become apparent as the following description of present preferred embodiments thereof proceeds.

In the accompanying drawings I have shown present preferred embodiments of the invention in which:

Figure 1 is a cross-sectional view through apparatus for forming a boiler head and illustrating the first step of my improved method;

Figures 2, 3 and 4 are views similar to Figure 1 illustrating succeeding steps of my improved method;

Figures 5 and 6 are cross-sectional views through apparatus for shaping the tubular projection so that it gradually increases in transverse dimension from one end to the other thereof; and

Figure 7 is a fragmentary cross-sectional view through a finished boiler head.

My boiler head or the like may be of conventional shape and adapted to be applied to a boiler shell in conventional manner but it may be made out of metal of thinner gauge than has heretofore been required for the manufacture of boiler heads with integral tubular projections to meet particular specifications because the tubular projection which I form integral with the head has at least as great wall thickness as the head. Indeed, I may form a tubular projection integral with a boiler head.
or the like having even greater wall thickness than the head or the like if for any reason such a structure should be desired.

Figures 1 to 4, inclusive, show one form of my apparatus for forming a boiler head or the like and illustrate my method. The apparatus comprises a base member 2 which is mounted in fixed position. The base member 2 carries an upsetting die 3 which is upwardly open and of annular shape as shown. The upsetting die is carried by the base member in fixed position.

A plurality of holes 4 are drilled through the base member 2, only one such bore being shown in the drawing for simplicity of illustration. The holes 4 preferably surround the upsetting die 3 and are uniformly spaced. Projecting upwardly through each of the holes 4 is a pin 5 which is resiliently forced upwardly, as, for example, by fluid under pressure. The lower extremity of each pin 5 may carry a piston (not shown) operating in a fluid pressure cylinder. When fluid under pressure is employed I prefer to employ air as the fluid under pressure but hydraulic fluid may be employed if desired.

The pins 5 resiliently support a die member 6 having extending therefrom a die cavity 7 snugly receiving the upsetting die 3 as shown. The die member 6 is adapted to move axially of the upsetting die 3 against the fluid pressure exerted against the pins 5 as will presently be described and may be guided in such movement by the upsetting die 3 alone, or other guide means for insuring properly guided movement of the die member 6 relatively to the base member 2 may be provided. Means not shown limit the upward movement of the die member 6, that member being shown in its extreme upper position in Figures 1 and 2, being maintained in that position by the pins 5.

A blank 8 is adapted to be supported upon the die member 6. The blank 8 may be a boiler head or the like on which an integral tubular projection is to be formed. The blank 8 may have a wall thickness no greater than the wall thickness required by the boiler specifications. It is pre-drilled to form therethrough an opening 9. The blank 8 is preheated to the proper temperature for hot forging the particular metal being employed, which may, for example, be a grade of carbon steel appropriate for forming boiler heads.

The blank 8 is maintained in position upon the die member 6 with the opening 9 coaxial with the die cavity 7 by the die member 6. The holding member 10 has therein an opening 11 of somewhat smaller transverse dimension than the die cavity 7 coaxial with the die cavity 7. The die cavity 7, the openings 9 and 11 and the upsetting die 3, as well as the punch presently to be described, may be of circular cross section although they may also be of other cross section so long as they are designed to conform with one another. In the present illustration they will be assumed to be of circular cross section.

I provide a punch designated generally by reference numeral 12 comprising a holder portion 13 and a punch member 14. The punch member 14 is adapted to pass through the opening 11 in the die member 6 and has a pointed nose 15. The punch member 14 is coaxial with the die cavity 7. A series of compression coil springs indicated diagrammatically at 16 are disposed about the punch member 14 for biasing the punch relatively to the holding member 10.

At the beginning of a cycle of operations of the die mechanism shown in Figures 1-4 the punch and holding member 10 are retracted upwardly away from the die member 6. The blank 8 is brought to the required heat and placed upon the die member 6 as shown in Figure 1 with the opening 9 coaxial with the die cavity 7. The holding member 10 is then brought into operative position to hold the blank 8 against the die member 6 as shown in Figure 1. The holding member 10 is pressed against the blank 8 by the springs 16 and may be guided in its movements toward and from the die member 6 by guide means not shown but of a type known to those skilled in the art. The punch holder 13 may be similarly guided.

With the blank 8 held firmly in place against the die member 6 by the holding member 10 the punch is moved downwardly successively to the positions of Figures 2 and 3. The tapered nose 15 of the punch member 14 enters the opening 9 of the blank and enlarges that opening and the punch hot die-forms the metal of the blank 8 at the periphery of the opening which projects radially inwardly of the periphery of the die cavity 7 as shown in Figures 2 and 3. It is inevitable that in such die-forming of the metal its wall thickness will be reduced. This is illustrated in the drawings.

When the punch 12 has reached the position shown in Figure 3 the springs 16 are fully compressed and the portion 13 of the punch directly engages the holding member 10 and has started to move the holding member 10, the blank 8 and die member 6 downwardly to a point just before the position of the parts shown in Figure 3, the fluid pressure acting upwardly against the pins 5 has been sufficient to hold the die member 6 in the position shown in Figures 1 and 2. As the punch moves downwardly it carries with it the holding member 10, the blank 8 and the die member 6. Since the upsetting die 3 is fixedly mounted in the fixed base member 2 the downward movement of the punch, holding member, blank and die member causes the annular upsetting die to upset the material of the tubular projection formed on the blank between the punch member and the wall of the die cavity as shown in Figure 4.

Thus I can form a tubular projection integral with a boiler head or the like having at least as great wall thickness as the material of the head and even greater wall thickness if desired. I eliminate the necessity of either applying a separate spud or employing for the head material of greater wall thickness than required by the boiler specifications.

It would be possible to utilize the tubular projection formed as above described and as shown in Figure 4 for holding a closure member in place to seal the boiler head, as, for example, by internally threading the tubular projection and screwing an externally threaded closure plug thereto. However, it is preferred, and customary in the art, to taper the tubular projection and internally thread it so that it is adapted to receive a tapered externally threaded closure plug of conventional construction. The tapering operation is shown in Figures 5 and 6.

The boiler head which has been hot die-formed as shown in Figures 1-4 and explained above is further formed in tapering dies, the tapering operation being performed either hot or cold.

There is provided a fixed base member 17 in which is mounted a female tapering die 18 whose inner annular face 19 at the upper portion thereof views Figures 5 and 6 is tapered downwardly and inwardly as shown. The mouth or upper extremity of the die 18 has substantially the same shape and transverse dimension as the outside of the tubular projection formed in Figures 1-4. The blank 8 after being hot die-formed as illustrated in Figures 1-4 is transferred to the tapering dies of Figures 5 and 6, with or without a reheating, and is positioned relatively to the die 18 as shown in Figure 5.

Mounted above the die 18 for vertical movement in a guide 20 is an annular holdown member 21 in which operates a male tapering die 22 having a downwardly and inwardly tapered nose 23 as shown.

While the die 22 remains stationary in the position shown in Figure 5 the holddown member 21 moves downwardly and engages the upper surface of the blank 8 and forces it down against the die 18 with the tubular projection entering the die 18 and being forced radially inwardly.

Then the die 22 is lowered to the position shown in
Figure 6, the tubular projection on the blank 8 being reformed to the shape shown in Figure 6. The wall thickness of the tubular projection remains substantially the same as formed in the operation shown in Figure 4, i.e., at least as great as the wall thickness of the blank 8 or greater if desired.

After the tapering operation of Figures 5 and 6 the tapered tubular projection is internally threaded as shown at 24 in Figure 7. This completes the formation of the boiler head or the like. Not only is the tubular projection of at least as great wall thickness as the head but it is of constant wall thickness and there is no zone of weakness due to reduced wall thickness in the finished wall such as has characterized previously integrally formed tubular projections which prior to the present invention as above explained necessitated the employment of metal for the head having a wall thickness or gauge greater than that required by the boiler specifications with the consequent disadvantages above pointed out.

While I have shown and described present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claim.

I claim:

Apparatus for forming a boiler head or the like comprising a base member, a die member disposed adjacent the base member, first resilient means spacing the die member from the base member, the die member having a cavity of uniform cross section therein adapted to support a blank having an opening therethrough with the opening in alignment with the cavity with the material of the blank at the periphery of the opening projecting radially inwardly of the periphery of the cavity, the cavity being free from obstructions in the region immediately above the mouth thereof so that the blank may lie flat across the mouth of the cavity, holding means cooperating with the die member to clamp to the die member about the cavity therein a portion of the blank outwardly of the cavity to hold such portion of the blank in fixed position relatively to the die member, a punch having a tapered nose and a body of uniform cross section behind the nose, second resilient means interposed between the holding means and the punch so that as the punch moves into the cavity it compresses the second resilient means and presses the same against the blank, the first resilient means being stronger than the second resilient means so that compression of the second resilient means does not move the holding means, blank and die member toward the base member, the punch having a portion engaging the holding means after the punch has moved a predetermined distance into the cavity to move the holding means, the blank and the die member against the action of the first resilient means toward the base member and an annular upsetting die carried by the base member which as the punch, holding means, blank and die member move toward the base member enters the cavity in a direction opposite to the direction of movement of the punch into the cavity to surround the body of uniform cross section of the punch and completely fill the space between the body of uniform cross section of the punch and the cavity of uniform cross section and upset the material of the tubular projection between the punch and the wall of the cavity.

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