W. HORSLEY.
METHOD OF MANUFACTURING NOZZLES.
APPLICATION FILED DEC. 28, 1909.

1,025,570

Patented May 7, 1912.

2 SHEETS—SHEET 1.

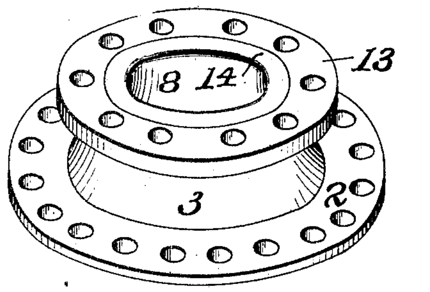


FIG. 1

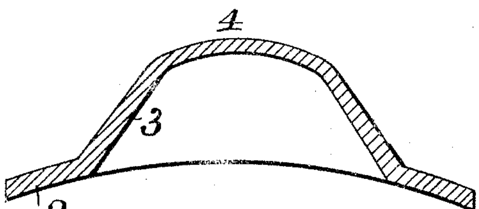


FIG. 2

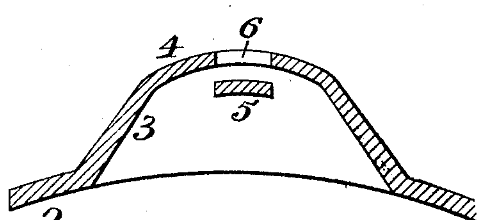


FIG. 3

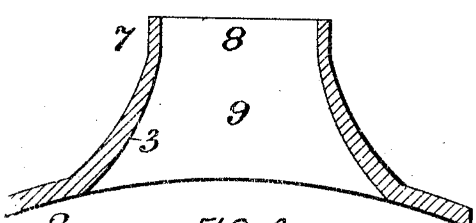


FIG. 4

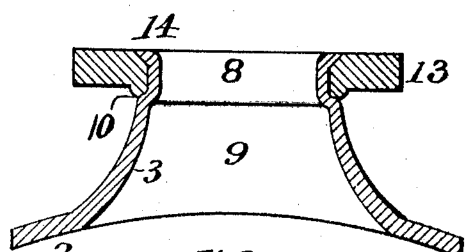


FIG. 6.

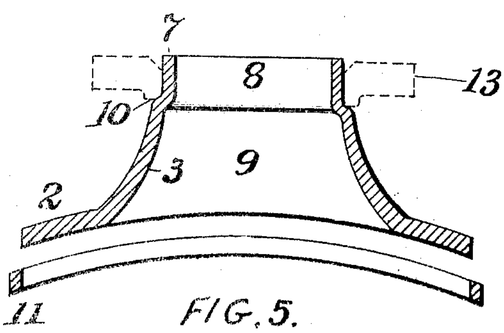


FIG. 5.

WITNESSES

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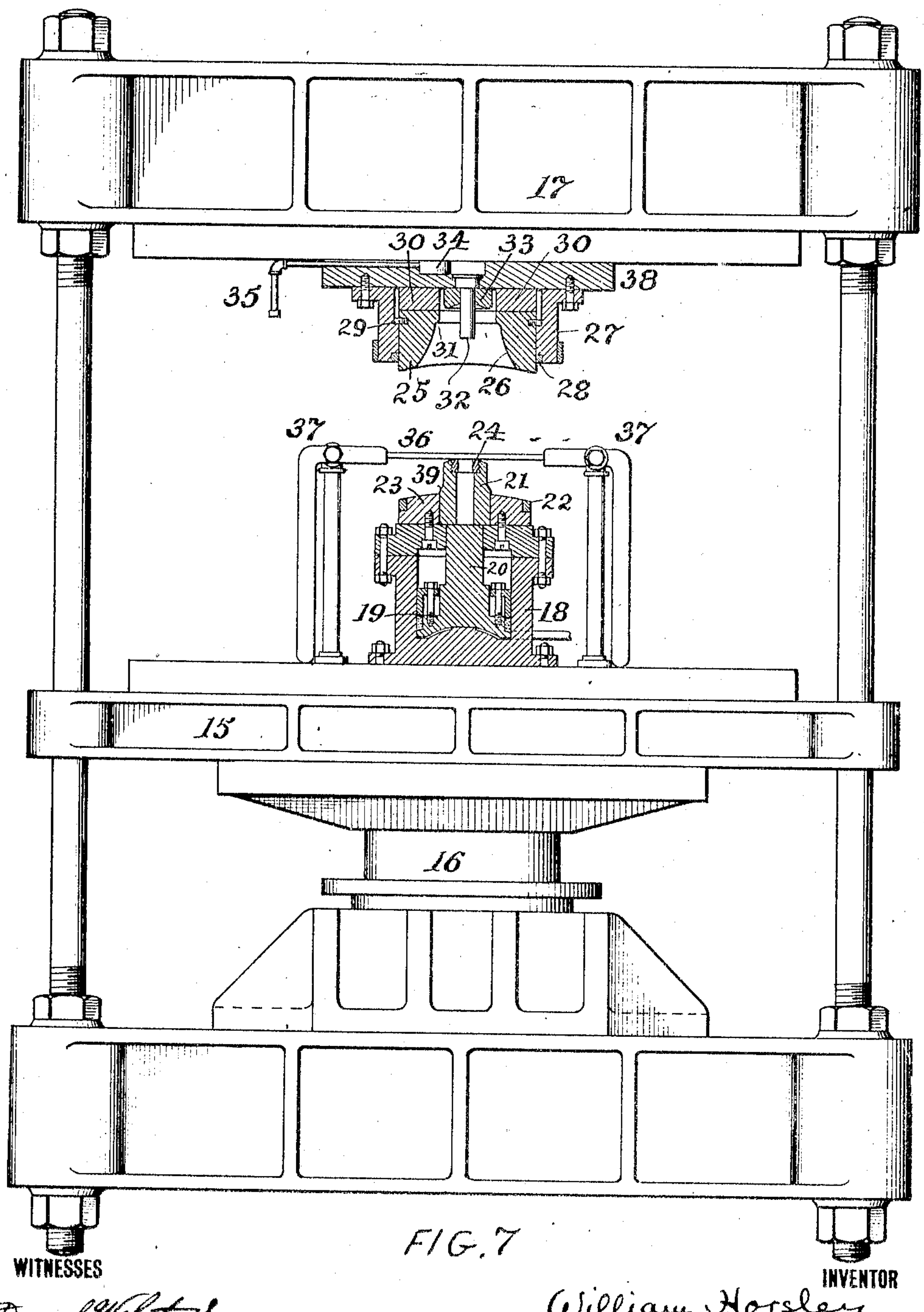


FIG. 7

WITNESSES

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# UNITED STATES PATENT OFFICE.

WILLIAM HORSLEY, OF JERSEY CITY, NEW JERSEY.

## METHOD OF MANUFACTURING NOZZLES.

1,025,570. Specification of Letters Patent. Patented May 7, 1912.

Application filed December 28, 1909. Serial No. 535,305.

*To all whom it may concern:*

Be it known that I, WILLIAM HORSLEY, a citizen of the United States, and resident of Jersey City, county of Hudson, and State of New Jersey, have invented an Improvement in Methods of Manufacturing Nozzles, of which the following is a specification.

My invention has reference to the method of manufacturing nozzles for steam boilers and other purposes, and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings which form a part thereof.

The nozzle produced by my improved method of manufacture, is of such character that it is adapted more particularly for use with steam boilers for permitting the escape of steam from the boiler into a supply pipe, but is also adapted for use in vessels requiring a contracted outlet, and for use between two flanged pipes of different diameters for forming a communication between them.

Heretofore, it has been the practice to make nozzles out of materials such as brass, cast iron and cast steel. Brass, while making a strong and efficient nozzle, is used only on very rare occasions on account of the price being prohibitive. Cast iron has been used extensively, but has great objection on account of brittleness and danger of cracking while being applied to the boiler or the other vessel and the danger of explosion while the boiler is under pressure. Cast steel nozzles are open to several objections, among which may be stated the great cost, not only because it is cast steel but also because of the extra cost of making the steel of a hard structure, and further because of the very large percentage of defective castings from blow-holes which make the manufacture uncertain and costly and prohibitive as to cost excepting for special cases where cost is not material.

My improved nozzle overcomes all of the above objections to the existing type of nozzles since it may be made of the finest grades of sheet steel and pressed and drawn up into shape in a speedy and economical manner, so that the nozzle not only has strength and cheapness, but is accurate as to form and shape, has a good finish, may be readily calked, and has elasticity in its flanges which enables it to form a perfect joint with the boiler and the other part to be united to it. It has, moreover, greater metal thickness at its larger diameter than at the smaller diameter so that with a given minimum weight of metal, the greatest uniform strength is secured.

My invention comprehends a method for manufacturing, in an economical manner, the above described improvements in nozzles, and more specifically, my invention consists in stamping, pressing or drawing a flanged body part out of one piece of sheet metal, the body part being more or less tapering or conical and of gradually decreasing thickness of metal from the flanged part to the smaller tubular end of the body, placing about the said smaller tubular end of the body an independent flange of smaller diameter than the integral flange of the body part, said smaller flange being made of stamped sheet steel or otherwise, as desired, and permanently or fixedly connecting the smaller independent flange to the tubular end of the body by expanding or otherwise connecting the parts with a steam-tight joint to form one integral structure.

My improved method is more fully described hereinafter in connection with the drawings, and is specifically defined in the claims.

My invention will be better understood by reference to the drawings, in which:

Figure 1 is a perspective view of a nozzle adapted to be made by my improved method; Figs. 2 to 6 inclusive, are cross sections of the sheet metal during the various stages of forming the tubular part of the nozzle; and Fig. 7 is an elevation of a hydraulic press and dies (the latter in section) adapted for use in connection with the carrying out of my improved method.

The character of nozzle which is adapted to be made by my improved method, is fully illustrated in Figs. 1 and 6 and comprise a structure having a flange 2 of large diameter, a tapering body part 9 integral with the flange and having inclined walls 3 of gradually reduced thickness, a cylindrical end 8 of smaller diameter than the internal diameter of the body adjacent to the large integral flange 2, and a flange 13 of smaller diameter secured to the cylindrical end 8 by an expanded or other suitable joint, 14.

In carrying out my invention, I form the body walls 3 and the lower integral large flange 2 of the nozzle from ductile metal, preferably steel plate, by pressing or drawing a suitable formed blank in dies so as to produce a tapered nozzle such as shown in Fig. 5, the lower flange 2 being substantially horizontal, and the upper flange or smaller tubular end 8 being substantially vertical so that its flanged portion is cylindrical. To this upper cylindrical flange 8, I secure an independent flange ring 13, preferably of ductile metal and desirably stamped from a sheet of steel plate; the flange ring 13 being fitted over the said cylindrical end 8 and secured in position by expanding, with or without upsetting of the flange 8 within it, or in any other suitable and well-known manner adapted for uniting a flange to a cylindrical tubular part. The flange 13 is preferably flat, whereas the flange 2 may be flat or curved to suit the curvature of the boiler or tank shell to which it is to be secured by rivets or otherwise.

The sheet steel, in being drawn or pressed into the tapered nozzle form has the metal drawn down to a gradually lessened thickness toward the smaller diameter or cylindrical portion 8 to which the flange 13 is secured and forming curved side walls 3 which have a maximum thickness adjacent to the flange 2, and a gradually reduced thickness adjacent to the cylindrical flange portion 8, as is clearly indicated in Figs. 4, 5 and 6.

By properly proportioning the diameters of the large and small end of the body and height of the nozzle between the two flanges, I am enabled to draw and stamp the body and lower flange from a single sheet of steel without materially weakening the smaller cylindrical flanged end.

In making the body part with the lower integral flange of large diameter, I employ suitable dies in connection with a hydraulic or other press, and these dies operate upon a plate of sheet steel to produce the successive forms indicated by the cross sections in Figs. 2 to 6 inclusive. The first action of the dies is to clamp part of the sheet which constitutes the lower flange part 2, and then to force up the central portion, drawing the metal within the area of the clamped portion to form the conical side walls 3 and a top or cap portion 4, forming in effect a dome-like structure, as shown in Fig. 2. When this action is accomplished, a small part of the dome 4 is punched out, as at 5, to form an aperture 6, shown in Fig. 3. A further action of the dies press the upper or cap portion 4 upward, and at the same time expand the diameter of the aperture 6 until it takes the shape indicated in Fig. 4, providing an upwardly extending cylindrical flange portion 8 of minimum thickness, and of an internal diameter of materially less than the internal diameter of the lower flange 2. By examination of Fig. 4, it will be seen that the cylindrical flange 8 extends upward from the smallest diameter of the conical body and forms that portion 7 where the metal is expanded. When the flanged nozzle is at this stage of completion, a further action of the dies expands the smaller diameter of the conical portion of the body 9 to provide the annular shoulder 10, indicated at Fig. 5, and at the same time the surplus portion of the sheet, outside of the required diameter of the flange 2 in the finished article, is punched off by suitable dies, as indicated at 11 in said Fig. 5. When the tapering body portion is thus completed, it is in a finished condition ready to receive the smaller flange 13 which flange may be of stamped metal or a casting, but preferably stamped from a thicker sheet of steel and of a cross section such as indicated in Fig. 6. This smaller flange 13 is then placed about the cylindrical flange of the body portion and made to rest upon the annular shoulder 10, and is secured in position by the said cylindrical flange 8 being expanded and upset within the annular flange 13 to form a steam-tight joint. The edge 7 may be upset over the flange as shown in Figs. 1 and 6.

Suitable dies and apparatus for carrying out my improved method in the manufacture of the steam nozzle, are shown in Fig. 7, and will now be described. The hydraulic press for applying the power may be of any suitable character, but that shown consists of the fixed head 17, the movable platen 15 and the large hydraulic cylinder and plunger 16 for vertically moving the platen. Portions of the dies are secured to the head 17, and the remaining portions are secured upon the platen 15, and by its movement caused to be raised and lowered.

The dies and their operating parts, which are upon the platen 15, consist of a cylinder 18 having a piston 19 provided with an upwardly directed plunger 20 working through the top of the cylinder. This piston and plunger may be operated by hydraulic or other pressure from any suitable source of supply, and under control of any of the well-known controlling valves. Bolted to the top of the cylinder 18 is a bed die 23 having an annular cutting edge 22. Centrally arranged with respect to the bed die 23 and vertically adjustable therethrough, is a tubular die 21 extending upward and terminating in an annular or female die 24. This die 21, in its downward position, rests upon the top of the cylinder 18 and is adapted to be raised by the plunger 20 of the piston 19.

It is further provided with an annular shoulder 39 at a distance below its top.

Referring now to the dies secured to the head 17, there is a die 25 adapted to coöperate with the die 23 of the platen and vertically adjustable within a cylindrical die 27 which has an annular cutting edge 28 for coöperating with the cutting edge 22 upon the aforesaid die 23. The inner part 26 of this die 25 is shaped to conform to what would be the outer portion of the tapering body of the finished nozzle, the said interior surface tapering from the lower part inwardly to a cylindrical neck at the top, which is provided with a shoulder 31 employed in the making of the shoulder 10 in the body of the nozzle. The die 25 is connected with the cylindrical die 27 by means of pin and slot devices indicated at 29, which normally support the die 25 so that its lower surface extends somewhat below the cutting edge 28 of the die 27, as indicated in Fig. 7. The die 25 may be retained in this position, during the drawing operation, by means of abutment bars 30 which are interposed between it and the bed 38 secured to the head of the press. This abutment 30 may be withdrawn after the nozzle body has been shaped, and preliminary to the trimming off of the surplus metal 11. A punch 32 is adjustably supported by a die block 33 with provision for vertical movement, and is adapted to coöperate with the die 24, previously described, for punching the hole 6 in the blank, as indicated in Fig. 3. This die may be retained in punching position by an adjustable abutment 34 adapted to be interposed between its upper part and the head 17, and which abutment may be moved by a handle 35. When the abutment 34 is withdrawn to the position indicated in Fig. 7, the punch 32 may move vertically without resistance.

36 represents the sheet of steel which is to be pressed and drawn into the improved nozzle, and 37 are adjustable clamps for temporarily supporting the plate in position above the lower dies, all of said parts being carried upon the platen 15. The clamping levers 37 are pivoted so that when the platen rises and the plate 36 is received against the bottom of the die 25, said levers may be oscillated by striking the bottom of the cylindrical die 27 and turned out of the way. These clamping and positioning devices 37, while found exceedingly useful in practice, are not essential.

The operation of the dies in forming the tubular nozzle will now be understood.

Assuming the plate 30 to be in the position shown in Fig. 7, the abutments 30 are withdrawn and the water pressure is then applied to the cylinder and plunger 16 and the platen 15 is caused to rise. The upward movement of the platen soon brings the plate 36 against the bottom of the die 25, with the result that it is pressed upward in the middle by the die 21, and at the same time the plate is clamped between the bottom annular edge of the die 25 and the top of the die 23 and forming that part which finally constitutes the main flange 2 of the nozzle. While the plate is so clamped adjacent to its periphery, water pressure is applied to the cylinder 18 and piston 19, causing the plunger 20 to rise. The rising of the plunger 20 pushes the die 21 upward against the under surface of the middle of the plate and draws the said plate into the dome-like shape shown in Fig. 2. When this is done, the platen 15 is lowered slightly to allow the blank to be lowered sufficiently to let the punch 32 drop down and the abutment block 34 to be shoved in above it. The platen is then raised again and the punch 32, coöperating with the die 24, punches out a part 5 and leaves an aperture 6 in the crown of the blank, as indicated in Fig. 3. A further upward movement of the die 21 causes the crown to be expanded into a cylindrical flange part 8, as indicated in Fig. 4, the outer diameter of said cylinder part being made to conform to the inner opening of the die 25 against which it is driven by the die 21. A further upward movement of the die 21 brings the shoulder 39 thereof in coöperation with the annular grooved shoulder 31 on the inner part of the dies 25 to produce in the nozzle body, at the base of the cylindrical flange 8, the shoulder 10 as shown in Fig. 5. During this action, the sheet metal forming the conical part 9 of the body of the nozzle, is caused to shape itself against the internal curved surface 26 of the die 25. The abutment blocks 30 are then withdrawn and a further upward movement of the platen 15 will force the dies supported upon it, together with the die 25, upward and the shearing edge 22 of the die 23 will coact with the shearing edge 22 of the ring die 27 to punch off the surplus exterior metal 11, Fig. 6, from the plate, so that the lower integral flange 2 will be brought to the right diameter. When this operation is done, the dies are all lowered to their original positions indicated in Fig. 7, the nozzle removed, the abutment 30 inserted and abutment 34 withdrawn preliminary to the making of another nozzle. It will be seen that this operation of drawing, punching, shaping and finishing of the nozzle is practically one continuous operation, and while accuracy is secured in the making of the nozzles, the manufacture is very economically performed.

After the nozzle is formed as indicated in Fig. 6, the second flange ring 13 is placed in position, as indicated in dotted lines in Fig. 5, and the cylindrical flange 8 expanded thereon and the upper edge 7 thereof upset over the flange ring 13, as indicated at 14 in Figs. 1 and 6.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. The herein described method of forming a nozzle from a sheet of ductile metal which consists in the following operations, namely, clamping the sheet annularly about its center, drawing the metal at the center of the sheet into a dome-like structure with gradually sloping walls, punching an aperture of relatively small diameter through the dome so as to provide a large annular radial flange bounding the aperture, and expanding the metal of the radial flange adjacent to the aperture in the dome outwardly through substantially ninety degrees into a cylindrical tubular flange.

2. The herein described method of forming a nozzle from a sheet of ductile metal which consists in the following operations, namely, clamping the sheet annularly about its center, drawing the metal at the center of the sheet into a dome-like structure with gradually sloping walls, punching an aperture of relatively small diameter through the dome so as to provide a large annular radial flange bounding the aperture, expanding the metal of the radial flange adjacent to the aperture in the dome outwardly through substantially ninety degrees into a cylindrical flange, and pressing the metal of the sloping walls adjacent to the part of the cylindrical flange most distant from its free edge outwardly into an outwardly extending annular shoulder.

3. The herein described method of forming a nozzle from a sheet of ductile metal which consists in the following operations, namely, clamping the sheet annularly about its center and at a distance from its outer edge, drawing the metal at the center of the sheet into a dome-like structure with gradually sloping walls, punching an aperture of relatively small diameter through the dome so as to provide a large annular radial flange bounding the aperture, expanding the metal of the radial flange adjacent to the aperture in the dome outwardly through substantially ninety degrees into a cylindrical flange, and punching off the surplus metal beyond the portion annularly clamped in the first instance to form the flange.

4. The herein described method of making a nozzle which consists in clamping a sheet of metal against an annular surface to form a flange, then drawing the metal into a conical condition to form a dome-like structure with sloping walls within the area of the clamped portion, perforating the dome substantially centrally to the annular clamped portion of the plate to form a small aperture with radial inwardly directed flange, and spreading the metal adjacent to the perforated dome outwardly through approximately ninety degrees into a cylindrical flange of substantially uniform thickness at an angle to the flange formed by the annularly clamped portion.

5. The herein described method of forming a nozzle from a sheet of ductile metal which consists in the following operations, namely, clamping the sheet annularly about its center, drawing the metal at the center of the sheet into a dome-like structure with gradually sloping walls, punching an aperture of relatively small diameter through the dome so as to provide a large annular radial flange bounding the aperture, expanding the metal of the radial flange adjacent to the aperture in the dome outwardly through substantially ninety degrees into a cylindrical flange, and pressing the metal of the sloping walls adjacent to the part of the cylindrical flange most distant from its free edge outwardly into an outwardly extending annular shoulder, placing a ring flange about the outside of the cylindrical flange and resting it upon the annular shoulder to cause it to take the required position with respect to the main flange formed by the part of the sheet originally clamped, and mechanically securing the ring flange to the cylindrical flange so as to make a steam-tight joint.

In testimony of which invention I hereunto set my hand.

WILLIAM HORSLEY.

Witnesses:
IRVING R. VERSOY,
HOMER S. MAGLEY.