No. 731,124. PATENTED JUNE 16, 1903.

K. PARK.

APPARATUS FOR FORMING SERPENTINE HOLLOW BODIES.

APPLICATION FILED APR. 17, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1.

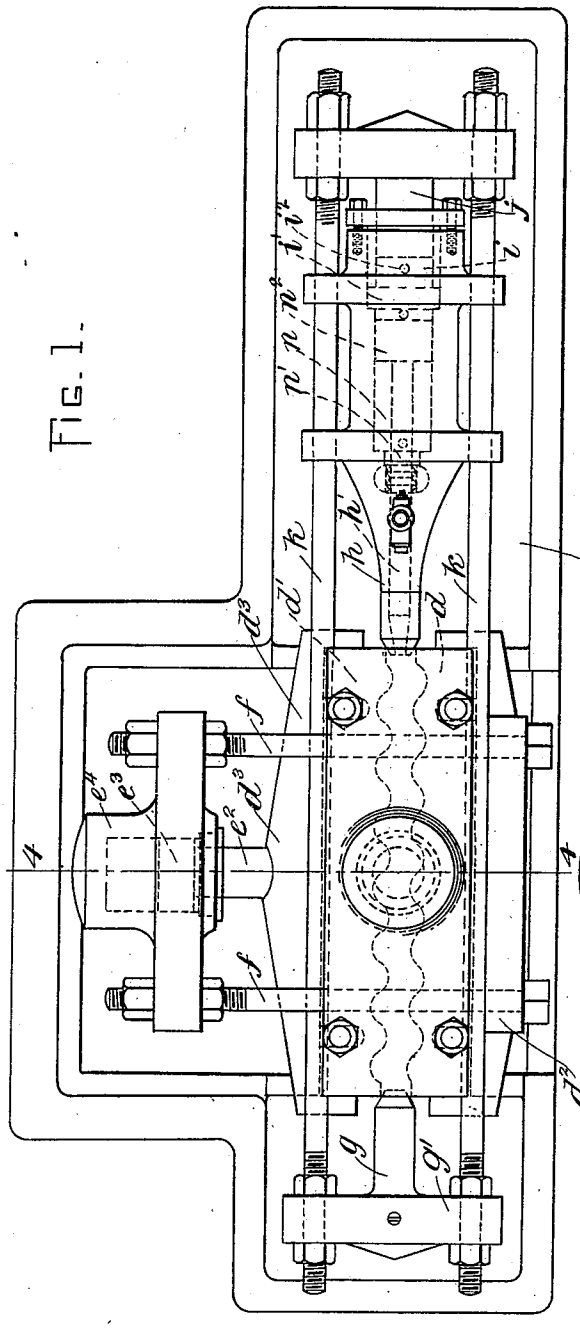
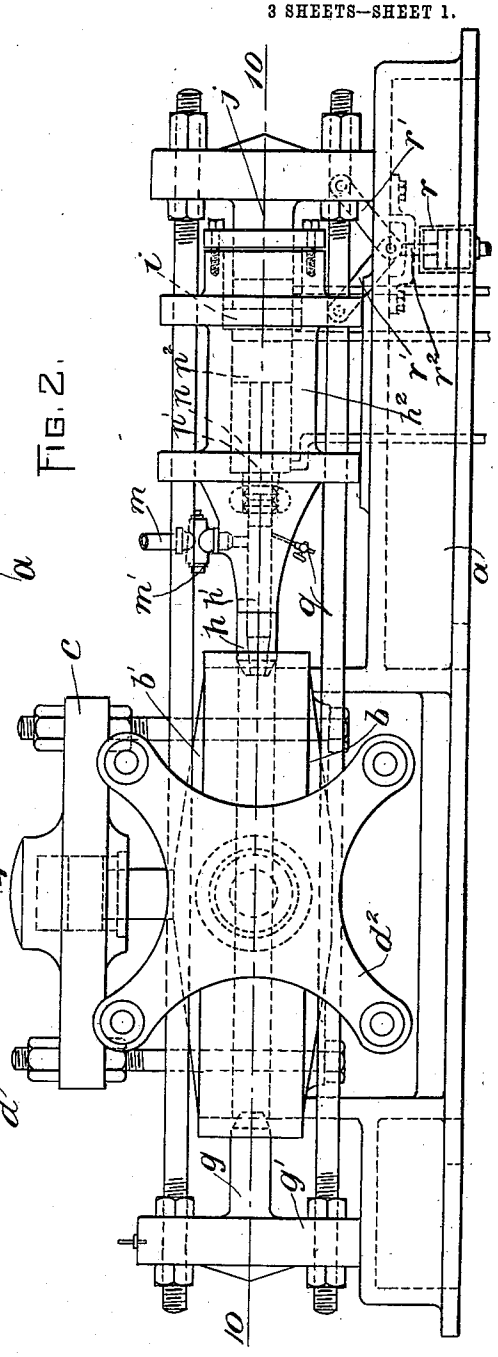


FIG. 2.



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NO MODEL. 3 SHEETS—SHEET 2.

FIG 3.

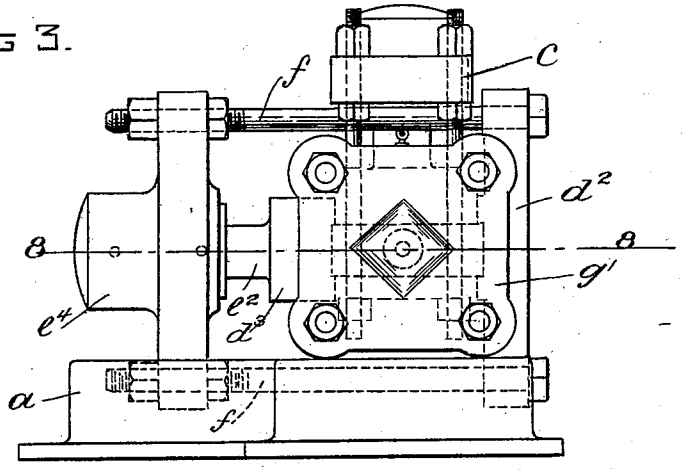


FIG 4.

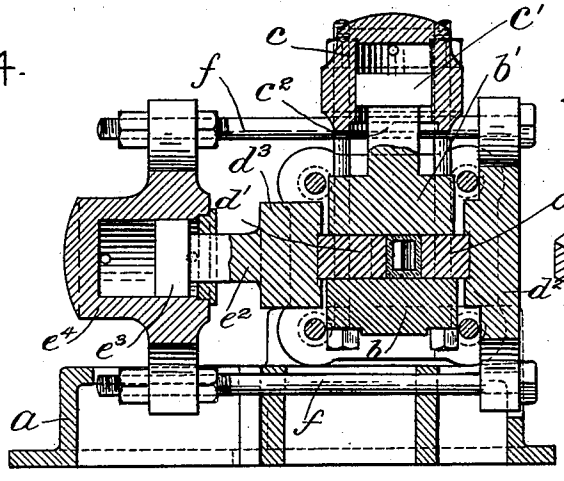


FIG. 6.

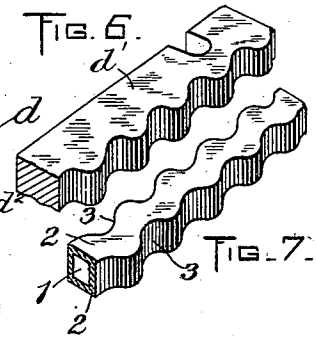
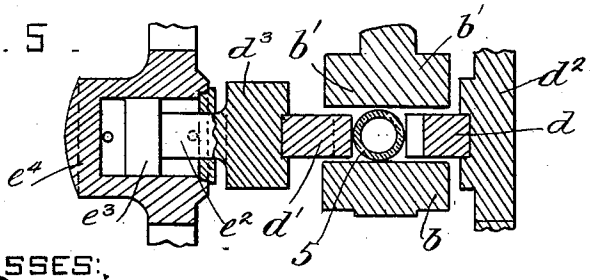


FIG. 7.

FIG. 5.



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NO MODEL. 3 SHEETS—SHEET 3.

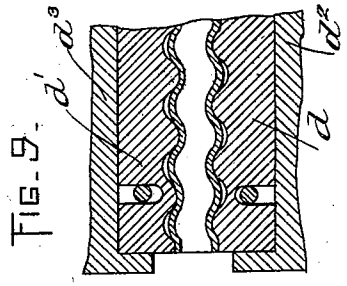


FIG. 9.

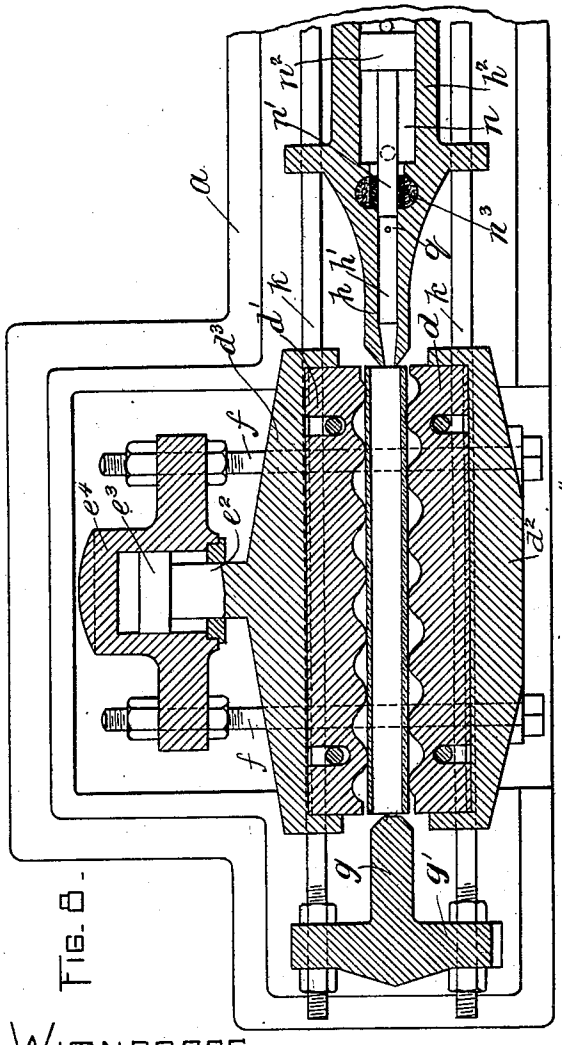


FIG. 8.

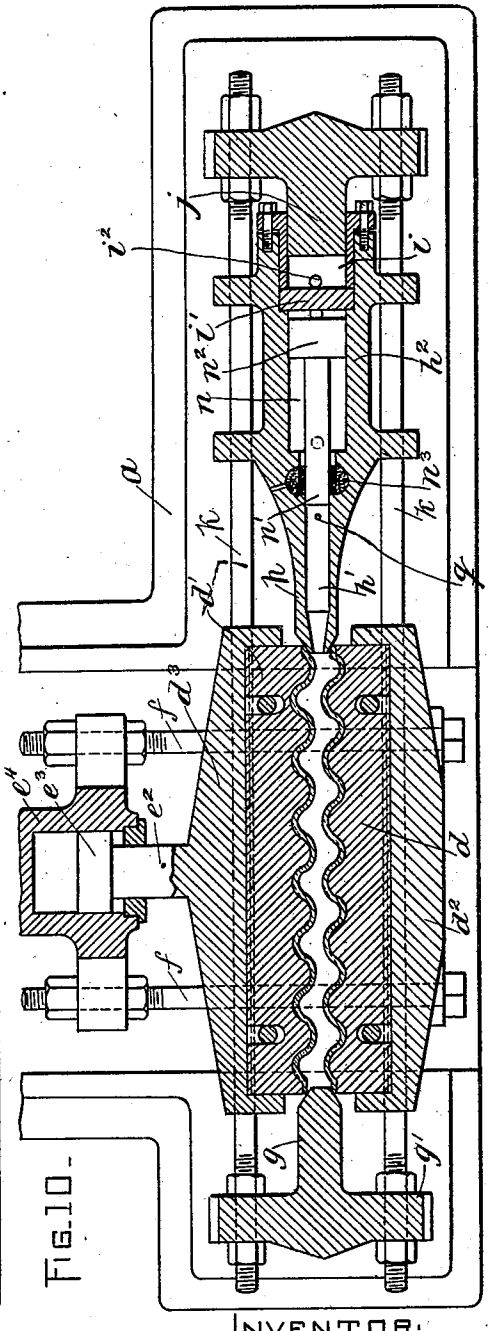


FIG. 10.

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No. 731,124. Patented June 16, 1903.

UNITED STATES PATENT OFFICE.

KENNEDY PARK, OF CAMBRIDGEPORT, MASSACHUSETTS.

APPARATUS FOR FORMING SERPENTINE HOLLOW BODIES.

SPECIFICATION forming part of Letters Patent No. 731,124, dated June 16, 1903.

Application filed April 17, 1902. Serial No. 103,362. (No model.)

To all whom it may concern:

Be it known that I, KENNEDY PARK, of Cambridgeport, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in an Apparatus for Forming Serpentine Hollow Bodies, of which the following is a specification.

This invention relates to the manufacture of serpentine headers which are rectangular in cross-section and flat on two opposite sides, the other two sides being serpentine. Headers of this character are used in sectional steam-boilers wherein the serpentine sides are nested together.

Serpentine headers are commonly made by applying pressure to a length of wrought-iron pipe or tubing in such manner as to change the form of its cross-section and impart to it the flat and serpentine sides above referred to, the pressure being applied by two pairs of dies, the dies of one pair being flat and the dies of the other pair corrugated. Heretofore the tube has been internally supported against the pressure of the dies by a mandrel formed to impart the desired shape to the interior of the header. It is impossible, however, to remove the mandrel bodily from the formed header, it being customary to make the mandrel in separable sections adapted to be removed one at a time, so that the mandrel can be dissected and removed piecemeal from the header after the forming operation. The construction of a sectional mandrel is expensive and much time is required in separating and reassembling its parts.

My invention has for its object first to dispense with a sectional mandrel or other rigid internal support and to provide instead means for confining and exerting pressure on a body of liquid within the tube, and thus forcing the walls of the blank outwardly against the dies after the tube or blank has been partially formed by the dies, the said body of liquid being adapted to be readily inserted and removed.

The invention also has for its object to provide certain improvements in the form and construction of the dies and in the means for operating the same.

The invention consists in the improvements which I will now proceed to describe and claim.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a top plan view of an apparatus embodying my invention. Fig. 2 represents a side view of the same. Fig. 3 represents an end view of the same. Fig. 4 represents a section on line 4 4 of Fig. 1. Fig. 5 represents a view similar to portions of Fig. 4, showing the dies separated. Fig. 6 represents a perspective view of one of the serpentine dies. Fig. 7 represents a perspective view showing a serpentine header as formed by my improved apparatus. Fig. 8 represents a section on line 8 8 of Fig. 3, showing the dies separated prior to the first forming operation. Fig. 9 represents a view similar to a portion of Fig. 8, showing the position of the serpentine dies after the inward movement of the movable die and before the final forming operation caused by the internal pressure. Fig. 10 represents a view similar to Fig. 8, showing the serpentine form of the header completed by the internal pressure.

The same characters of reference indicate the same parts in all the figures.

In the drawings, *a* represents the base portion of a suitable supporting-frame.

b and *b'* represent dies formed to impart to the serpentine header 1, as shown in Fig. 7, the sides 2 2, said sides being here shown as flat, although in certain styles of header the sides 2 2 may be provided with offset beveled faces or projections, in which case the dies *b* and *b'* will be correspondingly formed. I hereinafter refer to the dies *b* and *b'* as "side" dies in order to conveniently distinguish the same from the serpentine dies hereinafter described. The lower side die *b* is rigidly supported by the frame of the machine, while the upper side die *b'* is movable toward and from the lower die *b*. The means here shown for moving the upper die *b'* comprise a ram-cylinder *c*, suitably affixed to the supporting-frame, a piston *c'*, movable by hydraulic pressure in said cylinder, and a ram c^2, affixed to the cylinder and to the upper die *b'*. The cylinder is provided with suitable inlet and outlet passages whereby liquid under pressure may be admitted to

and released from either end of the cylinder to raise or lower the piston, ram, and upper die.

d and d' represent a pair of serpentine dies formed to impart the serpentine faces 3 3 to the header 1. The dies d and d' are arranged substantially at right angles to the dies b and b', the die d being detachably engaged with a fixed die-holder d^2, mounted on the supporting-frame. The die d' is detachably secured to a die-holder d^3, which is formed on or affixed to a ram e^2, affixed to a piston e^3 in the ram-cylinder e^4, said cylinder being suitably affixed to the supporting-frame. The ram e^2, die-carrier d^3, and die d' are movable toward and from the fixed die d and between the dies b and b'. The ram-cylinder e^4 is provided with suitable inlet and outlet passages, so that liquid-pressure can be caused to either project or retract the ram e^2 and the parts connected therewith. I prefer to brace and support the ram-cylinder e^4 and the fixed die-holder d^2 by means of transverse tie-rods $f\,f$, engaged with ears on said ram-cylinder and die-holder.

The blank from which the header shown in Fig. 7 is formed is a length of wrought iron or steel tubing 5, which is suitably heated prior to the forming operation. The said blank is inserted in the space surrounded by the dies, when the movable dies b' and d' are retracted, as shown in Figs. 5 and 8. The movable dies b' and d' are then moved toward the corresponding fixed dies, as shown in Figs. 4, 8, and 9, the dies being thus caused to partially form the blank. The formation imparted by the described movement of the dies is not complete and is substantially as represented in Fig. 9, from an inspection of which it will be seen that the serpentine faces of the blank only partially approximate the shape of the serpentine dies d and d'. To complete the formation of the header, I apply internal pressure to the blank, forcing its walls outwardly into exact conformation with the dies, as indicated in Figs. 4 and 10, said internal pressure being caused by introducing a filling of liquid into the partially-formed blank and then exerting pressure on said liquid to force the walls of the blank outwardly. The preferred means for confining the liquid within the partially-formed blank and for exerting pressure thereon will now be described.

g and h represent plugs which are movable toward and from the ends of the blank between the dies and are adapted to enter and seat themselves in the soft heated ends of the blank. The plug h is formed as a conduit, the same having a passage h', which communicates with the interior of the blank, so that a liquid mass introduced into the passage h' will flow therefrom into the interior of the blank and fill the latter. The plugs g and h are movable in opposite directions, so that they can be moved from the positions shown in Fig. 8 to the positions shown in Fig. 10. The plug g is mounted on a head g', which is adapted to slide upon the base a. The plug h is mounted upon a head h^2, which is also adapted to slide upon the base a. The head h^2 is provided with a ram-cylinder i, having a closed inner end or head i'. j represents a ram movable in said cylinder, the cylinder having a single inlet and outlet passage i^2 between the ram and the closed end i'. The ram is connected by rods $k\,k$ with the sliding head g', supporting the plug g. It will be seen that when water under pressure is admitted into the cylinder i the head h^2, with the plug h, will be impelled in one direction, the plug h being thus caused to enter one end of the partially-formed blank, and at the same time the ram j will be forced in the opposite direction, said ram imparting movements through the rods k and the plug g, which is thus forced in the opposite end of the partially-formed blank. The blank is thus adapted to receive the liquid filling, which is preferably of melted lead. This filling is introduced into the passage h' of the plug h through a supply-pipe m, which is connected with a suitable source of supply of melted lead and is sufficiently flexible to permit the necessary movements of the head h^2. The supply-pipe m is provided with a valve m', which is open to permit a body of lead to flow into the plug h and fill the blank, after which the valve m' will be closed to confine the said body. The liquid filling thus confined in the blank is next subjected to sufficient pressure to cause it to force the walls of the blank outwardly against the dies, and thus complete the operation of forming the hollow article or header. The means here shown for applying pressure to the liquid filling comprise a ram-cylinder n in the head h^2 and a ram n', connected with the piston n^2 in said cylinder, said ram passing through a stuffing-box n^3 and projecting into the passage h' in the plug h. The cylinder n is provided with suitable inlet and outlet passages at opposite sides of the piston, and when hydraulic pressure is admitted to the cylinder at the right-hand end of the piston, as viewed in Fig. 10, the ram n' is forced toward the blank and caused to exert pressure on the liquid filling therein, with the result as above described.

I prefer to arrange the machine on an incline, so that the blank when receiving the lead filling will be inclined downwardly from the plug h in order that the lead may gravitate to all parts of the interior of the blank and displace the air therein, a suitable air-outlet spout q being provided in the plug h for the escape of the displaced air.

After the completion of the header, as above described, the plugs g and h may be withdrawn from the ends of the header by any suitable means, the means here shown comprising a ram-cylinder r, affixed to the supporting-frame, and toggled links $r'\,r'$, jointed

to the ram r^2, one of said links being jointed to the sliding head h^2 and the other to the head of the ram j. When liquid-pressure is introduced in the cylinder r above the piston therein, the depression of the piston causes the links r' r' to move the plugs g and h in opposite directions outwardly from the ends of the header. The movable dies may then be retracted and the head g', with the plug g, removed from the rods k k to permit the withdrawal of the header from the dies.

Having thus explained the nature of my invention and described a way of constructing and using the same, though without attempting to set forth all of the forms in which it may be made or all of the modes of its use, what I claim, and desire to secure by Letters Patent, is—

1. An apparatus of the character stated, comprising dies adapted to externally form a serpentine hollow body, means for operating said dies to partially form a tubular blank placed between them, and means for introducing fused metal into said body to press the partially-formed walls of the blank outwardly against the dies.

2. An apparatus of the character stated, comprising dies adapted to externally form a serpentine hollow body, means for operating said dies to first partially form a tubular blank placed between them, and means for forcing a liquid against the inner surfaces of the blank to force its outer surfaces against the dies.

3. An apparatus of the character stated, comprising dies adapted to externally form a serpentine hollow body, means for operating said dies to first partially form a tubular blank placed between them, plugs adapted to close the ends of the blanks, one of the plugs constituting a conduit communicating with the interior of the blank, and means for introducing a liquid into the blank and exerting pressure thereon.

4. An apparatus of the character stated, comprising dies adapted to externally form a serpentine hollow body, means for operating said dies to first partially form a tubular blank placed between them, plugs adapted to close the ends of the blanks, one of the plugs constituting a conduit communicating with the interior of the blank, and having a valved inlet adapted to be closed to confine a body of liquid in the conduit and blank, and means for exerting pressure on the said confined body of liquid.

5. An apparatus of the character stated, comprising a pair of serpentine dies composed of a fixed die and a movable die, a pair of side dies, also composed of a fixed die and a movable die, the side dies being arranged substantially at right angles with the serpentine dies, means for forcing the movable dies inwardly against a tubular blank placed between the two pairs of dies to cause a partial conformation of the blank to the dies, and means for introducing fused metal into said body to press the partially-formed walls of the blank outwardly against the dies.

6. An apparatus of the character stated, comprising a pair of serpentine dies one of which is fixed and the other movable, a pair of side dies, one of which is fixed and the other movable, the dies of one pair being arranged substantially at right angles to the dies of the other pair, hydraulic rams engaged with the said movable dies, and adapted to force the same toward the fixed dies, to partially form a blank, and means for introducing fused metal into said body to press the partially-formed walls of the blank outwardly against the dies.

7. An apparatus of the character stated, comprising a supporting-frame, a side die b rigidly supported by said frame, a ram-cylinder rigidly supported above the die b, a ram movable in said cylinder, a side die b' affixed to the ram and movable therewith toward and from the die b, a die-holder d^2 rigidly supported and having a serpentine die d located between the dies b b', a ram-cylinder e^4 rigidly supported opposite the die-holder d^2, a ram movable in said cylinder, a die-carrier affixed to the ram, a serpentine die d' engaged with said carrier and movable therewith toward and from the die, and means for introducing fused metal into a hollow body between said dies.

8. An apparatus of the character stated, comprising two pairs of dies adapted collectively to externally form a serpentine hollow body, one die of each pair being fixed and the other movable, means for moving the movable dies toward the fixed dies to partially form a tubular blank in the space surrounded by the dies, two plugs movable in opposite directions toward and from the ends of the partially-formed blank and adapted to enter and close said ends, one of said plugs being formed as a conduit, means for moving said plugs into engagement with the ends of the blank, and means for exerting pressure on a body of liquid introduced into the blank through said conduit.

9. An apparatus of the character stated, comprising two pairs of dies adapted collectively to externally form a serpentine hollow body, one die of each pair being fixed and the other movable, means for moving the movable dies toward the fixed dies to partially form a tubular blank in the space surrounded by the dies, two plugs movable in opposite directions toward and from the ends of the partially-formed blank and adapted to enter and close said ends, one of said plugs being formed as a conduit, a sliding head h^2 supporting the conduit-plug and provided with a ram-cylinder, a ram movable in said cylinder, a sliding head g' supporting the opposite plug, and connections between said ram and the sliding head g', the said cylinder having an inlet between the ram and the closed end

of the cylinder, so that fluid-pressure introduced into said cylinder will move the heads g' and h^2 simultaneously in opposite directions and engage the plugs with the ends of the blank.

10. An apparatus of the character stated, comprising a sliding head h^2 having a conduit-shaped plug and a ram-cylinder n, means for supplying a liquid to the interior of the plug, and a ram movable in said cylinder.

In testimony whereof I have affixed my signature in presence of two witnesses.

KENNEDY PARK.

Witnesses:
C. F. BROWN,
E. BATCHELDER.