April 15, 1941. E. S. CORNELL, JR 2,238,037

METHOD AND MEANS OF PRODUCING WHOLLY INTEGRAL COLD WROUGHT TEES AND LIKE FITTINGS

Filed Feb. 14, 1936

Fig. 1.

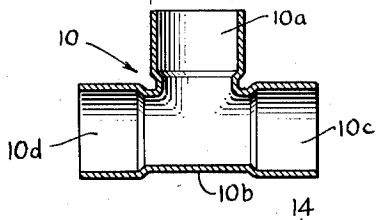


Fig. 2.

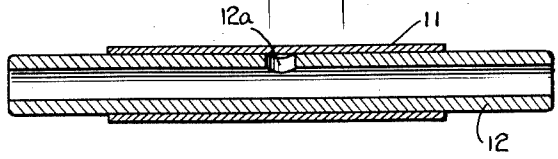


Fig. 3.

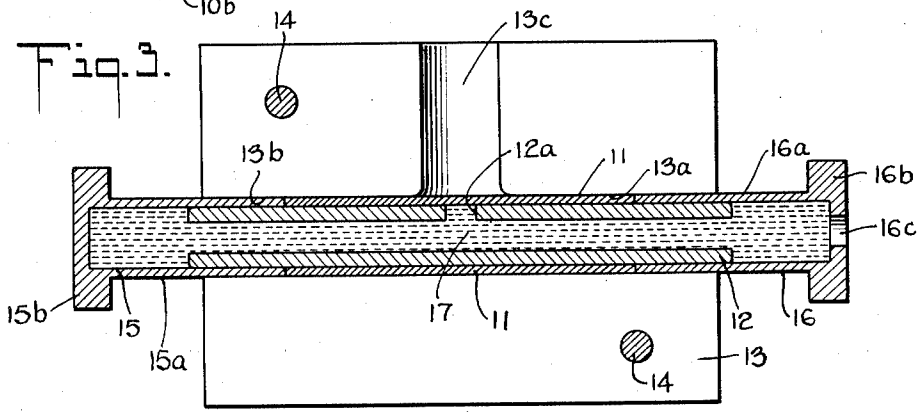


Fig. 4.

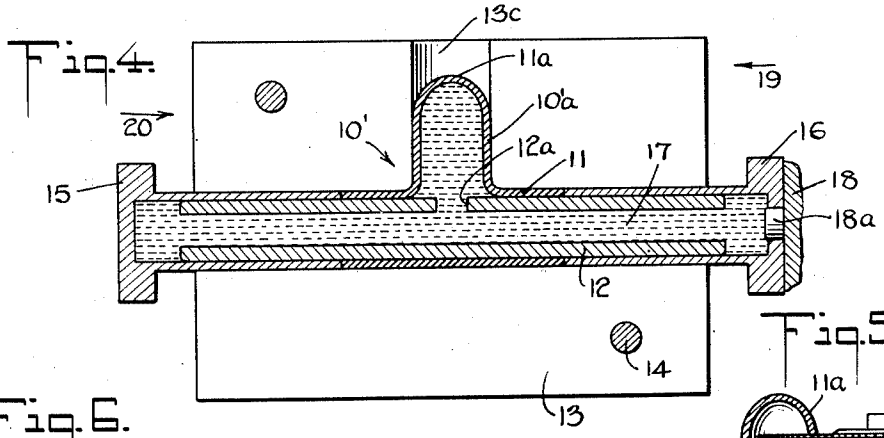


Fig. 5.

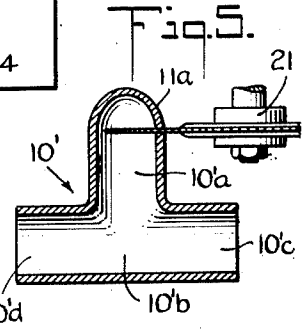


Fig. 6.

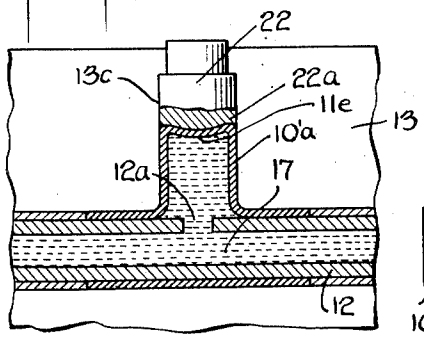
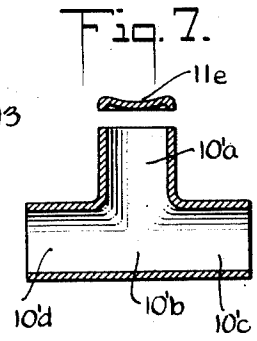


Fig. 7.



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METHOD AND MEANS OF PRODUCING WHOLLY INTEGRAL COLD WROUGHT T'S AND LIKE FITTINGS

Edward S. Cornell, Jr., Larchmont, N. Y.

Application February 14, 1936, Serial No. 63,853

8 Claims. (Cl. 113—44)

My present invention relates to the production of fittings, such as T's, Y's, X's or other types of lateral-provided fittings by cold working to final status.

Preferably, copper is employed as the material which is subjected to cold working. By "copper" I include commercially pure copper, alloys predominately of copper content, and other metals or the like which under condition of heat supplied additively to the heat ensuing under treatment, give rise to the formation of cuprous oxide or other deleterant, usually of oxidized character, defeating the successful production of fittings or the like, but when cold worked pursuant to my invention—and in the absence of supplied heat—the above stated fittings are successfully produced.

Generically, my invention comprises the cold working of an initial mass of the material, predetermined in its cubical content in correspondence to the cubical content of the resultant fitting, the treatment comprising a suitable die or equivalent suitably apertured to receive such initial mass and to effect contoural, dimensional and other characteristics desired of the resultant product, correlated with a hollow mandrel provided with a lateral determinative orifice and suitable male die members, such as hollow punches, or equivalent, whereby upon combined endwise bodily pressure and fluid pressure internally of the mass, one or more laterals and the body per se and the end openings of the body, having the desired characteristics, are produced.

Products of my invention are characterized by the body proper, end portions of the body, one or more laterals, individually integral and integral with one another without joint.

Products of my invention are further characterized by the cold working effects upon the copper mass ensuing in and by the successive steps of my method, including, inter alia, dense grain structure, high tensile strength, high degree of hardness, immunity against chemical or other corrosive effects in the presence of water in domestic supply lines, hot water, steam and other heating medium lines, oil and other transmission lines, and like and other forms and types of fluid conveyance.

By my method the product consists of copper work-hardened throughout to form an article of uniform strength and other superior characteristics to afford comparative lightness and to enable a lesser total material to be employed.

Further features and objects of my invention will be more fully understood from the following detail description and the accompanying drawing, in which

Fig. 1 is a central vertical sectional view of a T product of my invention.

Fig. 2 is a central longitudinal sectional view of a length of initial mass, in the form of a tube, associated with a hollow mandrel provided with a lateral determinative orifice.

Fig. 3 is a central sectional view through a die block provided with effective cavities corresponding to the product, in this instance a T, and the positioning therein of the initial tube and hollow mandrel shown in Fig. 2, and cooperating hollow fluid-operative punches. Fig. 3 shows the assembly of the stated parts at an initial stage in carrying out my method.

Fig. 4 is a central sectional view corresponding to that of Fig. 3, but illustrating a succeeding stage of operation of my method.

Fig. 5 is a central sectional view showing a stage of treatment of a T-formed product resulting from the treatment indicated in Fig. 4.

Fig. 6 is a central sectional view, corresponding to the view shown in Fig. 4, illustrating another embodiment of my invention.

Fig. 7 is a central sectional view, corresponding to the view of Fig. 5, illustrating the severing of a terminal formation of the lateral.

As above indicated, and as appears from the characteristics of the invention, the steps and sequence of steps shown in the respective figures of the drawing, depicting my method in its application to the production of a T, are illustrative of the production of all types of fittings provided with one or more laterals and of variant relation of axis, diameter, wall thickness and contour, etc., of any lateral to the axes, diameters, wall thicknesses and contours, etc., of the body per se and of the respective end openings in the "run," i. e., communicating with the longitudinal passage of the body at its opposite ends.

Thus for the formation of a T, such as the T 10 shown in Fig. 1, the detail parts of which are more fully described hereinafter, an initial mass 11, preferably imperforate from end to end, see Figs. 2 and 3, having a cubical content corresponding to the cubical content of the resultant T 10, is placed about a mandrel 12 suitably correlated therewith. Essentials of such tubular initial mass 11 and the correlation thereof with the mandrel 12 are, inter alia, an inner diameter of the tubular mass 11 relative to the outer diameter of the hollow mandrel 12, to have a fluid-seal fit therewith, an outer diameter of the tubular mass with respect to the diameter of the

effective longitudinal cavity of the die to place the wall of the tubular mass in contact with the wall of the die, and a length of tubular mass to provide for the ultimate cubical content of the walls of the fitting with minimum wastage.

Correlated with the aforesaid, I provide a suitable die 13, embodying, inter alia, an entrance bore 13a corresponding in diameter or other cross section to the diameter or other cross section of the right hand end portion of the initial mass, i. e., the tubular mass 11, and further embodying an entrance bore 13b corresponding in diameter or other cross section to the diameter or other cross section of the left hand end portion of the tubular mass 11; further, a lateral defining cavity 13c, in this instance, shown as an open ended cavity, corresponding in configuration to the configuration desired of the lateral of the resulting product, in this instance, a single lateral 10a of such T as shown in Fig. 1.

The angular relationship of such lateral defining cavity 13c corresponds to the angular relationship of the axis of the desired lateral to the axis of the body 10b and of the respective end openings 10c, 10d, of the T as shown in Fig. 1.

Such female die 13 is advantageously of the split type, usually of two parts, the respective parts of the die being suitably secured to one another, indicated by the holding pins or equivalent 14, 14.

The hollow mandrel 12 has a wall suitable for withstanding the stresses and strains, as described more fully hereinafter, and is provided with a lateral determinative orifice 12a, in this instance centrally located in the wall portion of the hollow mandrel 12 adapted, as is indicated in Fig. 3 and further appearing in Fig. 4, to be positioned centrally of and in axial alignment with the axis of the lateral defining cavity 13c, of the female die 13.

Coacting with such mandrel 12, I further provide suitable means for effecting the desired fluid pressure conjointly with the required bodily pressure applied in opposing directions at the opposing ends of the tubular mass 11 to effectuate to the desired extent axially and peripherally, the thereby resulting bulging of the central portion of the tubular mass 11 disposed in adjacency to the lateral defining cavity 13c of the female die 13.

Such provision of conjoint bodily pressure and fluid pressure means is advantageously in the form of a hollow punch 15, shown at the left of the assembled parts appearing in Fig. 3, the outer diameter or other cross section of the body 15a of such punch 15 making a fluid-tight sealing fit with the diameter or other cross section of the entrance bore 13b of the die 13. The punch 15 is further provided with a head 15b, in this instance shown closed, adapted for cooperation with a laterally operated ram or equivalent of a press.

Cooperating with such punch 15 I provide a punch 16, shown at the right in Fig. 3, which is hollow in its body 16a and of an outer diameter or other cross section making a fluid-tight seal with the diameter or cross section of the entrance bore 13a of the die 13. The punch 16 is also provided with a head 16b, in this instance shown open, adapted for cooperation with a laterally operated ram or equivalent of a press. Its head 16b in this instance is provided with a perforation 16c, the purpose of which appears more fully hereinafter. The interior of the punches 15, 16, and of the mandrel 12, inclusive of its lateral effecting perforation 12a, is filled with oil 17 or other suitable fluid, preferably of lubricating nature.

The supply of fluid and the maintenance of the fluid pressure may be carried out as preferred. Conveniently, the fluid, see 17, Fig. 3, is supplied by injection of such fluid, in predetermined effective quantity, within the hollow interiors of the mandrel 12 and of the left-hand punch 15 and of the right-hand punch 16, the opening 16c of the perforated punch 16 being closed against egress of the fluids 17 by suitable stopper means.

Such stopper means is advantageously, see Fig. 4, a part or incorporated with the ram 18, such as a protruding lug 18a, making a fluid-seal joint with the walls of the opening 16c of the right-hand punch 16.

Accordingly, upon operation of the press, effecting mutual approach—see arrows 19, 20, Fig. 4—of the respective punches 15, 16, and attendant bodily pressure applied endwise at the opposing ends of the tubular blank 11 together with the conjoint building-up and maintenance of pressure, within a predetermined range, exerted through the lateral determinative orifice 12a of the hollow mandrel upon the wall of the tubular blank 11, the lateral formation 11a is initiated and progressively formed, i. e., completed, defined by the walls of the lateral defining cavity 13c of the female die 13. Preferably, as appears, the hollow mandrel 12 has a length substantially that of or exceeding the original length of the tubular blank, also, its outer annular wall has a substantially uniform diameter and extends imperforately from end to end, excepting at its lateral determinative orifice 12a, shown located centrally of its annular wall, in the illustrated instance of the production of a single lateral-provided fitting, i. e., the resulting T body 10'.

Predicated upon the results obtained in the production, under commercial conditions, of T's and other lateral-provided fittings, pursuant to my invention as aforesaid the movement of the lateral formation 11a, effected by cold operation, ensues by the gradual and uniform flow of the metal toward the central portion, i. e. the portion adjacent the lateral defining die cavity, to successively constitute such central portion of the tubular blank toward and into the lateral defining cavity 13c of the die 13, the aforesaid being facilitated by a fluid of lubricating nature.

Upon completion to the desired extent of the lateral formation 11a within the lateral cavity 13c of the female die 13, the work, designated 10', is removed from the die, and finished as desired.

Assuming the lateral formation 11a of the nature as shown in Fig. 4, a finishing step may be the severing of the "dome" of the lateral formation 11a, as by means of a rotary knife, indicated diagrammatically at 21, see Fig. 5.

Additional finishing, subsequent to the severing or equivalent of the lateral, as aforesaid, may be carried out as preferred. To attain the particular diameter, contour and characteristics of the lateral 10a, the body per se 10b, body end openings 10c, 10d, as depicted in Fig. 1, the lateral 10'a, the body per se 10'b, the body end openings 10'c, 10'd, are treated correspondingly.

Figs. 6 and 7 indicate an alternative procedure in the employment of a plug 22 in the lateral cavity 13c of the die 13, the plug 22 having its effective face 22a preferably of centrally con-

vex and peripherally concave contour, whereby upon operation of the punches 15, 16, in correlation with the mandrel 12 and conjoint pressure operation of the fluid 17, the walls of the lateral formation 11*a* are more closely defined by the walls of the die lateral openings 13*a* and the "dome," see 11*e*, Fig. 6, is contoured for minimum wastage of metal.

By such or equivalent procedure, such concavo-convex "dome" 11*e* is removed, as by severing, as indicated in Fig. 5. The remainder of the fitting is completed as to its lateral 10'*a*, body per se 10'*b*, and body end openings 10'*c*, 10'*d*, as desired.

From the above, it appears that my method provides for the application of pressure bodily upon the original, preferably tubular, mass in direction from the respective ends of such mass toward the one or more lateral defining cavities of the female die, conjointly with fluid pressure effective upon the mass in direction toward and into such one or more lateral defining cavities. In such conjoint pressure-effective movement of the mass toward and into the one or more lateral defining cavities of the female die, and resulting laterals, the hollow mandrel, by reason of its continuation from end to end, i. e., absence of perforations, excepting for its one or more lateral determinative orifices, and extending in coordination with the walls of the longitudinal cavity of the female die relative to the original i. e. tubular mass, the respective portions of the tubular mass are positively maintained in dimensional characteristics—and without buckling, wrinkling or other collapse—while the material of the original i. e. tubular mass flows toward and into the one or into the respective lateral-defining die cavities, and the walls of the respective one or more lateral defining cavities thereupon serve to predetermine the contour and other dimensional characteristics of the one or more laterals thus formed from such original mass.

The contour and dimensional characteristic of each lateral are as desired, and controlled by the forces respectively applied bodily and by fluid pressure upon the tubular or other original mass. In the commercial production of a T or like lateral-provided fitting, the cubical content of the wall of each lateral is preferably in excess of the cubical content of the zone of the original mass defined at its outer boundary by the outer periphery of the lateral and having a wall thickness equal to the wall thickness of the body of the resulting T. The wall thickness, length and contour of the wall of each lateral may be varied as desired. The cubical content of each lateral in excess of the cubical content of its zone, above defined, is predetermined by the bodily pressure applied to the tubular or other original mass conjointly with and in correlation with the pressure created uniformly in and uniformly exercised through the pressure fluid.

As above indicated, by the successive stages of cold flow of the material of the original mass in direction longitudinally of the longitudinal cavities of the female die toward the central or other portion adjacent the location of the desired lateral or laterals and within the respective one or more lateral defining cavities, transmutes the physical characteristics of the material into the superior qualities of dense grain structure, high tensile strength, high fracture resistance, elimination of pores, immunity against corrosion or other chemical action in the presence of natural waters, and other fluids conveyed in commonly used systems, such as steam and hot water heating systems, domestic and industrial water and other fluid supplies, etc.

Whereas I have described my invention by reference to specific forms thereof, it will be understood that many changes and modifications may be made without departing from the spirit of the invention.

I claim:

1. The combination of female die means provided with a longitudinal cavity and with a lateral defining cavity, hollow mandrel means provided with a lateral determinative orifice located in correspondence to said lateral defining cavity, said hollow mandrel means and the longitudinal cavity of said female die means being arranged relative to one another to fluid-sealingly receive therebetween a length of tubular mass, and mutually spaced hollow means fluid-sealingly correlated to said hollow mandrel means and the walls of the longitudinal cavity of said female die means, and fluid means within the interior of said hollow mandrel means, whereby upon application of force through said mutually spaced hollow means pressure endwise in opposing direction is exerted upon said tubular mass effecting the flow of the material of said length of tubular mass toward said lateral defining cavity of the female die means, whereby a lateral is formed and defined in wall contour by said lateral defining die cavity integral with the body of the fitting.

2. The combination of female die means provided with a longitudinal cavity and with a lateral defining cavity, hollow mandrel means provided with a lateral determinative orifice located in correspondence to said lateral defining cavity, said hollow mandrel means and the longitudinal cavity of said female die means being arranged relative to one another to fluid-sealingly receive therebetween a length of tubular mass, mutually spaced hollow means fluid-sealingly correlated to said hollow mandrel means and to the walls of the longitudinal cavity of said female die means, fluid means within the interior of said hollow mandrel means and means for applying force upon said hollow means to transmit bodily pressure endwise in opposing direction upon said tubular mass toward said lateral defining cavity and conjointly transmit fluid pressure through its said lateral determinative orifice of said hollow mandrel means upon the wall of said tubular mass in direction toward and into said lateral defining cavity, said hollow means comprising punches respectively disposed in opposing relation to said tubular mass in the longitudinal cavity of said female die means, said punches being provided with an opening for the passage of the fluid.

3. The method of producing a cold worked wholly integral lateral-provided fitting of material of the nature of copper, which comprises providing a length of tubular blank of such material, providing a hollow mandrel having a lateral determinative orifice, and otherwise imperforate from end to end, and having a substantially uniform periphery, and a length at least the length of said tubular blank, and an external diameter substantially the same as the internal diameter of the blank, assembling said hollow mandrel within said length of tubular blank, positioning the thus assembled hollow mandrel and length of tubular blank within a suitable die provided with a lateral defining cavity, locating said lat-

eral determinative orifice of the hollow mandrel in alignment with the lateral defining cavity of the die, providing suitable fluid medium within the interior of said hollow mandrel, and subjecting said length of tubular blank to pressure endwise of the blank and conjoint fluid pressure internally of the tubular blank, whereby a lateral is formed and defined in wall contour by said lateral defining die cavity integral with the body of the fitting.

4. The method of producing a cold worked wholly integral lateral-provided fitting of material of the nature of copper, which comprises providing a length of circular tubular blank of such material, providing a hollow mandrel having a lateral determinative orifice, and otherwise imperforate from end to end and having a substantially uniform diameter, and a length at least the length of said tubular blank, and an external diameter substantially the same as the internal diameter of the blank, assembling said hollow mandrel within said length of tubular blank, positioning the thus assembled hollow mandrel and length of circular tubular blank within a suitable die provided with a lateral defining cavity and locating said lateral determinative orifice of the hollow mandrel in alignment with the lateral defining cavity of the die, providing suitable fluid medium within the interior of said hollow mandrel, and subjecting said length of circular tubular blank to pressure endwise of the blank and conjoint fluid pressure internally of the tubular blank by instrumentalities physically engaging the opposing ends of the blank, whereby a lateral is formed and defined in wall contour by said lateral defining die cavity integral with the body of the fitting.

5. The combination of female die means provided with a longitudinal cavity and with a lateral defining cavity, hollow mandrel means provided with a lateral determinative orifice located in correspondence to said lateral defining cavity, said hollow mandrel means and the longitudinal cavity of said female die means being arranged relative to one another to receive therebetween fluid-sealingly a length of tubular mass, mutually spaced hollow means fluid-sealingly correlated to said hollow mandrel means and to the walls of the longitudinal cavity of said female die means, fluid means within the interior of said hollow mandrel, and means for applying force upon said hollow means to transmit bodily pressure endwise in opposing direction upon said tubular mass toward said lateral defining cavity and conjointly transmit fluid pressure through the said orifice upon the wall of said tubular mass in direction toward and into said lateral defining cavity.

6. The combination of female die means provided with a longitudinal cavity and with a lateral defining cavity, hollow mandrel means provided with a lateral determining orifice located in correspondence to said lateral defining cavity, said hollow mandrel means and the longitudinal cavity of said female die means being arranged relative to one another to receive therebetween fluid-sealingly a length of tubular mass, mutually spaced hollow means fluid-sealingly correlated to said hollow mandrel means and to the walls of the longitudinal cavity of said female die means and to such length of tubular mass, fluid means within the interior of said hollow mandrel, and means for applying force upon said hollow means to transmit bodily pressure endwise in opposing direction upon such tubular mass toward said lateral defining cavity and conjointly transmit fluid pressure through the said orifice upon the wall of such tubular mass in direction toward and into said lateral defining cavity.

7. The method of producing a cold worked wholly integral lateral-provided fitting of material of the nature of copper, which comprises providing a length of tubular blank of such material, providing a hollow mandrel having a substantially uniform diameter substantially the same as the internal diameter of the blank and a length at least the length of said tubular blank, said hollow mandrel having a lateral determinative orifice and being otherwise imperforate over a length at least equal to the length of said tubular blank, assembling said hollow mandrel in fluid-seal relation to and within said length of tubular blank, positioning the thus assembled hollow mandrel and length of tubular blank within a suitable die provided with a lateral defining cavity and locating said lateral determinative orifice of the hollow mandrel in alignment with the lateral defining cavity of the die, providing suitable fluid medium within the interior of said hollow mandrel and subjecting said length of tubular blank to endwise pressure in opposing directions and simultaneously to pressure internally of the tubular blank by instrumentalities physically engaging the opposing ends of the blank and fluid-sealingly related to the thus assembled hollow mandrel and length of tubular blank, whereby a lateral is formed and defined in wall contour by said lateral defining die cavity integral with the body of the fitting.

8. The method of producing a cold worked wholly integral lateral-provided fitting of material of the nature of copper, which comprises providing a length of tubular blank of such material, providing a hollow mandrel having a substantially uniform diameter substantially the same as the internal diameter of the blank and a length at least the length of said tubular blank, said hollow mandrel having a lateral determinative orifice and being otherwise imperforate over a length at least equal to the length of said tubular blank, assembling said hollow mandrel in fluid-seal relation to and within said length of tubular blank, positioning the thus assembled hollow mandrel and length of tubular blank within a suitable die provided with a lateral defining cavity and locating said lateral determinative orifice of the hollow mandrel in alignment with the lateral defining cavity of the die, providing suitable fluid medium within the interior of said hollow mandrel, subjecting said length of tubular blank to pressure endwise of the blank and conjoint fluid pressure internally of the tubular blank, whereby a lateral is formed and defined in wall contour by said lateral defining die cavity integral with the body of the fitting, and severing the thus formed dome to provide an opening for the lateral.

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