Feb. 21, 1956 P. D. WURZBURGER 2,735,389

METHOD AND MEANS FOR MAKING WROUGHT FITTINGS

Original Filed Aug. 23, 1947

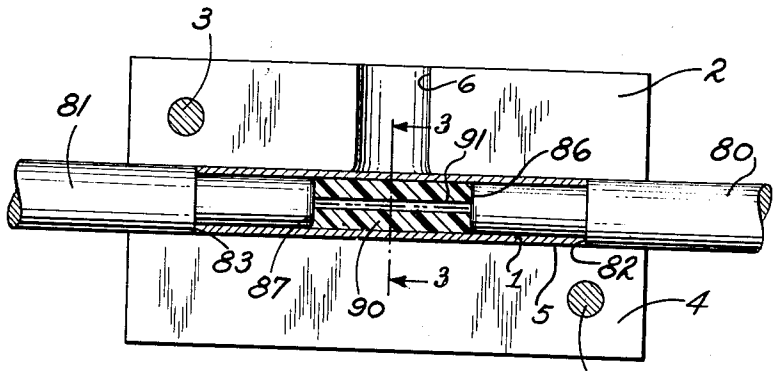


Fig. 1

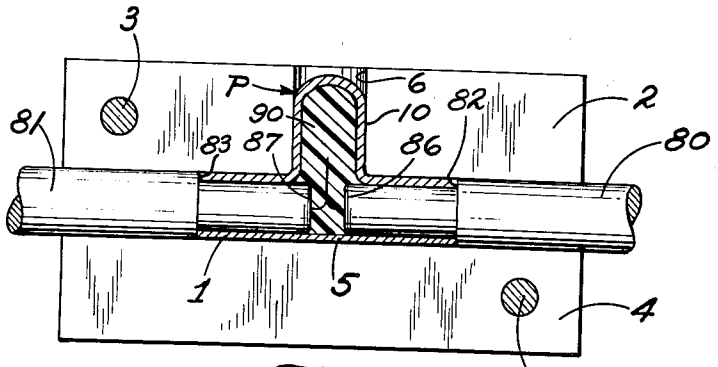


Fig. 2

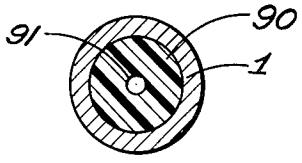


Fig. 3

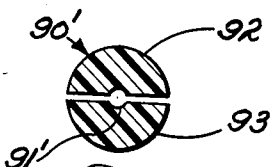


Fig. 4

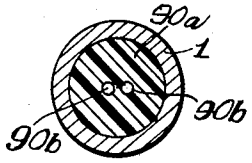


Fig. 5.

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METHOD AND MEANS FOR MAKING WROUGHT FITTINGS

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Original application August 23, 1947, Serial No. 770,293, now Patent No. 2,603,175, dated July 15, 1952. Divided and this application July 2, 1952, Serial No. 296,850

7 Claims. (Cl. 113—44)

This invention relates to metal working and more particularly to improved methods of forming wrought T fittings, crosses or other branch fittings from tubular stock.

This application is a division of my co-pending patent application entitled Method and Means for Making Wrought Fittings, Serial No. 770,293, filed August 23, 1947, now Patent No. 2,603,175, granted July 15, 1952.

My invention may be considered in general as an improvement upon prior methods in which a tubular blank is subjected to the combined forces of filler material under pressure and direct axial compression which cause the metal to flow and form the desired hollow branch fitting. In such a forming process the volume of the resultant fitting is smaller than the volume of the original blank. At least in part this shrinkage in volume is due to the tendency of the metal walls to become thicker.

When such a diminution in volume of a fitting results during the forming operation, the pressure of the filler material, which is usually virtually incompressible tends to increase beyond bounds. The result is the bursting strength of the fitting is exceeded and any unsupported portion of the blank tends to rupture.

Several methods of the prior art attempt to provide for pressure relief by permitting liquid filler material to escape from the partially wrought blank by means of preloaded relief valves. Because of the inertia effects inherent in such a method of pressure relief, the internal fluid pressure is subject to undesirable and abrupt variations, making control of the forming operation difficult if not impossible. Delayed pressure relief invites momentarily high pressures which often are destructive; over-relieving results in loss of pressure when the same is needed for proper forming of the fitting. The surges in pressure resulting from the use of relief valves are therefore to be avoided if consistently satisfactory results are to be achieved.

Another proposed solution to the problem suggests the use of a plastic filler material of high viscosity such as lead with a provision for pressure relief by permitting excess material to escape from the blank through a perforation in the wall, such perforation being located where the end of the lateral branch is to be formed. This expedient is disadvantageous in commercial production for it is very difficult to maintain correct internal fluid pressures when a portion of the filler material can escape outwardly without an opposing pressure to set a lower limit to the internal filler pressure. Another drawback to the use of a perforated blank is that the perforation tends to tear, especially if the edges are ragged, causing injury to the fitting and complete loss of control over the forming operation.

Yet another proposal to meet the problem of diminishing volume is to prevent wall thickening by supporting the blank positively during the forming operation by internal supporting plugs. This proposal is impracticable for commercial production; for, first, it is difficult if not impossible to prevent thickening of the wall of the blank at the

zone where the intercommunicating branches intersect. Secondly, if loosely fitting plugs are used the metal will first thicken to fill the clearance between the plug and the blank, and thirdly, the use of closely fitting plugs presents difficulties of insertion into and removal from the blank.

A general object of my invention is to provide methods and means for forming hollow tubular fittings such as T-fittings or the like in which the difficulties of the prior art described above are substantially overcome. It is therefore among the objects of my invention to provide a method for making such fittings out of tubular stock by creating desirable internal filler pressures in the blank throughout the forming operation. More specifically it is an object to provide that the rate of displacement of filler material be kept in harmony with the rate of change in volume of the blank or piece during the working operation as by working the filler at a rate in relation to the rate of working the piece that is proportional to the rate of diminution of volume of the blank from initial to final form.

Another object is to provide a filler material of novel and advantageous properties which can be handled, inserted into and removed from the work piece and/or can be precompressed in the work piece and which is readily soluble in water; which has a low melting point so that no problem of amalgamation or cleaning is involved and which has desirable lubricating and viscosity properties.

Another object is to provide a body of substantially incompressible plastic filler material having preformed void spaces which facilitate a controlled diminution in filler volume during the forming of the fitting so that a substantially constant and desirably high internal filler pressure can be developed and maintained.

These and other objects and advantages of my invention will more fully appear from the following description of certain preferred and modified forms thereof reference being had to the accompanying drawings in which:

Figure 1 is a longitudinal sectional partially fragmentary and partially diagrammatic view of a tubular blank and forming apparatus showing the parts at the beginning of the forming operation;

Figure 2 is a view corresponding to Figure 1 showing the parts at the end of the forming operation;

Figure 3 is a transverse sectional view taken along the lines **13—13** of Figure 1, and

Figure 4 is a view similar to Figure 3 showing a modified form and construction of filler material.

Fig. 5 is a view corresponding to Figure 3 showing a modified form of voided filler material with a plurality of voids.

Exemplary forms of my invention, including certain forms specifically disclosed in my co-pending application, contemplate forming branch fittings by applying forming pressures directly upon the end of a tubular blank and also applying pressure upon substantially incompressible filler material confined within the blank in relative amounts and rates which produce desirable flow and working of the metal. I prefer that filler material pressures will remain desirably high but below the bursting strength of the blank adjacent the weakest point thereof. Also I prefer that a preliminary pressure be built up in the filler material prior to the exertion of metal flowing pressure upon the ends of the blank so that the filler material will tend to act incompressibly during the working of the blank. Precompression of the filler may also tend to stress at least that portion of the blank adjacent the branch to be formed before or possibly simultaneously with the working of the blank in response to pressure exerted directly upon the ends thereof.

Throughout the following description and illustration of preferred and modified forms, embodiments and prac-

tices of my invention specific reference is largely confined to the making of the T forms of branched fittings, and the same is not to be taken by way of limitation but rather by way of exemplification of the principles of my invention as the same may be applied with like facility to the making of crosses and other branch forms not so specifically illustrated and described.

Referring now to Figures 1, 2 and 3 of the drawings the tubular blank 1 preferably in the right circular cylindrical form of the metal or alloy to be worked is disposed in the sectional die 2, one half only being shown, which with its companion half, not shown, provides a suitable T shaped channel 4 comprising a head portion 5 and a lateral branch or leg portion extending at right angles thereto; the tubular blank 1 being initially disposed in the head portion 5 of the channel as shown in Figure 1. The die may be divided along any one of several parting lines but I find it advantageous to split it longitudinally and symmetrically as shown, using centering pins 3 to align the separate halves, although the die might be split through the head portion of the channel in a plane normal to the branch 6 if that were desired.

The tubular blank preferably comprises workable metal such as fairly soft copper, aluminum, mild steel or other metals or alloys which will flow easily and which are extrudable under the influences and conditions to be hereinafter more fully set forth. The efficacy of my invention admits of the use of other desirable metals and materials, the working of which has been regarded as too difficult for practicability. It will be understood that the split halves of the die 2 may be opened and closed to permit the insertion of the blank 1 in the first instance and the removal of the wrought piece P by suitable opening, closing and clamping mechanisms which are known in the art but which are not specifically shown herein. The wrought piece P is shown in Figure 2 at the completion of the working thereof; the ends of the tubular blank 1 having been forced toward each other and the branch or leg 10 having been forcibly extruded into the branch channel 6 of the die as a result of simultaneous, preferably rapid and continuous, inward movements of the plungers 80 and 81 which may be so actuated by means well known in the art and/or by the hydraulic cylinders, not shown, but shown and described in my co-pending application.

As indicated above the practice of my invention includes the employment of filler material 90 disposed interiorly in the tubular blank 1 in the first instance and thereafter forcibly constrained to flow from its original position into the leg portion 10 of the piece as suggested by comparison of Figures 1 and 2. The filler material that I prefer to employ is characterized by its ability to flow or spread under pressure by that degree of fluidity, elasticity or viscosity most suitable for working different metals or alloys for the practice of the different forms of my invention presently to be described and by the ease with which it may be formed for use with the tubular blank and the ease with which it may be removed from the work piece. My preference is to use Woods metal or one or another of the polyethylene glycols or mixtures thereof having the characteristics of fluidity, viscosity and strength substantially corresponding to Woods metal.

The polyethylene glycols of the general formula $HOCH_2(CH_2OCH_2)_{2+x}CH_2OH$ having molecular weights of the order of about 1000 to about 7000 are wax-like solids whose melting points and viscosity increase substantially in proportion to their molecular weights and whose solubilities in water or organic solvents are roughly inversely proportional to their molecular weights. Polyethylene glycol having an average molecular weight of about 3000 is a hard translucent wax-like solid somewhat resembling paraffin wax in appearance and texture, which is soluble in water and which has a melting point around 50° C. When its molecular weight is increased

to between 6000 and 7500 the melting point increases to about 58 to 62° C. It is still soluble in water and its viscosity is substantially increased. Below an average molecular weight of about 700 the polyethylene glycols are liquids at room temperature. Within this range of choice from among the polyethylene glycols and mixtures thereof a number of advantages persist, namely, the fact that the filler may be very easily removed from the finished work piece by virtue of its solubility in water or other solvents at room temperature or alternatively by melting the filler at low temperatures which are harmless to the metal of the finished piece. Moreover the polyethylene glycols do not "tin" the interior of the work piece nor do they leave insoluble residues which must be removed as by de-tinning, de-greasing or de-waxing as is often the case with other known filler materials. Moreover the polyethylene glycols particularly in the range of molecular weights from about 1000 to 7000 have advantageous lubricating qualities which assist in the extrusion operation and facilititate the flow of metal and the flow of the filler material during the working of the blank. The filler material of my preference may be cast directly into the blank or the mid-portion thereof as shown in Figure 1, or alternatively it may be pre-cast or otherwise formed into slugs or pellets of a desired size with internal voids suitable for manual insertion into and fit within the tubular blank.

As shown in Figures 1 and 2 I prefer to employ a quantity of filler material 90 not greatly in excess of the volume of the lateral branch or branches that are to be extruded or formed from the tubular blank such as the branch or leg 10 shown in Figure 2. I find it desirable to use a minimum volume of filler material sufficient to fill substantially only that middle portion of the blank which is to be worked rather than any greater portion of length for a number of reasons. Firstly, the cost and expense of handling and recovering filler material is reduced. Secondly, it is practicable and at all times advantageous to support these portions of the blank which are not worked or not substantially worked by pilot portions of the plungers shown in Figures 1 and 2, which have a close sliding fit with the internal surface of the blank and constrain these so-called unworked portions of the blank to their desired size and shape more efficiently in many instances than filler materials whose characteristics may best be selected for the specific purpose of working the work parts of the material of the finished piece. Moreover by using substantially the minimum volume of filler material, I am able to create and maintain a much more nearly uniformly desirable pressure throughout the whole of the filler material than would otherwise be the case especially where it is desirable to use a filler material of high viscosity in which a large pressure gradient would be developed between the ends where pressure is applied by the plungers and the mid-portion where pressure is sought to be developed between the filler material and the portion of the blank to be worked.

Influencing the plungers to have the movements and to exert the pressures mentioned above taken with the employment of a desirably small mass of filler material and with the confinement of the whole mass of filler material between the ends of the rams, not permitting any of the mass of filler to escape or be "relieved" from its confinement nor be subjected in any part to substantially less than the desired pressure during the whole time of working the piece, gives, as I have observed, most satisfactory results in a number of respects which taken collectively enhance the product and facilitate the working and making thereof. Thus the initial and continued uniform collaboration of the filler material in the working operation resists undesirable tendencies or incipient tendencies of the metal to wrinkle, thicken, thin out, burst or shear as it might and often does where the filler material is not caused to play its full and best part in

relation to the forces and movements given to the ends of the blank to effect the direct working thereof by the plungers.

The change of reduction in the volume or cubical content of the blank or work piece does not necessarily take place at an exactly constant rate during the working of the piece. No doubt more specific factors enter into the differences between the instantaneous rates of change of volume than I am now aware of or could profitably speculate about within the confines of this specification. Mention of a few factors will illustrate the point. For example, where the ends of the rams extend for a long distance inwardly of the ends of the blank, as shown in Figure 1, and have a snug fit with the internal surface of the blank throughout a large portion of the internal area thereof, and assuming that the external surfaces of the blank are also snugly supported in the channel of the die, these things will greatly limit or reduce that part of the loss of volume arising from the thickening of the walls of the blank especially at and adjacent the ends thereof where the ends of the plungers bear thereupon. Insofar as this rate of loss of volume tends to be rapid at the beginning of the working stroke of the plungers, this factor is much diminished in this form of my invention. It may be mentioned in passing that the initial disposition of the ends of the rams as far as practicable into the blank consistent with the desired volume of filler material for the branch or branches to be extruded, goes hand in hand with the advantage and desirability of employing the minimum practicable volume of filler material.

Another factor bearing upon the instantaneous rate of change or reduction in volume of the piece is the sharpness of the corners of the intersection between the head and branch leg; the sharper and more abrupt corners tending to thicken up more than the more rounded and less abrupt corners around which the metal of the blank is caused to flow. This thickening or tendency to thicken takes place, as I believe, somewhat later in the stroke than the tendency to thicken the ends and is much reduced by the continuous and beneficient participation of the filler material in the working of the metal. Other factors, as I believe, are related to the softness, ductility and other physical characteristics of the stock of the blank as well as to the absolute speed with which the work is done. On the whole my invention tends of itself, for some or all the reasons above mentioned, and as hereinafter will more fully appear, to cause the rate of reduction of volume of the piece to be substantially uniform or more uniform than prior practice throughout the working stroke and also tends to cause the diminution or change in volume of the piece from tubular blank to finished form to be small or relatively small compared with prior practices.

The instant form of my invention as shown in Figures 1–4 contemplates the use of highly viscous and/or relatively tough and strong filler material in the form of a cylindrical slug **90** preferably provided with a cylindrical longitudinal void or bore **91** extending the full length of the slug; the void having a reduceable volume substantially equal to the shrinkage in volume of the fitting which takes place during the forming process. The slug **90** may be cast solid and the bore drilled or punched out or the slug may be extruded in the form of a tube and then cut to proper length, or formed by any other suitable method depending upon the filler material selected and on the relative convenience of the several methods. As suggested in Figure 4 the slug **90'** may be cast or otherwise formed in two longitudinally split halves which when assembled will define the voided bore **91'** of the desired size, or may be cast to define when assembled one or more spherical or other shaped voids. While I prefer to provide a single cylindrical void or bore in the slug of filler material my purpose admits of other forms and numbers of voids so long as the desired function and operation of the voided filler is preserved. It is mentioned for illustration that a

filler slug having a plurality of small spherical voids will tend to resist reduction of gross volume to better advantage than a slug having one cylindrical void of the same volume. As mentioned the volume or reduceable volume of void is substantially equal to the loss of volume occasioned by working the blank **1** to the form of the finished piece P, but the mere provision of any void or voids in or adjacent any filler will not necessarily support the other purposes and objects of my invention in creating and maintaining desirably high and substantially uniform pressure in the filler while accommodating the diminishing volume of the piece wherewith to facilitate the working of the piece and the flow and extrusion of metal into the extruded branch or branches. To this latter end the shape and disposition of the void or voids taken with the strength and viscosity of the filler material when regarded as a structural element resisting collapse under longitudinal compression, permits me to develop in the filler material the desired high pressure, prevent the pressure from exceeding a desired maximum and at the same time reduce the gross volume of the filler. For example if one employs polyethylene glycol of a high molecular weight or uses Woods metal of substantially the same strength and uses a single longitudinal void of a .10" diameter in a slug of a given size and otherwise suitably proportioned to carry out my invention, such a slug so voided might well develop a desirable pressure to facilitate the extrusion of a blank of thin walled soft copper. However, all other things being equal, and the blank being made of a tougher material such as stainless steel wherein higher pressure is sought to be developed in the filler prior or incident to the collapse or reduction in the void or voids then it would be practicable to develop the higher pressure by using two smaller, spaced longitudinally extending voids, such as the voids **90***b* in the slug **90***a*, Fig. 5, each of approximately .07" in diameter wherewith to provide the same volume of void but to have a higher resistance to collapse or constriction than the single larger void of like volume. As will presently appear and as is suggested in Figure 2 the compression upon the ends of the voided filler material is accompanied by the flow of filler material in the direction of the extruded branch whereby the material of the filler which defines a longitudinal void is induced to flow transversely thereof, thereby contributing to the collapse of the structure defining the void and the reduction of the volume occupied by the filler material and/or the filler material plus the voids therein.

Referring further to Figures 1 and 2 the voided slug of filler material **90**, which preferably closely fits the interior of the blank **1**, is disposed between the end faces **86** and **87** of the pilot portions of plungers **80** and **81**; the plungers having respectively square annular shoulders **82** and **83** which engage the ends of the blank when the plungers are caused to take their inwardly moving forming strokes as induced by such means as have heretofore been described. I prefer that the pilot portions of the plungers **80** and **81** snugly fit the interior of the blank **1**, and be as long as practicable consistent with the stroke of the plungers, the desired displacement of filler material and the desired length of the slug of filler material which may depend somewhat on the form of the voids provided therein. Preferably the slug **90** is compressed between the end **86** and **87** of the plungers a little prior to the moment of forcible engagement between the shoulders **82** and **83** and the ends of the blank whereby to pre-load the filler and tend to develop a desirably high initial pressure a little in advance of the direct working of the metal through the plungers. A following increment of movement of the plungers will begin the inward movement of the ends toward each other and such thickening of the stock as the sides of the pilots and the pressure of the filler permits. As plunger movement continues and as the volume of the piece diminishes pressure in the filler will rise or will have risen to the desired maximum near but

below the bursting strength of the piece and at or above the strength of the filler that defines the void or portion of the void that is first to collapse or suffer reduction in size under the conditions of working the piece and causing the filler to flow into the extruded branch. Thereafter as the work progresses filler pressure exerted against the piece is maintained and limited within the desired and useful limits specified whilst the gross volume of filler diminishes in accommodation of the diminishing volume of the piece.

After the leg 10 of the piece P has been formed to its desired length the plungers are withdrawn; the halves of the die 2 separated and the piece ejected. Thereupon the filler material is removed and the closed end of the extruded branch shaped and/or trimmed as may be desired. If polyethylene glycol has been used in the forms which I prefer, its removal from the piece before or after trimming the end of the extruded branch is facilitated by the low melting point or the high solubility of the filler. The T or other branched form of finished piece, i. e., finished with respect to the primary formation thereof according to the instant invention, may thereafter be used directly or worked additionally as by forming sockets in the ends of the branches or otherwise according to known practices.

In all forms of my invention I exact a full measure of service and utility from the filler material in the working of the piece while avoiding the hazard of rupturing or injuring the piece as a consequence of the diminution of the volume thereof as between its initial and finished forms. In all forms of my invention I preserve the desirable differential between the rate of displacement of the ends of the blank toward each other and the rate of displacement of filler material into the branch or branches being extruded, while maintaining on the filler material and between the filler material and the interior surfaces of the piece a desirably high hydrostatic pressure which however is retained below a deleterious value. In all forms of my invention the filler material is continuously confined within the piece and within the diminishing volume thereof and the mass of filler material as a whole is constrained to flow in the direction of the extrusion of the branch or branches wherewith to influence that extrusion favorably and to aid especially in the working and flowing of the metal around the corners of the intersection of the head with the legs or other branches of the finished piece. In all forms of my invention a desirably high initial pressure is created in the filler material and interiorly of the blank at or prior to the beginning of the direct working of the metal of the blank and the beneficently high pressure is maintained continuously and substantially uniformly throughout the whole time of working the piece; the pressure in and exerted by the filler in and upon the piece never being subjected to sharp changes positively or negatively whether incident to intended relief or merely without control.

While I have illustrated and described preferred and modified forms of my invention and preferred and illustrative means with which the same may be practiced, changes, modifications and improvements therein will occur to those skilled in the art who come to understand the underlying and fundamental principles hereof and the teachings of this specification, and I do not care to be limited in the scope of my patent to the form or forms of my invention herein specifically illustrated and described or in any manner other than by the claims appended hereto.

I claim:

1. The method of making a wrought branch fitting such as a T, whose volume is smaller than the volume of the blank from which it is formed by extruding at least one lateral leg outwardly from an imperforate tubular blank confined in the channel of a forming die while shortening the blank to form a head portion, which comprises confining a voided body of substantially incompressible flowable filler material having a volume greater than the leg to be formed within the imperforate tubular blank, said body of filler material having an internal void of volume at least as great as the difference between the volume of the blank and the volume of the wrought piece and having a high viscosity substantially resistant to reduction of its void at pressures below the bursting strength of said blank which facilitate working the blank but permitting reduction of its void at greater pressures likewise below the bursting strength of the blank, imposing longitudinal metal flowing compression forces upon the ends of said blank in the die and substantially simultaneously and continuously exerting on the whole area of the ends of said body of filler material forces which create and maintain an internal pressure within said body sufficient to facilitate extruding said leg but less than the bursting strength of said blank, moving all the filler material at the ends of the body of filler material toward the extruded leg, maintaining the end of the extruded leg unsupported, confining the whole of said body of filler material to a space of decreasing size within said fitting while forcing part of said body of filler material to flow into said leg, changing the shape of the internal void as said filler material flows into said leg, working the stock of the blank to induce extrusion of said leg, and reducing the volume of said void as the shape of the void is changed and as the stock of the blank is being worked.

2. The method of making a wrought branch fitting such as a T, whose volume is smaller than the volume of the blank from which it is formed by extruding at least one lateral leg outwardly from an imperforate tubular blank confined in the channel of a forming die while shortening the blank to form a head portion, which comprises confining a voided body of substantially incompressible flowable filler material having a volume greater than the leg to be formed within the imperforate tubular blank, said body of filler material having an internal void of volume corresponding to the difference between the volume of the blank and the volume of the wrought piece and having a high viscosity substantially resistant to reduction of its void at pressures below the bursting strength of said blank which facilitate working the blank but permitting reduction of its void at greater pressures likewise below the bursting strength of the blank, imposing longitudinal metal flowing compression forces upon the ends of said blank in the die and substantially simultaneously and continuously exerting on the whole area of the ends of said body of filler material forces which create and maintain an internal pressure within said body sufficient to facilitate extruding said leg but less than the bursting strength of said blank, moving all the filler material at the ends of the body of filler material toward the extruded leg, maintaining the end of the extruded leg unsupported, confining the whole of said body of filler material to a space of decreasing size within said fitting while forcing part of said body of filler material to flow into said leg, changing the shape of the internal void as said filler material flows into said leg, working the stock of the blank to induce extrusion of said leg, and reducing the volume of said void as the shape of the void is changed and as the stock of the blank is being worked.

3. The method of claim 2 in which the said void of said body of filler material takes the form of at least one small diameter hole extending longitudinally of the body with the step of progressively flattening the void by bending the body of filler material adjacent the extruded leg.

4. The method of claim 2 in which the said void of said body of filler material takes the form of a hole of uniform small diameter extending throughout the length of the body with the step of progressively reducing said void from the middle toward the ends of said body as the middle of said body is worked into said extruded leg.

5. The method of claim 2 in which said body is voided with a plurality of small diameter longitudinally extending centrally disposed holes extending from end to end of said body with the step of progressively reducing the void substantially adjacent the extruded leg as the body of filler material is worked into said leg.

6. Apparatus for making a branch fitting such as a

T or the like by extruding at least one lateral branch outwardly from a tubular blank of greater volume than the fitting and containing filler material, comprising a die having a main passage receptive of the blank and a lateral branch corresponding to the branch to be formed in the fitting, a pair of oppositely acting plungers having solid pilot portions with smooth flush continuous end faces entering and closely fitting the interior of the ends of the blank and shoulders for engaging the ends of the blank, said plungers being slidable in said main passage of said die with their shoulders and end faces respectively engaging the ends of said blank and engaging the whole area of the ends of the filler material and confining all the filller material within said blank throughout the working thereof, the improvement that said filler material comprise a dense substantially right circular cylindrical body of high viscosity incompressible flowable filler material with an internal open bore and an external surface closely fitting the interior of the blank and having length to engage said end faces of the pilot portions of said plungers approximately when said shoulders engage the ends of the blank, means for forcibly moving said plungers toward each other to work the piece and compress and work said filler material as a column overloaded at its ends and cause the lateral leg of said fitting and adjacent filler material to flow into the said branch portion of the die, the volume of said bore being substantially equal to the diminution of the internal volume of the wrought piece in respect to the original blank, said body of filler material in its right circular cylindrical form having strength in resistance to reduction of its bore when first engaged by said plungers greater than its resistance to outward bulging and buckling and substantially great enough to develop outward bulging pressure sufficient to induce extrusion of said leg, the strength in resistance to reduction of said bore being less than the bursting strength of the blank whereby said bore may be reduced to accommodate diminution in volume of said blank.

7. Apparatus for making a branch fitting such as a T or the like by extruding at least one lateral branch outwardly from a blank of greater volume than the fitting and containing filler material, comprising a die having a main passage receptive of the blank and a lateral branch

corresponding to the branch to be formed in the fitting, a pair of oppositely acting plungers slidable in said main passage of said die ends respectively engaging the ends of said blank and engaging and confining all the filler material within said blank and within a gross external volume of decreasing size throughout the working thereof, the improvement that said filler material comprise a dense, highly viscous cylindrical body filling the interior of the blank between the ends of said plungers and having an internal voided space with a large ratio of surface to volume and located at least in part adjacent said lateral branch, and means for forcibly moving said plungers toward each other to work the piece and compress said filler material and cause the lateral leg of said fitting and adjacent filler material to flow into the said branch portion of the die, the volume of said voided space being substantially equal to the diminution of the internal volume of the wrought piece in respect to the original blank, the strength of said body of filler material in resistance to diminution of the size of said voided space before said leg begins to flow into said branch being greater than its resistance to outward bulging and buckling and substantially great enough to develop outward bulging pressure sufficient to induce extrusion of said leg, the strength in resistance to reduction of said voided space being less than the bursting strength of the blank whereby said voided space may be reduced to accommodate diminution in volume of said blank, and the strength of said body in resistance to diminution of said voided space being reduced when the shape of said body is changed by displacement into said leg.

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