Aug. 6, 1940. F. B. WENDEL 2,210,437

BLANK AND METHOD FOR MAKING HOLLOW WROUGHT METAL ARTICLES

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Fig. 1.

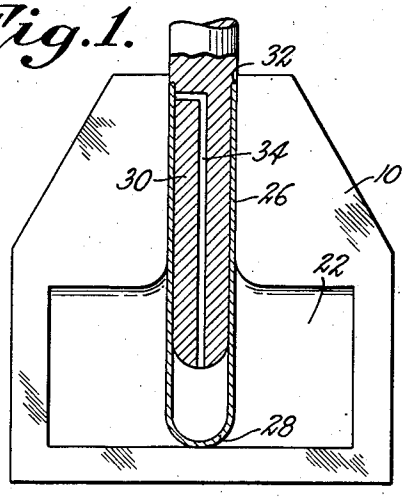


Fig. 2.

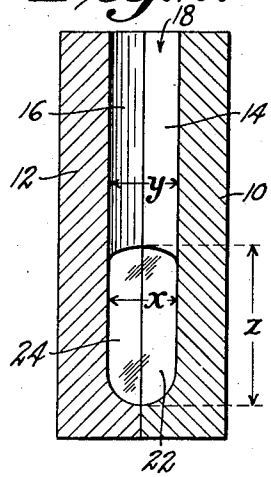


Fig. 3.

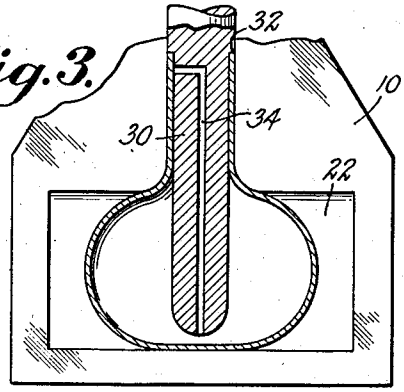


Fig. 4.

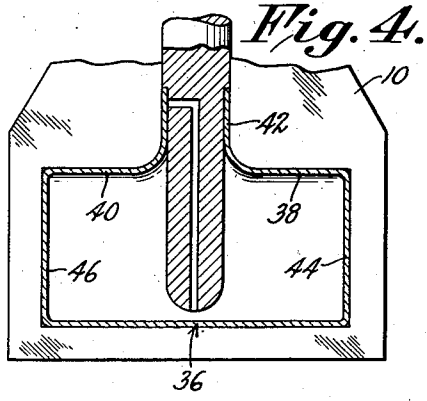


Fig. 12.

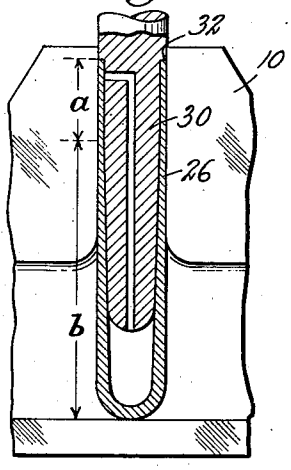


Fig. 13.

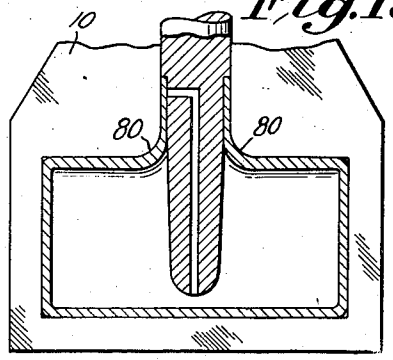
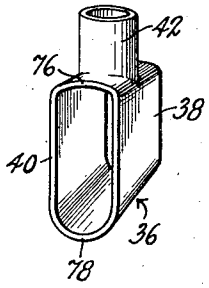


Fig. 5.



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Fig. 6.

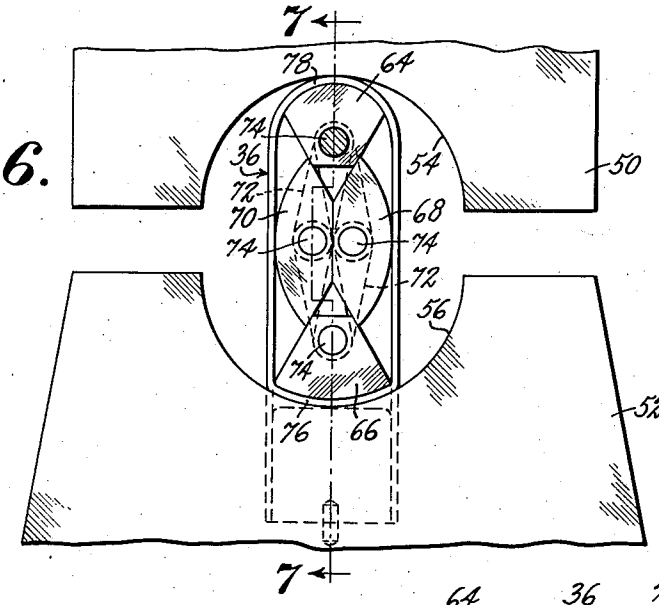


Fig. 7.

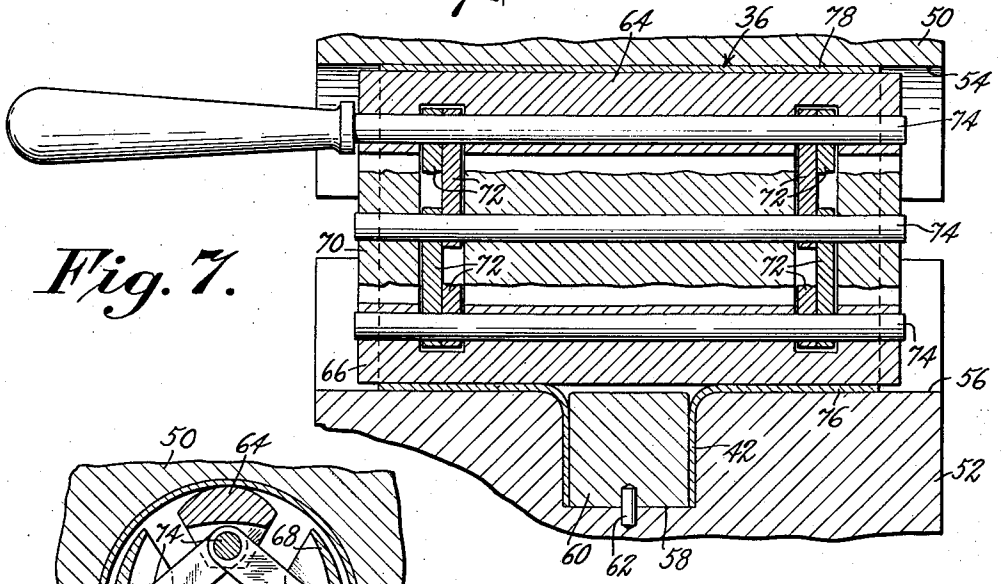
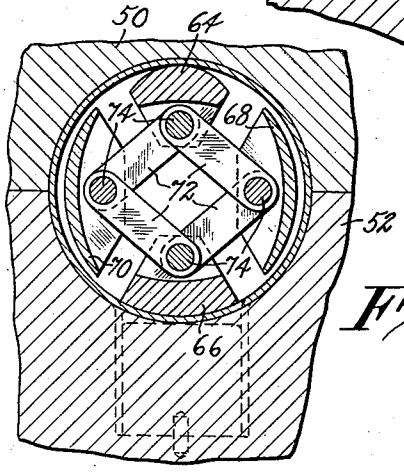


Fig. 8.



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BLANK AND METHOD FOR MAKING HOLLOW WROUGHT METAL ARTICLES

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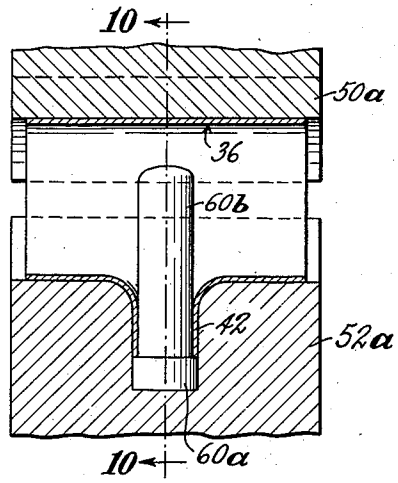


Fig. 9.

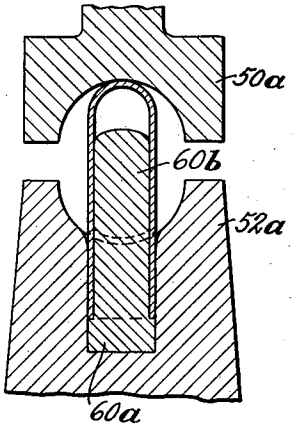


Fig. 10.

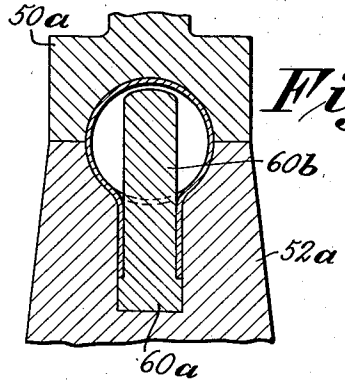


Fig. 11.

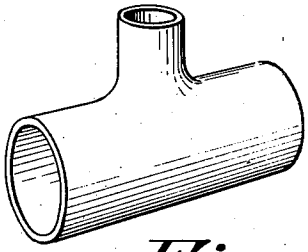
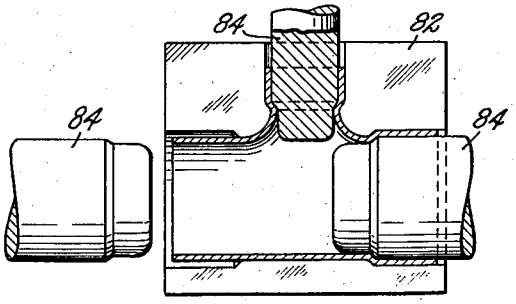


Fig. 14.

Fig. 15.



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UNITED STATES PATENT OFFICE

2,210,437

BLANK AND METHOD FOR MAKING HOLLOW WROUGHT METAL ARTICLES

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Application April 6, 1937, Serial No. 135,269

4 Claims. (Cl. 29—157)

The present invention relates to hollow articles of wrought metal. More particularly it relates to branched fittings having a plurality of angularly related branches, especially T fittings for pipe and like connections. Still more particularly the invention relates to so-called reduction fittings, that is, fittings having angularly related branches of different diameter adapted to be secured to and join pipes of different size.

Integral wrought metal fittings, as heretofore produced by the method hereinafter explained, when such fittings have been of the reduction type, have been made by first forming the fittings with branches of substantially the same diameter and after the fittings have been formed the desired reduction in diameter of one or more of the branches has been made by subsequent reducing operations, such as swaging or the like.

This method of manufacture is relatively expensive, the reduction fittings produced by such methods costing several times as much as T's of the same basic size and having branches of the same diameter.

The present invention has for its general objects the provision of improved method and means for the manufacture of reduction fittings, whereby the cost of such fittings may be substantially no greater than the cost of fittings having branches of equal diameter.

According to the method of the present invention, reduction fittings are obtained by first forming from shells, semi-finished integral blanks of hollow form having the required number and relation of branches, but with the branch or branches which are eventually to be of larger diameter than another branch or branches, being first formed so as to have a non-circular cross-section which is thereafter shaped to circular or other desired final cross-section having a minimum diameter substantially greater than the minimum diameter of such branch as first formed.

The branches which in the finished fitting are to be of larger diameter advantageously are formed with generally oval or elliptical cross-section, with the minor diameter equal to or substantially equal to the diameter of the shell from which the semi-finished blank is formed. The semi-finished blank is then apertured at the ends of the formed branches and thereafter worked by means of suitable die or mandrel apparatus to make the apertured branches into branches of desired cross-section having a minimum diameter greater than the diameter of the original shell.

For a more complete description of the invention and of the details thereof, reference may best be had to the ensuing portion of this description in which I will describe preferred method and means for manufacturing a reduction T fitting in accordance with the invention, it being understood however that such description is without limitation with respect to general use of the invention, which may be applied to other specific shapes of fittings.

In the drawings forming a part of this specification:

Fig. 1 is a side elevation, partly in section, of die forming apparatus and a shell blank used in carrying the invention into effect;

Fig. 2 is a transverse central section of the pair of die blocks, one of which is shown in Fig. 1;

Fig. 3 is a view similar to Fig. 1 showing the shell blank after a forming operation;

Fig. 4 is a view similar to Fig. 3 showing the shell blank after a further forming operation;

Fig. 5 is a perspective view of the semi-finished blank shown in Fig. 4 with the end walls of the blank removed;

Fig. 6 is an end elevation of die and mandrel apparatus for further forming the blank shown in Fig. 5;

Fig. 7 is a section taken on the line 7—7 of Fig. 6;

Fig. 8 is a section showing the dies and mandrel illustrated in Fig. 6, with the dies closed;

Figs. 9 to 11, inclusive, are views similar to Figs. 6 to 8 respectively showing different die apparatus for further shaping the blank shown in Fig. 6;

Fig. 12 is a fragmentary view similar to Fig. 1 showing a different shell blank;

Fig. 13 is a view similar to Fig. 4 showing the character of semi-finished blank formed from the shell shown in Fig. 12;

Fig. 14 is a perspective view of a completely formed T produced in accordance with the invention; and

Fig. 15 is a view showing die apparatus for belling the ends of the T shown in Fig. 14.

Referring now more particularly to the drawings, Fig. 1 illustrates one of a pair of die blocks 10 and 12 shown in Fig. 2. Each of these die blocks is semi-circularly recessed at 14 and 16 respectively to provide a cylindrical bore 18. This bore intersects the transverse bore formed by semi-oval recesses 22 and 24 in the respective die blocks. In the form of apparatus shown in Fig. 2, the transverse bore has the same trans-

verse dimension x as the transverse dimension y, in the same plane, of the bore 18. The dimension z of the bore 20 is substantially larger than that of dimension x, the difference between these dimensions x and z depending upon the desired relation of the final diameter of the run of the T (the portion to be formed in bore 20) to the outlet (the portion to be formed in bore 18) thereof.

In the following I will describe a preferred method of forming a semi-finished T blank by the aid of the above described dies, but it is to be understood that other specific steps and means may, within the scope of the present invention, be employed to effect the forming of the metal to the interior contour of the dies.

A cylindrical shell blank 26 having a hemispherical closed bottom 28 and open at the top is inserted in the dies, which are held together in a suitable press, and a filler of liquid is introduced into the shell. A punch 30 having a shoulder 32 is forced downwardly into the die bore 18, the shoulder seating against the upper end of the shell. A passage 34 in the punch permits excess liquid to flow from the shell prior to the seating of the shoulder 32. When the shoulder seats, the shell is filled with liquid which is trapped therein. As the punch descends, the mechanical end pressure on the shell combined with the internal pressure exerted by the trapped filler bulges the unsupported portions of the metal of the shell outwardly in lateral direction, as indicated in Fig. 3. In order to force the metal into uniform and complete contact with the inner surfaces of the die recesses, a plurality of punch operations may be required, the number depending upon the length desired for the run of the T.

After the final blank forming operation is carried out, the blank has the form shown in Fig. 4, the run portion 36 of the T, formed by the laterally bulged branches 38 and 40, being generally oval in cross section and the neck or outlet 42 being cylindrical. After the blank is thus formed, the branches 38 and 40 are apertured, preferably by cutting off the end walls 44 and 46 by sawing to form a semi-finished blank of the kind shown in Fig. 5.

As will be evident from Fig. 5, all that is required to make a reduction fitting of the desired character from the semi-finished blank shown in the figure is to work the run portion of the T to the desired final cross-sectional shape, which in the case of the usual pipe fitting is cylindrical. This may be accomplished by forcing a suitably shaped mandrel through the run of the T or by a pressing operation in suitable dies.

One suitable form of die apparatus is shown in Figs. 6 to 8 and comprises die blocks 50 and 52 having cooperating semi-cylindrical recesses 54 and 56. The die block 52 is provided with a suitable recess 58 for the reception of the neck 42 of the blank, and the neck may be advantageously supported internally by a plug or the like 60. Plug 60 may be loose or suitably pinned as at 62.

For internally guiding the run of the T during the pressing operation in these dies, a collapsible mandrel may be employed comprising top and bottom shoes 64 and 66 and side shoes 68 and 70. These shoes are connected by pivoted links 72, pivoted on the longitudinally extending pins 74, the shoes being suitably recessed to receive these links when the mandrel is collapsed so as to be insertable in the blank as indicated in Fig. 6.

The pressing operation for shaping the run of the T to cylindrical section will be largely obvious from the drawings. When the dies 50 and 52 are moved together from the position shown in Fig. 6 to the position shown in Fig. 8, the spreading action of the mandrel causes the side shoes 68 and 70 to bear against the side walls of the T and insure the outward bulging of these walls into contact with the die walls. As will be noted in Fig. 8, the length of the links 72 is such that when the dies close, there is some clearance between the side shoes 68 and 70 and the metal of the blank. Some clearance obviously is required in order to withdraw the mandrel from the blank after the pressing operation, and it will be evident that as the dies come into closed position, internal pressure from the shoes is not required in order to bring the blank to the desired shape in the dies.

In connection with this operation it is to be noted that the semi-finished blank is advantageously formed, as shown in Fig. 5, with the curved portion of the laterally extending bulges adjacent the neck 42 and indicated at 76, curved on a larger radius than the curved portion 78 at the bottom of the run. Advantageously, the portion 76 is curved to the same radius as that of the finished run portion of the T while the bottom portion 78 of the run portion is advantageously curved to the same radius as that of the bottom of the shell. These radii need not necessarily be employed but it will be evident from Figs. 6 and 8 that with the portion 76 curved as indicated, the blank shown in Fig. 5 can be formed so that the subsequent spreading operation does not necessitate any appreciable change in the contour of the walls of the T at the place of juncture of the run with the outlet.

In some instances when the run is finished to final form by means of pressing dies, the use of an internal mandrel may not be required due to the natural tendency of the side walls to bulge outwardly when subjected to compression by the dies, and Figs. 9 to 11 illustrate suitable die apparatus for use without an internal mandrel. In this form of the apparatus the die blocks 50a and 52a are generally similar to those shown in Fig. 6, but in this instance as a precautionary measure the plug 60a providing internal support for the neck of the blank is advantageously extended upwardly as indicated at 60b to insure against any possibility of the side walls of the blank buckling inwardly as the dies are brought together. From the nature of the curved surfaces of the dies and the blank as indicated in Fig. 10, it will be evident that the natural tendency of the side walls is to spread outwardly. In some instances it may be desirable to curve the side walls of the die recesses slightly outwardly to increase the dimension x (Fig. 2) at the center line of the run to facilitate the natural tendency of the side walls to bulge outwardly when compressed between the forming dies.

It will be appreciated that the exact cross-section of the run portion of the semi-finished blank may be varied within the scope of the invention and it will be appreciated that in so far as the invention is concerned, the primary characteristic of the blank forming operation or operations is to produce a laterally bulged branch or branches having cross-sectional areas larger than the cross-sectional area of the shell and having a cross-sectional dimension parallel to

the axis of the shell substantially greater than the cross-sectional dimension normal to the axis of the shell.

In many instances it is desirable to make reduction fittings with the branches of different diameter having different wall thickness. This is particularly true of pipe fittings intended to carry fluids under pressure and in which the branch or branches of larger diameter may require wall thickness greater than necessary or desirable for branch or branches of smaller diameter.

Such fittings may very advantageously be made in accordance with the present invention and in Figs. 12 and 13 there is illustrated the method by means of which this may be accomplished.

In this instance shell 26 is formed with walls the thickness of which varies along the length of the shell. Preferably, the portion of the shell denoted by dimension *a* is formed with walls of uniform thickness which are relatively thin, while the walls of the portion denoted by *b* are tapered to produce gradually increasing wall thickness toward the bottom of the shell. The degree of thickening of the tapered portion of the wall will depend upon the difference in thickness between the run portion and the neck desired in the finished T. With such form of shell the portion of the punch below the shoulder 32 is advantageously shaped to conform to the shape of the inner surface of the shell and the forming operations for producing the semi-finished blank are the same as those previously described. Due to the nature of the stresses imposed on the metal by the forming operations, and the tendency of the metal to compress where it flows around the rounded corners 30 of the die blocks 10 and 12, the tapered portion of the shell will be worked to provide a run portion for the T of substantially uniform wall thickness, which wall thickness will be greater than the wall thickness of the neck. It will be appreciated that the relative lengths of the dimensions *a* and *b* shown in Fig. 12 will be determined by the relative length of the neck and run portions of the finished T to be formed therefrom, the point on the shell where the tapered wall portion commences preferably being approximately at the place of juncture of the neck and run portions in the finished T.

After the forming operation described in conjunction with Figs. 6 to 11 has been performed, the T has the shape shown in Fig. 14. This shape obviously constitutes a complete T and in so far as the present invention is concerned may be considered as a finished T. The complete or finished T may, of course, be modified by further treatment to make it suitable for different modes of attachment. If the T is intended to be used as a welded fitting the T requires no further treatment other than suitable beveling of the open ends of the branches if such ends are desired for welding purposes. If desired, the ends of the branches may be treated in the usual manner for a threaded fitting, and if a fitting of the so-called sweat joint type is desired, the ends at the several branches may be bulged to receive the ends of the pipe to which the T is to be secured. Such bulging may advantageously be effected in known manner by means of suitably recessed die blocks, one of which is shown at 82 in Fig. 15, the bulged ends of the branches being formed within the die blocks by means of the shouldered punches 84.

The preferred method and means for effecting bulging of the shell into the die blocks to form a semi-finished blank, forms per se no part of the present invention but constitutes the subject matter of application Serial No. 42,624, filed jointly by me and Thomas H. Pearsall.

From the foregoing description it will be evident that many changes and variations in the method and apparatus hereinbefore described by way of example may be made without departing from the principles of the invention, and certain features hereinbefore described may, within the scope of the invention, be used to the exclusion of others.

The scope of the invention is understood to embrace all that may fall within the purview of the appended claims when they are construed as broadly as is consistent with the state of the prior art.

What I claim is:

1. The method of forming an integral wrought metal reduction T; by the aid of a punch having a pilot portion and a circumferential shoulder at the end of said pilot portion and a cooperating die having a T-shaped recess including a run portion of generally oval cross-section and a branch portion extending laterally from said run portion, said branch portion having substantially the diameter of the branch portion of the T to be made and said run portion having a major diameter substantially in line with the axis of said branch portion and of materially greater length than the diameter of said branch portion and a minor diameter normal to the major diameter and of substantially the same length as the diameter of said branch portion; which consists in placing a shell blank having a closed end and having substantially the diameter of said outlet branch in the die with the closed end of the shell at the juncture of the run and branch portions of the die recess, bulging the closed end portion of the shell laterally in opposite directions to form a T-shaped blank having a closed ended run portion of cross-sectional contour corresponding to the cross-section of the run portion of the die recess by one or more bulging operations each including the steps of introducing liquid filler into the shell, moving said punch inwardly of the die with the pilot portion of the punch within the open end of the shell to seat said shoulder against the end wall of the open end of the shell to effect a liquid tight seal and to trap the liquid in the shell and continuing the movement of the punch after such seating to form the shell inwardly of the die by mechanical end pressure, whereby to bulge the shell by the combined action of the mechanical end pressure and the trapped liquid, aperturing the closed ends of said run portion and thereafter working the run portion from the cross-sectional shape formed by the bulging operation or operations to a substantially circular cross-section of larger diameter than that of said branch portion.

2. The method of forming an integral wrought metal reduction T; by the aid of a punch having a pilot portion and a circumferential shoulder at the end of said pilot portion and a cooperating die having a T-shaped recess including a run portion of generally oval cross-section and a branch portion extending laterally from said run portion, said branch portion having substantially the diameter of the branch portion of the T to be made and said run portion having a major diameter substantially in line with the axis of said branch portion and of ma-

terially greater length than the diameter of said branch portion and a minor diameter normal to the major diameter and of substantially the same length as the diameter of said branch portion; which consists in placing a shell blank having a closed end and having substantially the diameter of said outlet branch in the die with the closed end of the shell at the juncture of the run and branch portions of the die recess, the closed end portion of said blank and the cylindrical portion thereof adjacent to the closed end having appreciably greater wall thickness than the cylindrical portion of the blank adjacent to the open end thereof, bulging the closed end portion of the shell laterally in opposite directions to form a T-shaped blank having a closed ended run portion of cross-sectional contour corresponding to the cross-section of the run portion of the die recess, and wall thickness greater than that of the branch portion of the blank, by one or more bulging operations each including the steps of introducing liquid filler into the shell, moving said punch inwardly of the die with the pilot portion of the punch within the open end of the shell to seat said shoulder against the end wall of the open end of the shell to effect a liquid tight seal and to trap the liquid in the shell and continuing the movement of the punch after such seating to form the shell inwardly of the die by mechanical end pressure, whereby to bulge the shell by the combined action of the mechanical end pressure and the trapped liquid, aperturing the closed ends of said run portion and thereafter working the run portion from the cross-sectional shape formed by the bulging operation or operations to a substantially circular cross-section of larger diameter than that of said branch portion.

3. A semi-finished blank adapted to be formed into a reduction T, said blank consisting of an integral seamless hollow T-shaped body of wrought metal having a closed ended run portion and a branch portion extending laterally therefrom intermediate its ends, said run portion being of generally oval shape in cross-section and having a major diameter in line with the axis of the branch portion and substantially longer than the diameter of the branch portion and a minor diameter normal to the major diameter and of substantially the same length as the diameter of the branch portion, whereby said run portion has a perimeter substantially greater than the perimeter of the branch portion and is adapted to be shaped to circular cross-section of larger diameter than that of the branch portion subsequent to aperturing the closed ends of the blank.

4. A semi-finished blank adapted to be formed into a reduction T, said blank consisting of an integral seamless hollow T-shaped body of wrought metal having a closed ended run portion and a branch portion extending laterally therefrom intermediate its ends, said run portion being of generally oval shape in cross-section and having a major diameter in line with the axis of the branch portion and substantially longer than the diameter of the branch portion and a minor diameter normal to the major diameter and of substantially the same length as the diameter of the branch portion, whereby said run portion has a perimeter substantially greater than the perimeter of the branch portion and is adapted to be shaped to circular cross-section of larger diameter than that of the branch portion subsequent to aperturing the closed ends of the blank, the wall thickness of each portion being substantially uniform and that of the run portion being substantially greater than the thickness of the wall of the branch portion, and the walls of the two portions merging with gradually varying thickness at the juncture between the run portion and the branch portion.

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