



US 20020043089A1

(19) **United States**

(12) **Patent Application Publication**
Reiche et al.

(10) **Pub. No.: US 2002/0043089 A1**

(43) **Pub. Date: Apr. 18, 2002**

(54) **METHOD OF AND APPARATUS FOR
MAKING A PIPE OF DIFFERENT WALL
THICKNESS**

Publication Classification

(51) **Int. Cl.⁷** **B21C 1/24; B21D 17/02**

(52) **U.S. Cl.** **72/283; 72/285; 72/370.04;
72/370.01; 72/370.14**

(76) Inventors: **Carl-Heinz Reiche**, Lage (DE); **Carl
Reiche**, Lemgo (DE)

Correspondence Address:
HENRY M FEIEREISEN
350 FIFTH AVENUE
SUITE 3220
NEW YORK, NY 10118

(57) **ABSTRACT**

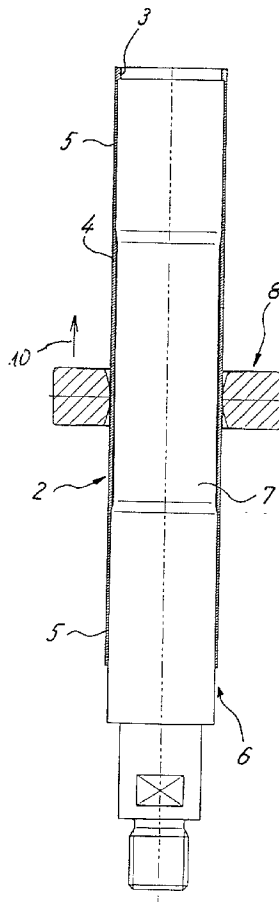
In a method of making a pipe of different wall thickness, a mandrel with at least one outer recessed axial section is inserted into a tubular blank. Subsequently a drawing die, having an inner diameter smaller than an outer diameter of the tubular blank, is pushed over the tubular blank while the pipe is held in place with respect to the mandrel in drawing direction, thereby pressing a wall portion of the blank into the recessed axial section of the die to form a pipe with a wall portion of greater wall thickness. As the mandrel is then withdrawn from the pipe, the wall portion of greater wall thickness of the pipe is pressed radially outwards.

(21) Appl. No.: **09/952,242**

(22) Filed: **Sep. 14, 2001**

(30) **Foreign Application Priority Data**

Sep. 23, 2000 (DE)..... 100 47 231.1



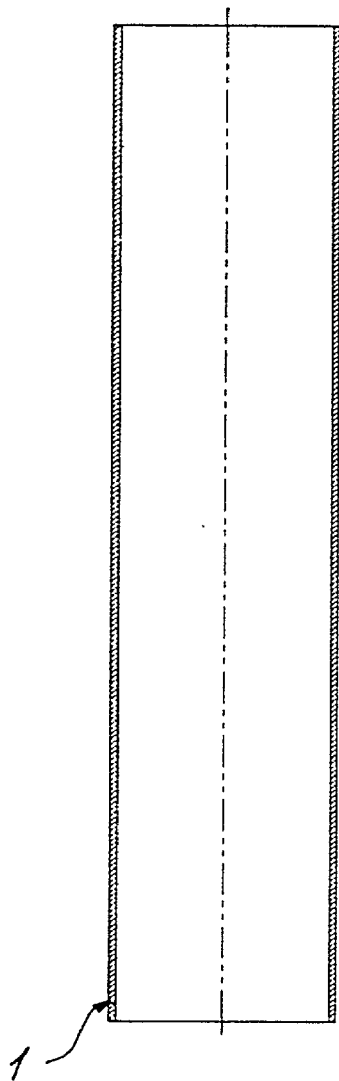


Fig. 1

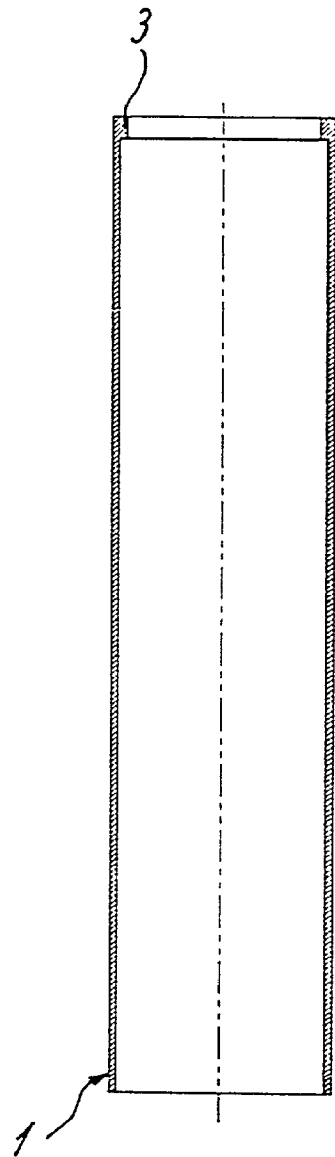
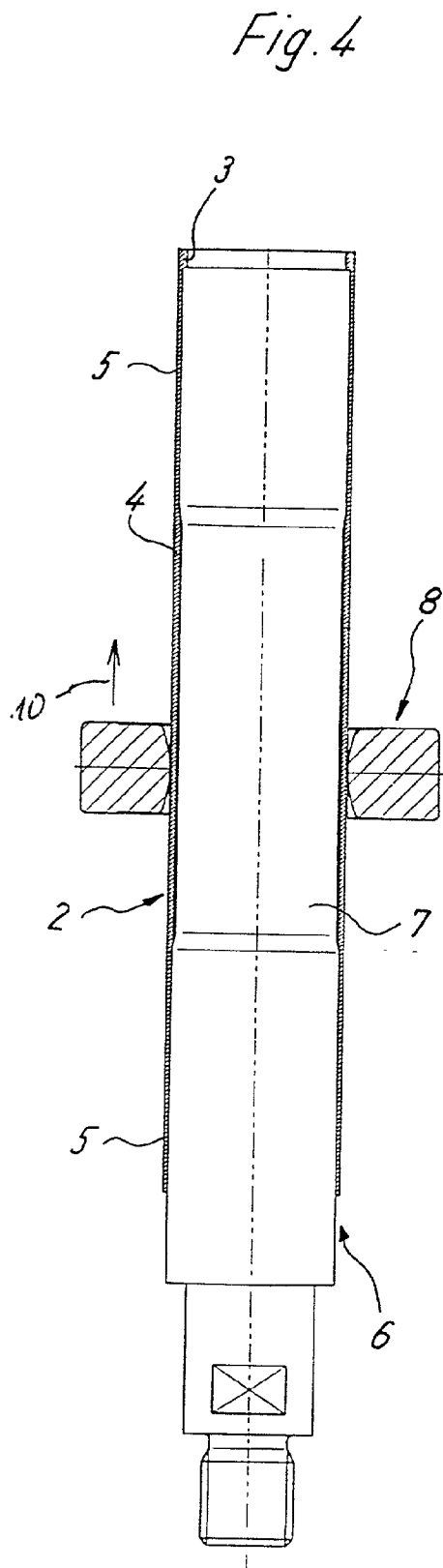
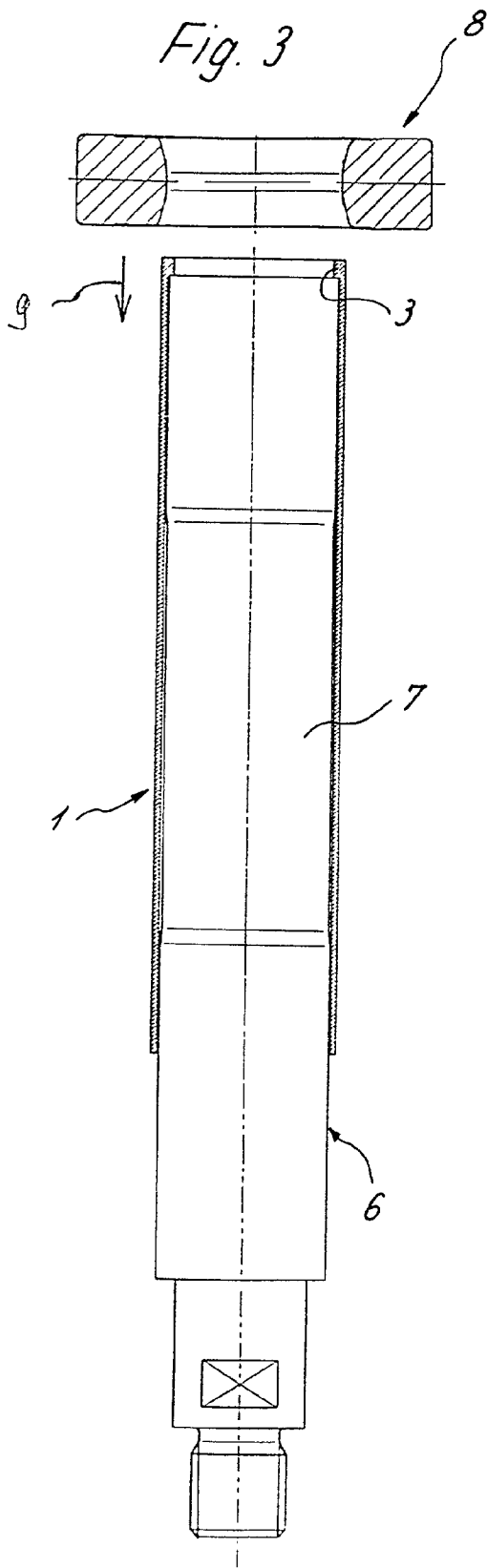


Fig. 2



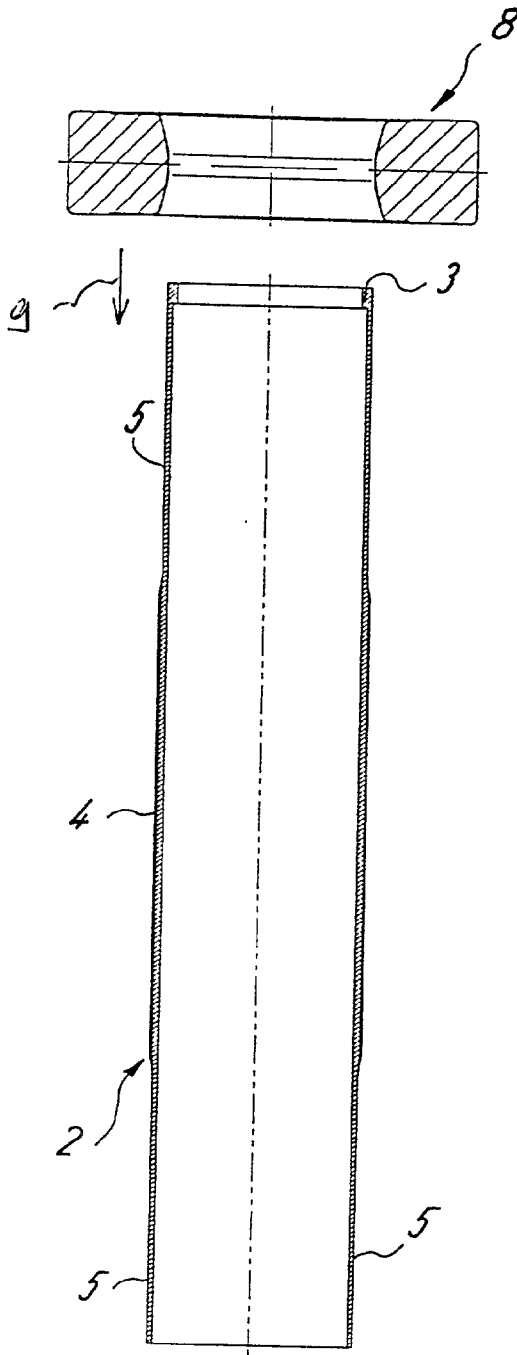


Fig. 5

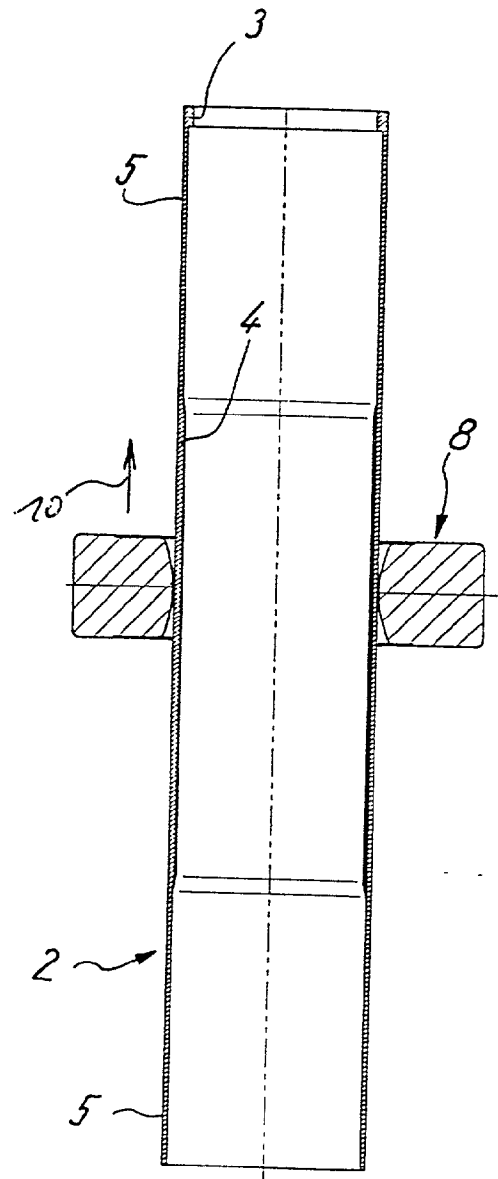


Fig. 6

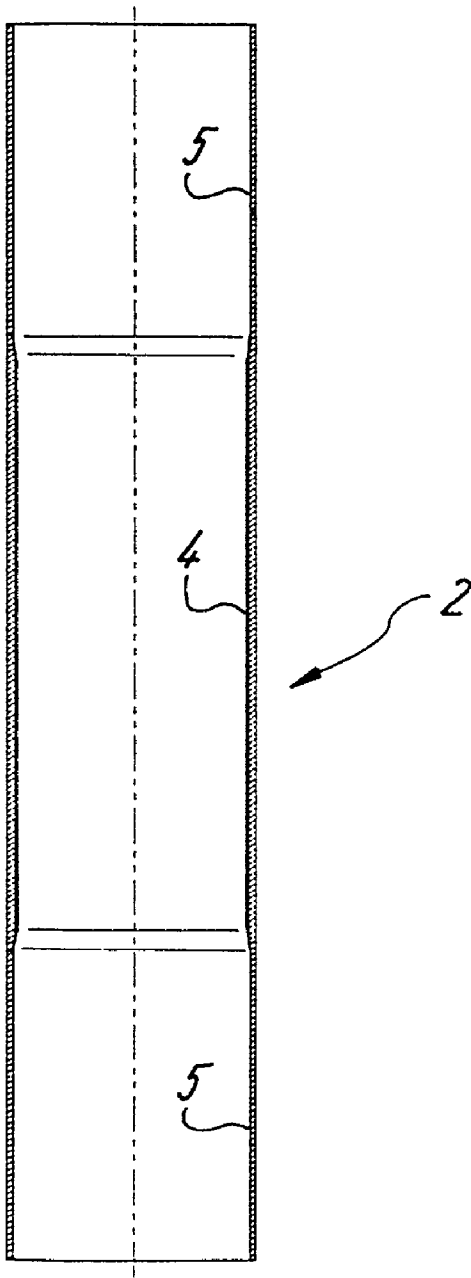


Fig. 7

METHOD OF AND APPARATUS FOR MAKING A PIPE OF DIFFERENT WALL THICKNESS

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the priority of German Patent Application, Serial No. 100 47 231, filed Sep. 23, 2000, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates, in general, to a method of and apparatus for making a pipe of different wall thickness.

[0003] Many industries, for example, the automotive industry oftentimes require pipes of different wall thickness, whereby areas of thicker wall thickness should be demarcated by areas of thinner wall thickness. Such pipe have been used, i.a. in the area of shock absorbers, couplings and components of the chassis. Different wall thicknesses of a pipe are demanded for reasons of weight saving. This has been realized by dimensioning the wall thickness commensurate with the encountered load. To date, such pipes have been fabricated by welding metal sheets together which are then shaped to a pipe and again welded, to thereby implement a partial strengthening in zones which should be thickened. It is also known to simply weld pipe section of different wall thickness together.

[0004] Apart from the fact that these fabrication processes are complex and expensive, the welding operation results in an alteration of the texture that adversely affects the strength of the pipe.

[0005] Another conventional process proposes to insert mandrels from opposite sides into a pipe, whereby confronting ends of the inserted mandrels have depressions, e.g. circumferential depressions, into which the wall of the pipe is hammered while neighboring wall regions are lengthened and thus exhibit a smaller wall thickness compared to the wall regions pressed into the depressions. A drawback of this process is the inability to provide pipes with a smooth outer surface as the depressions remain visible.

[0006] In many cases, there is a need for provision of a smooth outer surface. One example involves the field of internal high-pressure metal forming in which the pipe is enclosed by an outer mold and the interior thereof is set under pressure by a pressure medium so that the pipe wall bears against the contour of the outer mold. This process requires a smooth pipe surface without gradation. However, the afore-described conventional process is unable to satisfy this need so that the application of this process is rather limited.

[0007] It would therefore be desirable and advantageous to provide an improved method of and apparatus for making pipes of different wall thickness, which obviate prior art shortcomings while yet satisfying current requirements, without adversely affecting material properties.

SUMMARY OF THE INVENTION

[0008] According to one aspect of the present invention, a method of making a pipe of different wall thickness,

includes the steps of inserting a mandrel with at least one outer recessed axial section into a tubular blank, pushing a drawing die, having an inner diameter smaller than an outer diameter of the tubular blank, over the tubular blank while the tubular blank is held in place with respect to the mandrel in the drawing direction, thereby pressing a wall portion of the tubular blank into the recessed axial section of the die to form a pipe of different wall thickness, and withdrawing the mandrel from the pipe whereby the wall portion of the pipe is pressed radially outwards.

[0009] The method according to the present invention is simple in nature, whereby individual process steps can be continuously executed so that a large scale manufacture, demanded in particular by the automotive industry, can easily be met.

[0010] During application of the drawing die, the blank lengthens, whereby the blank wall is pressed into the recessed section of the mandrel while neighboring regions become longer as the wall thickness thins out. The smaller wall thickness is determined by the distance between the inner diameter of the drawing die and the maximum outer diameter of the mandrel. A stretching of the material effects a strain hardening in particular in the thin-walled region which can be defined commensurate with functional needs.

[0011] Basically, there is the possibility to implement the change in wall thickness along a pipe portion evenly across the entire circumference of the pipe. It is, however, also conceivable to provide the pipe portion with axial ribs about its perimeter. In any event, the method according to the present invention affords the possibility to simultaneously shape several portions of the pipe, thereby attaining not only the afore-stated advantages but also realize a weight saving which is especially appreciated in the automotive industry which constantly attempts to minimize the weight of components.

[0012] According to another feature of the present invention, the tubular blank is formed, before insertion of the mandrel, with a radially inwardly directed shoulder at the blank end face which is first passed by the drawing die during drawing operation. In this way, the shoulder bears against the mandrel, when the drawing die is pushed over the blank, so that the blank is securely held in place during the drawing operation.

[0013] After shaping through application of the drawing die, resulting in a lengthening of the tubular blank and inward pressing of the respective wall portion into the recessed section, and removal of the drawing die, the mandrel is withdrawn from the thus-shaped pipe. Hereby, the thicker end of the mandrel pushes the inwardly directed thicker wall portion of the pipe outwards to thereby form an outer graduation. A smooth outer surface of the pipe can then be implemented by subsequently pushing the drawing die again over the pipe to thereby press the raised wall portion of the pipe inwardly. As a consequence, a desired, and in many cases demanded, smooth and even bright outer pipe surface is obtained.

[0014] According to another aspect of the present invention, an apparatus for making a pipe with different wall thickness, includes a mandrel having an axial length and intended for insertion into a tubular blank, wherein the mandrel has at least one outer recessed section extending in

axial direction, and a drawing die intended for interaction with the mandrel and having an inner diameter which is smaller than an outer diameter of the tubular blank, wherein an inside radius of the drawing die and a radius of the mandrel define a distance which is smaller than a wall thickness of the tubular blank.

[0015] According to another feature of the present invention, the outer recessed section extends over a portion of the axial length of the mandrel such as to be bounded on opposite sides thereof. The recessed section has a depth which equals at a maximum wall thickness of the tubular blank.

[0016] It may also be conceivable to form the mandrel with a plurality of circumferentially spaced recessed sections which extend in the axial direction in parallel relationship, wherein the recessed sections may have varying configuration.

BRIEF DESCRIPTION OF THE DRAWING

[0017] Other features and advantages of the present invention will be more readily apparent upon reading the following description of a preferred exemplified embodiment of the invention with reference to the accompanying drawing, in which:

[0018] FIGS. 1 to 7 show various method steps to make a pipe according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] Throughout all the Figures, same or corresponding elements are generally indicated by same reference numerals.

[0020] Turning now to the drawing, and in particular to FIG. 1, there is shown a longitudinal section of a tubular blank 1 of substantially constant wall thickness as starting material. The blank 1 is formed at one end with an inwardly directed shoulder 3, as shown in FIG. 2. Next, as shown in FIG. 3, a mandrel 6 is inserted through the shoulder-distal other end of the blank 1 until the shoulder 3 bears upon the confronting end face of the mandrel 6. Blank 1 and mandrel 6 have both a circular cross section. The mandrel 6 is formed approximately in mid-portion with a recessed section 7 which extends in axial direction and has a depth which corresponds at a maximum to the wall thickness of the blank 1. The regions neighboring both sides of the recesses section 7 of the mandrel 6 have an outer diameter which corresponds to the inner diameter of the blank 1. A drawing die 8 is then pushed from the shoulder-proximal end face of the mandrel 6 over the blank 1, in the direction as indicated by arrow 9. The drawing die 8 has an inner diameter which is smaller than the outer diameter of the blank 1.

[0021] After being moved completely along the blank 1 and executing the drawing operation, the movement of the drawing die 8 is reversed in the direction of arrow 10 and the drawing die 8 is removed. As a result of the drawing operation, the blank 1 undergoes a stretching, as shown in FIG. 4, and is transformed into a pipe 2, with a portion of the pipe wall pressed into the recessed section 7 of the mandrel 6 to form a thicker wall portion 4, whereas neighboring wall regions 5 have been stretched to a wall thickness size which corresponds to the distance between the mandrel

area adjacent the recessed section 7 and the inside diameter of the drawing die 8. FIG. 4 clearly shows that the thinning of the wall thickness along the wall regions 5 results in a lengthening of the pipe 2.

[0022] Next, the mandrel 6 is withdrawn from the pipe 2. As a consequence, the wider area of the mandrel 6 adjacent the recessed section 7 in proximity to the shoulder 3, causes the thicker wall portion 4 of the pipe 2 to be pressed outwards and thus raised with respect to the neighboring wall regions 5, as shown in FIG. 5.

[0023] In order to provide a smooth surface, i.e. a straight surface in axial direction, the drawing die 8 is again pushed over the pipe 2 in the direction of arrow 9, to thereby press the thicker wall portion 4 inwards, as shown in FIG. 6. After removal of the drawing die 8, the wall area with the shoulder 3 is cut away, and, respectively the end face is after-treated, if necessary. FIG. 7 shows the pipe 2 in finished state.

[0024] Although not shown in the drawing, it is, of course, conceivable to so modify the process that instead of a single thickened wall portion, the pipe 2 may have a plurality of axially spaced central thickened wall portions.

[0025] While the invention has been illustrated and described as embodied in a method of and apparatus for making a pipe of different wall thickness, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

[0026] What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

What is claimed is:

1. A method of making a pipe of different wall thickness, comprising the steps of:

inserting a mandrel with at least one outer recessed axial section into a tubular blank;

pushing a drawing die, having an inner diameter smaller than an outer diameter of the tubular blank, over the tubular blank while the tubular blank is held in place with respect to the mandrel in drawing direction, thereby pressing a wall portion of the tubular blank into the recessed axial section of the die to form a pipe with different wall thickness; and

withdrawing the mandrel from the pipe whereby the wall portion of the pipe is pressed radially outwards.

2. The method of claim 1, and further comprising the step of pushing the drawing die again over the pipe after the mandrel is withdrawn from the pipe to thereby press inwards the wall portion of the pipe.

3. The method of claim 1, and further comprising the step of forming a radially inwardly projecting shoulder at an end face of the tubular blank, before the mandrel is inserted in the blank.

4. The method of claim 3, wherein the shoulder is formed at the end face which is first contacted by the drawing die.

5. A method of making a pipe of different wall thickness, comprising the steps of:

providing a pipe of substantially constant wall thickness;

inserting a mandrel with at least one outer recessed section into the pipe until the mandrel is secured against axial displacement relative to the pipe;

pushing a drawing die over the pipe, thereby lengthening the pipe and pressing a wall portion of the pipe into the recessed section of the mandrel so as to provide the pipe with a wall portion of greater wall thickness; and

withdrawing the mandrel from the pipe, thereby pressing the wall portion of greater wall thickness outwardly.

6. The method of claim 5, wherein the drawing die has an inner diameter which is smaller than an outer diameter of the pipe.

7. The method of claim 5, and further comprising the step of pushing the drawing die again over the pipe, after the mandrel has been withdrawn, to thereby force the wall portion of greater wall thickness inwardly.

8. The method of claim 5, and further comprising the step of forming a radially inwardly projecting shoulder at an end face of the pipe for abutment by the mandrel.

9. The method of claim 8, wherein the shoulder is formed at the end face which is first contacted by the drawing die.

10. Apparatus for making a pipe of different wall thickness, comprising:

a mandrel having an axial length and intended for insertion into a tubular blank, wherein the mandrel has at least one outer recessed section extending in axial direction; and

a drawing die intended for interaction with the mandrel and having an inner diameter which is smaller than an outer diameter of the tubular blank,

wherein an inside radius of the drawing die and a radius of the mandrel define a distance which is smaller than a wall thickness of the tubular blank.

11. The apparatus of claim 10, wherein the mandrel has an axial length, wherein the outer recessed section extends over a portion of the axial length of the mandrel such as to be bounded on opposite sides thereof.

12. The apparatus of claim 10, wherein the recessed section of the mandrel has a depth which equals at a maximum the wall thickness of the tubular blank.

13. The apparatus of claim 10, wherein the mandrel is formed with a plurality of circumferentially spaced recessed sections extending in the axial direction in parallel relationship.

14. The apparatus of claim 13, wherein the recessed sections have varying configuration.

15. Apparatus for making a pipe of different wall thickness, comprising:

a mandrel having an axial length and intended for insertion into a pipe of substantially constant wall thickness, wherein the mandrel has at least one outer recessed section extending in axial direction; and

a drawing die intended for interaction with the mandrel and having an inner diameter which is smaller than an outer diameter of the pipe, wherein the inner diameter of the drawing die and a maximum outer diameter of the mandrel define a distance which is smaller than the wall thickness of the pipe.

16. The apparatus of claim 15, wherein the recessed section of the mandrel has a depth which equals at a maximum the wall thickness of the pipe.

* * * * *