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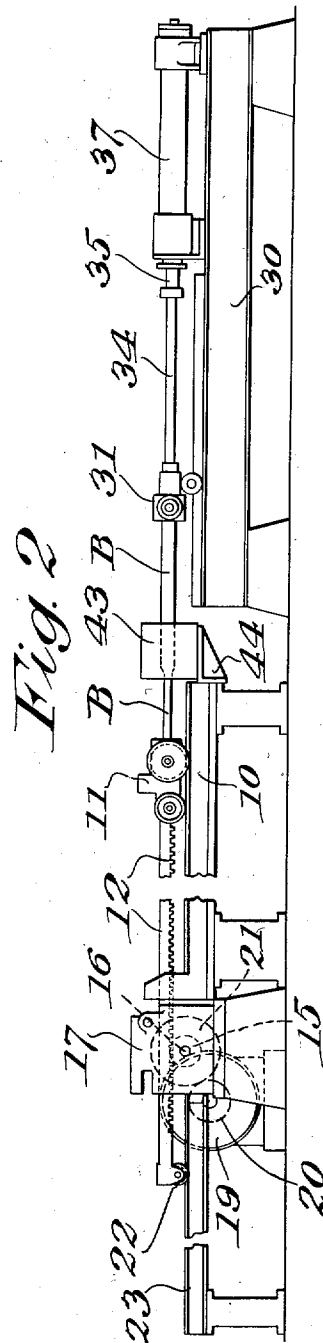
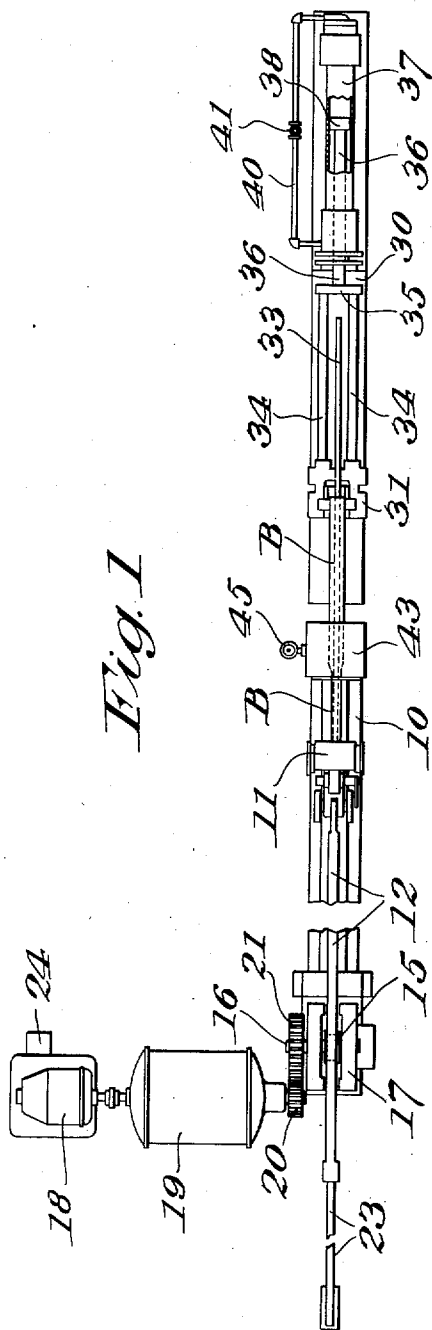
S. D. INSCHO

2,051,948

METHOD AND APPARATUS FOR REDUCING TUBING

Filed Dec. 23, 1933

2 Sheets-Sheet 1



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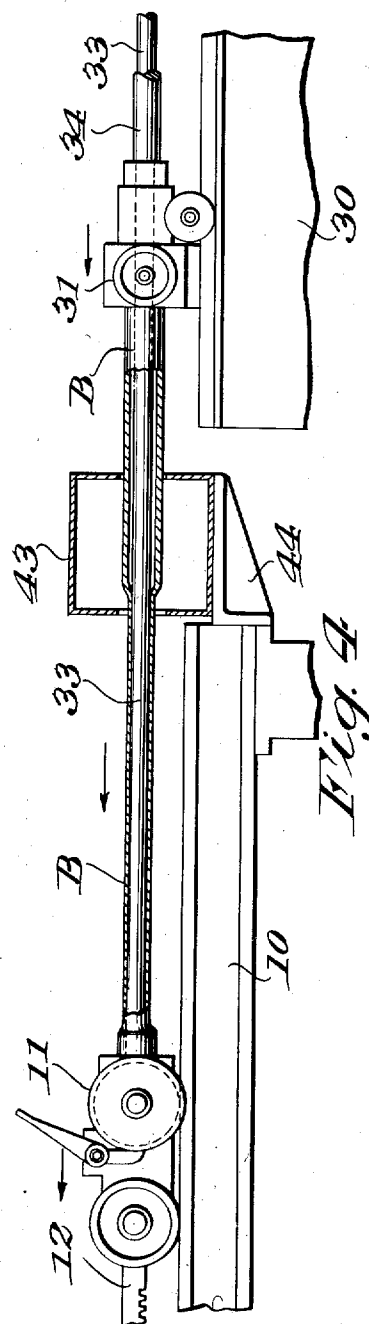
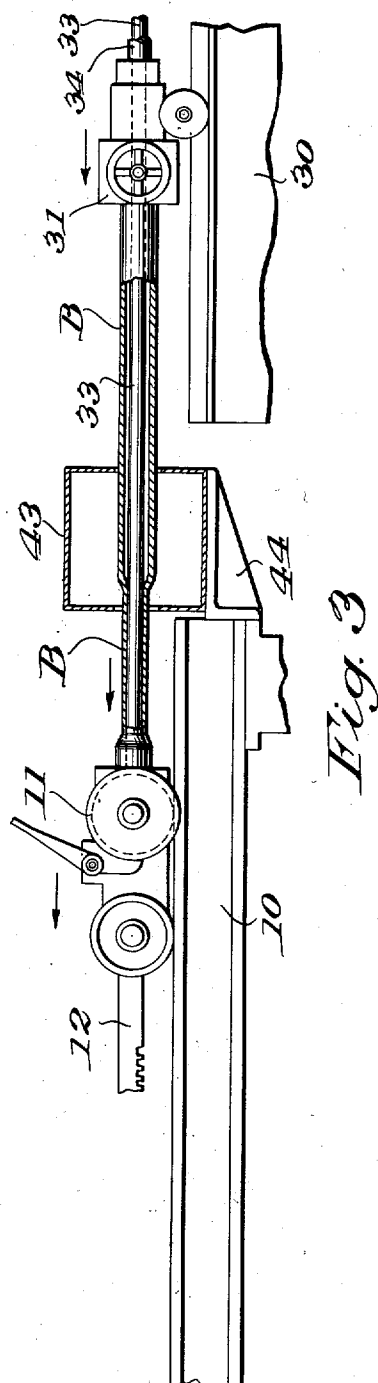
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METHOD AND APPARATUS FOR REDUCING TUBING

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UNITED STATES PATENT OFFICE

2,051,948

METHOD AND APPARATUS FOR
REDUCING TUBING

Sidney D. Inscho, Shelby, Ohio

Application December 23, 1933, Serial No. 703,821

26 Claims. (Cl. 205—3)

This invention is directed particularly, although not exclusively, to the manufacture of tubular products, such as seamless tubes, from tubular blanks.

5 The first step in the manufacture of a seamless tube is the production of a tubular blank by piercing a solid cylindrical billet. In accordance with customary practice, heretofore, the diameter and wall thickness of the blank has been reduced with resulting elongation either by hot rolling operations or by cold drawing.

10 The hot rolling operations require considerable power to overcome the surface friction between the rolls and the outer surface of the blank and the surface friction between the mandrel and the inner surface of the blank, as well as to overcome the resistance of the metal to deformation. There are many variable factors which may detrimentally effect the inner and outer surfaces of the tube produced and render a finished product unfit for commercial purposes. Consequently, the quality of the finished product depends largely on the care and skill of the various operators. Some of the evils of these operations are the scoring and scratching of both surfaces, also tearing and checking, any one of which is very detrimental to the finished product.

15 The cold drawing operation also requires considerable power for pulling the tubular blank between the mandrel and the die. Before each drawing operation the blank must be carefully annealed so that the metal will not be subjected to undue strain or be fractured during the drawing operation. The blank must be pickled after annealing to remove the thin film of scale and must be well lubricated to avoid injury to the inner and outer surfaces of the tube and the die and mandrel. The size of the mandrel must have a definite relation to the size of the die in order to produce a finished product having the desired diameter and wall thickness. The die and mandrel must be made of high grade material carefully prepared and accurately finished, and inasmuch as they wear considerably, their maintenance is a costly item. A soft spot on these tools tends to cause the metal on the surface of the tube to be picked up and scratch the surface of the tube.

20 Stainless steel tubes, particularly of certain analyses, have been very difficult to cold draw due to some of their peculiar characteristics. In the preparation of stainless steel for cold drawing, it is necessary to anneal at a much higher temperature than that used for ordinary steels. Furthermore, stainless steel does not shed its scale as readily as ordinary steels and greater care must

be taken in the pickling operation. Perhaps one of the greatest difficulties encountered in cold drawing stainless steels is to find a lubricant that will give its surface sufficient smoothness to offset the resistance set up by the die and mandrel.

5 The present invention in contradistinction to the above mentioned prior methods contemplates the reduction of a blank by elongation. In other words, the blank is elongated by stretching and as a result its cross sectional area is reduced. In the practice of the invention the tensile strength of adjacent local portions or sections of the blank is reduced progressively by heating, and at the same time the blank is subjected to tension to stretch and permanently elongate the same. Tubular products, such as seamless tubes, are produced by heating local adjacent portions of the tubular blanks progressively and by stretching the same a predetermined amount to control the wall thickness, the inner diameter of the resulting product being limited by a mandrel.

10 The invention will be more clearly understood from the following description in conjunction with the accompanying drawings: in which,

Fig. 1 is a plan view, partly in section, of an apparatus for the practice of the invention;

Fig. 2 is a side elevation of the apparatus; and

15 Figs. 3 and 4 are fragmentary elevational views, partly in section, of a portion of the apparatus shown in Figs. 1 and 2 and illustrating different stages in the stretching of the blank.

Before explaining in detail the present invention, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

20 The apparatus illustrated in the accompanying drawings comprises a draw bench 10 upon which a gripping device 11 for gripping one end of a tubular blank B is movably mounted. One end of a rack 12 is suitably connected to the gripping device 11 and is adapted to engage a rack gear 15 fixed upon a shaft 16 suitably mounted for rotation in a machine 17 of the pinch roll type. The other end of the rack 12 carries a roll 22 resting upon a suitable support 23. Power is supplied to move the rack 12 from a variable speed motor 18 through a gear reduction unit 19 having a gear

20 meshing with a gear 21 fixed upon the shaft 16. A suitable control device 24 may be associated with the motor 18 to control the electrical energy supplied thereto.

5 A suitable support 30 is spaced from one end of the draw bench 10 and in alinement therewith. A suitable gripping device 31 is movably mounted upon the support 30 and is adapted to grip the other end of the tubular blank B while permitting the free movement therein of a mandrel 33
10 carried by the gripping device 11. The gripping device 31 is connected by rods 34, which straddle the mandrel 33, to a yoke 35 suitably fixed upon one end of a piston rod 36 slidably mounted in the hydraulic cylinder 37. A piston 38 is fixed
15 upon the inner end of the piston rod 36. The hydraulic cylinder 37 is provided with a by-pass 40 communicating with the interior of the cylinder at opposite sides of the piston. The by-pass 40 is
20 provided with a suitable control valve 41.

An electric inductive furnace 43 is mounted upon a bracket 44 on the draw bench 10 and is so arranged and positioned as to permit the progressive movement of the adjacent local portions of the mandrel 33 and the blank B into and
25 out of the same. The furnace 43 is provided with a suitable control device 45 so that the temperature within the furnace may be accurately controlled.

30 In the production of a seamless tube, a tubular blank B, either cold or preheated, is placed over the mandrel 33 so as to project through the furnace 43. One end of the blank is gripped by the gripping device 11 or forward pulling head and the other end is gripped by the gripping device
35 31 or rear pulling head. Power is supplied to cause the gripping device 11 and the blank B to move in the direction indicated by the arrows in Figs. 3 and 4. This movement is resisted by the action of the hydraulic cylinder 37 to cause
40 the blank to be subjected to tension and the gripping device 31 to move in the direction of the arrows in Figs. 3 and 4 but at a slower rate than the gripping device 11. Consequently, adjacent local portions of the blank are caused to
45 move progressively into the furnace 43 and be heated to reduce their tensile strength a predetermined amount. As the adjacent local portions of the blank are heated to the desired temperature they are stretched and reduced in diameter and wall thickness until they engage the
50 relatively cold mandrel. After contact with the mandrel, stretching of this portion of the blank ceases and it moves at the same rate of speed as the mandrel and the gripping device 11. After the stretching operation has been completed, the unreduced end portions where the blank has been gripped are cut off. The tube may be expanded in any well known manner to relieve it so the
60 mandrel can be withdrawn, as by running through cross rolls.

It will be understood that the gripping device 31 will move a distance equal to the initial distance between the first and last local portions of the blank elongated and reduced, while the gripping device 11 will move a distance equal to the final distance between the first and last local portions of the blank elongated and reduced. In other words, disregarding the portions of the blank which are gripped by the devices 11 and 31 and which are not heated to the proper temperature for stretching, the gripping device 31 will move a distance equal to the length of the original
75 blank while the gripping device 11 will move a

distance equal to the length of the finished tubular product.

The tension applied to the blank causes it to stretch at its weakest point. Thus, in accordance with the invention, adjacent local portions of the blank are progressively heated to weaken them. In practice satisfactory results have been secured in stretching steel tubular blanks when the adjacent local portions have been heated to a temperature between about 1000° F. and 1600° F. 10

The forces applied to the blank which subject the same to tension and the temperature to which the local adjacent portions of the blank are heated are controlled to obtain a predetermined substantially uniform and permanent elongation 15 of the local adjacent portions. It will be understood that finished products of various sizes may be obtained by varying the size and wall thickness of the blank and the size of the mandrel.

The practice of the invention requires considerably less power for effecting reduction and elongation of the blank than the prior rolling and cold drawing operations. One explanation of this is that in the practice of the invention there are no mechanical forces acting upon the outer 25 or inner surfaces of the blank and, consequently, there is no surface resistance or friction to overcome. The absence of surface friction results in an increased yield of the finished product because of the elimination of defective material 30 caused by surface defects. The practice of the invention is particularly advantageous for shaping materials, such as stainless steel, which are very susceptible to surface injury. Any scale formed as a result of heating to reduce the tensile strength is removed by stretching. Furthermore, it is not necessary to anneal, pickle, lubricate or point the blank. Inasmuch as there is no surface friction between the tube and mandrel to cause wear of the mandrel, there are no costly tools to maintain, such as the die and mandrel used in cold drawing operations. 40

From the foregoing it will be seen that in the preferred practice of the method the tubular blank is subjected to a pulling force at one end 45 and to a moving resisting force at the opposite end, and intermediate the points of application of these forces the blank preferably passes through a furnace or other heating means, preferably at a fixed location, which heats only a localized region of the blank at a given time to a temperature effective to produce a weakened portion intermediate the two pulling heads. If desired the entire blank may be heated, but it is contemplated in the preferred practice of the present method that there be produced a continuous hot spot at a given locality which will provide the weakest point in the tube. Hence the effect of the pulling forces will be to cause the tube to stretch at this hot spot or weakest point and "neck down" to the mandrel, thereby causing a reduction in diameter and wall thickness. When the tube portion at the hot spot necks down and strikes the relatively cold mandrel, this portion of the tube, when it contacts with the mandrel, is cooled, and due to frictional resistance the stretching of this portion ceases. The principal function of the mandrel, therefore, is to stop the reduction of the tube diameter and to reinforce the stretched reduced section of the tubing. 70

Thus, as the tubing is stretched and hence travels through the furnace or high heat zone a moving hot spot or weakened area is progressively 75

formed along the length of the tubing and the stretching progressively takes place at this point only. Throughout the stretched tube section the tube becomes with the mandrel rod substantially a solid piece and in practice it has been found that no slippage of the tubing on the mandrel occurs after the tube wall has been reduced down to the mandrel.

It will also be seen that the only resistance to the tube reduction entering into the present operation is due to the tensile strength of the steel. Variable conditions due to the different tensile strengths of different steels can be readily met by varying the temperature of the local or hot spot or varying the differential between the opposed forces applied to the tubing. Variations in the required resistance force may be accomplished through the valve 41, by which the resistance action of the hydraulic piston in its cylinder may be adjusted. This piston during operation functions as a cushioning means and is of such sensitiveness as to compensate for slight variations in temperature or in the tube wall thickness. In practice the furnace is provided with a suitable temperature control so as to hold the temperature at the hot spot to the required degree in relation to the opposing forces. The cylinder valve control for the forward pulling head, and the furnace temperature control will preferably be centralized at a common location for convenient manipulation by the operator. Obviously these controls can be either manually or automatically synchronized.

Although in the preferred method, as herein described to exemplify one embodiment of the invention, the elongation of the tubular blank by stretching action is secured by utilizing a stationary heating means and forwardly moving elements or heads exerting forces in opposition to each other, one being herein termed a pulling force and the other a resistance force; yet the invention in other aspects thereof may be carried out in somewhat different manner. A forwardly movable element exerting a pulling force may be attached to one end of the blank. A stationary element exerting an opposing or resisting force may be attached to the other end of the blank. And a moving heating unit may be utilized to progressively heat the blank locally. With this method the blank may be heated progressively at the successive local portions to provide what may be termed a travelling hot spot where the weakest point in the blank will occur. Or, the entire blank may be in heated condition and the local portions where stretching occurs may be heated to a greater temperature than the remainder of the blank. In another aspect of the invention, claimed in my copending application, Serial No. 727,647, the pulling heads at opposite ends of the blank may travel in opposite directions, exerting opposing forces. The heating means may be two elements starting centrally of the tubular blank and travelling outwardly and away from each other along the blank to heat progressive local portions thereof. Since these portions are successively the weakest points in the blank the latter will be progressively reduced to the mandrel, which remains stationary, from the middle of the blank longitudinally toward opposite ends thereof, it being understood that in such instance the heating means or elements will travel relatively to and at a greater speed than the travel of the pulling heads.

I claim:

1. An apparatus for elongating a metal blank comprising means for heating local portions of a blank to weaken the same, and separate means for continuously applying opposed forces to said blank at opposite sides of said heating means, at least two of said means being movable to cause relative movement between each other and the other of said means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank.

2. An apparatus for elongating a metal blank to form a substantially cylindrical seamless tube, comprising means for heating local portions of a blank to weaken the same, separate means for continuously applying opposed forces to said blank at opposite sides of said heating means, at least two of said means being movable to cause relative movement between each other and the other of said means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, and means for controlling said heating means and said means for applying opposed forces to said blank so that said local portions of the blank are elongated permanently a desired predetermined amount.

3. An apparatus for making metal tubular products which comprises means for heating local portions of a tubular metal blank to weaken the same, separate means for continuously applying opposed forces to said blank at opposite sides of said heating means, at least two of said means being movable to cause relative movement between each other and the other of said means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, and a mandrel movable with the permanently elongated portions of the blank and extending into the blank to render the inner diameter and wall thickness of the tubular product substantially uniform throughout its length.

4. An apparatus for making tubular products which comprises means for heating local portions of a tubular metal blank to weaken the same, separate means for continuously applying opposed forces to said blank at opposite sides of said heating means, at least two of said means being movable to cause relative movement between each other and the other of said means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, a mandrel movable with the permanently elongated portion of the blank and extending into the blank to render the inner diameter and wall thickness of the tubular product substantially uniform throughout its length, and means for controlling said heating means and said means for applying opposed forces to said blank so that said local portions of the blank are elongated permanently a desired predetermined amount.

5. An apparatus for elongating a metal blank to form a substantially cylindrical seamless tube, comprising means for heating local portions of a blank to lower substantially uniformly the resistance of the same, and separate means movable relatively to each other and to said heating

means for continuously applying opposed forces to said blank at opposite sides of said heating means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank.

6. An apparatus for elongating a metal blank to form a substantially cylindrical seamless tube, comprising means for heating local portions of a blank to weaken the same, separate means movable relatively to each other and to said heating means for continuously applying opposed forces to said blank at opposite sides of said heating means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, and means for controlling said heating means and said means for applying opposed forces to said blank so that said local portions of the blank are elongated permanently a desired predetermined amount.

7. An apparatus for making tubular products which comprises means for heating local portions of a tubular metal blank to weaken the same, separate means movable relatively to each other and to said heating means for continuously applying opposed forces to said blank at opposite sides of said heating means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, and a mandrel movable with the permanently elongated portions of the blank and extending into the blank to render the inner diameter of the tubular product substantially uniform throughout its length.

8. An apparatus for making tubular products which comprises means for heating local portions of a tubular blank to weaken the same, separate means movable relatively to each other and to said heating means for continuously applying opposed forces to said blank at opposite sides of said heating means whereby adjacent local portions of said blank are heated progressively, said opposed forces being of such magnitude as to elongate permanently the progressively heated portions of the blank, a mandrel having a substantially uniform diameter throughout its length, movable with the permanently elongated portions of the blank and extending thereinto to control the inner diameter of the tubular product, and means for controlling said heating means and said means for applying opposed forces to said blank so that said local portions of the blank are elongated permanently a desired predetermined amount.

9. An apparatus for elongating a metal blank comprising a heating furnace adapted to permit movement of adjacent local portions of a blank therethrough to successively weaken the same, separate movable members adapted to be operatively connected to said blank at opposite sides of said furnace, means for moving one of said members to apply a force to said blank tending to move the same and the other movable member, and an hydraulic piston operatively connected to said other movable member to apply a controlled force tending to resist movement of said blank whereby adjacent local portions of the blank are heated progressively, said forces being of such magnitude as to elongate permanently the progressively heated portions of the blank.

10. An apparatus for making tubular metal products which comprises a heating furnace adapted to permit movement of adjacent local portions of a tubular blank therethrough to weaken the same, a movable member adapted to be operatively connected to said blank at one side of said furnace, a mandrel carried by said member and adapted to be positioned within said blank, means for moving said member to apply a force to said blank tending to move the same, another movable member adapted to be operatively connected to said blank at the other side of said furnace, and an hydraulic piston operatively connected to the last mentioned movable member to apply a force tending to resist movement of said blank whereby adjacent local portions of the blank are heated progressively, said forces being of such magnitude as to elongate permanently the progressively heated portions of the blank.

11. An apparatus for elongating a tubular metal blank, comprising means for progressively heating successive local portions of the blank to a temperature greater than the temperature of the remainder of the blank, pulling members adapted to be operatively connected to said blank at opposite sides of the locally heated portions thereof, both of said members being mounted to travel in the same direction but at different rates of speed whereby said blank will be progressively stretched at said successive locally heated portions, and means for controlling the internal diameter of the stretched portions.

12. In an apparatus for elongating a tubular metal blank, the combination of a pair of members adapted to be attached to the blank at spaced points in its length and mounted to travel in the same direction, means for moving one of said members at a greater rate of speed than the other member thereby to exert a stretching force on the blank intermediate the members, and means for progressively weakening the blank by heat at a localized region intermediate said members to effect progressive reduction of the blank by stretching action at said region.

13. The method of forming a tube from a metal blank which comprises heating adjacent local portions of the blank progressively to weaken the same, and progressively and permanently elongating the locally weakened portions a predetermined amount.

14. The method which comprises heating adjacent local portions of a tubular metal blank progressively to weaken the same, applying opposed forces of different magnitude at opposite sides of the locally heated portions to reduce said weakened portions by stretching action, and controlling the amount of reduction of the blank at said portions.

15. The method of making tubular products which comprises heating adjacent local portions of a tubular metal blank during elongation thereof progressively to weaken the same, applying opposed forces at opposite sides of the locally heated portions of such magnitude that their resultant causes permanent elongation of said weakened portions, and limiting the inner diameter of the elongated portions of the blank.

16. The method of fabricating seamless tubing which comprises progressively heating adjacent local portions of a metal blank to a temperature greater than the temperature of the rest of the blank to weaken the same, and progressively and permanently elongating the local weakened portions a predetermined amount.

17. The method which comprises progressively heating adjacent local portions of a metal blank to a temperature between 1000° F. and 1600° F. to weaken the same, applying opposed forces at opposite sides of the locally heated portions of such magnitude that their resultant causes permanent elongation of said weakened portions, and controlling said forces with relation to said heating to obtain substantially uniform elongation of the blank to a predetermined amount.

18. In the method of reducing and elongating a tubular metal blank, the steps of progressively heating successive local portions of the blank to a greater temperature than the remainder of the blank, applying opposed forces of different magnitude at opposite sides of the locally heated portions to stretch and reduce the blank at said portions, and limiting the inner diameter of the reduced portions of the blank.

19. In the method of reducing a tubular metal blank, the steps of progressively heating successive local portions of the blank to a greater temperature than the remainder of the blank, and applying opposed forces of different magnitude at opposite sides of the locally heated portions to cause permanent elongation of said portions by stretching action.

20. An apparatus for making a tubular product of substantially uniform diameter throughout its length which comprises means adapted to act upon successive portions of a tubular metal blank to render such portions temporarily weaker than the remaining portions, and means for applying opposed forces to opposite ends of the blank thereby to move one end relative to the other when the successive portions of the blank are temporarily weakened.

21. An apparatus for making a tubular metal product which comprises heating means adapted to act upon successive portions of a tubular metal blank to render the same weaker than the remaining portions, means for applying opposed forces to opposite ends of the blank to move one end relative to the other, and a mandrel for controlling the inner diameter of said tubular product.

22. An apparatus for making a tubular metal product which comprises means adapted to act upon successive portions of a tubular blank to render the same weaker than the remaining portions, and means for applying opposed forces to opposite ends of the blank to move said ends in the same direction at different rates.

23. An apparatus for making a tubular metal product which comprises means adapted to act upon a portion of a tubular blank to render the same weaker than the remaining portions, means for applying opposed forces to opposite ends of the blank to move said ends in the same direction at different rates, and a mandrel for controlling the inner diameter of said tubular product.

24. An apparatus for making a tubular metal product which comprises heating means adapted to act upon successive portions of a tubular metal blank to render the same weaker than the remaining portions, a mandrel for controlling the inner diameter of said tubular product, and means for applying opposed forces to opposite ends of the blank and to one end of said mandrel to move the latter and one end of said blank relative to the other.

25. In an apparatus for elongating a tubular metal blank, the combination of a pair of relatively movable members adapted to be attached to the blank at spaced points in its length, means for moving one of said members relative to the other to exert a stretching force on the blank intermediate the members, and means for progressively weakening the blank at a localized region intermediate said members to effect progressive elongation of the blank by localization of the stretching action in said region.

26. An apparatus for reducing the diameter of and elongating tubes, comprising a mandrel smaller in cross-section than the bore of the tube and over which the tube is adapted to be placed, means for grasping the tube at two points spaced along the length of the tube, means for making a short section of tube between the grasping means hotter than the rest of the tube between the grasping means, and means for moving one of the grasping means away from said section.

SIDNEY D. INSCHO.

CERTIFICATE OF CORRECTION.

Patent No. 2,051,948.

August 25, 1936.

SIDNEY D. INSCHO.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 62-63, claim 15, strike out the words "during elongation thereof" and insert the same after "blank" and before the period in line 68, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of November, A. D. 1936.

(Seal)

Henry Van Arsedale
Acting Commissioner of Patents.

17. The method which comprises progressively heating adjacent local portions of a metal blank to a temperature between 1000° F. and 1600° F. to weaken the same, applying opposed forces at opposite sides of the locally heated portions of such magnitude that their resultant causes permanent elongation of said weakened portions, and controlling said forces with relation to said heating to obtain substantially uniform elongation of the blank to a predetermined amount.

18. In the method of reducing and elongating a tubular metal blank, the steps of progressively heating successive local portions of the blank to a greater temperature than the remainder of the blank, applying opposed forces of different magnitude at opposite sides of the locally heated portions to stretch and reduce the blank at said portions, and limiting the inner diameter of the reduced portions of the blank.

19. In the method of reducing a tubular metal blank, the steps of progressively heating successive local portions of the blank to a greater temperature than the remainder of the blank, and applying opposed forces of different magnitude at opposite sides of the locally heated portions to cause permanent elongation of said portions by stretching action.

20. An apparatus for making a tubular product of substantially uniform diameter throughout its length which comprises means adapted to act upon successive portions of a tubular metal blank to render such portions temporarily weaker than the remaining portions, and means for applying opposed forces to opposite ends of the blank thereby to move one end relative to the other when the successive portions of the blank are temporarily weakened.

21. An apparatus for making a tubular metal product which comprises heating means adapted to act upon successive portions of a tubular metal blank to render the same weaker than the remaining portions, means for applying opposed forces to opposite ends of the blank to move one end relative to the other, and a mandrel for controlling the inner diameter of said tubular product.

22. An apparatus for making a tubular metal product which comprises means adapted to act upon successive portions of a tubular blank to render the same weaker than the remaining portions, and means for applying opposed forces to opposite ends of the blank to move said ends in the same direction at different rates.

23. An apparatus for making a tubular metal product which comprises means adapted to act upon a portion of a tubular blank to render the same weaker than the remaining portions, means for applying opposed forces to opposite ends of the blank to move said ends in the same direction at different rates, and a mandrel for controlling the inner diameter of said tubular product.

24. An apparatus for making a tubular metal product which comprises heating means adapted to act upon successive portions of a tubular metal blank to render the same weaker than the remaining portions, a mandrel for controlling the inner diameter of said tubular product, and means for applying opposed forces to opposite ends of the blank and to one end of said mandrel to move the latter and one end of said blank relative to the other.

25. In an apparatus for elongating a tubular metal blank, the combination of a pair of relatively movable members adapted to be attached to the blank at spaced points in its length, means for moving one of said members relative to the other to exert a stretching force on the blank intermediate the members, and means for progressively weakening the blank at a localized region intermediate said members to effect progressive elongation of the blank by localization of the stretching action in said region.

26. An apparatus for reducing the diameter of and elongating tubes, comprising a mandrel smaller in cross-section than the bore of the tube and over which the tube is adapted to be placed, means for grasping the tube at two points spaced along the length of the tube, means for making a short section of tube between the grasping means hotter than the rest of the tube between the grasping means, and means for moving one of the grasping means away from said section.

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