Jan. 22, 1952 D. H. GARDNER 2,583,046

APPARATUS FOR HEAT-TREATING BIMETALLIC STRIP MATERIAL

Filed May 3, 1949 6 Sheets-Sheet 1

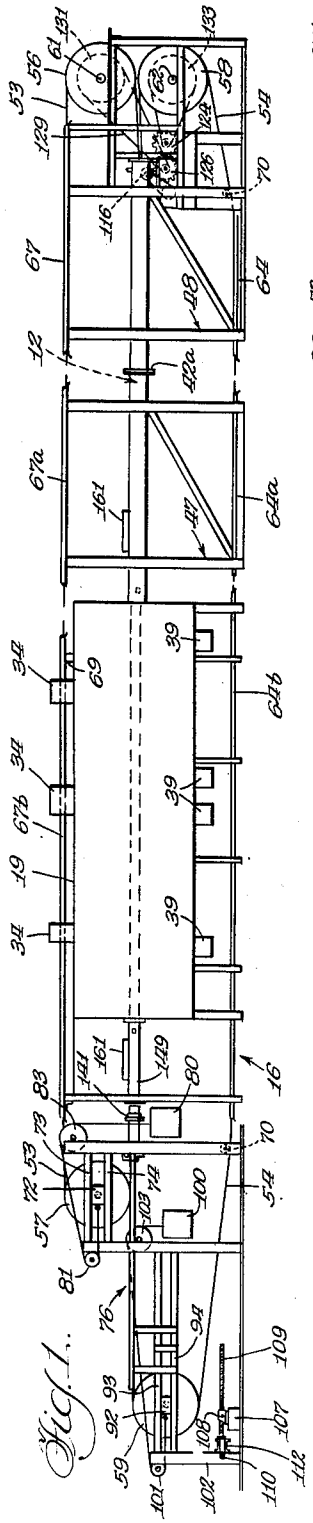


Fig. 1.

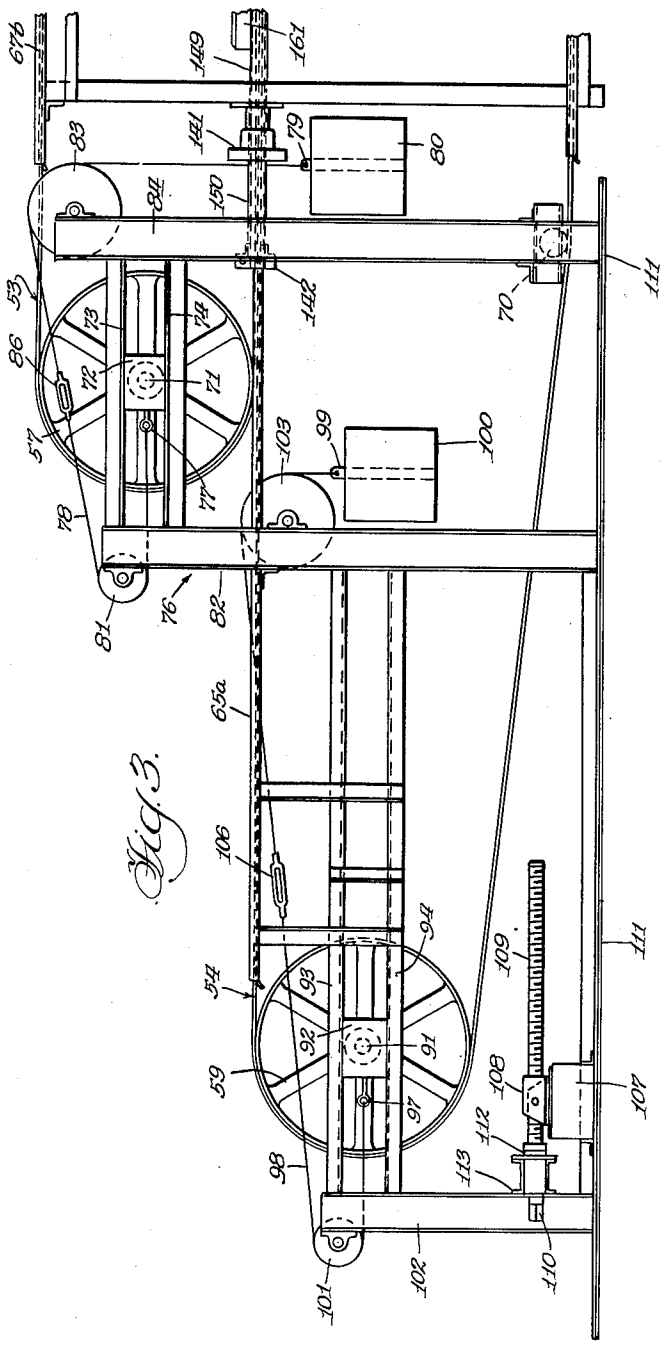


Fig. 3.

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Filed May 3, 1949 6 Sheets-Sheet 2

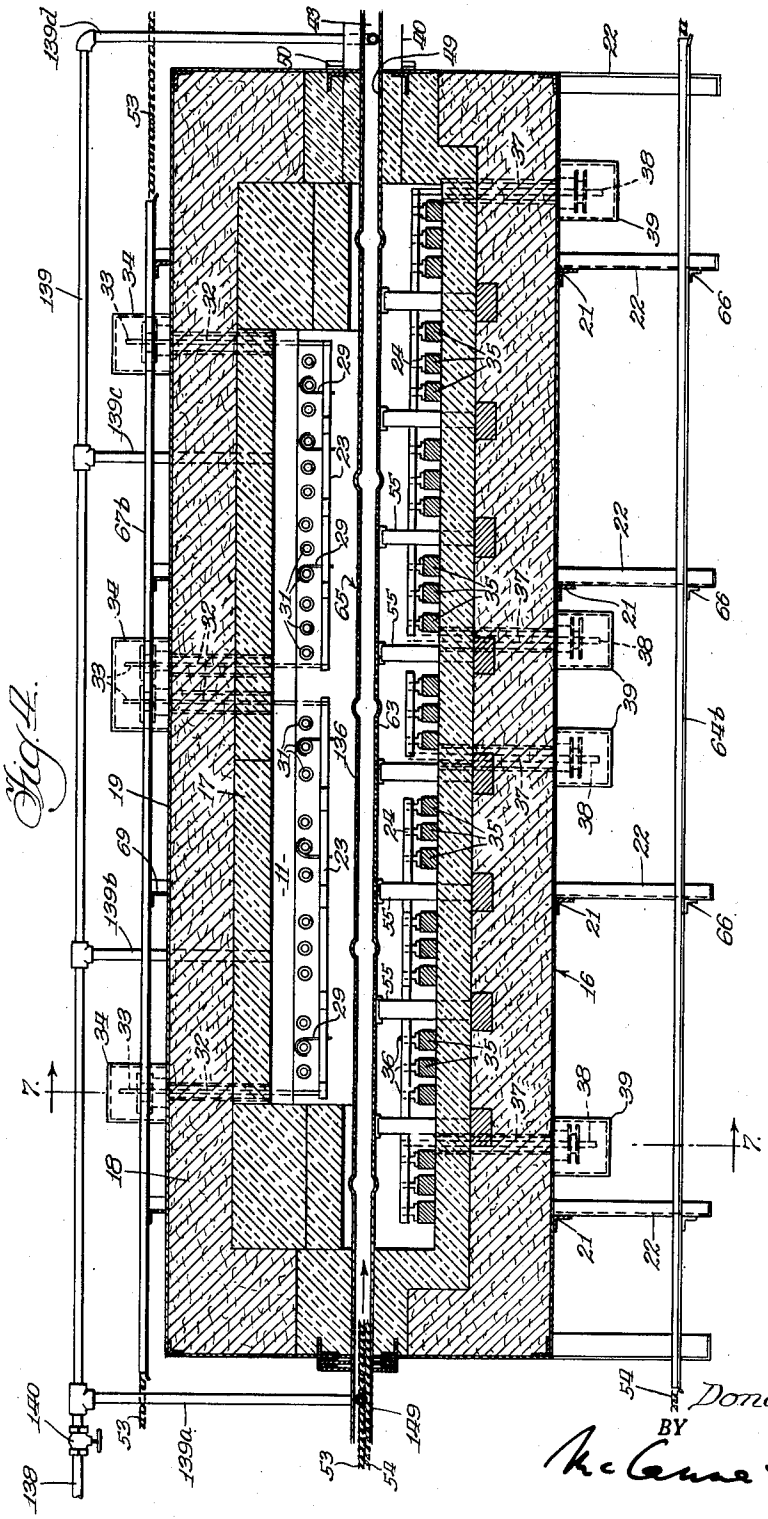


Fig. 1.

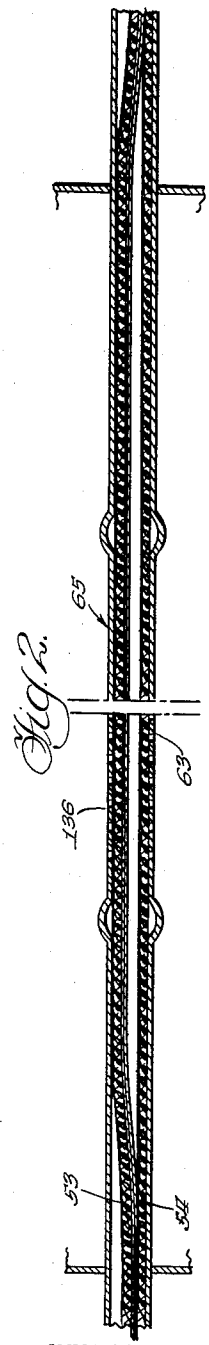


Fig. 2.

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Filed May 3, 1949 6 Sheets-Sheet 3

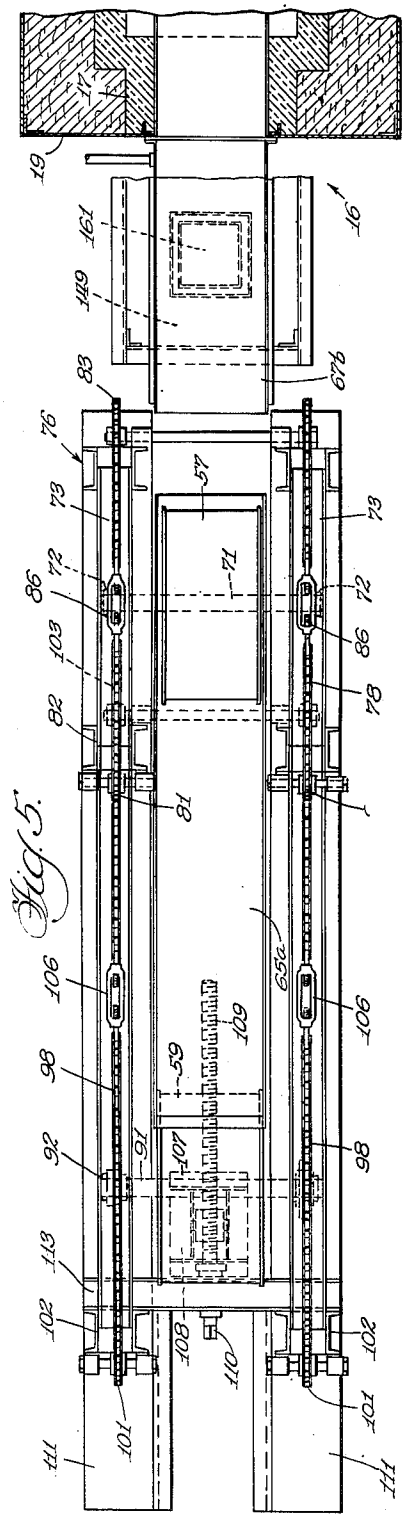


Fig. 5.

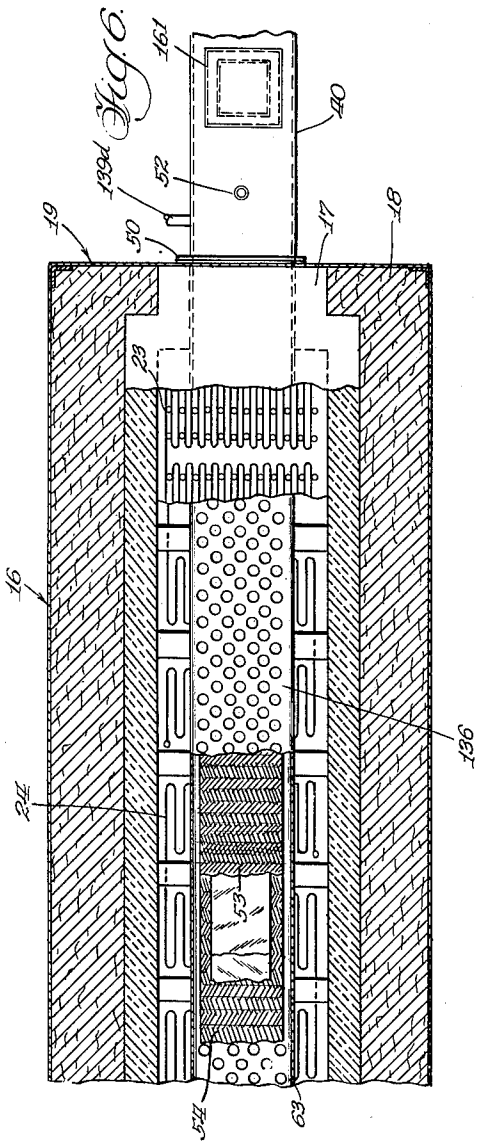


Fig. 6.

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APPARATUS FOR HEAT-TREATING BIMETALLIC STRIP MATERIAL

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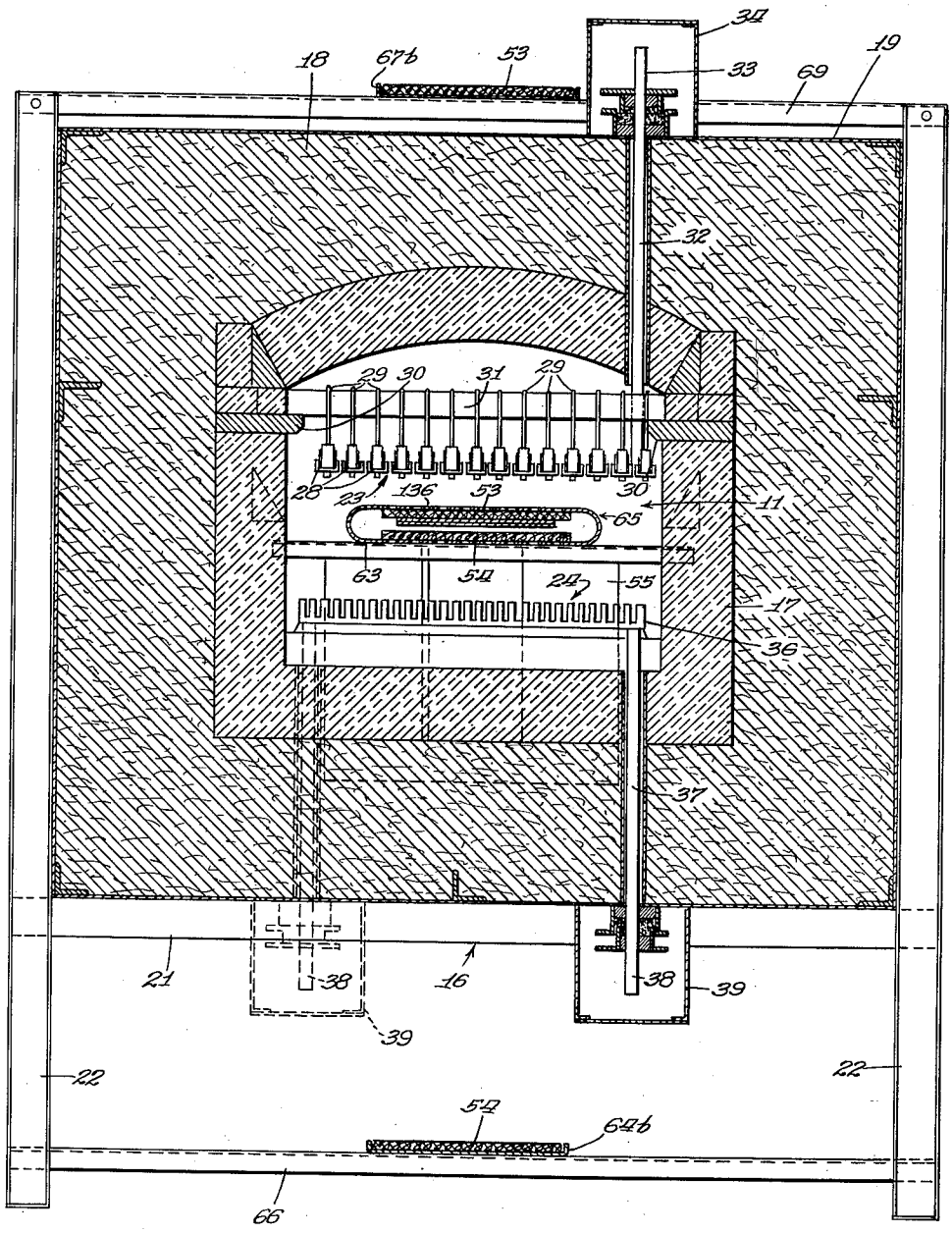


Fig. 7.

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APPARATUS FOR HEAT-TREATING BIMETALLIC STRIP MATERIAL

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Fig. 8.

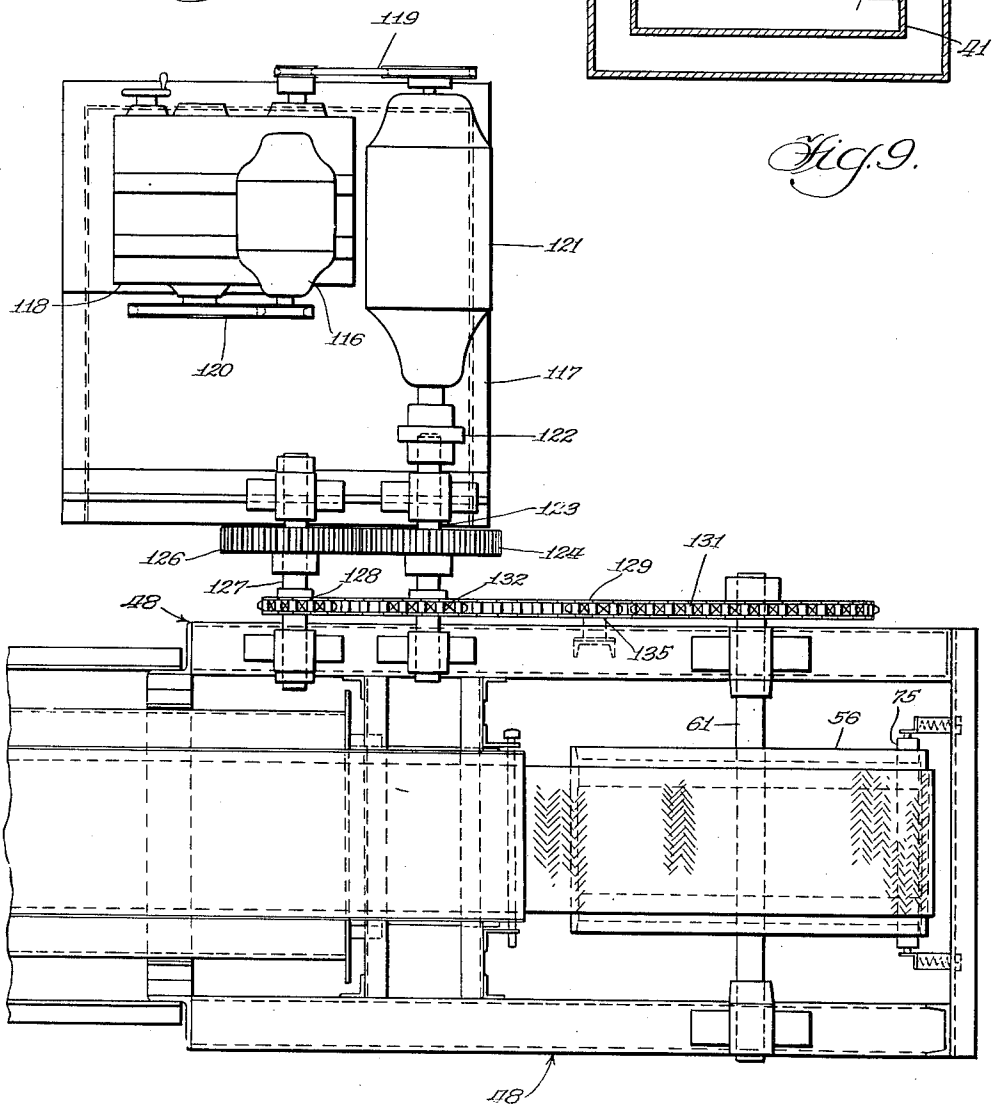
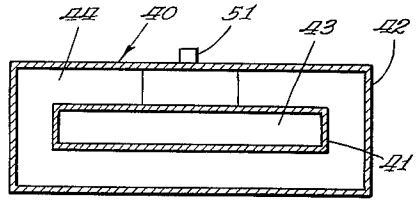


Fig. 9.



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APPARATUS FOR HEAT-TREATING BIMETALLIC STRIP MATERIAL

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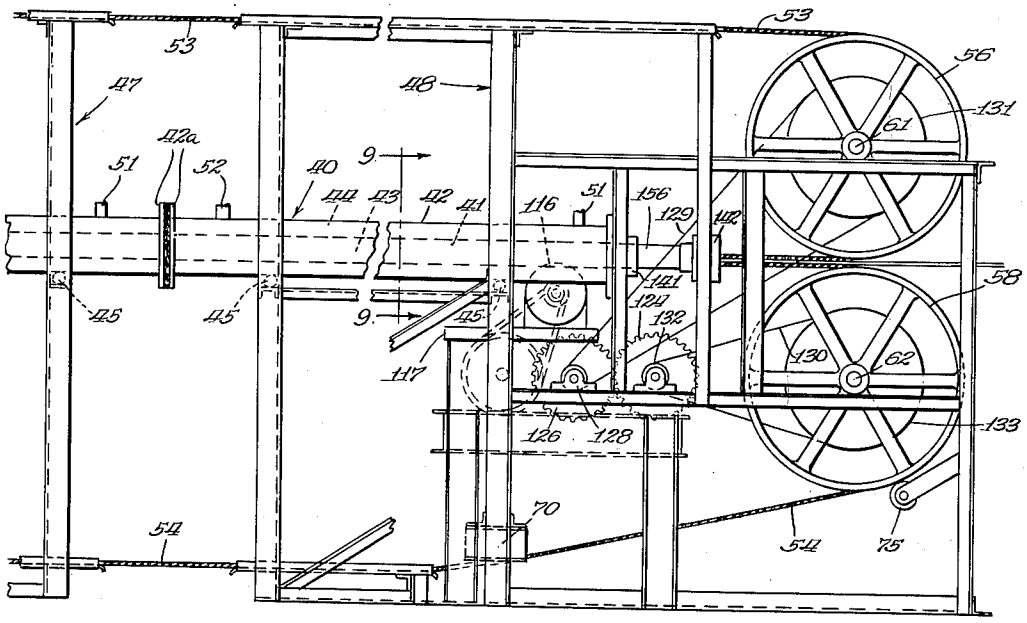


Fig. 10.

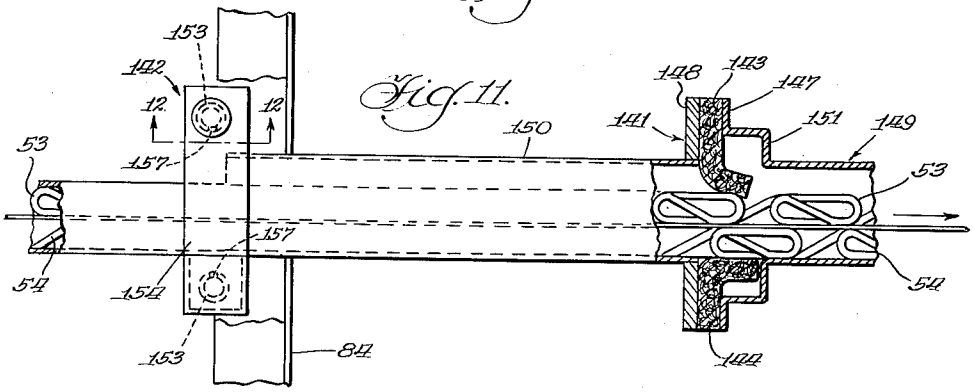


Fig. 11.

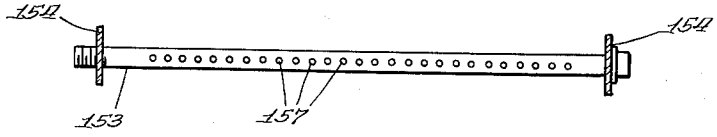


Fig. 12.

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UNITED STATES PATENT OFFICE

2,583,046

APPARATUS FOR HEAT-TREATING BIMETALLIC STRIP MATERIAL

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Application May 3, 1949, Serial No. 91,194

13 Claims. (Cl. 266—3)

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This invention relates to an apparatus for heat treating strips of metal material of the type such as bimetal strips that tend to warp when heated.

In the making of bimetal strips two or more slabs of preselected metal are placed in side by side relation and are pressed together by a suitable pressure applied at the proper temperature. Thereafter the composite slab is passed through rollers a number of times until the slab is rolled out to the desired thickness; that is, it can be cut into small strips for use in instruments and the like or can be readily coiled. The characteristics of the bimetal material are such that as it is heated it tends to bend or become deflected, this of course is the basis for its use in industry. This inherent bending of bimetal material, when heated, presents a real problem in handling during the annealing processes between successive rollings of the slab. Heretofore no satisfactory means has been available for handling bimetallic material between the time it is in composite slab form until it is of such thickness that it can be readily used. For example the conventional electric strip annealing furnaces are not suitable for heavy stock due to the high losses of material involved in spot welding short strips together to produce continuous lengths. One of the methods widely used heretofore comprises forcibly coiling the strips in the direction in which they would bend when heated, binding them with wire to prevent uncoiling and then loading the bound coils into baskets for immersion into oil fired salt pots. To conserve space the strips are generally coiled in decreasing diameter so that one coil can be loaded or supported inside another coil and together the coils form a comparatively solid unit. Several of these solid coils are then stacked, one upon the other in the basket. After these coils have been heated the required length of time the basket is removed from the salt pot and cooled in water to wash off the salt. The coils or strips are then removed from the basket, the binding wire for the individual coils removed and the strips straightened and passed through a special decoiling and cleaning machine. The above process although widely used is objectionable on several grounds. It is obvious that there are many hazards insofar as the safety of the operating personnel is concerned. For example the unloading of the salt furnace involves danger to the personnel due to the fumes and splattering of the salt as the basket is raised from the salt pot. The removing of the coils from the salt

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pots and then subsequently placing them in cool water is very dangerous, being almost explosive in nature. Personnel in factories in which salt pots have been utilized have complained of the noise resulting from the immersion of the coils in the salt pot and cool water and also from the fact that the buildings housing this equipment frequently shake rather severely during this process because of the concussion waves resulting from the immersion of the coils in the salt pots and water. Due to the fact that this process is inherently so dangerous factories utilizing salt pots for this purpose have found that they have an extremely high labor turnover for operators of salt pots. In addition to presenting hazards to the personnel such salt pots have constituted a fire hazard and in general detract from the appearance of the factory. As a matter of fact these salt pot installations are an eye sore. In other instances slabs have been stacked one on the other in a furnace with weights distributed over the top of the stack to prevent deflection of the slabs during the heat treating thereof. Preferably, adjacent slabs are placed in side by side relation so that the deflection of one slab counteracts that of another. This method is not satisfactory in that it requires a considerable amount of handling of the bimetal slabs both in preparing the slabs and in placing them in the furnace and in removing the slabs therefrom. Considerable scaling has also been encountered with prior heat treating units. One of the big objections to previous constructions for heat treating bimetal slabs has been that they have required a large number of operating personnel.

An object of the invention is to provide a novel annealing furnace means for bimetal and the like materials, that insures that the bimetal strip is uniformly annealed, that the bimetal strip has a bright finish, and provides for the expeditious handling of the bimetal strip to, through, and from the furnace means.

Another object of the invention is to provide a novel furnace means for satisfactorily annealing bimetal strips particularly in the initial stages of the formation of the strip while the latter is of a relatively heavy stock.

Another object of the invention is the provision of furnace means of the above character having novel means for advancing bimetal slabs through the furnace means.

Another object of the invention is the provision of furnace means of the above character having novel means for limiting the deflection of the

bimetal strip or slab as it advances through the furnace means.

Another object of the invention is the provision of furnace means of the above character for bimetal strips or slabs and the like that requires a minimum of operating personnel.

Another object of the invention is to provide furnace means of the above character wherein the operation thereof entails a minimum of hazards to the operating personnel, both of the furnace means and adjacent equipment in a factory.

Another object of the invention is to provide furnace means of the above character wherein the bimetal strip after passing through the furnace means is ready for cold rolling without further treatment.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of an annealing furnace unit embodying the present invention in a greatly reduced scale;

Fig. 2 is a diagrammatic view showing the approximate shape a bimetal strip or slab assumes as it passes through the furnace;

Fig. 3 is an enlarged fragmentary view showing the receiving end of the annealing furnace unit;

Fig. 4 is a side elevational view in section of the furnace per se;

Fig. 5 is a top elevational view of the charge or receiving end of the furnace shown in Fig. 3;

Fig. 6 is a fragmentary top plan view with cutaway portions showing the construction of the furnace per se;

Fig. 7 is a transverse sectional view of the furnace per se taken along the section line 7—7 in Fig. 4;

Fig. 8 is a top plan view of the discharge end of the furnace unit;

Fig. 9 is a sectional view taken substantially along the line 9—9 of Fig. 10;

Fig. 10 is a side elevational view of the portion of the furnace unit shown in Fig. 8;

Fig. 11 is an enlarged sectional view showing the gas curtain and sealing arrangement for preventing the leakage of gas from the furnace unit, and

Fig. 12 is a sectional view taken substantially along the line 12—12 of Fig. 11.

Referring now to the drawings, the invention is shown embodied in a heat treating or annealing unit adapted for heat treating bimetal slabs or strips. Such strips may consist of two or more metals laminated together in a conventional manner to form composite strips or slabs. In general these strips or slabs will vary in length from 6 to 35 feet, are ¼" thick, initially, and are generally somewhat less than a foot wide. They are rolled until the final strip may be approximately .020 inch thick or the like, depending on the ultimate use of the strip.

While the heat treating unit to be described hereinafter is intended primarily for bimetal strips, it is to be understood that any other type of strip may be used if desired particularly where the strips are the type that distort as a result of heating the strip. In this embodiment of the invention the heat treating unit in general comprises a heating chamber 11 of suitable size to accommodate the material being handled, a cooling chamber 12 of suitable size to accommodate the material being handled adjacent the heating chamber, means for advancing the strip

of stock successively through the heating and cooling chambers 11 and 12 respectively and means for limiting or restraining the distortion or deflection of the bimetal strip as it is heated and subsequently cooled in passing through the heat treating unit.

The heating chamber 11 in this instance is formed in a furnace 16. The chamber 11 is defined by a suitable thickness of refractory material such as firebrick 17. As shown in Figs. 4 and 7 the chamber 11 is relatively long and has a generally rectangular cross section with an arched top of conventional construction. The bricks 17 are encased in suitable insulating material 18, which in turn is housed in a suitable housing 19 formed by metallic sheets suitably fastened together. The housing 19 is mounted on suitable cross members 21 spaced lengthwise of the housing and supported by spaced uprights 22 on opposite sides of the housing. The chamber 11 should be made gas tight so that an atmosphere may be introduced therein.

While any suitable means may be provided for supplying heat to the furnace in this instance it is shown as being heated by electric resistance units 23 and 24. In the present instance four electric resistance units are utilized, two units 23 supported at the top of the chamber 11 and two units 24 supported at the bottom of the chamber 11. The resistance elements 23 are formed by ribbons shaped and positioned as shown in Fig. 6 and supported on conventional insulated supporting units 28 in turn supported by elements 29 suspended from cross members 31. The cross members 31 are suitably supported on opposite sides at the top of the chamber 11 as by ledges 30 and the side walls defining the chamber 11. The ends of the heating elements 23 are connected to conductors 32. The latter project vertically through the top of the furnace unit and terminate in suitable terminals 33 disposed in houses 34 mounted on top of the housing 19. In a similar manner the heating elements 24 are formed by ribbons shaped and positioned as shown in Fig. 6. The ribbons are supported on suitable insulating supports 36 mounted on transversely extending ribs 35 on the bottom of the chamber 11. The ends of the ribbon 24 are connected to conductors 37 which project through the bottom of the housing 19 and terminate in terminals 38 located in houses 39 suitably supported on the bottom of the housing 19. By providing four sets of elements as shown, two zones of heating are provided in the furnace, one being used to bring the charge in the furnace up to temperature and the other being used to saturate the charge with heat. The temperature in the furnace may be automatically controlled by any suitable conventional means well known in the art. The latter is not shown for purposes of simplifying the drawings. The power leads for connecting the resistance units in the power system have also been omitted to simplify the drawings, it being understood that any suitable conventional conductors may be used for this purpose.

The cooling chamber 12 is in axial alinement with the furnace and is positioned at the discharge end thereof. The cooling chamber is defined by a plurality of sections 40 each formed as shown in Figs. 9 and 10 by two generally tubular members 41 and 42, disposed one within the other, and each having elongated rectangular cross sections. At the ends of each section 40 the tubular members are joined together as by

flanges 42a to form a central axially extending passageway 43 opening on both ends of the section and a water chamber 44 closed at both ends of the section and surrounding the axially extending passageway 43. The sections are suitably supported on spaced rollers 45 (see Fig. 10) supported on frameworks 47 and 48. The sections 40 are rigidly secured together by bolts extending through the flanges 42a on adjacent sections so that the axial passageways 43 are in alinement to define the cooling chamber 12 in turn in alinement with the discharge opening 49 of the furnace. Any suitable connection 50 may be used for attaching the section 40, adjacent the furnace, to the latter. Water is supplied to each water chamber 44 through an inlet conduit 51 attached to the outer tubular member 44 and is exhausted from the chamber through an exhaust conduit 52. The flow of water to the respective sections 40 may be controlled by any suitable means such as termostatic valves and the like (not shown), so that any desired cooling temperature may be maintained in the cooling chamber 12. Preferably the temperature in the cooling chamber 12 should be such that when the bimetal strip is discharged from the heat treating unit the temperature of the strip is below the oxidizing temperature. Moreover the temperature should be low enough so that the strip can be readily handled and is ready for cold rolling without any further treatment.

The means for advancing the bimetal strip through the heating chamber 11 and the cooling chamber 12 in this instance comprises two endless flexible belts, an upper belt 53 and a lower belt 54 disposed and arranged in coplanar relation as best seen in Figure 1. The upper belt 53 is supported on pulleys 56 and 57 supported at opposite ends of the heat treating unit. The lower belt is supported on pulleys 58 and 59 also supported at opposite ends of the heat treating unit. The mounting pulleys for the upper and lower belt are arranged so that the bottom portion of the upper belt 53 and the top portion of the lower belt 54 are adjacent each other in side by side relation and the bottom portion of the upper belt normally rests on the lower belt. With this construction the belts are so arranged that a strip of metallic stock disposed between the adjacent portions of the upper and lower belts is gripped sufficiently tight so that it is drawn along or advanced in unison with the corresponding gripping portions of the belts. Preferably the belts 53 and 54 are of woven wire construction as best seen in Figs. 6 and 11. The pulleys 56 and 58 which are the drive pulleys are preferably provided with a layer of friction material on their periphery so as to prevent slippage between the pulleys and the flexible belts 53 and 54. The pulleys 56 and 58 are mounted on shafts 61 and 62 respectively supported in suitable bearings mounted on opposite sides of the framework 48. The top portion of the belt 54 is supported by a bottom 63 of a muffle 65 extending through the heating chamber 11, the bottom of the cooling chamber 12 and a horizontally extending trough 65a at the charge end of the furnace unit, together forming a guide for the belt 54. As shown in Figs. 4 and 7 the muffle 65 is supported by suitably capped spaced ribs 55, projecting upwardly from the bottom of the chamber 11 and the ends of the furnace so that the muffle is held substantially centrally of the chamber 11. The lower portion of the belt 54 is supported by guides 64, 64a and 64b, beneath the heat treating unit

and suitably supported by the frameworks 47 and 48 and by cross members 66 attached at their opposite ends to uprights 22 beneath the furnace 16. Rollers 70 at opposite ends of the heat treating unit also support the belt 54 and provide friction free surfaces for the belt. A tension roll 75 is mounted on the framework 48 to engage the belt 54 adjacent the pulley 58. The upper portion of the top belt 53 is supported by trough-shaped guides 67, 67a and 67b supported on top of the heat treating unit respectively by the frameworks 47 and 48 and cross members 69 on the housing 19 connected on opposite sides to the uprights 22. Where desired the guides 64, 64a, 64b, 67, 67a and 67b may be replaced by suitable rollers. The belts 53 and 54 are arranged so that when they are not advancing a strip of metal the lower portion of the belt 53 normally rests on the top portion of the lower belt 54 as best seen in Fig. 11. To facilitate the placing of the bimetal strip between the conveying belts 53 and 54 the lower belt 54 extends forwardly of the charge end of the furnace a substantially greater distance than the upper belt to define a table for readily receiving the bimetal strip as shown in Figs. 1 and 3.

Provision is made for automatically adjusting the tension in the belts 53 and 54. In this instance automatic tensioning thereof is effected by means of a weight. The tensioning means for the belt 53 is best shown in Figs. 3 and 5. Therein it is seen that the pulley 57 is supported on a shaft 71. The latter is supported at opposite ends in blocks 72 supported between horizontally disposed ways 73 and 74 forming a part of a support or framework 76 at the charge end of the heat treating unit. Attached to each block 72 is an eye 77. A chain 78 is secured at one end to the eye 77 and at its opposite end is connected to an eye in a member 79 supporting a weight 80. Between the eye 77 and the weight 80 the chain loops over a sprocket 81 supported on an upright 82 of the support 76 and a sprocket 83 supported on an upright 84 of the support 76 spaced from the upright 82. A turnbuckle 86 is connected in the chain 78 for adjustment purposes. The weight 80 is disposed between the framework 76 and the furnace 16. With this construction whenever there is any change in the length of the belt 53, due to heating of the belt or as it passes through the heating chamber 11 or the like the weight 80 will move downwardly thereby pulling the blocks 72 and in turn the pulley 57 to the left as shown in Fig. 3 and thereby assure that a desired tension is maintained in the belt 53. Contraction of the belt will cause the weight 80 to be raised. Any desired tension may be obtained in the belt by changing the weight 80.

The tension in the belt 54 is automatically adjusted in the same manner as that described for the belt 53. In this instance the pulley 59 is supported on a shaft 91 supported at opposite ends by slide blocks 92. The latter are supported between horizontally disposed spaced ways 93 and 94 forming a part of the framework 76. An eye 97 is connected with each of the blocks and extends in a direction outwardly from the furnace 16. Attached to each eye is a chain 98 which is connected at its opposite end to an eye of a member 99 supporting a weight 100. Between the eye 97 and the weight 100 the chain 98 passes over a sprocket 101 suitably supported on an upright 102 of the framework 76 and a sprocket 103 supported on the upright 82 below the sprocket 81. A turnbuckle

106 is connected in the chain for purposes of making adjustments. The weight 100 causes the pulley 59 to be moved to the left upon expansion of the belt due to heating of the belt and the like. When the belt contacts the stresses are sufficient to cause the slide blocks 92 to return to approximately their original position and thereby raise the weight 100. With this construction the belt is automatically tensioned.

In some instances after prolonged periods of use it has been found that flexible belts of this character tend to stretch. Accordingly, provision is made for manually simultaneously taking up the slack in the belts 53 and 54 due to the stretching of the belts. For this purpose the framework 76 is mounted on suitable slides 111 for movement lengthwise toward and away from the furnace 16. Disposed between the slides is a rigid block 107 rigidly fastened to the same support as the slides 111. Secured on the block 107 is a nut 108. Threaded through the nut 108 is a screw 109 having a squared end 110. The squared end 110 is mounted in a bushing 112 for rotational movement but is securely held against longitudinal movement. As shown the squared end 110 is positioned to be accessible from the extreme front end of the heat treating unit. The bushing 112 is supported on a suitable cross member 113 supported by the spaced uprights 102. With this construction rotation of the screw 109 by means of a wrench or crank attached to the squared head 110 will cause the framework 76 to move towards or away from the charge end of the furnace depending on the direction of rotation of the screw 109 and thereby simultaneously adjust the tension in both belts.

The belts 53 and 54 may be driven by any suitable means. In this instance they are driven by a motor 116 mounted on a platform 117 disposed at one side of the heat treating unit (see Figs. 8 and 10). The motor 116 is connected by a V-belt 120 to a speed change unit 118. The latter in turn is connected by a V-belt 119 to a speed reducer 121 mounted on the platform 117. The speed reducer unit 121 is connected by means of a coupling 122 to a shaft 123 suitably supported at opposite ends on the platform 117 and the framework 48. A spur gear 124 is mounted on the shaft 123. Meshing with the spur gear 124 is a spur gear 126 mounted on a shaft 127 having its ends suitably supported by bearings mounted on the platform 117 and the framework 48. A sprocket 128 is mounted on the shaft 127 in spaced relation to the spur gear 126 and is connected by means of a chain 129 to a sprocket 131 mounted on the shaft 61. Suitable tensioning means 135 may be provided for the chain 129. A sprocket 132 mounted on the shaft 123 in spaced relation to the spur gear 124 is connected by a chain 130 with a sprocket 133 mounted on the shaft 62. With this arrangement it will be seen that both belts are positively simultaneously driven through the pulleys 56 and 58 from the single motor 116. Suitable tensioning means for the chain 130 may be provided if desired.

As the bimetal strip passes through the heat treating unit it distorts as it is first heated up. This distortion continues until after what can be considered the critical temperature of the bimetal strip is reached. Thereafter additional heat, i. e. a higher temperature has little or no effect on the distortion of the bimetal strip. The strip again becomes distorted when the strip passes from the temperatures above the critical temperature down to a lower temperature. The amount of distortion decreases in this case with a decrease in temperature until at relatively low temperatures the bimetal strip assumes its normal position in which it is relatively free from distortion. While the distortion of the strip is the prime reason for its use in industry this inherent bending of the strip during the heating and cooling steps of the heat treating process has presented a real problem to the industry insofar as handling of it is concerned. Accordingly one phase of the invention is concerned with means for restraining the distortion of the bimetal strip as it is advanced successively through the heating chamber 11 and the cooling chamber 12. This is effected in this instances by limiting the permissible movement of the bottom portion of the top belt 53 away from the upper portion of the lower belt 54. A top 136 of the muffle 65 (see Figs. 4 and 7) and the bottom 63 is utilized for this purpose in this instance for restraining the defective movement in the heating chamber 11. The distance between the top portion 136 and the bottom 63 of the muffle 65 is sufficient to accommodate both thicknesses of the belts 53 and 54 and a bimetal strip disposed therebetween, sufficient clearance being provided to prevent sticking of parts. In a similar manner the top and bottom portions of the inner tubular member 41 provide restraining or distortion limiting means for the belts in the cooling chamber 12. To lower the temperature head required in the heating chamber the bottom portion 63 and top portion 136 are preferably perforated. This allows for better circulation of heat between the heating elements and the bimetallic strip carried between the belts. A flexible wire belt construction formed as illustrated herein is also advantageous in that hot air is permitted to circulate freely about the bimetal strip as it passes through the heating chamber. The bottom 63 and the top 136 may be formed in separate sections secured together in any conventional manner or may be formed by a plurality of tubular members welded together at their ends as shown in Fig. 4.

A preselected atmosphere may be maintained in the furnace. The particular atmosphere may vary considerably for different materials as is well known in the art. Herein the gas for producing the atmosphere may be introduced into the heating chamber 11 from a header 139 (see Fig. 4) through branch lines 139*a*, 139*b*, 139*c* and 139*d*. As shown the header 139 is mounted on top of the housing 19 and is connected to a gas supply line 138. A valve 140 may be connected between the header 139 and the line 138 for control purposes. Preferably the branch lines are arranged to be connected to the furnace unit at spaced positions therealong. Thus the branch line 139*a* is connected to the section 149 to be in communication with the heating chamber 11 at the forward end of the furnace. The branch line 139*d* is connected to be in communication with the passageway 43 at the discharge end of the furnace. The branch lines 139*b* and 139*c* are connected to the chamber 11 at positions intermediate the ends thereof.

Frequently atmospheres in a furnace are of a relatively explosive character, particularly when mixed with proper proportions of air. This is particularly true when a hydrogen atmosphere is

employed as is often the case. Accordingly provision is made for preventing the exhaust of this atmosphere into the room in which the heat treating unit is disposed. To this end both a felt seal 141 and a gas curtain 142 are utilized at both ends of the heat treating unit to prevent the leakage of the atmosphere from the furnace. As best shown in Fig. 11 each felt seal 141 comprises an upper portion 143 and a lower portion 144. These portions are retained between flanges 147 and 148 on extensions 149 and 150 respectively of the muffle 65 and project forwardly of the charge end of the furnace 16. The section 149 is formed with a stepped portion 151. With this construction the felts 143 and 144 engage the outer sides of the belts, yet will not provide a friction surface which will interfere with the movement of the belts. The upper felt rests on the top portion of the upper belt 53. In the event of distortion of the strip so that the belt is moved upwardly slightly the end of the felt 143 will be forced into the recess defined by the stepped portion 151 at the top of the extension 149. The weight of the belts 53 and 54 normally forces the extreme upper end of the felt 144 into the recess defined by the stepped portion 151. One position of the felts during operation of the heat treating unit is shown in Fig. 11.

One flame or gas curtain 142 is mounted at the end of the extension 150 and the other is mounted at the end of an extension 156 of the cooling chamber 12. In general the flame curtain comprises spaced tubular members 153 having a plurality of ports 157 and closed at one end. At opposite ends the tubular members 153 are held in assembled relation by suitable brackets 154, which are attached to the frameworks 76 and 48 respectively. Gas is supplied to the tubular members 153 by a suitable connection, not shown. During the operation of the heat treating unit the gas curtain burns continually and thus burns any gas such as hydrogen which escapes or leaks from the furnace. By having both the felt seal 141 and the gas curtain 142 it will be seen that effectively no furnace atmosphere can escape into the room adjacent the furnace.

As an additional safeguard to operating personnel of the heat treating unit conventional blow-out ports 161 are provided adjacent the charge and discharge ends of the furnace 16. In this instance the blow-out port 161 at the charge end of the furnace is formed in the section 149 between the felt seal 141 and the charge end of the furnace 16 (see Fig. 5) and the other blow-out port 161 is located in the first section 40 of the cooling chamber 12 (see Fig. 6).

The operation of the above furnace is readily apparent but may be summarized briefly as follows: The strip of bimetal is placed on the table formed by the belt 54 at the charge end of the heat treating unit. As soon as the belt 54 carries the bimetal forward a sufficient distance the bimetal is gripped securely between the two belts 53 and 54 and is advanced first through the heating chamber 11 and then through the cooling chamber 12. As the bimetal heats up in the heating chamber 11 it tends to distort. This distortion of the bimetal causes the adjacent portions of the belts 53 and 54 to spread apart. The distance which the belts may be spread however is limited in this instance by the top 136 and bottom 63 of the muffle 65. In effect the deflection movement of the strip is limited. When the temperature in the heating chamber 11 goes above the critical temperature of the bimetal strip, the forces causing the distortion are at a minimum and the weight of the upper belt itself is probably sufficient to limit the distorting movement of the bimetal strip. However when the bimetal strip is cooled from the high temperature through the critical temperature to a low temperature in passing through the cooling chamber so that it can be readily handled, the bimetal strip is again distorted. This distortion of the strip is limited in a similar manner as described by the above tops and bottoms of the inner tubular members 41 defining the cooling chamber. As the temperature of the cooling chamber 12 approaches relatively low values the distortion of the bimetal strip decreases and when the bimetal strip is discharged from the discharge end of the heat treating unit the bimetal is a relatively flat piece of material that is ready for the cold rolling process.

This construction is adaptable for other types of material besides bimetal. The construction described herein may be operated by one person. One of the important advantages of this furnace construction is that the cost of handling bimetal is greatly decreased and consequently the per unit cost of bimetal is greatly reduced.

While I have shown one embodiment of my invention I do not wish to be limited thereto since many modifications may be made and I therefore contemplate by the claims to cover such modifications as fall within the true spirit and scope of my invention.

I claim:

1. In a furnace for annealing a bimetal and the like strip material that distorts on heating, the combination of a heating chamber, a pair of opposed flexible belts having movable portions disposed in said chamber and spaced apart to receive a strip of said material therebetween and convey the same through said heating chamber, and means associated with said belts and disposed above and below said movable belt portions capable of engaging said belts at an infinite number of points along the length of said heating chamber upon distortion of said strip material to hold said belts in a predetermined spaced relation to limit warpage of said strip as it passes through said heating chamber.

2. In a heat treating unit for annealing bimetal and the like strip material that distorts on heating, the combination of a furnace having a heating chamber therein, a first endless flexible metal belt having a portion extending through said heating chamber, means on the outside of said chamber for mounting and driving said belt, a second endless flexible belt having a portion extending through the heating chamber adjacent said portion of the first endless belt to define gripping means to secure a strip of material and advance it through the heating chamber, means on the outside of said chamber for mounting and driving said second belt, and means encasing said portions of the endless belt in the heating chamber to guide the belts, said last mentioned means being continuous in extent throughout said heating chamber and capable of engaging said belts at an infinite number of points therealong and being so dimensioned to limit the separation of said belts to a predetermined amount upon distortion of the strip as the latter advances through the heating chamber.

3. In a heat treating furnace unit for bimetal and the like strip material that distorts on heating, the combination of a heating chamber, a cooling chamber, a pair of flexible endless metallic belts having portions in said heating and

cooling chambers in opposed relation to define a gripping means for advancing a strip of said material through the heating and cooling chambers respectively, and rigid means extending for at least the length of said heating chamber encasing said portions and forming a guide for said portions for limiting at any point therealong relative displacement of said portions away from each other whereby to limit the distortion of said strip of material.

4. The combination recited in claim 3 including means for continuously applying a predetermined tension in each of said belts.

5. The combination recited in claim 3 with manual means for simultaneously adjusting the tension in both belts.

6. In a heat treating furnace unit for bimetal and the like material that distorts on heating, the combination of a heating chamber, a cooling chamber, a pair of flexible endless metallic belts having portions in said heating and cooling chamber in opposed relation to define a gripping means for advancing a strip of material through the heating and cooling chambers respectively, means for continuously applying a predetermined tension to said belts, manual means for simultaneously adjusting said last mentioned means, and rigid means extending throughout the length of said furnace unit for completely encasing said portions thereby forming a guide for said portions and limiting at any point therealong relative displacement of the belts away from each other to limit the distortion of said strip.

7. In a heat treating furnace unit for bimetal and the like strip material, the combination of a furnace having an elongated heating chamber, a muffle extending through said chamber having a passageway therethrough defined by top and bottom surfaces in closely spaced relation, an elongated cooling chamber in alinement with said passageway defined in part by top and bottom surfaces in closely spaced relation and forming a continuation of the top and bottom surfaces of the muffle, a pair of flexible endless belts having portions extending through said passageway and said chamber in adjacent relation defining opposed gripping surfaces for holding a strip of material, pulley means on the outside of said heating chamber and said cooling chamber for mounting said belts, and driving means for driving said pulley means to advance said gripping surfaces successively through the heating chamber and the cooling chamber, said top and bottom surfaces defining continuous restraining means engageable with said belts respectively to limit the distortion of said strip as it passes through the heating and cooling chambers.

8. The combination recited in claim 7 in which a portion of the muffle is perforated.

9. In a heat treating unit for bimetal and the like material, the combination of a treating chamber having openings at opposite ends and adapted to contain an atmosphere, a pair of endless belts having portions movable through said chamber in overlying relation to define top and bottom gripping portions for advancing a strip of material through said chamber, tubular means encasing substantial length of said portions of the belts defining a guide for said portions of the belts, said tubular means defining continuous restraining means for limiting distortion of said strip as it passes through said chamber, and resilient felt seal means mounted on said tubular means to be engageable with the top and bottom portions of the belts respectively to minimize leakage of atmosphere through said openings for any relative position of the belts due to distortion of the strip.

10. The combination recited in claim 9 in which a gas curtain is in spaced relation with each of said felt seal means and together with said felt means effectively prevents leakage of furnace atmosphere to the atmosphere surrounding the heat treating unit.

11. The combination recited in claim 9 in which the felt seal means have ends projecting inwardly of the top and bottom portions of the tubular means to engage the top and bottom portions of the belts respectively and in which the top and bottom portions of the tubular means are formed with recesses to receive the end portions of the felt seals when the belts are in side by side sliding movement with the top or bottom portions of the tubular means respectively to provide substantially friction free surfaces for said portions of the belts.

12. In a furnace for annealing relatively short lengths of strip material such as a bimetallic material that distorts when subjected to temperature changes, the combination of a chamber for causing a substantial change in temperature of said strip material when passing therethrough, a pair of opposed flexible belts having movable portions disposed in said chamber and spaced apart to receive a strip of said material therebetween and convey the same through said chamber, and means associated with said belts extending continuously through said chamber and disposed above and below said movable belt portions to engage said belts upon distortion of said strip material at an infinite number of points therealong to hold said belts in a predetermined spaced relation to limit distortion of said strip as it passes through said chamber.

13. The combination recited in claim 12 in which the flexible belts permit air circulation therethrough.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
890,252	Thompson	June 9, 1908
1,319,085	Jacobson	Oct. 21, 1919
1,367,049	Jackman et al.	Feb. 1, 1921
1,714,040	Naugle et al.	May 21, 1929
1,753,828	Greer et al.	Apr. 8, 1930
2,061,910	Kingston	Nov. 24, 1936
2,101,065	Hayes	Dec. 7, 1937
2,237,966	Koehring	Apr. 8, 1941
2,319,300	Cook	May 18, 1943