May 27, 1930. A. S. PHELPS 1,760,169

PROCESS OF MANUFACTURING SPRINGS

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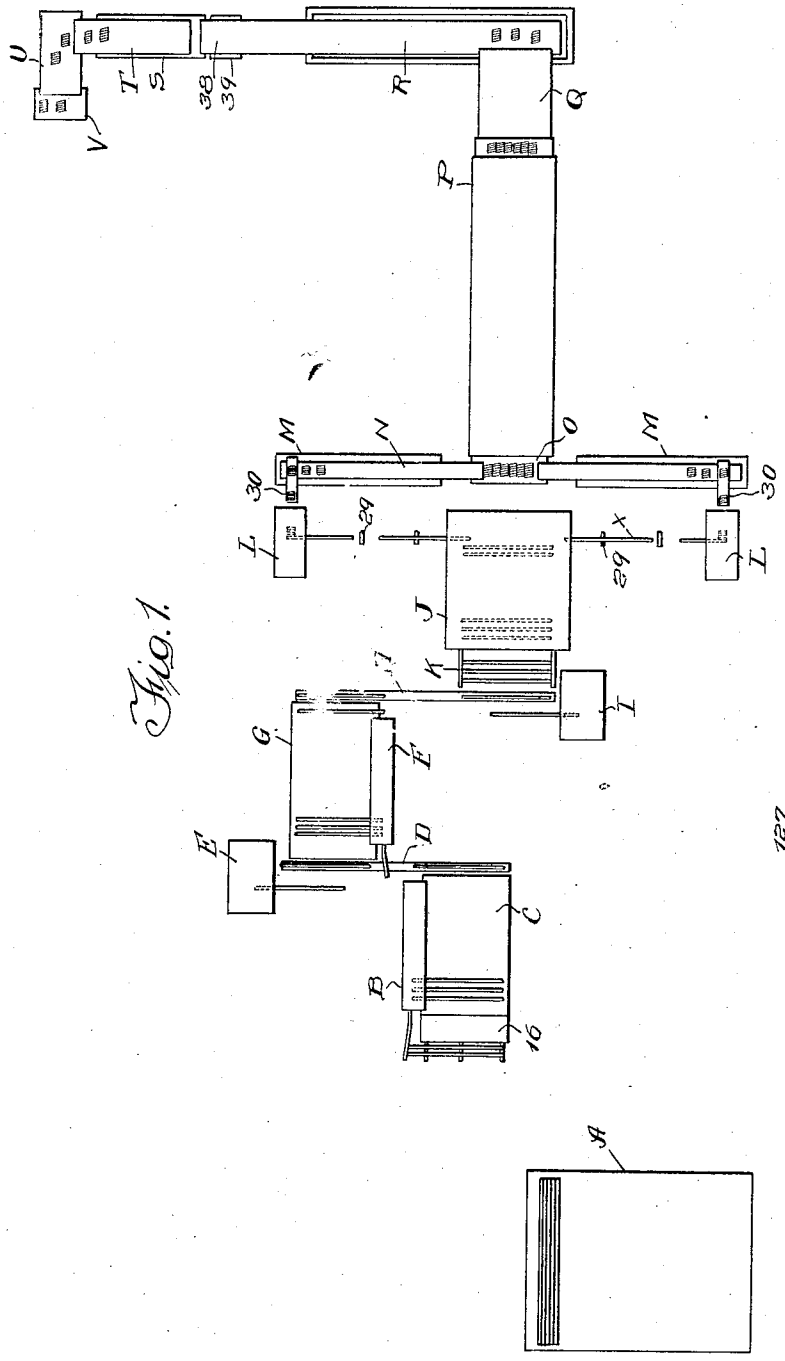


Fig. 1.

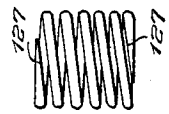


Fig. 2.

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Fig. 4.

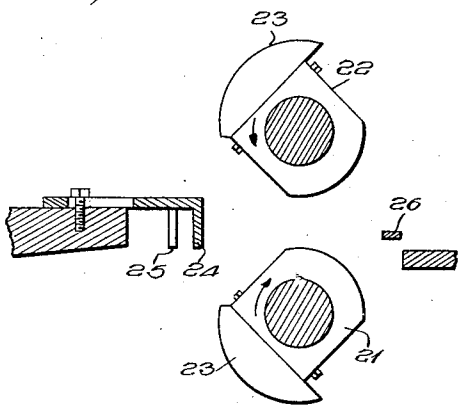


Fig. 3.

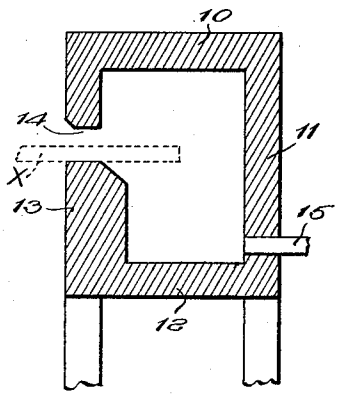


Fig. 5.

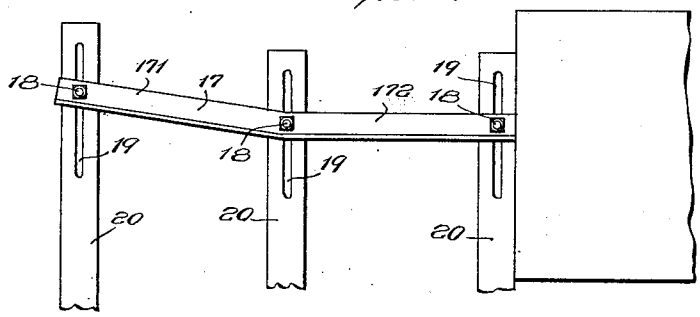


Fig. 6.

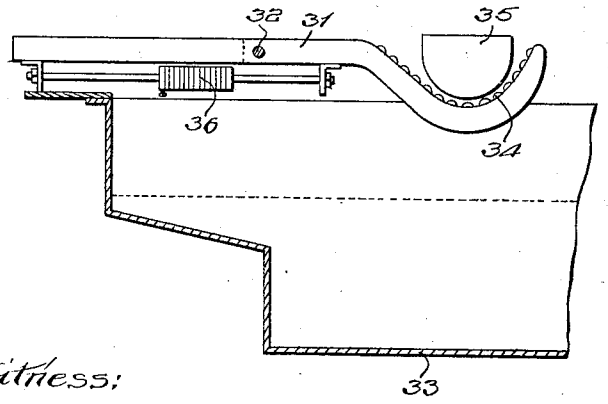


Fig. 7.

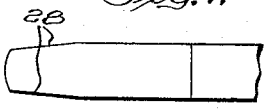
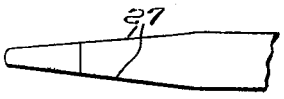


Fig. 8.



Witness:

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UNITED STATES PATENT OFFICE

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PROCESS OF MANUFACTURING SPRINGS

Application filed November 5, 1928. Serial No. 317,135.

This invention relates to improvements in process of manufacturing springs.

Heretofore, in the manufacture of springs and more particularly heavy coil springs, such as used in railway draft gears and on railway trucks, it has been customary to place the ends of a number of bars or rods all at one time in a furnace, and heat all of them until the operator judges that the same are of the proper temperature for working. The bars are then withdrawn by the operator, one at a time, from the furnace and the heated ends subjected to several passes in a tapering machine until the ends are properly tapered, so as to obtain the necessary flat end for the spring when coiled. After the first tapering operation of the bars, the operator then turns the bars end for end and inserts the opposite or cold ends thereof in the furnace, whereupon the group of bars is again heated. When the operator judges that the second set of ends of the group has reached the proper temperature, they are again withdrawn, one at a time, and the opposite ends tapered in the same manner as before. The bars, with both ends now tapered, are next taken by the operator and placed in another furnace by him, where they are allowed to become heated throughout, after which the same are taken to a coiling machine by hand and the bars there individually coiled. The coiled springs are next seized by tongs and stripped one at a time from the coiling machine and dipped by hand in a quenching bath. After the quench, the coiled springs are then placed by hand in a draw furnace, either in batches or on an inclined hearth and allowed to roll through.

Many disadvantages are present in the heretofore customary manner of making heavy coiled springs, above outlined (and which has remained practically unchanged for decades). Among the disadvantages are the following. In first placing a group of the bars in a furnace, to heat one set of ends thereof, different bars will be differently heated since they occupy different positions while stationary in the furnace and it is left entirely to the judgment of the operator to determine whether or not all of the ends of the bars have been heated to the necessary degree. Due to the fact that the bars are placed in the furnace by hand, promiscuously, and are withdrawn without regard to the sequence in which the bars were placed in the furnace, it is obvious that unequal heats of the bars will result and lack of uniformity in the texture of the metal in the subsequent forming and coiling operations. These disadvantages occur twice in the process of manufacture, inasmuch as both ends of the bars are processed in the same manner.

A further and very serious disadvantage in the former method of manufacturing springs arises at each tapering operation. The operator, in taking an individual bar from the furnace and subjecting the heated end to the passes in the tapering machine, is then required to completely turn the bar end for end in order to place the opposite cold end of the bar back in the furnace. Not only does this involve an obvious loss of time which, in the aggregate of a day's work is substantial, but the turning of the bar end for end is extremely fatiguing to the operator since the bars are very heavy, frequently weighing as high as sixty-five pounds each and the constant handling of such a weight, with the necessary turning of the bars end for end, so fatigues the operator before the end of a working shift, that his output is materially lessened.

Further, in heating the entire bar previous to coiling the same, the same disadvantages are present in that it is left entirely to the judgment of the operator to determine when the entire bar has been properly heated, with consequent wide variations in the quality of the metal when coiled. After the coiling, the quenching, being carried out by hand, and from the quench the coiled spring placed by hand in the draw furnace, the operators are again called upon for heavy manual efforts, which result in unduly fatiguing these operators.

One object of my invention is to provide a process wherein the springs are substantially automatically handled from the time the raw stock is first started in the process until the completed spring is delivered in a painted or unpainted condition, as desired.

Another object of my invention is to pro-

vide a process of manufacturing springs such that the several steps of the operation are carried out without any turning around end for end of the stock, from the initial step until the coiling is completed, so that where the manual operations are required, the operators may handle a greater quantity in a given time and with less fatigue than heretofore.

Another object of my invention is to provide a process of manufacturing springs, insuring uniform heat treatment of all the stock, to thereby eliminate the usual errors of judgement where dependence has heretofore been placed upon the operators.

Another object of my invention is to provide a process comprising a coordinated series of operations of successively conveying the stock for the springs, in such manner that the stock is never turned end for end and of conveying the stock successively through two end heating furnaces, then to a whole stock heating furnace, thence to a quenching bath, then to a draw furnace, and in such manner that at the intermediate stations where manual manipulation is required, the stock is so presented to the operators that a minimum of effort is required in the handling of the stock.

Another object of my invention is to provide a process for more quickly and uniformly manufacturing springs with a minimum of manual labor and coordinated means for carrying out such process.

Other objects of the invention will more clearly appear from the description and claims hereinafter following.

In the drawings forming a part of this specification, Figure 1 is a schematic or diagrammatic view illustrating the general layout of the several instrumentalities for carrying out my invention. Figure 2 is an elevational view of a coiled spring such as adapted to be made by my invention. Figure 3 is an enlarged vertical sectional view illustrating one of the furnaces for heating the ends of the bars. Figure 4 is a sectional view showing the essential parts of a bar tapering machine. Figure 5 is a plan view of a portion of a feed table for the bars and illustrating more particularly the means for properly positioning the bars to insure uniform treatment of the ends. Figure 6 is a vertical sectional view of one of the automatic quenching means employed in my invention. And Figures 7 and 8 are two elevational views at right angles to each other showing the formation of a tapered end of the bar.

Referring first to Figure 1, A represents conventionallly a storage rack for the rods or bars, as received in the plant. An end heating furnace is indicated conventionally at B, adjacent which and extending lengthwise thereof is a chain conveyor C. At the right hand end of the chain conveyor C, as viewed in Figure 1, is indicated conventionally a sprocket chain endwise conveyor D, opposite the end of which is indicated conventionally a tapering machine E. A second end heating furnace is indicated conventionally at F and lengthwise of which is disposed a second chain conveyor G. Adjacent the delivery end of the chain conveyor G is a second sprocket endwise conveyor H, opposite the end of which is located a second tapering machine I. A third bar heating furnace is indicated conventionally at J and through which operates a walking beam conveyor K. Preferably on opposite sides of the bar heating furnace J are two coiling machines L—L, indicated conventionally. Opposite each of the coiling machines L, is an oil quench bath M, the baths M being alined and through each of which extends a conveyor N adapted to deliver the coils from either side onto a slat belt conveyor O which passes through an elongated draw furnace P. At the delivery end of the draw furnace P is another conveyor Q arranged to deliver the coiled springs onto a cooling conveyor R moving at right angles to the conveyor Q. The conveyor R is in turn alined with a paint tank S within which works a conveyor T arranged to deliver the articles onto a chute U, the latter in turn delivering the articles into boxes or onto a truck, indicated conventionally at V.

The two end heating furnaces B and F are preferably of like construction, a section of one furnace being indicated in Figure 3. As there shown, each said furnace has a top wall 10, back wall 11, bottom wall 12 and front wall 13, the latter having a longitudinally extending mouth or slot 14 therein through which the ends of the bars X are adapted to pass, as the bars are advanced bodily in a broadside manner, as hereinafter described. The furnaces B and F may be of any suitable or well known type but are preferably heated by gas under pressure, one gas inlet being indicated at 15. Furthermore, in carrying out my invention, each of the furnaces B and F will be under pyrometer control so as to accurately regulate the temperature within the furnace and prevent under- or over-heating. In this connection, it will be understood that different size bars being used will require different quantities of heat in the furnaces but by employing pyrometer control, the quantity and degree of heat are automatically regulated, thus eliminating the haphazard judgment of an operator.

In carrying out my process, one operator takes the stock from the rack and places the bars one at a time on an inclined table 16, located at the forward end of the conveyor C. To insure heating of equal sections of the bars X, as they are passed through the furnace B, the bars are automatically gauged as

the same feed or roll down the inclined table 16, this being accomplished by a gauge bar best illustrated in Figure 5. Said gauge bar 17 preferably comprises a section of angle having an inclined portion 171 and a straight portion 172. Said angle is adjustable laterally with reference to the furnace and conveyor by any suitable means such as the bolts 18 and slots 19, the latter being provided in horizontal supporting plates 20.

As the bars are placed on the table at its upper end, which corresponds to the lefthand end of the gauge bar as shown in Figure 5 (the table being omitted) all the ends thereof which are to be heated are placed against the inclined section 171 of the gauge bar and hence as the bars feed or roll down the incline, they are automatically cammed or wedged over until all ends are brought in line with the straight section 172 of the gauge bar and hence the bars X are delivered uniformly onto the chain conveyor C and an equal length of each bar X thereby projects into the furnace B, as the bars are advanced progressively therethrough and heated progressively thereby. By making the gauge bar 17 adjustable transverse to the furnace B, the length of the parts of the bars X projecting into the furnace may be varied in accordance with the size of the stock and the portion of the bar which is to be subsequently tapered. As will be understood, the bars X are advanced through the furnace B at a very slow rate so as to allow the projecting ends of the bars to be gradually heated without danger of burning and, due to the automatic pyrometer control, no injury to the bars from overheating or underheating can occur.

The bars, with one set of ends heated, are delivered very slowly one at a time from the chain conveyor C to the endwise sprocket conveyor D and the bars X are then conveyed endwise without turning, until presented to the tapering machine E. The operator at the tapering machine E (who stands to the left of the conveyor D, in front of the tapering machine E) then seizes the bar and subjects it to several passes in the tapering machine. The latter may be of any well known form, certain details of which are illustrated in Figure 4. Preferably, the tapering machine includes two rotating partial rolls 21 and 22 having eccentrically disposed dies 23—23.

Adjacent the rolls are two gauge stops 24 and 25 and on the opposite side of the rolls, that is, the side adjacent the operator, is a support indicated at 26. The operator first places the heated end of the bar against the stop 24 whereupon the rolls 21 and 22, rotating in the direction of the arrows, engage the bar and force the same toward the right as viewed in Figure 4 and simultaneously tapering the end of the bar on the top and bottom sides to provide the beveled surfaces 27—27, shown in Figure 8. The bar is then subjected to a lateral squeeze between reciprocating dies, not shown, to thereby taper the sides of the bar and provide the surfaces 28—28 shown in Figure 7. The operations are then repeated by the operator again placing the bar between the rolls, against the stop 25, whereupon the taper of the surfaces 27 will be further extended. Again the bar is placed between the squeezing dies to finish the lateral taper 28—28 and a final pass is had between the rolls 21 and 22, to insure the proper finish as to size.

The operator at the tapering machine E next, without substantially shifting his position and without turning the bar X, places it upon the chain conveyor G which is preferably similarly provided with end gauging means such as previously described in connection with the conveyor C. The bars X are then advanced automatically by the conveyor G with the opposite ends of the bars within the furnace F, so that said opposite ends are progressively heated in a similar manner, it being understood that the chain conveyor G moves very slowly, as in the case of the conveyor C. The bars, with the opposite ends heated, are next delivered slowly, one at a time, to the sprocket endwise conveyor H and presented to the second tapering machine I where the operator goes through the same steps as previously described, to taper the opposite ends of the bars.

The operator at the tapering machine I again, without substantially shifting his position and without turning the bars, places the latter successively on the walking beam conveyor K, by which the bars are advanced slowly through the bar heating furnace J. Said furnace J is also of the gas heated type and under double pyrometer control, one control being at the admission end and the other near the delivery end, the double pyrometer control being employed because of the greater amount of metal being heated and the necessity of maintaining uniform temperature throughout the entire length of the furnace J.

Near its delivery end, the furnace J is preferably provided with side doors on each side thereof, so that the bars may be taken from the furnace at either side, to thus coordinate the coiling of the springs with the tapering operations, it being understood that the coiling operation will require considerably more time than a tapering operation. As the bars X reach the delivery end of the furnace J, they are taken therefrom one at a time by either of the operators located on opposite sides thereof, the operators obviously using tongs to handle the same. The bars are then slid over any suitable rollers or table indicated conventionally at 29, where the advance ends of the bars are locked to the mandrel of the respective coiling machine L. The coiling

machines may be of any well known or desired construction and, per se, form no part of the invention. When the bar has been coiled, the coiled spring is then stripped from the mandrel and delivered to an automatic dipper 30, there being one such dipper for each coiling machine L. The details of each dipper 30 are indicated best in Figure 6 and, as there shown, the dipper comprises a lever arrangement 31 pivoted at 32 above the tank 33 of the oil bath. The lever arrangement 31 is provided at one end with a rack basket 34 in general alinement with the mandrel of the coiling machine so that the coils are slipped endwise onto the basket 34 and stopped by a gauge plate 35.

To the underside of the lever arrangement 31 is applied an adjustable weight 36 so that when the spring is delivered to the basket 34 it will automatically overbalance the dipper and tilt the latter, thus quickly and completely immersing the spring in oil for quenching and finally permitting it to roll off the basket 34 onto the quench tank conveyor. As soon as the coiled spring has rolled from the basket, the dipper lever will immediately return to its normal position, as shown in Figure 6. By adjusting the weight 36 relative to the pivot 32, the dipper is adapted for springs of different sizes and weights. Each conveyor M works within a corresponding tank 33 and rises therefrom so as to ultimately roll the coiled spring onto the slat belt type conveyor O, it being evident that the coiled springs are delivered from both sides of the line onto said conveyor O.

The springs are then conveyed through the draw furnace P which may be of any well known or desired construction, said furnace P being also under double pyrometer automatic control as to heat. After passing through the furnace P, the coiled springs are dropped from the delivery end of the conveyor O onto the lower conveyor Q and from the latter are dropped onto the conveyor R which moves at right angles to the conveyor Q. Preferably, the conveyor R (which is a cooling conveyor) will be located outside of the factory building and the same rises upwardly to its delivery end, indicated at 38. At this point, the springs may be dropped into a collecting box or bin 39 in those instances when the springs are not to be painted. When, however, the springs are to be painted, a chute is interposed between the upper end of the conveyor R and the tank S, so as to drop the springs into the paint tank S, whereupon the springs are dipped in paint and coated. From the bottom of the tank S arises the final conveyor T, of open formation, which lifts the springs to the delivery end of the conveyor T where the springs are then dropped onto the chute U and from the latter delivered into boxes or onto trucks, as indicated conventionally at V.

Referring to Figure 2, a completed spring is there indicated and it will be noted that the ends of the bar are there tapered, as indicated at 127—127, so as to provide flat ends for the springs in order to obtain the desired bearing against followers or other elements of the mechanisms with which the springs are used.

In carrying out my invention, all of the conveyors are operated by either adjustable speed motors or speed regulators so that the several conveyors may be properly synchronized to obtain uniform movement of the articles as the latter are advanced from one place to another. Also, preferably, the operator at the tapering machine E will have an electric control switch for the motor which operates the conveyor C so that the operator may prevent the bars accumulating too rapidly at his station. Similarly, the operator at the tapering machine I will have control of the conveyor G. On account of the furnaces B and F being under pyrometer control, stoppage of the conveyors C or G will not occasion any injury to the articles, as will be understood.

From the foregoing description, it will be seen that all of the operations are automatic except those of tapering and coiling and as to these operations, it is evident that the minimum of effort is required of the respective operators, since at no time is it necessary for the operator to swing the bars end for end or hold them otherwise than parallel to the initial position of the bars when first started. By maintaining automatic heat control throughout the several furnaces, I am enabled to keep the product moving continuously while at the same time insuring uniform heat treatment for all of the articles. Further, the arrangement is such that it is adaptable for bars of different sizes and weights and because of the arrangement of steps and means, a much larger output for a given number of men, for a given amount of time, is obtainable than heretofore possible under any prior known method, this greater efficiency also being accompanied by the certainty of a more uniform and satisfactory product. Stated otherwise, with my improvements a given output per day is obtainable with fewer operators than heretofore, in addition to which the operators are relieved of the excessively fatiguing operations under the former practice.

I have herein shown and described what I now consider the preferred manner of carrying out the invention but I am aware that various changes and modifications may be made without departing from the spirit of the invention. All changes and modifications are contemplated that come within the scope of the claims appended hereto.

I claim:

1. The herein described process of manu-

facturing springs which includes: successively conveying through a furnace a plurality of pieces of the stock, with the pieces arranged transverse to the line of bodily movement of the pieces and heating one set of ends of the pieces; successively conveying the pieces of stock endwise to an operating station as the pieces successively leave the furnace; forming the heated ends of the pieces at said station; then successively conveying through another furnace the pieces of stock with the pieces arranged transverse to the line of bodily movement of the pieces and heating the other set of ends of the pieces; and successively conveying the pieces of stock endwise to a second operating station as the pieces successively leave the second furnace.

2. The herein described process of manufacturing springs which includes the following steps: conveying an end of a piece of stock through a furnace and heating the same; conveying the piece of stock endwise; conveying the opposite end of the piece of stock through a furnace and heating the same; and thereafter conveying the piece of stock endwise.

3. The herein described process of manufacturing springs which includes the following steps: conveying a piece of stock broadside with one end in a furnace while being conveyed; then conveying the piece endwise; forming the heated end; again conveying the piece broadside without turning and with the opposite end in a furnace while being conveyed; conveying the piece endwise; and forming the last heated end.

4. The herein described process of manufacturing springs which includes the following steps: conveying a piece of stock broadside with one end in a furnace while being conveyed; then conveying the piece endwise; forming the heated end; again conveying the piece broadside without turning and with the opposite end in a furnace while being conveyed; conveying the piece endwise; forming the last heated end; then, without turning, conveying the piece broadside through another furnace and heating the entire piece; then transferring the piece endwise to a coiler and there coiling the same.

5. The herein described process of manufacturing springs which includes the following steps: simultaneously advancing one end of a piece of stock through a furnace and heating the same; then conveying the piece to a forming machine; forming the heated end while hot; then simultaneously advancing the other end of the piece through a furnace and heating the same; then conveying the piece to a second forming machine; and forming said second heated end while hot.

6. The herein described process of manufacturing springs which includes the following steps: automatically moving a bar in a broadside manner with one end in a furnace; then automatically conveying the bar endwise and presenting the heated end to a tapering machine; tapering said heated end; then automatically moving the bar in a broadside manner with the opposite end within another furnace; then automatically conveying the bar endwise and presenting said opposite heated end to a second tapering machine; tapering said opposite heated end; then conveying the bar broadside bodily through a third furnace and heating the entire bar; then transferring the bar endwise to a coiling apparatus; coiling the bar; quenching the coiled bar; then automatically conveying the quenched coil to and through a draw furnace.

7. The herein described process of manufacturing springs which includes the following steps: maintaining a plurality of bars always in parallel relation while successively conveying the same through an end heating furnace, thence to a forming machine, then through an end heating furnace, thence to a forming machine, then through a third furnace for heating the entire bar.

8. The herein described process of manufacturing springs which includes the following steps: simultaneously advancing a quantity of pieces of stock through and progressively heating one set of ends of the pieces in a furnace; forming the heated ends of the pieces one at a time as delivered from the furnace; again simultaneously advancing a quantity of pieces through and progressively heating the other set of ends in a second furnace; forming the other heated ends of the pieces one at a time as delivered from said second furnace; then simultaneously advancing and progressively heating, in their entireties, a quantity of the pieces in a third furnace; then coiling the pieces singly as delivered hot from said third furnace; quenching the coiled pieces: and then advancing a quantity of the coiled pieces through a draw furnace.

9. The herein described process of manufacturing springs which includes the following steps: continuously conveying the ends of the bars of stock through a furnace with the bars arranged broadside to the line of movement; conveying the bars endwise in one direction as individually delivered from the furnace; tapering the heated ends, one bar at a time; again continuously conveying the opposite ends of the bars through a furnace with the bars positioned broadside and in the same relative end for end position as before; conveying the bars endwise in the opposite direction as individually delivered from the second furnace; tapering said oppositely heated ends one at a time; again conveying the entire bars through a furnace, the bars being positioned broadside and in the same relative end for end position as before; then individually coiling the bars after delivery

from said third furnace; then quenching the coiled bars; and then drawing the coiled bars.

10. The herein described process of manufacturing coiled springs from bars, which includes the following steps: continuously advancing and consecutively subjecting, always in the same order, the bars first to a heating of one set of ends, then tapering of said set of ends, then heating the opposite set of ends, then tapering said opposite set of ends, then heating the entire bars, then coiling the bars, and coordinating the several heating and tapering steps and the coiling to insure uniform treatment of all the bars.

In witness that I claim the foregoing I have hereunto subscribed my name this twenty-fourth day of October, 1928.

ARTHUR S. PHELPS.