S. W. BALDWIN.

ART OF SPRING MANUFACTURE.

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908,440. Patented Jan. 5, 1909

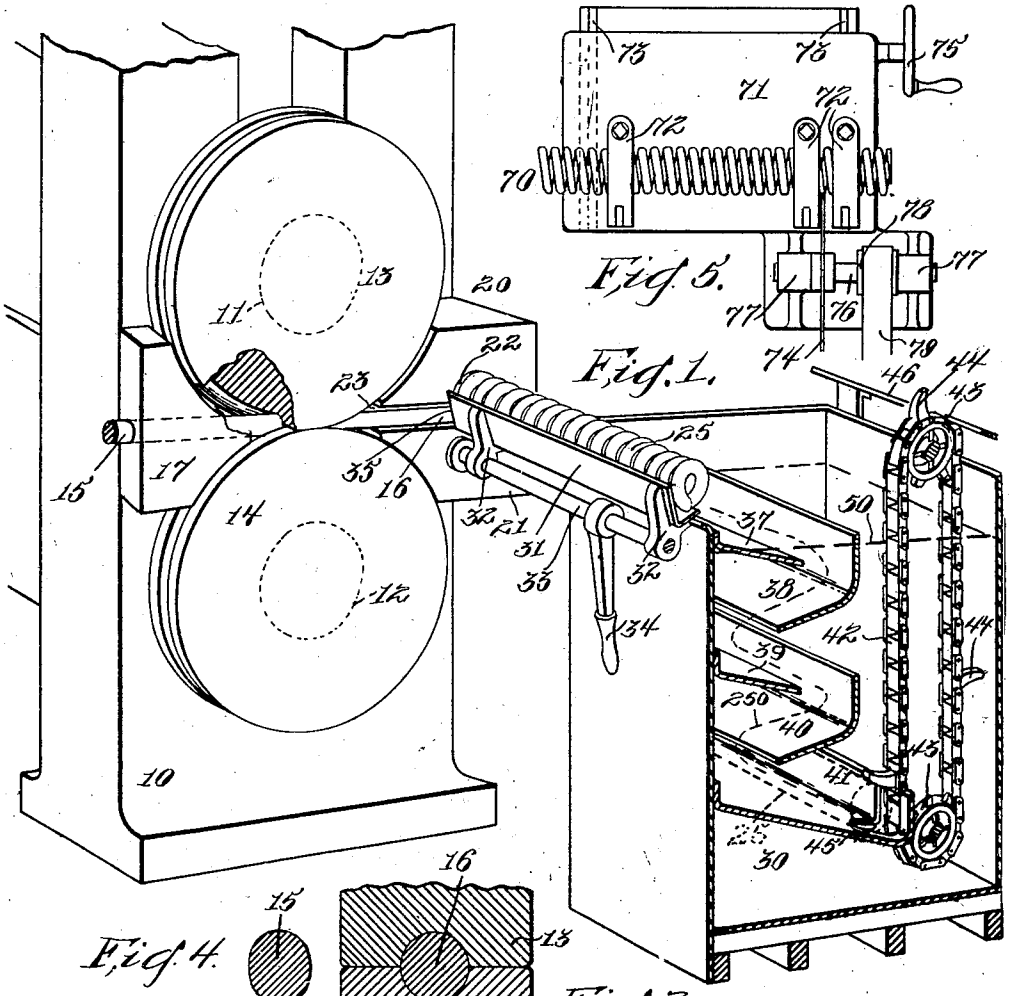


Fig. 1.

Fig. 5.

Fig. 3.

Fig. 4.

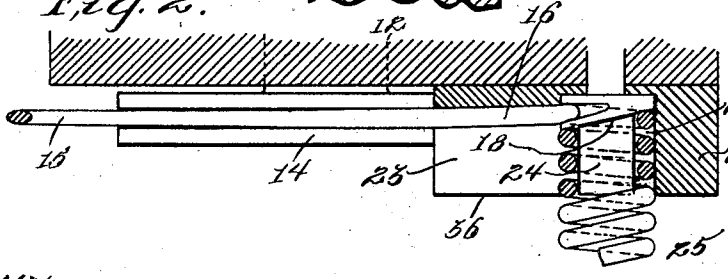


Fig. 2.

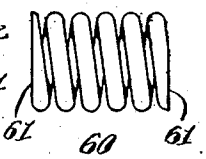


Fig. 6.

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UNITED STATES PATENT OFFICE.

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ART OF SPRING MANUFACTURE.

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Application filed November 5, 1904. Serial No. 231,466.

To all whom it may concern:

Be it known that I, STEPHEN W. BALDWIN, a citizen of the United States, residing in Manhattan borough, city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in the Art of Spring Manufacture, of which the following is a specification.

This invention relates to the art of manufacturing springs, and has for its object to provide a method of making tempered coiled springs and particularly compression springs of short length from long bars or rods.

Compression springs, particularly those employed in railroad cars and locomotives, are made up in short coils having the ends beveled so as to give a square engaging surface at each end of the coil.

The present invention contemplates the production of tempered coiled springs from an ingot or billet by one heat. The billet or ingot being heated to a sufficient degree of temperature to enable it to be passed through a rod or bar rolling mill, passing the same through such mill until a finished bar is delivered therefrom and immediately upon the delivery of the bar, coiling the same into a coil of diameter and pitch corresponding to the completed spring-coil, and then while the bar or coil maintains heat imparted to the metal thereof while in the ingot or billet, hardening or tempering the coil, and then cutting the coil up into short lengths, and in such cutting beveling or chamfering the ends of the coils to give each a square end to engage the abutments in connection with which it will perform its work.

In rolling round bars it is frequently the custom to give the bar alternately an elliptical and a round cross-sectional formation, the last pass, of course, in finishing the bar, giving it its completed round shape. The action of the rolls upon the bar forges it down giving it a compact and finished surface, which compacting and closeness of grain will extend inwardly for a considerable distance, and in some instances may extend throughout the entire bar. If the rolling is done with sufficient rapidity the bar will issue from the finishing pass with heat enough to permit it to be coiled, and if the coiling is also done with sufficient alacrity the coil will maintain enough of the heat given to its metal when in the ingot to permit it to be passed into a bath and hardened.

If the bar is permitted to cool and is then reheated, as for instance for the purpose of tempering or for coiling, the outside of the bar or its outer shell or tube will become of a coarser texture than the bar was when it left the rolls, the expansion of the particles of steel tending to press and yield away from each other leaving minute interspaces which can only be reduced by a forging action, but when the spring fresh from the action of the rolls is thrown into the tempering bath it will in addition to the temper also carry with it the compactness and closeness of grain produced by the rolling operation. And in cooling and reheating there is a certain amount of scale formation produced which will not be present in cases in which the spring is thrown directly or immediately into the bath upon its emergence from the roll, and tempered at the finished rolling mill heat.

The coil may be dropped into a bath and hardened and then tempered, but in many instances the heat remaining in the coil will upon its plunging into the bath be just sufficient to give the proper spring hardness and elasticity without having resort to drawing or tempering the hardness.

Springs which are produced by forcing a hot bar into a coiling device as contradistinguished from wrapping the bar about a mandrel by the rotation of the mandrel to produce the coil, have certain characteristics which are lacking in such latter form of spring manufacture. And owing to the fact that in finishing the bar from its elliptical to its round formation the finishing rolls firmly grip or bite the rod and advance it with a certain amount of irresistible force, such force may be utilized for pushing the bar through a coiling device and the coiling device may be placed contiguous to the rolls to gain the full benefit of the force of advance of the bar, and also to have the bar coiled before the heat has had an opportunity to diminish through contact with the atmosphere.

After the bar has come from the rolls and after it has passed through the coiling device the core is hotter than the walls. The outer surface is smooth and perfect because of the forging action of the walls.

The mass through its whole section is compacted and in this condition it is immediately plunged into the hardening bath. In case the bar or coil is reheated, after rolling, the surface becomes scaled and roughened, and the grain of the steel is raised and made coarse. The walls are hotter than the core and if plunged into the tempering bath in this condition the results are not so good as under the former conditions when the bar or coil is plunged into the bath immediately as it comes from the rolls and not reheated.

The coiling is done at the rolling mill speed and the hardening to spring temper is done at approximately the finished rolling mill heat.

Although the method of my present invention may be carried out in many different ways, yet for the purpose of more clearly illustrating the nature of the invention, the drawings accompanying and forming a part of this specification illustrate mechanism which may be employed in practicing the present invention.

Figure 1 shows a perspective view of the ends of a pair of rolling mill rolls, a coiling device and a hardening bath tank shown in cross-section, which device may be used in the carrying out of my improved method. Fig. 2 is a plan view of one of the rolls and a horizontal section of the coiling device shown in Fig. 1. Fig. 3 is a cross-section through the working periphery of the rolls and through the bar, such view being larger than that shown in Fig. 1. Fig. 4 is a cross-section of the bar before it has entered the finishing pass illustrated in Fig. 3. Fig. 5 is a plan view of a device for cutting or sawing the coil into spring lengths, and Fig. 6 is a side view of a spring which may be the product of the present method. This shows a compression spring but it will be apparent that this method is equally adapted to the production of extension springs. Many of the parts in this drawing are out of proportion to other parts and certain parts are shown more diagrammatically than is good workshop practice, yet the discrepancies will be evident to those skilled in the art.

In the drawings in Fig. 1 the end frame 10 of a rod rolling mill is illustrated, the journals 11, 12 of the rolls having thereon wheels or supplemental rolls 13, 14 which will have between them the finishing pass. The bar 15 as it is fed to the rolls is elliptical in cross-section, as illustrated in Fig. 4, and is reduced to a round rod 16, as illustrated in Fig. 3, in the finishing pass. There will be provided at the back of the rolls a guide 17 having an elliptical formation to prevent the bar 15 from turning over in the rolls. The gripping action of the rolls in reducing the rod from an elliptical to a circular formation is utilized to force the rod into a coil forming device, designated in a general way by 20, and which as shown as comprising a block 21 having a cylindrical chamber 22 within it, and an opening 23 leading from the delivery point of the rolls to said chamber. The chamber 22 may have within it an inner forming member comprising a mandrel 24 and a spirally disposed shoulder 18 adapted to give the proper pitch to the spring. After the end of the bar has passed out of the bite of the rolls there will remain an uncoiled portion or end of the bar which may be removed through the opening 23 by drawing the coil on a line with its axis. After the bar has been formed into a coil, designated in a general way by 25, it will have sufficient heat within to permit it to be subjected to a hardening or tempering process, as for instance by immersion in a bath of oil. A tank, designated in a general way by 30, is shown located adjacent to the coiling device, and the coil 25 may be received in a trough 31 supported by hangers 32 upon the shaft 33 supported in some convenient bearings. The trough may have a certain amount of reciprocatory movement upon the shaft and be actuated or operated by a handle 34. The trough will normally be placed with its end 35 against the face 36 of the block 21 and after the end of the bar has run out from between the rolls the trough may be drawn away from the coiling device a distance sufficient to withdraw the end of the coil and the uncoiled end of the bar out of the coiling device when the trough may be rocked upon its shaft and the coil dropped into the tank. The tank is shown as provided with a number of oppositely disposed inclined faces or shelves 37, 38, 39 and 40, and a bottom shelf 41 upon which the coil finally drops, where it may be engaged by a carrying device, in the present instance comprising a chain 42 running over sprocket wheels 43 driven by some suitable means not shown and which chain or endless belt carries engaging member 44 passing through openings 45 in the shelf 41 so that the spring after it has fallen upon the shelf 41 and run to its lowest point, the spring 25 being here indicated by dotted lines and its course by the dotted line 250, will be picked up by the fingers or engaging members 44 and carried out of the bath and to the top of the tank and deposited upon a shelf 46 where it may be run to any desired point either into another bath or to the saw table. The tank is shown as partly filled with a bath 50 which may be oil, if it is desired to oil harden the springs.

For use in many employments and particularly under cars the spring coil will be cut into short lengths, one of which is illustrated in Fig. 6 wherein the coil 60 is shown as having beveled ends 61 to form square faces for the engagement of the parts which press upon and support the spring. In Fig. 5 a device is illustrated for severing the long coil

into short lengths, and in such severance to place the proper bevel upon the spring ends. A coil designated as 70 is shown as resting upon a table 71 and held thereto by suitable securing means 72. The table in the present instance is shown as mounted upon ways 73 and may be moved toward the saw 74 by means of a hand wheel 75. The saw is shown as fast upon the shaft 76 supported by bearings 77 and driven by means of a pulley 78 and belt 79 from some suitable source of power. The saw will be rotated at a sufficiently high rate of speed to do the proper cutting upon the cold hardened bar in the coil, and as the same is fed to the saw in a line coinciding with the plane of the saw blade, and with the axis of the coil transverse to such plane, the cutting will produce spring lengths having the end faces of the end convolutions upon planes transverse to the axis of the coil.

In some instances the hardening of the coil will not be uniform throughout the entire cross-sectional area of the bar, that is it will be harder at or adjacent to the surface than it will be upon the interior. This is desirable in many instances and assuming that the quenching action of the bath was sufficient to cause a hardness down to a given depth from the surface and the spring lengths having their ends beveled before being plunged into such bath, the hardening action of the bath then would extend completely through the beveled ends making them unduly brittle as compared with the rest of the spring, but by sawing the coil into lengths after it has been hardened a greater uniformity of hardness in the ends will be maintained.

Applicant in the specification and claim when employing the word "tempering" does not necessarily mean the technical tempering of metal, that is drawing the hardness or tempering the same down to the desired hardness, but rather means in the common use of the word treating a piece of metal which has been brought to the proper degree of hardness to to give it the desirable elasticity, whether such hardness has been produced at one operation or whether it has been produced by over-hardening, and then tempering or modifying such hardness, and following such use of the word has said that the springs are tempered directly from the coiling device by being plunged into the bath.

By this present method time is saved, the amount of handling is reduced, the expense of second heating done away with, and not only are these economies had, but a superior article is produced owing to the absence of scale being raised by cooling and reheating, and also by the roll-finish of the surface being maintained and not opened by reheating.

The term "billet" as used herein has a general application to the mass of metal to be reduced to the bar or rod and without reference to any peculiar technical distinction from other masses of metal known by different names. And likewise the word "bar" as used in the claim is used literally and not technically.

When it is stated that the coil is tempered at the billet heat it, of course, means the heat imparted to the metal in the coil when such metal was in the billet, and not to the temperature of the billet which is in excess of the temperature of the metal after it has left the coiling device.

In carrying out my improvement in spring-making there is a direct co-action between the rod-forming driving rolls and the coiling die in such manner that the bite of the rolls upon the rod incident to the reshaping of the rod immediately as driven forward into the coiling die operates to create a sufficient driving power for successfully forcing the perfectly formed bar into the die, and by this means, it will be observed, the resistance of the coiling die is overcome by driving power created not by the mere impingement of frictional driving rolls upon a finished rod, but by the resistance due to the transformation of the rod from one sectional form into another, the latter form being the one which it is required the rod shall have in the finished spring-coil. In this connection it will be remembered that owing to the large sizes of the rods required in many cases as compared with the diameter of the finished coil the resistance of the coiling die is relatively large, and that in the rolling of rods the subjection of a heated rod of circular cross-section to the heavy roll-pressure which would be required for properly feeding a fully formed rod to the coiling die would, of itself, operate to impair or destroy the required true and circular form of the rod as this passes into the die. By means of my present improvements, however, I so combine together into one operation the rod-shaping and rod-coiling that each co-acts directly and immediately with the other in the production of two concurrent results which include the reshaping of the preliminarily formed bar into its final form and the coiling of the finished bar through the power used in the reshaping of the preliminarily formed bar. Thus the two results required are simultaneously and rapidly accomplished on the same bar, with the exception of course that a very short piece, extending across the short distance between the bite of the rolls and the coiling die, remains, this piece, however, being so small that it may in practice be neglected. There is a concurrence in action as regards the bar in the shaping and coiling.

The changing of the bar from an oval cross-section to a round cross-section is a heat producing operation, as is also the coiling but in most instances to a less degree.

And these when properly carried out, as herein contemplated, will conserve the heat in the bar for the subsequent hardening.

Assuming that the outer shell or zone of the bar is colder than the inner zone or core, upon the quenching of the bar the outer zone which was under contractile stress, cools down upon the core which was normally under expansive stress or pressure and upon the completion of cooling the inter-pressure of the zones will not be so great as where the shell is the hotter or where a uniform temperature exists throughout the bar, and when the bar so hardened is in the form of a coiled spring the torsion in the bar incident to the compression and expansion of such spring will be more readily accommodated by the bar, since there will be a condition existing within the bar which will permit the expansion in the torsion and the contraction in the returning independently of the core which, being at the neutral axis, will not feel the expansive or stretching action incident to the torsion to the extent it is felt in the shell or outer zone, thus producing a spring which will not break as readily under the torsional stress as when the shell has a greater pinching action upon the core when hardened.

Having thus described my invention, I claim:

The art which consists in heating a billet, rolling the billet into a bar, forming the said bar into a coil, and hardening the said coil at the heat remaining after the rolling and cooling.

Signed at Nos. 9 to 15 Murray street, New York, N. Y., this 31st day of October 1904.

STEPHEN W. BALDWIN.

Witnesses:
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