No. 716,680. Patented Dec. 23, 1902.

F. H. DANIELS, C. S. MARSHALL & J. O. E. TROTZ.

MANUFACTURE OF SPRINGS.

(Application filed Feb. 10, 1902.)

(No Model.) 3 Sheets—Sheet 1.

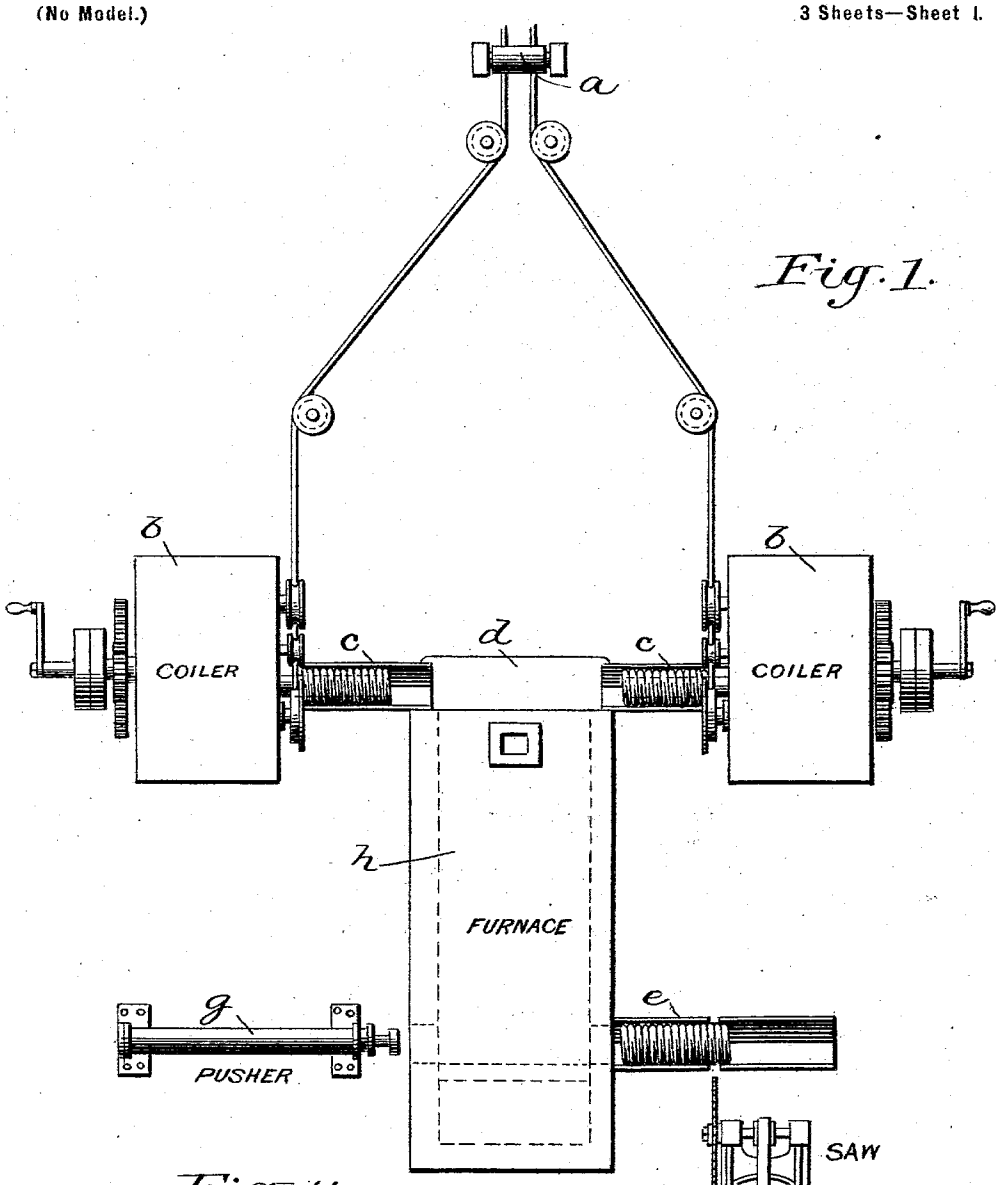
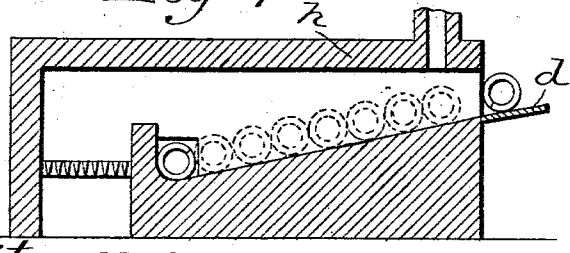


Fig. 1.

Fig. 4.



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Fig. 2.

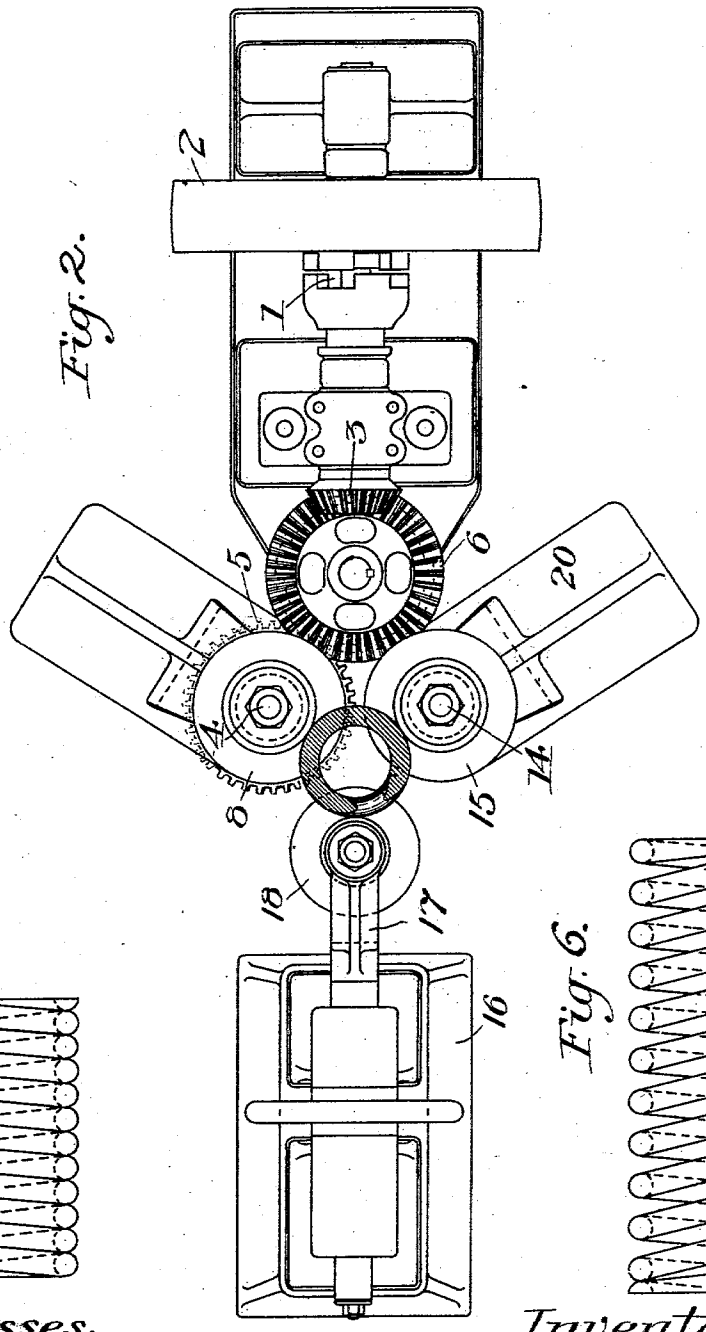


Fig. 5.

Fig. 6.

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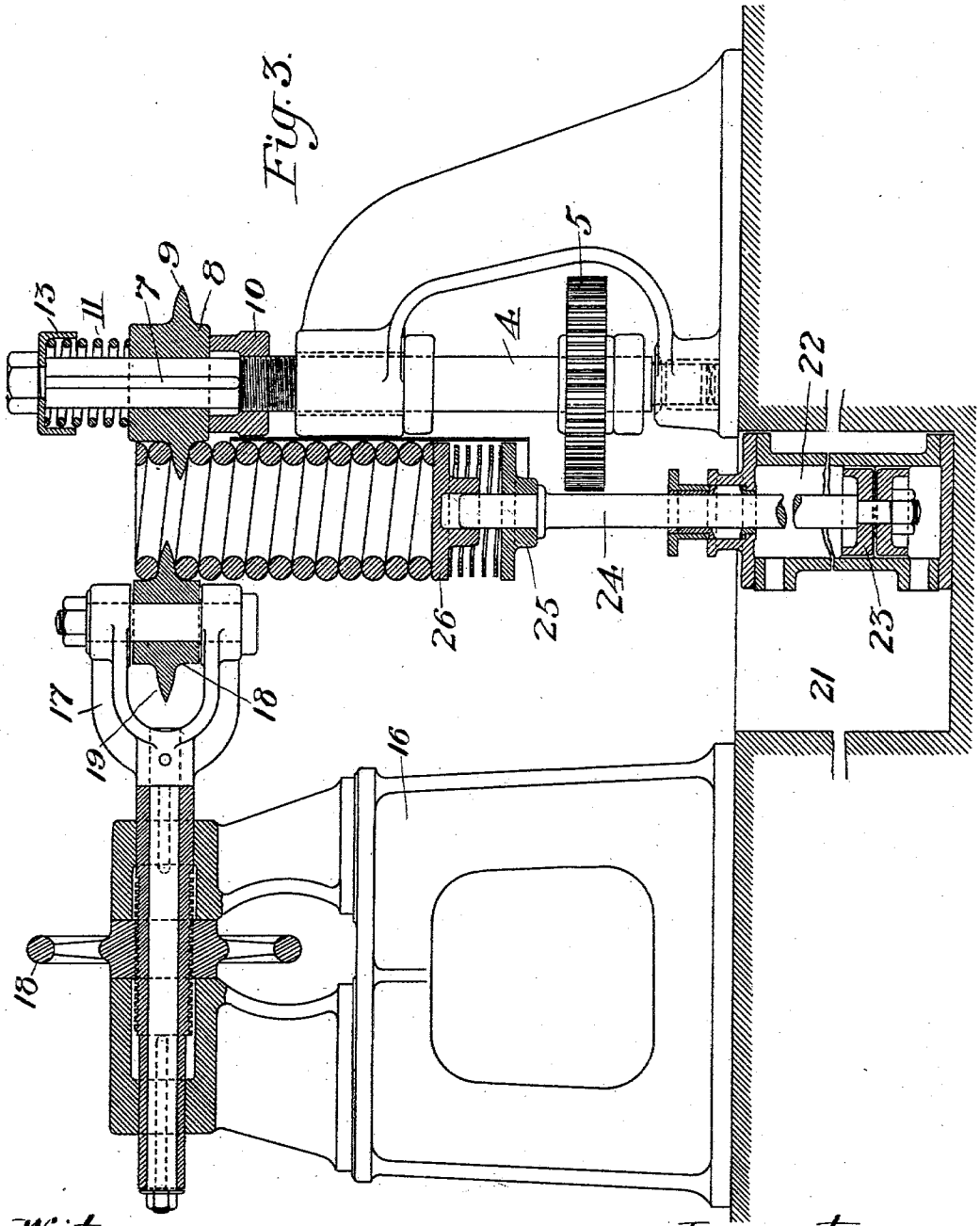
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Fig. 3.



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UNITED STATES PATENT OFFICE.

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MANUFACTURE OF SPRINGS.

SPECIFICATION forming part of Letters Patent No. 716,680, dated December 23, 1902.

Application filed February 10, 1902. Serial No. 93,446. (No model.)

To all whom it may concern:

Be it known that we, FRED H. DANIELS and CLINTON S. MARSHALL, citizens of the United States, and JOHAN O. E. TROTZ, a subject of the King of Sweden and Norway, all residing at Worcester, county of Worcester, and State of Massachusetts, have invented certain new and useful Improvements in the Manufacture of Springs; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention is more particularly concerned with the manufacture of open-coil compression-springs, and especially with such heavier varieties as are employed in railroad-cars and are designed to stand up vertically with their ends resting on flat-surface seats provided for them in the trucks and support the weight of the car-bodies on their upper ends. Heretofore such springs have usually been made by heating pieces of rod or wire of a length just sufficient to make one spring each, each piece having been previously beveled or chamfered at its ends in a special machine, so that the coil would be left with square flat ends for the spring to stand on. These pieces were withdrawn from the heating-furnace by hand and delivered to a conveniently-located coiling-machine, by which they were wound with open windings or convolutions of the pitch required in the completed springs, after which they were hardened and tempered in the usual way. The present invention is a departure from this the usual method, having in view particularly to expedite and cheapen the process by dispensing with the preliminary beveling of the ends of the rods or wire and at the same time to insure a better squaring of the ends of the coil than has heretofore been possible, except by a careful and expensive finishing off of the flat surfaces left by the beveled ends of the rods or wire composing the coils. Incidentally the invention contemplates the winding of a plurality of springs by one continuous coiling operation and the subsequent squaring of the ends of a couple of springs simultaneously by one and the same operation.

In carrying out our method we proceed as follows: Instead of cutting the rods or wire into short lengths sufficient for individual springs and heating the same before coiling we dispense entirely with all preliminary heating and conduct the wire or rods in full lengths from the mill-rolls directly to the coiling-machine. The ends of the rods or wire do not have to be beveled or subjected to any other treatment preliminarily to coiling, and the ends of the completed springs are squared off by the novel manner of cutting the coils, which will be presently described. The coiling-machine to which the wire or rods are fed is of the ordinary construction, except that the guides or rollers are so adjusted as to wind the coils with closed helices or convolutions, as in the case of expansion-springs, instead of with open or separated windings. In other words, the product of the coiling-machine is not a spring at all in the sense of this invention, for the reasons that the convolutions or individual coils being in contact with one another there is no elasticity of compression in them. As will be readily understood by those skilled in the metal-working art, the wire or rods come from the mill-rolls at about a cherry-red heat, and as they are led directly to the coiling-machine no extra heating is required, as the coiler has sufficient power to coil them without difficulty. During the coiling operation, however, the metal cools off, and by the time this operation is completed it is too cool to permit of realizing the best results from cutting of the coil in the way contemplated by our invention, owing to the fact that the passing of the saw through the metal when cool would leave a surface requiring a further finishing and bur-removing operation. We therefore prefer to conduct the coil from the coiling-machine immediately to a furnace, where it is raised to such a heat that a metal-saw will cut through it and leave a substantially smooth surface and will not form burs. In this operation it is not essential that the coil should be brought to any exact temperature, and it will be understood by those skilled in the art what substantial temperature ought to be employed in order to secure the best results. We have secured good re-

sults by raising the coils to a heat between a cherry-red and orange, or somewhat above what is known as a "good hardening heat." When the coils have been brought to the required heat, they are conducted from the furnace to a metal-sawing machine having, preferably, a rotary high-speed saw. Here they are cut up into lengths having the requisite number of convolutions to form the desired springs, the saw cutting clear across each coil on a line perpendicular or at right angles to its axis and cutting the convolutions on a line oblique to their individual axes. The effect of this cutting is to leave the end convolution with a long gradual taper, as shown in Figures 5 and 6, forming a perfectly square flat surface on the end of the coil, as shown in Fig. 2, that extends very nearly around the circle described by the convolution. Fig. 5 illustrates one of the short lengths of coil at this stage of the operation. The convolutions, as will be seen from the figure, are still tightly closed; but the coil is now ready for the last step in the process, which consists in opening up and setting the convolutions at the proper pitch or clearance. For this purpose the coil is then transferred to a machine, the general structure of which is illustrated in Figs. 2 and 3, and while still hot all the convolutions or windings, except the end ones, are separated and opened up to the pitch which it is desired the completed spring should have.

The accompanying drawings illustrate apparatus adapted for carrying out our process.

Fig. 1 is a diagrammatic plan view showing everything but the means for opening up the coils. Figs. 2 and 3 are sectional views of the machine for doing this. Fig. 4 is a section of the furnace illustrated in the first figure. Fig. 5 is an elevation of a spring after the ends have been squared and before the coils have been opened up, and Fig. 6 shows a completed spring.

Referring to the views, *a* denotes the mill-rolls, and *b b* the machines for winding the rods or wire coming from the rolls into coils. These coiling-machines may be of any preferred construction. Two of them are employed merely as a matter of convenience, and one is arranged to wind right-hand coils and the other left-hand ones. From these coilers the springs pass in troughs *c c* to a ledge *d* in front of a furnace. They roll from this ledge into the furnace, which preferably has an inclined floor, but may be of any suitable construction. At the end of the incline of the floor there is an opening in each side wall of the furnace, and a trough *e* leads from one of these openings sidewise to and past a rotary metal-sawing machine *f*. At the other side of the furnace there is a pusher *g*, that may be operated by hand or otherwise in any convenient manner. The trough is preferably slit across just opposite the sawing-machine, and either the saw of the latter or the trough *e* is adapted to be advanced so as to cut clear across the coils as they lie in the trough. After the coils have been cut by the saw they are transferred to the machine shown in Figs. 2 and 3, and their coils are opened up or separated and allowed to set. This machine is generally as follows: A shaft 1 on a suitable stand is driven by a band-wheel 2 and has a bevel-pinion 3 at its end, which meshes with a bevel-gear 6 on a shaft below. In standards adjacent to this driving arrangement a vertical shaft 4 is mounted and has a gear 5, that meshes with a similar gear on the shaft of the bevel-gear 6. The upper portion of shaft 4 is splined at 7 and provided with a roller 8, that has a sharp-pointed flange 9 projecting from about the center of its length. The roller is adjustable on the shaft by means of a nut 10, working on a threaded part of the shaft, a spring 11 on the shaft above the roller serving to hold it down on the nut. A cap 13 covers the upper end of the spring, and a nut over the cap holds the spring down. Opposite the shaft 4 (see Fig. 2) there is located a similar shaft 14, having a flanged roller 15 in all respects like that of shaft 4, and at a point about opposite the middle line between the shafts 4 and 15, so that the three shafts stand at different angular positions around a central point, there is a standard 16, carrying a horizontally-adjustable yoke 17, that is operated by a hand-wheel working on a thread on the shank of the yoke. This yoke carries a loosely-revolving roller 18, having a tapering flange 19, precisely like that of the shaft 4, first described. The shaft 14 is movable in its standard 20 so as to be adjustable in and out, so as to enlarge or decrease the space inclosed by the three rollers 8, 18, and 15. In a well 21, located about centrally with respect to these rollers, there is a hydraulic cylinder 22, carrying a piston 23 and a plunger 24. At the upper end of this plunger there is a disk or collar 25, which carries above it a yielding platform or table 26, a spring 27, arranged between the two, serving to support the table elastically. As fast as the coils are received from the saw they are placed on the platform 26 of the hydraulic plunger, the roller 18 being withdrawn and the plunger being in its lowest position. After seating the coil on the plunger the roller 18 is moved up into position until the flanges, as well as the flange on rollers 8, are forced in between the convolutions of the coil, as shown in Fig. 2. The shaft 4 is thereupon set in motion, and the coil, which is tightly held by the three rollers, is revolved, the friction of the rollers 8 and their flanges on the convolutions of the coil serving to turn the latter at the speed of the shafts. Immediately that the rolls begin to turn the hydraulic plunger is operated, so that the table 26 gradually rises, pushing the coils up with a speed commensurate with the rotation of the rolls. The flanges of the rolls are therefore compelled to travel from one end of the coil to the other and operate on account of their wedge shape to spread or open up the

convolutions of the coil. When the spring has been raised to the point where the flanges separate the last two convolutions, the machine is stopped and the coil removed and conducted to the usual tank for hardening. It is to be understood that the construction of this coil-opening machine forms no part of the present method, and it is only illustrated and described herein to illustrate one way of performing what is believed to be an entirely new step in the manufacture of compression-coil springs. Any other machine for doing the same thing might be employed.

When the springs leave the furnace, they should be at a considerably higher temperature than is considered the right thing for the hardening-bath, and this temperature should be so regulated that they will not become during the sawing-stretching process too cool for the bath. As the stretching or opening of the coils proceeds at a comparatively slow rate the convolutions receive a secure and permanent set in the position and pitch, determined by the thickness of the flanges which separate them, and there is no liability to distort the squared ends of the coil, which are left as illustrated in Fig. 3, the operation of the opening-up machine being discontinued at the proper point not to separate the tapered part of the last convolution from the adjacent one. From this machine the coils (which are now springs) are conducted to the hardening-bath, where they are further set and hardened in the usual way.

Our improved method and one form of mechanism and apparatus for carrying out the same having now been described, it is to be noted (referring particularly to Fig. 1) that by cutting clear across the coil in a plane at right angles or perpendicular to its axis the end is left with the last convolution divided on a line that is at such a long oblique angle to its individual axis that a flat surface results which continues almost all the way around the circle, as best illustrated in Fig. 2. This leaves the coil, considered as a whole, with a preferably square end suitable for resting upon a flat base in a vertical position or for receiving the compressive force and distributing it throughout the convolutions, if located in a horizontal or other position.

Although described as particularly adapted for manufacturing car-springs, we do not intend to limit ourselves thereto, for obviously any sort of compression-coil springs may be made in the same way. We also desire it to be understood that we do not limit ourselves to the feeding of the rods or wire directly to the coiler from the mill-rolls nor to the employment of the stock in any given lengths. We prefer the plan already described in this respect; but as the gist of our invention is the winding of the coils with closed convolutions, squaring the ends by cutting across at a right-angle to their axes, and subsequently opening up the convolutions and giving them a permanent set, we are not to be restricted to the making or finishing of more than one spring at a time. Neither do we desire to be limited to the heating of the coils before sawing, as we believe ourselves to be the first to saw the coil clear across in the manner described, whether it be hot or cold. The hot sawing we regard, however, as the superior method, for the reason that it leaves the surface in a smooth condition, requiring little or no finishing.

We have described the coils as having their convolutions closed together in actual contact; but if they are substantially closed we should regard them as within our invention, even if not in actual contact. The cutting of the coil as above described would always leave a surface perpendicular to the axis of the coil; but in order to secure a substantially square end for the coil the convolutions must be substantially closed when the cut is made.

Having thus described our invention, what we claim is—

1. In the art of making spiral coiled springs, the herein-described improvement consisting in winding a length of rod or wire into a coil with closed windings or convolutions, squaring the ends by severing clear across the coil in a plane at right angles to its axis, and subsequently opening up or separating and setting the convolutions.

2. In the art of making spiral coiled springs, the herein-described improvement consisting in winding a length of rod or wire into a continuous coil with closed windings or convolutions, dividing the coil into shorter lengths and simultaneously squaring the ends by sawing it in a plane at right angles to its axis, and opening up or separating and setting the convolutions of said shorter lengths.

3. In the art of making spiral coiled springs, the herein-described improvement consisting in feeding a length of rod or wire directly to a coiler from the mill-rolls, winding it into a continuous coil with closed windings or convolutions, heating the wound coil, dividing the same into shorter lengths and simultaneously squaring the ends by sawing it through in a plane at right angles to its axis, and opening up or separating and setting the convolutions of said shorter lengths.

In testimony whereof we affix our signatures in presence of two witnesses.

FRED H. DANIELS.
CLINTON S. MARSHALL.
JOHAN O. E. TROTZ.

Witnesses:
W. H. MORSE,
THOS. MACDUFF.