(No Model.)

2 Sheets—Sheet 1.

T. H. DODGE.

ROLLING WIRE RODS AND APPARATUS THEREFOR.

No. 290,002. Patented Dec. 11, 1883.

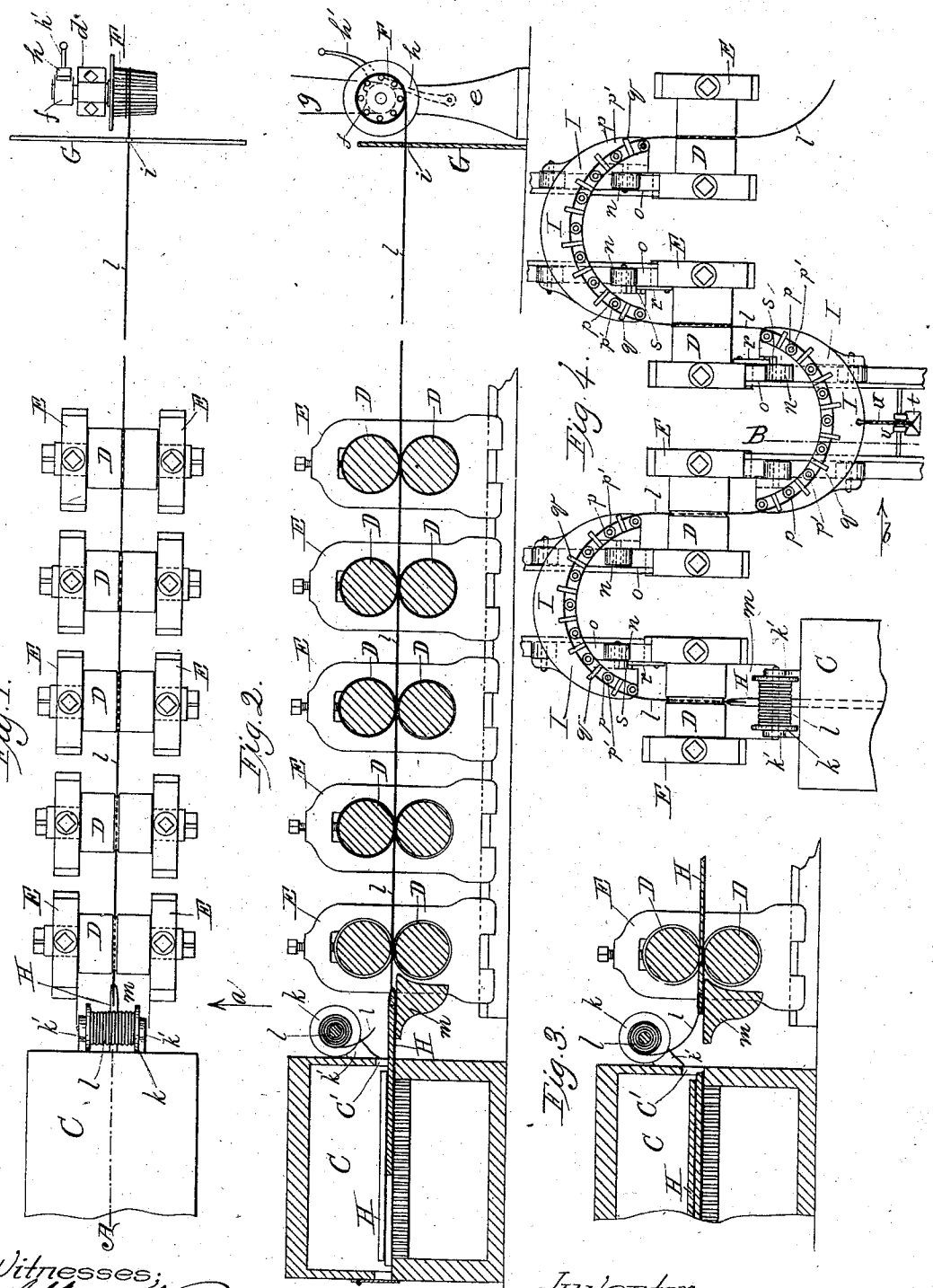


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

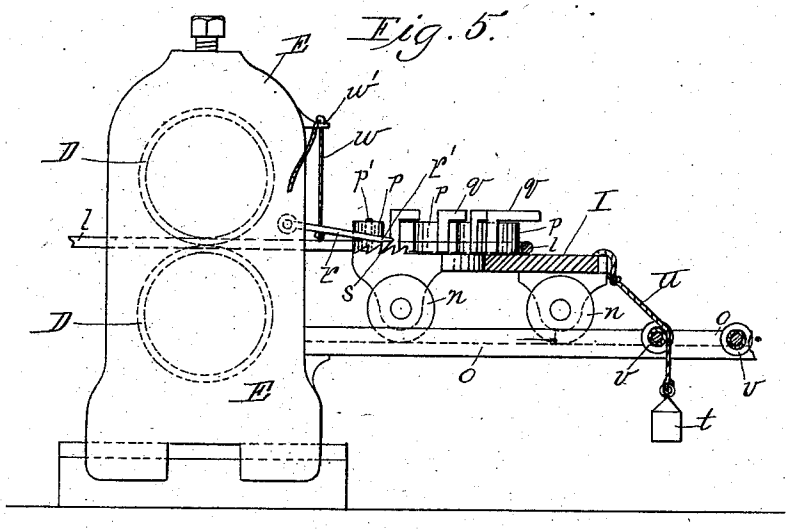


Fig. 6.

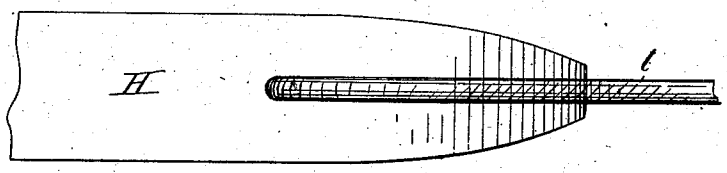
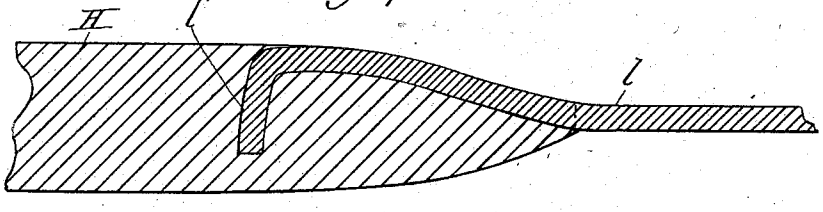


Fig. 7.



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UNITED STATES PATENT OFFICE.

THOMAS H. DODGE, OF WORCESTER, MASSACHUSETTS.

ROLLING WIRE RODS AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 290,002, dated December 11, 1883.

Application filed May 28, 1883. (No model.)

To all whom it may concern:

Be it known that I, THOMAS H. DODGE, of the city and county of Worcester, and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Rolling Wire Rods and in Apparatus Therefor; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and in which—

Figure 1 represents a top or plan view of so much of a continuous wire rod and wire rolling mill as is necessary to illustrate my improvements upon said mill and the process of rolling continuously wire rods and wire and coiling the same, as will be hereinafter more fully described. Fig. 2 represents a central vertical section through the parts shown in Fig. 1, taken on line A of said figure, looking in the direction of arrow *a*. Fig. 3 represents a central vertical section similar to that shown in Fig. 2, including only the first set of reducing-rolls, and a section of the heating-furnace, the guide-wire and billet being shown in different relative positions from those shown in Figs. 1 and 2, as will be hereinafter more fully described. Fig. 4 represents a modification showing my improvements applied to a Belgian continuous rolling-mill, so much of said mill being shown in plan view as is necessary to illustrate my said improvements applied thereto. Fig. 5 represents, upon an enlarged scale, a vertical section taken on line B, Fig. 4, looking in the direction of arrow *b*, same figure; and Figs. 6 and 7 represent full-size details of parts hereinafter more fully described.

My invention relates to improvements in rolling-mills heretofore employed for reducing steel and other metals from the size of a "billet" (about one and one-eighth inches square in cross-section) to the size of what are known as "wire rods," whereby the reducing operation can be extended in these continuous mills, so as to reduce the size of the rod to No. 13 or smaller wire-gage, and that, too, without any very great additional cost or expense.

The invention is alike applicable to other similar rolling-mills for reducing iron or steel billets to rods and wire.

My said invention or improvements consist, first, in the combination, with the end of the billet or bar, of a guide wire or rod, whereby the forward end of the billet to be rolled is guided through the rolls to the reel, as will be hereinafter more fully described; second, in the combination, with the rear end of the bar or billet, of a guide wire or rod to be drawn through the rolls preparatory to being attached to the forward end of the next billet, to serve the purpose of a guide-wire for the next succeeding billet, as will be hereinafter more fully explained; third, in the combination, with a continuous rolling-mill, of a spool of guide-wire, as will be hereinafter described; and, fourth, the combination, in a continuous rolling-mill, of movable guide-carriages, for the purposes hereinafter described; fifth, the improved process of rolling metal bars or billets into wire rods or wire by a continuous operation, substantially as hereinafter described.

The metal bar or billet to be rolled, from the time it enters the first set of reducing-rolls as a heated bar or billet, passes through the mill between each set of rolls from one stage of reduction to another to the last set or finishing-rolls, and from there to the reel, upon which it is coiled as fast as finished, being guided through all of said operations by a cold guide rod or wire of smaller size than the size to which the billet is to be reduced, the forward end of said guide wire or rod being attached to the reel which winds up the finished wire or rod, and the rear end of the heated bar or billet, thus forming a continuous connection between the heated metal and reel from the time the former first enters the mill. If preferred, the forward end of the guide-wire may be attached to a moving carriage or weight, and the finished rod or wire drawn away from the mill in a straight line, and reeled or coiled up after the entire billet has been rolled and delivered from the mill.

To enable those skilled in the art to which my invention and improved process belongs to understand and use the same, I will proceed to describe the said improvements more in detail.

In the drawings, C represents so much of an ordinary heating-furnace as is necessary to illustrate my invention.

The parts marked D represent the reducing or shaping rolls, which may be of any desired number; but for the purpose of convenience in illustrating my said improvements, I have only shown five sets of rolls and their housings E in Figs. 1 and 2 and four sets in the modification showing my improvements applied to a Belgian continuous rolling-mill in Fig. 4.

In practice the housings E are provided with adjustable bearings for the rolls D to turn in, and suitable guides are also arranged upon each side of said rolls, to properly guide the heated metal into the reducing and shaping grooves formed in the same, and my improvements may be used in connection with all such parts, if preferred; but as said parts are in common use and well known, I have not shown them in the drawings, and they need not be further described.

The part marked F represents an ordinary spool or reel used for coiling up the wire rods as fast as they are finished and delivered by the mill; said reel is, in this instance, shown arranged to turn in a suitable bearing, *d*, in the top of a supporting-standard, *e*. It is provided with a driving-pulley, *f*, over which an endless belt, *g*, is passed, driven from above in this instance, and with a friction-brake, *h*, operated by the handle *h'*, the purpose of said brake being to enable an attendant to keep the proper tension upon the wire rod or wire while it is being coiled upon the reel F.

G represents a metal guard-partition, which is provided with an opening or guide, *i*, for guiding the wire rod or wire so that it may be properly coiled upon the reel F. Any suitable arrangement of guides may, however, be employed for directing the wire to its proper position on the reel, in lieu of the one described above.

By the present method of allowing the rod, as it is delivered from the finishing-rolls, to fall upon and coil about upon a metal or stone flooring slightly inclined toward the reel, such a guard is indispensable to prevent injury to the attendants and to prevent accident by the rod or wire getting entangled in the arms of the rapidly-revolving reel, whereas by guiding the rod or wire by a continuous connection to the reel, as elsewhere described, such difficulties and objections are obviated in a great measure. Said old method now employed is attended by many objectionable features, the most prominent of which are the following: One rod is fed forward after another in rapid succession, leaving the finishing set of rolls at a high rate of speed, and is allowed to fall upon the floor. It is therefore very liable to become entangled, since quite an accumulation of coils are formed before the attendant can pick up the end and enter it in the reel preparatory to reeling up the loose and looped accumulation, thus causing much loss, trouble, and expense, notwithstanding an attendant is kept constantly where the rod leaves the finishing-rolls, to guide and distribute it properly upon the floor; and several attendants are also required at each side of the space upon which the rod is distributed, to keep it within proper bounds. As will be seen, the necessity of employing so many attendants is objectionable, not only on account of the expense, but from the greater liability to accidents, which are of common occurrence in a manufacturing establishment of this kind.

By the application of my invention the attendance can be greatly reduced, while the liability to accidents is proportionately obviated.

In attaching or welding the rear end of the guide-wire to the forward end of the billet or bar, a tool or device may be emyloyed to first form a cavity in the heated bar or billet, into which the end of the guide-wire may enter and bury itself, as indicated in Fig. 7.

The operation of guiding forward the heated metal as it is reduced, and the finished rod or wire to the reel, when my invention is used, is as follows: Over the opening C' of the heating-furnace through which the heated bar or billet is drawn is arranged a spool, *k*, which is fitted to turn in suitable bearings, *k' k'*, secured to said furnace, and upon said spool *k* is coiled the guide-wire or wire rod *l*. If preferred, said guide-wire may be in sections of sufficient length to reach from in front of the first set of reducing-rolls to the reel, allowing for sufficient length to fasten one end to said reel and the other end to the forward end of the billet.

In fastening the end of said guide-wire or rod *l* to a billet or bar, H, the attendant first draws down said wire from the spool and passes it through between each set of reducing-rolls to the reel, and there fastens it. He then cuts it apart, as shown in Fig. 2, (if not spooled in sections,) and drawing a heated billet, H, forward from the furnace, so that its forward end will rest on the rigid support *m*, lays the end of the guide-wire *l* over said end, overlapping it, and then with a hammer or other device strikes two or three sharp blows upon the top of said guide-wire, which operation forces it down into the soft heated metal, thereby securely welding or fastening the two ends together, as shown in the drawings, more especially in Fig. 7.

If preferred, for more securely fastening the ends of the guide-wire to the billet, the end of said guide-wire may be bent down, as shown at *l'* in Fig. 7, prior to the welding operation, and, if desired in any case, the end of the guide-wire may be thrust into the mouth C' of the furnace before it is fastened to the front end of the heated bar or billet, whereby it will be heated to a red or welding heat. The two ends having been welded or fastened together, as before described, the reel is slowly started up at the same time the billet is pushed forward and passed between the reducing-rolls, the gentle draft of the guide-wire aiding greatly or assisting the entrance of the

billet between the rolls, and such aiding operation continues through the entire series, the reel coiling first the guide-wire and then the newly-finished rod or wire as fast as it is delivered from the finishing-rolls, the tension produced by the reel being in practice adjusted by the attendant to conform with the speed at which the finished rod or wire is delivered by the mill, thus keeping said rod or wire taut, or nearly so, between the finishing rolls and reel. When the rear end of the billet H arrives over the block *m*, the attendant may weld or fasten the forward end of the next section of guide-wire *l* to said end of the billet in the same manner that the rear end of the first section of guide-wire *l* was welded to the forward end of the first billet. As the forward movement of the billet at this point is quite slow, sufficient time is allowed the attendant to perform said operation without retarding the progress of the mill.

In Fig. 3 the end of the guide-wire is shown welded or fastened to the advancing rear end of the heated bar or billet H, and will consequently be drawn forward through the rolls to the reel, at which point the attendant, by a suitable cutting apparatus arranged for that purpose, severs the guide-wire, which is then suddenly stopped in its passage through the rolls by a suitable brake applied to spool *k*, after which the guide-wire *l* is severed in front of the mouth C′ of the furnace, when the operation of securing the front of the guide-wire to the reel and its rear end to the front end of a heated bar or billet is repeated, and such series of operations are continued as long as desired.

It will be understood that a suitable clamp or pair of jaws may be arranged near the reel, to clasp and hold the guide-wire *l* between the reel and the rolls where it is severed from the rear end of the finished rod or wire; and, inasmuch as the connection is formed by the iron in a heated or red state, the clamping of the guide-wire in many cases would be quite sufficient to sever or pull apart the end of the guide-wire from the rear end of the finished rod or wire. As soon as one reel is filled (a single billet or bar fills a reel when rolled to the proper size) the coil is slipped from the reel and taken away by an attendant, while the front end of a fresh guide-wire is attached to the reel, as before indicated.

Various arrangements of reels may be adopted, and, if preferred, several reels may be employed and moved into position successively, the finished coil of wire being removed without haste.

I employ the same method for guiding the metal through the Belgian mill shown in Fig. 4, except its serpentine motion in passing from one set of rolls to another, with the combination of the additional feature of adjustable guiding-carriages I, (see Figs. 4 and 5,) which, in this instance, are arranged to move toward and from the rolls, for the purpose of increasing or decreasing the tension upon the metal being reduced, said carriages being provided with trucks or wheels *n*, which travel on tracks *o*, properly secured in position, whereby the slack which accumulates between the different sets of rolls is taken up by the adjustable carriages, thus obviating the old, expensive, and dangerous mode of allowing the loops to fall upon the floor or be drawn out by attendants.

In order that but little friction may be produced upon the guide wire or metal in passing through, I arrange a circular row of small wheels or rolls, *p*, turning on vertical axes *p′*, secured in the top of each caariage I. I also form upon or secure to said carriage, between the friction-rolls *p*, angular guides or guards *q*, for keeping the guide wire or metal in its proper position in passing through the mill, as well as the partially-finished rod or wire that follows it. Each carriage is, in this instance, fastened to one of its respective housings by means of a hinged pawl or dog, *r*, which holds in one of the notches *s*, formed on the top of the carriage.

A constant outward strain to move the carriage in the direction away from the rolls is produced by means of a weight, *t*, connected by a chain or wire, *u*, with the rear part of the carriage, said chain or wire being passed over a rod or roll, *v*, upon projections from the tracks *o*, at some distance away from the carriage, as shown in Fig. 5.

The principle of the invention shown in Figs. 4 and 5 of the drawings, for taking up the slack of the partially-rolled bar or billet, is applicable to a mill when constructed as shown in Figs. 1 and 2. In such case, however, the movement of the carriage should be up or down, thus leaving the metal rod always in the same vertical plane.

In releasing a carriage, as soon as the heated bar has passed around and enters the next set of rolls, the attendant pulls upon the chain *w*, (see Fig. 5,) fastened at its lower end to pawl *r*, and passed through a fixed bearing or ring, *w′*, above said pawl. The latter is fastened in any suitable manner at the proper level for its hooked end *r′* to slide over and catch in one of the notches *s* by simply pushing the carriage forward the proper distance.

If preferred, the carriage I may be suspended from above, or any other suitable device for accomplishing the aforesaid result employed in lieu of the one herein shown and described.

The arrangement and manner of supporting the guide-wire spool *k* may also be varied; and, if desired, a trip-hammer device may be arranged over the point of welding or fastening the ends of the guide-wire and billet or bar together, which may be quickly and conveniently operated by the attendant at the proper time to fasten the ends together; and the front end of the billet may be hammered or pressed into a conical form, as indicated in Fig. 7 of the drawings.

Those skilled in the art of wire or wire-rod manufacturing will readily perceive the practical advantages and value to be derived from the application of my invention to rolling-mills of the description named for the reasons before enumerated. The expense of applying said improvements is but trifling to mills in common use, which is a great advantage, since such mills are very expensive.

This invention is alike applicable to rolling-mills in which the end of the bar or rod being reduced is passed back and forth from side to side of a set of two-high or more rolls, and termed "Belgian mills." This style of mill is shown in Figs. 4 and 5. As used heretofore numerous attendants are required, since in passing the first end of the billet or bar through the mill it has to be taken by means of tongs or nippers and entered between each set of reducing-rolls, and often the attendants have to keep the slack or loops between the different sets of rolls out or extended to prevent kinking and snarling of the same, and consequent waste and loss of metal and time. This last-named mill differs in this respect from the style of continuous mill shown in Figs. 1, 2, and 3, since in the latter mill each succeeding set of rolls move a little faster than the last set, thereby keeping a slight strain upon the bar or billet as it passes from one set to the other.

Two difficulties have heretofore prevented the rolling of the billet or bar to sizes smaller than No. 7 wire-gage: First, the end of the heated metal, when much smaller, is liable to buckle up in entering rolls, thereby causing stoppage of the mill and loss of time and production, and often great damage to the mill; second, when the metal is rolled smaller than No. 7, it is delivered so fast upon the floor that before the attendant can pick up the end and enter it in the reel so much wire will be delivered in a mass of coils and loops that in attempting to coil it up it kinks and snarls and renders the production damaged and unsalable, while at the same time the lives and limbs of the workmen are endangered. All these difficulties are, as before stated, obviated in a great measure by my invention, while the slow and expensive process of cleaning in acid and drawing the rods through die-plates is saved. Large sums may thus be saved in operating the mills in use, while the production thereof is greatly enhanced.

My invention may be applied in various ways and under various modifications of the various parts of a rolling-mill without departing from the principle thereof; and I do not, therefore, limit my claims to the one good or practical way which I have hereinbefore shown and described for its application or use, but desire and intend my claims shall extend to and cover its use under such different arrangements and constructions, they being within the scope of mere mechanical skill.

Having described my improvements in rolling wire rods, and an apparatus therefor, what I claim therein as new and of my invention, and desire to secure by Letters Patent, is—

1. In the process of rolling bars or billets of metal continuously into wire rods, the improvement consisting in guiding the forward end of the bar or billet successively between each pair of rolls by means of a guide-wire, substantially as described.

2. In the process of rolling bars or billets continuously into wire rods, the improvement consisting in attaching to the end of the bar or billet as it leaves the furnace a guide-wire by welding, and guiding the end of said bar or billet between the rolls by means of said wire, substantially as described.

3. In the process of rolling bars or billets of metal continuously into wire rods, the improvement consisting in connecting the rear end of one billet to the front end of the next by a wire, substantially as and for the purposes set forth.

4. The combination, with a continuous rolling-mill, of a spool of guide-wire, substantially as and for the purpose set forth.

5. In a continuous rolling-mill, or mill comprising a series of rolls, the combination of the guide-wire and sliding carriage, substantially as described.

6. In combination with a series of rolls, a sliding carriage between each two of said series, said carriages being provided with a series of anti-friction rollers and angular guides, and with means for exerting a tension thereon away from the said rolls, substantially as described.

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