(No Model.) 3 Sheets—Sheet 1.

R. A. CARTER.

ART OF ROLLING METAL.

No. 390,344. Patented Oct. 2, 1888.

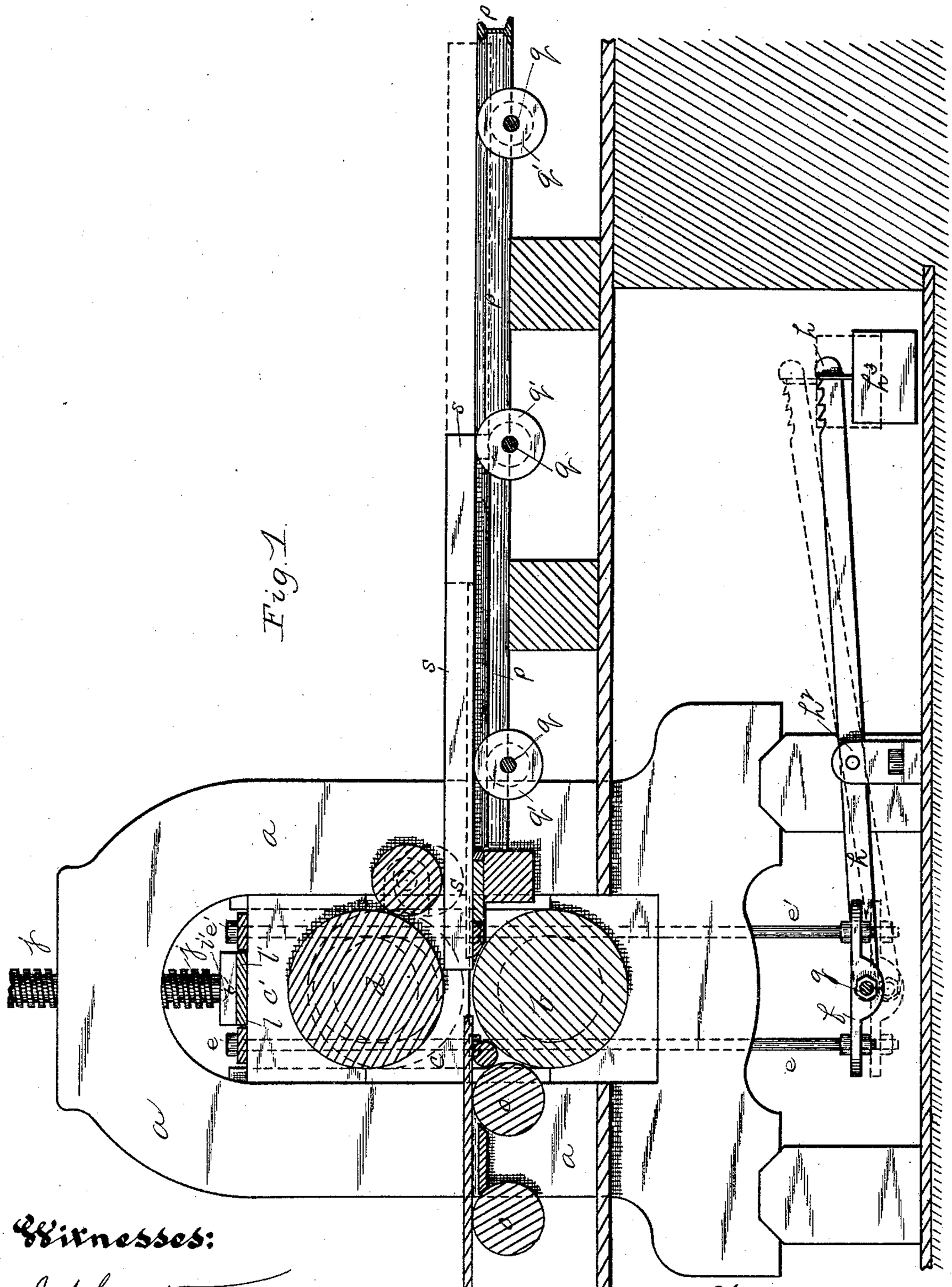

Fig. 1.

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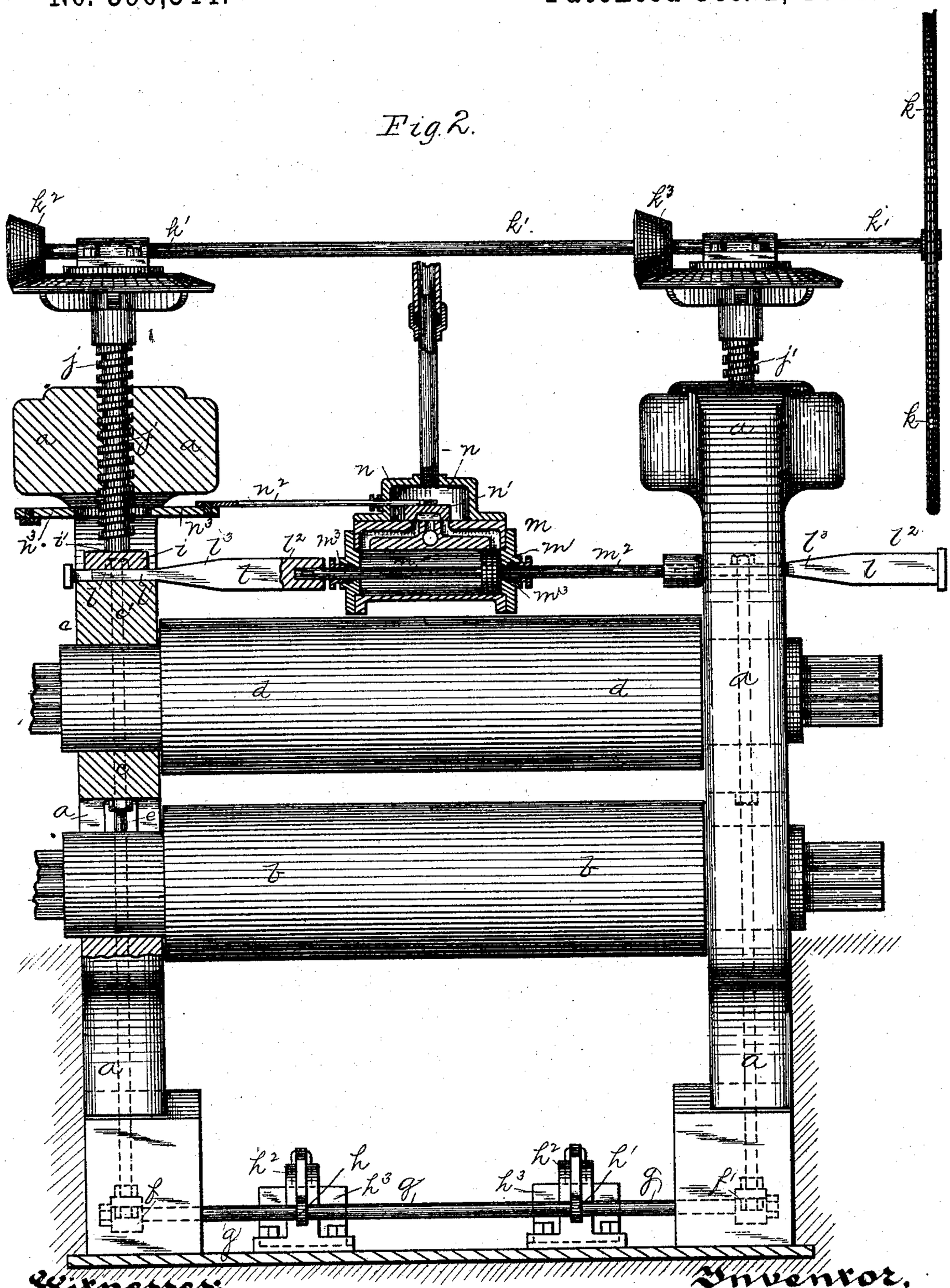
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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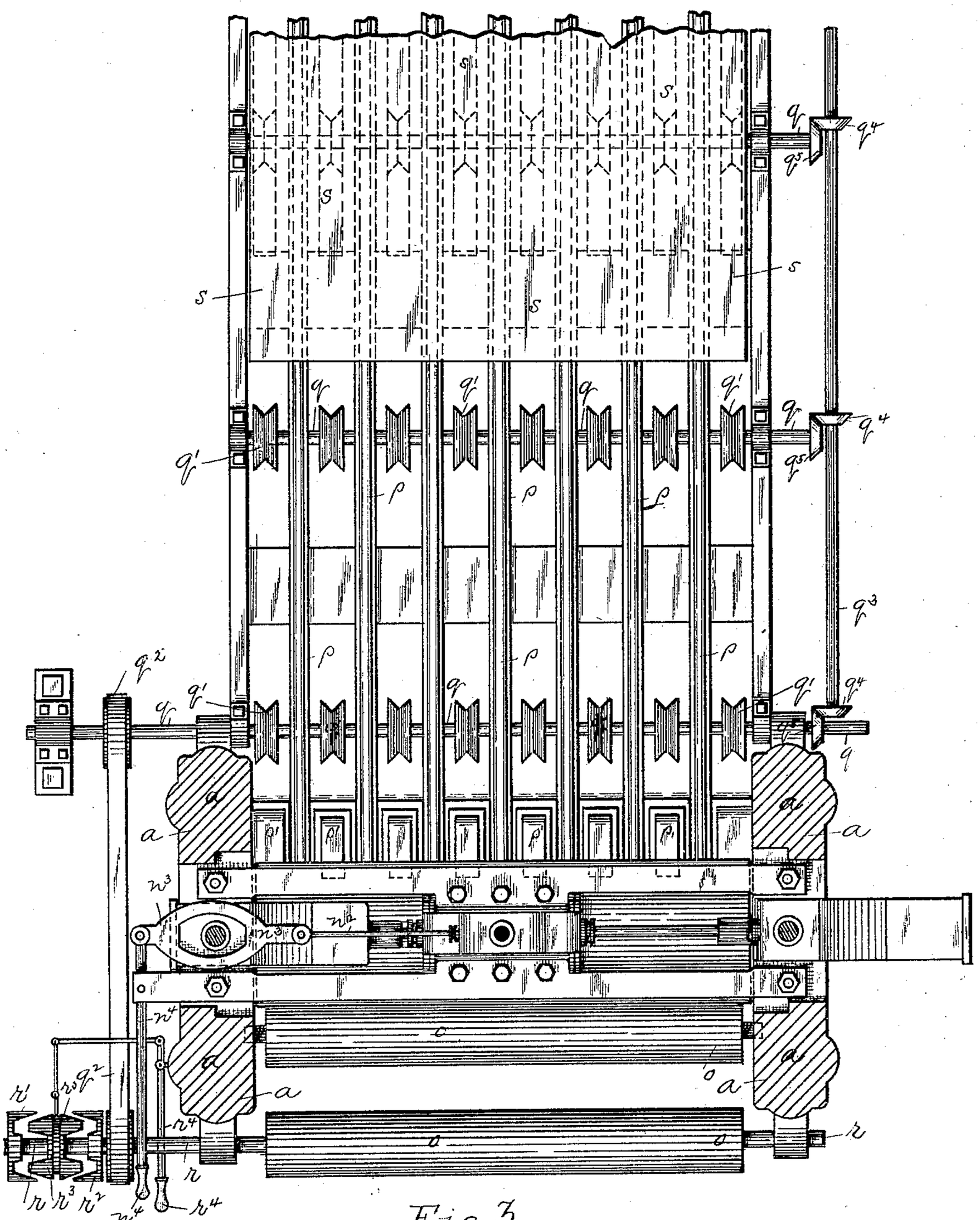

Fig. 3.

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UNITED STATES PATENT OFFICE.

ROBERT A. CARTER, OF PITTSBURG, PENNSYLVANIA.

ART OF ROLLING METAL.

SPECIFICATION forming part of Letters Patent No. 390,344, dated October 2, 1888.

Application filed February 23, 1888. Serial No. 264,998. (No model.)

To all whom it may concern:

Be it known that I, ROBERT A. CARTER, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Art of Rolling Metals; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the art of rolling metals, and more especially plate metal. Heretofore in the rolling of plate metal three general methods and types of machines have been employed, one consisting in the employment of a two-high set of rolls and a lifting table on one side of the rolls to receive the billet or slab as it comes from the pass and raise it above the top of the upper roll to drop it back on a fixed table on the other side of the rolls, to be again fed into the pass of the latter, another method consisting in using a three-high set of rolls with lifting-tables on each side of the rolls, so that the metal can be passed in one direction between the bottom and middle roll, and in the reverse direction between the top and middle rolls. The third method consists in the use of a two-high reversing-train, in which the direction of rotation of the rolls is changed after each pass by reversing the driving-engines, so that the metal may be rolled in both directions. The objection to the first of these methods is that it requires a very large number of men to carry on the rolling operation and manipulate the slab, and where large sizes of plates, such as armor-plates, are rolled, even a large number of men have great difficulty in manipulating the metal so as to secure quick and uniform rolling. In the second method the great disadvantage lies in the very heavy cost of the three-high rolling-mills and tables and the expense of operating them. With the third or reversing method the cost of the machinery is also very large, as the driving-engines and boilers have to be of extra strength and power, and the wear and tear on the engines is very great from the severe strains of the reversing operation.

The object of my invention is to avoid all these objections by employing a method in which the necessity of heavy and expensive machinery is avoided and the labor of manipulating the metal reduced.

To these ends my invention consists, generally stated, in rolling the metal between the rolls in one direction, then separating the rolls and passing the metal back in the reverse direction between the space thus formed between the rolls, to be again fed forward when the rolls are brought together, as will be more fully hereinafter set forth.

To enable others skilled in the art to practice my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of a form of apparatus adapted to carry out my invention. Fig. 2 is a face view of the same, partly in section; and Fig. 3 is a plan view of the apparatus with the top of the roll-housings removed.

Like letters refer to like parts in each of the figures of the drawings.

In practicing my invention the form of rolling apparatus which I prefer to employ is that which is described and claimed by me in an application filed on even date herewith. Other forms of apparatus may, however, be employed. This apparatus consists of housings *a a*, of the usual or any suitable construction, in which are journaled in fixed bearings the lower roll, *b*, and above this, in movable or sliding bearings *c*, the upper roll, *d*, which is balanced or counterpoised, so that its normal position is raised. For this purpose any of the well-known means may be employed—such, for instance, as that shown in the drawings, which consists in attaching to each bearing *c* of the roll *d* two vertical rods, *e e'*, which pass down through suitable passages in the bearings of the roll *b* and in the lower part of the housings *a*, and are connected at their lower ends, in the pit below the rolls, by yokes *f f'*, which yokes have secured to their middle the ends of the bar *g*, to which are attached, at suitable points between the two yokes *f f'*, the ends of levers *h h'*, which are fulcrumed at h^2 in the pit below the rolls, and carry on their outer ends weights h^3, which are so disposed that they tend to keep the upper roll, *d*, in a raised or elevated position, except when held down, as hereinafter explained. On the top of each rider *c'*, at the upper part of the bearings *c* of the roll *d*, rests a block, *i*, against a seat, *i'*, in

which bears the end of the adjusting-screws *j j'*, that serve to vary the distance of the rolls apart, and thus the height of the pass between the rolls. These screws are operated by the usual hand-wheel, *k*, and shaft *k'*, on which the same is mounted, and bevel-wheels k^2 and k^3 connecting said shaft with the screws *j j'*, so that the upper roll, *d*, may be forced toward the roll *b* as much as may be desired by turning the hand-wheel *k*, the effect of said screws being opposed to the weights or balances h^3. In order to obtain a quick separation of the rolls, so that sufficient space will be allowed between the rolls for the free passage of the billet, slab, or bloom therethrough after the rolling operation, as hereinafter explained, which separation is independent of and in addition to the adjustment of the rolls toward each other for the purpose of varying the pass, a wedge or tapering filling piece or block, *l*, is placed between each block *i* and the top of the rider *c'*, these filling-pieces or wedges being connected together to secure a uniform movement of the roll at each end of the same. The form of this wedge or filling-piece should be such that at its point of greatest thickness it will be equal to the distance which it is desired to separate the rolls in addition to the thickness of the plate or billet rolled—that is, the amount over and above the distance they have already been separated to obtain the desired reduction in metal at that pass.

The form of wedge which I have shown in the drawings consists of the parallel side portion, *l'*, which is comparatively thin, and serves to hold the wedge or filling-piece in position when the roll is raised, and a similar parallel side portion, l^2, whose increase of thickness over that of the portion *l'* is equal to the amount of separation of the rolls desired, in addition to the thickness of the bloom or slab, the two portions being connected by the tapering part l^3, so that as the wedge or filling-piece is forced laterally by suitable means the roll *d* will be forced down by the gradually-tapering faces of the part l^3 until the portion l^2 is interposed between the block *i* and the rider *c'*, which brings the upper roll, *d*, to just the right distance from the lower roll, *b*, to give the desired reduction in the metal, which distance may of course be varied by the raising or lowering of the adjusting-screws *j j'*, as the weights h^3 always hold the roll in the highest possible position. When the thick portion, l^2, is interposed between the riders *c'* and the block *i*, then the rolls are in a position for rolling—that is, brought together; but by forcing the wedges *l* laterally, so that this thick portion is withdrawn and the thin portion, *l'*, interposed between the block *i* and the rider *c'*, the upper roll, *d*, will immediately be moved upward by the counterpoises h^3, and the rolls separated an additional amount to what they were before, which separation for the same wedge or filling-piece *l* always remain the same whatever may be the adjustment of the rolls by the screw *j*. To operate these wedges or filling-pieces, any suitable system of hand-levers may be employed; but I prefer to use steam or hydraulic pressure. For this purpose two parallel bars are secured at each end to the top of the riders *c'* on each side of the blocks *i*, and attached to these bars and supported between them over the middle of the roll *d* is the cylinder *m*, having the piston *m'* therein and piston-rod m^2 passing through a stuffing-box, m^3, in each head of the cylinder, one end of said rod being secured to one wedge or filling-piece, *l*, and the other end to the other wedge. The cylinder is also provided with a steam or valve chest, *n*, therein supplied with suitable supply and exhaust pipes, which are preferably made telescopic to provide for the movement of the cylinder with the rolls *d*.

To operate the slide or other suitable valve, *n'*, of the cylinder, the valve may have attached thereto a rod, n^2, which is provided with loop n^3 to embrace and extend beyond the adjusting-screw *j* to the outer side of the housing *a*, where it is attached by a sliding connection to the end of an operating-lever, n^4, which is pivoted to any suitable support on the side of the frame. By this means the roll *d* can be raised or lowered at any time by the movement of the operating-lever n^4, which admits the steam into the proper end of the cylinder to move the wedge *l* in or out, as may be desired.

To feed the bloom, billet, or slab to and fro during the rolling operation, one side of the rolls is provided with a table composed of the positively-driven friction-rolls, *o*, which are geared together, and are connected to some suitable motive power similar to those now in general use. On the other side of the rolls is a table of somewhat different construction. This table consists of a series of longitudinal fixed bars or rails, *p*, between the inner ends of which are guides *p'*, which extend over the roll *b* and serve to prevent the metal from following the roll *b* as it comes from the pass. Back of these guides and mounted on a series of cross shafts, *q*, are a series of V-shaped grooved friction-rollers, *q'*, which are between the bars *p* and project slightly above the upper surface of the latter. A number of these cross-shafts carrying friction-rollers are arranged back of each other, the first two or three shafts, or more if necessary, being geared together and to some motive power, so that they can be positively drawn in either direction. The system of belting and gearing which I have illustrated for this purpose consists in connecting the first cross-shaft, *q*, by a belt, q^2, to a shaft, *r*, on which is arranged two loose pulleys, *r'* and r^2, positively driven in the reverse direction, and between said pulleys a clutch, r^3, having a sliding connection with the shaft, so that it can be thrown into engagement with either pulley to drive the shaft correspondingly, a shifting-lever, r^4, being provided for the operation of this clutch. To drive the other cross-shafts from the first cross-shaft, *q*, any suitable system of gearing may be employed—such, for instance, as the longitudinal shaft

q^3, connected to the cross-shaft q by means of the bevel-gears q^4 thereon meshing with the bevel-gears q^5 on the ends of the cross-shafts q.

Resting on the grooved rollers q' is a block or ram, s, which is provided with a series of V-shaped ribs on its under side, which fit in the grooves of the rollers q' and serve to give a greater friction-surface to the action of the rollers, and thus facilitate the propulsion of this block by the latter. The rotation of the rollers q' causes this block to move to and fro over the table formed by the bars and the rollers, and by running it back to the outer end of the table an unobstructed receiving-table is left in front of the rolls for the slab, bloom, or billet when the latter comes through the pass, and then by bringing up the ram s, by turning the rollers forward, the slab or bloom can be again shoved through the rolls, as hereinafter explained.

In practicing my invention the adjusting-screws j are turned until the upper and lower rolls are the proper distance apart to produce the desired reduction of the metal, the filling-piece or wedge l having its thickest or parallel part, l^2, interposed between the rider c of the upper roll and the bearing-block i of the adjusting-screw during this adjustment. The slab, bloom, or billet is now laid on the friction-rollers o and fed by them to the pass of rolls, through which it is driven and reduced by the rotation of the two rolls in that direction, coming out on the bars p and upper edge of the rollers q', the ram s having been run back to be out of the way. During the passage of the metal through the rolls the small roll d', which is carried by the same bearings as the roll d, serves to prevent the metal from coiling upward and following the upper roll, and at the same time, as it is driven by its frictional contact with the roll d in the reverse direction to the latter, it also serves to scrape the upper surface of the metal as it is passing onto the bars p. When the metal has cleared the rolls, the latter are separated an extent sufficient to permit the free passage of the metal backward to the feed table o without being acted upon by the rolls or requiring the stoppage of the latter. This separation in the apparatus heretofore described the operator effects by admitting steam or hydraulic pressure in the cylinder m, so that the filling-piece or wedge l is withdrawn from between the rider c and block i, or until the thin part, l', is between the same, which permits the upper roll, d, to be raised by the weights h^3. There is now between the rolls a distance which is sufficient for the free passage of the bloom, billet, or slab back through the rolls to the other side, to be again fed forward by the rollers. This shoving through may of course be effected by hand, but mechanical means are preferable, and a variety of forms well known to those skilled in the art may be used. In the apparatus heretofore described this is effected by starting the rollers q' in rotation toward the rolls, which brings up the ram s until it strikes against the slab or bloom resting on the table in front of it, carrying the slab along and by its impact shoving the slab through the rolls and over the top of the bottom roll to the table on the opposite side of the rolls. As the bottom roll, b, is moving in a direction contrary to that of the slab, the movement of the latter over the surface of the roll b, when it is shoved back between the rolls, also serves to scrape off the scale from the under side of the slab, which is a considerable advantage in rolling plate.

When the plate or bloom has been shoved through to the other side of the rolls, as above set forth, the rotation of the rollers q' is reversed and the ram s withdrawn to the rear end of the table. At the same time the filling-piece or wedge l is forced in between the blocks i and riders c until the thickest part, l, of the wedge is interposed between them, which again brings the rolls to the same relative position with respect to each other that they occupied during the first reduction, and if it is desired to further reduce on the next pass the adjusting-screws j are turned to bring the top roll down the desired amount. As the top roll is always raised a uniform amount by the action of the filling-piece and counterpoise, the relative position of the rolls at each pass is unaffected. After each rolling operation the rolls are separated and the billet or slab forced back. The rolls are then again brought together and the metal fed forward, to be again reduced.

If desired, in carrying out my method the lower roll may be separated from the upper rolls, or the two rolls may be moved away from each other instead of moving the upper roll, as in the apparatus heretofore described. This method of rolling has the great advantage that no labor or power is required to lift the bloom or billet at each operation, to accomplish which it is not necessary to employ a reversing-mill, and the number of men required to manipulate the metal is very small compared with the present practice. At the same time a better and more uniform finish is obtained on the metal rolled.

I do not claim in this application the apparatus for rolling metal heretofore described, as that forms the subject-matter of a separate application filed by me on even date herewith.

Having now described my invention, what I claim is—

1. The improvement in the art of rolling metal, which consists in reducing the metal by passing it through the rolls in one direction, then separating the rolls and passing the metal back between the rolls to the other side to be again reduced when the rolls are brought together, substantially as and for the purpose set forth.

2. The improvement in the art of rolling metal, which consists in reducing the metal by passing it through two-high rolls in one direction, then separating the rolls and passing the metal back between the rolls, so as to be ready

to be again acted upon when the rolls are brought together, substantially as and for the purpose set forth.

3. The improvement in the art of rolling metal, which consists in rolling the metal between a pair of rolls driven in one direction, then separating the rolls and passing the metal back over the surface of the rotating lower rolls, substantially as and for the purpose set forth.

In testimony whereof I, the said ROBERT A. CARTER, have hereunto set my hand.

ROBERT A. CARTER.

Witnesses:

N. S. STOCKWELL,

J. N. COOKE.