(No Model.)

3 Sheets—Sheet 1.

R. A. CARTER.

ROLLING MILL.

No. 390,343. Patented Oct. 2, 1888.

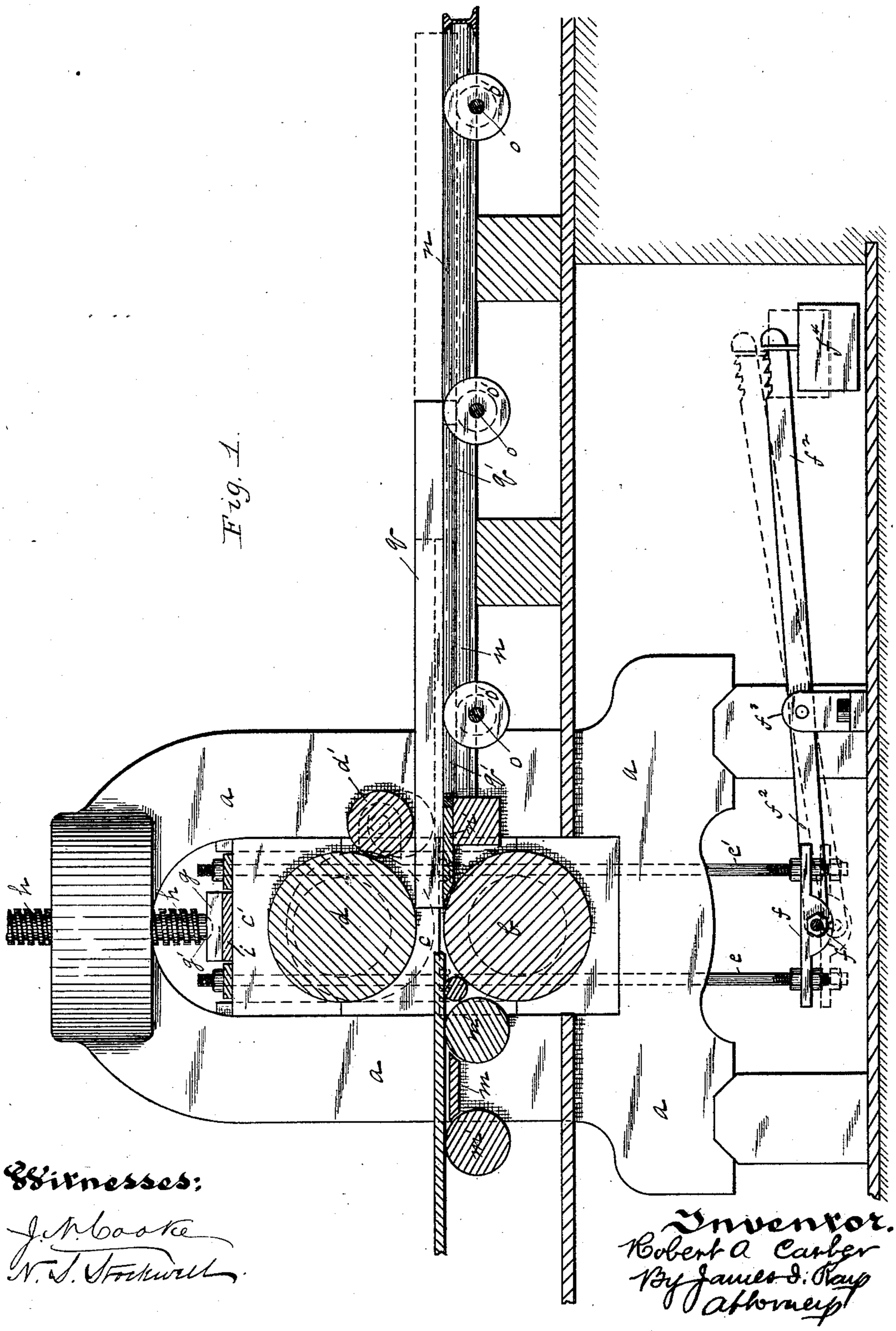

Fig. 1.

Witnesses:
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N. S. Stockwell.

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(No Model.) 3 Sheets—Sheet 2.

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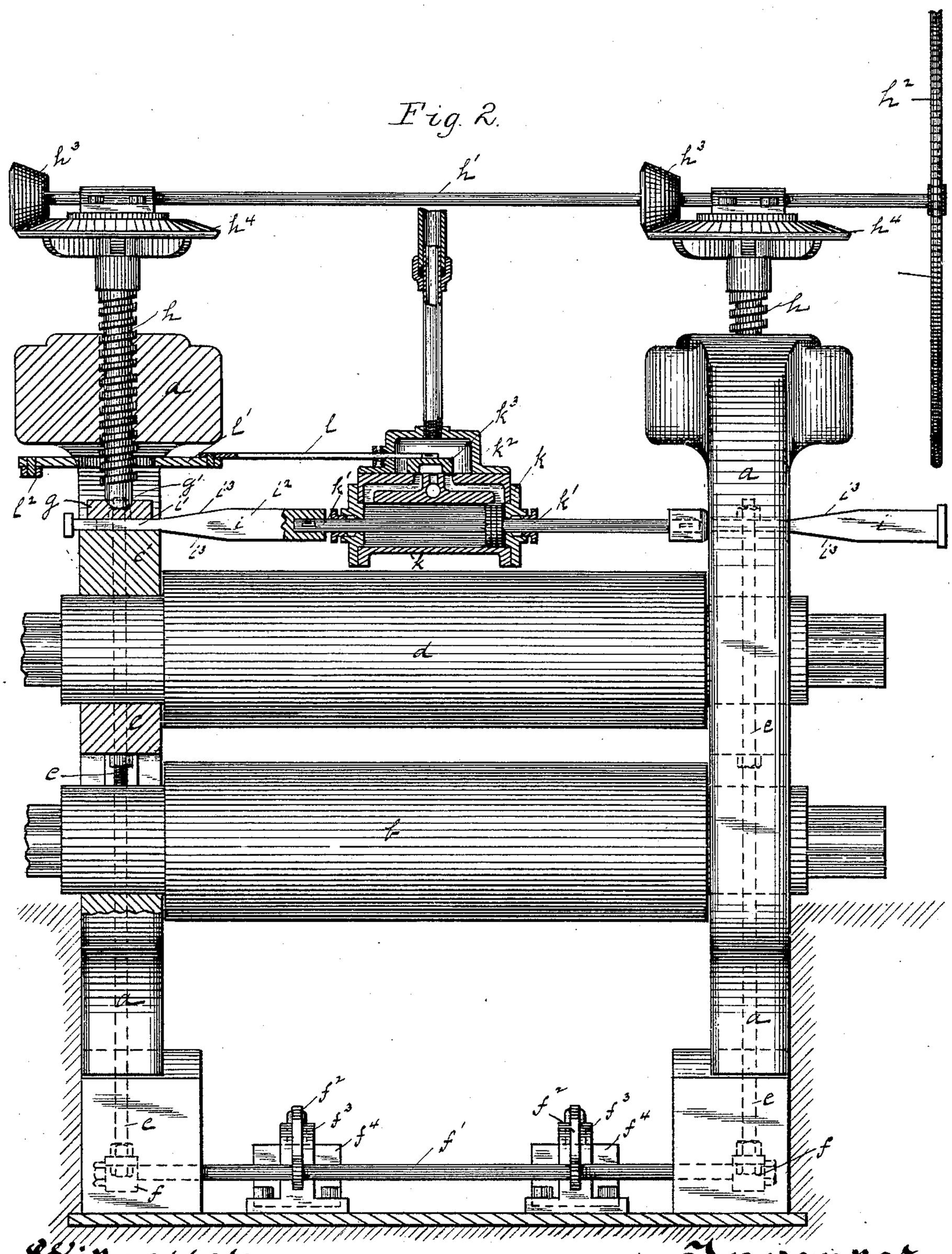
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

R. A. CARTER.

ROLLING MILL.

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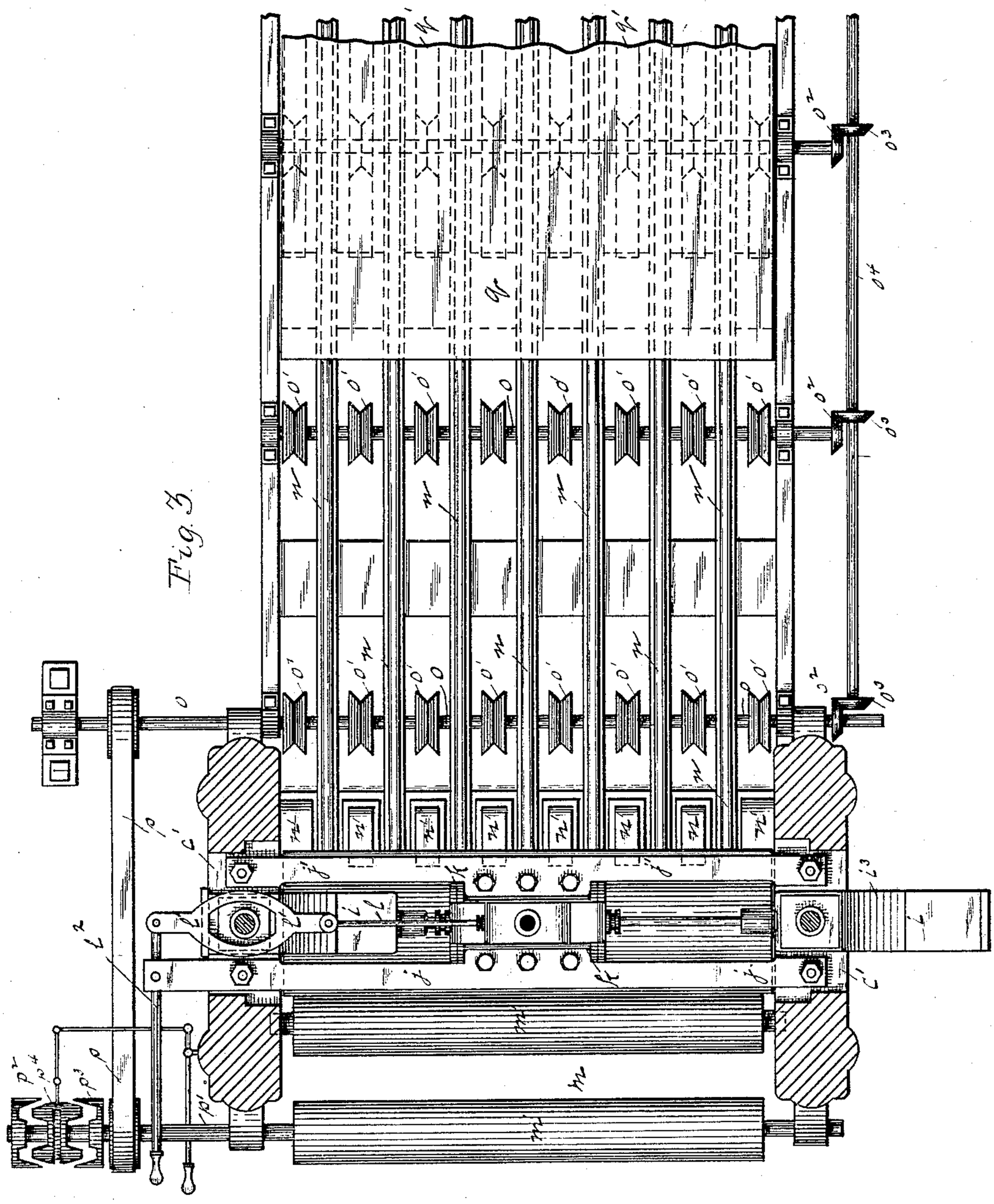

Fig. 3.

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UNITED STATES PATENT OFFICE.

ROBERT A. CARTER, OF PITTSBURG, PENNSYLVANIA.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 390,343, dated October 2, 1888.

Application filed February 23, 1888. Serial No. 264,997. (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 Rolling-Mills; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to rolling-mills, and more especially to those employed in rolling plate and blooming metals.

At the present time there are three different types of rolling-mills employed for these purposes, one consisting of a two-high set of rolls, with a fixed table on one side and a lifting-table on the other, which receives the metal as it comes from the rolls and lifts it up above the upper surface of top roll and dumps it back on the fixed table to be again fed forward to the rolls. Another consists of a three-high set of rolls, with lifting-tables on each side, so that the metal may be passed in one direction through the bottom and middle roll, then raised by the table and passed back between the top and middle roll, where it is received by the table on that side and lowered, so as to be again passed through the lower pass, as before. The third appliance consists of a two-high train coupled to a reversing-engine, so that when the metal has been rolled in one direction the direction of rotation of the rolls can be reversed and the metal again rolled in the opposite direction. The objection to the first of these mills or appliances is that it requires a large number of men to manipulate the metal, and it is almost impossible to handle large sizes of plate—such as armor-plate—with it. The three-high set of rolls with lifting-tables does its work very satisfactorily; but the mill is very costly to build and requires a large amount of power for its operation. With the reversing-mill the heavy expense of its construction, in consequence of the large power of the engines and boilers required, and the excessive wear on the engines and mill are the main objections to its use.

The object of my invention is to provide a mill in which the necessity of lifting the metal is avoided and a two-high set of rolls made available without the reversing of the rolls.

To these ends my invention consists, generally stated, in providing means for separating the rolls after each rolling operation, in addition to the adjusting devices for varying the relative position of the rolls, so that the metal may be pushed back between the rolls after each rolling operation, to be again acted upon when the rolls are brought together; and the invention also consists in a particular form of feed-table for the rolls, as well as certain other improvements, all of which will be more fully hereinafter set forth.

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

Figure 1 is a central longitudinal section of my improved rolling-mill. Fig. 2 is a front view, partly in section, of the same; and Fig. 3 is a plan view, with the tops of the housings removed.

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

The housings *a a* are of the usual or any suitable construction, and they have mounted in fixed bearings therein the lower roll, *b*, and in the sliding bearings *c* the upper roll, *d*, the bearings of the latter also carrying at its back and in frictional contact therewith a small roll, *d'*, whose under surface is nearly in a line with that of the roll *d*. This upper roll, *d*, is balanced, so that its constant tendency is to keep, while unobstructed, in a raised position. To effect this balancing several well-known methods may be employed, one of which is shown in the drawings, and consists in attaching to each bearing *c* of the roll *d* two vertical rods, *e e'*, which extend down through passages in the bearings of the lower roll, *b*, and in the lower part of the housings *a*, and are joined in the pit below the rolls by yokes *f*, which yokes are connected together by a rod, *f'*, that has secured thereto one end of a lever or levers, f^2, fulcrumed at f^3 in the pit below the rolls, and carrying a weight or poise f^4 on its outer end. This weight or poise *f* is sufficiently heavy with its lever-arm to more than counterbalance the roll *d*, and thus keep the latter constantly pressing upward. On the top of each rider *c'* of the upper part of the bearing *c* of the roll *d* is a bearing-block, *g*, having a seat, *g'*, therein, in which bears the end of the adjusting-screw *h*, which serves to vary the distance of the rolls apart to effect the desired reduction in the metal. These adjusting-

screws may be operated by any of the well-known means, the most common of which consists of a shaft, h', having a hand-wheel, h^2, on its outer end, and bevel-pinions h^3, which mesh with bevel-pinions h^4 on the upper ends of the adjusting-screws, so that by turning the hand-wheel any amount of adjustment of the top roll up or down may be effected, as the screws act in opposition to the weight f^4. To effect the quick separation of the rolls at any time without affecting the adjustment of the screws h, or other means employed for this purpose, a tapering wedge or filling-piece, i, is interposed between each bearing-block g and the rider c', so that by forcing said wedge into its maximum width the rolls are held together—that is, so as to form a reducing pass—but by withdrawing said wedge then the roll d will be raised by the balance f^4 and a greater distance between the rolls obtained than the thickness of the metal. I have shown in the drawings a form of wedge or filling-piece which is well-adapted for this purpose. This has a thin parallel side portion, i', and a thicker parallel side portion, i^2, connected to the portion i' by tapering faces i^3, to facilitate the entry of the thicker portion between the block and the rider, the difference between this thicker portion and the thin portion being equal to the amount of separation of the rolls. These wedges, to secure a uniform movement at each end of the roll, are connected together, and they may be operated by any system of hand-levers, if desired. I prefer, however, to operate them by steam or hydraulic pressure, for which purpose there are secured to the top of each rider c' of the roll d the ends of two bars, j j', which support over the middle of the rolls a cylinder, k, which has therein a piston, k', extending through stuffing-boxes in each cylinder-head and being attached at its outer ends to the wedges i.

The cylinder k is provided with a suitable valve-chest, k^2, having an operating-valve, k^3, therein, and with pressure-supply and exhaust pipes, k^4, which are preferably provided with a telescope-joint to provide for the movement of the cylinder with the top of the roll d. To afford a convenient means of operating the valve k^3 from the side of the housings, a rod, l, is attached to said valve at one end, and embraces by a loop, l', the adjusting-screw h, so that it extends out beyond the housings a at its other end, to which is attached by a suitable connection an operating-lever, l^2, pivoted to some suitable support on the side of the housing. The operator can then, by shifting this lever l^2, force the wedges out or in, and thus separate the rolls or bring them to their normal position.

To feed the billet, slab, or plate to and fro during the rolling operation, each side of the rolls is provided with a non-lifting table. On one side of the rolls the table m consists of a series of driven friction-rollers, m', which are geared together and to some moving power, as hereinafter explained. The table on the other side of the rolls consists of a series of bars or rails, n, which extend at right angles to the axis of the rolls and at a suitable distance apart, and between these bars at their inner ends are a series of guides, n', which extend over the rolls b and receive the metal as it comes from the latter, preventing the metal from attempting to follow the roll and falling into the pit below. Back of these guides, and mounted beneath the bars n, are a series of parallel cross shafts, o, which carry V-shaped grooved friction-rollers o', which extend up between the bars n and project slightly above the surface of the latter. The first two or three or more of these cross-shafts are geared together, so that they can be compelled to rotate in whatever direction desired. To effect this, each cross-shaft to be rotated has on its outer end a bevel-pinion, o^2, which meshes with a bevel-pinion, o^3, on the longitudinal shaft o^4, the first of the cross-shafts, or any other suitable one, being connected by a belt, p, to a counter-shaft, p', which has thereon two loose pulleys, p^2 and p^3, that are driven in opposite directions, and a sliding hub-clutch, p^4, which can be thrown into engagement with either of said pulleys, so that the shaft p^3 and its connections may be driven in opposite directions. The counter-shaft p' is also coupled to one of the shafts of the friction-rollers m' of the table m, so that these rollers may also be driven in either direction and correspondingly to the rollers o'. Resting on the rollers o' is a ram or block, q, which has a series of V-shaped ribs, q', on its under side, that fit in the grooves of the rollers o' and serve to give a greater exposure of frictional surface to said rollers to facilitate the movement of the ram or block by the rollers. The ribs q' of this ram do not extend the entire length of the ram, but are cut off near the front of the latter, so as to serve as a stop for the ram by striking against the guides n', and prevent the ram from going too far between the rolls—that is, from going across the line of contact of the rolls.

The manner of operating my improved rolling-mill is as follows: The wedge or filling-pieces i are forced inward, so that their thickest or parallel part is interposed between the blocks and the riders c', and then the adjusting-screw h turned to bring the rolls the right distance apart to secure the desired reduction in the metal. The ram q is also run back to the outer end of the table to give an unobstructed platform in front of it for the receipt of the metal as it comes from the rolls. The slab, bloom, plate, or pile is now laid on the rollers m' of the table m and these rollers started in rotation toward the rolls, which causes the metal to be carried to the pass of the rolls, and to be drawn through the latter by the draft of the rolls, coming out on the other side onto the surface of the bars n and the rollers o'. While the metal is passing from the rolls the smaller roller, d', being driven by its frictional contact with the roll d in the reverse direction from that in which the

metal is moving, it serves to scrape the scale from the upper surface of the metal as it passes onto the bars *n*. When the metal has finally cleared the rolls, the wedge *i* is withdrawn from its seat over the bearings, or until the thin part is in position, which causes the upper roll, *d*, to immediately rise, the amount of the wedge, as heretofore explained, leaving a clear space between the rolls for the free passage of the metal backward therethrough. The ram *q* is now brought forward by throwing the clutch p^4, so that the rollers *o'* will be driven toward the rolls, causing the ram to shove before it the metal between the rolls and over the surface of the bottom roll onto the table *m*, where it is carried back by the rollers *m'*. The effect of pushing the metal back over the lower roll, *b*—that is, moving in opposite direction to that of the metal—is to scrape from the under side of the metal more or less scale formed during rolling. When the metal has been shoved back to the table *m*, the ram *q* is drawn back out of the way and the wedge *i* forced in to bring the rolls *b d* back to their original position. If the operator desires a further reduction of the metal on this pass, he turns the adjusting-screws *h*, as usual. The rolls are now in condition for the next rolling operation. As the wedge *i* always effects a uniform displacement of the upper roll, and the latter always is returned to the same position that it occupied before said displacement, no disturbance of the relative position of the rolls in the successive rollings is effected.

My improved rolling-mill requires but comparatively few men to operate it and no increase in the weight of the appliance or in the power to operate it. At the same time it can be readily applied to many of the existing two and three high mills.

I do not claim in this application the method of rolling the 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. In a rolling-mill, the combination, with mechanism for adjusting the rolls to and from each other, of independent means for effecting a separation of the rolls in addition to that caused by the adjusting mechanism, substantially as and for the purpose set forth.

2. In a rolling-mill, the combination, with means for adjusting the upper roll to and from the lower roll, of a movable filling device interposed between the top of the upper roll and the adjusting mechanism, substantially as and for the purpose set forth.

3. In a rolling-mill, the combination of a balanced upper roll and means for adjusting the same toward the lower roll, with a movable wedge or filling piece interposed between said adjusting mechanism and the upper roll, substantially as and for the purpose set forth.

4. In a rolling-mill, the combination of the balanced upper roll and the screws for adjusting the same to and from the lower roll, with a movable wedge interposed between each adjusting-screw and the top of the roll, substantially as and for the purpose set forth.

5. In a rolling-mill, the combination of the balanced upper roll, *d*, the adjusting-screws *h*, block *g*, against which the screws bear, and a wedge, *i*, interposed between each block *g* and the top of the bearings of the roll *d*, substantially as and for the purpose set forth.

6. In a two-high rolling-mill, the combination, with the upper roll, of a smaller roll carried by said upper roller back of the same and in frictional contact therewith, substantially as and for the purpose set forth.

7. In a rolling-mill, a feed-table composed of fixed bars, and driven feed-rollers interposed between said bars, substantially as and for the purpose set forth.

8. In a rolling-mill, a feed-table composed of bars, and driven feed-rollers interposed between said bars, and a ram or block resting on said rollers and driven by the same, substantially as and for the purpose set forth.

9. In a rolling-mill, the combination, with the rolls, of a receiving-table, and a ram or pusher for pushing the metal over said table, substantially as and for the purpose set forth.

10. In a rolling-mill, a feed-table composed of the bars *n*, grooved friction-rollers *o'* between said bars, means for driving said rollers, and the block or ram *q*, resting on said rollers and moved to and fro by the same, substantially as and for the purpose set forth.

11. In a rolling-mill, the combination of the rolls, and means for separating the same, with a pusher or ram for shoving the metal between the rolls while they are separated, substantially as and for the purpose set forth.

12. In a rolling-mill, the combination, with means for adjusting the upper roll to and from the lower roll, of a movable filling device interposed between the top of the upper roll and the adjusting mechanism, and a pressure-cylinder for moving said filling device, said cylinder being carried with the upper roll, substantially as and for the purpose set forth.

13. In a rolling-mill, the combination of a balanced upper roll, and means for adjusting the same to and from the upper roll, with a movable wedge interposed between each adjusting-screw and the top of the roll, and a pressure-cylinder carried by the bearings of said upper roll and movable therewith, the piston of said cylinder being connected to said wedge, substantially as and for the purposes 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.