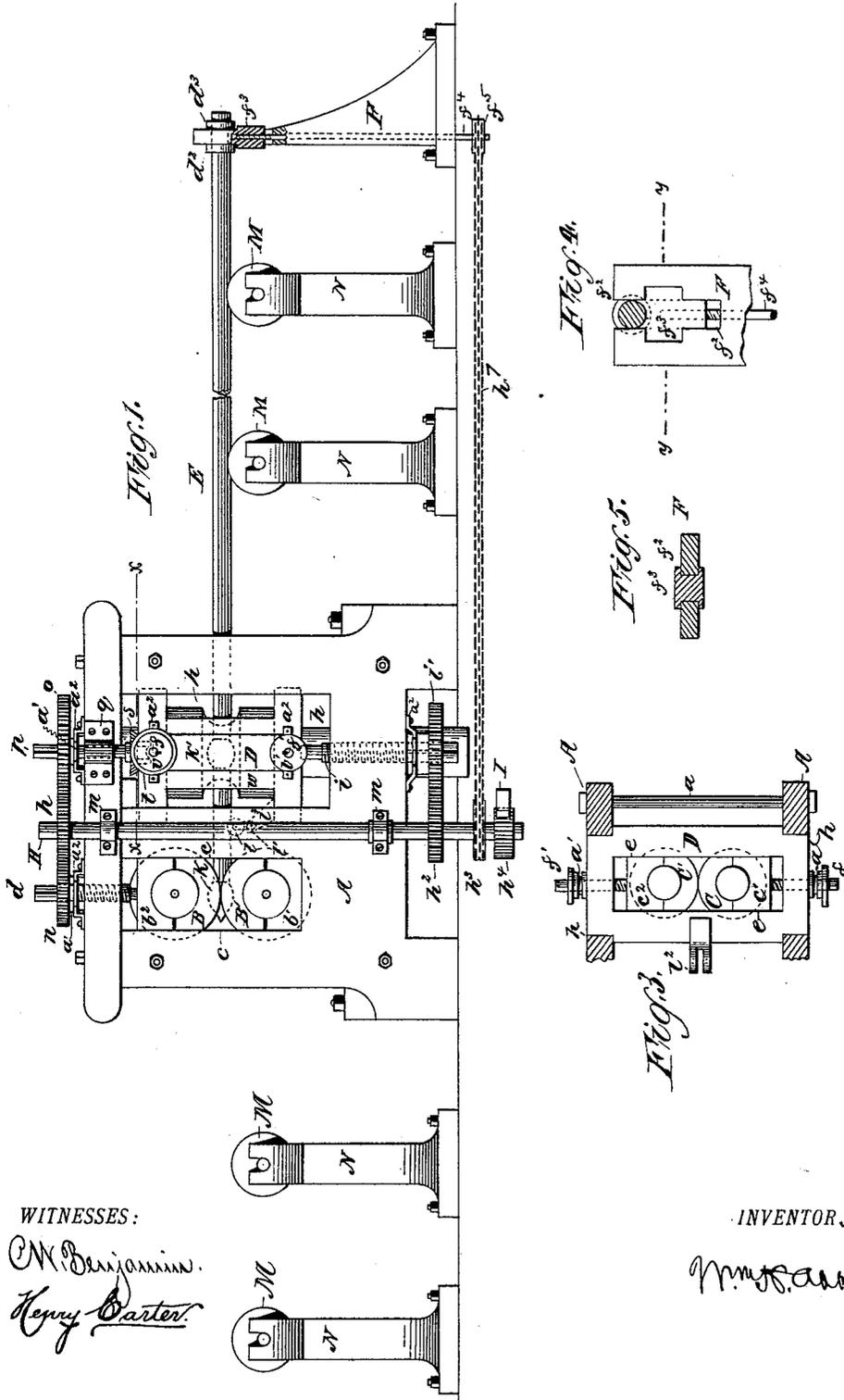


W. H. APPLETON.

ROLLING MILL.

No. 394,635.

Patented Dec. 18, 1888.



WITNESSES:
Wm Benjamin.
Henry Carter.

INVENTOR,
Wm H Appleton

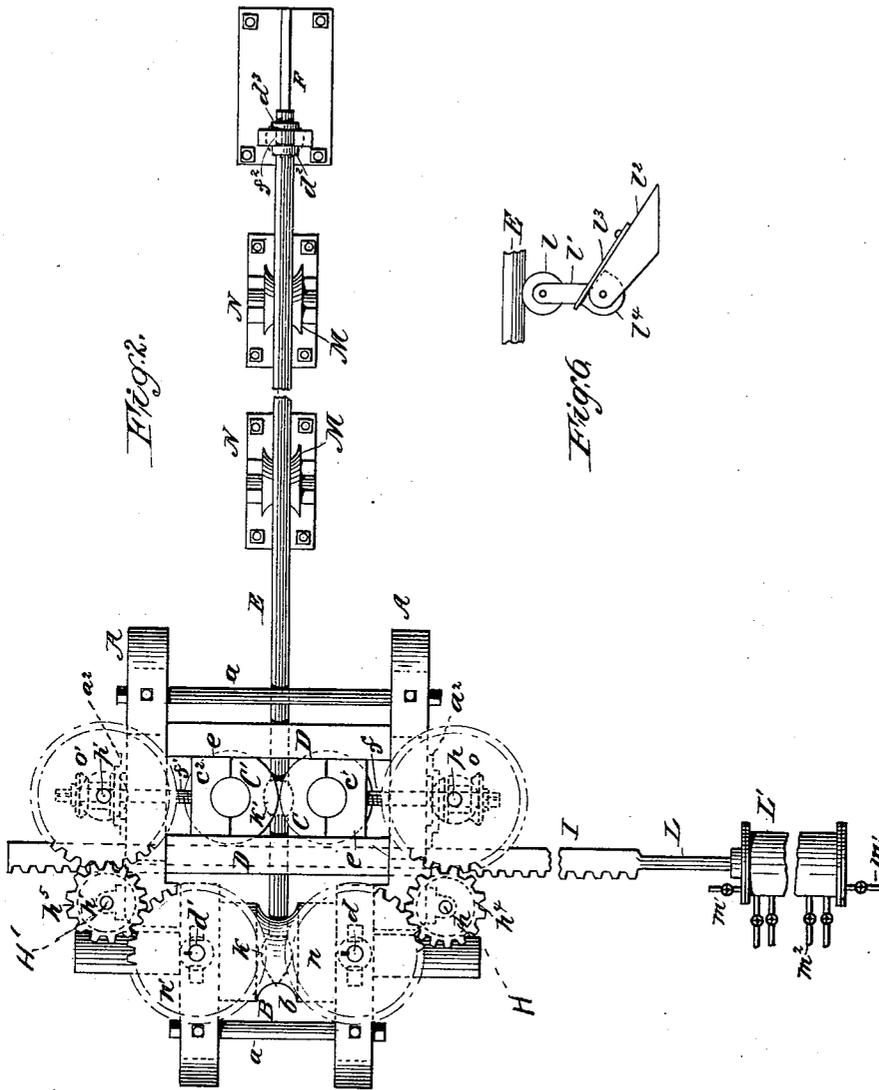
(No Model.)

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UNITED STATES PATENT OFFICE.

WILLIAM H. APPLETON, OF NEW YORK, N. Y., ASSIGNOR TO THE KELLOGG SEAMLESS TUBE AND MANUFACTURING COMPANY, OF BOSTON, MASSACHUSETTS.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 394,635, dated December 18, 1888.

Application filed February 11, 1888. Serial No. 263,703. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. APPLETON, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Machines for Rolling Seamless Tubing, Columns, and other Hollow Articles from Hollow Ingots, of which the following is a specification.

My invention relates to that class of tube-rolling machines in which a pair of horizontal and a pair of vertical rolls are employed in connection with a stationary mandrel which extends between them, and is designed as an improvement upon the machine illustrated in Letters Patent of the United States, numbered 369,311, which were granted to me September 6, 1887, and to which reference may be had.

In the rolling of tubes and other hollow articles with machines of this class it is necessary to maintain at all times the axis of the mandrel in true central relation with respect to the grooves in the rolls or to the bearing-surfaces thereof, in order that the walls of the tube or other article being rolled may be of uniform thickness throughout. In the machine illustrated in the Letters Patent aforesaid this result is accomplished by mounting each of the rolls of both the horizontal and vertical pairs in movable bearings and so connecting and operating their adjustment-screws that in effecting each of the adjustments of said rolls toward and away from the mandrel necessary to the operation of the machine all of such screws will be rotated in unison to the same extent, and the several rolls thereby all be moved to precisely the same distance. This construction, while effective for the purposes stated, necessitates in the operation of the machine the employment not only of the usual rolls or tables for supporting the ingot or other article being reduced as it passes to and away from the machine, but also devices by means of which these supporting rolls or tables may be adjusted and maintained in proper relation with respect to the under roll of the horizontal pair, as the same is adjusted to effect the reduction of the article being rolled. I have

discovered that by mounting this under roll of the horizontal pair in fixed bearings and so supporting the mandrel and the vertical rolls, in addition to the adjustment of the latter toward and away from the mandrel, such mandrel and vertical rolls may have a vertical movement imparted to them of the proper extent at the time the adjustment of the latter and the upper roll of the horizontal pair for reducing the article being rolled is effected. I am able not only to maintain the axis of the mandrel in true central relation with respect to the grooves in the rolls, but also to dispense with the complicated mechanism heretofore made use of for adjusting the supporting rolls or tables.

My invention therefore consists, first, in the mechanism whereby these adjustments of said rolls are effected; second, in the combination, with such rolls and the mechanism for imparting to them their various adjustments, of a mandrel and appliances for causing the same to move vertically in unison with the vertical rolls; and, third, in various other combinations and arrangements of parts, all as will hereinafter more fully appear.

Referring to the accompanying drawings, which form a part of this specification, Figure 1 is a side elevation of a tube-rolling machine with my invention applied thereto, a portion of the bracket for supporting the rear end of the mandrel being shown in section; Fig. 2, a plan view of the same; Fig. 3, a section taken on the line xx of Fig. 1, showing the frame for supporting the vertical rolls and the manner of mounting the same in the housing of the machines; Fig. 4, a detail showing the upper portion of the bracket for supporting the rear end of the mandrel, which is illustrated in section; Fig. 5, a section taken on the line yy of Fig. 4, and Fig. 6 a detail showing the devices by means of which the inner or free end of the mandrel is supported.

In all the figures like letters are employed to designate corresponding parts.

A A indicate standards or housings, which are or may be connected by cross-bars a , and B B' the upper and under rolls, respectively, of the horizontal pairs mounted therein. These rolls are each preferably provided with

a circumferential groove, *b*, in its periphery, which is of the proper shape in cross-section to conform to the outer contour of the article being rolled, and the under roll, *B'*, thereof is so mounted as to be incapable of any vertical movement either in an upward or downward direction, its boxes *b'* being fixedly and immovably secured in the lower end of the guideways *c c*, formed in the standards or housings *A A*. The upper roll, *B*, of this pair, on the other hand, in order to provide for the proper adjustment to effect the reduction of the ingot and the production of the finished article, is mounted in bearings *b²*, which are movable in said guideways and may be lowered and raised to adjust such roll toward and away from the under roll, as may be required in the operation of the machine by means of screws *d d'*.

Located in the rear of the horizontal rolls *B B'* are the vertical rolls *C C'*, which, like the former, are each provided with an appropriately-shaped circumferential groove in its periphery. These rolls are mounted in bearings *c' c²*, which are fitted to slide in suitable guideways, *e e*, and are adjustable therein to carry said rolls toward and away from each other by means of screws *f f'*.

The under roll, *B'*, of the horizontal pair, as before indicated, being mounted in fixed bearings, and the adjustment of the rolls of such pair necessary to the operation of the machine being effected wholly by the movement of the upper roll thereof toward and away from the same, it follows that the center or axis of the figure formed by the grooves in said rolls at the point where the latter operate upon the material is constantly being changed from a higher to a lower plane, and vice versa, according as such upper roll is moved toward or away from the under roll. In order, therefore, to maintain at all times, as is essential, the axis of the figure formed by the grooves in the vertical rolls at the point of their nearest approach in coincidence with the movable axis of the figure formed by the grooves in the horizontal rolls, it becomes necessary to so mount such vertical rolls that in addition to their movements toward and away from each other they shall be caused to rise and fall to the proper extent in unison with the upper roll, *B*. Instead, therefore, of forming the guideways *e e*, which receive and guide the bearings *c' c²* of the vertical rolls, in the standards or housings *A A*, or in a stationary part thereof, I find it convenient to form such guideways in the upper and under sides of a frame, *D*, which is fitted to slide in guideways *h h*, formed in the standards or housings *A A*, and to raise and lower it therein by means of screws *i i*.

Projecting between the rolls of both the vertical and horizontal pairs, and resting centrally within the grooves formed therein, is the mandrel *E*, over and from which the article being rolled is alternately forced and withdrawn, the same being constructed either solid

or tubular, as may be preferred, and provided at appropriate points opposite the bites of the rolls with enlargements *k k'*, in which may be arranged rolls, if desired, as shown in Fig. 3 of the Letters Patent, to which reference has been made. This mandrel, instead of being supported at all times in the same horizontal plane, is so mounted that while restrained from all longitudinal movement it is, like the vertical rolls *C C'*, raised and lowered in unison with the upper roll, *B*, of the horizontal pair in order to maintain it in true central relation with respect to the grooves in said pair in whatever position its upper roll may be adjusted. To accomplish this result, I employ the bracket *F* and pulley *l*, the former of which is provided in its upper end with an open slot, *f²*, in which is fitted to slide a movable bearing, *f³*, that is raised and lowered therein at the proper times by means of a screw, *f⁴*, and the latter is journaled in the upper end of an arm, *l'*, which is jointed at its lower end in a stand projecting upward from the movable frame *D*. The rear end of the mandrel rests upon the movable bearing *f³* within the open slot *f²*, and is provided with two collars, *d² d³*, which are placed on opposite sides of the upper portion of the bracket *F*, and serve with the latter to prevent the mandrel from moving longitudinally, while its inner or free end rests upon the pulley *l*.

The normal position of the arm *l'*, which supports the pulley *l*, is vertical, as shown in Figs. 1 and 6, being held therein by means of the spring *l²*, resting upon the cam *l⁴*, secured to its side, but may be swung to the right or left on its pivot to carry its pulley down and away from the article being rolled, when such pulley is struck by the article as it passes on and off the mandrel. By these means, as will be seen, provision is made not only for restraining the mandrel from all longitudinal movement, but also for raising and lowering it to the proper extent at the times required, the roll *l'*, mounted upon the movable frame *D*, partaking of the rising-and-falling movement of the same, and the movable bearing *f³* being elevated and depressed by the action of the screw *f⁴*.

The devices for effecting the various adjustments of the rolls, as well as the rising and falling movements of the mandrel, may be operated separately or connected by suitable mechanism and moved together, as desired. This last-mentioned arrangement I prefer in practice, since thereby not only are the adjustments of the various parts effected simultaneously, but the exact relative movement and position of each with respect to the other or others is at all times insured. To this end I employ the vertical shafts *H H'*, which are mounted in suitable bearings, *m m*, upon opposite sides of the machine, and are provided at their upper ends with spur-gears *h h'*, respectively, and at a point near the lower end of each with a similar gear, *h²*, the shaft *H*, in addition thereto, carrying at a point still

lower down a wheel, h^3 . The gears $h h'$, respectively, mesh with the gears $n n'$ appropriately fitted to the upper end of the adjusting-screw $d d'$, and also with the gears $o o'$, appropriately fitted to the upper ends of the short shafts $p p'$, which are supported in suitable hangers, $q q$. These short shafts each carry at its lower end a bevel-gear, s , which engages with a similar bevel-gear, t , fitted to the end of each of the adjusting-screws $f f$, which in turn are connected with the screws $f' f'$ below through the instrumentality of the wheels $v v'$ and chains $w w$. Similarly the gear h^2 meshes with the gears i' , secured to the lower end of the screws $i i$, while the wheel h^3 , through the medium of the chain h' , is connected with a wheel, f^5 , secured to the lower end of the screw f^4 , and thus, through the train of mechanism as here described, the several devices made use of for effecting the adjustments of the various rolls, as well as for raising and lowering the mandrel, are all connected with the shafts $H H'$, and are all simultaneously operated therefrom.

In making the adjustments necessary to the operation of the machine, the vertical movements of the rolls $C C'$ and the mandrel E will be only one-half of that imparted to the former and the rolls B by the screw $f f'$ and $d d'$, respectively, the various gears, wheels, and pitches of the screws being so proportioned as to effect that result.

The gears $n n' o o' i' i'$ and wheels $v v'$, instead of being rigidly secured to their respective screws and shafts, are connected thereto by grooves and feathers, so that while compelling these latter to rotate with them said screws and shafts are yet free to move longitudinally therethrough to adapt themselves to the various adjustments to which they may be subjected, and in order to maintain such gears and wheels at all times in the same position they are each provided with a circumferential groove, a' , in its hub, which engages lugs a^2 , secured to the standards or housings $A A$ and frame D in proper relation with respect thereto.

To connect and operate the two vertical shafts $H H'$, so as to cause them not only to rotate in unison, but also to move to the same extent, various devices may be employed. The means, however, made use of by me for this purpose consists of a rack, I , which meshes with gears h^4 and h^5 , of the same diameter, secured to the lower ends of said shafts, respectively, and is moved back and forth to the proper extent at the times required by a piston-rod, L , from a steam-cylinder, L' , which is provided with suitable induction and education pipes, $m' m^2$, and is or may be of the form of that employed for the same purpose in the machine illustrated in the Letters Patent aforesaid, and requires no further description herein.

$M M$ indicate the rolls, by means of which the article being rolled is supported and carried to and away from the machine, and $N N$

the standards in which they are supported. These rolls are preferably constructed with a circumferential groove of circular form in the periphery of each, the bottom of which is maintained at all times at the proper elevation with respect to the groove in the roll B' of the horizontal pair by their standards N , which may be each constructed of a single piece of metal, as shown or otherwise.

I have not thought it necessary to illustrate more than four of these rolls, two of which are arranged in front and two in the rear of the machine; but it is to be understood that in practice this number will be increased; or, if preferred, stationary tables or troughs may be employed in lieu thereof.

By the construction above set forth it will be seen that I produce a machine for rolling tubing and other hollow articles in which not only is the complicated mechanism heretofore employed for adjusting the supporting rolls or tables with respect to the different positions assumed by the movable under roll omitted, but the apparatus as a whole simplified and in some respects rendered more effective.

In the foregoing I have described the best means contemplated by me for carrying my invention into practice; but I wish it distinctly understood that I do not limit myself strictly thereto, as it is obvious that I may modify the details thereof in various ways without departing from the spirit thereof—as, for instance, if desired, instead of mounting the under roll of the horizontal pairs in stationary bearings I may arrange one of the vertical rolls in stationary bearings, in which event the horizontal rolls will, in addition to their movement toward or away from each other, be so disposed as to move laterally in unison with the mandrel, the vertical movement of the vertical rolls and of said mandrel being omitted.

Having thus described my invention and one way in which it is or may be carried into effect, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the under horizontal roll mounted in stationary bearings, the upper horizontal roll mounted in movable bearings, and devices for adjusting the latter roll toward and away from the former, of a pair of vertical rolls, a mandrel, and mechanism for adjusting said vertical rolls toward and away from each other and for imparting to them a vertical movement, substantially as described.

2. The combination, with the under horizontal roll mounted in fixed bearings, the upper horizontal roll mounted in movable bearings, and devices for adjusting the latter toward and away from the former, of a pair of vertical rolls, a mandrel, and mechanism for adjusting said vertical rolls toward and away from each other and for imparting to them and to the mandrel a vertical movement, substantially as described.

3. The combination, with a circumferentially-grooved under horizontal roll mounted in fixed bearings, a circumferentially-grooved upper roll mounted in movable bearings, and devices for adjusting the latter roll toward and away from the former, of a pair of circumferentially-grooved vertical rolls, a mandrel extending between the rolls of both pairs, and mechanism for both adjusting the rolls of said vertical pair toward and away from each other and for imparting to them and to the mandrel a vertical movement, whereby to maintain them in proper relation with respect to the horizontal rolls, substantially as described.

4. The combination, with the under horizontal roll mounted in fixed bearings, an upper roll mounted in movable bearings, supports for the article being rolled as it passes to and away from the machine arranged at a fixed elevation, and devices for adjusting said upper roll toward and away from the under roll, of a pair of vertical rolls, a mandrel, and devices for both adjusting said vertical rolls toward and away from each other and for im-

parting to them and to the mandrel a vertical movement, substantially as described.

5. The combination, with a horizontal roll mounted in fixed bearings, and a horizontal roll mounted in movable bearings, and devices for moving the latter roll toward and away from the former, of a mandrel and mechanism for raising and lowering the same to maintain it in proper central relation with respect to said rolls, substantially as described.

6. The combination, with a roll mounted in fixed bearings, a companion roll mounted in movable bearings, and devices for adjusting the latter roll toward and away from the former, of a mandrel and mechanism for moving it transversely of its axis to maintain it in proper relation with respect to the rolls, substantially as described.

In testimony whereof I have hereunto set my hand this 7th day of February, 1888.

WILLIAM H. APPLETON.

Witnesses:

W. W. HICKEY,
HENRY CARTER.

Corrections in Letters Patent No. 394,635.

It is hereby certified that in Letters Patent No. 394,635, granted December 18 upon the application of William H. Appleton, of New York, New York, for an invention in "Rolling Mills," errors appear in the printed specification requiring correction as follows: In line 54, page 1, the word *that* should be inserted after the word "and" and in line 61, page 1, the period after the word "effected" should be stricken out and a comma inserted instead; and that the said Letters Patent should be read with the above corrections therein to conform to the papers pertaining to the case in the Patent Office.

Signed, countersigned, and sealed this 25th day of December, A. D. 1888.

[SEAL.]

H. L. MULDROW,
First Assistant Secretary of the I

Countersigned:

BENTON J. HALL,
Commissioner of Patents.