(No Model.) 2 Sheets—Sheet 1.

W. H. APPLETON.

MACHINE FOR ROLLING SEAMLESS TUBING FROM HOLLOW INGOTS.

No. 412,011. Patented Oct. 1, 1889.

Fig: 1.

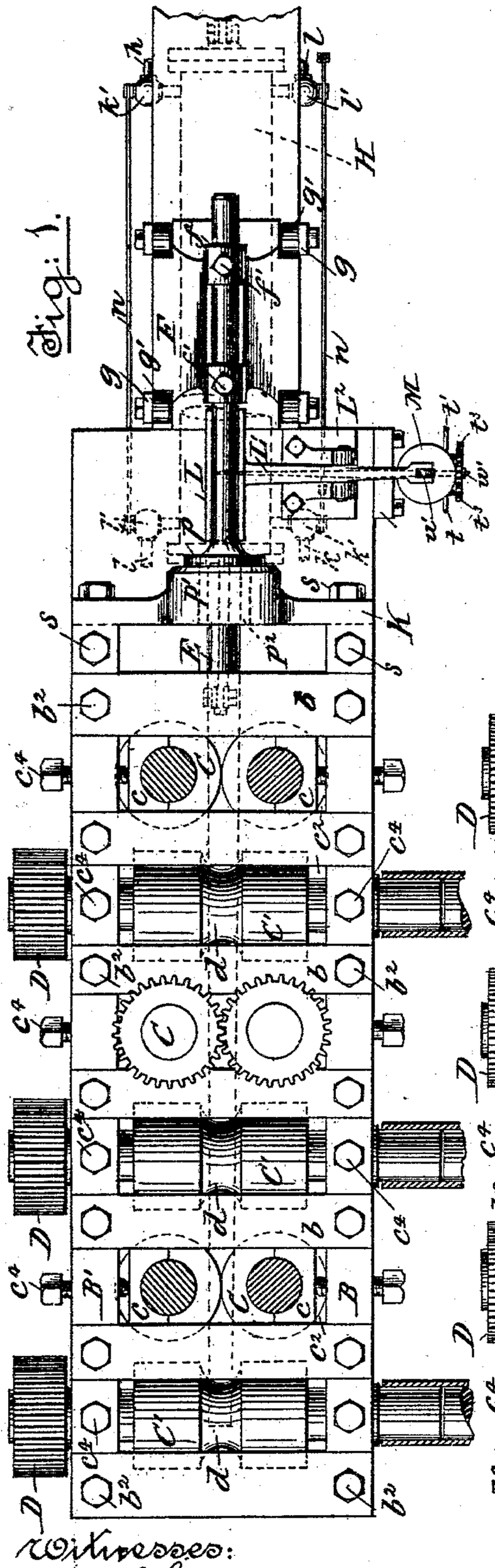
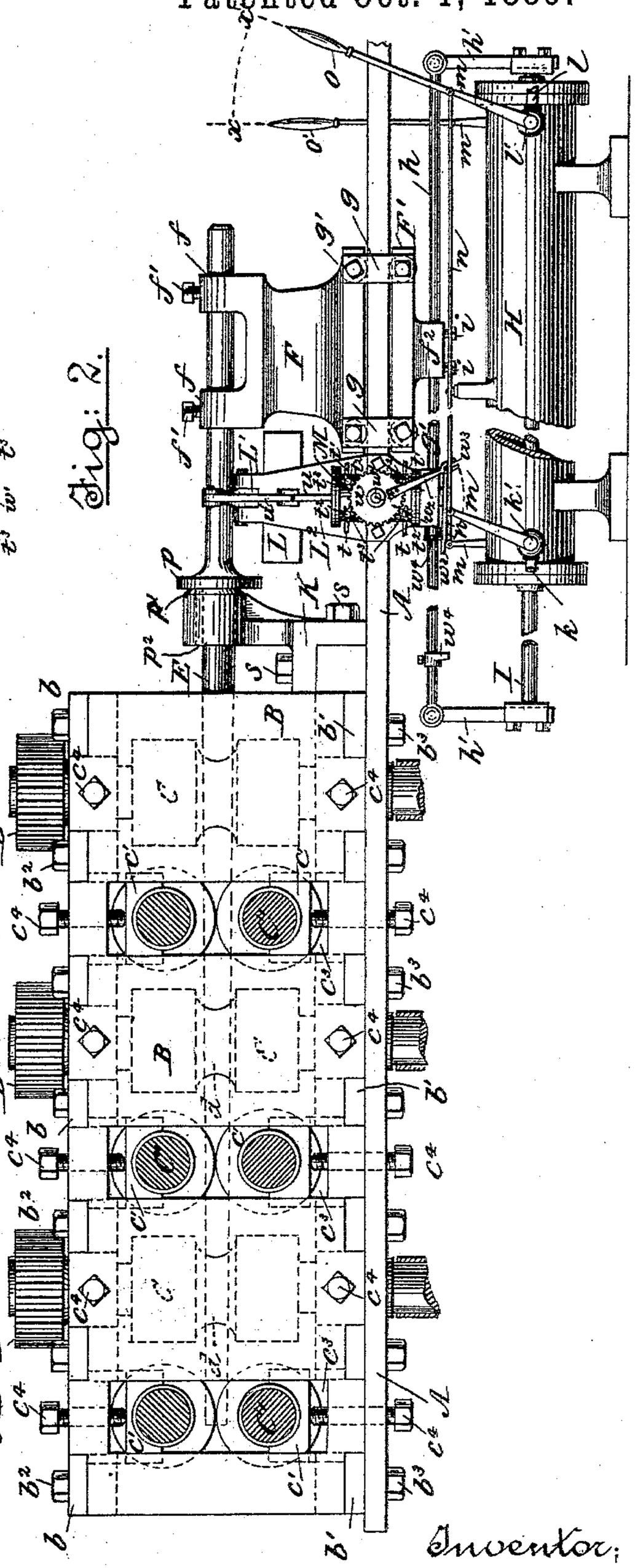


Fig: 2.



Witnesses:
John A. Penne
Henry Carter

Inventor;
Wm. H. Appleton

(No Model.) 2 Sheets—Sheet 2.

W. H. APPLETON.

MACHINE FOR ROLLING SEAMLESS TUBING FROM HOLLOW INGOTS.

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Fig. 7.

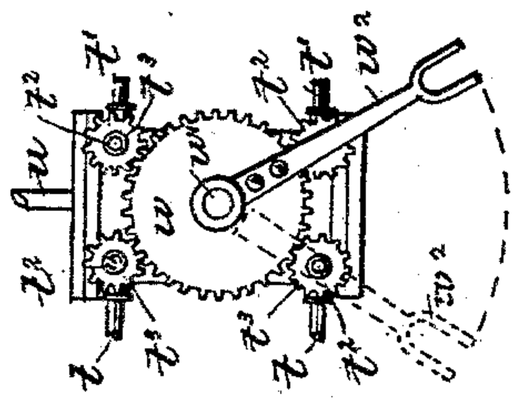

Fig. 8.

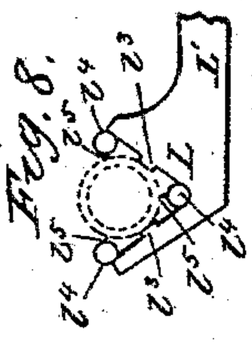

Fig. 6.

Fig. 5.

Fig. 4.

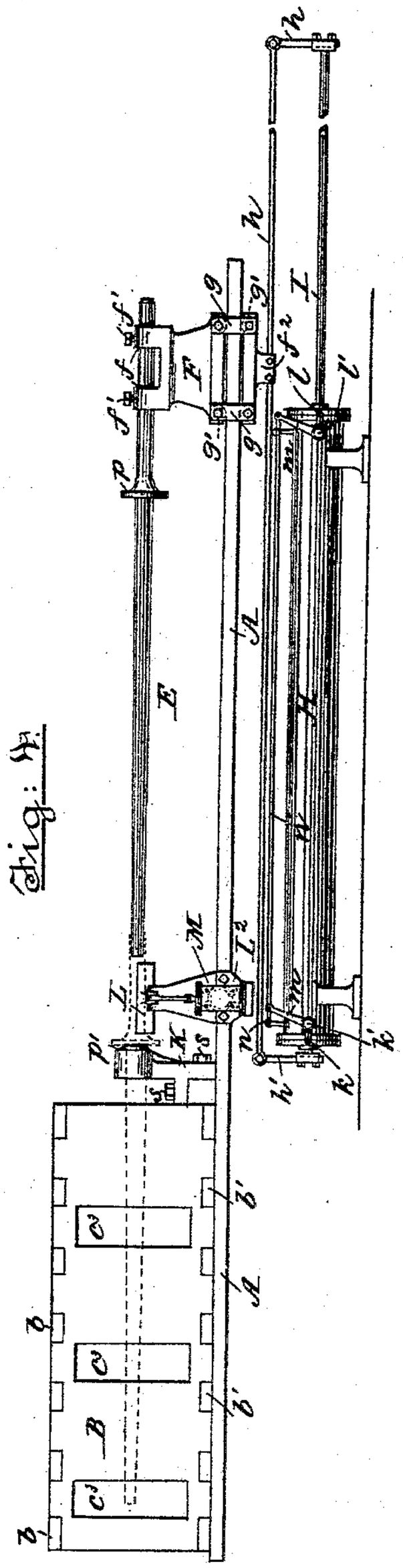

Fig. 3.

Witnesses:
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UNITED STATES PATENT OFFICE.

WILLIAM H. APPLETON, OF NEW YORK, N. Y.

MACHINE FOR ROLLING SEAMLESS TUBING FROM HOLLOW INGOTS.

SPECIFICATION forming part of Letters Patent No. 412,011, dated October 1, 1889.

Application filed November 2, 1888. Serial No. 289,817. (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 machines in which a plurality of pairs of rolls are employed in connection with a mandrel extending between them, its object being to produce a machine of this class which shall not only be simple in construction and convenient in operation, but shall at the same time hold the mandrel during the rolling operation more securely than is possible with the machines heretofore in use.

To this end my invention consists, first, in the means whereby the mandrel is supported and its insertion between the reducing-rolls and withdrawal therefrom effected; second, in the combination, with a plurality of pairs of rolls and a mandrel for co-operating with them, of devices whereby the mandrel may be inserted between the rolls and withdrawn therefrom; third, in the combination, with a plurality of pairs of reducing-rolls, a mandrel for co-operation therewith, and devices for both supporting said mandrel and effecting its insertion between and withdrawal from such rolls, of devices for supporting an ingot in proper position to permit of the mandrel passing through its orifice when inserted between the rolls, and, fourth, in various other constructions and combinations of parts, all as will hereinafter more fully appear.

Referring to the accompanying two sheets of drawings, which form a part of this specification, Figure 1 is a plan view of a machine embodying my invention, some of the parts being shown in section, and the driving mechanism for the rolls omitted; Fig. 2, a side elevation thereof, the driving mechanism for the rolls being omitted, as in the preceding figure; Fig. 3, an end elevation of the machine, looking toward the left in Figs. 1 and 2, the same parts being omitted as in said figures; Fig. 4, a side elevation showing the mandrel and devices for supporting and operating it, the devices for supporting the ingot, and the housings of the machine; Fig. 5, a similar view showing a slightly-modified form of both mandrel and mandrel inserting and withdrawing devices; Fig. 6, a detail in plan of a portion of the mandrel inserting and withdrawing devices shown in Fig. 5; Fig. 7, a detail showing the cylinder for operating the holder for the ingots and the appliance by means of which its several valves are operated; and Fig. 8, a detail showing a modified form of the holder, by means of which the ingot is presented to the mandrel at the proper time.

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

A indicates the base-plate or support upon which are or may be mounted the main housings of the machine, the same preferably consisting of the two side frames or members B B′, which are connected by cross-pieces *b* *b*′, extending across from one to the other, and being secured thereto by suitable screws or bolts b^2 b^3.

C C′ indicate the rolls through the instrumentality of which the reduction and transformation of the ingots are effected, the rolls C being arranged to turn upon vertical axes and the rolls C′ upon horizontal axes. These rolls will be made either smooth upon their peripheries or provided with appropriately-shaped circumferential grooves, as the nature of the work in which they are to be used may demand. When employed in the manufacture of articles having a square or rectangular form in cross-section they will preferably be made smooth; but when used in the rolling of cylindrical or polygonal forms they will be provided with grooves *d* of appropriate contour in cross-section to conform thereto. The rolls of both the vertical and horizontal series are arranged in pairs and are so placed as to bring them into alternate relation with, for instance, a pair of horizontal rolls following a pair of vertical rolls, and a pair of vertical rolls following a pair of horizontal rolls, and so on throughout the train. As thus disposed the vertical series are mounted in bearings *c*, which are fitted to suitable guideways c^2, formed in the upper and under sides of the housings, and the rolls of the horizontal series in bearings *c*′, likewise fitted to appropriate guideways c^3 in the upright sides thereof, the bear-

ings for both the vertical and horizontal series being adjustable in their respective guideways by means of screws c^4, whereby to bring the rolls into proper relation.

D indicates the gears by means of which the rolls of each pair are connected and caused to rotate in unison. These gears are preferably of the spur form and are so proportioned as to insure the same surface velocity of the companion rolls of each pair; but, while the rolls of each pair are thus moved at the same velocity the rolls of the different pairs are caused to travel at different speeds, the first or entering pair moving at one velocity, the next pair at a greater surface speed, and the succeeding pair at a still further accelerated velocity, and so on throughout the train, each successive pair moving enough faster than the preceding pair to not only take up the same amount of ingot as the preceding pair, but also the elongation due to its action thereon. The means whereby the several pairs of rolls are operated and this differential velocity imparted to them, however, has not been illustrated herein, as the same forms no part of my present invention, but is or may be of the form shown and described in an application for Letters Patent filed by me of even date herewith, to which reference may be had.

E indicates the mandrel over which the ingot is passed and the completed article produced. This mandrel may be of uniform diameter throughout or tapering, as desired. I prefer, however, to make it of tapering form, or at least that portion of it over which the ingot passes as its transformation is being effected, and to so mount it that while held in true central relation with respect to the rolls it is yet free to be withdrawn from between them and afterward inserted, as may be required. To effect this mounting, I find it convenient to employ the carriage F in suitable sockets or seats f f, in the upper portion of which such mandrel is secured by means of screws f' f'. This carriage may be supported in various ways, as shown in the drawings. However, it is fitted to slide upon the base-plate A and is held in proper position thereon by means of the plate F′, arranged beneath the same, and either forming a part of said carriage or being connected thereto by strap or connections g g, suitable rollers g' g' being arranged between the carriage and plate and the base-plate to reduce the friction of such parts thereon to the minimum as they are moved back and forth over it in the operation of the machine. As thus mounted the withdrawal of the mandrel from between the rolls and its insertion may be effected either by hand or by power. I prefer, however, to employ power for this purpose, as greater efficiency of the machine is thereby attained, and in its application various forms of mechanism may be adopted. The form preferred by me, however, consists of a steam-cylinder H of proper length, having fitted within the same a suitable piston, to the rod I of which is connected the carriage F through the intermediary of a rod h and arms h' h', the former of which passes through an orifice in the lug f^2, depending from the under side of the carriage or plate F′, and is secured therein by means of screws i i, as shown. By this arrangement of parts, as will be seen, the movement of the mandrel will be effected directly from the piston, the action of the steam or other agent against one side of the latter serving to withdraw the mandrel from between the rolls, and its action upon the other side to insert it therebetween. In order, therefore, to govern the flow of steam or other agent to accomplish these results, I find it convenient to provide the cylinder H at each of its ends with both an induction-pipe k and an eduction-pipe l, which are each equipped with a suitable valve, as shown, for instance, at k' and l', respectively, in Fig. 1. These several pipes are so arranged that while the induction and eduction pipes at the same end of the cylinder are located upon opposite sides of its axis those upon opposite ends of the cylinder are situated upon the same side, and their valves are connected by means of the arms m m and a rod n, whereby to insure their opening and closing in unison. The means whereby this opening and closing of the valves is effected may be of various kinds. I prefer, however, to employ the levers o o' as being the most simple and convenient for this purpose, the lever o in the construction shown being connected to the arm m of the valve l' and the lever o' to the corresponding arm of the valve k', both of which valves are located at the outer end of the cylinder H; but, if preferred, such levers may be applied to the arms m of the valve of the inner end of the cylinder, in which event the lever o would be secured to the arm of the valve k' and the lever o' to the corresponding arm of the valve l'.

As thus constructed and arranged the withdrawal of the mandrel from between the rolls will be effected by opening the valves of both the induction-pipe k, which is located at the inner end of the cylinder, and of the eduction-pipe at the outer end thereof by turning the lever o into the position shown in full lines in Fig. 2. This operation will admit the steam or other agent to the front end of the cylinder, which, acting upon the piston, will force it back, carrying with it the carriage and mandrel to the desired extent, when the said valves will both be closed by turning the lever into the position shown in dotted lines in said figure, and the further movements of the parts arrested. The insertion of the mandrel between the rolls when withdrawn, on the other hand, will be accomplished by opening the valves of both the induction-pipe k, which is arranged near the outer end of the cylinder, and of the eduction-pipe l, located near the inner end of the same, by turning the lever o' into the position indicated in

dotted lines in Fig. 2. This will permit the steam or other actuating agent to pass into the rear of the cylinder, thus forcing the piston inward toward the machine, carrying with it the carriage F, and inserting the mandrel between the rolls, the steam or other actuating agent in front of the piston passing out through the eduction-pipe at the inner end of the cylinder. When the parts have reached the desired point in their inward travel, the valves which were opened at the commencement of the movement will be closed by turning the lever *o'* into the position shown in full lines in the figure last mentioned, when the inflow of the actuating agent to the cylinder will be cut off and the further movement of the parts will be suspended.

In Figs. 1, 2, and 4 the mandrel is shown in the two positions it will occupy when at the extreme of its movements in the two directions, the last figure illustrating it as fully withdrawn from between the rolls and in place to receive a fresh ingot, and the two former figures showing it as inserted between the rolls and in the situation it will occupy during the time the ingot is undergoing the process of reduction and transformation. To hold the mandrel in this last-mentioned position against the strain put upon it by the ingot as the latter is withdrawn from the former, the carriage alone may be employed, in which event a suitable stop against which the carriage will abut when in its extreme inward position will be necessary. I prefer, however, to make use of special means for this purpose, in order to insure a more positive holding of the mandrel than is possible with the carriage when alone employed, and to this end I provide the said mandrel near its rear end with a collar or flange *p*, which co-operates with a suitable stop *p'* carried by the cross-bar or girt K, extending across from one side of the housing to the other and being secured thereto by means of screws *s s*, or otherwise. This stop may be constructed so as to afford a surface against which the collar or flange will abut upon that portion of it alone which is below the axis of the mandrel, or against which the entire surface may bear, if preferred. In the embodiment of the invention shown in the drawings this last-mentioned construction has been adopted, the said stop being made of proper form to surround the mandrel with an orifice p^2 through it sufficiently large to permit of the ingot passing therethrough. Provisions are thus made whereby the said mandrel will be held against longitudinal strain with great firmness and security.

The means whereby the ingots are presented and held for the mandrel to pass through when being inserted between the rolls may be of various forms. In the form of construction illustrated in Figs. 1, 2, and 3 it consists of a holder L, which is secured to the inner end of a lever L', pivoted in the upper end of a standard or bracket L, which in turn is secured to the base-plate A', or other suitable support, by screws or otherwise. This holder will preferably be provided in its upper side with a V-shaped groove for reception of the ingot, and in its normal position will rest some distance below the mandrel, as shown in dotted lines in Fig. 3. In this position it will receive the ingot, after which it will be presented to the mandrel by raising said holder to the position shown in full lines in said figure. The raising and lowering of this holder for the purpose of presenting the ingot to the mandrel, and afterward for placing it in position to receive a fresh ingot, may be effected by hand, if desired. I prefer, however, to accomplish it by power, and to this end I employ the cylinder M, to the piston arranged in which the rear end of the holder-supporting lever is connected by the rod *u* and pitman *u'*. This cylinder, like the cylinder H, is provided at each of its ends with an induction-pipe *t* and an eduction-pipe *t'*, (see Fig. 7,) in each of which is arranged a suitable valve t^2, that carries at the end of its stem a small pinion t^3, which meshes with a gear *w*, mounted upon a stud *w'*, projecting from the cylinder or other support. As thus arranged provision is made whereby the valves of all the pipes, both induction and eduction, are operated in unison, the oscillation of the gear *w* in one direction serving to open the valve of the induction-pipe and close the valve of the eduction-pipe at one end of the cylinder and to close the valve of the induction-pipe and open the valve of the eduction-pipe at the other, while its oscillation in the opposite direction will reverse these operations, opening the valves which were closed at the former oscillation and closing those that were opened thereby.

In order to provide for the oscillation of the gear *w*, and through it for the automatic operation of the valves t^2 in the induction and eduction pipes *t t'*, the said gear is equipped with an arm w^2, which engages at its lower end with the outer extremity of a lever w^3, pivoted to the under side of the bracket or standard L and having its inner extremity lying in the path of the dogs w^4, secured to the rod *h* in such a manner as to be struck by them, and thereby vibrated upon its pivot as they travel back and forth in the operation of the machine. This vibration of the lever w^3 will be communicated through the arm w^2 to the gear *w*, which will be oscillated thereby, and through it the several valves in the cylinder M will be operated.

In Figs. 5 and 6 I have shown a mandrel of slightly-modified construction, the same being made up from a number of short cylindrical sections *e e'*, &c., the diameter of each of which from the outer to the inner or free end of the mandrel being made of a less diameter than the preceding one, and their several lengths being such as to bring their inner ends into the bites of their respective pairs

of rolls or slightly in rear thereof when inserted between them. With this peculiarly-shaped mandrel is also shown in said figures a modified arrangement of parts for operating its supporting-carriage, the same consisting of the screw N, which, passing through a suitable threaded nut or projection a, depending from the under side of said carriage, is rotated back and forth to withdraw and insert the mandrel from and between the rolls from a pulley a' through the intervention of the bevel-gears a^2 a^3, shaft a^4, pulley a^5 fast thereon, loose pulleys a^6, straight and cross belts a^7 and a^8, respectively, and shipper a^9.

With the holder L, I sometimes find it convenient to employ burners l^5, which project from pipes l^4, arranged in the ingot-holding groove, as shown in Fig. 8, whereby a flame of gas or other fuel may be applied to the ingot to maintain it at the proper temperature and prevent it from cooling during the time the mandrel is being withdrawn from and reinserted between the rolls, and in order that such heat may be uniformly applied the ingot, instead of resting against the sides of the groove, as in the former construction, is supported upon lugs l^3, projecting inward therefrom in such a manner as to permit of the flame completely enveloping it.

The operation of my invention is as follows: The mandrel being inserted between the rolls, the lever o will be thrown into the position shown in full lines in Fig. 2, and steam or other actuating agent admitted to the inner end of the cylinder. This will cause the withdrawal of the mandrel from between the rolls. Prior to or at the time of the emergence of its inner end from the stop p' a heated ingot will be placed in the holder L. The continued outward movement of the mandrel-supporting carriage and its actuating devices will bring the inner dog w^4 into contact with the inner extremity of the lever w^3, turning such lever upon its pivot, and through the arm w^2 oscillating the gear w upon its pivot, and thereby operating the valves in the induction and eduction pipes t t' and admitting the steam or other actuating agent to the upper end of the cylinder M. The effect of this operation will be to elevate the holder L and bring the axis of the ingot into substantial coincidence with the axis of the mandrel just as the inner end of said mandrel passes, in its outward movement, beyond the outer end of the holder L. The lever o will then be turned into the position indicated in dotted lines x in said figure, closing the valve in the induction-pipe at the inner end of the cylinder, and thereby arresting the further movement of the mandrel. The lever o' will next be thrown into the position indicated by dotted lines x' in the figure last mentioned, allowing the steam or other agent to enter through the induction-pipe in the rear end of the cylinder, and that admitted at the previous operation to escape through the eduction-pipe at the inner end thereof. As a result of this the mandrel will be caused to pass its inner end through the orifice in the ingot and enter between the rolls. The continued flow of steam or other agent to the rear of the cylinder will force the mandrel home, carrying the flange thereon into contact with the stop p', which flange and stop will then hold the mandrel against the strain put upon it by the ingot as it is withdrawn therefrom during its transformation without assistance. During the time that the mandrel is thus traveling inward between the rolls the ingot will be held by its holder L free from contact therewith until the point on the mandrel which will be at such distance from the rolls as will just carry the inner end of the ingot into the bite of the first pair thereof when such mandrel is at the extreme limit of its inward movement, arrives opposite the rear end of the ingot, when the outer dog w^4 on the rod h will strike the inner end of the lever w^3, operating through it and the gear w the appropriate valves in the cylinder M, admitting steam to the lower end of said cylinder, and thereby lowering the holder and allowing the ingot to rest upon the mandrel, which latter, as it continues its inward movement, will carry it between the rolls for their action thereon. The reduction or transformation of the ingot having been completed by passing it over the mandrel and between the several pairs of rolls, the resulting tubing or other product will be discharged upon suitable supporting rolls or tables arranged for that purpose. The lever o will then be thrown into the position shown in full lines in Fig. 2 and the several steps above pointed out repeated, and so on, the withdrawal of the mandrel from between the rolls being for the purpose of receiving a fresh ingot, and its insertion between them being to place it in proper position to co-operate with such rolls during the rolling operation and conversion of the ingot.

From the foregoing it will be seen that I produce a machine for rolling tubing and other hollow articles from hollow ingots which is extremely simple in construction, efficient in operation, and, aside from the operation of the valves for controlling the flow of steam or other actuating agent to the mandrel-carriage-actuating cylinder, is practically automatic in its various movements.

While I have shown the best means contemplated by me for carrying my invention into practice, I wish it distinctly understood that I do not limit myself strictly thereto, as it is obvious that I may modify the same in various ways without departing from the spirit thereof.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination, with the rolls of a rolling-machine and a mandrel for co-operation therewith, of a carriage in which said mandrel is mounted, a support for such carriage, and a motor for moving said carriage back

and forth to withdraw and insert the mandrel from and between the rolls, substantially as described.

2. The combination, with a plurality of pairs of rolls, a mandrel extending between them, and a carriage in which said mandrel is mounted, of a track or support upon which the carriage is mounted and a motor for moving said carriage back and forth upon its track or support to withdraw and insert the mandrel from and between the rolls, substantially as described.

3. The combination, with a plurality of pairs of vertical and horizontal rolls arranged in alternate relation, a mandrel extending between them and provided with a flange or collar, and a carriage for supporting said mandrel, of a support upon which the carriage is mounted, mechanism for moving the carriage back and forth upon the support to withdraw and insert the mandrel from and between the rolls, and a stop against which the flange on the mandrel abuts to resist the strain put upon the mandrel by the ingot as it is withdrawn therefrom during the rolling operation, substantially as described.

4. The combination, with a plurality of pairs of vertical and horizontal rolls arranged in alternate relation, a mandrel for co-operation with such rolls, a carriage in which the mandrel is mounted, and a track or support upon which the carriage traverses, of a cylinder, a piston, a piston-rod, and connecting devices intermediate such piston-rod and carriage whereby the said carriage may be caused to move back upon its track or support to withdraw the mandrel from the rolls and afterward move forward over it to reinsert it between them, substantially as described.

5. The combination, with the rolls of a rolling-machine, a mandrel for co-operation therewith, and a carriage for supporting the mandrel and permitting of its withdrawal from and insertion between the rolls, of a holder for receiving an ingot and presenting it in the path of movement with the mandrel with its axis coincident with the axis of said mandrel, substantially as described.

6. The combination, with the rolls of a rolling-machine, a mandrel for co-operation therewith, a carriage for supporting said mandrel, and a track or support upon which said carriage is mounted, of mechanism for moving such carriage back and forth upon its track or support to withdraw and insert the mandrel from and between the rolls, a holder for receiving a fresh ingot and presenting it in the path of movement of the mandrel with its axis coincident therewith, and a motor whereby the holder is caused to operate from the mechanism which moves the carriage, substantially as described.

7. The combination, with a holder for the ingot, a lever for supporting the same, and a bracket or support in which such lever is pivoted, of a cylinder, a piston, a piston-rod, a pitman, and devices for controlling the flow of steam or other actuating agent to and from the cylinder, substantially as described.

8. The combination, with a mandrel, a carriage in which it is supported, a track upon which the carriage is mounted, a cylinder, a piston, a piston-rod, connecting devices intermediate the piston-rod and the carriage, provided with suitable dogs, and devices for controlling the flow of steam or other actuating agent to and from the cylinder, of a holder for the ingot, a lever for carrying the same, a bracket in which such lever is pivoted, a second cylinder, a piston and a piston-rod, a pitman, and devices for controlling the flow of steam or other agent to and from such second cylinder, operated from said dogs, whereby the automatic movement of the ingot-holder in proper relation to the movements of the mandrel is insured, substantially as described.

9. The combination, with the cylinder M, the piston-rod n, provided with a suitable piston upon its lower end, the induction and eduction pipes $t\,t'$, the valves t^2, and pinions t^3, the gear w, provided with the arm w^2, lever w^3, and mechanism for vibrating said lever upon its pivot, of the mandrel E and the carriage in which it is supported, substantially as described.

In testimony whereof I have hereunto set my hand this 31st day of October, 1888.

WILLIAM H. APPLETON.

Witnesses:
ADOLPHUS J. NORRAIKON,
HENRY CARTER.