(No Model.)

4 Sheets—Sheet 1.

R. J. GATLING.

MACHINE FOR FORGING AND COMPACTING INGOTS.

No. 496,873. Patented May 9, 1893.

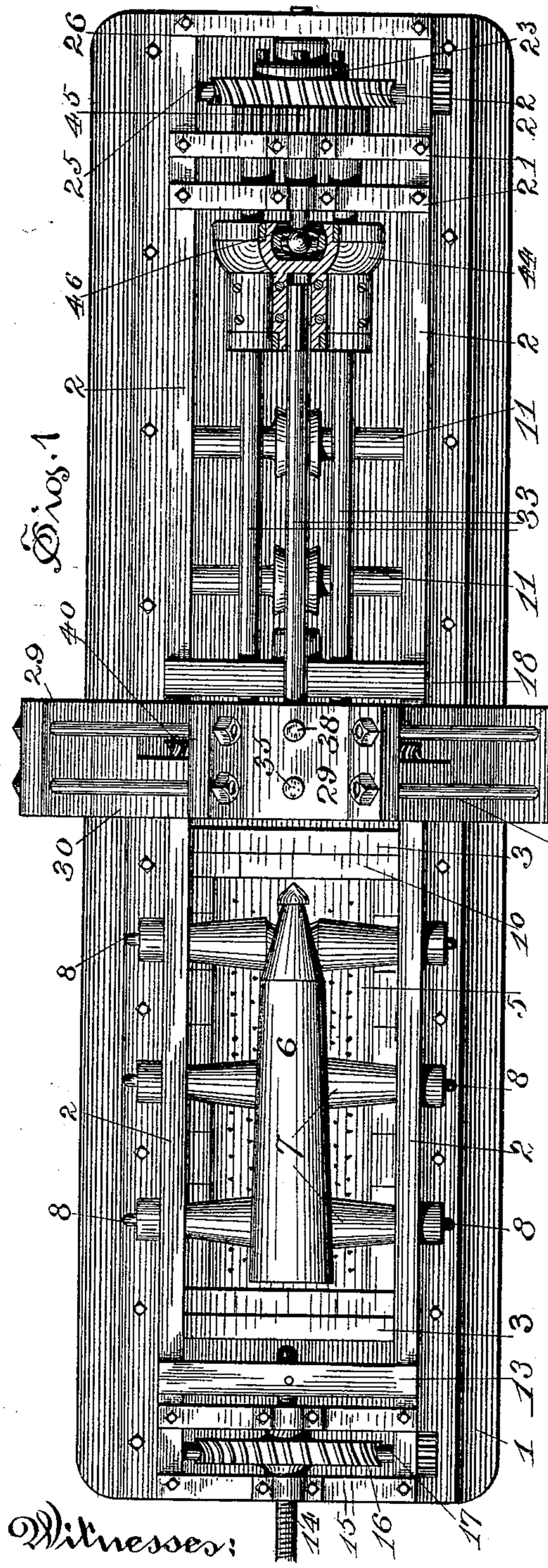

Fig. 1.

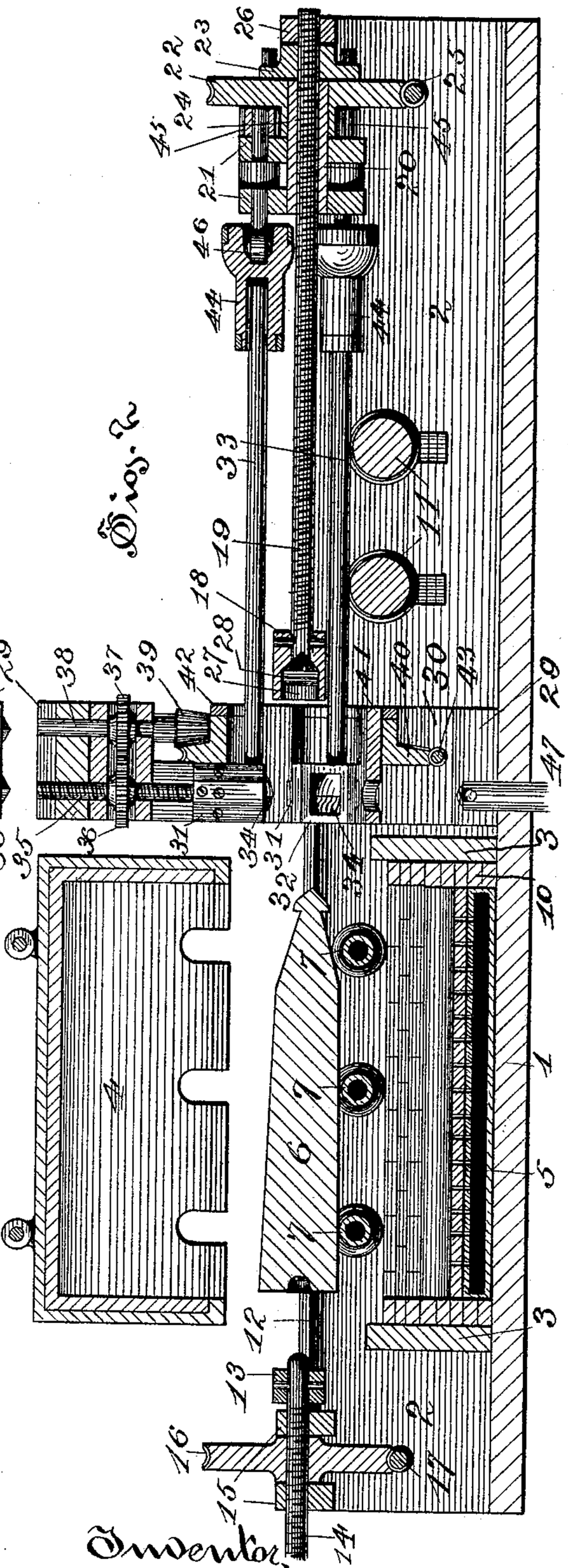

Fig. 2.

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(No Model.) 4 Sheets—Sheet 2.

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MACHINE FOR FORGING AND COMPACTING INGOTS.

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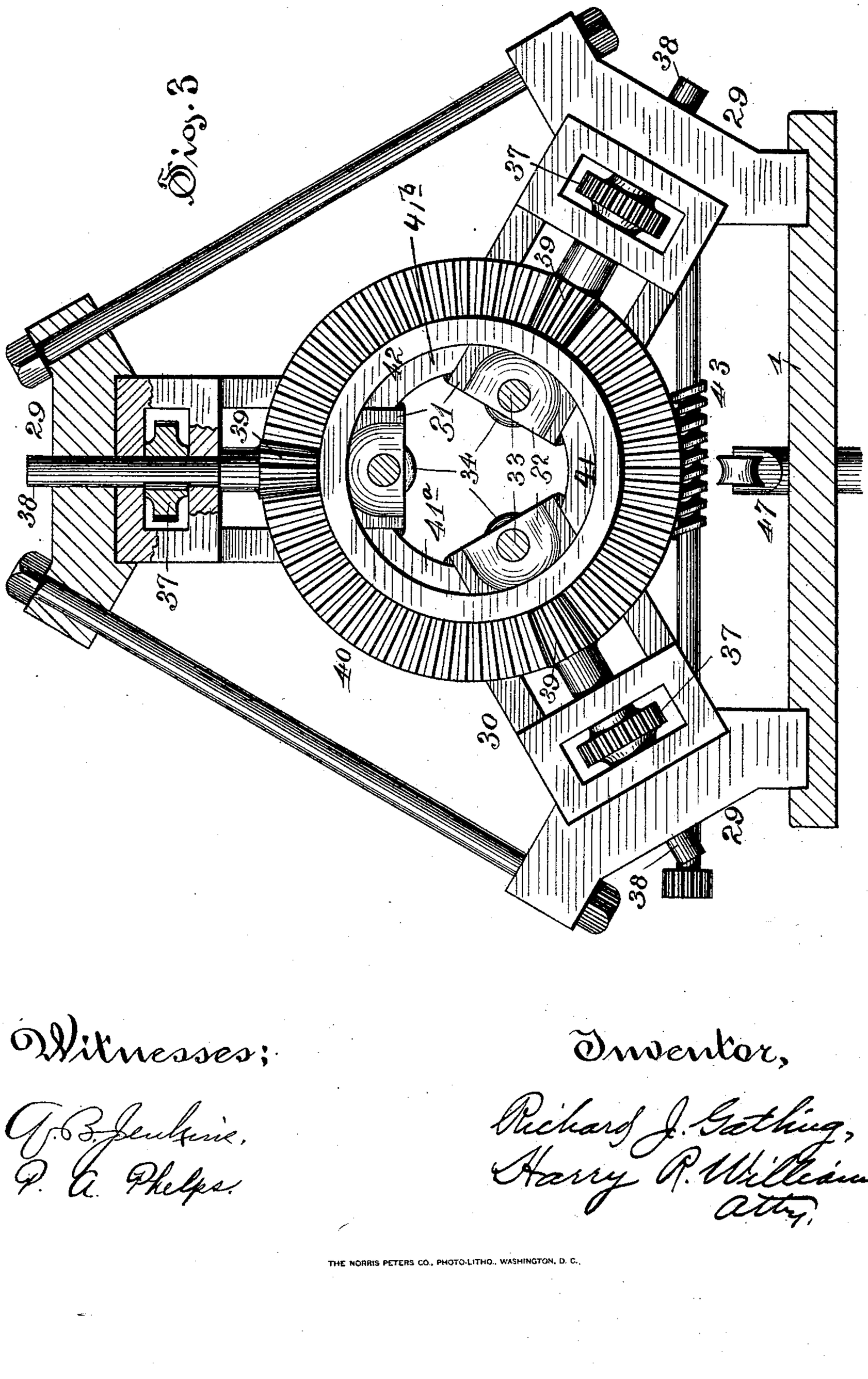

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(No Model.) 4 Sheets—Sheet 3.

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MACHINE FOR FORGING AND COMPACTING INGOTS.

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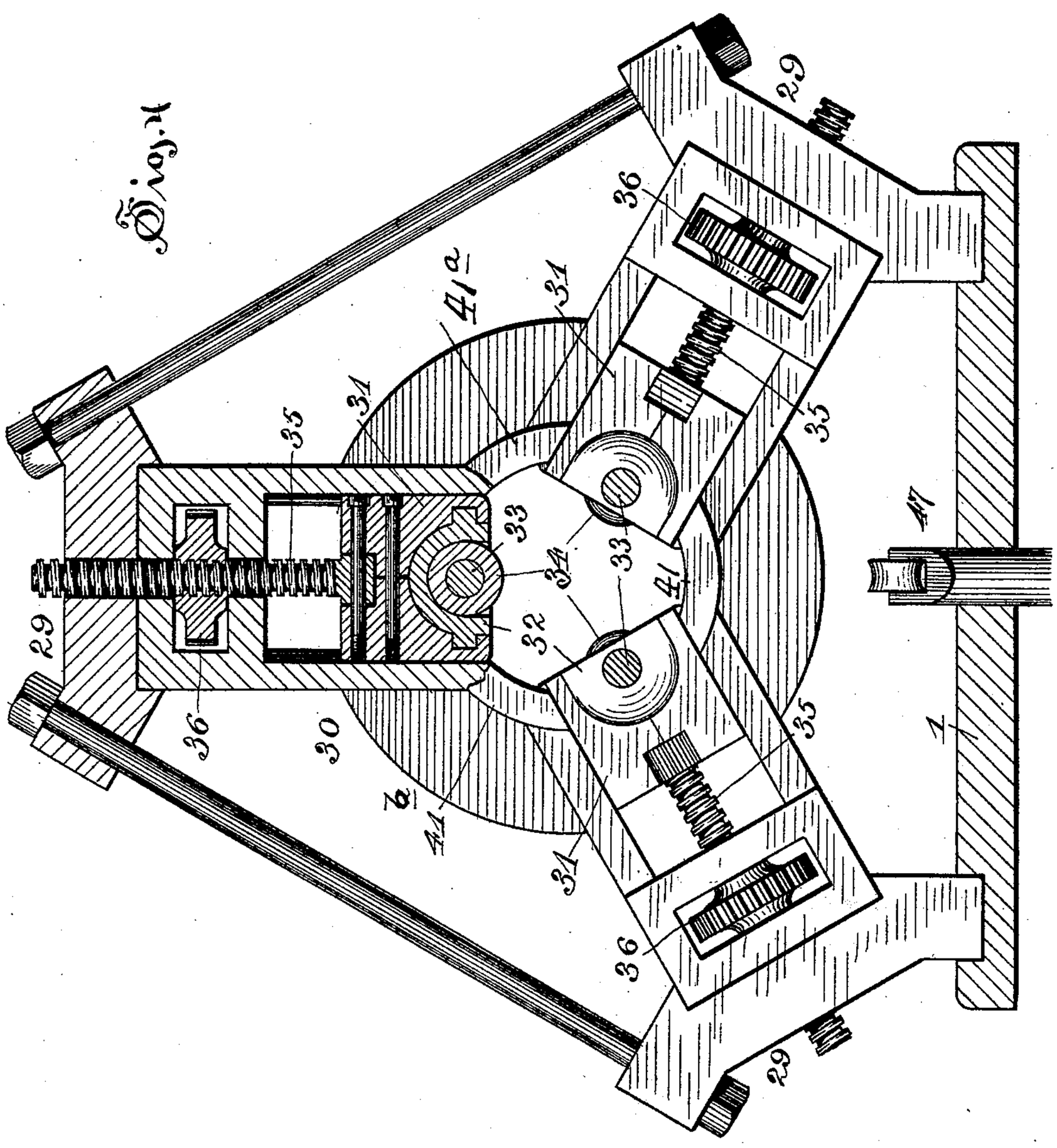

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(No Model.) 4 Sheets—Sheet 4.

R. J. GATLING.

MACHINE FOR FORGING AND COMPACTING INGOTS.

No. 496,873. Patented May 9, 1893.

Fig. 5

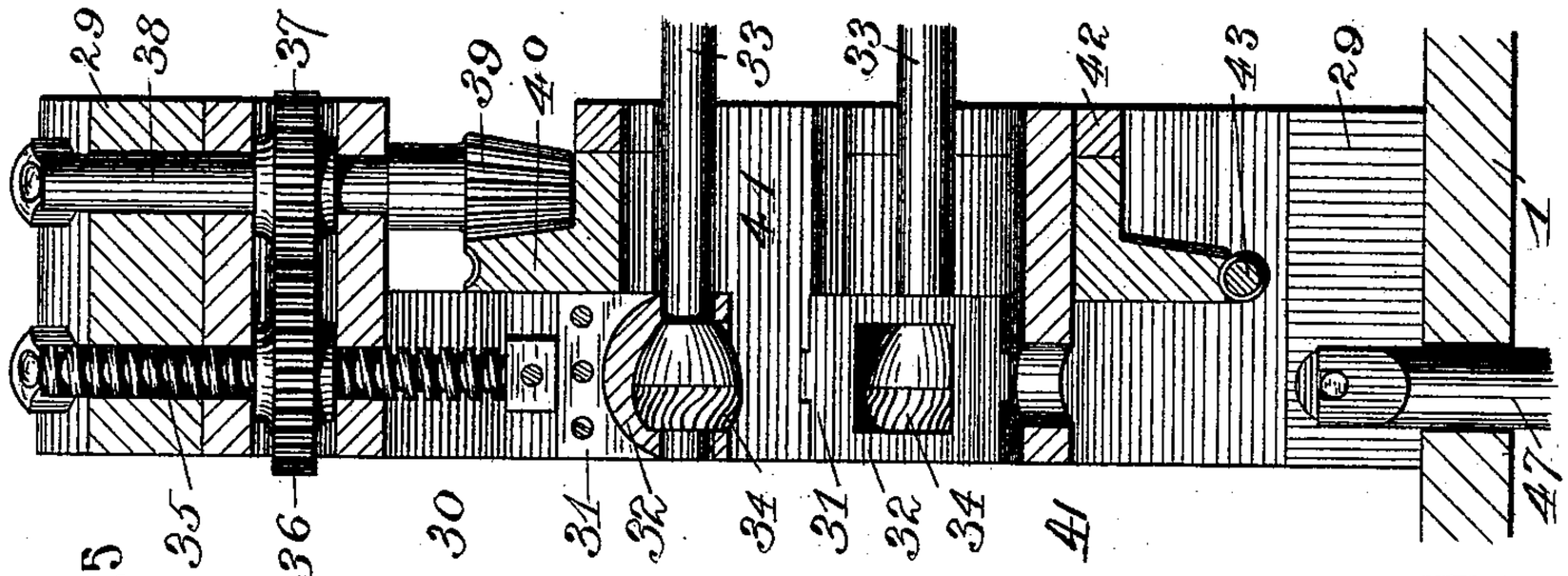

Fig. 6

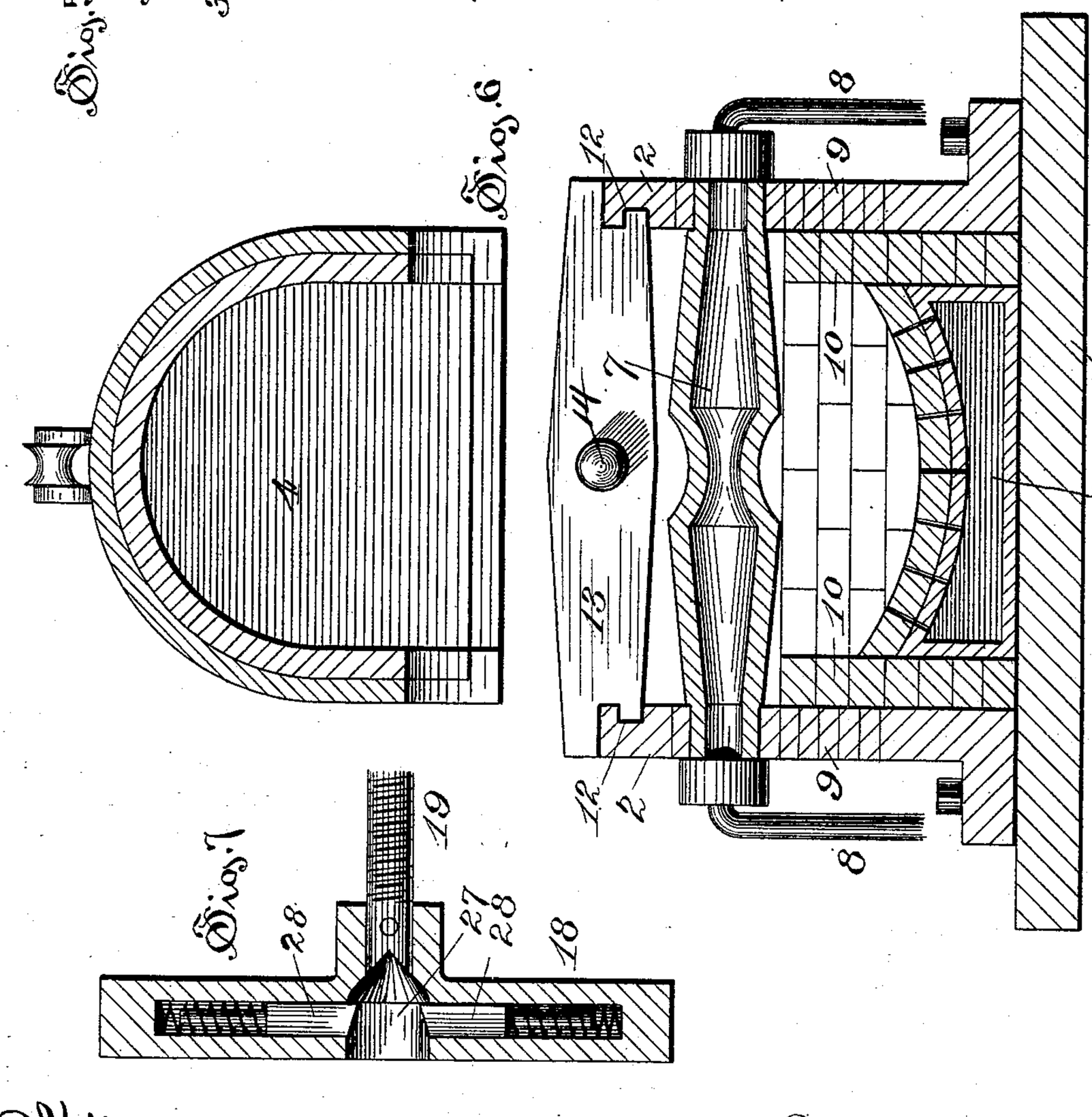

Fig. 7

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UNITED STATES PATENT OFFICE.

RICHARD J. GATLING, OF HARTFORD, CONNECTICUT.

MACHINE FOR FORGING AND COMPACTING INGOTS.

SPECIFICATION forming part of Letters Patent No. 496,873, dated May 9, 1893.

Application filed March 4, 1892. Serial No. 423,721. (No model.)

To all whom it may concern:

Be it known that I, RICHARD J. GATLING, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Machines for Forging and Compacting Ingots, of which the following is a full, clear, and exact specification.

This invention relates to an improved mill for forging and compacting cylinders, tubes or shafts of malleable cast metal, the object being to condense the metal and change the crystalline structure thereof, which is the form assumed by all cast metal, into the homogeneous fibrous condition of forged metal.

To this end the invention consists in a mill having a chamber in which an ingot may be heated, combined with rolls for compacting, condensing or forging the ingot, as more fully hereinafter set forth and specifically indicated in the claims.

Referring to the accompanying drawings:—Figure 1 is a plan of the mill with the cover of the furnace removed. Fig. 2 is a central vertical longitudinal section of same. Fig. 3 is an enlarged transverse section looking toward the roll frame. Fig. 4 is a similar section with part of the roll feed mechanism removed. Fig. 5 is a central vertical section through the roll frame. Fig. 6 is a transverse vertical section through the furnace. Fig. 7 is a detail section of the head for drawing the ingot.

In the views 1 indicates a foundation or bed on each side of the middle of which, secured parallel by bolts are vertical side walls 2. At one side of the center these walls are connected by transverse walls 3, upon which and the side walls a domed cover 4 is lowered and rested to form a heating chamber or furnace. In the bottom of this furnace is placed a burner 5 which may be connected with any natural gas, or other fuel system, or upon which an ordinary fire may be built, to heat the ingot 6 placed in the furnace upon the rollers 7 that have a surface somewhat conforming to the contour of the ingot, and that are made hollow and connected by suitable couplings with the pipes 8 of a water system so that a cooling liquid may be conducted through the rollers to keep their temperature low while the ingot is being heated. (Fig. 6.) These rollers are desirably supported upon bearings formed of thin pieces of metal 9 that can be easily and quickly inserted in openings in the side walls above or below the journals so that the rollers may be raised or lowered according to the diameter of the ingot.

The furnace is usually lined with fire clay or brick 10 to protect the walls and burner, and the dome which is also lined with heat resisting material is provided with means whereby it may be readily lifted away from the furnace in order to place or remove an ingot. (Figs. 2 and 6.) On the other side of the center, supported in adjustable bearings similar to those described, are rollers 11 for receiving and supporting the ingot after it has been drawn from the furnace and while it is being forged. (Figs. 1 and 2.)

Movably resting upon the side walls, with a locking portion entering a groove 12 near the tops of the walls, is a cross-head 13. (Figs. 6, 1 and 2.) Attached to this head is a threaded rod or screw 14 supported at the end of the bed by cross ties 15, between which the screw bears a gear or worm wheel 16 having a threaded hub that meshes into the screw. This wheel is preferably driven by a worm 17 of suitable pitch supported by the walls below and driven by any power. In the construction shown the forward end of this screw passes through the head 13 forming a stud that will project into a recess in the end of the ingot (Fig. 2) to center it when moved up. When an ingot is to be heated this cross-head is drawn back so that the cover may be lowered upon the furnace, but the screw is preferably of sufficient length to move the head to the opposite end of the furnace when pushing out an ingot. Movably resting on the side walls, is a similar cross-head 18 attached to a threaded rod or screw 19 supported by a bearing 20 secured to cross ties 21 at the end of the bed. On this bearing rotates a gear or worm wheel 22 to one face of which is secured a hub 23 having a threaded perforation that

fits the screw, while on the other face is a pinion 24. This wheel is preferably driven by a worm 25 of suitable pitch supported by a bearing below, and revolves between the cross ties 21 and 26 near the end of the wall. (Fig. 2.) The cross-head 18 has a pocket 27 into which project spring catches 28, (Figs. 2 and 7.)

About the middle of the bed is located a roll supporting frame, the upper head-block of which is bolted to the two lower that are anchored to the foundation. These head blocks 29 hold a frame 30, in ways in the arms of which are supported the radially movable roll blocks 31. These blocks are preferably formed in two pieces held together by bolts or screws, and in sockets in their inner ends hold boxes 32 that have trunnions projecting into corresponding sockets to permit the oscillation of the boxes. On each side of a central mortise the boxes have bearings to support the shafts 33 to which the rolls 34 in the mortises are keyed. (Figs. 3, 4 and 5.) This allows the rolls to oscillate and adjust themselves without straining or bending the shafts as they are moved toward or from the ingot when the blocks are moved in or out by the action of the screws 35 that are attached to the blocks by heads that project into mortises, and pass through the threaded hubs of the gears 36 that rotate between cross-heads of the arms of the frame. Just in front of the gears 36 and meshing into them are gears 37 keyed to shafts 38 that bear upon their inner ends pinions 39 which mesh with an annular gear 40 that rotates on a hub consisting of three sections 41, 41^a and 41^b projecting from the front of the roll frame. This annular gear which is held upon the hub by a ring 42, has its edge cut with worm teeth, and into these meshes a worm 43 supported below by the frame, and driven by any suitable power at the desired speed. (Figs. 3 and 5.) According to the direction of rotation of the worm the annular gear rotates the pinions and small gears to move the screws in or out, uniformly feeding the rolls to or from the ingot as it passes between them. The rolls which are so located as to move radially toward and from the ingot, preferably are conical and have their peripheries fluted or grooved so that in revolving in one direction they will compress the metal of the ingot, but when revolving in the opposite direction will twist and draw out the metal from the center by the now well known action of fluted tapering rolls on a hot ingot. The shafts 33 have flexible joints 44 to permit the movements of the rolls in or out as desired, and are connected with pinions 45 that mesh with and are driven by the pinion 24 attached to the worm wheel 22. Each of the flexible joints 44, which is preferably formed in two parts held together by screws and bands, receives at one end the keyed end of the shaft 33 while the opposite end is enlarged and socketed to receive oscillating pieces 46, in sockets in which project trunnions on the enlarged ends of the continuation of the shaft which is connected with the pinion. (Figs. 1 and 2.)

Below the bed preferably near the middle of the rolls, in a vertical plane passing through the axis of the ingot being forged, is a ram 47 with a roll on its upper end, adapted to be raised and lowered by any hydraulic press to lift the end of the ingot, when necessary, in order to center the same, (Figs. 2, 3, 4 and 5.)

The cylinder or ingot to be forged, cast to approximate shape and size, with a central recess in one end and the other end provided with a hook, barb, or indentation, is placed in the furnace upon the rollers, the dome lowered in position to cover the furnace, the fire started to heat the ingot, and a flow of cold water passed through the rolls to keep their temperature low. When the ingot is heated to the desired degree by the flames, preferably of natural gas but of course any kind of fuel may be employed, the cover is lifted out of the way, the cross-head 13 moved up by the screw under the rotation of its wheel worm until the end projects into the pit in the end of the cylinder, which is then pushed along until its forward end is pushed into the grasp of the catches in the pocket of the cross-head 18. If the forward end is below the level of this pocket, the ingot is raised to the proper level, and supported by the hydraulic ram 47 until the end is pushed into the pocket and grasped by the catches. By means of its worm, the wheel 22 bearing the pinion 24 is rotated and this feeds the screw so as to slowly pull the ingot forward. At the same time the pinion 24 rotates the pinions 45 so that through the shafts 43 the rolls are revolved against the face of the ingot as it is drawn forward, forging and compacting the metal of the ingot. As the rolls revolve in the same direction against the surface they cause the ingot to rotate as it is drawn along so that the entire periphery is forged or compacted with a rolling pressure changing the whole surface from a crystalline into a fibrous texture.

In this mill regular or irregular, straight or tapering, shafts or cylinders of large size and great weight may be heated to the proper degree of malleability and quickly drawn automatically from the heating chamber and passed between forging, compacting or condensing rolls which move toward or from the work according to the rapidity and direction of movement of the feeding screws so that the entire surface of a large mass may be compacted to the desired shape by a rolling pressure.

I am aware that mills embracing a furnace for heating billets, skelps, or cylinders of wrought metal, and drawing and reducing the same by means of drawing rolls, which reduce and elongate the metal, have been employed heretofore, and such I do not claim, the gist of my invention consisting of a mill,

in which a body of cast metal properly heated, is compacted, condensed or forged, without being materially drawn or elongated, so as to change its crystalline structure to the homogeneous structure of forged metal.

I claim as my invention—

1. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls borne by a support upon the bed adjacent to the heating chamber, mechanism for removing an ingot from the heating chamber mechanism for moving the rolls toward or from each other and shafts and gears for revolving the rolls, all substantially as specified.

2. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, mechanism for removing an ingot from the heating chamber, compacting rolls borne by a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, and shafts and gears for revolving the rolls, all substantially as specified.

3. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, a removing head adapted to push an ingot from the heating chamber, compacting rolls borne by a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, and shafts and gears for revolving the rolls, all substantially as specified.

4. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, a movable clutch for pulling an ingot from the heating chamber, compacting rolls borne by a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, and shafts and gears for revolving the rolls, all substantially as specified.

5. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, a movable head for pushing an ingot along the heating chamber, a movable clutch for pulling an ingot from the heating chamber, compacting rolls borne by a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, and shafts and gears for revolving the rolls, all substantially as specified.

6. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls borne by a support upon the bed adjacent to the heating chamber, mechanism for moving the rolls toward and from each other, jointed shafts connected with the rolls, and gears for revolving the shafts, all substantially as specified.

7. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, blocks borne by a support on the bed adjacent to the heating chamber, rolls held in said blocks, screws, gears and pinions for moving the blocks toward and from each other, an annular gear for rotating the pinions, and shafts and gears for revolving the rolls, all substantially as specified.

8. In a mill for heating and forging ingots, the combination of a bed, parallel walls supported upon the bed, a heating chamber formed between a portion of said walls, compacting rolls borne by a support on the bed adjacent to the heating chamber, adapted to rotate in contact with an ingot, shafts and gears for revolving the rolls, and movable draw heads resting upon the walls, for passing the ingot from the heating chamber between the rolls, all substantially as specified.

9. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls borne by oscillating bearings in a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, jointed shafts connected with the rolls, and gears for revolving the shafts, all substantially as specified.

10. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, rolls borne by a support upon the bed adjacent to the heating chamber, adapted to revolve in contact with an ingot, shafts and gears for revolving the rolls, a head for pushing an ingot from the heating chamber, a ram for raising an ingot, and a moving clutch for pulling the ingot from the heating chamber between the rolls all substantially as specified.

11. In a mill for heating and forging ingots, the combination of a bed, a heating chamber with a removable top supported upon the bed, hollow rollers mounted in the heating chamber, rolls borne by a support upon the bed adjacent to the heating chamber, jointed shafts for revolving the rolls, mechanism for moving the rolls toward and from each other, a movable cross-head resting upon the walls for pulling an ingot from the heating chamber, and a ram below for raising an ingot, all substantially as specified.

12. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls arranged to come into contact with the ingot at different points of its circumference and in the same diametrical plane, means for moving the rolls toward and from the ingot, and means for delivering the ingot to said rolls, substantially as described.

13. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls supported adjacent to the chamber to come into contact with the ingot at different points of its circumference and in the same diametrical plane, rollers journaled in the heating chamber to support the ingot while it is be-

ing heated, and means for delivering the ingot to the reducing rolls, substantially as set forth.

14. In a mill for heating and forging ingots, the combination of a bed, a heating chamber supported upon the bed, compacting rolls supported adjacent to the chamber to come into contact with the ingot at different points of its circumference and in the same diametrical plane, rollers journaled in the heating chamber to support the ingot, a pusher head to deliver the ingot from the rollers to the reducing rolls and a pulling clutch, said ingot being rotated by said reducing rolls during its passage between the same, substantially as set forth.

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