No. 869,284. PATENTED OCT. 29, 1907.

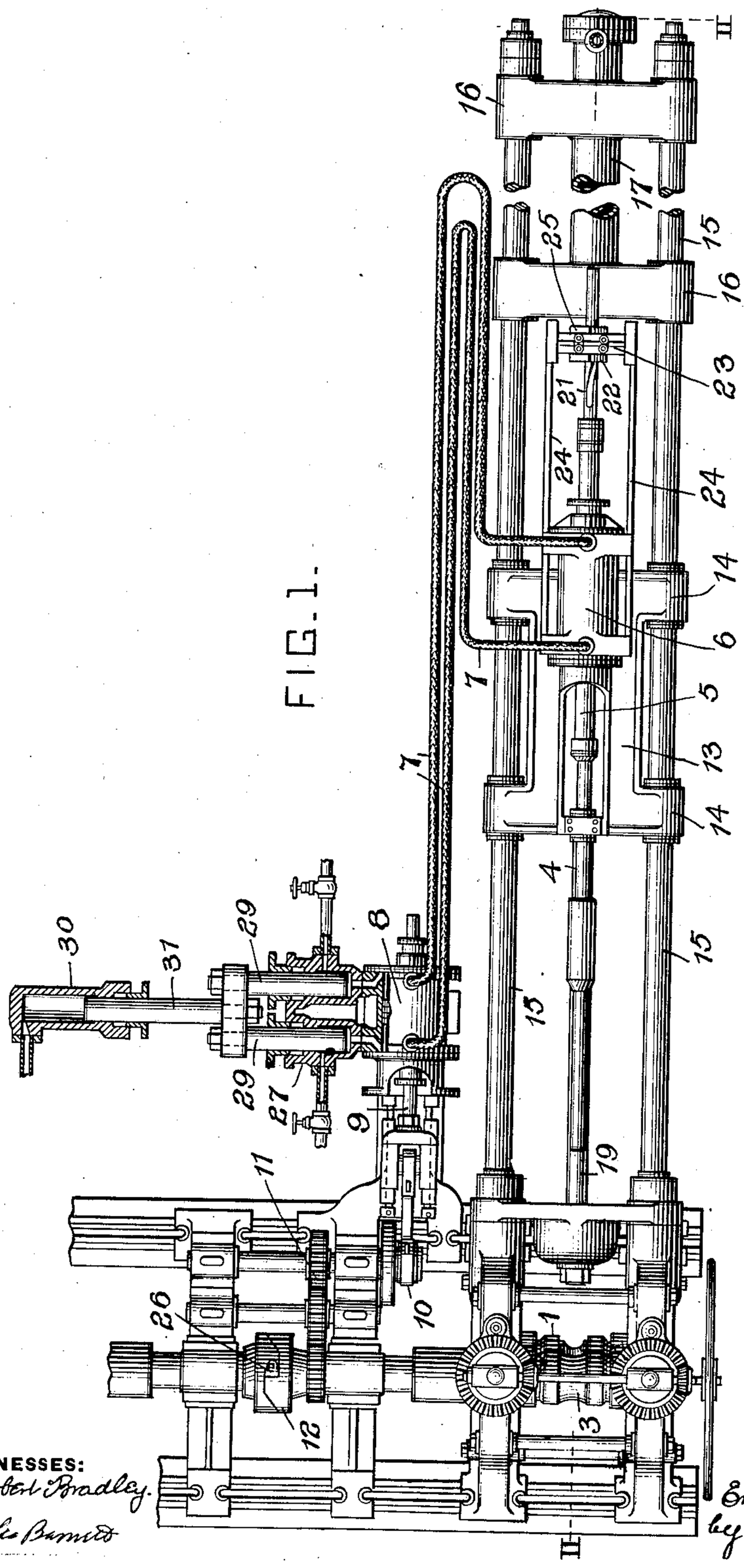
E. WINTER.

SWAGING MILL.

APPLICATION FILED JAN. 14, 1907.

2 SHEETS—SHEET 1.

FIG. 1.



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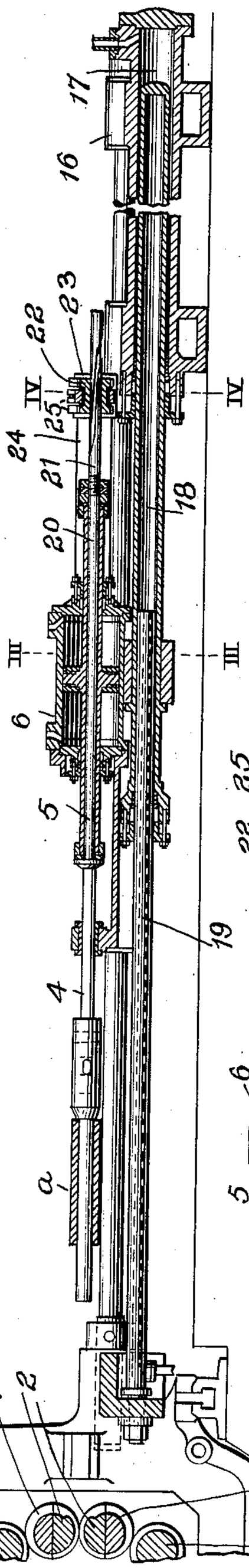

FIG. 2.

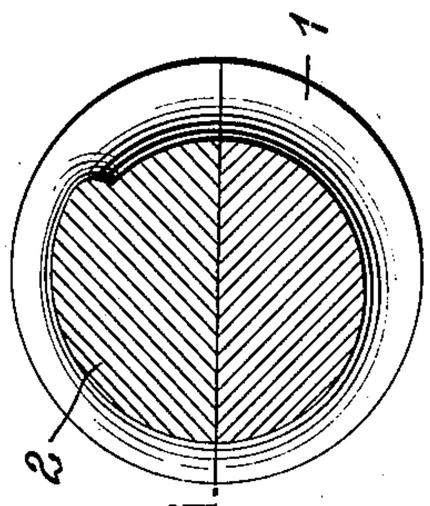

FIG. 6.

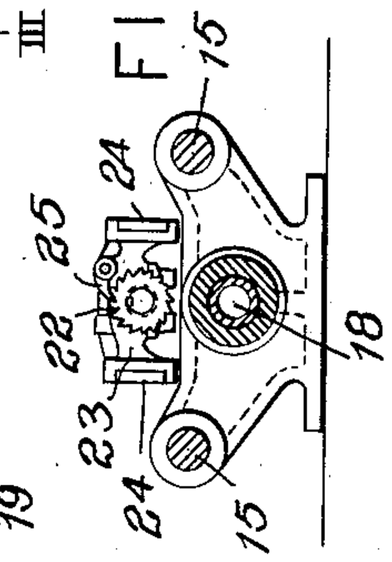

FIG. 4.

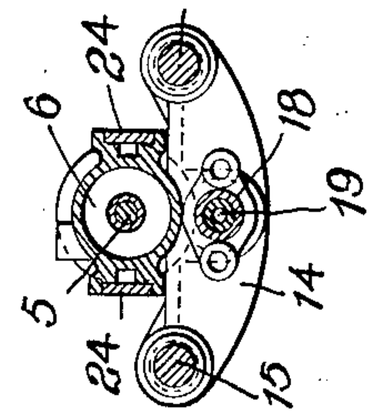

FIG. 3.

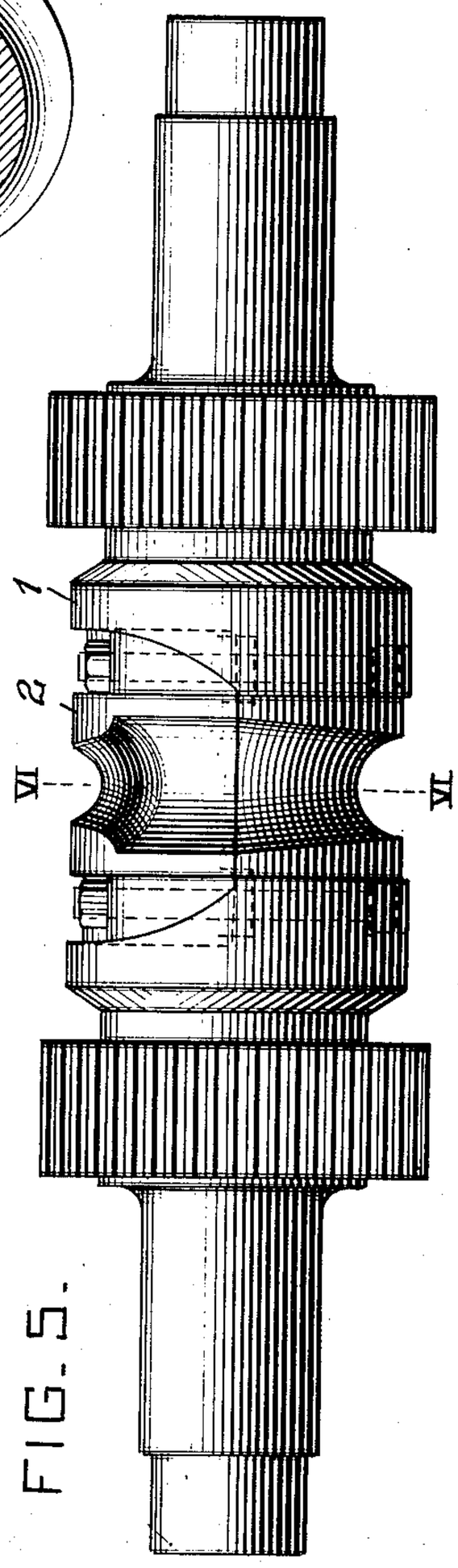

FIG. 5.

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SWAGING-MILL.

No. 869,284. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed January 14, 1907. Serial No. 352,281.

To all whom it may concern:

Be it known that I, EMIL WINTER, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Swaging-Mills, of which improvements the following is a specification.

In an application filed May 9th, 1905, Serial No. 259,501, I have described and claimed certain improvements in mechanism for the manufacture of seamless tubes, said improvements consisting generally stated in so constructing and combining the parts or elements of the mechanism that the billet shall have a movement at the time the swaging rolls bite thereon, in the direction of rotation of the rolls and at a speed equal or approximately equal to the peripheral speed of the rolls or dies.

The invention described herein has for one of its objects the application of a resilient pressure to the billet in opposition to the movement imparted by the swaging rolls, proportional or approximately proportional to the reduction being effected by the rolls.

It is characteristic of all tube swaging mills, whether of the Mannesmann or the Briede or other type, that a spring is employed for holding the billet within the bite of the rolls, presenting a yielding resistance to the movement of the billet by the rolls or swages during reduction. According to the present practice, the greatest reduction is at or near the beginning of the movement of the dies or rolls in opposition to the direction of feed, and the reduction or work done gradually decreases during this movement of the dies or rolls. As a result of this operation, compression of the billet holding spring begins with the bite of the dies or swages on the billet and gradually increases, while by reason of the construction of the operative faces of the dies, the reduction of work being effected gradually decreases from the point of maximum reduction. This gradual decrease of bite or grip of the dies on the billet results in less resistance to the increased spring pressure and practice has shown that the dies slip on the billet, thereby producing a scoring and rapid wearing of the dies and a roughness on the outer surfaces of the finished tube. In order to overcome this objectionable operation, I provide for shifting the abutment or wall sustaining the yielding resisting pressure so that the resistance presented by such pressure will not only not increase after the maximum reduction or work has been performed, but will decrease as or nearly as the reduction effected by the rolls or dies decreases.

In the accompanying drawings forming a part of this specification, Figure 1 is a top plan view of my improved mill; Fig. 2 is a sectional elevation of the same on a plane indicated by the line II—II Fig. 1. Figs. 3 and 4 are transverse sections on planes indicated respectively by the lines III—III and IV—IV Fig. 1. Fig. 5 is an elevation of one of the rolls with die secured therein and Fig. 6 is a transverse section on the line VI—VI Fig. 5.

In the practice of my invention the rolls 1 are provided with reducing portions or dies, which are preferably formed in blocks 2 removably secured in recesses in the rolls. In order to permit of the use of small rolls, which as is well known are more efficient than large rolls, reinforcing rolls 3 are preferably employed. Heretofore it has been the practice to arrange these reinforcing rolls with their axes in the plane of the axes of the reducing rolls, it has been found however that if the reinforcing rolls should be so arranged in the rear of the reducing rolls and in such relation thereto that the space between the reinforcing rolls is less than the combined diameters of the reducing rolls. It results from this construction and arrangement that in operation the reducing rolls will have a tendency to wedge themselves between the reinforcing rolls being held more firmly to their work. The mandrel carrying the billet *a* is detachably connected to the rod 4 of the piston 5 of the cylinder 6. The ports at or adjacent to the ends of this cylinder have flexible connections as by pipes 7 to ports at or adjacent to the ends of a cylinder 8 which has its piston rod 9 connected to a crank pin 10 operated by the roll driving shaft through suitable interposed gearing 11 and a suitable clutch 12. The cylinders 6 and 8 and their uninterrrupted connections are charged with a compressible fluid as air under such a pressure that the piston in cylinder 6 will promptly respond to any movement of the piston in cylinder 8 and will present a resistance to a movement independent of that of the piston in cylinder 8, corresponding to that of a stiff spring. In the operation of the mill, the compressed fluid may be considered as the equivalent of a spring interposed between the billet and a movable abutment shiftable as will be hereinafter explained in certain accord with the movement of the reducing dies or rolls.

The driving mechanism of the piston of cylinder 8 is so adjusted that the billet will be reciprocated back and forth on each revolution of the rolls and will have a rate of movement at the time the rolls or their operative portions bite on the billet equal or approximately equal to the peripheral speed of the rolls, thereby avoid all hammer-like action of the rolls on the billet.

The cylinder 6 is secured to a frame or bed 13 having sleeves 14 mounted on guide rods 15, which preferably extend from the housings of the rolls to pillow-blocks 16. The frame or bed with the cylinder is moved forward to effect a feed of the billet between the rolls, by any suitable means, preferably by fluid pressure in a cylinder 17, the piston or ram 18 of the cylinder being connected to the movable frame or bed 13. In order to shift the frame or bed, when a new billet is to be operated on, fluid pressure is admitted to the cylinder

formed by the ram 18, the piston or ram 19 of this second cylinder being secured to the housing of the rolls and having a passage longitudinally through it for the admission of fluid to the interior of the ram 18.

In order to rotate the billet, the mandrel bar 20 is extended through the piston rod 4 and a spirally grooved rod 21 secured thereto. This rod extends through a disk 22 having a projection engaging the spiral groove in the rod. This disk is rotatably mounted in a block 23 secured to the frame or bed 13 or the cylinder 6 by bars 24. The disk has a peripherally toothed portion engaged by a pawl 25 pivotally mounted on the block 23. In such a construction the disk will rotate in its bearing when the mandrel is moved back, but will be held stationary by the pawl during the forward movement of the mandrel and the latter will be turned a suitable distance and impart a corresponding angular movement to the billet.

As heretofore stated the crank pin 10 has a speed of revolution equal or approximately equal to the peripheral speed of the dies or rolls 1, but as will be readily understood by those skilled in the art, the rectilinear speed of the billet will vary in accordance with the angular relation of the crank to the axis of the cylinder 8. In operating the crank-pin is so adjusted with reference to the working or reducing portions of the rolls 1, that the billet will have a rate of movement in the direction of rotation of the roll equal or approximately equal to the peripheral speed of the rolls, at the time such working or reducing portions engage or bite on the billet. When the mill is so constructed that reduction of the billet is effected while the dies or swages move in opposition to the direction of feed, the maximum work or reduction will be effected immediately subsequent to the engagement of the dies or swages with the billet and hence the greatest resistance to the tendency of the dies to push the billet from between the dies or swaging portions of the rolls should be exerted at this time. Hence the mill is so adjusted that the crank-pin, while imparting to the billet the desired rate of movement relative to the rolls, will be moving through such portion of its arc of revolution as to effect the least acceleration to the movement of the billet. In other words at the time the dies or swages engage the billet the crank-pin should form a small angle with a plane passing through the axis of the cylinder 8, and should be moving away from such plane, and consequently the rate of movement of the billet will be very slowly accelerated. By reason of the push exerted by the dies or swages, there will be an increase of pressure in the rear of the piston of cylinder 6 or similar abutment movable by the billet so that the resilient medium employed will present a rapidly increased resistance to the push exerted by the dies or swages and yieldingly hold the billet to the rolls, but with increased effectiveness. As the dies or swages continue to move in a circular path, reducing the billet, the crank pin is moving through such portion of its arc as to impart progressively and gradually a rate of movement greater than the peripheral speed of the dies, to the rectilinearly moving piston or abutment. In swaging under the conditions mentioned the maximum work is performed during the first portion of the movement of the dies after biting on the billet and during the remaining portion of the movement of the dies while engaging the billet the work performed or reduction effected gradually and progressively decreases, requiring less pressure on the billet to hold it to its work. The gradual increase in speed of the abutment or piston of cylinder 6, whereby holding pressure exerted on the billet is decreased corresponds so closely to the decrease in work or reduction effected by the dies or swages, that the two operations may be said to be almost exactly proportional one to the other.

In rolling mills of this class where the swages or dies perform their work or reduction, while operating in the direction of the feed of the billet (a mode of operation generally undesirable for practical reasons), the work performed by the dies will increase from the time the dies or swages engage the billet, from the minimum at the beginning of the working stroke and for a somewhat variable distance, say approximately through half, more or less of the working stroke. From that point on the evil or objection referred to of a decrease of working resistance and an increase of spring resistance as such mills have heretofore been organized, will occur. To the latter part of such work and movement the present invention is beneficially applicable. In such mills however the reducing action does not cease at the point of maximum work, but by reason of the peripheral shape or contour of the dies or swages, reduction is continued beyond the point of maximum work, but grows rapidly less. During this reduction beyond the point of maximum, the billet is being drawn in between the dies or swages, and consequently the resistance of the resilient billet-restraining member continues to increase and this latter portion of the operation hence is diametrically opposed to the improvement described herein.

It is characteristic of my improvement that the means employed for holding the billets in operative relation to the dies or swages, is varied or adjusted from time to time in accordance with the work or reduction being effected by the dies. Hence a maximum efficiency is maintained and no injury to the rolls is caused by the slip of the dies on the swages or vice versa.

In order to adjust the position of the crank-pin relative to the position of the working or operative portions of the rolls, wedges 26 are interposed between the working faces of the members of the clutch 12. By adjusting the wedges the position of the crank-pin 10, with reference to the working portions of the rolls, can be advanced or moved back as required.

During the swaging or reduction of a billet there will be a gradual loss of heat in the unreduced portions and hence greater pressure must be exerted to maintain the billet in such relation to the dies or swages, as to insure approximately the same amount of reduction by the dies or swages at each operation thereof. This can be effected by increasing the tension of the resilient member of the billet reciprocating mechanism as reduction of the billet progresses. In the construction shown this regulation of the tension of the resilient member is effected by connecting two cylinders 27 to one of the members of the billet reciprocating mechanism, as the cylinder 8, so that said cylinders will be in free communication with the cylinder 8. The pistons 29 of the cylinders are adapted to be shifted simultaneously in or out to change the pressure

of air in the cylinders 8 and 6, by any suitable means, as for example a fluid pressure cylinder 30 and piston 31, the latter being connected to both pistons 29. A valve accessible to the operator controls the fluid pressure flow to and from the cylinder 30, or such flow may be regulated so as to gradually and progressively increase the pressure of air in cylinders 6 and 8, as reduction of a billet progresses.

I claim herein as my invention:

1. In a mill for swaging billets, etc., the combination of dies or swages adapted to move in the arc of a circle while operating on the billet, means for holding the billet in position to be operated on by said dies or swages, means for adjusting the holding means, and operative connections from the rolls for said adjusting means, constructed to cause such holding means to present a resistance to the movement of the billet by the dies or swages, proportional to the reduction being effected by the dies or swages.

2. In a mill for swaging billets, etc., the combination of dies or swages adapted to move in the arc of a circle while operating on the billet, resilient means for holding the billet in position to be operated on by the dies or swages, and means so connected with the rolls as to vary the tension of the resilient member of the holding means so as to cause such holding means to present a resistance to the movement of the billet by the dies or swages, proportional to the reduction being effected by the dies or swages.

3. In a mill for swaging billets the combination of dies or swages movable in the arc of a circle while operating on the billet, means having a resilient member for holding the billet from movement by the dies or swages and means for changing the tension of the resilient member during the operation of the dies or swages.

4. In a mill for swaging billets, etc., the combination of dies or swages movable in the arc of a circle while operating on the billet, means including a fluid pressure cylinder and piston for reciprocating the billet, and means for changing the fluid pressure in the cylinder equally and in the same direction on both sides of the piston during the reciprocation of the billet.

5. In a mill for swaging billets, etc., the combination of dies or swages movable in the arc of a circle while operating on the billet, a crank pin revoluble synchronously with the dies or swages, a cylinder and piston, the piston being operatively connected to the crank pin, a second cylinder and piston and fluid passage connections extending from the first to the second cylinder, and a billet holder arranged to be operated by the piston of the second cylinder.

6. In a mill for swaging billets, etc., the combination of dies or swages movable in the arc of a circle, a billet holder, a fluid pressure cylinder having its piston connected to the billet holder, a second fluid pressure cylinder having its ends connected to the ends of the first cylinder, means for reciprocating the piston of the second cylinder and means for varying the pressure of fluid in said cylinders and their connections.

7. In a mill for swaging billets, etc., the combination of dies or swages movable in the arc of a circle, a billet holder, a fluid pressure cylinder having its piston connected to the billet holder, a second fluid pressure cylinder having its ends connected to the ends of the first cylinder so as to permit the passage of fluid, and means for reciprocating the piston of the second cylinder at a variable speed during each stroke.

8. As an improvement in the art of swaging billets, etc., the method herein described which consists in reducing the billet step by step by the action of dies or swages moving in the arc of a circle, holding the billet in position to be operated on by the dies or swages, and varying the resistance presented by the holding means to the movement of the billet by the dies or swages in accordance with the reduction being effected by the dies or swages.

9. As an improvement in the art of swaging billets, etc., the method herein described which consists in reducing the billet step by step by the action of dies or swages moving in the arc of a circle, yieldingly holding the billet in position to be operated on by the dies or swages and varying the resistance presented by the holding means to the movement of the billet by the dies or swages in accordance with the reduction being effected by the dies or swages.

In testimony whereof, I have hereunto set my hand.

EMIL WINTER.

Witnesses:

WILLIAM H. WILSON,

CHARLES BARNETT.