L. C. STEELE.

ROLLING MILL.

APPLICATION FILED OCT. 28, 1918.

1,342,608.

Patented June 8, 1920.

4 SHEETS—SHEET 1.

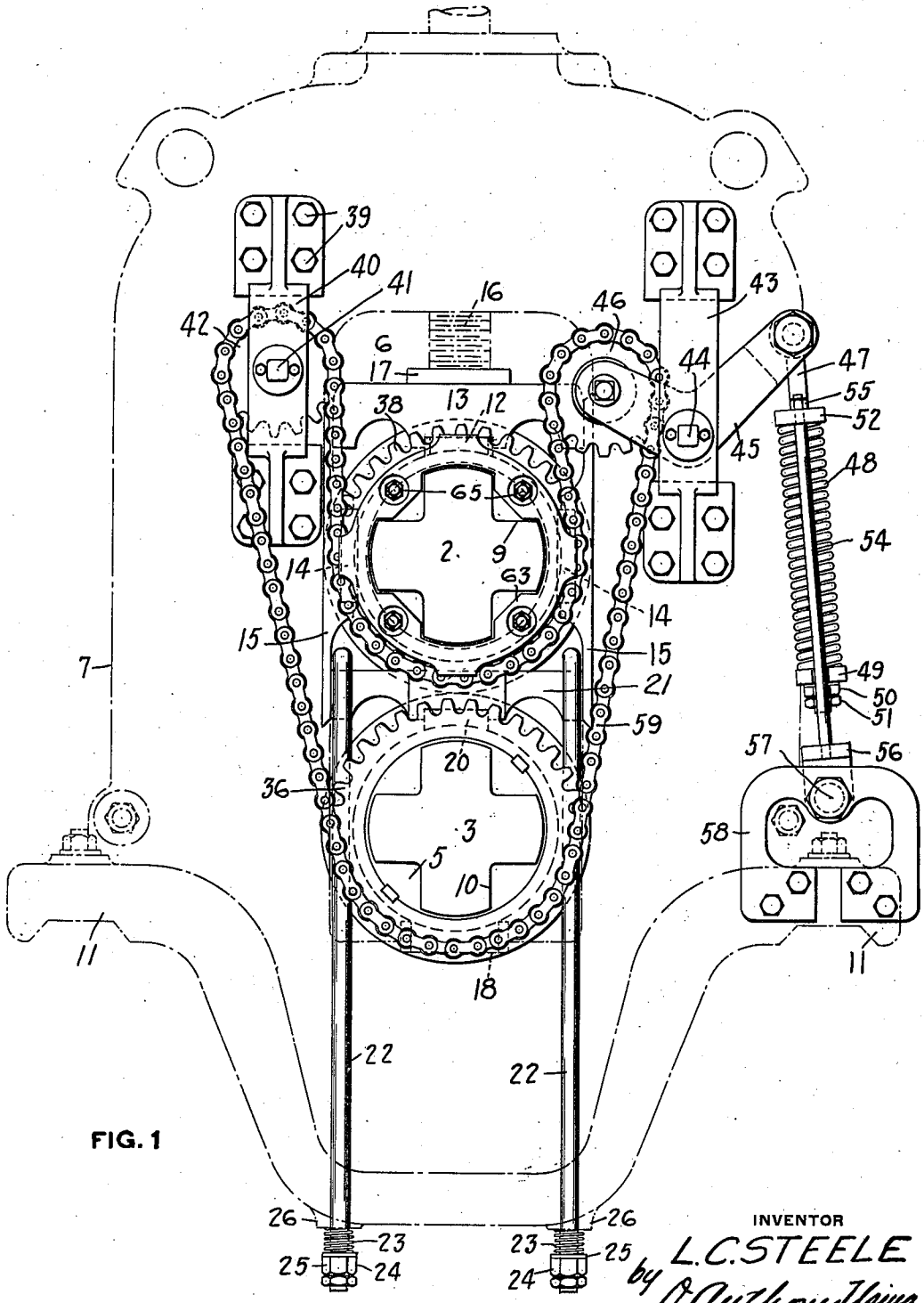


FIG. 1

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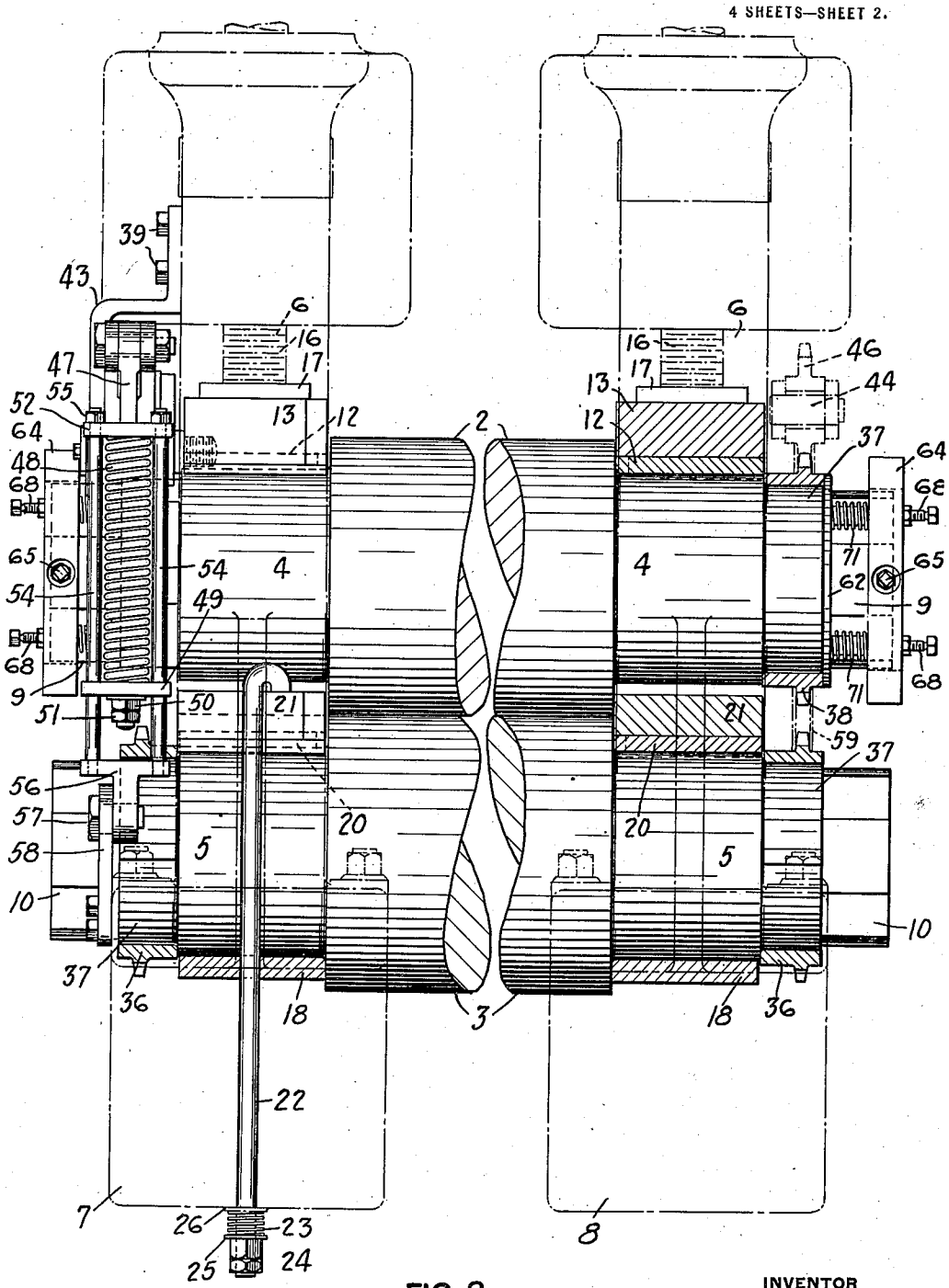


FIG. 2

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4 SHEETS—SHEET 3.

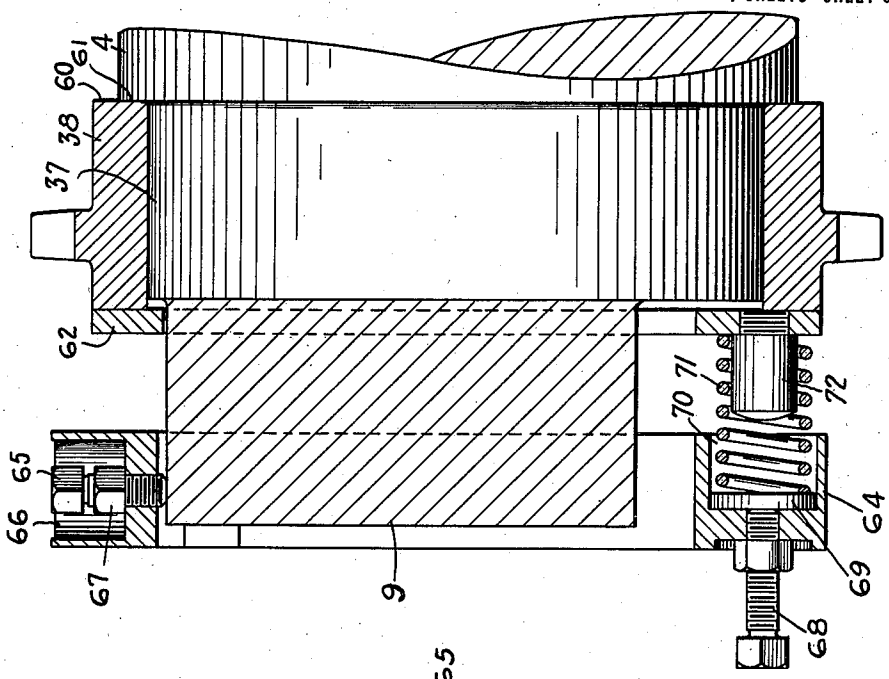


FIG. 3

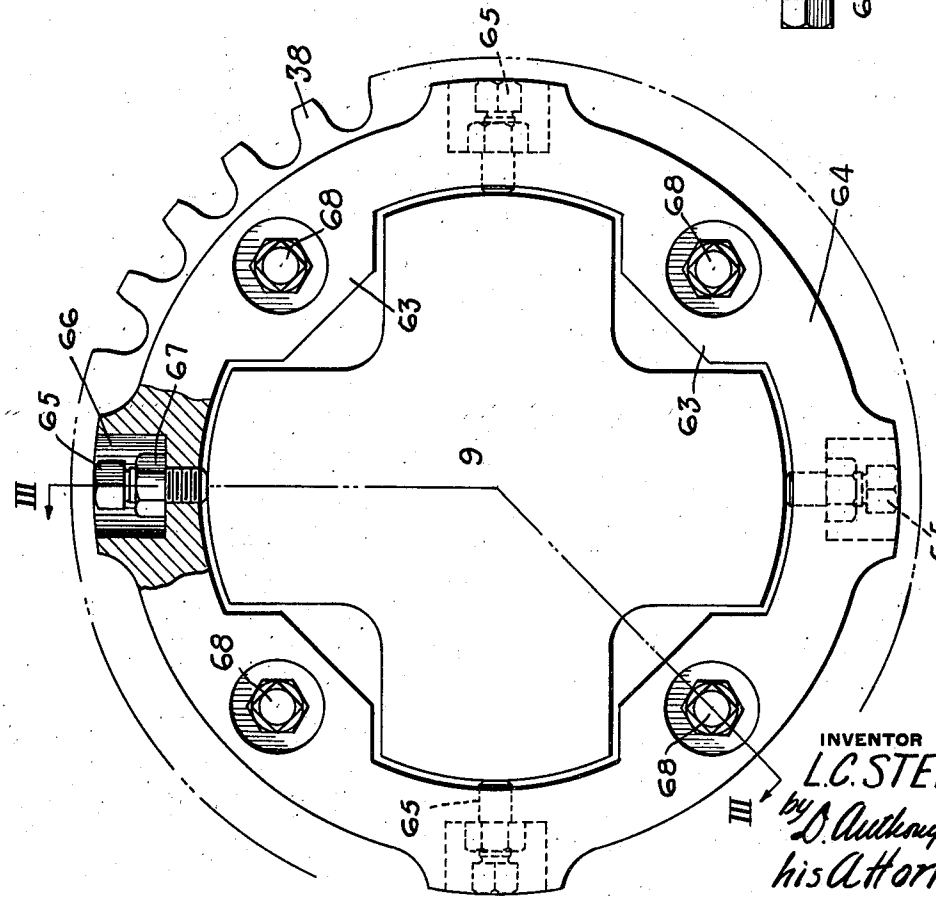


FIG. 4

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4 SHEETS—SHEET 4.

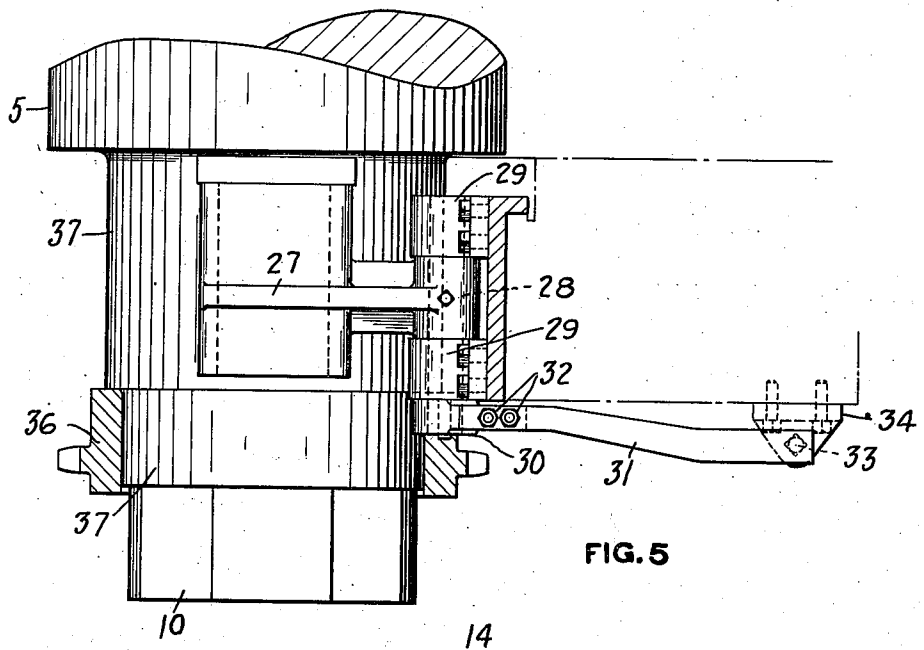


FIG. 5

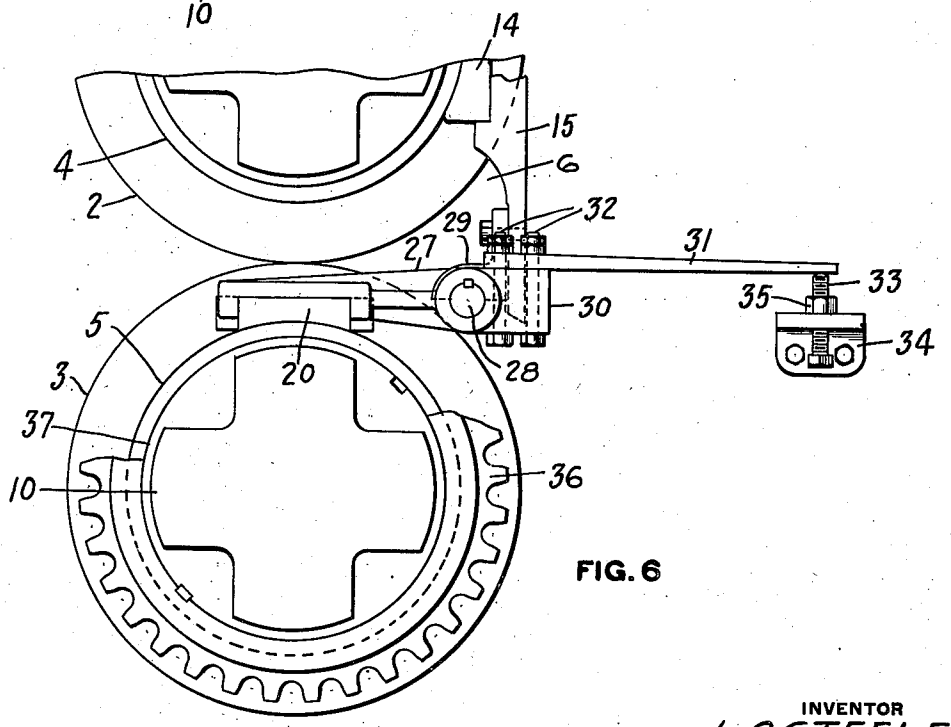


FIG. 6

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UNITED STATES PATENT OFFICE.

LAWRENCE C. STEELE, OF PITTSBURGH, PENNSYLVANIA.

ROLLING-MILL.

1,342,608. Specification of Letters Patent. Patented June 8, 1920.

Application filed October 28, 1918. Serial No. 260,006.

To all whom it may concern:

Be it known that I, LAWRENCE C. STEELE, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Rolling-Mills, of which the following is a specification.

My invention relates to rolling mills and more particularly to two-high rolling mills, such as are used in rolling sheets and tin plates and similar types.

Heretofore the bottom roll of such mills has been positively driven, the top roll, which is not balanced, "riding" on and being rotated by frictional engagement of its barrel with that of the bottom roll, except during the time the metal being reduced is between the rolls, when the top roll is caused to rotate by engagement with the metal being rolled.

In other mills, such as three-high sheared plate mills, both the top and bottom rolls, which constantly rotate in the same direction, are positively driven by means of separate driving spindles, and the middle roll, which is a small frictionally driven idler, is used to change the direction of travel of the metal being rolled, the top roll being balanced by means of a complicated system of counterweights and bell-crank levers, which is entirely separate from and independent of the roll driving mechanism.

Still other rolling mills, such as two-high reversing blooming mills, have each roll positively driven through separate spindles and employ a separate and independent balancing mechanism which includes a system of counterweights and bell-cranks for the vertically adjustable top roll.

One object of my invention is to provide a rolling mill having novel means whereby its top roll is balanced and driven.

Another object of the invention is to provide a rolling mill having novel means whereby its top roll is balanced in a simple and effective manner.

A further object of this invention is to provide a rolling mill of improved construction having a balanced top roll and having novel means for frictionally driving its balanced top roll.

A still further object of my invention is the provision in a rolling mill of a combined roll driving and balancing mechanism having the novel constructions, arrangements and combination of parts shown in the drawings and to be described in detail hereinafter and particularly pointed out in the appended claims.

Referring now to the drawings, forming part of this specification, Figure 1 is an end elevation showing a two-high rolling mill embodying my invention.

Fig. 2 is a side elevation of the apparatus shown in Fig. 1.

Fig. 3 is a sectional side elevation on the line III—III of Fig. 4, showing details in the construction of the friction drive forming part of the roll balancing and driving mechanism of Figs. 1 and 2.

Fig. 4 is an end elevation of the apparatus shown in Fig. 3.

Fig. 5 is a sectional plan, showing details in the construction and arrangement of a modified form of top bearing for the bottom roll of the mill of Figs. 1 and 2.

Fig. 6 is an end elevation of the apparatus shown in Fig. 5.

In the accompanying drawings, which show a two-high sheet or tin-plate mill embodying my invention, the numeral 2 designates the top and 3 the bottom roll. The rolls have necks 4, 4 and 5, 5 on the ends of the roll barrels, and the roll necks extend through the windows 6 of the pair of roll housings 7 and 8, the projecting ends of the necks 4, 4 of the roll 2 having a wabbler 9 thereon, and the necks 5, 5 on the roll 3 having a similar wabbler 10, the wabblers being constructed in the usual known manner. The roll housings 7 and 8 have feet 11, 11 by which the mill is secured on housing shoes. (Not shown.)

Each neck 4 of the top roll 2 has a top "brass" or bearing 12, which is removably secured in a "rider" 13, and also has side "brasses" or bearings 14, 14 which are removably secured in removable side liners 15, 15, of which there is one at each side of each housing window 6, and an adjusting screw 16 is provided on the top of each housing, which projects downwardly into the housing window into engagement with a breaker block 17 on top of the riders 13, to move the top roll 2 downwardly and to hold it in adjusted position relative to the bottom roll 3.

The necks 5, 5 of the bottom roll 3 rotate on bottom "brasses" or bearings 18, and have the usual side bearings of the usual construction (not shown). Top bearings

20 and riders 21 therefor, which are mounted in the windows 6 between the side liners 15, 15 are provided to prevent the bottom roll 3 from "jumping" in the housings, when operating the mill. The bearings 20 and riders 21, as shown in Figs. 1 and 2, are held in place by pairs of spring loaded hook bolts 22, the hook end of these bolts engaging with the riders 21 and the bolts extending downwardly through vertical holes in the bottom or lower end of the housings. Helical springs 23, positioned between the lower end of the housings 7, 8, and the nuts 24 on the screw threaded lower ends of the hook bolts 22, yieldingly maintain the bearing 20 and rider 21 in holding engagement with the necks 5, 5 of the bottom roll 3. A washer 25 and a boss 26 on opposite ends of the springs 23 provide a square bearing for the ends of the springs and the tension put on the hook bolts 22 by the springs 23 is maintained and varied by adjustment of the nuts 24 on the threaded lower ends of the bolts 22.

In the modified bearing construction of Figs. 5 and 6, the riders 21, hook bolts 22, and helical springs 23 are not used, and a jump bearing 20 for each neck 5 of the bottom roll 3 is removably secured on the swinging end of a pivoted lever 27. Each lever 27 is fixed at one end to a horizontal rock shaft 28, and these shafts are detachably mounted in pairs of half bearings 29, 29, the bearings 29 being bolted or otherwise fastened on the lower end of one of the pair of side liners 15 in the window 6 of each roll housing. One end of the shafts 28 overhangs its adjacent bearing 29, and keyed or otherwise fastened on the overhanging shaft end is a boss 30 forming part of the spring levers or arms 31. The outer ends of the spring arms, which are formed of two parts 30, 31, for convenience in making, fastened together by bolts 32, 32, are engaged by adjusting screws 33 screwed into threaded openings in the brackets 34 which regulate the tension on the spring arms 31. The brackets 34 are bolted on the side of the roll housings 7 and 8, and jam nuts 35 lock the screws 33 in adjusted position on the brackets.

A sprocket wheel 36 is keyed or otherwise fastened on a reduced portion 37 of each neck 5 of the bottom roll 3, so as to be rotated thereby, and loosely mounted on the reduced portion 37 of each neck on the top roll 2, so as to rotate thereon as well as therewith, is a similar sprocket wheel 38. Rigidly secured on the outer side of each housing by bolts 39, is a bracket 40 for supporting one end of a pin or axle 41, on which an idler sprocket wheel 42 is rotatably mounted, and also secured on a similar bracket bearing 43 on the outer side of each housing, by means of a pivot pin or stud 44 is a rocking bell-crank 45. The inner ends of the pins or studs 41 and 44 are screwed into threaded holes in the side of the housings, and provision will be made for locking the pins against rotation. The bell-crank 45 is pivotally secured on the bracket 43 at an intermediate point in the length of the bell-crank. The short arm of this bell-crank 45 is forked, and rotatably mounted in the fork is a small idler sprocket wheel 46 similar to the wheel 42. The long arm of the bell-crank 45 is pivotally connected by a pin or bolt to one end of a spring loaded bolt 47 which extends downwardly through a helical compression spring 48 and through a suitable opening in the spring seat or follower 49 on the lower end of the spring 48. Nuts 50 and 51 are provided on the screw-threaded lower end of the spring bolt 47 to adjust or regulate the initial amount of compression put on the spring. The upper end of the spring 48 engages a seat or follower 52 which has holes in its opposite ends, and extending upwardly through the holes are bolts 54, 54 having nuts 55 on the screw-threaded upper ends thereof. The threaded lower ends of the bolts 54 are screwed into a T-shaped support 56 which is pivotally secured by a pin 57 to a bracket or plate 58, and the plates 58 are rigidly fastened to the sides of one foot 11 of the housings 7 and 8, as is clearly shown in Figs. 1 and 2.

An endless sprocket chain 59 extends around the sprocket wheel 36 on each end of the bottom roll 3 and, after passing over the small sprocket wheels 42 and 46, extends around the loosely mounted companion sprocket wheel 38 on the ends of the top roll 2. Each sprocket chain 59 engages with the lower half of a sprocket wheel 36 on the roll 3 and a sprocket wheel 38 on the top roll 2, and the horizontal axis of rotation of the idler sprocket wheels 42 and 46 on the sides of the roll housings is some distance above the horizontal axis of the top roll 2, so that the chains 59, when in operative position, form double loops adapted to support the top roll 2 and to rotate the sprocket wheels 38 and top roll 2 in the opposite direction to that of the sprocket wheels 36 on the bottom roll 3 when the chains 59 are actuated by the positively driven bottom roll 3.

The forked arm of the bell-cranks having the small sprocket wheels 46 thereon, is shorter than the other arm, this arrangement being provided in order to at all times equalize the compressive force of the springs used in maintaining the sprocket chains 59 under tension, and in counterbalancing the upper roll 2. The effective length of the short, forked arm of the bell-crank is lessened as this arm is rocked or moved in a clock-wise direction, and at the same time the effective length of the long arm of the bell-crank 45 increases. By properly pro-

portioning the relative length of the two arms of the bell-crank 44, the loss in compressive force of the springs 48 as they open or lengthen is offset or counteracted by the increased leverage of the long arm, so that the tension put on the sprocket chains 59 will be substantially uniform at all points in the swinging or rocking movement of the bell-cranks.

The sprocket wheels 38 are loosely mounted on the reduced portion 37 of the necks 5 of the top roll 2, one end 60 of the hub of these sprocket wheels engaging with the shoulder 61 formed at the junction of the reduced portion 37 with the bearing portions of the roll necks. The other end of the sprocket wheel hubs is engaged by a friction plate 62 which has a central opening through which the wabbler 9 projects. The opening in the friction plates has projections 63 extending into the grooves in the periphery of the wabblers, so that the friction plates 62 are positively connected to the top roll 2 so as to prevent relative rotation thereof.

Also secured on each wabbler 9 of the top roll 2 is a spring carrier 64 which is rigidly fastened in position on the wabbler by the series of set screws or bolts 65 projecting through the threaded portions of radial holes in the spring carrier into holding engagement with the peripheral surface of the wabblers 9. The holes for the bolts 65 have a counterbored recess 66 to provide a seat for the jam nuts 67 on each bolt, and to shroud the nuts 67 and squared outer end of the bolts 65. (See Figs. 3 and 4).

Projecting through threaded openings in the spring carriers 64 is a series of spring adjusting screws 68 which extend lengthwise parallel to the axis of the roll 2 and are spaced at equi-distant points around the periphery of the roll wabblers on which the spring carriers are mounted. The inner end of these adjusting screws 68 engage with washers 69 which are seated in the counterbores or recesses 70 on the periphery of the spring carrier, and also projecting into the recesses 70 with one end in engagement with the washers 69, are helical compression springs 71. (See Figs. 3 and 4). The other end of the springs 71 extends outwardly into contact with one side surface of the friction plates 62, and short pins 72 on one face of the friction plates project into and act to keep the springs in spaced relation between the opposite faces of the friction plates 62 and spring carriers 64.

The operation of mills constructed in accordance with my invention, such as the sheet and tin-plate mill shown, will be readily understood. The metal being rolled will be manipulated during the reduction thereof, and the rolls will be adjusted in the usual manner. In adjusting the rolls, the top roll 2 will be moved downwardly into the desired position relative to the bottom roll 3 by means of the housing screws 16, and in moving the top roll downwardly the vertical distance between the horizontal axes of the sprocket wheels 42, 46, and corresponding axis of the roll 2 will be lengthened. This causes the bell-cranks 45 to swing in a direction to shorten the springs 48 on the bolts 47, which are pivotally secured at one end to the long arm of the bell-cranks.

When the engine or other prime mover is started, the "leading" spindle (not shown) connecting the prime mover to the wabbler 10 on one neck of the bottom roll 3, positively rotates the roll 3 and the sprocket wheels 36 keyed on the roll 3. The sprocket wheels 36 actuate the endless sprocket chains 59 and in this way cause the chains to positively rotate the loosely mounted sprocket wheels 38 on the necks of the top roll 2. As the friction plates 62 are tightly pressed against the contiguous end of the hubs of the sprocket wheels 38, rotation of the wheels 38 tends to turn the friction plates 62 and, through these friction plates, acts to frictionally drive the top roll 2. The adjusting screws 68 on the spring carriers 64 will, of course, have been adjusted to compress the springs 71 to the required extent before the mill is started, and the jam nuts on these bolts will be jammed to lock the screws 68 in adjusted position. On account of slippage between the friction faces of the plates and sprocket wheel hubs, caused in overcoming the inertia of the top roll 2, some little time will elapse after starting the roll 3 to rotate before the surface speed (or when the rolls are of unequal diameter the angular velocity) of the top and bottom rolls will be equalized. But after the surface speeds are once equalized the friction clutches formed by the chain driven sprockets 38 and the friction plates 62 will readily drive the top roll during the successive intervals during which metal is not being reduced or rolled between the rolls 2, 3. The chains 59 and spring loaded bell-cranks 45 will sustain the weight of the top roll 2 so that it need not or will not "ride" on the bottom roll, as in the mills as constructed heretofore, the flexible chains and spring loaded bell-cranks forming a simple, strong and effective balancing mechanism for the vertically adjustable top roll as well as providing means for driving the rotary top roll.

In fact the arrangement of flexible chains is adapted for use as a roll balancing mechanism on mills of other types having a vertically adjustable top roll, instead of as a combined counterbalancing and driving mechanism for such top roll.

The advantages of my invention will be readily appreciated by those skilled in the art.

Many modifications in the construction and application of my invention may be made, and other changes in design and arrangement of parts made without departing from my invention as defined in the appended claims.

I claim:—

1. A rolling mill comprising roll housings having a vertically adjustable roll in the window thereof and a roll balancing mechanism having flexible members looped around said roll engaging with and yieldingly supporting the same within the windows of the housings.

2. A rolling mill comprising roll housings having a vertically adjustable roll in the windows thereof and a roll balancing mechanism, said balancing mechanism having flexible members looped around said roll for supporting the same within the windows of the housings, and yielding means for maintaining said looped flexible members in operative engagement with said roll.

3. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, said top roll being vertically adjustable, a roll balancing mechanism having endless flexible members looped around the top roll, and yielding means for maintaining said flexible members in balancing engagement with said top roll.

4. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, and a roll balancing mechanism having endless flexible roll supporting members looped around the top roll, said balancing mechanism having yielding means for maintaining said flexible members in supporting engagement with said roll and having adjustable means for varying the tension on said yielding flexible members.

5. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, and a roll balancing mechanism, said balancing mechanism having endless flexible roll supporting members looped around the top roll and having means for maintaining a constant tension on said looped flexible members.

6. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, and roll a balancing mechanism having endless flexible members looped around said top and bottom rolls, said flexible members being arranged to rotate the top roll when the bottom roll is rotated, and yielding means for maintaining said looped flexible members in operative engagement with said rolls.

7. A rolling mill comprising roll housings having a vertically adjustable top roll and a bottom roll operatively mounted in the windows thereof, and a roll balancing mechanism having endless flexible members looped around said top and bottom rolls, said flexible members being arranged to rotate the top roll when the bottom roll is rotated, and yielding means for maintaining said looped flexible members in operative engagement with said rolls, and means for maintaining a constant tension on said flexible members.

8. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, and a roll balancing and driving mechanism for said top roll having endless flexible members looped around said rolls, said flexible members being arranged to drive said top roll when the bottom roll is rotated, yielding means for maintaining said flexible members in supporting engagement with said top roll, and adjustable means for varying the tension on said looped flexible members.

9. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, sprocket wheels on the necks of said rolls, endless sprocket chains looped around the sprocket wheels on the adjacent necks of the top and bottom rolls, and yielding means for maintaining said looped sprocket chains in operative engagement with the sprocket wheels to support and drive the top roll when the bottom roll is driven.

10. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, sprocket wheels on the necks of each roll, endless sprocket chains looped around the sprocket wheels and arranged to drive the sprocket wheels on said top roll when the bottom roll is driven, and yielding means for maintaining said looped sprocket chains in operative engagement with the sprocket wheels.

11. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, sprocket wheels on the necks of each roll, endless sprocket chains looped around the sprocket wheels and arranged to drive the sprocket wheels on said top roll when the bottom roll is driven, yielding means for maintaining said looped sprocket chains in operative engagement with the sprocket wheels, and adjustable means for varying the tension on said sprocket chains.

12. A rolling mill comprising roll housings having top and bottom rolls operatively mounted in the windows thereof, sprocket wheels on the necks of said rolls, endless sprocket chains looped around the sprocket wheels on the adjacent necks of the top and bottom rolls, means for frictionally

connecting the sprocket wheels to said top roll, and yielding means for maintaining said looped sprocket chains in operative engagement with the sprocket wheels to thereby support and drive the top roll when the bottom roll is driven.

13. A rolling mill comprising a vertically adjustable roll and a balancing mechanism having flexible means looped around said roll for yieldingly supporting the same.

14. A rolling mill comprising top and bottom rolls, a balancing mechanism having endless flexible roll supporting means looped around the top roll and a tension device for said supporting means.

15. A rolling mill comprising top and bottom rolls, a balancing mechanism having endless flexible means looped around the top and bottom rolls and a tension device for maintaining said flexible means in driving engagement with said rolls.

In testimony whereof I have hereunto set my hand.

LAWRENCE C. STEELE.