No. 685,468. Patented Oct. 29, 1901.

J. FAWELL.

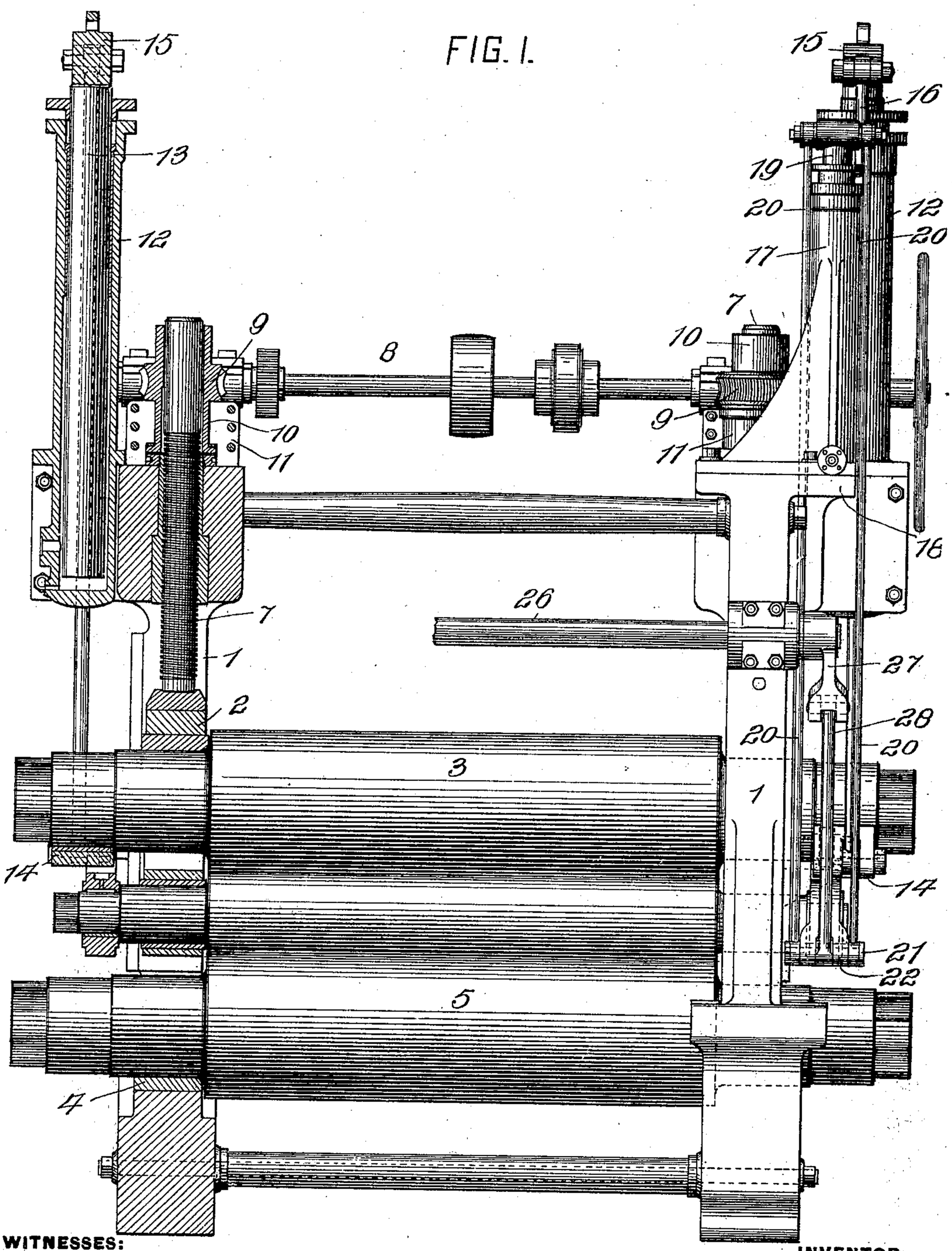
ROLLING MILL.

(Application filed Nov. 23, 1900.)

(No Model.)

10 Sheets—Sheet 1.

FIG. 1.



WITNESSES:

M. Moss

Herbert Bradley.

INVENTOR

Joseph Fawell

by Dawson & Wolcott Att'y.

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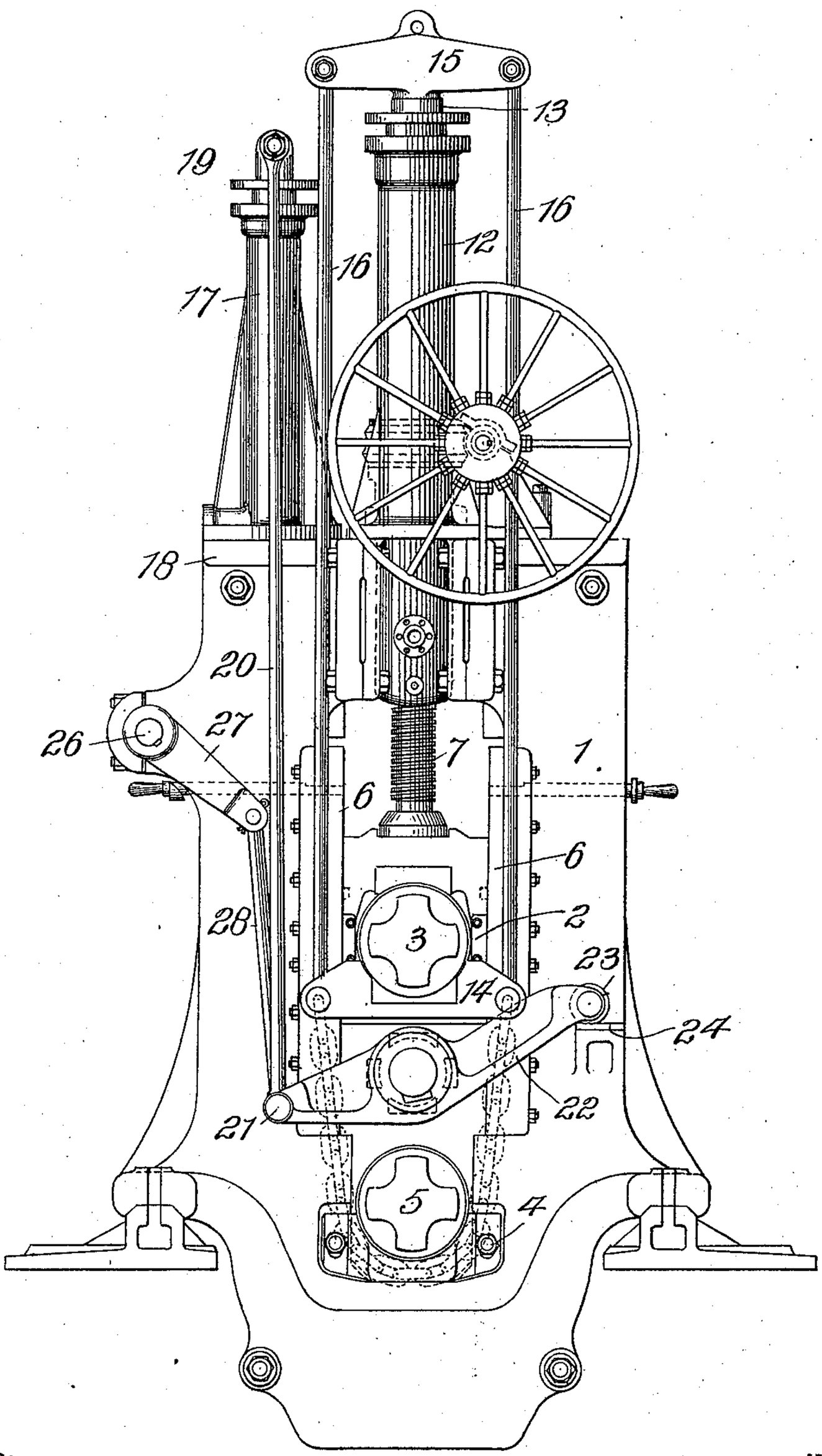
(No Model.) 10 Sheets—Sheet 2.

FIG. 2.



WITNESSES:
M. Moss
Robert Bradley.

INVENTOR
Joseph Fawell
by Dawson & Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

J. FAWELL.

ROLLING MILL.

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(No Model.) 10 Sheets—Sheet 3.

FIG. 3.

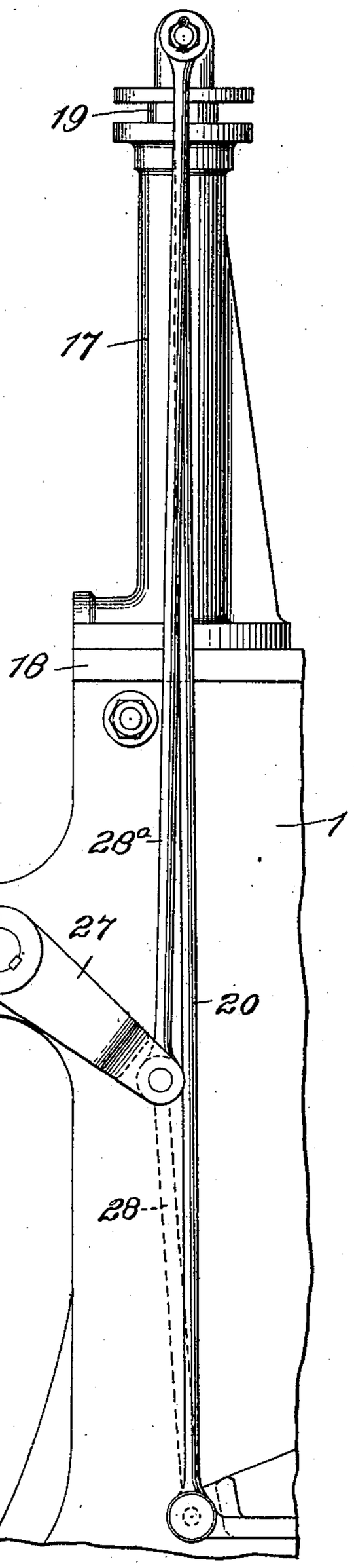
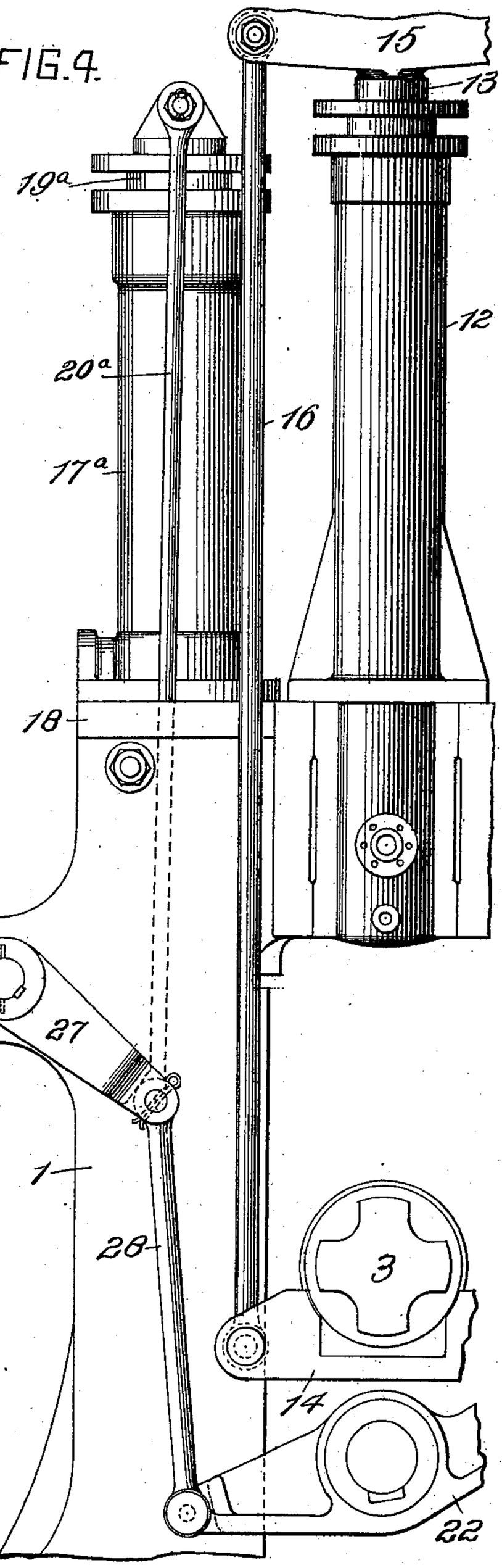


FIG. 4.



WITNESSES:
M. Moses
Herbert Bradley.

INVENTOR
Joseph Fawell
by Damrin & Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

J. FAWELL.

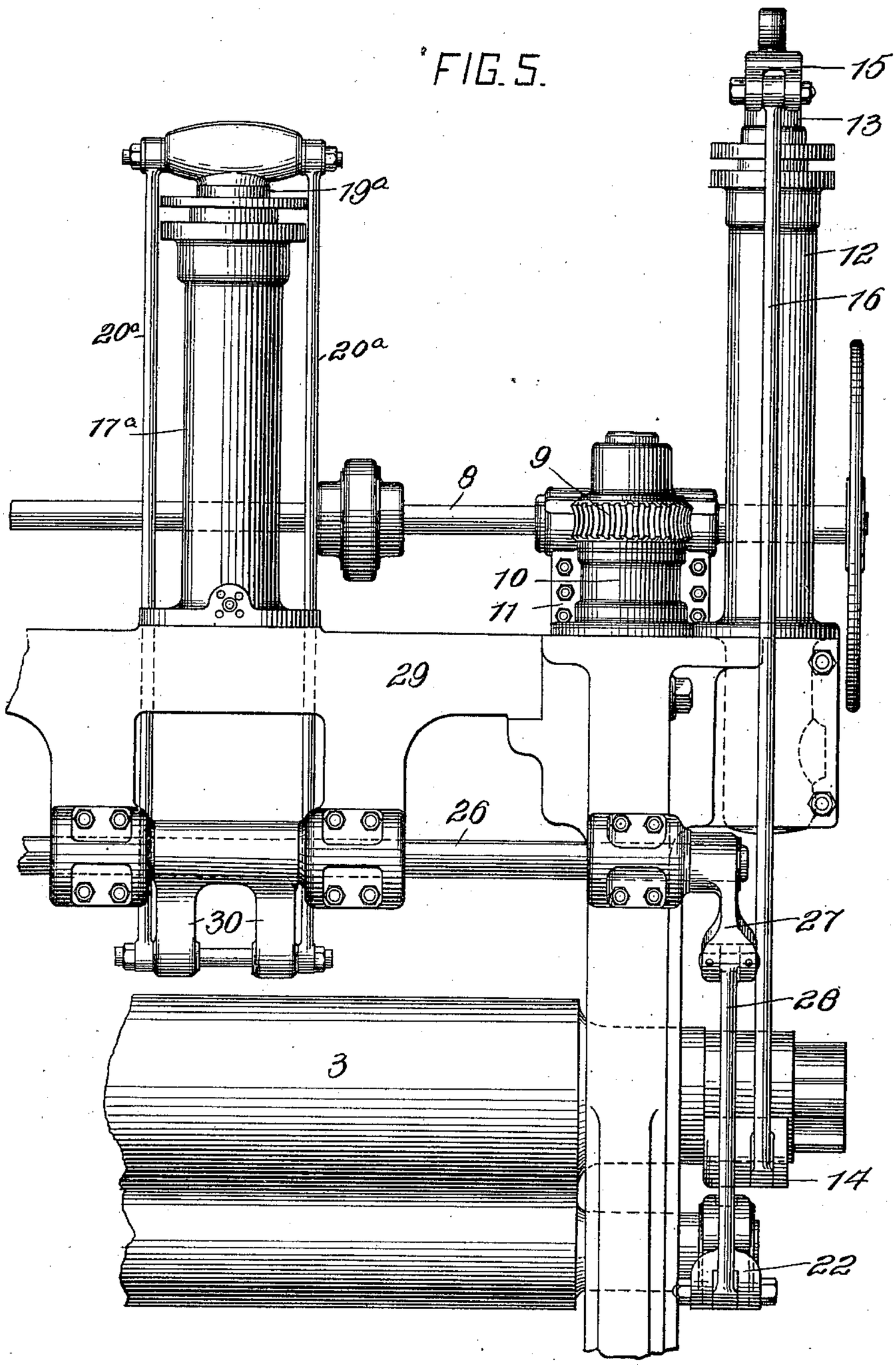
ROLLING MILL.

(Application filed Nov. 23, 1900.)

(No Model.)

10 Sheets—Sheet 4.

FIG. 5.



WITNESSES:
M. Moss
Herbert Bradley.

INVENTOR
Joseph Fawell
by Dennis B. Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

J. FAWELL.

ROLLING MILL.

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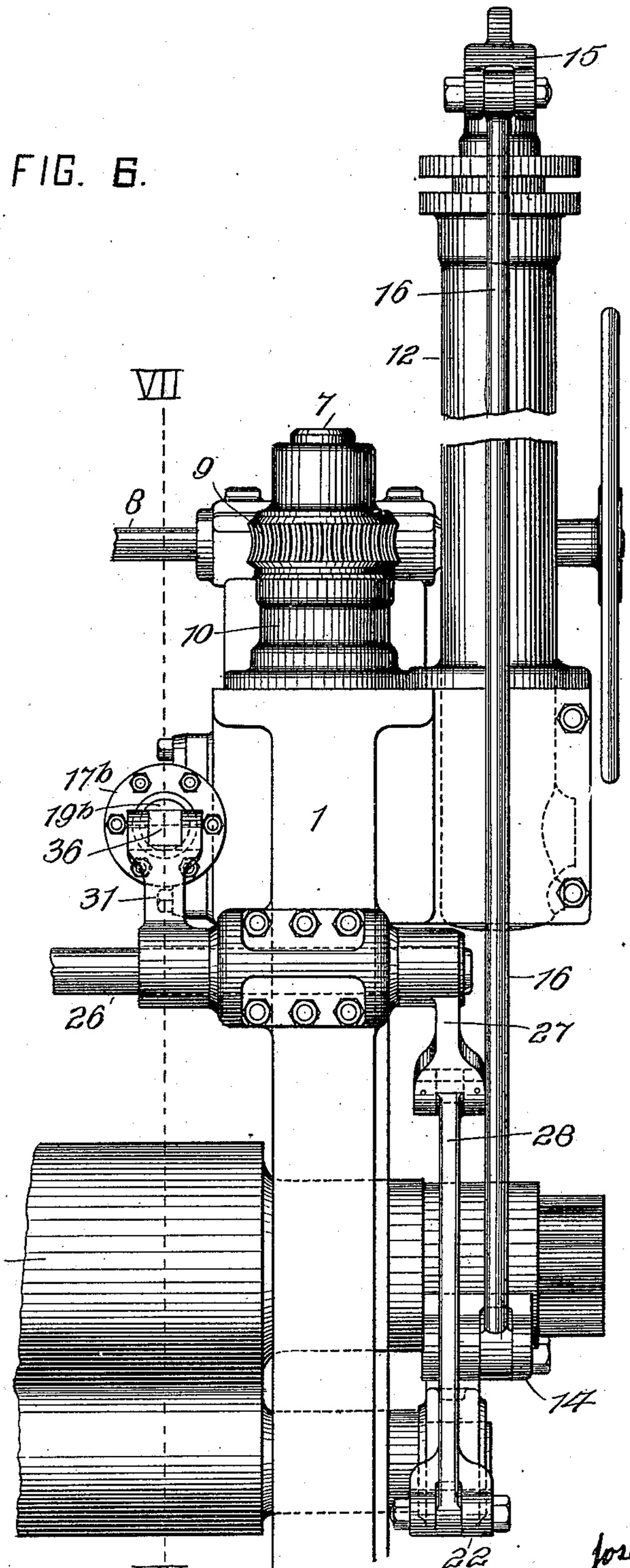
(No Model.) 10 Sheets—Sheet 5.

FIG. 6.



WITNESSES:
M. Moss
Herbert Bradley.

INVENTOR
Joseph Fawell
by Dennis S. Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

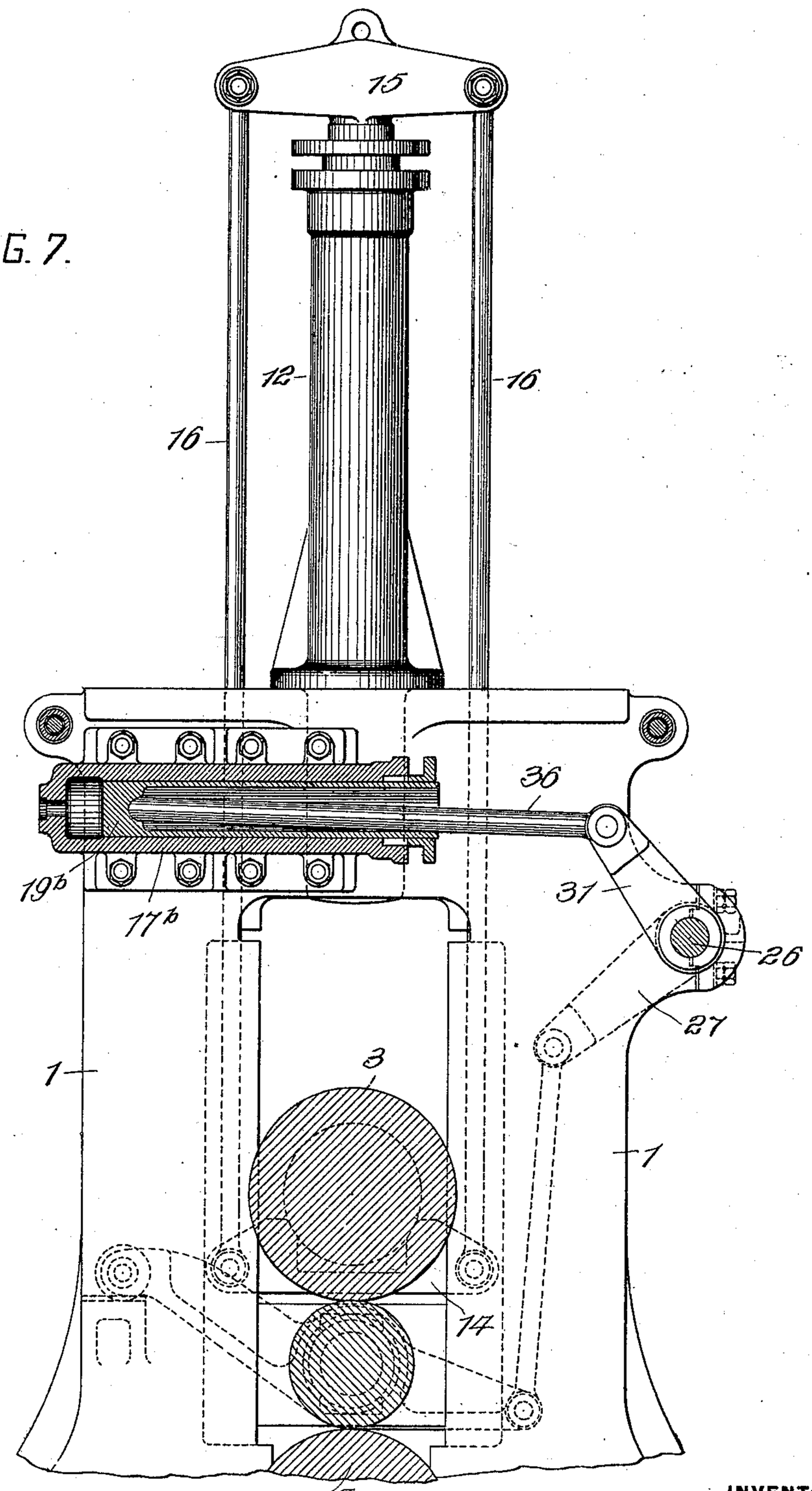
J. FAWELL.

ROLLING MILL.

(Application filed Nov. 23, 1900.)

(No Model.) 10 Sheets—Sheet 6.

FIG. 7.



WITNESSES:
M. Mors
Herbert Bradley.

INVENTOR
Joseph Fawell
by Dewain & Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

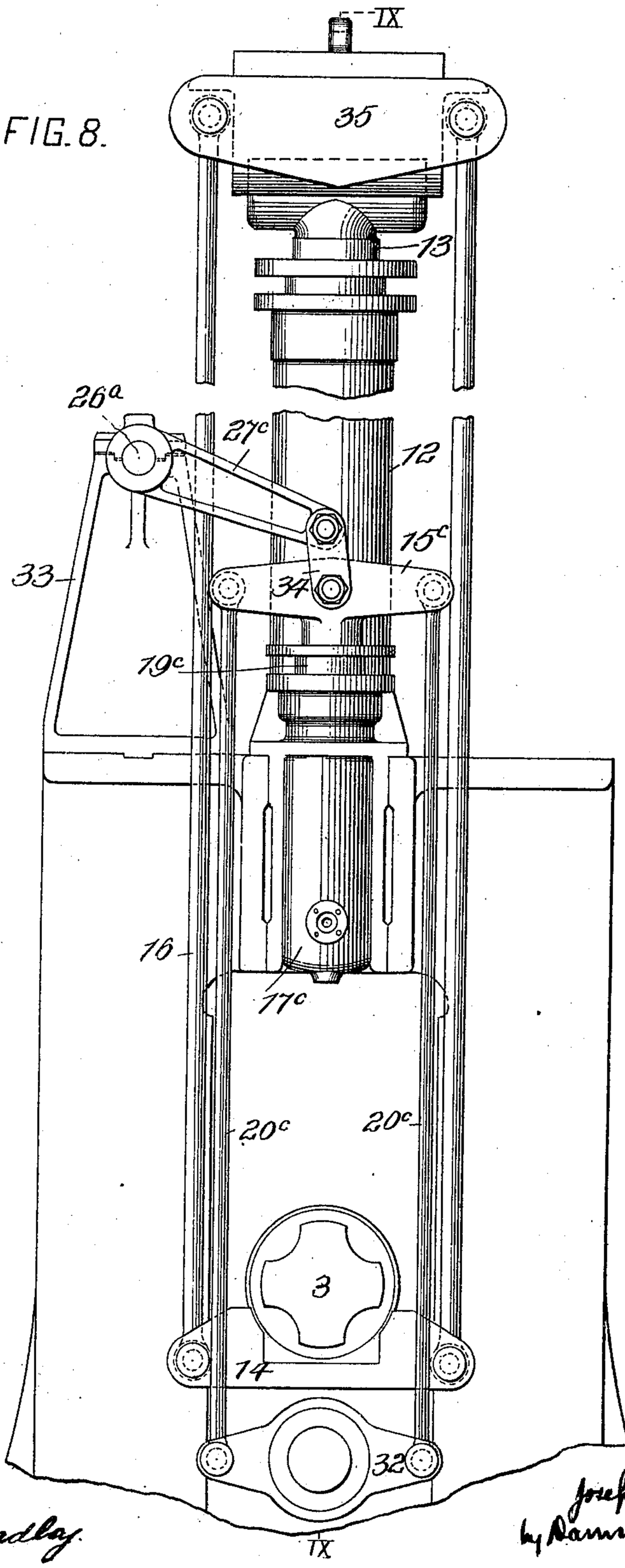
J. FAWELL.

ROLLING MILL.

(Application filed Nov. 23, 1900.)

(No Model.) 10 Sheets—Sheet 7.

FIG. 8.



WITNESSES:
M. Moss
Herbert Bradley

INVENTOR
Joseph Fawell
by Dannis & Wolcott Att'y.

No. 685,468. Patented Oct. 29, 1901.

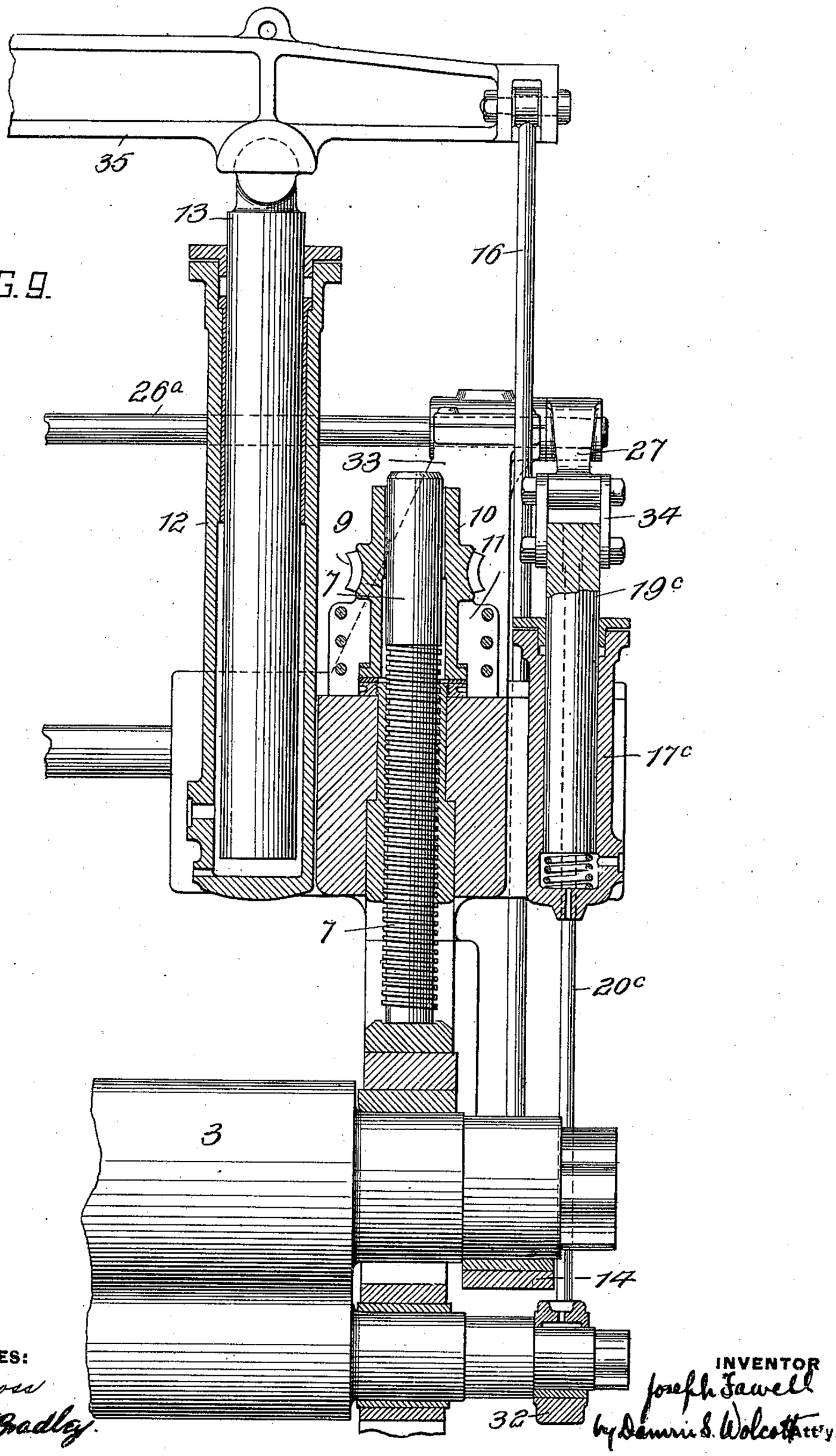
J. FAWELL.

ROLLING MILL.

(Application filed Nov. 23, 1900.)

(No Model.) 10 Sheets—Sheet 8.

FIG. 9.



WITNESSES:
M. Moss
Herbert Bradley.

INVENTOR
Joseph Fawell
by Dennis S. Wolcott Att'y.

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J. FAWELL.

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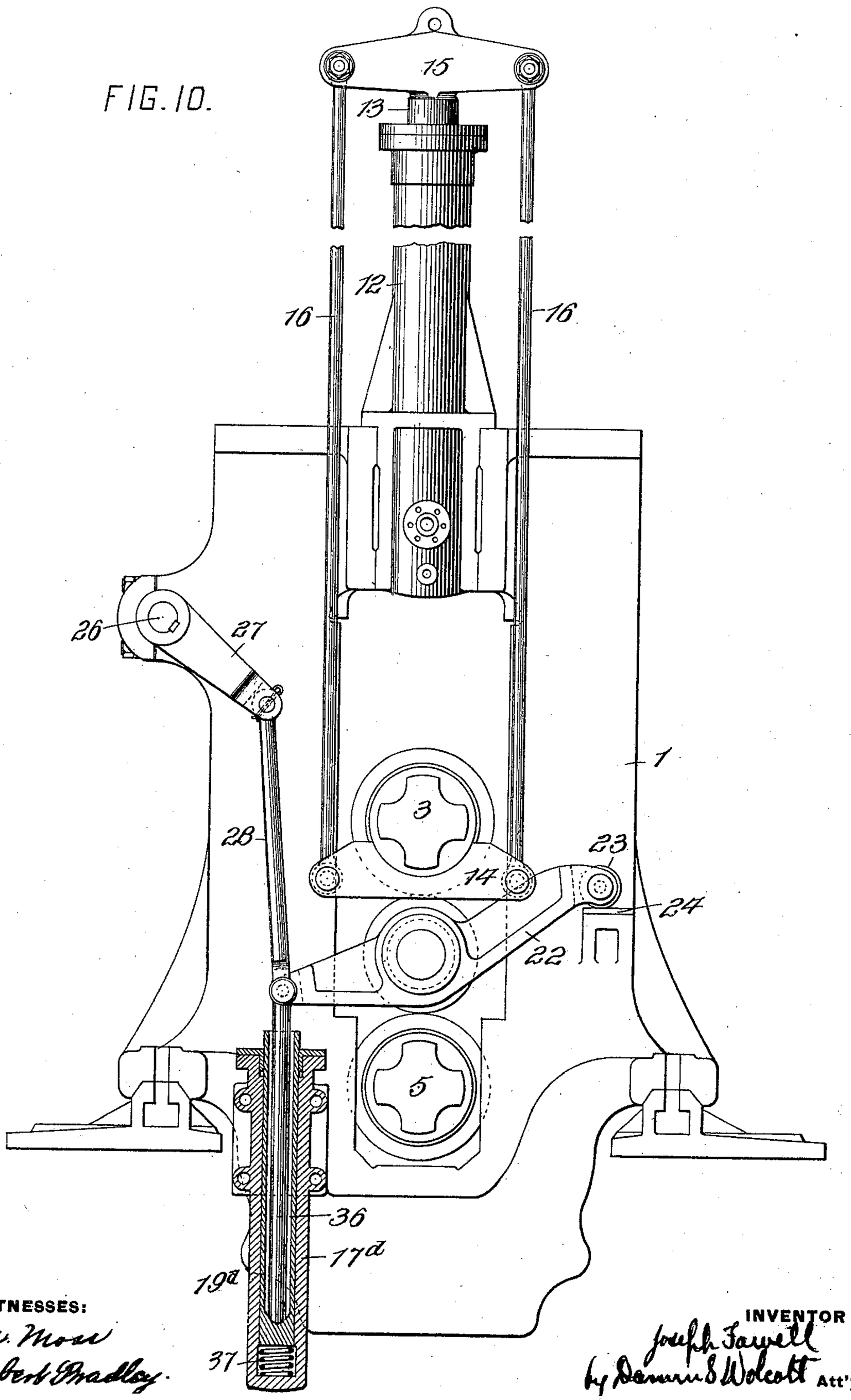
(Application filed Nov. 23, 1900.)

(No Model.)

10 Sheets—Sheet 9.

FIG. 10.



WITNESSES:

M. Moss

Herbert Bradley.

INVENTOR

Joseph Fawell

by Dennis & Wolcott Att'y

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J. FAWELL.

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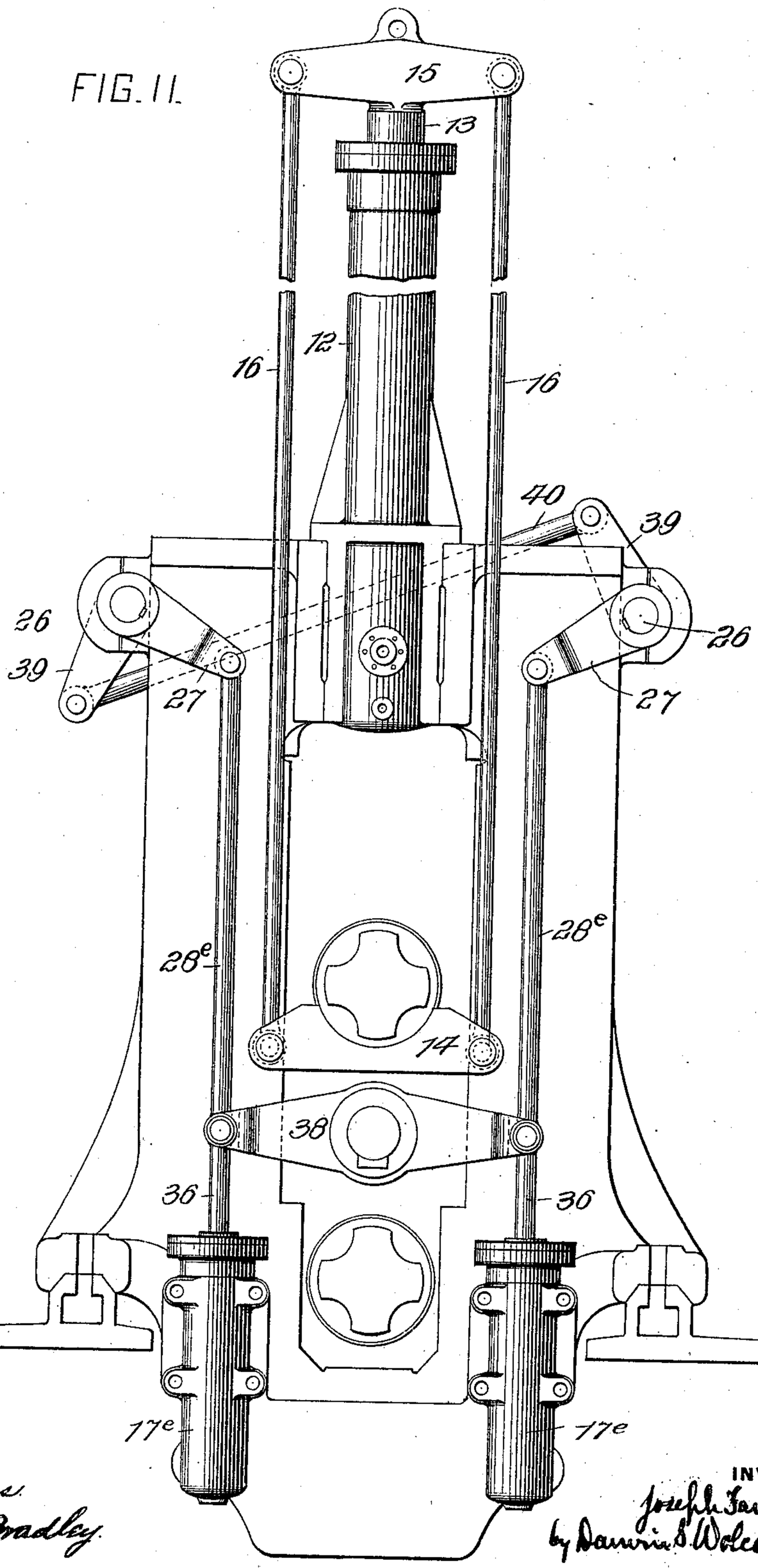
10 Sheets—Sheet 10.

FIG. 11.



WITNESSES:

M. Moses

Herbert Bradley.

INVENTOR

Joseph Fawell

by Dawin S. Wolcott Att'y.

UNITED STATES PATENT OFFICE.

JOSEPH FAWELL, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO MACKINTOSH, HEMPHILL & COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 685,468, dated October 29, 1901.

Application filed November 23, 1900. Serial No. 37,454. (No model.)

To all whom it may concern:

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

In Letters Patent No. 661,470, granted November 6, 1900, certain improvements in rolling-mills for the purpose of facilitating the changing of rolls are described and shown, said mechanism being also applicable for balancing one of the rolls while the mill is in use.

The present invention has for its object the employment of fluid-pressure cylinders for holding the upper roll of a two or three high mill against its adjusting-screws and the employment of independent fluid-pressure cylinders for controlling or effecting the up-and-down movement of the middle roll of a three-high mill, such balancing or adjusting cylinders being arranged on the housing in such position as to avoid liability of their being injured by scale, &c.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a view, partly in section and partly in side elevation, of a rolling-mill having my improvements applied thereto. Fig. 2 is an end elevation of the same. Fig. 3 is an end elevation of a portion of the mill, illustrating a modification of the arrangement shown in Figs. 1 and 2. Fig. 4 is a view similar to Fig. 3, illustrating a second arrangement of the adjusting-cylinders and their connections. Fig. 5 is a side elevation of a portion of the mill, further illustrating the arrangement shown in Fig. 4. Fig. 6 is a side elevation of a mill, showing the arrangement of the cylinders for the middle roll in a horizontal position on the housing. Fig. 7 is a sectional elevation, the plane of section indicated by the line VII VII, Fig. 6. Fig. 8 is an end elevation of the mill, illustrating a further modification in the arrangement of the adjusting-cylinders. Fig. 9 is a sectional elevation on a plane indicated by the line IX IX, Fig. 8; and Figs. 10 and 11 are end elevations of the mill, illustrating additional modification in the arrangement of the adjusting-cylinders and their connections.

In the practice of my invention the rolling-mill is constructed in the usual or any suitable manner, and it consists of housings 1, which may be of the closed type or of the open-top type having suitable caps, having windows therein for the reception of the bearing-blocks 2 and 4 of the upper and lower rolls 3 and 5, the upper blocks 2 moving in guides 6, secured within the windows. Adjusting-screws 7 pass through threaded sleeves in the upper ends of the housings or the housing-cap and are rotated simultaneously by any suitable means—such, for example, as that shown, consisting of a shaft 8, mounted in suitable bearings on the tops of the housings or caps and provided with worms which intermesh with worm-wheels 9, preferably formed on sleeves 10, which are so connected by a groove and fin with the screws 7 that the latter are caused to rotate with the sleeves, but are free to move longitudinally through them, the sleeves being secured to the housings or caps in any suitable manner, as by clamps 11. The upper roll is supported so that its bearing-block 2 will bear against the end of the screw 7 by means of fluid-pressure cylinders 12, mounted on the housings or caps and preferably in line with each other and with the adjusting-screws. The pistons or rams 13 of these cylinders are connected in any suitable manner to yokes 14, which pass under the journals of the upper roll 3. A desirable construction for connecting the rams of the cylinders with the yokes 14 is shown in Figs. 1, 2, 5, 6, and 7, and consists of cross-heads 15, secured to the upper heads of the rams and have their ends connected by rods 16 to the ends of the yokes. Sufficient pressure is maintained in these cylinders by any suitable means to support the rolls at all times firmly against the ends of the screws; but the pressure should not be sufficient to present a considerable resistance to the downward movement of the rolls by the adjusting-screws.

In three-high mills where the upper and lower rolls are driven in opposite directions and the article is fed in one direction between the lower and middle roll and in the opposite direction between the middle and upper roll the middle roll should be moved first against the upper roll, so as to be supported and frictionally driven thereby, and then against the lower roll when the feed is between the upper and middle roll, whereby the lower roll will serve as support and driver for the middle roll during this pass. This shifting of the middle roll up and down has been effected by mechanical means and also by fluid-pressure cylinders arranged in a pit below the roll-housing and having lever connections to the ends of the middle roll. This construction involves providing a deep pit below the rolls for the reception of the balancing and shifting mechanism, and such mechanism is liable to injury by the scale, &c., dropping down onto the mechanism while the mill is in use. In order to avoid these objectionable features, I provide for supporting the adjusting-cylinders upon the housing adjacent to or above the floor-line of the mill.

In the construction shown in Figs. 1, 2, and 3 adjusting-cylinders 17 are arranged upon the housings in line or approximately in line transversely with the lifting-cylinders 12 of the upper roll, a ledge 18 being formed on the housing or the housing-cap extended for supporting these cylinders. The rams 19 of the cylinders are provided with cross-heads, to the ends of which are connected the upper ends of rods 20, whose lower ends are connected to pins 21 in the ends of levers 22. These levers, which are designed to support the middle roll and to effect or control its up-and-down movement, are so connected to the housings and to the projecting journals of the middle roll that the lever can move up and down without effecting any lateral movement of the middle roll. This function can be effected in several ways—as, for example, in Fig. 2 the pivotal end of the lever is shown provided with a friction-roller 23, resting upon a ledge 24, formed on the housing, and the lever is constructed as regards its engagement with the journals of the middle roll with a boss or bearing-piece, through which the journals of the middle roll project. This construction will permit of the pivotal end of the lever moving back and forth without any change in the lateral position of the middle roll.

As shown in Fig. 1, adjusting-cylinders are mounted on each of the housings and have their rams or pistons connected in the manner described to the journals of the middle roll; but as the movement of the rams may be unequal suitable equalizing mechanism should be interposed between the ends of the roll or some portions of its shifting mechanism whereby both ends of the roll will be caused to move simultaneously and equally. A desirable construction of equalizing mechanism consists of a shaft 26, mounted in suitable bearings on the housings and having arms 27 keyed thereto. The outer ends of these arms may be connected by rods 28 to the pins 21 in the ends of the levers 22, as shown in Figs. 1 and 2, or, as shown in Fig. 3, the ends of the arms 27 may be connected by rods 28^a to the cross-head at the upper ends of the rams or pistons 19 of the fluid-pressure cylinders. A further modification consists in the entire omission of the rods 20 and forming the connection between the cross-head on the rams 19 and the arms 27 and lever 22 by rods 28 and 28^a. In this construction the adjacent ends of these rods will be connected together and to the ends of the arms 27 by pins.

As shown in Figs. 4 and 5, a single adjusting-cylinder 17^a may be employed for effecting the adjustment of the middle roll. This cylinder is secured upon a bridge-piece 29, which has its ends supported and secured to the housings 1, as clearly shown in Fig. 5. The cross-head at the upper end of the ram or piston 19^a of the cylinder is connected by rods 20^a to an arm 30, secured upon the equalizing-shaft 26, and the arms 27 at the ends of this shaft are connected by rods 28 to the ends of the levers 22, as described.

In the construction shown in Figs. 6 and 7 the adjusting-cylinders 17^b are secured in a horizontal position on the inner faces of the housings 1, and the rams 19^b have axial openings therein for the reception of the pins 36, which have their outer ends pivotally connected to arms 31 on the equalizing-shaft 26. The arms 27 on the ends of this shaft are connected in the manner described to the ends of the levers 22.

As shown in Figs. 8 and 9, the adjusting-cylinders 17^c may be secured to the outer faces of the housings or to the housing-caps in line with the cylinders 12 and with the adjusting-screws 7. In other words, these cylinders are arranged with their axes in or approximately in the vertical plane passing through the axis of the middle roll. In this construction the cross-heads 15^c on the upper end of the rams or pistons of the cylinders have their ends connected by rods 20^c with the ends of yokes 32, through which the journals of the middle roll project. The equalizing-shaft 26^a is mounted in bearings on posts or standards 33, secured upon the housings or caps, and the arms 27^c are connected by links 34 with the cross-head on the ram or piston. In this construction the upward movement of the middle roll is effected by a straight direct pull by the ram 19^c on the rods 20^c.

As shown in Figs. 8 and 9, the cylinders 12 may be arranged between the screws 7, being supported by the housing or cap, and operate to support the upper roll through a cross-head 35, resting upon bearings on the upper

ends of the rams 13 and having its outer ends connected by rods 16 to the yokes 14, supporting the upper roll.

In Fig. 10 I have shown what is practically a reversal of the construction shown in Figs. 1 and 2. The adjusting-cylinder 17^d is secured on the outer faces of the housings 1 near their lower ends, and the ram 19^d is made hollow for a portion of its length for the reception of a pin 36, as in the construction in Figs. 6 and 7. This rod rests in a concave seat at the end of the opening in the ram. The opening or hole in the ram is made larger than the pin, so that the latter can vibrate as it moves up and down with the lever, to the free end of which it is attached. In order to cushion the piston as it descends with its roll, a spring 37 may be interposed between the ram and the lower end of the cylinder. This construction or manner of connecting the lever with the cylinder may be employed in all forms or arrangements shown and described. The equalizing mechanism is the same as shown in Figs. 1 and 2.

In the construction shown in Fig. 11 two cylinders 17^e, one on each side of the window of the housing, are secured to the latter near its lower end. These cylinders, with their rams, are constructed as shown in Figs. 6, 7, and 10 and have their supporting-pins 36 connected to the ends of yoke 38, which engage and support the middle roll. The ends of the yokes 38 are connected by rods 28^e with arms 27, secured on the ends of shafts 26, which are mounted in suitable bearings on the housings, and the shafts are provided with arms 39, connected together by rod 40. This construction insures not only the equal movement of the ends of the roll, but also the equal and simultaneous movement of both ends of the yoke at each end of the roll.

It is characteristic of the several arrangements of cylinders shown and described that said cylinders are liable to injury from scale, &c., dropping from the article being rolled and that the cylinders and their connections are readily accessible. The arrangements having the cylinders above the upper roll are preferable, as they will not be liable when so located to injury by the breaking of the spindles and coupling-boxes connecting the rolls to their driving mechanism.

The arrangement of cylinders described and shown can be employed for changing rolls. In such operation the upper roll is raised by the cylinders 12 until its bearing-blocks can be spiked to the housings, as described in Letters Patent heretofore referred to. The middle roll is then raised and the roll-carrying buggy run in under the middle roll, which is then lowered onto the buggy and the levers 22 removed and the roll drawn out through the window in the housing. The buggy is then returned to receive the upper roll, which is lowered down, the bearing-blocks being held up by the spikes or pins. After the removal of the upper roll the rods 16 are connected to chains (shown in dotted lines in Fig. 2) or other suitable form of bridle passing under the projecting ends of the lower roll, which is then raised and lowered onto the roll-buggy.

It has heretofore been customary to hold the upper roll in contact with the adjusting-screws by weights, &c., operative through bars arranged in grooves in the sides of the windows in the housings and bearing at their upper ends on cross-pieces arranged between the journals of the upper rolls and the journal-boxes of the middle roll for carrying the upper roll. On account of the limited space in the windows of the housings neither the cross-piece supporting the upper roll nor the upper portion of the bearing-block for the middle roll can be made as strong as desirable, and when the rolls are turned down either the cross-piece or bearing-block, or both, must be planed down to permit the upper and middle rolls to be shifted to proper proximity to each other. In order to avoid this objectionable feature, the ends of the upper roll are extended sufficiently to permit of connecting the supporting mechanism to the roll at points outside of the housing, as clearly shown in Figs. 1 and 9.

I claim herein as my invention—

1. In a three-high mill, the combination of adjusting-screws for shifting the upper roll, fluid-pressure mechanism for balancing the upper roll arranged on the housing in line or approximately in line with the adjusting-screws, fluid-pressure mechanism for adjusting the middle roll, mechanism connecting such fluid-pressure mechanism with the middle roll, and means for equalizing the movements of the ends of the middle roll, substantially as set forth.

2. In a three-high mill, the combination of fluid-pressure cylinders arranged on the housing in line or approximately in line with the adjusting-screws and connected with the upper roll, fluid-pressure cylinders carried by the housing above the upper roll for adjusting the middle roll, levers having their pivotal ends movably mounted on the housings and connected to the ends of the middle roll, connections from the rams of said cylinders to said levers, and means for equalizing the movements of the ends of the middle roll, substantially as set forth.

3. In a three-high mill, the combination of screws for adjusting the upper roll, fluid-pressure mechanism mounted on the housing above the rolls for yieldingly holding the upper roll against the ends of the screws, fluid-pressure mechanism arranged outside the planes of the outer faces of the housings, means for connecting the rams on said cylinders with the middle roll and means for equalizing the ends of the middle roll, substantially as set forth.

4. In a rolling-mill, the combination of

adjusting-screws, fluid-pressure cylinders mounted on the housing in or approximately in line with the adjusting-screws, yokes arranged under the projecting ends of the upper roll, and connections from the fluid-pressure cylinders to said yokes arranged outside of the housings, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOSEPH FAWELL.

Witnesses:
DARWIN S. WOLCOTT,
F. E. GAITHER.