(No Model.) 4 Sheets—Sheet 1.

J. HEMPHILL & J. FAWELL.

ROLLING MILL.

No. 431,261. Patented July 1, 1890.

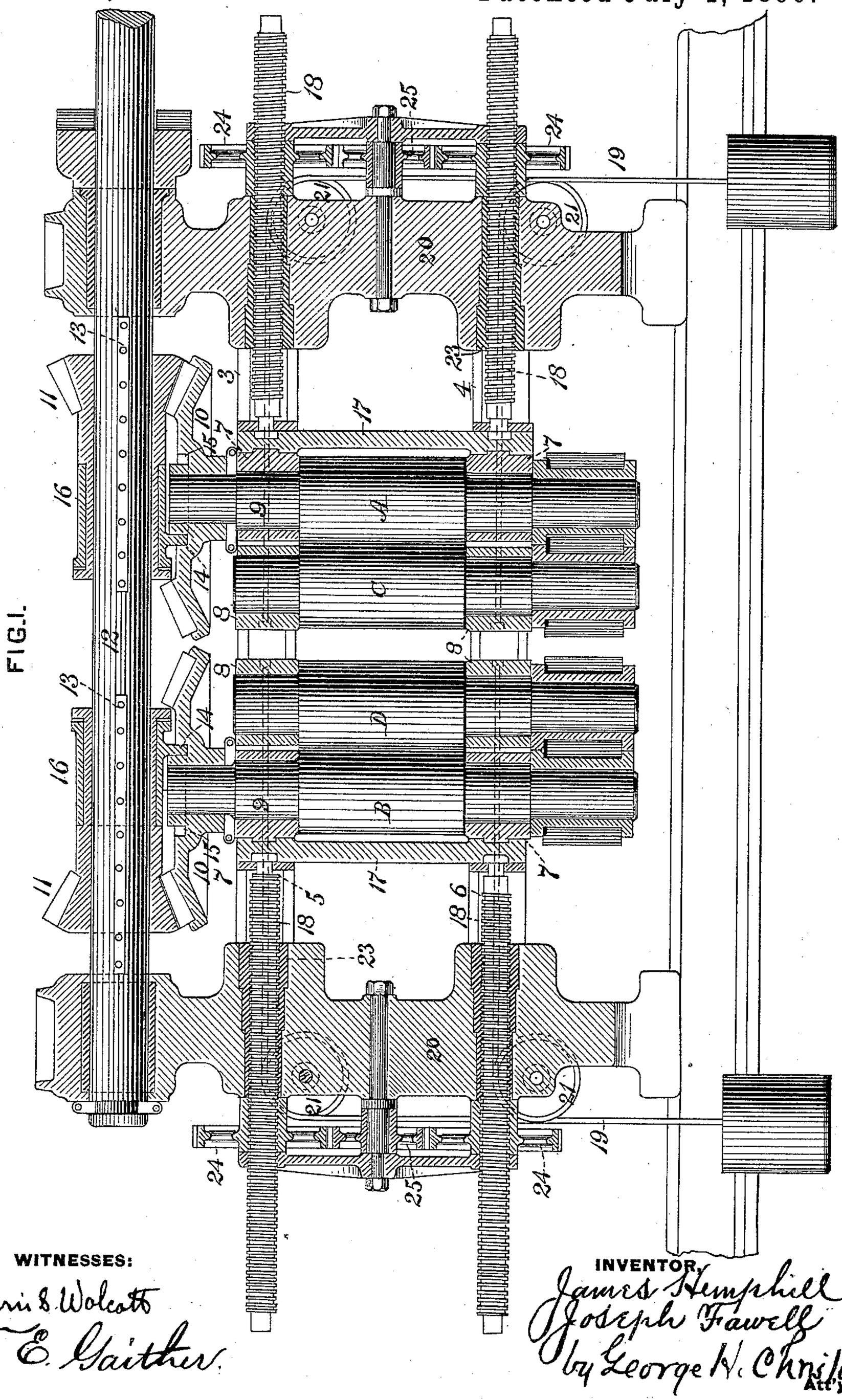

FIG. I.

WITNESSES:

Dennis S. Wolcott

F. E. Gaither.

INVENTOR,

James Hemphill

Joseph Fawell

by George N. Christy

Att'y.

(No Model.)

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J. HEMPHILL & J. FAWELL.

ROLLING MILL.

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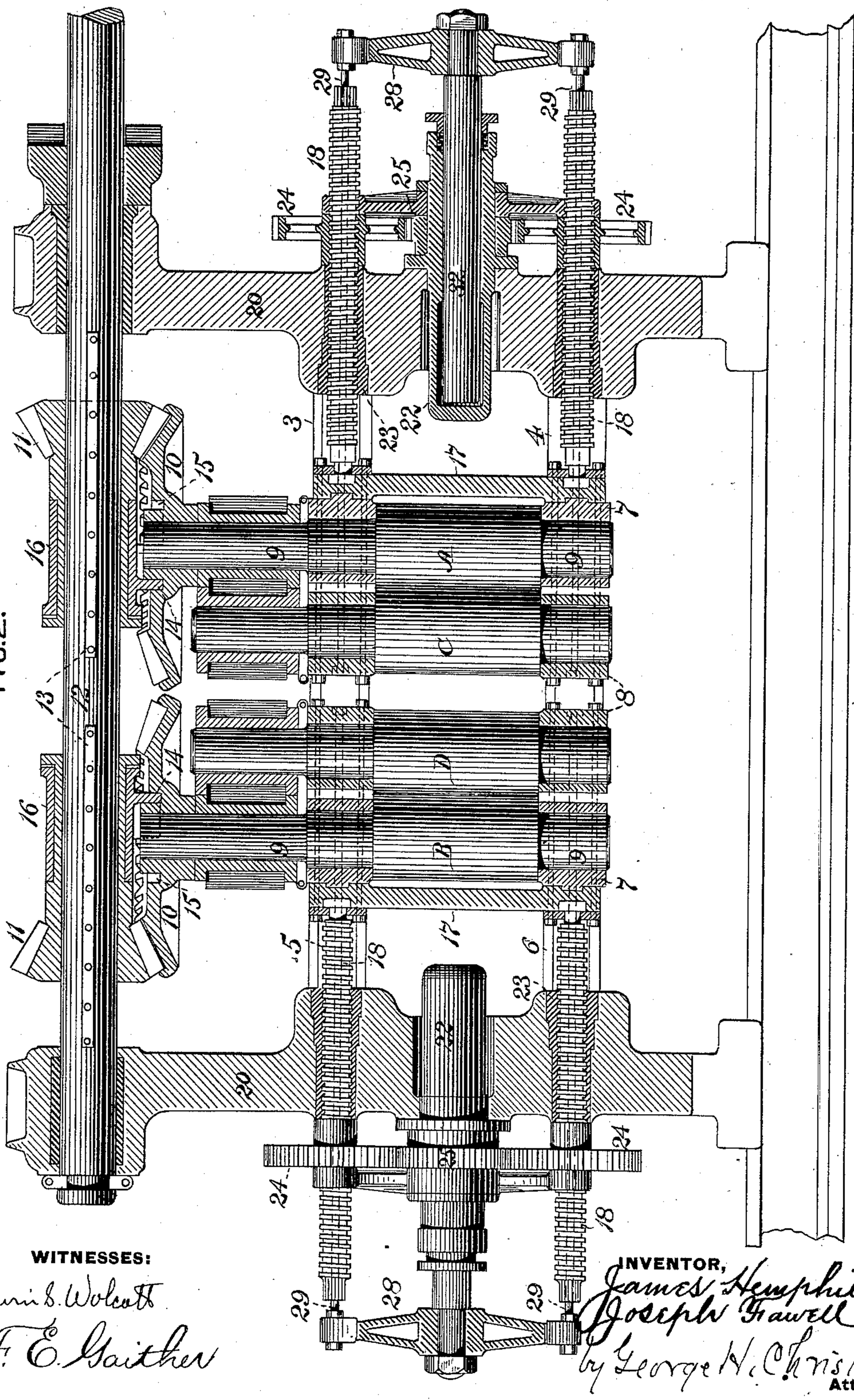
FIG. 2.



WITNESSES:

Dennis B. Wolcott

F. E. Gaither

INVENTOR,

James Hemphill

Joseph Fawell

by George N. Christ

Att'y.

(No Model.) 4 Sheets—Sheet 3.

J. HEMPHILL & J. FAWELL.

ROLLING MILL.

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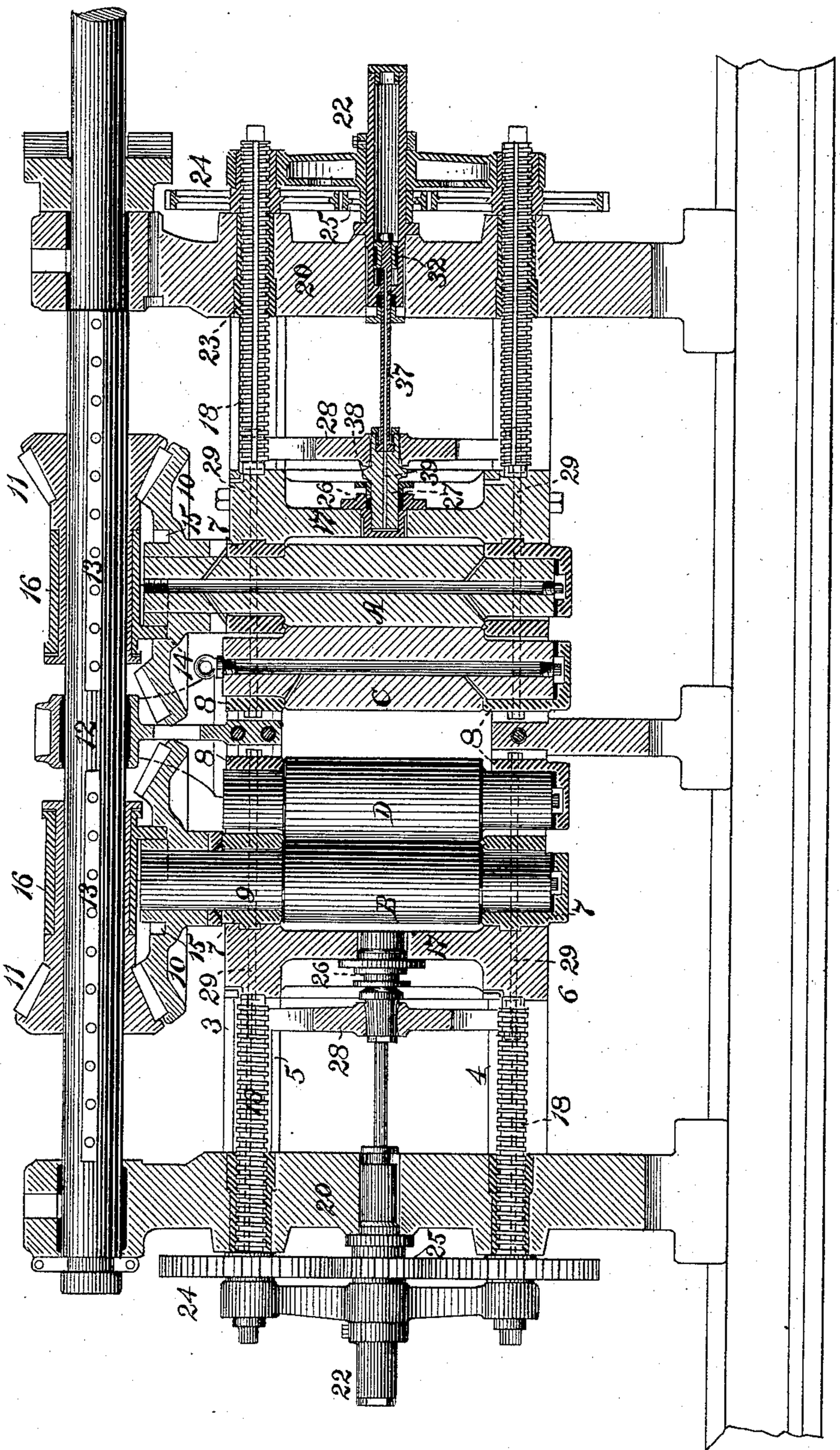
FIG. 3.



WITNESSES:

Dannie S. Wolcott

F. E. Gaither

INVENTOR,

James Hemphill

Joseph Fawell.

by George H. Christy

Att'y.

(No Model.) 4 Sheets—Sheet 4.

J. HEMPHILL & J. FAWELL.

ROLLING MILL.

No. 431,261. Patented July 1, 1890.

FIG. 4.

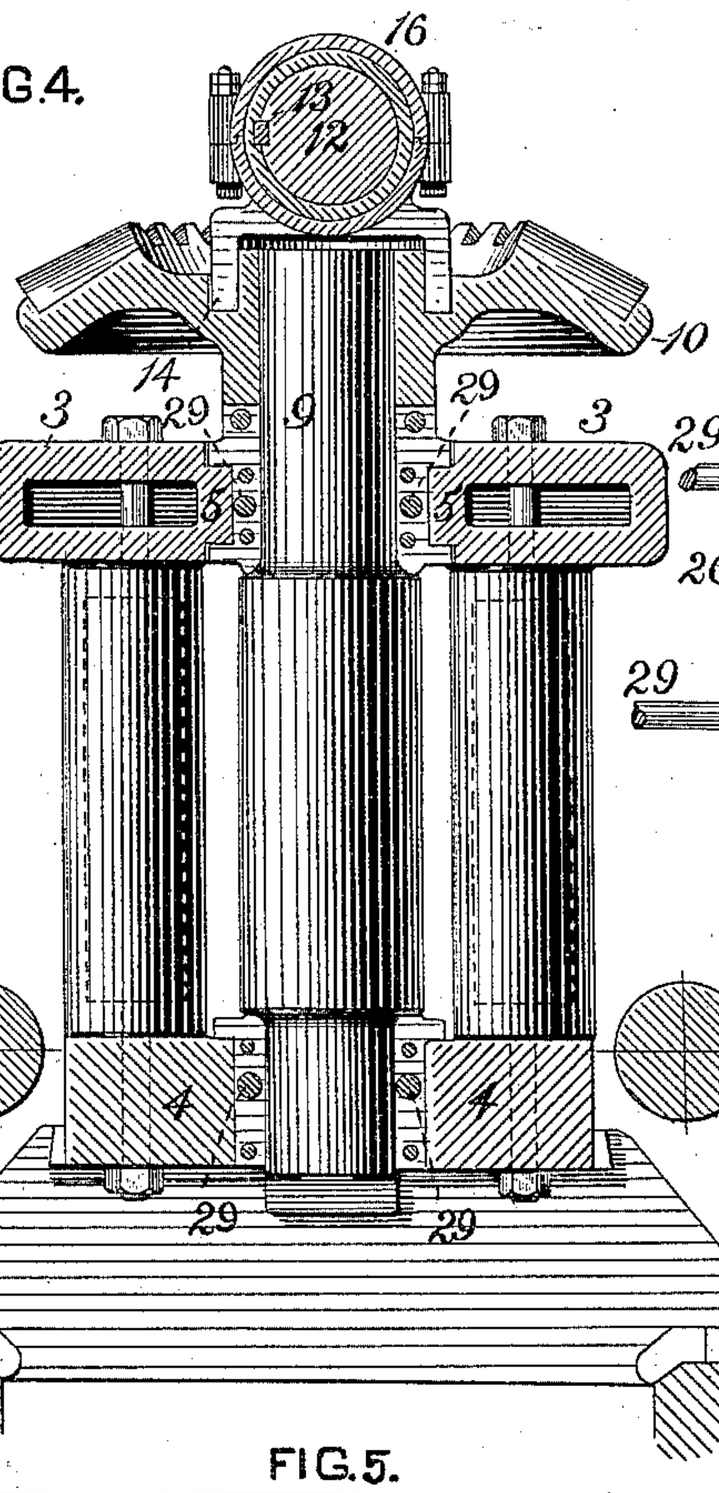


FIG. 7.

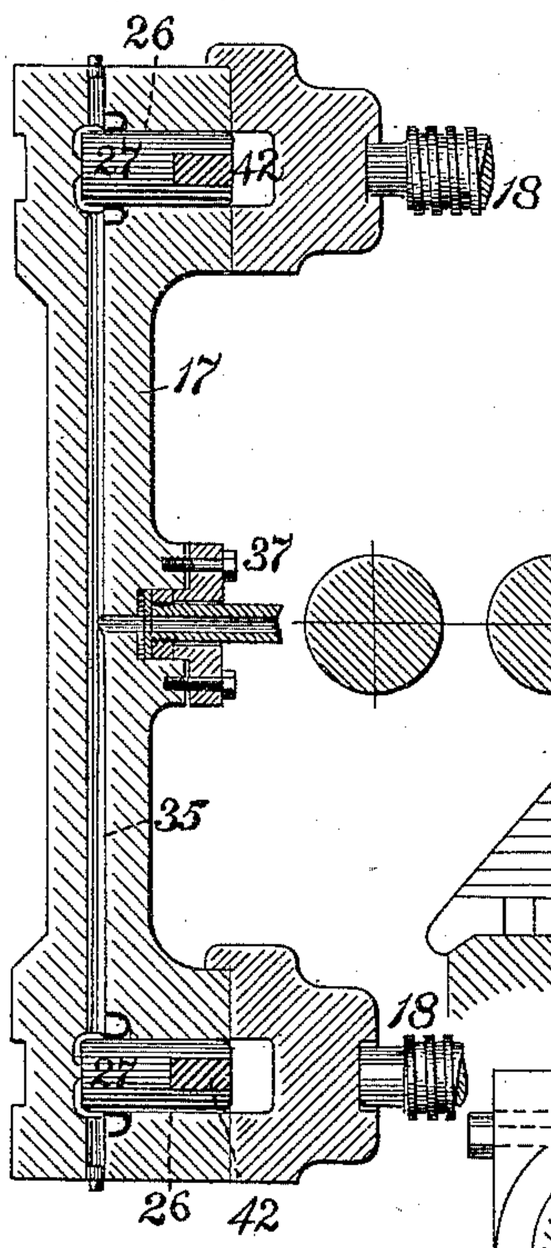


FIG. 8.

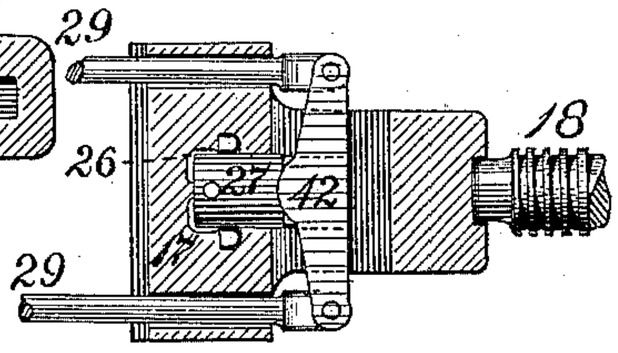


FIG. 5.

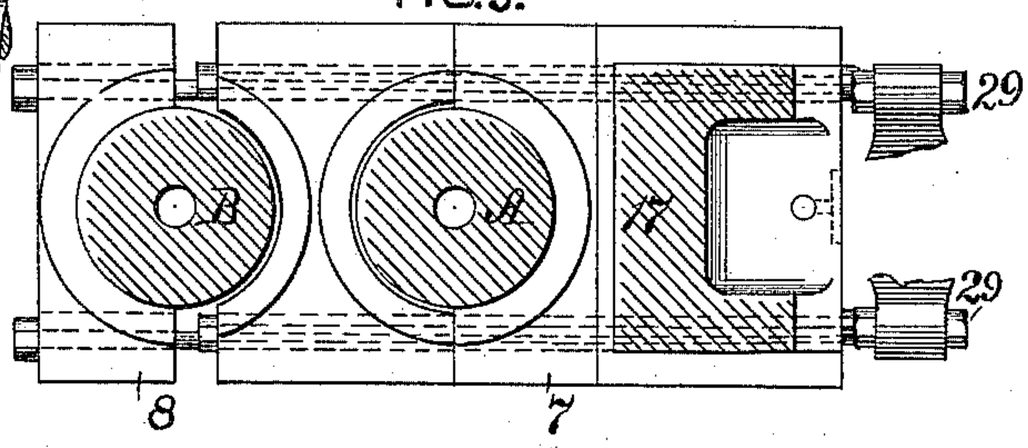
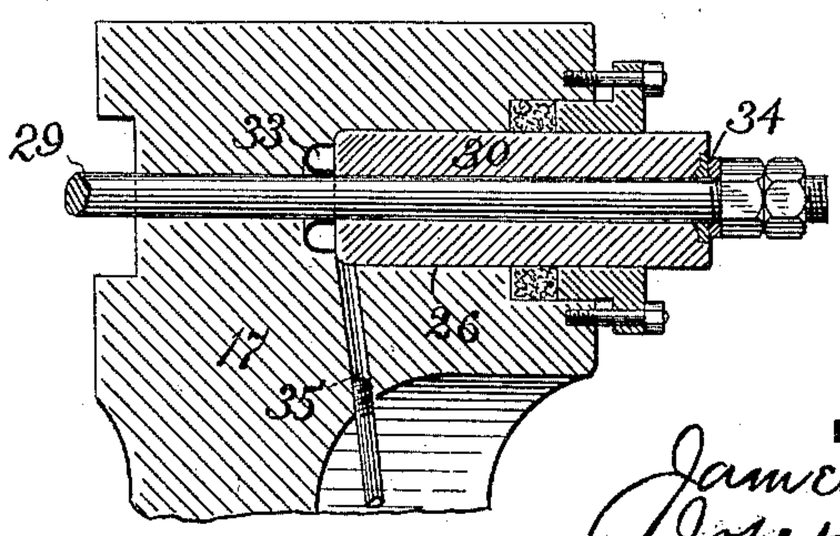


FIG. 6.



WITNESSES:

Daniel S. Wolcott

F. E. Gaither.

INVENTOR,

James Hemphill

Joseph Fawell.

by George H. Christy

Atty.

UNITED STATES PATENT OFFICE.

JAMES HEMPHILL AND JOSEPH FAWELL, OF PITTSBURG, PENNSYLVANIA.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 431,261, dated July 1, 1890.

Application filed April 9, 1890. Serial No. 347,217. (No model.)

To all whom it may concern:

Be it known that we, JAMES HEMPHILL, a citizen of the United States, and JOSEPH FAWELL, a subject of the Queen of Great Britain, 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. 382,035, granted to us May 1, 1888, we have described certain improvements in universal mills, whereby provision is made for reversing the operation of the mill by the shifting of a roll intermediate of two constantly-rotating rolls.

The invention described herein relates to further improvements in universal mills, such improvements having for their objects a construction whereby more effective driving mechanism may be employed, which shall also be readily accessible, the employment of a more effective means for holding the intermediate rolls in contact with the driving-rolls, and certain other mechanical features, each contributing in increasing the effectiveness of the mill.

In general terms, the invention consists in the construction and combination of mechanical devices or elements, all as more fully hereinafter described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a view, partly in elevation and partly in section, of a portion of a universal mill, showing the arrangement of the driving and intermediate rolls. Figs. 2 and 3 are similar views showing modifications in the means employed for adjusting the rolls. Fig. 4 is a sectional view on the line *x x*, Fig. 1. Fig. 5 is a sectional detail showing the arrangement of the journal-boxes and the bolts connecting them with the roll-adjusting mechanism. Figs. 6, 7, and 8 are sectional details showing different modifications of the means employed for holding the intermediate rolls in contact with the driving-rolls.

The horizontal beams 3 and 4, forming the guides for the vertical-rolls A, B, C, and D, are held in position, as described and shown in the Letters Patent referred to. Each of the beams consists of two parts or members provided with ribs 5 and 6 on their inner and adjacent faces for engagement with corresponding grooves formed in the sides of the journal-boxes 7 and 8 of the vertical rolls, as shown in Fig. 4. The necks 9 on the upper ends of the driving-rolls A and B are extended upwardly, as shown, and on these necks are secured the beveled pinions 10, with which corresponding pinions 11 on the horizontal driving-shaft 12 engage. The shaft 12 is provided with a longitudinal rib or ribs 13, adapted to engage corresponding grooves in the hubs of the pinions 11, thereby causing the pinions to rotate with the shaft, while free to move along the same. The pinions 11 are moved along the shaft by the pinions 10, through the medium of semicircular ribs 14, engaging grooves 15, formed in the hubs of the pinions 10, said ribs being formed on one part of sleeves 16, surrounding the hubs of the pinions 11.

The journal-boxes of the driving-rolls A and B are bolted to the adjustable cross-heads 17, which are held against the ends of the adjusting-screws 18, by weights attached to wire ropes 19, having their inner ends secured to the journal-boxes 8 of the intermediate rolls C and D, said ropes passing through suitable holes in the cross-heads and housings 20 and over guide-pulleys 21, said weights also serving to hold the intermediate rolls in contact with the driving-rolls A and B. In lieu of the weights, it is preferred to hold the cross-heads 17 against the ends of the screws 18 by means of fluid-pressure cylinders 22, arranged on the housings 20, as shown in Fig. 2. On the outer ends of the pistons 32 of the cylinders 22 are secured frames 28, to which are attached rods 29, having their inner ends connected to the boxes of the intermediate rolls, whereby said cylinders are adapted for holding the intermediate rolls against the driving-rolls and the cross-heads against the ends of the adjusting-screws. The adjusting-screws 18 pass through nuts 23, arranged in the housings 20, and on their outer ends are placed pinions 24, which are provided with keys or feathers engaging longitudinal grooves in the screws, thus permitting the latter to move through the pinions while rotating therewith. One of the pinions 24 at each end of the mill is driven by any suitably-arranged mechanism, and motion is transmitted therefrom to

the other pinions by idlers 25, loosely mounted on suitable pins or journals.

In lieu of either of the constructions hereinbefore described, it is preferred to employ independent fluid-pressure cylinders for holding the intermediate rolls against the driving-rolls and for holding the cross-heads against the adjusting-screws, as shown in Fig. 3. To this end fluid-pressure cylinders 26, provided with pistons 27, are secured to the cross-heads 17, and on the outer ends of the pistons are mounted the frames or spiders 28, to which are attached bolts 29, passing loosely through the cross-head and journal-boxes 7 and secured to the journal-boxes 8 of the rolls C and D. On the admission of fluid-pressure into the cylinders 26 the spiders or frames will be forced outwardly, thereby drawing the rolls C and D tightly against the driving-rolls A and B. The spider or frame 28 is so mounted on the piston 27 as to be capable of a slight rocking movement, for the purpose of equaling its action in case one of the bolts 29 is tightened up more than the others, or of the passage of scale or other substance between the driving and driven rolls. In lieu of such construction, the holes formed in the cross-head for the bolts 29 may be enlarged for a portion of their lengths, and plugs or blocks 30, having axial openings for the bolts 29, placed therein, as shown in Fig. 6. These plugs or blocks are surrounded by suitable stuffing-boxes 31, and have the bolts 29 secured thereto, and serve in all respects as pistons, the bolts 29 forming the piston-rods. At the inner ends of the cylinders 26, formed by enlarging the holes for the bolts 29, are placed cup-shaped packing-rings 33, which surround the bolts 29 and prevent the escape of fluid-pressure, and a suitable packing 34 is placed around the bolts at the outer ends of the pistons for the same purpose. The several cylinders 26 are connected at a common point of convergence by passages 35 to a common supply of fluid-pressure for the purpose of insuring an equal fluid-pressure in each cylinder.

In lieu of either of the constructions described for maintaining the intermediate rolls in contact with the driving-rolls, it is preferred to form a single fluid-pressure cylinder 26 at each end of the cross-heads 17, as shown in Fig. 7, and intermediate of the bolts 29, as shown in Fig. 8. An equalizing-lever 42 is connected to the outer ends of the bolts 29 and has a pivotal bearing upon the piston 27. The cylinders 26 are connected by passages 35, leading from the point of connection of the piston-rod 37, with the cross-heads.

In the construction shown in Fig. 3 the pistons 32 of the cylinders 22 are connected by hollow piston-rods 37 to the pistons 27 of the cylinders 26, the pistons 27 being provided with shoulders 38, adapted to engage the frames or spiders 28, and through the medium of the bolts 29 draw the intermediate rolls against the driving-rolls and the cross-heads against the ends of the adjusting-screws. The pistons 27 have passages 39 therethrough communicating with the hollow piston-rods 37, so that whatever fluid-pressure is admitted to the cylinders 22 is conducted by the piston-rods 37 and passages 39 to the cylinders 26, the piston-rods being provided with a port 40, so located with reference to the movements of the pistons 32 as to be constantly within the cylinders 22. Where the constructions shown in Figs. 6 and 7 are employed the piston-rods 37 are connected directly to the cross-heads 17, as shown in Fig. 7, and the passages 35 are in communication with the opening through the piston-rods.

In the constructions hereinbefore described the entire movements of the rolls are controlled by the adjusting-screws, the driving-rolls or the cross-heads being yieldingly held against the ends of the screws and the intermediate or driven rolls similarly held against the driving-rolls. As shown in Fig. 3, it is preferred to form longitudinal openings through the rolls for the purpose of providing a receptacle for oil, which is conducted to the points of desired application by inclined passages. The upper and lower ends of the longitudinal openings in the rolls are closed by plugs screwing thereinto, the plugs closing the upper ends being provided with eyes, whereby the rolls may be lifted when it is desired to remove them from the mill. The employment of the rolls C D, which are driven by frictional contact with the rolls A and B, permits of such a separation of the driving-rolls that large bevel-pinions can be employed on the driving-rolls, thereby increasing the effective power transmitted to the rolls A and B.

If desired, the intermediate rolls may be driven through the medium of spur-wheels or pinions keyed to the necks on the lower ends of the rolls, the necks being extended for the reception of the pinions, as shown in Fig. 1; or the upper necks may be extended and the pinions secured thereon, as shown in Fig. 2; or pinions may be employed at both ends of the rolls.

We claim herein as our invention—

1. In a universal mill, the combination of two positively-driven vertical rolls, two intermediate rolls, and fluid-pressure cylinders for holding the intermediate rolls in frictional contact with the driving-rolls and movable with said rolls, substantially as set forth.

2. In a universal mill, the combination of two positively-driven vertical rolls, two intermediate rolls, cross-heads movable with the positively-driven rolls, fluid-pressure cylinders arranged on the cross-heads and connected to the intermediate rolls, adjusting-screws having a bearing against the cross-heads, and fluid-pressure cylinders for holding the cross-heads against the adjusting-screws, substantially as set forth.

3. In a universal mill, the combination of two positively-driven rolls, two intermediate rolls, cross-heads movable with the positively-

driven rolls, and fluid-pressure cylinders arranged on the cross-heads and adapted through equalizing-levers to hold the intermediate rolls in contact with the positively-driven rolls.

4. In a universal mill, the combination of two positively-driven rolls, two intermediate rolls, cross-heads movable with the positively-driven rolls, fluid-pressure cylinders arranged on the cross-heads and connected to the intermediate rolls, and fluid-pressure cylinders 22, connected to the cross-head, the cylinders 22 being connected to the other cylinders, whereby an equal pressure is maintained in all the cylinders, substantially as set forth.

In testimony whereof we have hereunto set our hands.

JAMES HEMPHILL.
JOSEPH FAWELL.

Witnesses:
DARWIN S. WOLCOTT,
R. H. WHITTLESEY.