H. SACK, DEC'D.

A. SACK, ADMINISTRATRIX.

UNIVERSAL ROLLING MILL.

APPLICATION FILED OCT. 29, 1906.

939,167.

Patented Nov. 2, 1909.

5 SHEETS—SHEET 1.

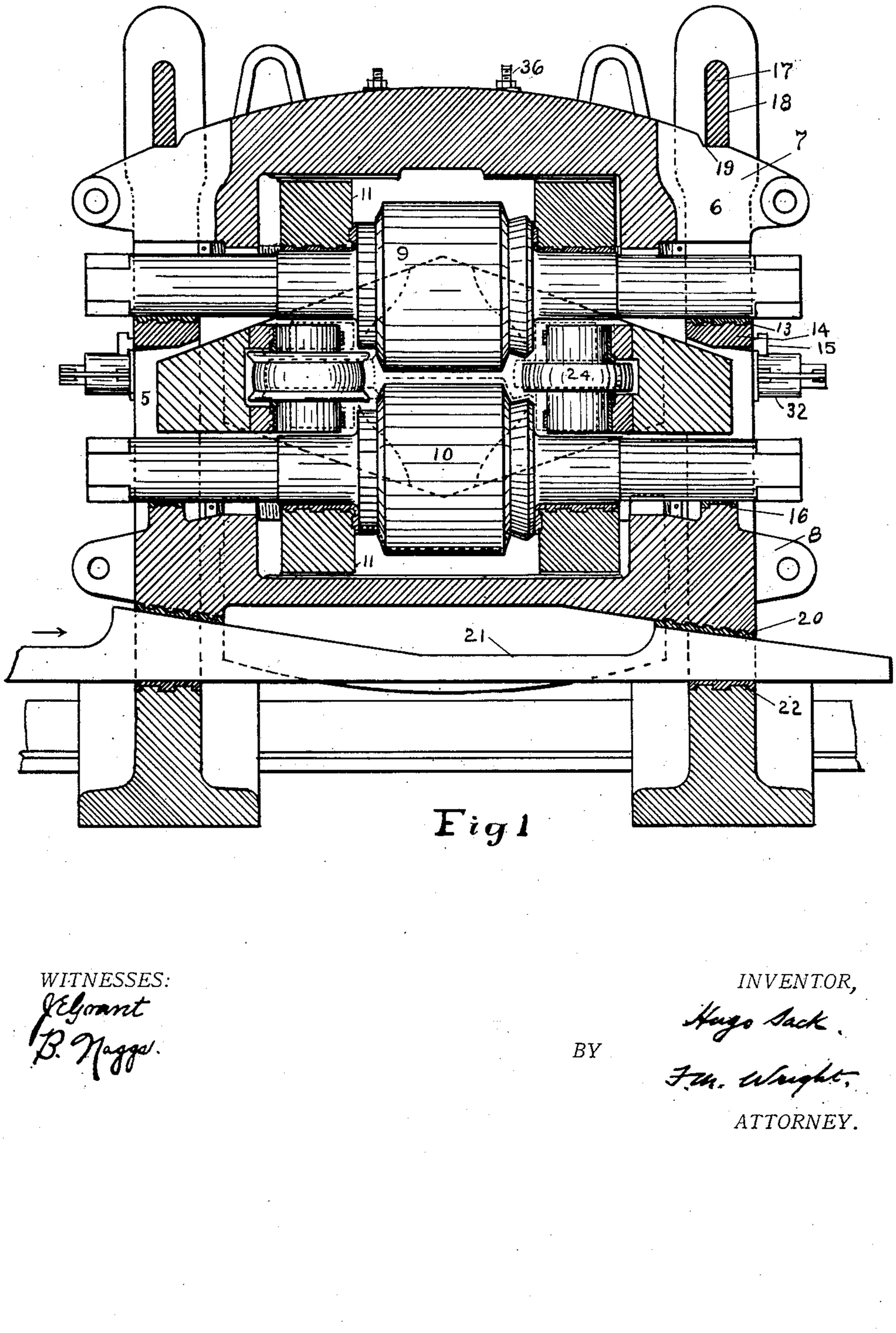

Fig 1

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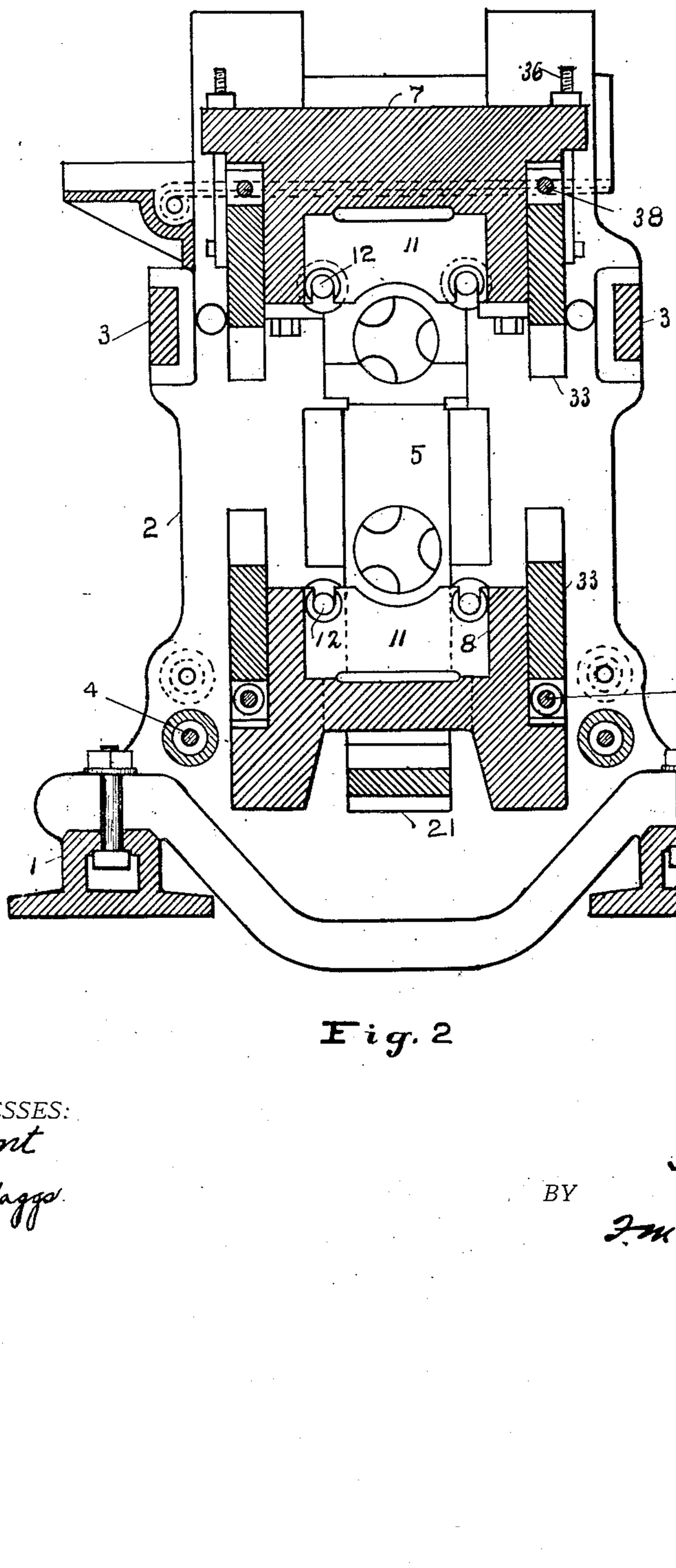

Fig. 2

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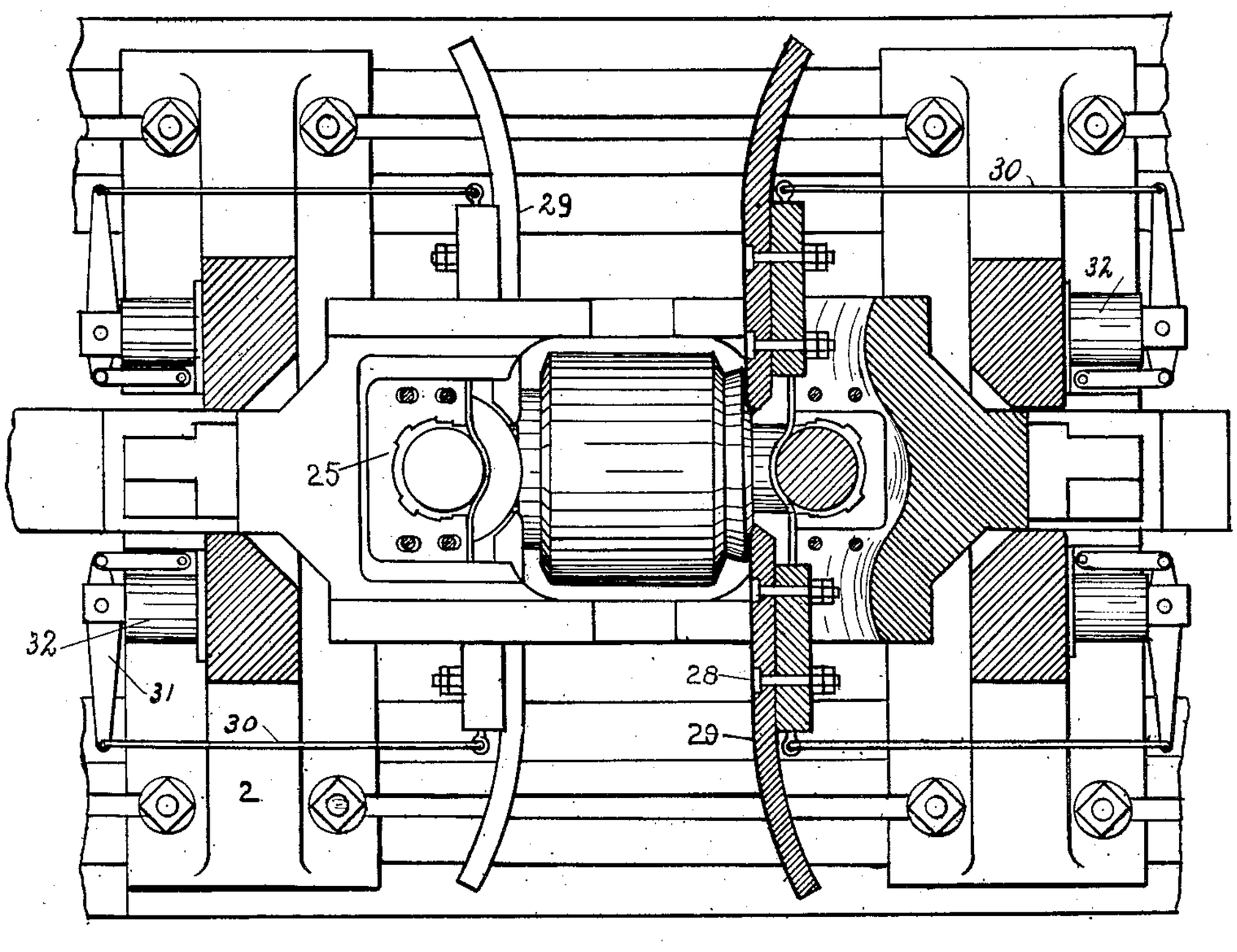

Fig. 3

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5 SHEETS—SHEET 4.

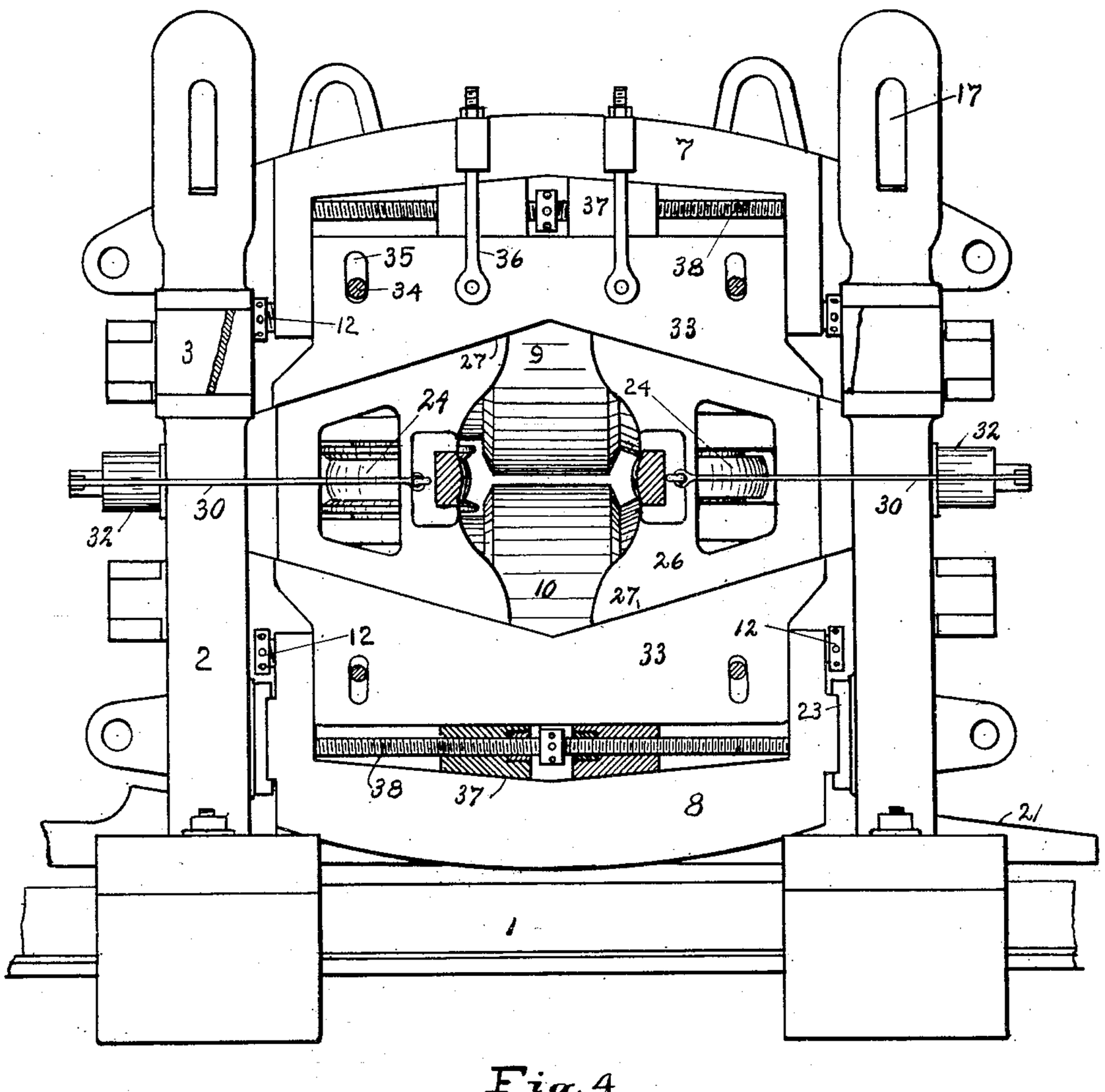

Fig. 4

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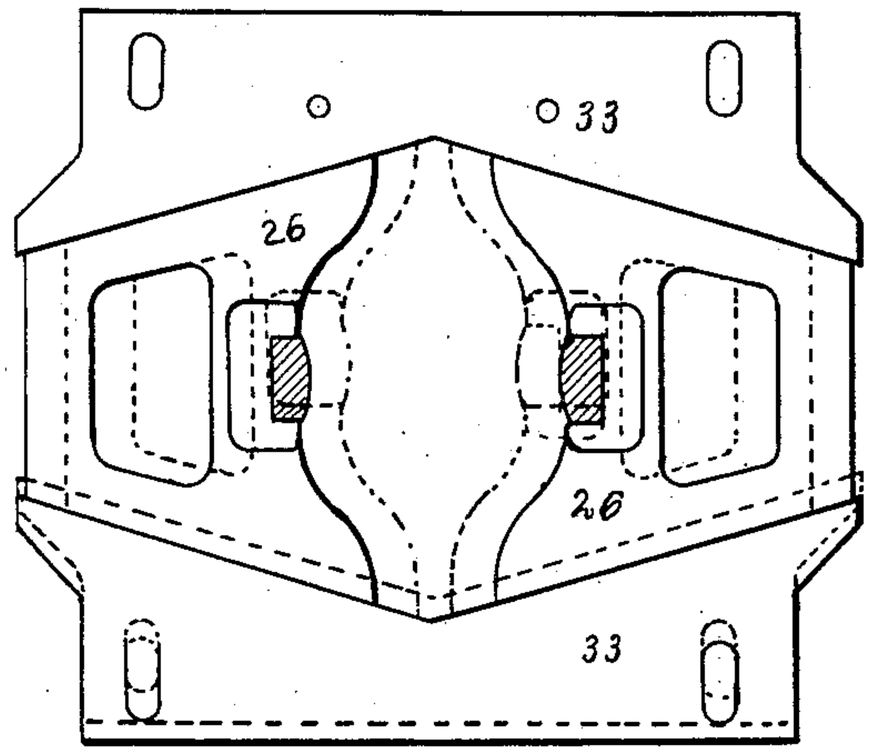
5 SHEETS—SHEET 5.

Fig. 5



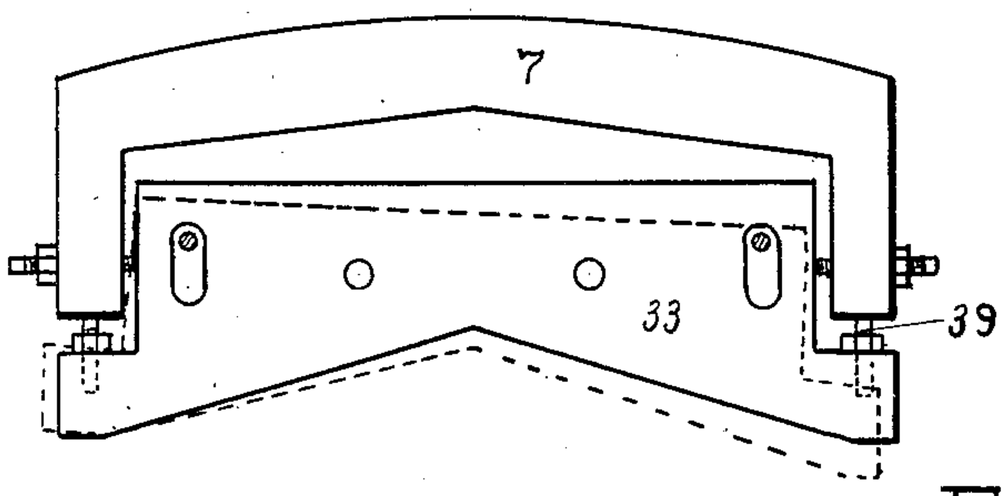
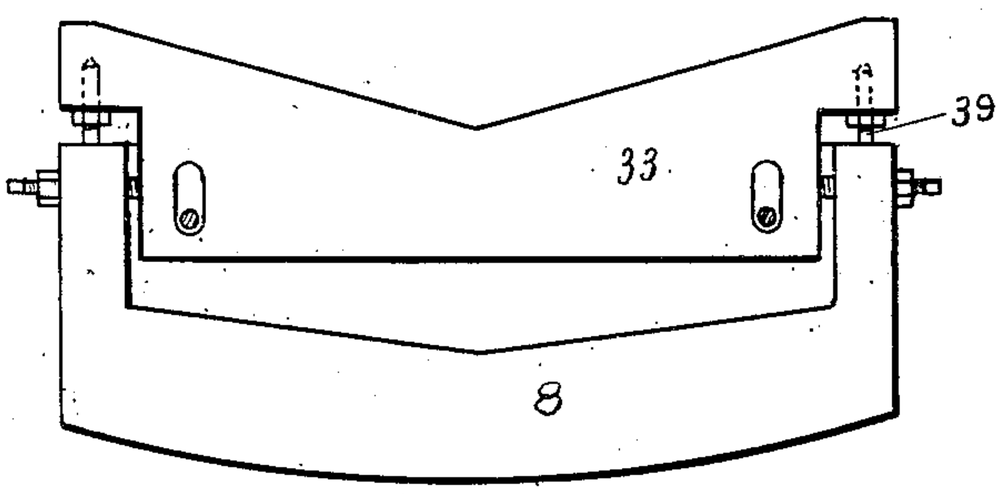


Fig. 6



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UNITED STATES PATENT OFFICE.

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UNIVERSAL ROLLING-MILL.

939,167. Specification of Letters Patent. **Patented Nov. 2, 1909.**

Application filed October 29, 1906. Serial No. 341,142.

To all whom it may concern:

Be it known that I, HUGO SACK, a citizen of the German Empire, residing at Dusseldorf, Rheinish Prussia, Germany, have invented certain new and useful Improvements in Universal Rolling-Mills, of which the following is a specification.

This invention relates to improvements in rolling mills of the class in which four rolls are situated in the same vertical plane for the purpose of producing the same elongation of the metal in every part of the cross section of the bar which is being rolled.

The object of the present invention is, in general, to render such rolling mills more simple and convenient in operation. In these mills, as a rule, the horizontal rolls are positively driven, while the vertical rolls are rotated only by frictional contact with the bar which is passed between the four rolls. In so called universal mills of this class a number of successive passes are made through or between the rolls, and, in order to make such successive passes, either the upper horizontal roll must be lowered, or the lower horizontal roll must be raised. It is indeed possible to move both of the horizontal rolls simultaneously, but, in practice, in most cases, only one of the horizontal rolls is so moved. It is necessary, when thus setting the horizontal rolls, to move the vertical rolls toward each other at the same time, and in such a manner that the ratios of approaches of the two pairs of rolls maintain always a constant ratio to each other in order to produce the above mentioned elongation of the metal. This constant ratio is determined by the relative thicknesses of the flanges and of the web or the girders, and since, as a rule, the flanges of H-girders are one and one-half times as thick as the web, it follows that the ratio of approach of the vertical rolls must be three times as great as that of the horizontal rolls. Means for insuring said constant ratio between the rates of approaches were disclosed in my United States Patent dated July 8, 1890, No. 431,623, which showed a construction and arrangement of setting plates having upper and lower inclined faces, the vertical rolls being mounted in appropriate bearing boxes having projections in the form of wedges engaging said setting plates, so that, by the relative approach of the setting plates, the bearing boxes for the vertical rolls were also moved toward each other at the proper rates of speed. In the present invention similar devices are used for setting the vertical rolls, but the means for adjusting the setting plates, and all the parts, are rendered much more accessible. Means are provided whereby horizontal rolls varying greatly in the distance between the necks can be used interchangeably without the necessity of changing the distance between the mill stands or housings. And, in general, the mill is simpler and more easily operated.

In the accompanying drawings, Figure 1 is a vertical transverse section of the mill; Fig. 2 is a vertical longitudinal section thereof; Fig. 3 is a horizontal section; Fig. 4 is a front view of the mill, certain parts being shown in section; Fig. 5 is a detail front elevation of the setting plates, showing the same, by full and dotted lines, in two positions; Fig. 6 is a detail front view showing a modification in the means for adjusting the setting plates.

Referring to the drawings, 1 indicates foundation plates, to which are bolted the mill stands or housings 2 connected with each other by the spacing bars 3, and the distance bolts 4, and formed with the central vertical guideways 5. Into said guideways extend the reduced ends 6 of the upper and lower blocks 7, 8, of the horizontal rolls 9, 10. The inner or opposing sides of said blocks are channel shaped, as clearly seen in Fig. 2, to receive the bearings 11 for said horizontal rolls, said bearings being adjustable longitudinally of the blocks to correspond with the locations of the necks of the rolls, and being pressed tight against said necks by screws 12, (Figs. 2 and 4) screwed through the ends of said channel shaped portions of the blocks and outside their reduced ends. The bearings 13 to support the shaft of the upper horizontal roll are supported on suitable shoulders 14 on the mill stands, and are adjusted by means of wedge-shaped keys 15. The bearings 16 to support the shaft of the lower roll are carried on the lower block 8. In the present instance I have shown the upper roll as stationary and the lower roll as movable toward the upper roll as the thickness of the bar diminishes, but it will be understood that the invention applies equally well to a mill in which the lower roll is stationary and the upper roll is movable toward the lower. The upper block 7 is sup-

ported against upward movement by powerful cotters 17 held in slots 18 in the upper portions of the housings. The lower edges of the cotters enter notches 19 in the upper side of the block and thus hold said block against longitudinal movement. The lower block 8 is supported on suitable bearings 20 upon the two inclined faces of a double wedge 21, the latter extending through the guideways 5 in the housings and being slidably supported on bearings 22 in said housings at the bottom of said guideways. By any appropriate means, not here shown, said wedge may be moved longitudinally, and the lower block and horizontal roll may be raised to reduce the distance between the latter and the upper horizontal roll. To support the lower block against longitudinal movement, it is provided with removable shoes 23, which move vertically against the sides of the housings with the vertical movement of the block.

The vertical rolls 24 are supported in bearing boxes 25, the ends of which also extend into the guideways 5, as shown in Figs. 1 and 3, and are guided both vertically and horizontally therein. Each box has formed integral therewith front and rear wings 26, wedge-shaped, having upper and lower inclined wedges or setting rails 27 sloping toward each other outward, as clearly shown in Fig. 4. These wings have secured thereto by the bolts 28 the curved side guide bars 29, which guide the metal between the rolls. They have also secured thereto the links 30 connected to levers 31 operated by hydraulic cylinders 32 secured upon the housings. By means of these cylinders said bearing boxes can be moved outward, or away from each other.

The wedge-shaped wings are contained between setting plates 33, which lie entirely between the mill stands and which have edges meeting the edges or setting rails 27 and correspondingly sloped. Two of the plates 33 are carried by each of the blocks 7, 8, at the front and rear sides thereof. The setting plates are held to the blocks by bolts 34 passing through slots 35 in the plates, and the setting plates of the upper block are also attached thereto by hanger bolts 36. Said setting plates are adjusted vertically with reference to said blocks by means of counter-wedges 37, movable to and from each other by means of right and left screws 38. However, in Fig. 6, another means of adjustment is shown, namely, the screws 39, by means of which even a non-parallel adjustment can be obtained, which would be necessary if the necks of the horizontal rolls should wear unequally at the two ends.

The construction being as above described, the operation is as follows. A pass having been made between the rolls, and it being necessary to move said rolls closer together for a succeeding pass, the pressure is removed from the hydraulic cylinders 32, so as to allow the bearing boxes for the vertical rolls to move inward or toward each other. Then power is applied to the wedge 21, by a hydraulic cylinder, or other means, to advance it longitudinally. The lower block and the lower horizontal roll are thereby raised. The lower setting plates 33 are also raised, and, being brought nearer to the upper setting plates, the opposing inclined edges of these plates act as wedges upon the intervening wedge-shaped wings 26, forcing them inward, as they are now free from the restraint of the hydraulic cylinders, and moving toward each other the vertical rolls in the boxes 25. The ratio of the rates of approaches of the horizontal and vertical rolls depends upon the angle of inclination of the edges of the wings and setting plates. In the present instance this inclination is shown as that proper for producing a rate of approach of the vertical rolls bearings to that of the horizontal rolls a ratio of 3 to 1, that being the ratio corresponding with a ratio of thickness of the flange to that of the web $1\frac{1}{2}$ to 1, which is the standard ratio for H girders. When the rolls have been moved sufficiently near for the next pass, the hydraulic cylinders are again set in operation and the bearing boxes 25 are retracted so that their wings 26 bear tight against the edges of the setting plates. The action of the setting plates 33 upon the wings 26 is illustrated in detail in Fig. 5, which shows these parts in full lines in one position and in dotted lines in another position. The rate of approach of the vertical rolls is seen to be three times that of the horizontal rolls. This ratio being proper for all H beams, the same setting plates and bearing boxes can be used for H beams of all sizes in cross section. For H beams unusually high, or long in cross section, the vertical rolls can be properly adjusted, provided that sufficient amplitude for the setting plates is afforded by the counter wedges 37.

The rolls here shown are of the shape disclosed in my United States Patent No. 365,100, dated June 21, 1887, and are adapted to produce a preparatory form of H-beam, which, when sufficiently elongated, is squared up by one or more passes through a special set of finishing rolls. The advantage of this method of rolling is that thereby H-beams can be provided without any taper of the flanges. However, I by no means confine myself to this shape of roll.

From the above description and comparison of the drawings, it will be readily seen how convenient and accessible for adjustment are the setting plates and the various adjusting devices, such as the screws 12 for the adjustment of the chocks 11, the counter wedges 37, and the right and left screws 38.

By means of this arrangement both the vertical rolls and the horizontal rolls can be adjusted easily, quickly, and accurately. Thus, supposing that the rolls have been changed in the mill, the vertical rolls are adjusted by screwing the counter wedges 37 to insure an accurate horizontal center line of the cross section, and the horizontal rolls are adjusted by the screws 12. A similar adjustment is necessary when the necks are worn unevenly to any considerable extent. But, after these adjustments of the rolls have been made, the relative positions of the rolls are maintained proper for the reduction of the bar as the wedge 21, or the usual top screw gear, as the case may be, is operated for the purpose of moving the rolls together, or retracting them.

An important feature of this construction is that the blocks 7, 8, are made long enough to admit the longest horizontal rolls between the necks that may be necessary, the position of said horizontal rolls being fixed by adjusting the bearings 11. Thus the mill stands do not have to be moved to permit of horizontal rolls varying greatly in length between the necks being used interchangeably.

It is to be understood that the invention can be used equally well for mills where only one pass is made through the rolls, as for so called universal mills where a number of successive passes are made through, or between, the same rolls.

I claim:—

1. In a rolling mill, a horizontal roll, and a vertically-adjusted member carrying longitudinally-adjustable bearings for each end of said roll, said member and bearings arranged to prevent movement of the roll away from the pass.

2. In a rolling mill, a pair of mill stands having vertical guide-ways, horizontal rolls, and a vertically-adjustable member having ends entering said guide-ways and carrying longitudinally-adjustable bearings for each end of one horizontal roll.

3. In a rolling mill, a horizontal roll, a vertical roll, a vertically-adjustable member carrying bearings for each end of said horizontal roll, and means, directly actuated by said vertically-adjustable member, so constructed and arranged that vertical movement of said member laterally shifts said vertical roll.

4. In a rolling mill, a horizontal roll, a vertical roll, a vertically-adjustable member carrying longitudinally-adjustable bearings for each end of said horizontal roll, and means, directly actuated by said vertically-adjustable member, so constructed and arranged that vertical movement of said member laterally shifts said vertical roll.

5. In a rolling mill, a stand having a vertical guide-way, a horizontal roll, a vertical roll, and separate bearing members for said rolls having portions engaging said guide-way and independently movable therein.

6. A universal rolling mill, comprising a pair of stands having vertical guide-ways, a pair of horizontal rolls, a pair of vertical rolls, members extending between said stands and into said ways, each having two bearings for a horizontal roll, one of said members being vertically adjustable, and separate vertically and horizontally adjustable members directly guided by said ways and each having bearings for one vertical roll.

7. In a rolling mill, a pair of stands having vertical guide-ways, a pair of horizontal rolls, a pair of vertical rolls, a vertically-movable member having bearings for each end of a horizontal roll, said member extending between the stands and into their guide-ways, and means directly actuated by the vertical movement of said member to laterally shift said vertical rolls.

8. In a rolling mill, the combination of mill stands, horizontal rolls, a support for the upper roll extending entirely across between the mill stands, and cotters for holding said support against upward movement, the upper parts of the stands having slots to receive said cotters, substantially as described.

9. In a rolling mill, the combination of mill stands, horizontal rolls, a support for the upper roll extending entirely across between the mill stands, and cotters for holding said support against upward movement, the upper parts of the stands having slots to receive said cotters, the upper side of said support being also formed with notches to receive the lower edges of the cotters to hold the support against longitudinal movement, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HUGO SACK.

Witnesses:
WILLIAM ESSENWEIN,
ALFRED POHLMEYER.