J. FAWELL.

MANUFACTURE OF STRUCTURAL MATERIAL.

APPLICATION FILED FEB. 3, 1911.

996,008.

Patented June 20, 1911.

12 SHEETS—SHEET 1.

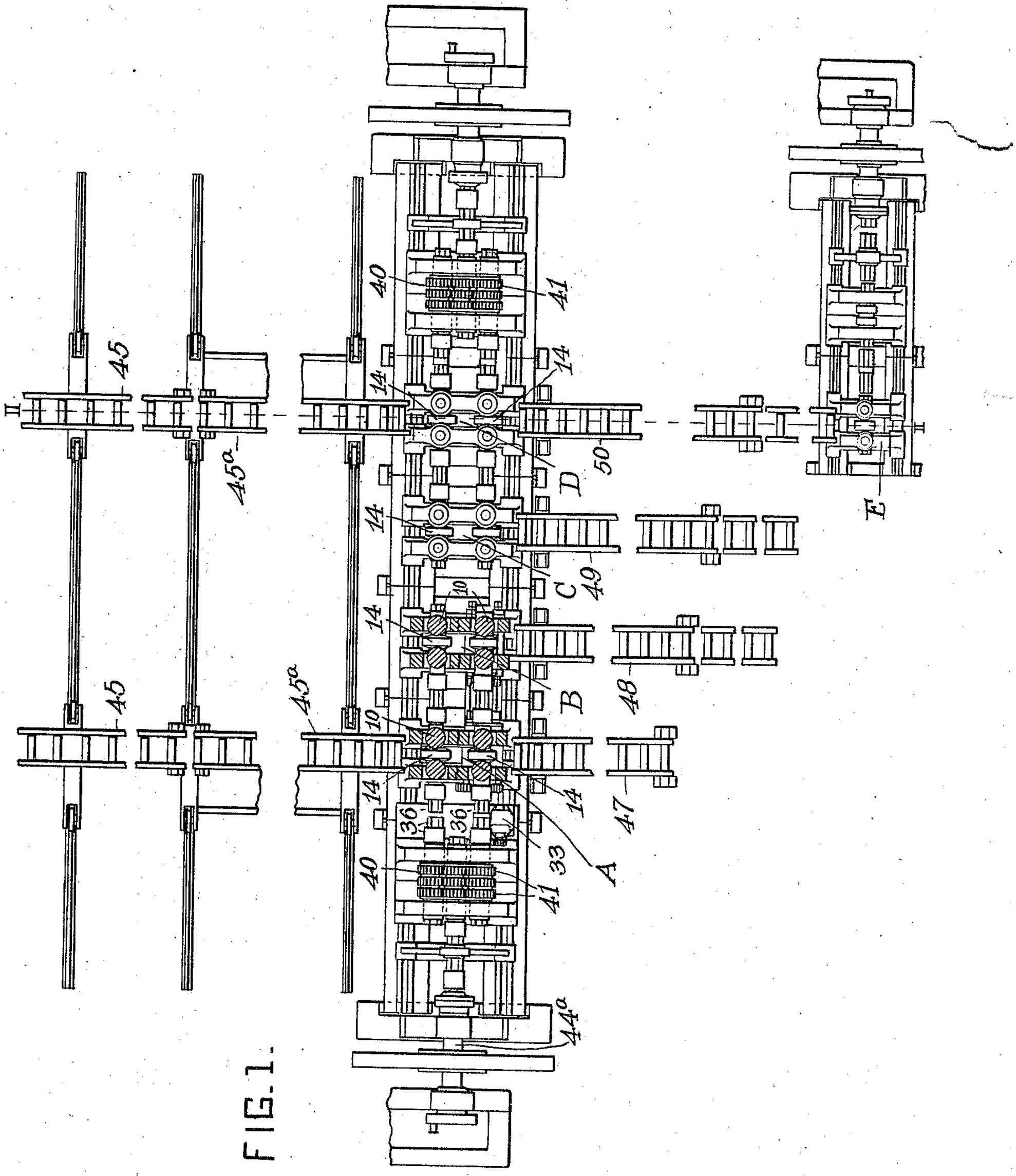

FIG. 1.

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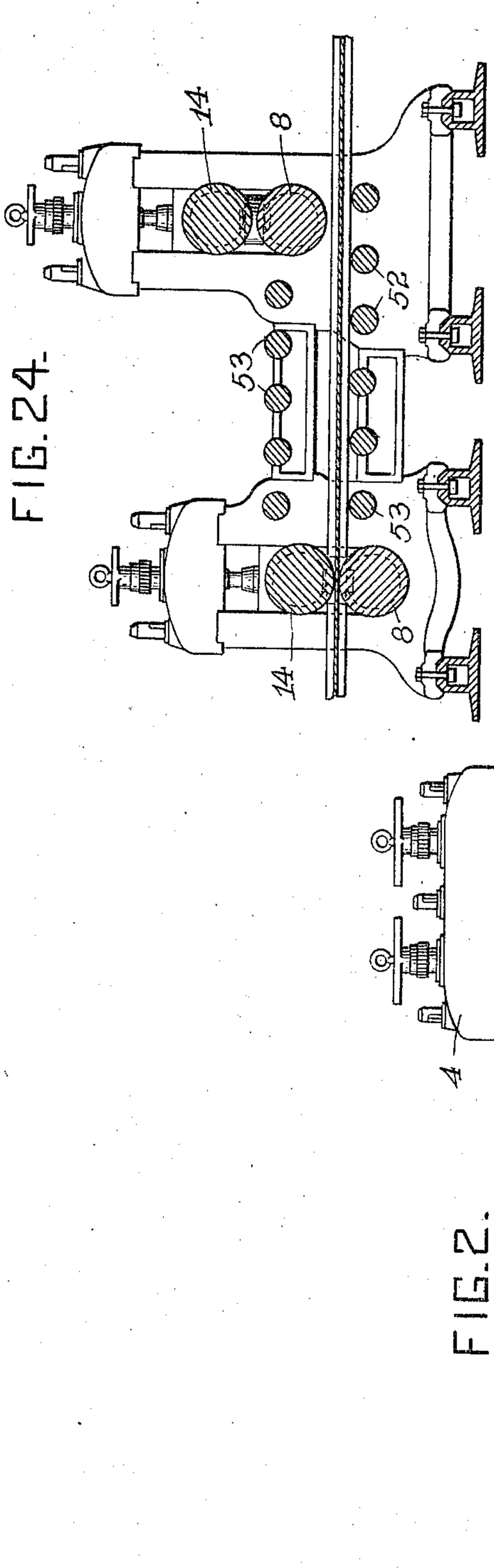

FIG. 24.

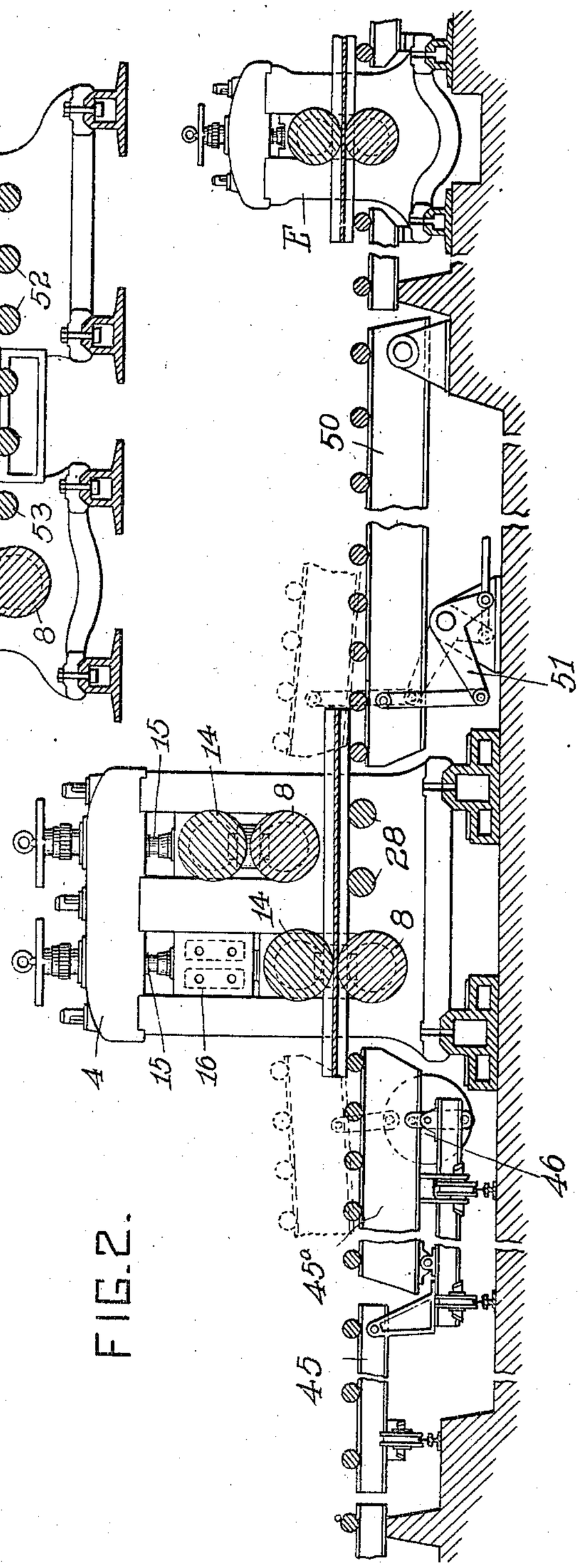

FIG. 2.

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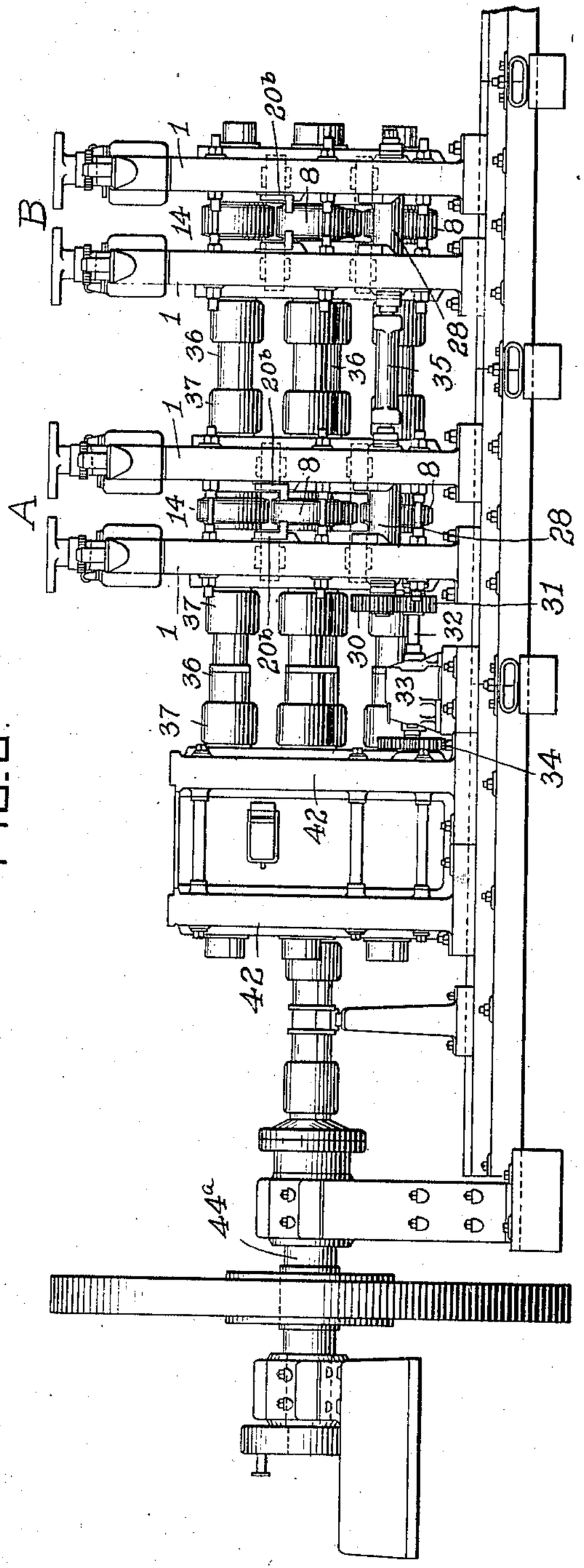
12 SHEETS—SHEET 3.

FIG. 3.



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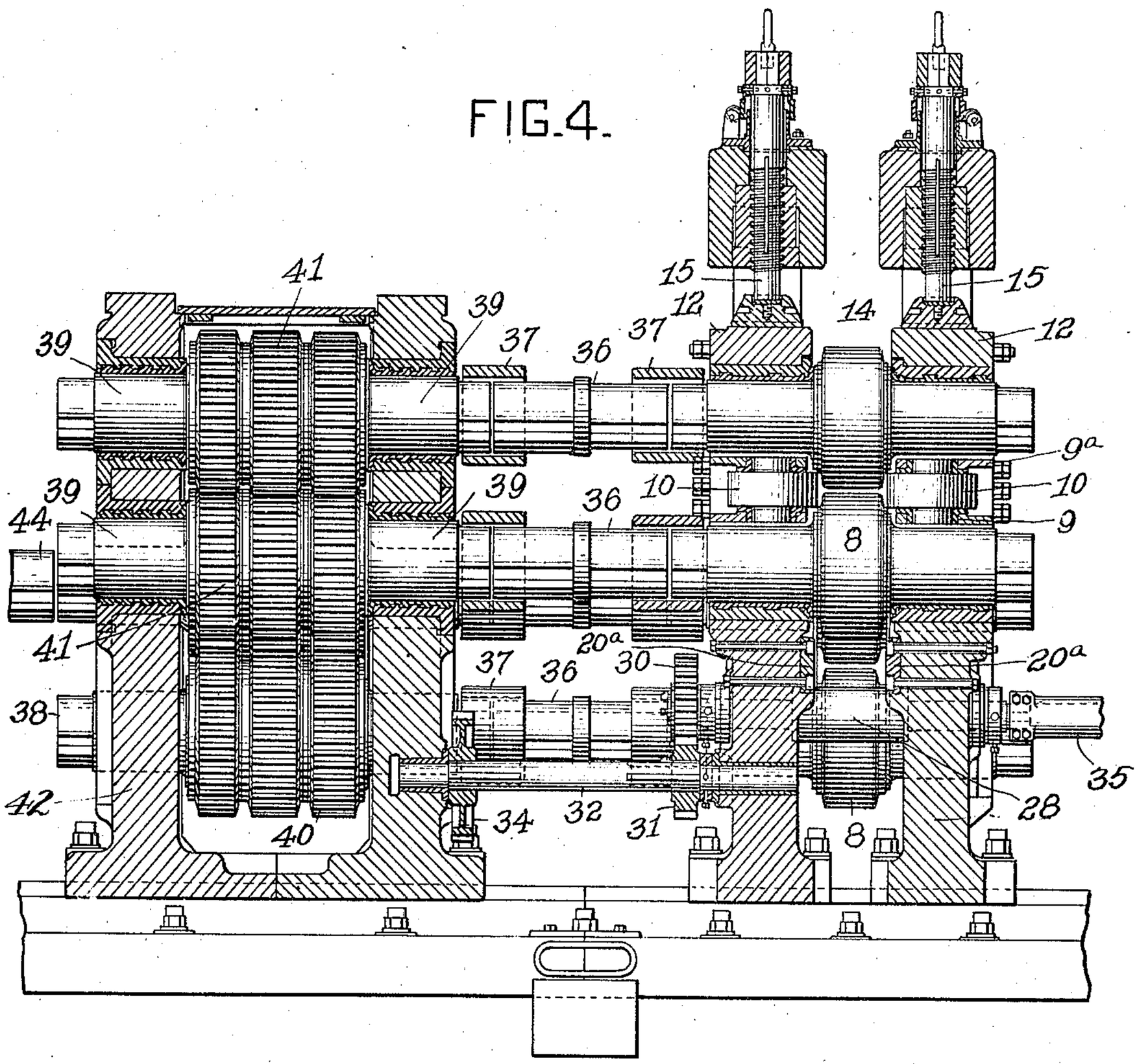
12 SHEETS—SHEET 4.

FIG. 4.



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12 SHEETS—SHEET 5.

FIG. 6.

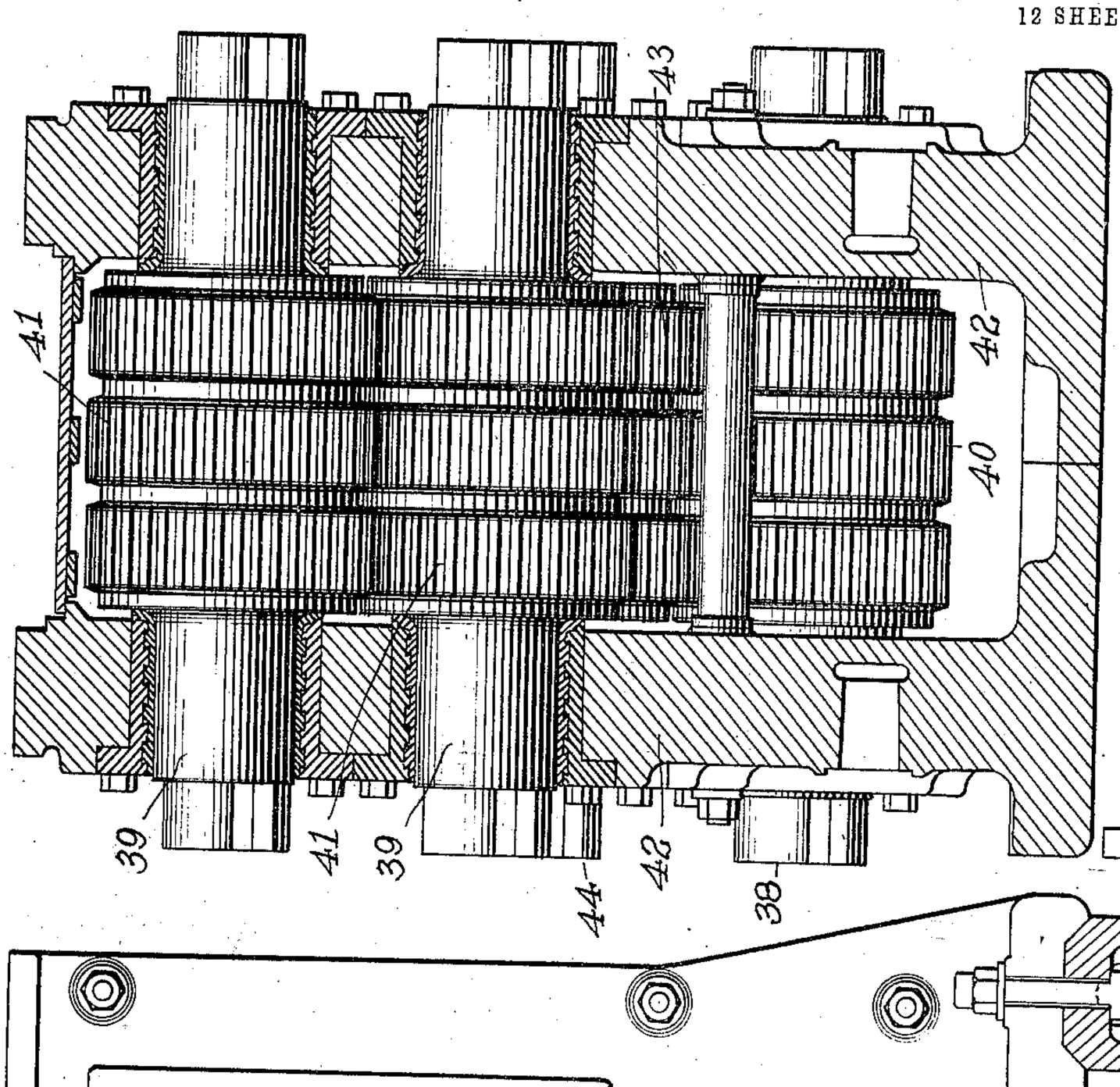
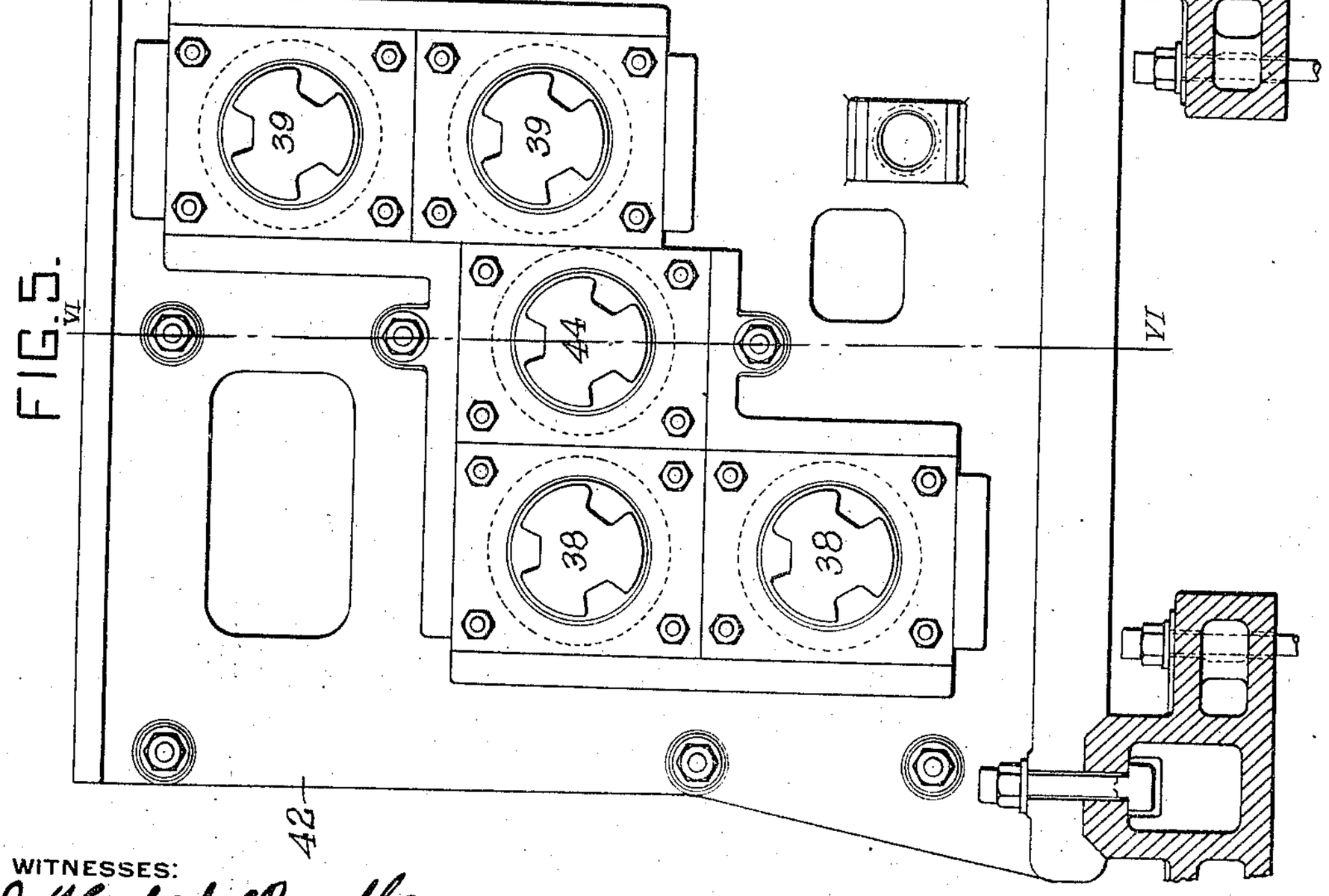


FIG. 5.



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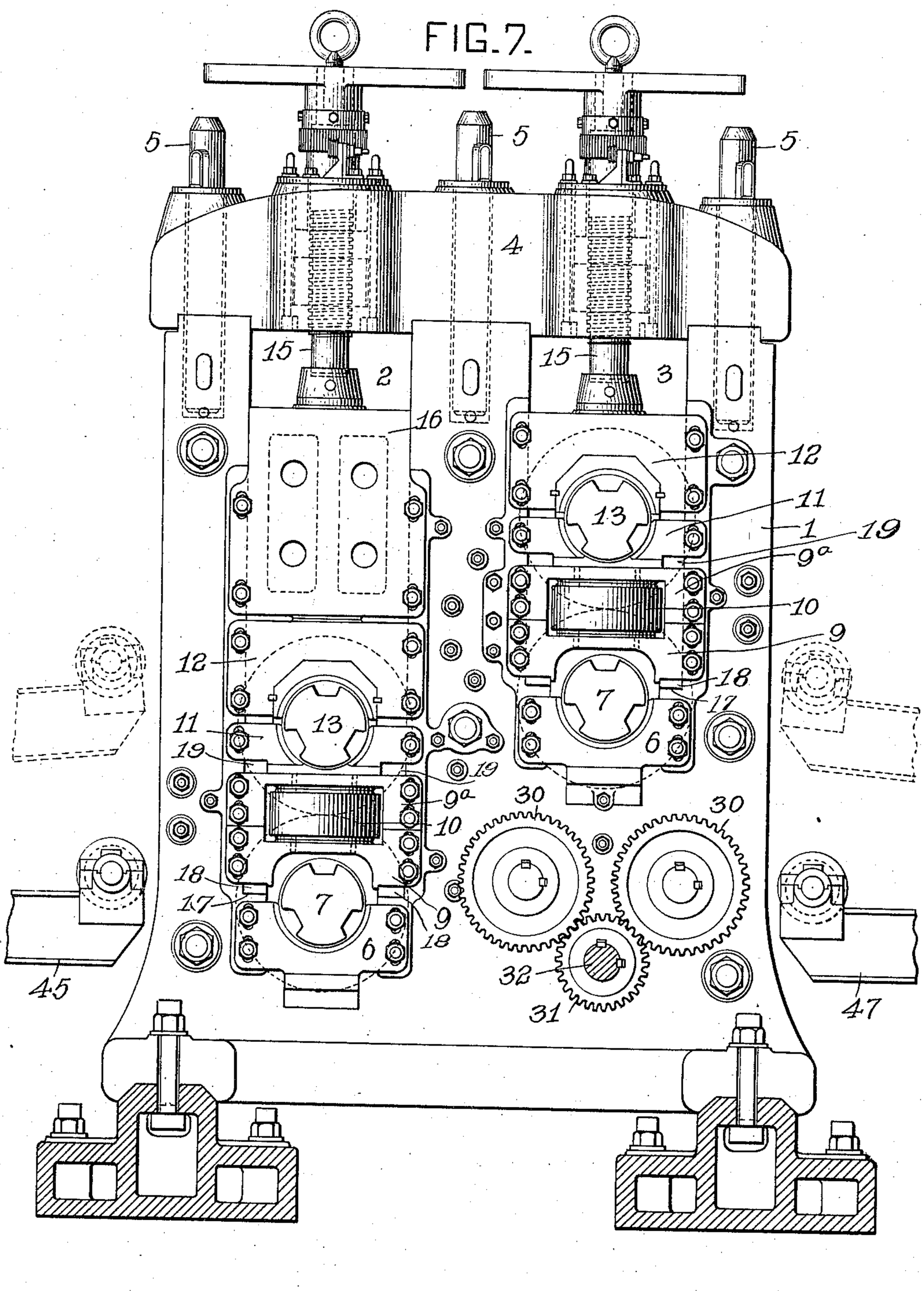
12 SHEETS—SHEET 6.

FIG. 7.



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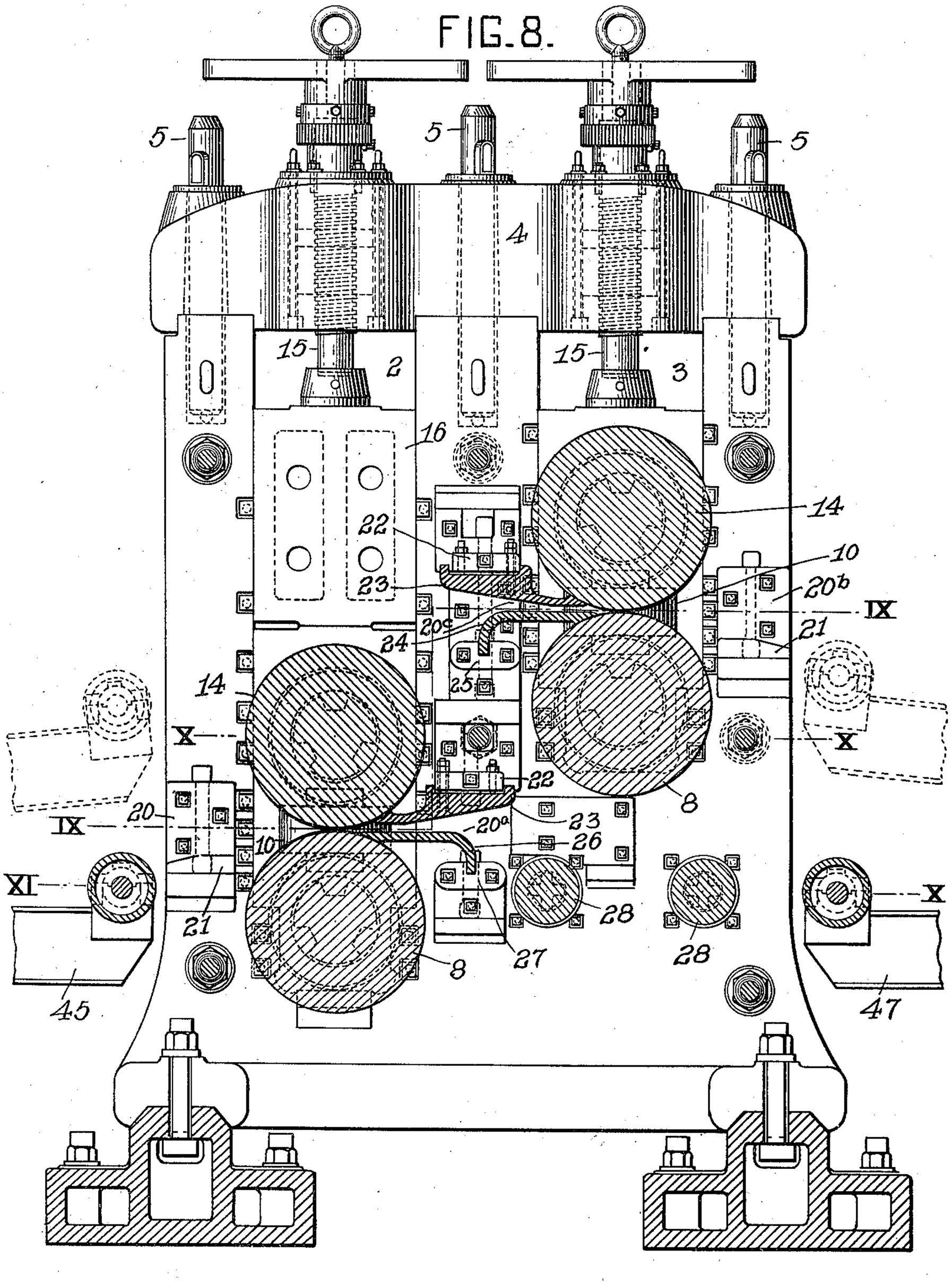
12 SHEETS—SHEET 7.

FIG. 8.



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12 SHEETS—SHEET 8.

FIG. 9.

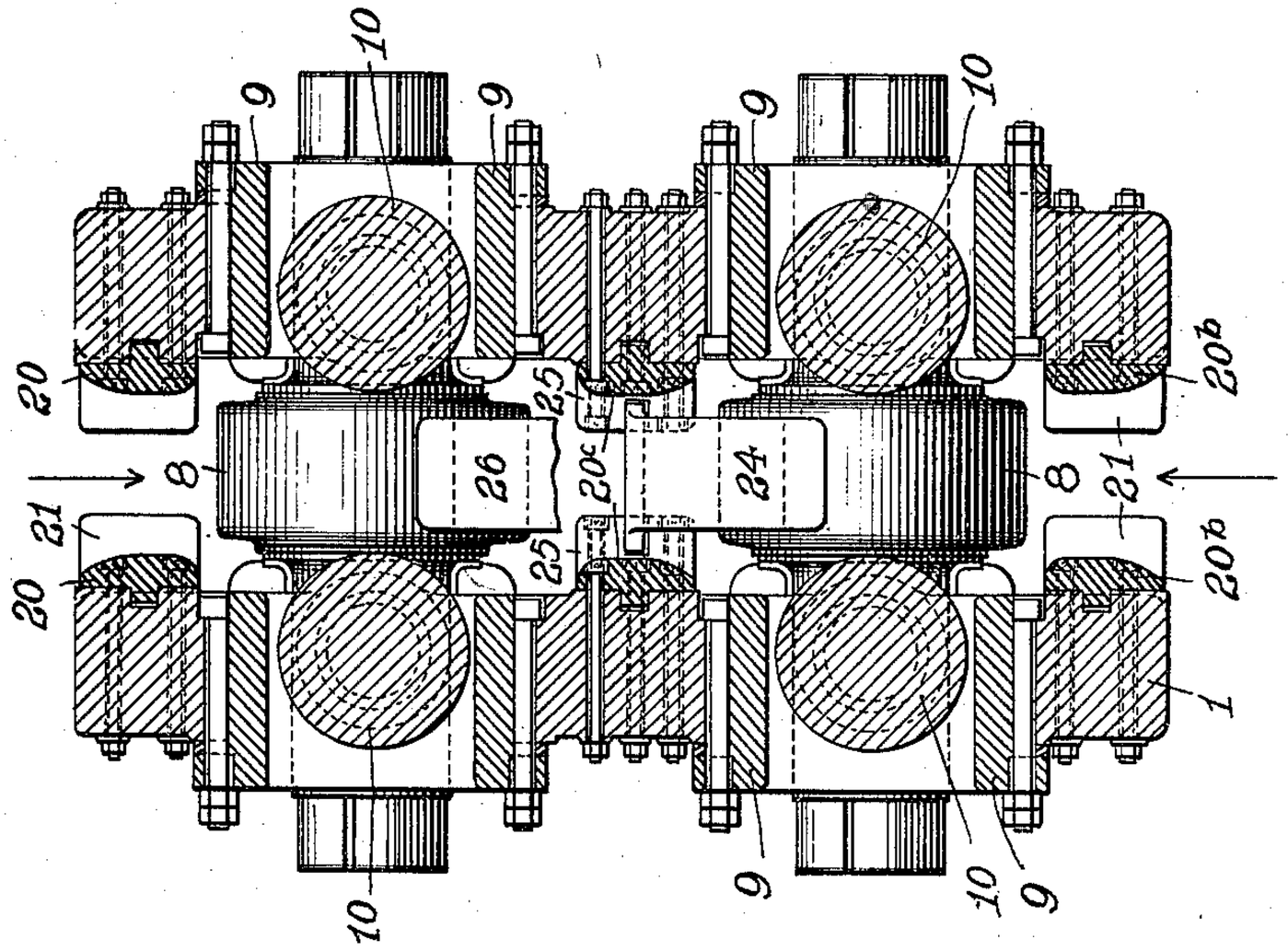
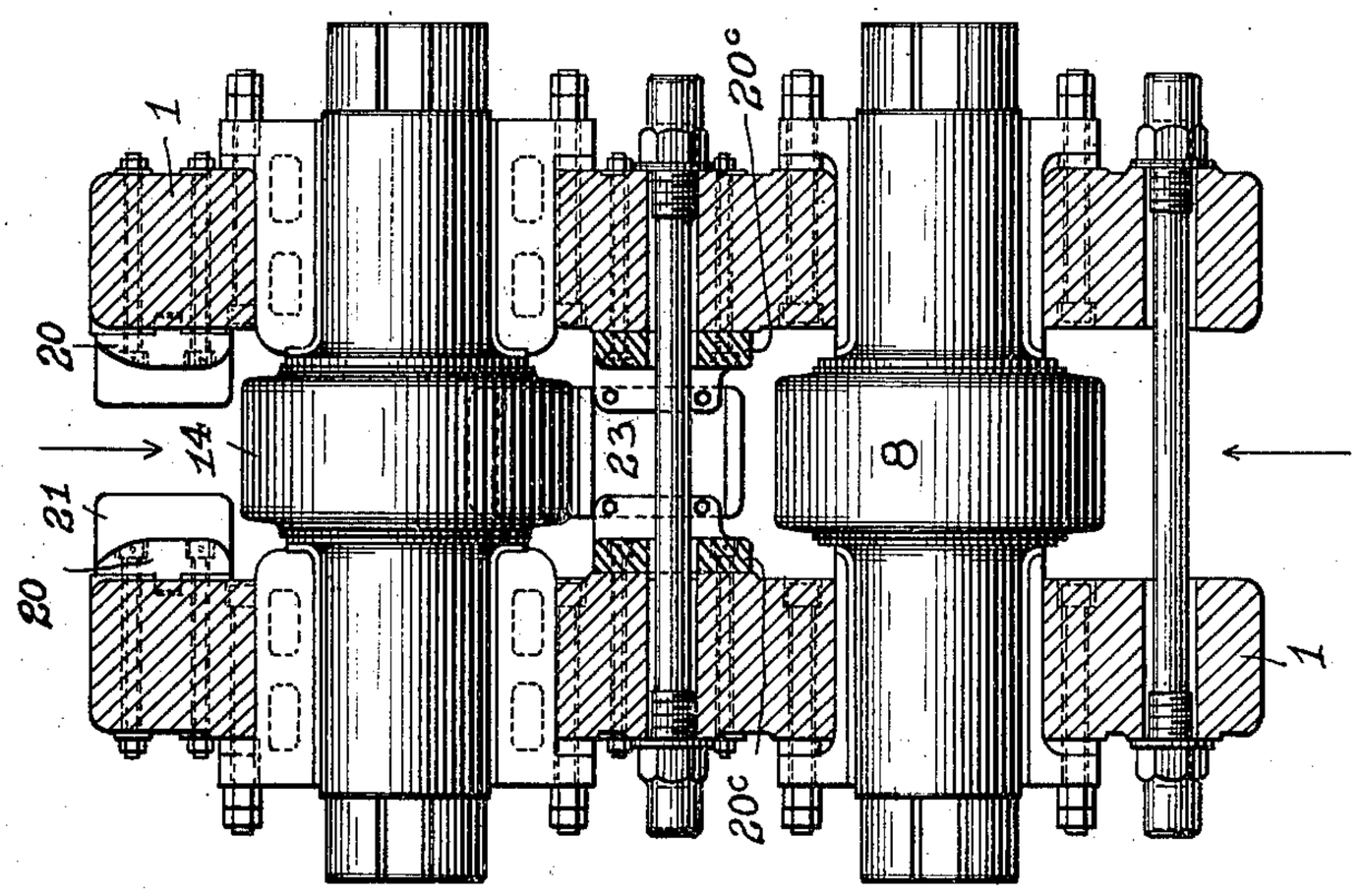


FIG. 10.



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12 SHEETS—SHEET 9.

FIG. 11.

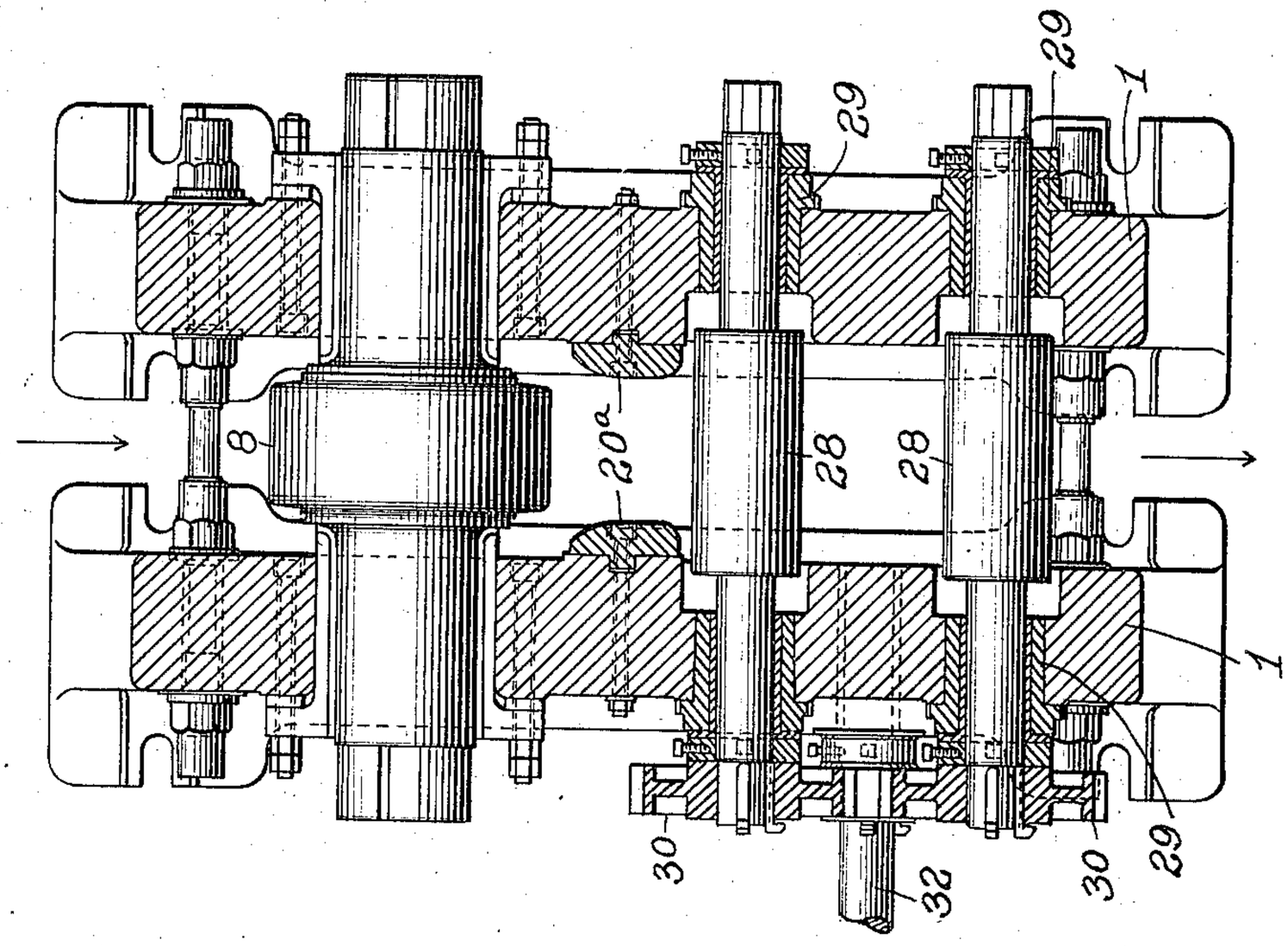
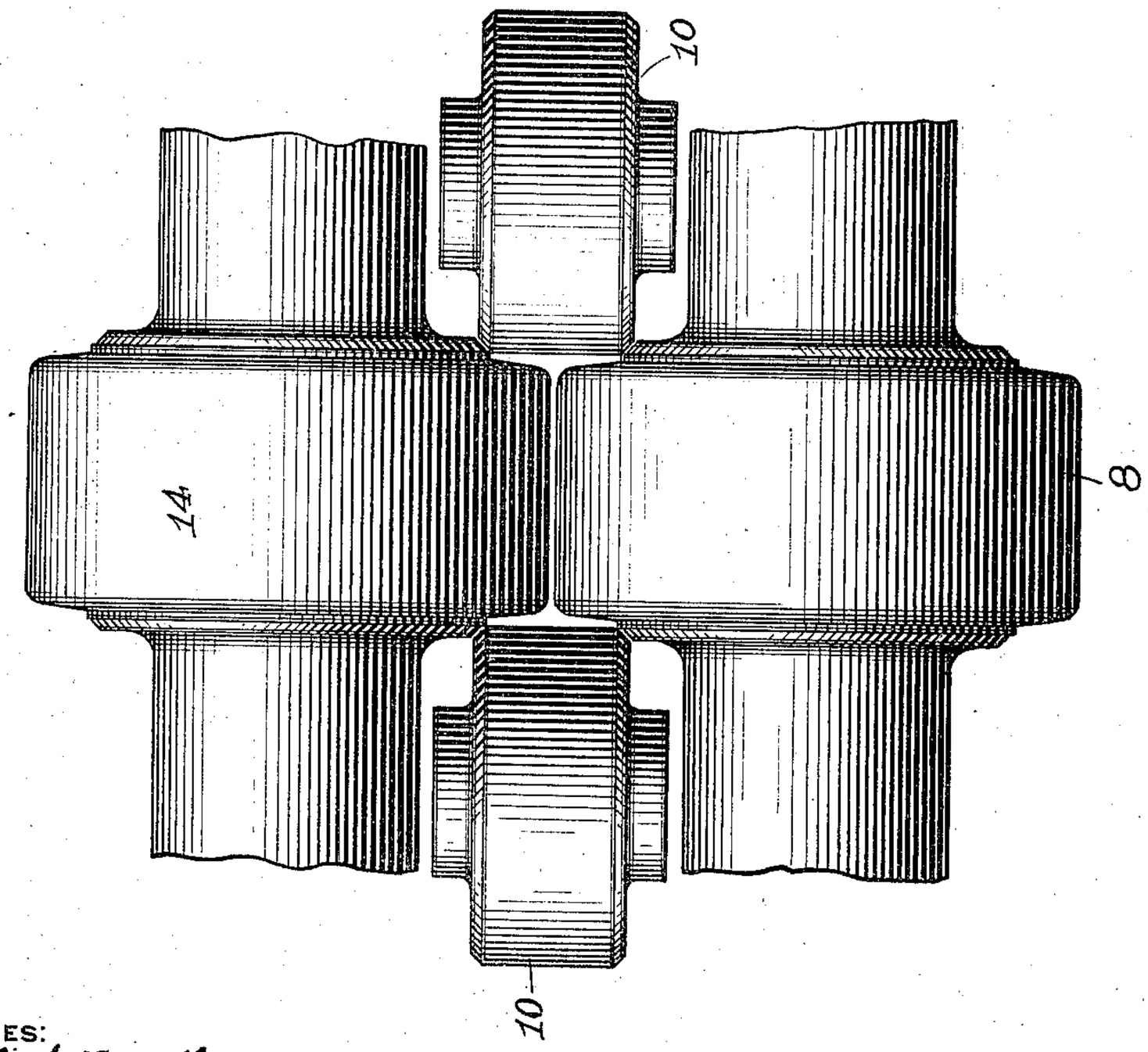


FIG. 12.



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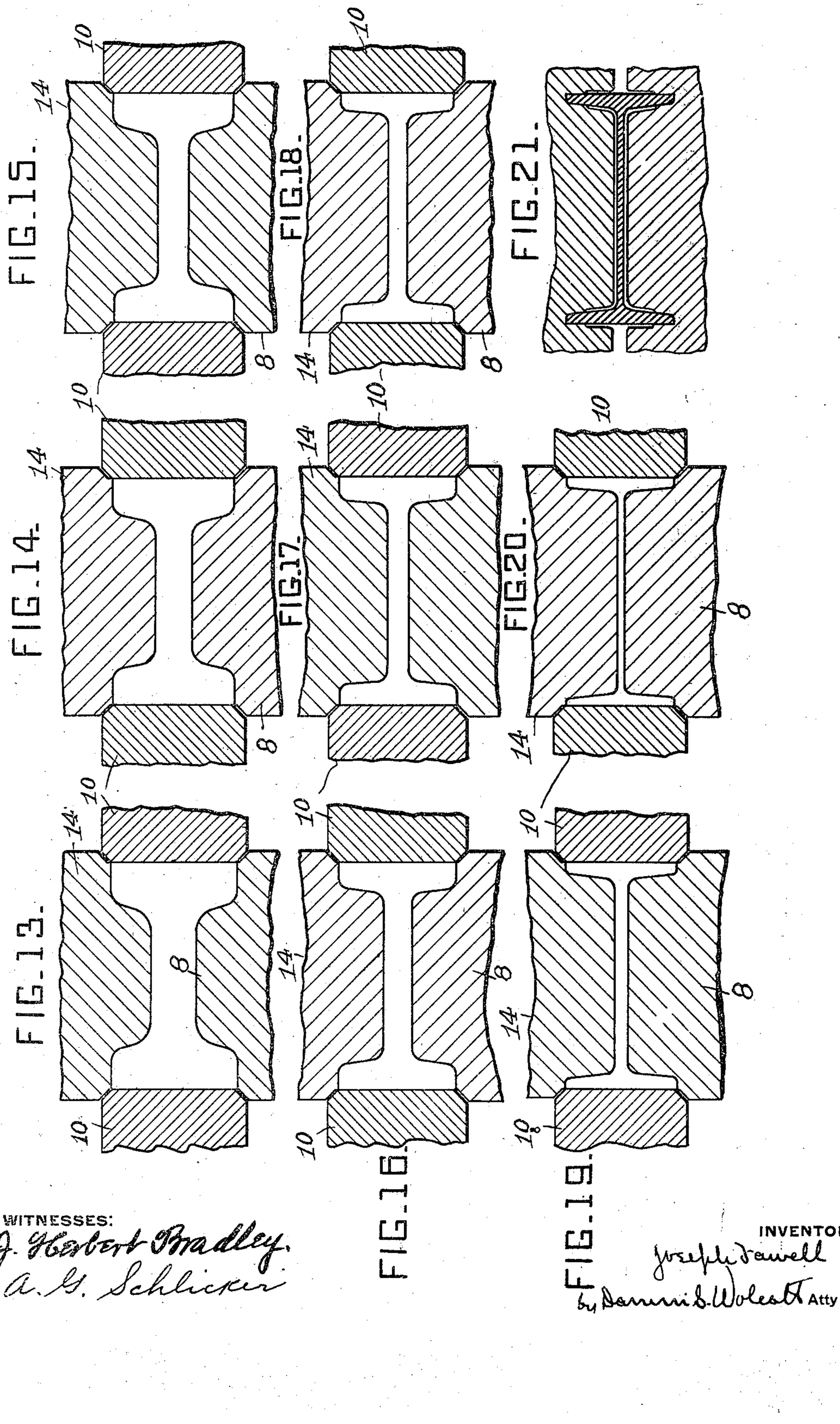
12 SHEETS—SHEET 10.



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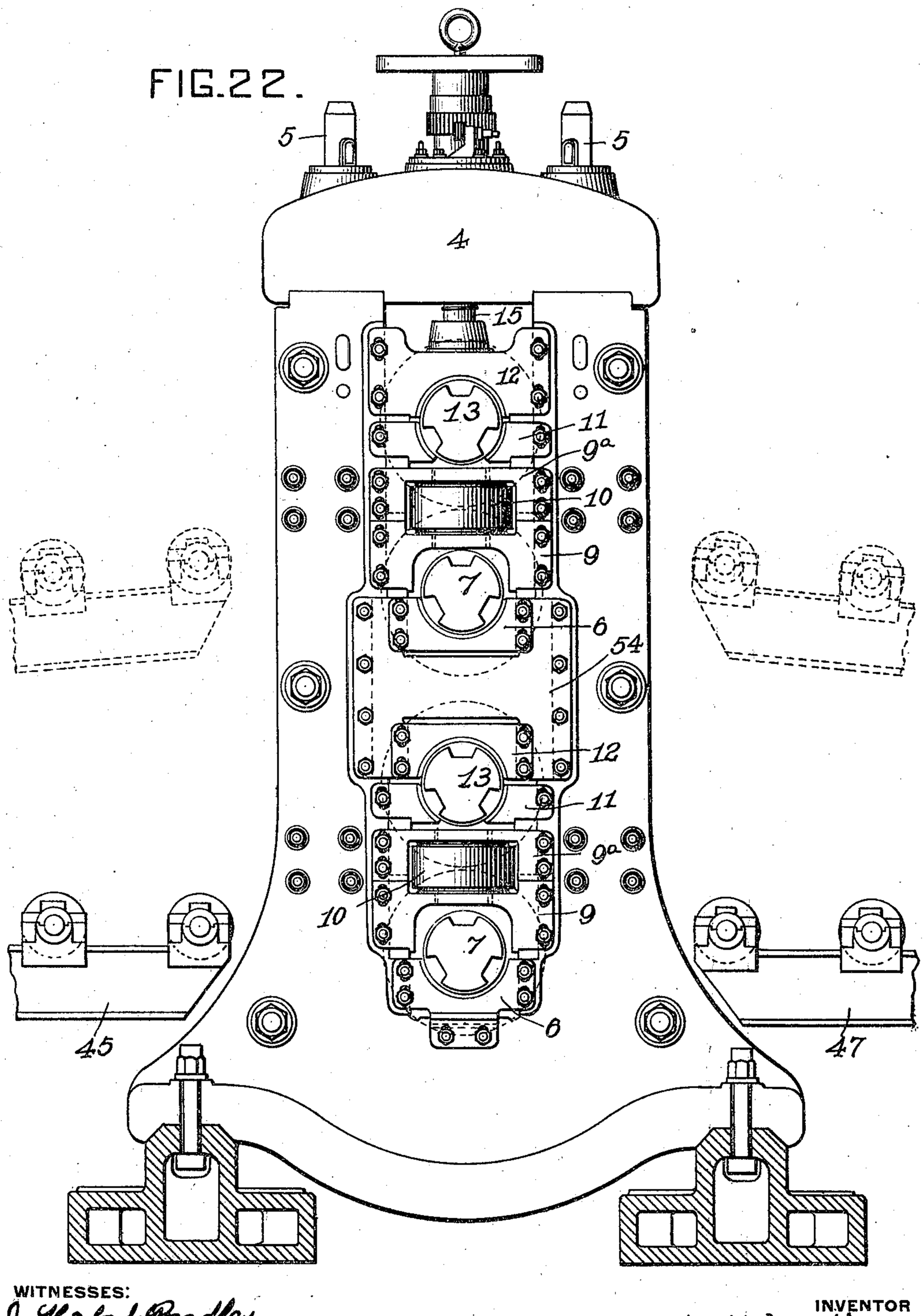
12 SHEETS—SHEET 11.

FIG. 22.



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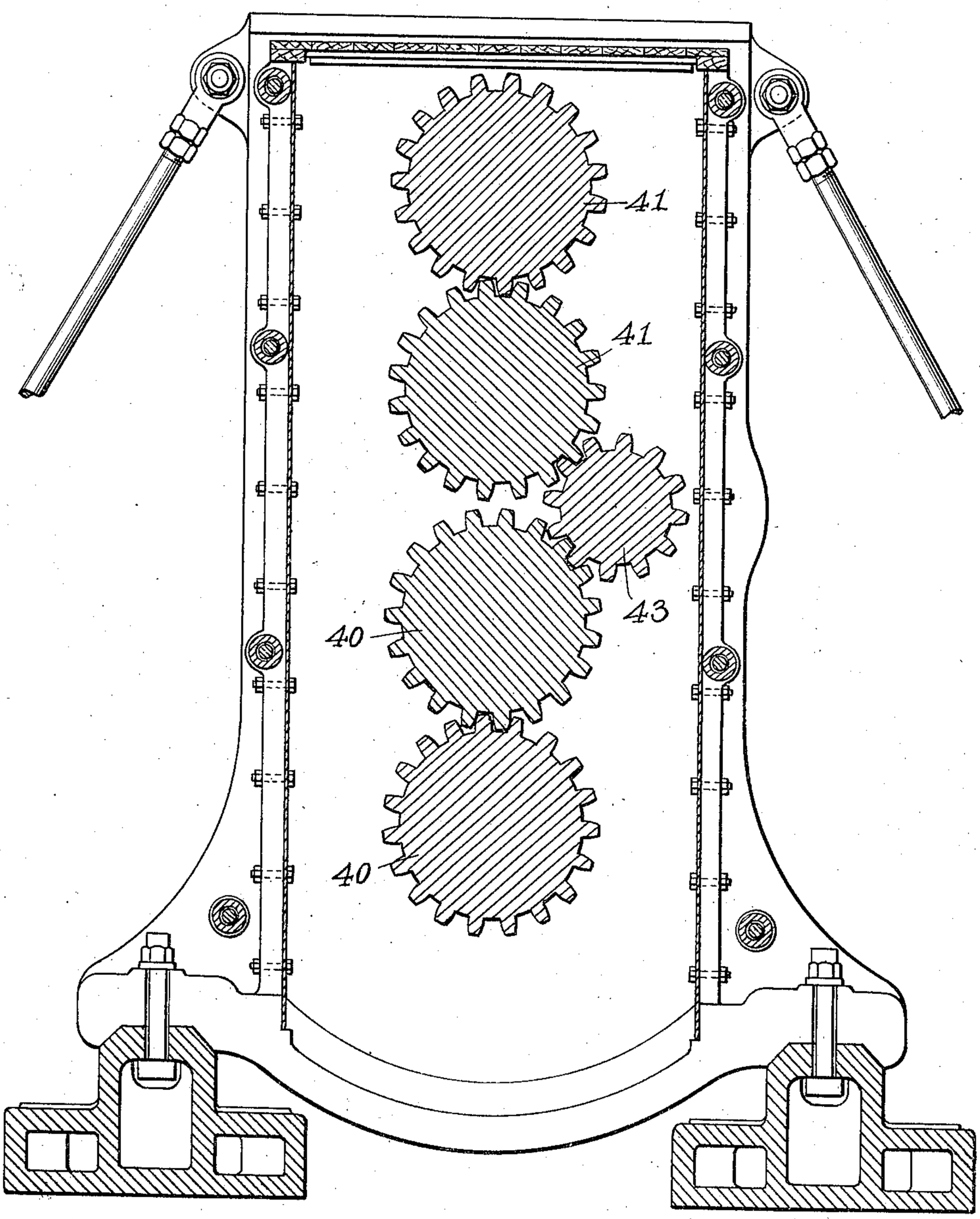
12 SHEETS—SHEET 12.

FIG. 23.



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UNITED STATES PATENT OFFICE.

JOSEPH FAWELL, OF PITTSBURG, PENNSYLVANIA.

MANUFACTURE OF STRUCTURAL MATERIAL.

996,008. Specification of Letters Patent. Patented June 20, 1911.

Application filed February 3, 1911. Serial No. 606,417.

To all whom it may concern:

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

The invention described herein relates to certain improvements in mills for rolling structural material.

For reasons well known to those skilled in the art it is exceedingly difficult to roll structural shapes such as I beams in two or three high mills especially if such articles have wide flanges. Hence resort has been had to universal mills having the reducing passes formed by horizontal and vertical rolls. Several types of this form of mill have been suggested, one having fixed passes formed by non-adjustable horizontal and vertical rolls, the latter being driven directly by the former. The several stands of these rolls are arranged in tandem so that during reduction, the metal is rolled in one direction only and therefore the metal is not properly worked. In addition to this most serious objection, there are many difficulties encountered in its use which have prevented its practical adoption. A second type of universal mill which has been put into practical use, has its vertical and horizontal rolls adjustable, so as to vary the dimensions of the pass after each reduction of the article which is rolled forward and back between the same rolls. There are many objections both as regards construction, operation and renewal to this style of mill, the most serious objection being that by reason of the repeated back and forth passing of the large mass of highly heated metal between the rolls, the latter become so highly heated as to wear away very rapidly requiring frequent renewals of the rolls.

The invention described herein has for its object the combination of a series of stands of universally arranged rolls in such manner that reduction is effected by back and forth rolling of the metal in successive passes formed by rolls non-adjustable except to compensate for wear or shifting the rolls into proper operative relation to form the desired pass.

The invention is hereinafter more fully described and claimed.

In the accompanying drawings forming a part of this specification, Figure 1 is a plan view of a mill embodying my inprovements; Fig. 2 is a sectional elevation of the same the plane of section being indicated by the line II—II Fig. 1; Fig. 3 is a front elevation of a portion of the mill showing the pinion housing and two stands of rolls; Fig. 4 is a sectional elevation of the pinion housing and a stand of rolls; Fig. 5 is a side elevation on an enlarged scale of the pinion housings; Fig. 6 is a sectional elevation of the same on a plane indicated by the line VI—VI Fig. 5; Fig. 7 is a side elevation on an enlarged scale of a stand of rolls; Fig. 8 is a sectional elevation of the same; Figs. 9, 10 and 11 are sectional plan views the planes of section being indicated respectively by the lines IX—IX, X—X and XI—XI Fig. 8; Fig. 12 is an elevation showing the relative arrangement of horizontal rolls to form a pass; Figs. 13 to 21 inclusive show the several successive passes for reducing a blank to a finished beam; Fig. 22 is a sectional elevation illustrating a modification of my improved mill; Fig. 23 is a sectional elevation showing the driving pinions and their housing for the construction of mill shown in Fig. 22 and Fig. 24 is a sectional elevation showing a further modification of my improvement.

In the practice of my invention it is preferred that two stands of rolls, each stand consisting of two horizontal and two vertical rolls having their axes in or approximately in a common vertical plane, should be arranged in the same housing one in front of the other and the top of the lower roll of the rear stand being above a horizontal plane tangential to the top of the upper roll of the front stand.

Where a plurality of passes is required as in reducing a beam blank to a finished beam, two or more pairs of stands of rolls are arranged side by side and the rolls of one stand have their journals connected by wabblers and couplings to the journals of corresponding rolls of the adjacent pairs of stands.

In rolling it is preferred that the article be fed by a suitable table into the pass formed by the front and lower stand of rolls, from which it is received on a suitable vertically movable table. As soon as the article has passed onto the table, the latter is raised and its feed rollers are reversed to feed the

article into the pass formed by the rear and upper stand of rolls. From this stand of rolls the article passes over the front and lower stand of rolls onto a table which may be the table employed for feeding the article into the first pass or may be a second table. In either case the table is laterally movable and a portion at least vertically movable. As soon as the article has passed onto this table it or a portion thereof is lowered and the table shifted laterally to bring the article into line with the lower front pass of the second pair of stands of rolls into which it is fed by reversing the feed rollers. The article is received from this pass by the table on which it was received from the first pass, if such table is laterally movable, but it is preferred that horizontally stationary tables be employed to receive the article from the lower stand and that a portion thereof be vertically movable so as to raise the article sufficiently to permit its being fed between the upper rear stand of each pair. By employing horizontally stationary tables in the rear of the mill, the delay incident to shifting a table laterally and bringing it into exact line with a pass is avoided. With laterally stationary tables and with the passes of a pair of stands in or substantially in line with each other vertically, only a vertical movement of the table is necessary.

It will be observed that in my improved mill the article is rolled first one way and then the other as is necessary to properly knead the metal and that the blank is progressively reduced in the successive passes to the finished articles as shown in Figs. 13 to 21 inclusive. As reduction is effected in successive independent passes, excessive heating of the rolls is prevented as the rolls after acting on an article will have opportunity to cool down very considerably before another blank is started through the mill.

It is preferred that two stands of rolls should be arranged in a common housing, in which case the sides 1 of the housing are provided with windows 2 and 3, the former being considerably longer than the rear windows 3, as shown in Figs. 7 and 8. The caps 4 are preferably notched on their under sides for the reception of the upper ends of legs, into which the sides 1 are divided by the windows, thereby tying such legs together. These caps are held in position by bolts 5. In each of the windows of the housing is arranged as shown in Fig. 7 a supporting block 6 for the journals 7 of the lower roll 8, a frame formed in two sections 9, 9^a for the vertical rolls 10, a carrier 11, and rider 12 for the journals 13 of the upper rolls 14, as shown in Figs. 7, 9, 10 and 11. Each of said parts is provided with flanges, which extend laterally beyond the edges of the windows and over-lap for a short distance the outer faces of the sides of the housing, and through these flanges are passed bolts for securing the parts to the housing. In order to permit of the rolls being adjusted into proper relation to each other, either when the mill is erected or to compensate for wear, the openings in the flanges through which the securing bolts pass are elongated vertically as shown in Fig. 7.

As the bolts whereby the rider is attached to the housing as stated, will not present sufficient resistance to the upward thrust on the upper rolls when a piece is being rolled, screws 15 are passed through the cap 4 and bear in one case directly on the rider and in the case of the lower stand of rolls on filling blocks 16 which in turn bear on the riders. These screws are employed for effecting such slight adjustment of the upper rolls as is necessary to move the latter into proper operative relation to the other rolls and not for a shifting of the upper roll for varying the dimensions of the pass for the reduction of a piece which has been previously rolled in such pass.

As shown in Figs. 4 and 7, the journals of the vertical rolls 10 are mounted in the sections 9 and 9^a of their supporting frames, which rest on shoulders 17 extending into the windows 2 and 3. It is preferred however that liners 18 should be interposed between the shoulders and frames to facilitate the adjustment of the vertical rolls. Similar liners 19 are interposed between these frames 9, 9^a and the carriers of the upper roll 14 as shown in Fig. 7.

In order to prevent the piece from striking the vertical rolls in entering a pass and also from striking the housing after leaving a pass, guard pieces 20, 20^a, 20^b and 20^c are secured to the inner faces of the housing in line horizontally with the vertical rolls and project inwardly a distance nearly equal to the inward projection of the vertical rolls as shown in Figs. 4, 7, 9, 10 and 11. These guards are beveled, or given an outward flare so as to properly direct the piece between the vertical rolls. The guards 20 and 20^b on the entering sides of the passes are provided with ledges 21 projecting inwardly and serving as fore-plates to support the article, as it approaches the rolls. The guards 20^a and 20^c on the delivery sides of the passes are provided with flanges 22 to which are secured the upper strippers 23. The lower stripper 24 is supported by flanges 25 on the guard piece 20^c, while the lower stripper 26 is supported by blocks 27 secured to the inner faces of the housings.

As before stated, it is preferred although not necessary, to feed the article into the lower stand of rolls and after passing through this to raise at least the end of the article to the level of the upper stand of rolls. As the feed table or tables cannot extend in under the upper stand of rolls, one

or more feed rollers 28 are provided to bridge the space between strippers 23 and 26 and the end of the feed table, as shown in Figs. 4, 7, 8 and 11. The journals of these rollers, which project through the sides of the housing are mounted in suitable bearings 29 arranged in suitable openings in the housing as shown in Fig. 11. When a series of two or more rollers 28 are arranged in line, gear wheels 30 are secured on the ends of the journals adjacent to the gear housing of the mill as shown in Fig. 4. These gear wheels intermesh with a pinion 31 on a shaft 32 which preferably has its respective ends mounted in suitable bearings in adjacent sides of the gear and roll housing, as shown in Fig. 4. This shaft may be driven in any suitable manner but preferably by an electric motor 33 having on its armature shaft a pinion intermeshing with a gear wheel 34 on shaft 32. The opposite journals of the rollers 28 are suitably shaped to permit of their being connected by the coupling member 35 to the journals of the corresponding rollers of the next mill.

The first mill of the series has the projecting ends of the journals of the horizontal rolls so constructed, as is customary in the art, as to enable them to be placed in driving connection by wabblers 36 and coupling boxes 37 with the ends of the shafts 38 and 39 of the driving pinions 40 and 41. The shifts of the pinions are mounted in the sides 42 of the gearing housing as shown in Figs. 4, 5 and 6, the shafts 38 being in line or approximately so with the horizontal rolls of the lower stand, and the shafts 39 similarly arranged with reference to the rolls of the upper stand of rolls. The upper pinion of one pair and the lower pinion of the other pair intermesh with a pinion 43 on the shaft 44, which is suitably connected to the driving shaft 44ª as shown in Figs. 1 and 3. By this construction and arrangement of driving mechanism, the rolls of one stand are driven to feed the article in one direction, while the rolls of the other stand are oppositely driven.

The plant shown in Fig. 1 is designed to have eight reducing passes and a finishing or edging pass, and has four mills in line. While all of these mills or units may be driven by an engine at one end of the series of horizontal rolls of one unit being connected by wabblers and coupling boxes to those of an adjoining unit, except at the engine end, where as before stated the journals on one end of the horizontal rolls would be connected to the driving pinions, it is preferred to employ an engine at both ends of the line of mills so that only two mills or units will be driven by one engine. In operating this mill, the article as it comes from the blooming mill is placed on a feed table 45 having positively driven and reversible rollers and adapted to be shifted laterally from one mill or unit to the next. A portion at least of this table is adapted to be raised and lowered by any suitable means known in the art as indicated at 46 in Fig. 2.

While only one table of the character stated is necessary on what, for convenience, is termed the front side of the plant, it is preferred to employ two or more dependent on the number of mills or units forming the plant, so that two or more articles may be under reduction at the same time. It is preferred as reducing cost of erection and the delay of adjusting a laterally movable table to receiving position, to employ tables 47, 48, 49 and 50 stationary as regards lateral movement but having a portion at least vertically movable, on the rear side of the line of mills, as shown in Figs. 1 and 2. The vertical movement of said tables may be imparted by any suitable means, such for example as that shown in Fig. 2.

The article properly heated is fed by one of the tables 45, 45ª into the lower stand of rolls of the mill A from which it passes onto the table 47, being carried from the reducing rolls to the table by feed rollers 28. The article is then raised by table 47 so that it can be fed by reversing the rollers of said table, into the upper stand of rolls of mill or unit A. As the passes of the two stands of rolls in unit A, as is also the case in all the mills or units are in the same vertical plane parallel with the line of feed, no lateral shifting of the article need be made in order that it may enter between the rolls of the upper stand.

From the upper stand of mill A, the article will pass over the upper roll of the lower stand onto the table 45, it having been raised as indicated by dotted lines in Figs. 2 and 8, to receiving position. The table 45 is next shifted laterally to bring the article in line with the passes of mill or unit B, where the above operations are repeated. At this point, when two feed tables are employed along the front of the series of mills, two modes of operation are practicable. First, the table which carried the article to mill B, could be shifted back to position in front of mill A after feeding the article into the lower stand of rolls of mill B, and the second table moved to receiving position in front of mill or unit B and thereafter employed for working the article through mills or units C and D, while the first table is receiving another blank and working it through the first or lower stand of rolls of mill or unit A. Or the first table on the receiving side may work the article through mills A and B and the first stand of rolls of mill C, and then be returned to receiving position in front of mill or unit A, and the second table employed for receiving the article from the upper stand of rolls

of mill or unit C and for working it through mill D.

It is generally desirable that the finished article be delivered on the side of the mill opposite that on which the blank was initially started, and hence the finishing stand of rolls E is arranged on the rear side of the series of mills A, B, C, D, as shown in Figs. 1 and 2, and the table 50 is shown extended to carry the article to this finishing mill. As there are eight passes in the series of mills or units A to D, the last pass between the upper stand of rolls of mill D will deliver the article to the second table 45ª in front of the lines of mills, so that it will be necessary to drop that table and feed the article a second time between the rolls of the lower stand of mill D onto table 50, whereby it will be carried to the finishing mill in which no material reduction is effected beyond rolling down any fins or other roughness which may have been formed on the edges of the flanges. The mill may be of the two high or of the universal type, but is preferably constructed as regards the type and shape of the pass as described and claimed in application Serial No. 608,458 filed by me February 13, 1911. A form of pass suitable for finishing the beam is shown in Fig. 21. It will be understood that the invention claimed herein is in nowise limited to the position of the finishing mill with reference to the other mills, as such mill can be arranged in any desired position relative to the other mills and such position will vary according to many conditions.

While it is preferred to arrange the two stands of rolls forming a unit in one housing, they may be arranged in separate housings as shown in Fig. 24. But in such case, feed rollers 52 would be required to carry the article from the lower stand of rolls under the upper stand of rolls onto the rear feed table, which is arranged as in Fig 2. Feed rollers 53 would also be employed for carrying the article from the upper stand of rolls over the lower stand to the front feed table. It will be understood by those skilled in the art, that when two stands of rolls forming a unit, are mounted in independent housings they may be separated any desired distance.

As shown in Fig. 22, the two stands of rolls forming a unit may be arranged one directly over the other. In which case the lower bearing blocks 6, frames 9, 9ª for the vertical rolls, the carriers 11, and riders 12 for the horizontal rolls will be arranged in the same windows in the housing. It is preferred that the riders for upper roll of the lower stand and the bearing blocks for the lower roll of the upper stand should be adjustably secured to blocks 54, which are secured to the sides of the housing as clearly indicated. In such an arrangement the pairs of pinions 40 and 41 are arranged in line with each other vertically, and have their shafts connected by wabblers and coupling boxes to the horizontal rolls of the respective stands. The driving pinion 43 is connected as hereinbefore described to a suitable motor.

While in Figs. 13 to 21 inclusive is shown a relative combination and construction of rolls, whereby reduction is effected within planes coinciding with the outer faces of the flanges as described and claimed in an application filed by C. E. Duncan and Joseph Fawell, February 13th, 1911, Serial No. 608,458, it will be understood that the claims made herein are not limited to a combination and construction of rolls for carrying out such method of reduction, but said rolls may be arranged to effect any desired method of reduction.

While I have disclosed herein an improved method of rolling no claim is made thereto as the same will form the subject matter of an application to be filed in due time.

I claim herein as my invention:

1. A rolling mill having two sets or stands of rolls each set or stand consisting of two vertical and two horizontal rolls arranged to form a reducing pass and with their axes in or approximately in a common vertical plane, the sets or stands of rolls being so arranged that the central lines of the passes formed by the rolls are in or approximately in the same vertical plane but in different horizontal planes in combination with means for rotating said sets of rolls in opposite directions respectively.

2. A rolling mill having two sets or stands of rolls each set or stand consisting of two vertical and two horizontal rolls arranged to form a reducing pass and with their axes in or approximately in a common vertical plane, the sets or stands of rolls being so arranged that the central lines of the passes formed by the rolls are in or approximately in the same vertical plane but in different horizontal planes in combination with means for rotating said sets of rolls in opposite direction respectively, and means on each side of the mill for receiving an article from one stand of rolls and feeding it to the other set or stand of rolls.

3. A rolling mill having two sets or stands of rolls each set or stand consisting of two vertical and two horizontal rolls arranged to form a reducing pass and with their axes in or approximately in a common vertical plane, the sets or stands of rolls being so arranged that the central lines of the passes formed by the rolls are in or approximately in the same vertical plane but in different horizontal planes, in combination with means for rotating said sets of rolls in opposite directions respectively, and vertically movable

feed tables arranged respectively on the front and rear sides of the mill.

4. The combination of a series of mills or units each consisting of a lower stand of universally arranged rolls and an upper stand of universally arranged rolls, the passes formed by said stands of rolls being in or approximately in the same vertical plane, a feed table laterally movable along one side of the series of mills or units, means for moving a portion at least of said table vertically, a feed table arranged on the opposite side of the series of mills, and means for moving a portion at least of said table vertically.

5. The combination of a series of mills or units each consisting of a lower stand of universally arranged rolls and an upper stand of universally arranged rolls, the passes formed by said stands of rolls being in or approximately in the same vertical plane, a feed table laterally movable along one side of the series of mills or units, means for moving a portion at least of said table vertically, a series of feed tables arranged on the opposite side of the series of mills or units in line with the passes formed by the stands of rolls, and means for moving a portion at least of said tables vertically.

6. A rolling mill consisting of a lower stand of universally arranged rolls, an upper stand of universally arranged rolls, the latter being out of line horizontally with reference to the lower stand of rolls and having the pass formed by its rolls in line or approximately in line vertically with the pass formed by the rolls of the lower stand, in combination with a vertically movable feed table arranged to feed an article into the rolls of the lower stand, feed rolls arranged to receive the article from the lower rolls and a vertically movable feed table arranged to receive the article from said rollers and to feed it into the rolls of the upper stand.

7. The combination of a series of two or more stands of universally arranged rolls, said stands being arranged side by side with the axes of the rolls in or approximately in a common vertical plane and a second series of two or more stands of universally arranged rolls, the stands of the second series being arranged with the passes in a higher horizontal plane than the passes of the other series, the horizontal roll members of both series being driven by the horizontal rolls of the adjacent stand in same series.

8. The combination of a series of two or more stands of universally arranged rolls, said stands being arranged side by side with the axes of the rolls in or approximately in a common vertical plane, a second series of two or more stands of universally arranged rolls, the stands of the second series being arranged with the passes in a higher horizontal plane than the passes of the other series, means for rotating the rolls of each series but in opposite directions respectively.

9. The combination of a stand consisting of a pair of non-shiftable vertical and horizontal rolls, means for positively rotating the horizontal rolls, a second stand consisting of non-shiftable horizontal rolls and a pair of non-shiftable vertical rolls, and means for rotating the horizontal rolls of the second stand in a direction opposite that of the horizontal rolls of the first stand, the rolls of the two stands having their axes in different vertical planes and having the passes formed by their respective rolls in the same vertical plane but different in different horizontal planes.

10. The combination of a series of three or more stands of universally arranged non-shiftable rolls, the passes formed by the rolls of said stands being adapted to effect a progressive reduction of an article, means for rotating the rolls of adjacent stands in opposite directions and means for reversing the direction of movement of the article after each reduction and feeding it into the next pass.

In testimony whereof, I have hereunto set my hand.

JOSEPH FAWELL.

Witnesses:
OSCAR BRASHEAR,
E. H. HASLAM.